

# Nottingham City Council Zero Emission Bus Regional Areas (ZEBRA)

## Phase 2 Business Case

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Produced by:



With support from:



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## Executive Summary

Nottingham City Council (NCC) seeks **£15,228,028** through the Department for Transport's (DfT's) Zero Emission Bus Regional Areas (ZEBRA) fund to support delivery of a total of **78 new electric bus vehicles** that will operate in the city. Delivery will be phased over two years, with all new vehicles operational within the fleet by the end of the 2023/24 financial year.

This proposal sets out our ambition to deliver the new battery electric vehicle (BEV) buses with Nottingham's dominant urban operator, Nottingham City Transport (NCT). These will replace the operator's entire single deck fleet, which will be sold, and support the company's ambition to become the **UK's first carbon neutral bus operator**.

Great strides have been made locally in decarbonising the local bus network through the roll-out of 120 biomethane double deckers and the pioneering electrification of Nottingham City Council's linkbus network. But now that e-bus technology has significantly matured and battery range had improved dramatically, the time is right for Nottingham City Transport to begin its transition to a full electric fleet at scale across the commercial network; delivering a fully zero emission public transport system for Nottingham across bus and tram. This will accelerate the delivery of transport decarbonisation, in line with complementary investment in active travel and expansion of electric vehicle charging infrastructure across the city.

### Changes from our expression of interest submission

We have made limited changes to our proposal since the initial Expression of Interest (EoI). Based on advice from the ZEBRA Team at DfT and its advisers at Ernst & Young, key amendments have been limited to:

- Removal of solar PV microgeneration array for installation at an NCT depot.
- Removal of battery energy storage infrastructure for installation at an NCT depot.
- Removal of the Nottingham City Council element, which was replacing 16 Optare Solo buses with eight longer range new BEVs and the associated infrastructure costs to upgrade existing chargers.
- Updated vehicle and infrastructure specification and associated costs, in line with more in-depth supplier engagement since the EoI submission

While the above investments remain desirable, given their scope to improve the sustainability and reduce the cost of powering our city's growing BEV bus fleet, they are recognised as sitting at the edge of the ZEBRA fund's core objectives – which focus on the replacement of fossil fuel buses with BEVs. As such we shall seek alternative sources of funding with which to implement these measures. The 16 NCC-operated Optare Solos will continue to run in the short term, but a longer-term solution to resolving their higher-than-average maintenance costs will need to be identified within the next couple of years.

Removing these items from our proposal has decreased the total costs by about £11 million. Further details and rationale behind these changes are included within the main Strategic Case.

## Strategic Case

NCC has a proud tradition of investing in public transport, cycling and walking. As a result, Nottingham is one of the least car-dependent cities in the UK and has some of the highest bus use per head of any UK city outside of London.

Our ZEBRA objectives have been developed in accordance with the national programme aims and wider DfT priorities, as well as local strategies and policies. They aim to:

- Support the ambition of Nottingham's Carbon Neutral Charter for 2028.
- Improve local air quality.
- Enhance operational efficiency of vehicle fleet.
- Support local opportunities for jobs and skills.
- Promote inclusive access to high quality bus services.

Decarbonising our transport operations is a critical element to our ambitious plan to be the **UK's first carbon neutral city by 2028**. While we have made significant progress in reducing our carbon emissions to date, we need to **drive our reductions faster** than over the last 12 years if we are going to meet this target. Our Air Quality Strategy for Nottingham and Nottinghamshire (2020-2030) sets out the need to act, with local deaths attributable to air pollution higher than those related to alcohol consumption and road traffic accidents combined.

Our proposal will deliver significant reductions in emissions (down 3,800 tonnes CO<sub>2</sub>e per annum) from buses operating within the City **Air Quality Management Area (AQMA)**, which covers the full administrative area, and across the wider conurbation - including AQMAs in County Council districts of Gedling and Rushcliffe. This can only be achieved if higher-emission diesel buses are replaced with new Battery Electric Vehicles (BEVs) that make best use of the latest electric propulsion and battery storage technology. Without ZEBRA funding from DfT, the significant outlay costs and marginal commercial investment case for bus operators (themselves recovering from the effects of sustained patronage reductions following the COVID-19 pandemic) will combine to delay this switch in bus vehicle fleet makeup that is needed to achieve our aims.

Nottingham has a longstanding Bus Quality Partnership, a comprehensive Advanced Quality Partnership Scheme for the city centre, and is now committed to implementing an Enhanced Partnership across the wider urban area by April 2022 (as part of our published [Bus Service Improvement Plan](#)). The proposal has been developed in partnership with NCT and reflects the vision of **Nottingham's 2020-25 Bus Strategy**. It is both highly deliverable, aligned directly to our strategic imperatives, and focused on sustaining and expanding a 'fit for purpose' 21<sup>st</sup> Century bus network across the Nottingham urban area.

## Economic Case

The economic appraisal work undertaken in relation to our ZEBRA proposal, using DfT's provided Greener Buses Model indicates that a Benefit: Cost Ratio of 1.21: 1 could be achieved in the core scenario. This reflects a 'Low' value investment under the DfT's Value for Money framework, with additional non-monetised benefits pushing towards a 'medium' category.

Assumptions are considered robust and the resulting **monetised economic** values for the proposal are set out below.

Economic Indicator	Core scenario
Carbon Savings	-64,605 (tonnes CO <sub>2</sub> e)
Present Value of Benefits (PVB)	£ [REDACTED]
Present Value of Costs (PVC)	£ [REDACTED]
Net Present Value (NPV)	£ [REDACTED]
<b>Benefit Cost Ratio (BCR)</b>	<b>1.21</b>
<b>VfM category</b>	<b>Low</b>
<b>Cost Effectiveness Indicator (CEI)</b>	<b>190.2</b>

Sensitivity tests were undertaken using the Greener Buses Model (GBM) based on the guidance document and identified key risks and uncertainties.

In addition to the monetised benefits, the scheme is also expected to generate additional key benefits on noise, local landscape, journey quality and jobs and skills, that have not been quantified and monetised within the Greener Buses Model analyses. These further strengthen the monetised benefits and move the scheme towards a 'medium' value for money category.

- **Noise: Beneficial** – Electric vehicles generate lower levels of noise when operating compared to their internal combustion engine (ICE) equivalents. This will be a particularly notable benefit of this proposal as the Trent Bridge depot is located within 'The Meadows' residential area. NCT has been approached by Environmental Health in the past in relation to noise negatively affecting residents during late depot shifts.
- **Landscape: Beneficial** – As well as BEVs being quieter to operate, attractive town buildings can discolour through soot generated by traffic pollution. Diesel vehicles can have oil and fuel leaks which can damage road surfaces over time which BEVs will not.
- **Journey quality: Beneficial** – Electric vehicles can offer a physically smoother journey, particularly benefitting passengers moving around the bus to find a seat or standing, where any turbulence negatively affects the user experience.

- **Jobs & skills: Beneficial** – NCT Engineers and mechanics will become skilled in maintaining and servicing electric vehicles, enhancing their employability. Local colleges already interested in offering courses in the maintenance and servicing of electric vehicles will now be able to develop local pathways into employment. This will build on local growing expertise, with Nottingham University’s Centre for Advanced propulsion and the Nottingham Electrical Vehicle Service Centre (see letter of support in Appendix I).

## Financial Case

The **total cost of the proposal is £[REDACTED]**. This is made up of **£15,228,028 ZEBRA funding ask** and £[REDACTED] private sector contribution from the operator, Nottingham City Transport (NCT)<sup>1</sup>. The high value of private sector contribution from NCT is a key factor behind the relatively low level of Net Present Benefits, and BCR, for our ZEBRA bid.

This spend is planned across two years with about 35% in 2022 and 65% in 2023. The funding sought by this proposal aligns with the guideline proportions; the DfT funded element covers 75% of the infrastructure cost and 75% of the difference in the cost of purchasing BEV buses in place of Euro VI diesel vehicles.

- Total capital cost of the new buses is £[REDACTED], reflecting an average total cost of £[REDACTED] per vehicle, where the DfT funded part is within the ceiling of 75% of the difference in new electric bus cost, compared to an equivalent diesel. This cost includes a standard level of warranty offered by the supplier.
- Long-term part replacement costs and additional warranty allowances have not been included in the grant ask.
- The total cost of infrastructure is £[REDACTED]<sup>2</sup> (reflecting £[REDACTED] per bus), where 25% of this is paid for by the operator (NCT) and the remaining 75% is the ZEBRA fund ask.
- The total quantified risk is £[REDACTED] (2% of the total base cost) and is included within the figures above.

With the level of funding requested by this proposal, Nottingham City Council and operators (NCT) are confident that our scheme is affordable and viable and that our scheme objectives can be met. The operator commitment is evidenced by their letter of support in Appendix I.

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<sup>1</sup> all including a quantified risk allowance but excluding any optimism bias

<sup>2</sup> including quantified risk allowance and excluding optimism bias

## Commercial Case

NCC, on the behalf of NCT, will facilitate the procurement of the first batch of 26 buses and all of the infrastructure via a Crown Commercial Services framework. The remaining 52 buses will be procured via a new electric vehicle framework being developed by NCC that will include manufacturers not available via Crown Commercial Services currently, including but not limited to Wrightbus, Scania, Arrival, Caetano and Mercedes-Benz. This approach will give the project team access to a wider range of manufacturers and allow the option to purchase buses that have not yet come fully to market to be considered.

NCC will procure the buses and infrastructure and transfer the assets fully to NCT. Payments will be made as each individual procurement exercise completes in line with agreed delivery milestones.

Preparations and groundwork, both from a physical infrastructure (electrical supply upgrade) and project management perspective, are well-advanced in relation to this proposal.

NCC's Major Projects team is working with NCT to scope their requirements through soft market-testing dialogue with potential infrastructure partners, including Western Power Distribution, SWARCO and Zenobē, as well as their shortlisted electric bus manufacturers. NCT's staff are actively exploring opportunities to increase their knowledge and understanding of electric bus operations across the UK, engaging with vehicle and power/energy providers as well as other operators and attending EV conferences.

The infrastructure required for the electrical supply upgrade needed for vehicle charging at the depot has been fully scoped. It builds on extensive renovations to NCT's Trent Bridge depot which have been made in readiness for electric bus operations.

## Management Case

The scheme is strongly supported by key stakeholders, including the operator Nottingham City Transport (NCT), Sustainable Transport Nottingham, the Local Enterprise Partnership (D2N2) and the University of Nottingham.

The project will be delivered by experienced NCC and NCT staff in a defined project team structure, with sufficient project support and dedicated assurance team members.

Project reporting will occur regularly, with the Project Management Office group attended by the project Senior Responsible Officer (SRO) meeting and NCT Board exercising project oversight, both meeting on a monthly basis.

We are confident that buses and infrastructure can be delivered by quarter 4 of 2023. Given the current levels of preparedness at the Trent Bridge depot (garage reconfiguration works complete) and discussions with bus manufacturers on their order fulfilment timescales, we are assured that this proposal is deliverable within the scheme timescales. Assurances have been

received from bus manufacturers to deliver the buses on time. We also have assurances from UK Power Networks, our local Distribution Network Operator (DNO), that it will be able to expedite delivery of power connection upgrades.

The management of risk is an essential part of NCC's programmes and project management processes. The approach to managing risk is to establish an iterative and on-going cycle of risk management activity, covering the identification, assessment, mitigation, reporting (including escalation) and reviewing risk. Issues are to be recorded (utilising a Risks, Issues, Actions and Decisions (RIAD) log) by the Programme Manager. Three key scheme specific risks in relation to this project have been identified as follows:

- *First time implementation of Electric Bus Technology at scale by commercial operators with little or no experience of operating this type of bus.* This risk is mitigated by the pioneering experience and knowledge accrued by NCC in relation to the operation and delivery of infrastructure for one of the UK's oldest electric bus projects. This is coupled with NCT's engineering department's longstanding research, groundwork and trials in relation to the technology.
- *Inadequate power supply.* Work with Western Power Distribution has established that there are two points of High Voltage power supply that can be connected into the Trent Bridge Depot which will house the new fleet and infrastructure.
- *Insufficient patronage to support future operating and maintenance costs.* Prior to the reintroduction of Covid-19 restrictions, patronage had returned to 75% of normal and was growing as working and learning from home reduced and leisure and hospitality had re-opened. This provides confidence that sustainable levels of patronage will be achieved to support the operation of the new fleet. New ticketing products to better reflect new travel demand and working patterns have also been implemented and will continue to be developed alongside a range of marketing campaigns targeted at various passenger segments to "Get Back on Board" to help grown the market further and provide reassurance to travellers that public transport is safe post-Covid. Investment will and is being made into the network via the Transforming Cities programme and Bus Service Improvement Plan initiative to further enhance the efficiency and attractiveness of the network which will support the control of costs by local bus operators.

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# 1. Introduction

- 1.1 This document sets out the Phase 2 Business Case prepared by Nottingham City Council (NCC) in response to the Department for Transport's (DfT's) Zero Emission Bus Regional Areas (ZEBRA) fund. It builds on our successful Expression of Interest, submitted earlier in 2021, for consideration through the standard process.
- 1.2 Our proposal will increase options for local residents, employees and visitors to reduce their carbon footprint when travelling into, and around, the Nottingham urban area. This complements NCC's [published action plan to be the UK's first carbon-neutral city by 2028](#).
- 1.3 This Business Case has been prepared in line with the principles of HMT Green Book appraisal and DfT's Major Scheme Business Case guidance (as set out in its online [Transport Analysis Guidance](#), or TAG), and structured around the five cases (Strategic, Economic, Financial, Commercial and Management) for a business case of this nature. The make-up of the investment packages, and our approach to preparing this business case, has been guided by advice and support from DfT colleagues and its advisers from Ernst & Young. We have listened to feedback through the co-development process, tailoring our submission accordingly in conjunction with our delivery partners at local bus operator Nottingham City Transport (NCT). We will welcome further feedback upon funding award and as we work to deliver our local ZEBRA fund investments.

## Changes Since Expression of Interest

- 1.4 The main changes since the Expression of Interest (EoI) submission are set out in Table 1-1. The financial implications of these changes are presented in the financial case.

Table 1-1: Changes since EoI

Expression of Interest	Business Case	Rationale
Solar PV microgeneration array for installation at an NCT depot	These elements have been removed and the proposal now relies on establishing a suitable grid connection to the depot. However longer term the aspiration for local electricity generation remains, but funds will not be sought as part of the ZEBRA proposal	Based on advice from the ZEBRA Team at DfT and its advisers at Ernst & Young
Battery energy storage infrastructure for installation at an NCT depot		
Nottingham City Council element, replacing 16 Optare Solo buses with eight longer range new BEVs and the associated infrastructure costs to upgrade existing chargers	This element has been removed; the business case now focuses solely on the 78 NCT buses to be replaced	Replacing first generation electric buses with new electric buses was not felt to be an optimal use of the grant funding as it would not support the decarbonisation of diesel buses, nor deliver value for money in the context of the greener buses model.
Vehicle and infrastructure costs	More detailed and up to date quotes for grid connection and charging infrastructure have been included.	This is in line with more in-depth supplier engagement since the EoI submission.
Extended warranties to cover major component replacement for up to 10 years	This has now been removed from the initial purchase cost, with the proposal including the standard warranty cover provided by the vehicle supplier	Based on updated vehicle and component replacement quotes, the financial risk of not taking out the extended warranty no longer outweighs the additional cost

## Structure of the Remainder of this Document

- 1.5 The remainder of our Business Case is structured around the following sections:
- **Strategic Case (Section 2)** – outlines how our proposal meets the core policy objectives of ZEBRA and why we are pursuing this approach.
  - **Economic Case: Value for Money (Section 3)** – sets out the costs, benefits and value for money assessment for our proposal, detailing how they were calculated.
  - **Financial Case: Costs and Financing (Section 4)** – sets out the capital and maintenance costs associated with our proposal, and identifies sources of matched funding contributions alongside spend profiles over the two years of the ZEBRA fund and the vehicle life.
  - **Commercial Case: procurement and delivery (Section 5)** – demonstrates the market engagement activities we have undertaken while developing this business case and our expected approach to procuring the vehicles and associated infrastructure included.
  - **Management Case: Governance, risks, management and evaluation (Section 6)** – explains how we will work to plan, deliver and monitor the programme based on tried-and-tested approaches to reducing/mitigating risks and maximising sustainable mobility impacts.
  - **Equality Impact Assessment (Section 7)** – sets out our consideration of the impacts of our ZEBRA proposals on people who live and work in Nottingham in respect of the Protected Characteristics defined in the Equality Act (2010).
- 1.6 A number of analytical documents and technical appendices are included in support of this business case. They set out the calculations and methodologies which underpin our use of the Greener Buses Model, as well as the governance, procurement and partnership working arrangements that we will rely upon to deliver this scheme.

## 2. Strategic Case

### Introduction

- 2.1 Nottingham City Council has a proud tradition of investing in public transport, cycling and walking and boasts one of the highest bus patronage levels outside London<sup>3</sup>.
- 2.2 This proposal will deliver **78 battery electric buses** and the implementation of the required charging infrastructure at the Trent Bridge Depot to operate them, allowing NCT to operate a 100% electric single decker fleet.
- 2.3 Our ambitions for transport in Nottingham, and specifically the bus operations set out in this proposal, align with local plans and policies, regional strategies and wider national agendas. The ZEBRA proposal builds on our success and plans adopted in our Local Transport Plan, our carbon-neutral action plan, BSIP and our Transforming Cities Fund programme, which promote bus priority, technological solutions and active transport use across the City.
- 2.4 The proposal aims to decarbonise Nottingham’s transport, improve air quality, level-up the economy through building local skills and improve transport for the user.
- 2.5 The evidence set out in this section has directly shaped our proposal to ensure it offers a sound strategic fit with identified fund objectives.

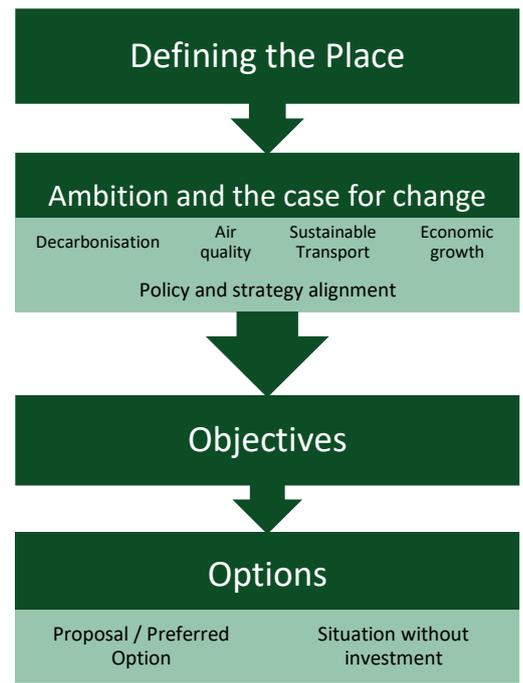
### Defining the Place

#### *About Nottingham*

- 2.6 Nottingham is a city and unitary authority area in the East Midlands region. With an estimated population of 332,900 people<sup>4</sup>. Nottingham’s wider economic area, being more accurately representative of the city’s functional economy, includes the local authority districts of Erewash, Rushcliffe, Broxtowe, Hucknall and Gedling. This wider conurbation has a population of over 785,000 people, making the Nottingham urban area the largest in the East Midlands, and the second largest in the Midlands region (after Birmingham).

<sup>3</sup> <https://www.nottinghaminsight.org.uk/>

<sup>44</sup> Office for National Statistics 2019 mid-year estimates



- 2.7 Nottingham is the 11th most deprived district in the country out of 317 across England<sup>5</sup>. While it has relatively low levels of unemployment, the impact of the economic downturn has been greater than in many other cities with long-lasting effects.
- 2.8 The proposed ZEBRA routes to be electrified will serve some of the most deprived communities around Nottingham, providing connections between the City Centre and Clifton, to the south of the river, and on corridors to the north of the city, towards Bulwell and Bestwood.
- 2.9 Prior to the reintroduction of Covid-19 restrictions, patronage had returned to 75% of normal<sup>6</sup> and was growing, as working and learning from home reduced and leisure and hospitality had re-opened. This provides confidence that sustainable levels of patronage will be achieved to support the operation of the new fleet. New ticketing products have been implemented and are being developed to better reflect new travel and working patterns to further encourage return to public transport locally. We are confident patronage levels will quickly return to autumn levels and continue to strengthen over time as restrictions are lifted and public confidence returns.
- 2.10 The buses will operate through and support connections to some of Nottingham's most socially disadvantaged areas including St Ann's, The Meadows, Forest Fields and Hyson Green, areas which have significant health inequalities which can be exacerbated by poor air quality and also are home to significant BAME communities, low levels of car ownership and high levels of unemployment.
- 2.11 Nottingham's economic performance, when measured by Gross Disposable Income (GDI) per head, appears low at approximately 70% of the national average. However, when measured by Gross Value Added (GVA) per capita – the most commonly used measure of economic output – it is the highest of any Core City, at £25,300.
- 2.12 Nottingham has the highest levels of net in-commuting in the East Midlands, with its extensive public transport network, enabling the city to draw upon a wider economic area for its workforce. The result is a productive city supporting a prosperous region, but with inner-city socio-economic challenges typical of any major UK conurbations (see Figure 2-1)<sup>7</sup>.

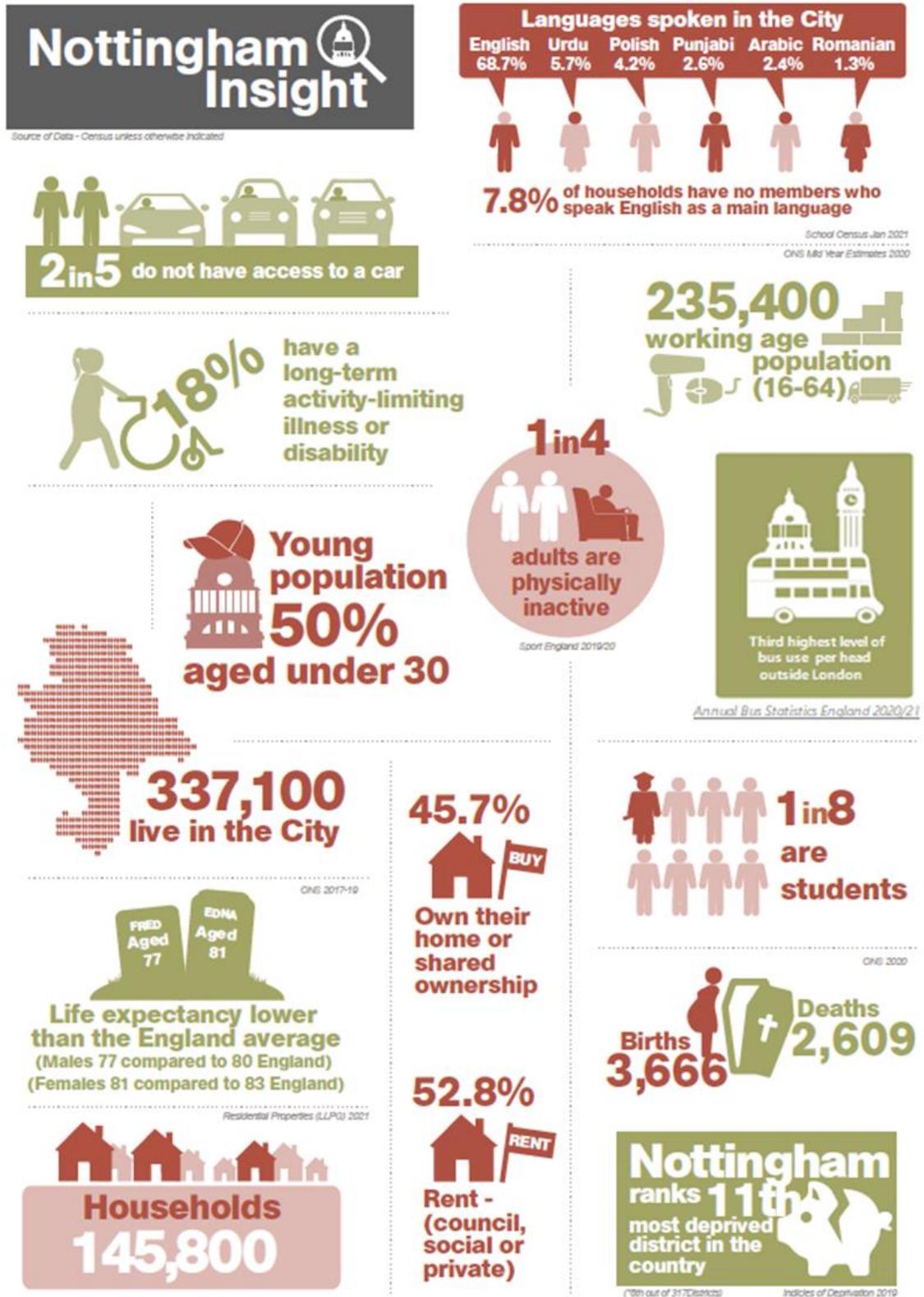
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<sup>5</sup> using the Average Score measure - Indices of Deprivation 2019 - ONS

<sup>6</sup> November 2021

<sup>7</sup> Nottingham Growth Plan: <http://documents.nottinghamcity.gov.uk/download/3499>

Figure 2-1: Overview of Nottingham's socio-economic and demographic makeup



## Local transport

- 2.13 Nottingham City Council has a proud tradition of investing in public transport, cycling and walking. This deliberate, and longstanding policy approach has helped NCC to develop a tram network that is integrated with local and national rail services, as well as high quality and high frequency urban bus networks. As a result, Nottingham is now one of the few UK cities to boast rising public transport patronage. NCC's introduction of the UK's first, and only, Workplace Parking Levy (WPL) further underlines our commitment to delivering on a sustainable mobility vision.
- 2.14 The revenue generated by the WPL is invested in sustainable transport system improvements, including the local Link Bus network (providing socially necessary services that would otherwise be uncommercial). The £9m a year raised pre-pandemic by the WPL has supported an extension to the tram network and investment in electric buses for Nottingham City Council's linkbus network which plugs gaps in the commercial bus offering. Whilst also constraining congestion which has helped to support the reliability of bus services. The ZEBRA investment can build on this success and benefit in particular from the experience accrued from the operation of one of the longest standing fleets of electric buses in the UK and accelerate the decarbonisation of buses locally from a firm foundation.
- 2.15 NCC is currently in the process of developing its latest Local Transport Plan (LTP4). This will build on the success of our LTP3, which had at its heart the development of a world class sustainable transport system as well as encouraging the use of Ultra Low Emission vehicles and behaviour change.
- 2.16 The updated LTP will go further, by aiming to ensure the Council makes full use of new and emerging technologies that will achieve substantial reductions in carbon emissions from transport. We know that the majority of carbon emissions from transport in Nottingham come from road transport and of those emissions the vast majority come from cars. Encouraging the use of walking, cycling, and local public transport options as alternatives to driving will again be central to our LTP, alongside reducing the need to travel – building on evolving lifestyles in the wake of the COVID-19 pandemic.



### *The customer*

- 2.17 In Nottingham 20.7 % (69,100) of the population is aged 0-17 years old, 69.6% (231,600) are of working age - 16-65 years old, and 11.6% (38,800) are over 65 years old. Our permanent resident population is boosted by the presence of two internationally renowned universities. Their combined student population of over 43,000 people means the city has one of the youngest populations of any UK city.
- 2.18 Bus users are generally considered to reflect the demographics of the city as a whole. In the city of Nottingham, this includes 18% of people who have long-term health problems that limit day-to-day activities and 27% of the resident population belonging to Black and Minority Ethnic (BAME) communities. Further demographic information can be found in the Equality Impact Assessment (EqIA) in section 7.
- 2.19 The population of Nottingham City is comprised of 51% females and 49% males. Lone parents are predominantly female and car ownership amongst lone parents tends to be low. There are also a higher proportion of female carers when compared to male carers. This makes both pushchair and wheelchair spaces particularly relevant on-board our buses.
- 2.20 The proposed investment will not only benefit bus users, but those inhabiting space around the bus depot and routes vehicles will operate on. BAME groups more frequently face socioeconomic disadvantages, which can correlate with living in more densely populated areas where air quality is poor. Densely populated areas affected include St Ann's, The Meadows, Forest Fields and Hyson Green, where BAME communities represent 50.4%, 48.2%, 52.3% and 49.6% respectively. Some proposed bus routes that would be electrified during the ZEBRA project operate through these areas.
- 2.21 These socio-demographic characteristics combine with our progressive, 'pro-sustainable transport' policies to make Nottingham one of the least car-dependent cities in the UK. Two out of every five residents do not have access to a car, while we also have the highest level of bus use per-head of population across all UK cities outside London<sup>8</sup>.

### *Details of local bus operators and market share*

- 2.22 With 489 buses in operation across Nottingham, around 60% of these are operated by Nottingham's dominant urban operator, Nottingham City Transport (NCT). They currently operate 120 biomethane double-deckers alongside 185 Euro VI diesel buses and, at pre-pandemic levels of operation, carried 85% of all bus passengers in Nottingham. The addition of electric buses to the fleet will continue their decarbonisation journey and support the company's ambition to become the UK's first carbon neutral bus operator.

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<sup>8</sup> <https://www.nottinghaminsight.org.uk/>

- 2.23 By 2028 the company aims to have a 100% Zero Emission and Biogas fleet. With the transition away from the purchase of Biogas Double Deckers beginning in 2025/26 as the remaining Diesel Double Deckers begin to be replaced. Of the current stable of 185 Euro VI diesel buses not replaced by this ZEBRA proposal, 23 new double deckers powered by Biogas will be purchased with the remaining 84 double deckers set for replacement with Battery Electric or Hydrogen from 2025/26 onwards.
- 2.24 TrentBarton, the other large operator in Nottingham, serves the majority of the rest of the commercial bus network. It focuses primarily on catering for inter-urban travel between Nottingham and Derby, as well as to the outlying towns and villages north and south of Nottingham – which make up the city region’s hinterland.
- 2.25 As shown in Table 2-1, the rest of the city’s bus market is made up of a handful of commercial services, Park & Ride routes, and the electric Linkbus network (operated by NCC and tendered to CT4N) – many of which are tendered services that plug important gaps in the commercial bus market.

Table 2-1: Breakdown of the Nottingham urban area bus market

Operator	Single Decker	Double Decker	Emissions	Total Buses	Market Share
Nottingham City Transport (NCT)	78 (Diesel)	120 (Biogas) 107 (Diesel)	100% Euro VI	305	85%
TrentBarton	125 (Diesel)	0	97% Euro VI	125	12%
Nottingham City Council	29 (Electric)	0	Zero at tail pipe	29	3%
Stagecoach	6 (Diesel)	0	100% Euro VI	6	
CT4N	16 (Diesel)	0	100% Euro VI	16	
Marshalls	4 (Diesel)	0	100% Euro VI	4	
Centrebus	4 (Diesel)	0	Unknown	4	

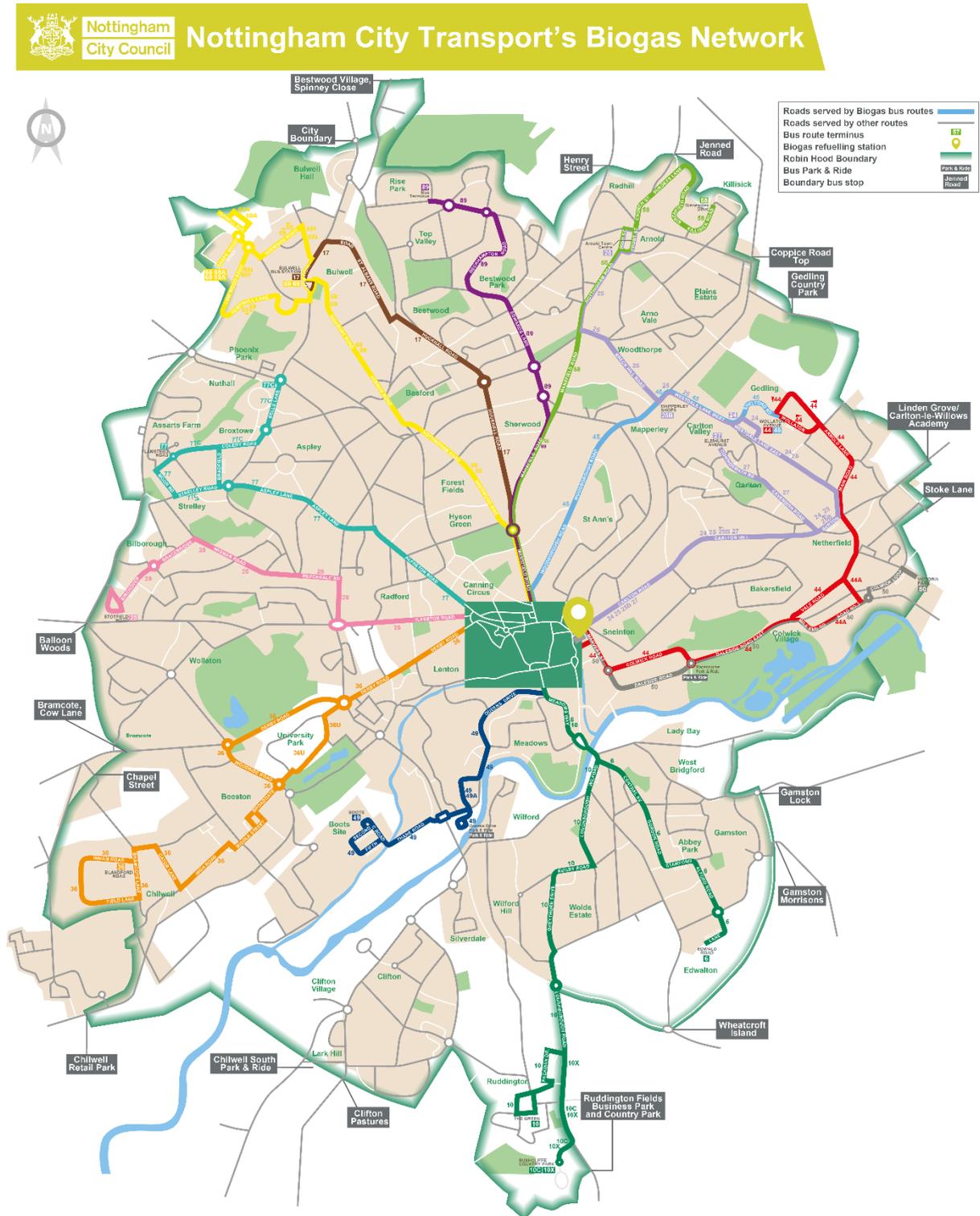
- 2.26 Based on the annual mileage operated by NCT’s single deck fleet ( [REDACTED] ) and using Copert (V5) modelling, the 78 Euro VI diesel buses that will be replaced are currently estimated to generate in the region of 75,000 tonnes of CO<sub>2</sub>e annually.

### **ZEBRA funding bid implications**

The relatively high levels of bus use in Nottingham, and extensive bus fleets that operate into and across the city, present considerable scope for effecting significant and near-term reductions in Greenhouse Gas emissions that are typically associated with local bus operations.

- 2.27 The maps below include the Robin Hood ticketing boundary, relevant infrastructure / refuelling stations and key depots.
- Figure 2-2 shows the existing low emission network, illustrating the complete bus network in Nottingham and highlighting the biogas routes.
  - Figure 2-3 shows the biogas bus routes and the existing electric linkbus routes operated by NCC.
  - Figure 2-4 shows the bus routes that are proposed to be electrified as a result of this proposal.

Figure 2-2: Nottingham's Existing biogas and other bus routes







## Our Ambition, and the Case for Change

### *Passenger satisfaction and bus user / non-user feedback on zero emission buses*

- 2.28 This section highlights the interrelationships between the ZEBRA funding proposal and our wider ambitions in respect of **decarbonising Nottingham’s transport systems, improving local air quality, Levelling-up through economic growth**, and delivering our ambitious **Bus Service Improvement Plans**.
- 2.29 Nottingham has a long tradition of delivering of some of the best bus services in the UK, but a recent passenger survey as part of the research for the Greater Nottingham Bus Service Improvement Plan highlighted a number of areas that passengers identified that can be addressed by this proposal.
- 2.30 An online survey was undertaken during July and August 2021 to gather opinions from both users and non-users of buses in Greater Nottingham on how bus services could be improved in order to attract more passenger trips. When asked what improvements would make them use the bus at all/more - **64%** of respondents agreed that electric / zero emissions vehicles would encourage them to use bus services more often.

Figure 2-5: Highest passenger satisfaction results in England – transport focus bus passenger survey 2019

## Nottingham City



## Decarbonising Nottingham's transport systems

### Current Position

- 2.31 Nottingham has been at the forefront of demonstrating what local authorities can achieve in respect of transport decarbonisation. The Nottingham Climate Emergency Declarations and our current strategies for energy transition and climate change mitigation drive our progress. NCC's actions have made a real difference to people's homes, businesses, transport and to the way the Council operates.

*"We met our 2020 energy strategy emissions target, of reducing CO<sub>2</sub> emissions by 26% from 2005 levels, ahead of schedule. The most recent monitoring figures, from 2017, show a reduction of 41% for the city and 49% per person<sup>9</sup>."*

- 2.32 Despite this progress, Nottingham remains a significant source of carbon emissions.

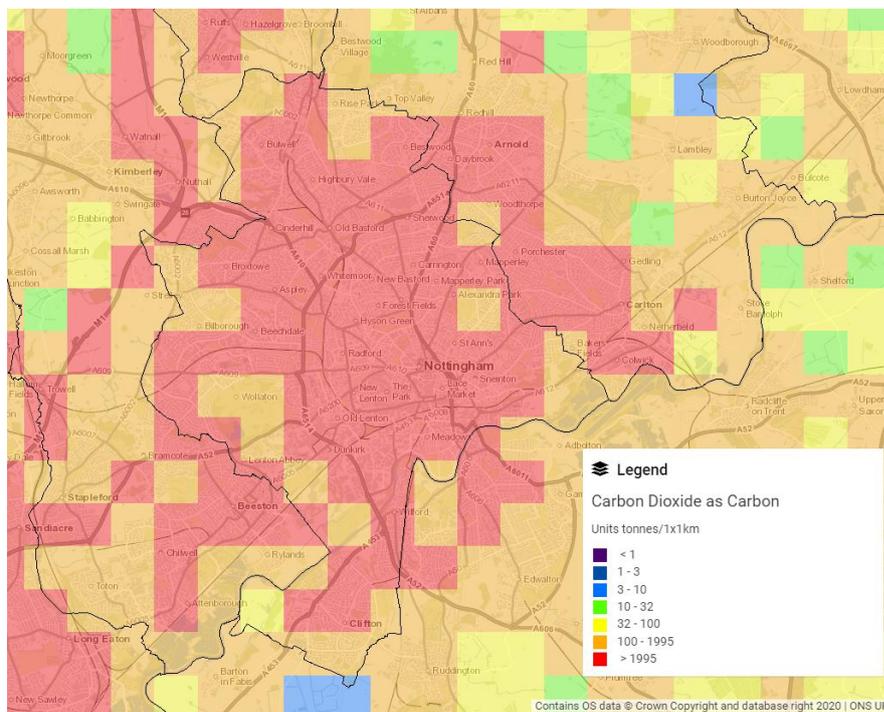


Figure 2-6: Carbon Dioxide (as carbon), total emissions all sectors

Source: <https://naei.beis.gov.uk/emissionsapp/>

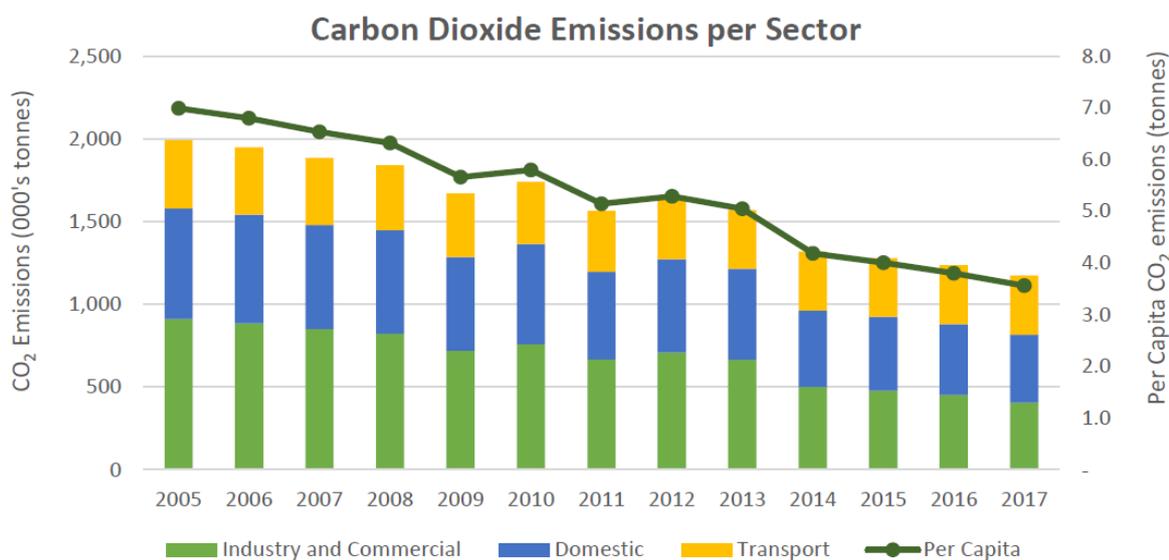
- 2.33 Figure 2-7 shows the extent to which the city's emissions, both by sector and per-capita, have been falling steadily since 2005. Total CO<sub>2</sub> emissions for Nottingham in 2017 (as derived from

<sup>9</sup> Nottingham 2028 Carbon Neutral Charter – a copy can be found in Appendix A

government figures<sup>10</sup>) were 1,171,364 tonnes, which equates to approximately 6 billion miles driven by the average new car in the UK<sup>11</sup>.

- 2.34 NCC is also on track to meet the target of generating 20% of the city's energy demand through low and zero carbon sources by 2020<sup>12</sup>. This stems from the successful implementation of key strategies and through our partnerships with local businesses, universities and other local authorities, enabling many forward-thinking carbon reduction actions to take place.
- 2.35 However, despite considerable and ongoing investments in sustainable transport infrastructure and service provision, the contribution of transport towards total emissions has remained stable at around 400,000 tonnes of CO<sub>2</sub> per annum, or 1.0 tonnes per person over this time. In essence, transport-related emissions have actually increased as a percentage of total carbon emissions – up from around 20% in 2005 to around 33% in 2017.

Figure 2-7: Nottingham City area CO<sub>2</sub> emissions breakdown



Source: BEIS, 2019

<sup>10</sup> <https://data.gov.uk/dataset/723c243d-2f1a-4d27-8b61-cdb93e5b10ff/emissions-of-carbon-dioxide-for-local-authority-areas>

<sup>11</sup> <https://www.theguardian.com/business/2018/feb/27/co2-emissions-from-average-uk-new-car-rise-for-first-time-since-2000>

<sup>12</sup> Nottingham Energy strategy (2010 to 2020)

[https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=2ahUKEwjf\\_trT45PkAhWGLFAKHeAcC50QFjAAegQIABAC&url=http%3A%2F%2Fdocuments.nottinghamcity.gov.uk%2Fdownload%2F3497&usg=AOvVaw0e\\_b-PQzK2-YyMUIJD3BD8](https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=2ahUKEwjf_trT45PkAhWGLFAKHeAcC50QFjAAegQIABAC&url=http%3A%2F%2Fdocuments.nottinghamcity.gov.uk%2Fdownload%2F3497&usg=AOvVaw0e_b-PQzK2-YyMUIJD3BD8)

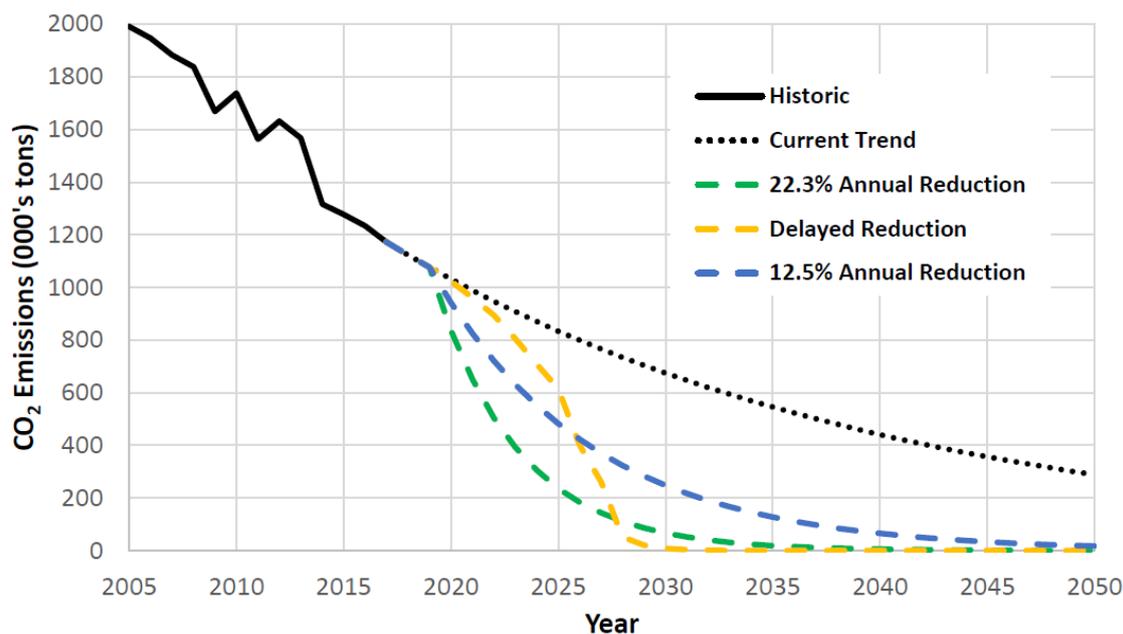
## **Ambition**

- 2.36 Nottingham City Council has responded to the climate and environmental crisis by setting an **ambition to become the first carbon neutral city in the UK by 2028**. In keeping with Nottingham's proud tradition of climate leadership, this Charter sets out a vision for sustainable carbon neutrality on behalf of the Council and the city's Green Partnership. At the heart of this shared vision is an approach that not only positively addresses wider environmental challenges, but improves quality of life and builds a new form of clean growth for our economy through a green industrial revolution.
- 2.37 Nottingham City Council has created an ambitious Carbon Neutral by 2028 plan (See Appendix A) which identifies decarbonisation of public transport as a key objective, mirroring the ambition of the city's 2018 public transport vision "Every Journey Matters – The Future of Public Transport In Our City" (See Appendix B) which called for every bus to be Euro VI or Ultra Low Emission by 2020. This latter objective has been achieved but is one which we now want to take to next level by accelerating the proportion of Zero Emission Buses in the fleet. These plans are further cemented by Nottingham's 2020-2025 Bus Strategy (See Appendix C), which further commits the city to the decarbonisation of buses.

## **Future Trends**

- 2.38 Figure 2-8 demonstrates that our current carbon reduction trend will not achieve our ambition to reach net zero carbon by 2028, or Government's wider aims to decarbonise by 2050. Consequently, NCC is placing greater emphasis on reducing emissions as quickly as possible to increase the chance of staying within our carbon budget and meeting our objective for carbon neutrality by 2028.
- 2.39 If we want to build on our early successes in the industrial and domestic sectors and achieve our ambition to be carbon neutral by 2028, then we need to drive our reductions faster than we have over the last 12 years. This includes targeting transport emissions, given the lack of tangible progress over the last 15-years.
- 2.40 To achieve this, we know we need to reduce emissions at a rate in excess of 22.3% each year. This is the rate of emission reduction required to keep cumulative emissions up to 2100 within 5% of Nottingham's total carbon budget. While we acknowledge the technical challenges behind removing all emissions in our Carbon Neutral Action Plan and note that negative emissions technologies and offsetting could be used to neutralise remaining emissions, our central aim is to reduce emissions at, or beyond, this level to stand the best chance of limiting global warming to +1.5°C above pre-industrial levels.

Figure 2-8: Illustrative emission reduction pathways to meet 2028 commitment



Source: Carbon Neutral Nottingham: 2020 – 2028 Action Plan (June 2020)<sup>13</sup>

2.41 The key point here is the **urgency** needed to act to reduce Nottingham’s emissions. Delaying action by just one year means the minimum 12.5% annual reduction to remain below Nottingham’s carbon budget becomes 13.5% and the 22.3% annual reduction to achieve the commitment rises to 24.3%. Essentially, the longer we delay, the greater the effort needed in ensuing years.

### ZEBRA funding bid implications

Our immediate aim to decarbonise local transport networks can be directly supported by converting as many Euro VI and first generation electric buses as possible over to the latest Battery Electric Vehicle (BEV) bus technologies. We estimate that around 3,800 tonnes of CO<sub>2</sub>e will be saved each year on average (See Appendix D).

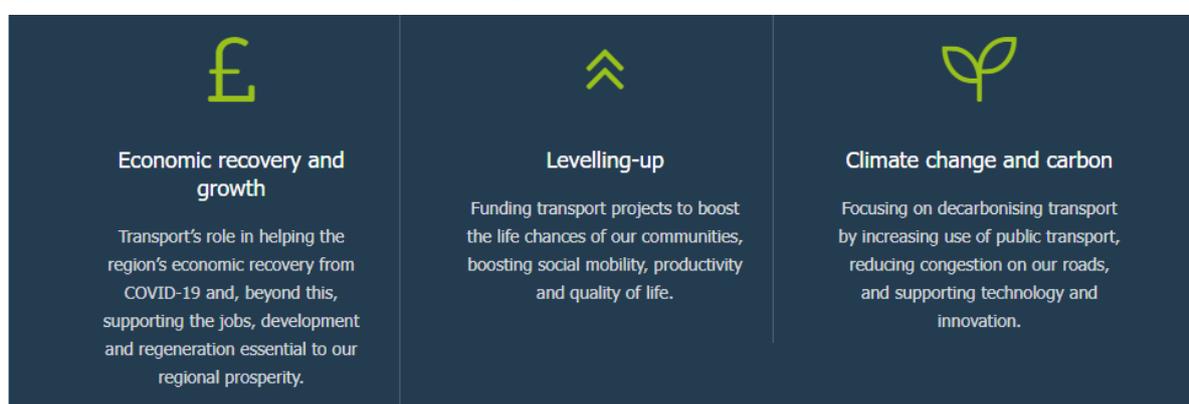
Beyond the scope of this bid, our wider ambition is to install Solar PV arrays and battery storage infrastructure at bus depots and bus stations across the Nottingham urban area. This will maximise the value of the most significant bus network infrastructure assets by enabling them to store electricity that can be used to rapidly charge our city’s growing electric bus fleets. This will further support our decarbonisation goals and improve operational resilience by reducing our reliance on third party energy tariffs and bringing down the cost of commercial bus operations.

<sup>13</sup> <https://www.nottinghamcity.gov.uk/media/2619917/2028-carbon-neutral-action-plan-v2-160620.pdf>

## Regional Policy: Midlands Engine / Midlands Connect

- 2.42 Attractively located at the UK's heart, the Derby-Nottingham city region is home to major global businesses. The [Midlands Engine](#) identifies Nottingham as a key location within the area's 'Strategic economic hubs' and 'intensive growth corridors'<sup>14</sup>; together with Derby it is one of four priority areas with potential to drive forward the Midlands economy<sup>15</sup>.
- 2.43 Midlands Connect has outlined the context for its refreshed strategy (due to be published later this year), focusing on how regional transport and connectivity can help tackle the challenges outlined in Figure 2-9. This ZEBRA proposal aligns with all three of these, promoting decarbonised transport, better quality of life for our communities and supporting the economy and bus passenger recovery.

Figure 2-9: Midlands Connect Strategy Focuses



### ZEBRA funding bid implications

One of the key parts of the Midlands Engine Ten Point Plan for Green Growth is Net Zero Transport and accelerating the shift to net zero vehicles<sup>16</sup>. This proposal will contribute to the wider regional ambition to develop and promote the Midlands Engine as a centre of excellence for battery electric vehicles and charging and refuelling technologies and building a skilled workforce in this area.

### Air quality

#### Nottingham's current air quality challenge

- 2.44 In July 2017, the Department for Environment Food and Rural Affairs (DEFRA) published its "UK Plan for tackling roadside Nitrogen Dioxide concentrations". Nottingham City Council's administrative area was named in the document as having concentrations of Nitrogen Dioxide

<sup>14</sup> Midlands Connect Strategy (2017): <https://www.midlandsconnect.uk/media/1224/midlands-connect-strategy-march-2017.pdf>

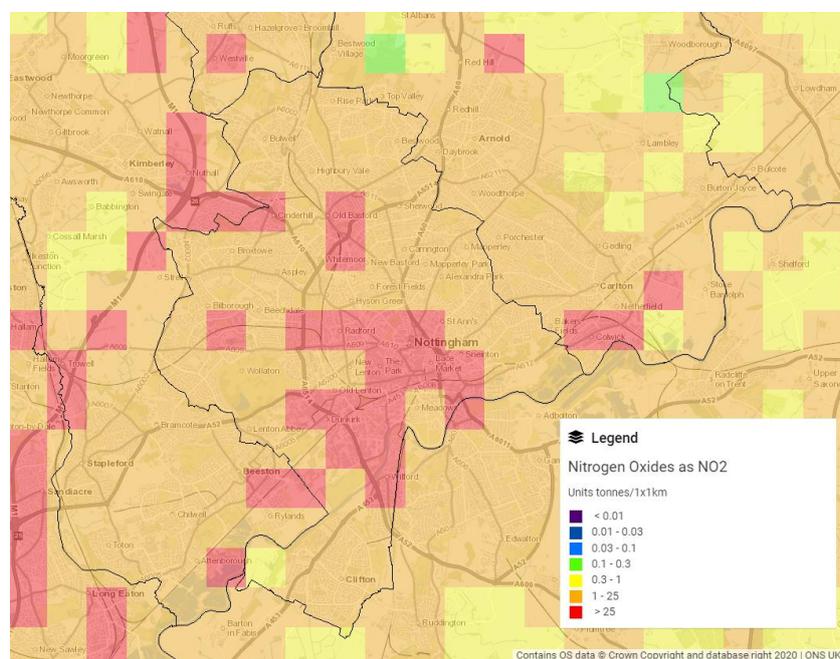
<sup>15</sup> Delivering a Transport Strategy for the Midlands <https://www.midlandsconnect.uk/media/1058/mc-transport-strategy.pdf>

<sup>16</sup> [https://www.midlandsengine.org/wp-content/uploads/Ten-Point-Plan-for-Green-Growth-in-the-Midlands-Engine\\_V1.pdf](https://www.midlandsengine.org/wp-content/uploads/Ten-Point-Plan-for-Green-Growth-in-the-Midlands-Engine_V1.pdf)

(NO<sub>2</sub>) above the average annual legal limit of 40µgm-3. The City Council was then mandated by the Secretary of State to produce a plan that would show how the Council would reduce concentrations of NO<sub>2</sub> to within the legal limits.

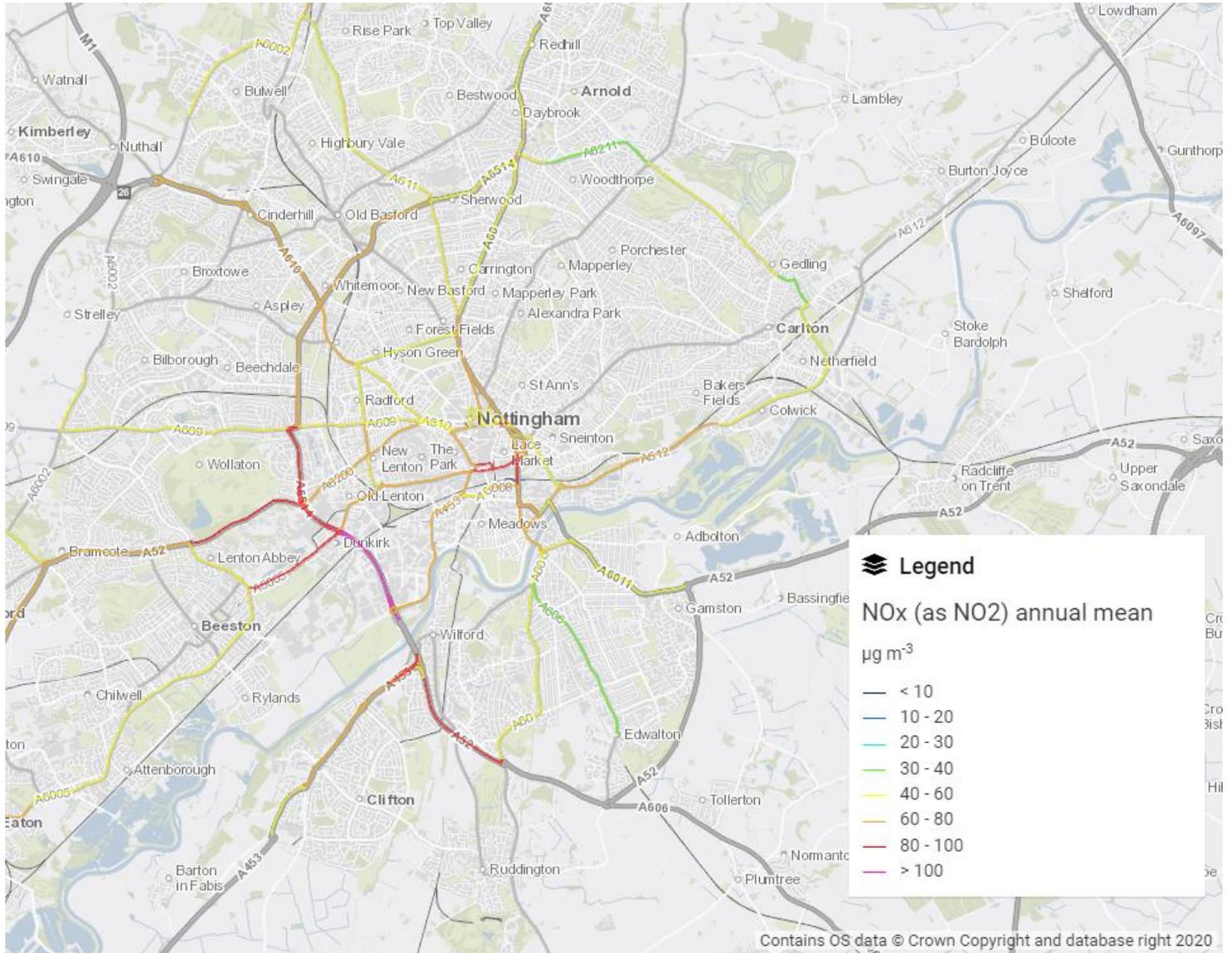
- 2.45 The Local Plan (See Appendix E) was submitted and approved by DEFRA in September 2018. On the 21st November 2018 the Ministerial Direction (Environment Act 1995, Nottingham City Council) Air Quality Direction 2018 came into force which compelled the Council to implement its plan.
- 2.46 Notwithstanding the measures already delivered, the plan contained a commitment to go much further in improving air quality than just meeting the air quality directive limit for NO<sub>2</sub>. Acting on this commitment the Council extended one of our existing Air Quality Management Areas for nitrogen dioxide to cover the entire City.
- 2.47 Air quality monitoring data for 2020 generally show a reduction in the annual average NO<sub>2</sub> and particulate concentrations. When examined in detail, the monitoring data shows that the lowest measured NO<sub>2</sub> and particle concentrations coincided with the strictest periods of 'lockdown'. However, on three key arterial routes (not identified in the detailed infraction modelling), diffusion tube data continues to indicate NO<sub>2</sub> concentrations in the range 39-43 ug/m<sup>3</sup>.

Figure 2-10: Nitrogen Oxides as NO<sub>2</sub> – total emissions all sectors



Source: <https://naei.beis.gov.uk/emissionsapp/>

Figure 2-11: 2019 Annual mean NOx – Roadside

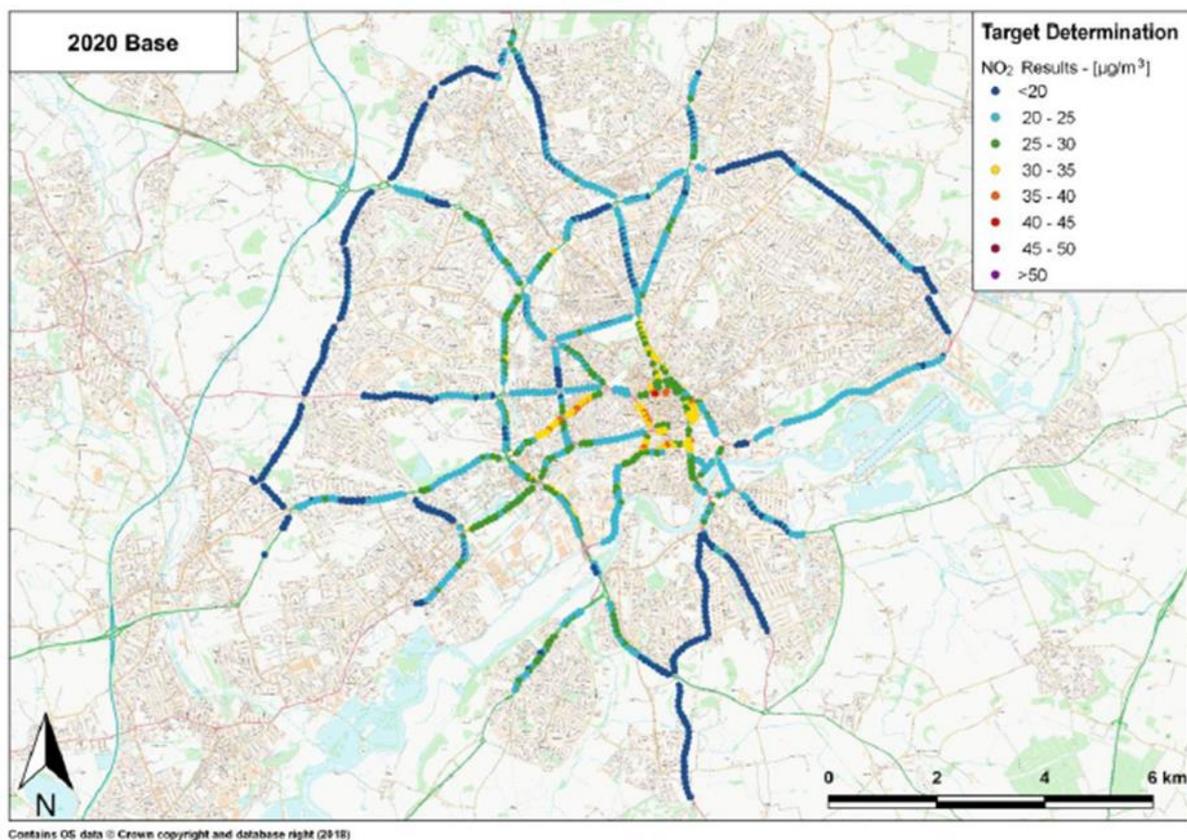


Source: <https://uk-air.defra.gov.uk/data/gis-mapping/>

## Air quality management

2.48 Figure 2-12 shows forecast nitrogen dioxide (NO<sub>2</sub>) levels in Nottingham, which are one of the key metrics for air quality in urban areas. An Air Quality Management Area (AQMA) covers the City's boundary and monitors levels of Nitrogen Dioxide (NO<sub>2</sub>) in the air – of which exhaust emissions from motorised vehicles are a primary source. When initially declared in 2002 the AQMA was focused upon the Broadmarsh area, Maid Marian Way, and along the A6008 to Upper Parliament Street. This was extended in 2019 to cover the entirety of NCC's administrative area<sup>17</sup>.

Figure 2-12: Nottingham 2020 NO<sub>2</sub> air quality model forecasts



Source: Nottingham City Council (2018) Air Quality Annual Status Report

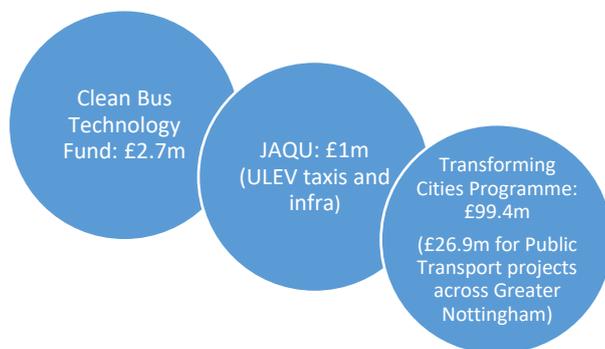
2.49 Nottingham was in the first wave of UK city authorities that are required to comply with EU air quality limits in the shortest time. This has resulted in the preparation of Local Air Quality Plans setting out measures to deliver air quality compliance.

<sup>17</sup> [https://uk-air.defra.gov.uk/aqma/details?aqma\\_ref=112](https://uk-air.defra.gov.uk/aqma/details?aqma_ref=112)

2.50 Public consultation on the issue of air quality revealed the importance of this issue locally, with 90% of respondents supporting measures to improve air quality in the city and 88% believing that improving air quality should be a key priority. Specific measures are underway to accelerate compliance, including:

- Retro-fitting 185 Nottingham City Transport buses with clean exhaust technology (68 of these previously retrofitted buses will now be upgraded to battery electric as part of this ZEBRA proposal).
- Requiring every taxi and private hire vehicle to be either Euro 6 or Ultra Low Emission (ULEV).
- Replacing the Council's own specialist vehicles – such as cage tippers and vans – with electric or other low emission vehicles.
- Reviewing the city's Clear Zone - which restricts access to the city centre - to include emissions criteria and a taxi permit scheme.

2.51 In combination with previously implemented measures; including the Workplace Parking Levy, NET tram network, electric and biogas bus initiatives, cycle ambition plan and travel behaviour change programmes; the Government's Joint Air Quality Unit (JAQU) concluded that a charging Clean Air Zone was not required in Nottingham.



2.52 The City is participating in the delivery of the Go Ultra Low (OLEV funded) initiatives to increase the uptake of Ultra Low Emission Vehicles (ULEVs), helping to contribute to air quality improvements. This includes the creation of a publicly accessible charge point network across the area, comprehensive support for businesses (advice and sustainable transport grants) and events/campaigns to raise the awareness of electric and other ULEVs to the public.

2.53 Infrastructure for electric vehicles is becoming increasingly important as quarterly statistics published by DfT and The Society of Motor Manufacturers and Traders (SMMT) show that plug-in vehicle registrations have been increasing significantly since 2017. According to a letter from the Secretary of State for Transport (29<sup>th</sup> Oct 2019) which included 'Zap-Map' survey data, the East Midlands' average of public charge points per 100,000 of population is 15. The comparable figure for Nottingham is 31.

2.54 The focus of these other investments is around decarbonising our activities and enhancing sustainable travel choices. Our current bus fleet conflicts with these aims by producing carbon emissions and polluting our local environment thus preventing maximum value of other initiatives and investments in the city being fully realised. Without making changes to the

majority of the bus services in the City, the increased levels of walking and cycling will suffer from existing levels of poor air quality, and health benefits will be limited.

### **ZEBRA funding bid implications**

Our ZEBRA-funded project will see the entire fleet of single deck diesel buses currently being run by Nottingham City Transport electrified. This will deliver significant reductions in emissions from buses that contribute to poor air quality – both within the City AQMA and across the wider conurbation, including AQMAs in the County Council districts of Gedling and Rushcliffe.

Based on pre-pandemic operated bus vehicle kilometres (calculated from November 2019 levels of operations) we estimate that on average around 1,829 kilograms fewer NO<sub>x</sub> emissions and 46 kilograms fewer PM<sub>2.5</sub> emissions<sup>18</sup> will be emitted each year as a result of converting the diesel-powered routes within this bid to electric buses.

### *Supporting an improving sustainable transport network*

- 2.55 ZEBRA funding presents an opportunity to further improve the quality and sustainability of Nottingham's local transport networks. This necessitates that we further develop existing transport infrastructure and build on high quality public transport services, such as the Nottingham Express Transit (NET) tram, SkyLink bus services (that connect Nottingham to East Midlands Airport and major employment areas nearby), and the extensive NCT, Trent Barton and Linkbus networks.
- 2.56 This means evolving our mass transit system and key bus corridors, and capitalising on planned and recently completed investments, (including A52 and A38 road capacity improvements, and Nottingham's rail and bus station upgrades). We must also exploit and deploy new technologies along key corridors that connect existing urban areas with emerging growth.

### **Encouraging wider public transport and cycling uptake**

- 2.57 Our proposal forms part of a 360-degree approach to improving bus services in Nottingham, as highlighted in the Nottingham 2020-25 Bus Strategy (see below). It is a key component of improving the passenger experience through quieter, more comfortable, modern buses which fit better within more people-focused 'Healthy Street' environments which prioritise walking, cycling, e-scooter/micro mobility and clean public transport travel choices over other motorised journey options.

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<sup>18</sup> Calculated within the Greener Buses Model (see Appendix D)

- 2.58 This is particularly important given many Nottingham residents do not own or have access to a car (0.76 cars per person), which is already reflected by high levels of public transport use (over 40% of all trips in the city are by bus and tram).
- 2.59 Nottingham has bucked recent national trends for declining public transport use in English core cities. This has been driven by the extended Nottingham Express Transit (NET) network, a progressive Workplace Parking Levy, a highway network/city centre environment which prioritises public transport connections, and the award-winning approach of our city's two main bus operators: Nottingham City Transport and Trentbarton. Consequently, the annual number of passengers has increased to 82.75m (of which 17.73m were by tram) in 2018/19<sup>19</sup>, representing a 24% increase since 2003/4.
- 2.60 Since its expansion in 2015, Nottingham's tram network offers direct cross-city routes between Clifton (South West of Nottingham) and Toton Lane (West of Nottingham) and Hucknall/Phoenix Park to the north of the city<sup>20</sup>. It is complemented by a hub and spoke bus network, which also offers a range of orbital and local 'Link' bus services.

### **Aligning investment to passenger growth**

- 2.61 Despite these positive trends, historic infrastructure investment has not kept pace with local growth. Central Government statistics (from 2015/16) show the East Midlands had the lowest levels of public expenditure on transport – both in total and per capita<sup>21</sup>. This has contributed to the Nottingham area not achieving its full potential, with productivity consistently below the national average.
- 2.62 This historic shortfall in investment, particularly on transport connections serving major employment growth locations on the edge of Nottingham's urban areas, has contributed to high levels of car dependence for trips outside of the urban centre – many of which travel across the city on primary roads.
- 2.63 Many active travel projects including those being delivered through our Transforming Cities Fund programme and identified in the Local Cycling Walking Infrastructure Plan (See Appendix F) are integrated with bus priority corridors. These will provide dedicated bus lanes alongside segregated cycle lanes and secure bicycle parking 'hubs' close to key bus stops. Improved pedestrian facilities and links to support better access to bus stops are also being delivered locally as part of public realm and wayfinding improvements across the city.

### **National bus strategy: bus back better**

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<sup>19</sup> Nottingham City Authority Monitoring Report (2019): <https://www.nottinghamshireinsight.org.uk/d/aAXDCdN>

<sup>20</sup> Nottingham Express Transit tram patronage figures (Nottingham City Council 2019): <https://www.gov.uk/government/collections/light-rail-and-tram-statistics>

<sup>21</sup> East Midlands Council report: <http://www.emcouncils.gov.uk/write/Levels of Public Investment in East Midlands.pdf>

2.64 In September 2019, the government set out how it would launch a revolution in bus services – delivering a better deal for bus users and committing to publishing a National Bus Strategy. This national strategy sets out the vision and opportunity to deliver better bus services for passengers across England, through ambitious and far-reaching reform of how services are planned and delivered.

### **Nottingham’s bus quality partnership and bus service improvement plan**

2.65 Nottingham’s 2020-25 Bus Strategy identifies the importance of Nottingham’s longstanding Bus Quality Partnership. NCC’s effective collaboration with key local bus and tram operators has led to a comprehensive Advanced Quality Partnership Scheme for the city centre (See Appendix G). Its members are now committed to implementing an Enhanced Partnership across the wider urban area by April 2022 as part of the Strategy, which has evolved into our Bus Service Improvement Plan.

2.66 The strategy identifies a number of work packages being taken forward as part of our £29m Transforming Cities Fund Programme, which builds on the prior long-term investments in bus priority and public transport information. Developed in partnership with the Bus Quality Partnership and included within the Bus Service Improvement Plan (BSIP), these include:

- Roll-out of traffic light priority for late running buses across all core high-frequency bus corridors.
- Upgrades to our digital public transport information systems and hardware.
- Additional Bus Lanes and Bus Lane enforcement along key arterial routes.
- A new Park and Ride site to the North of the city.
- An operator pinch-point package.
- Broadmarsh Bus Station, Victoria Bus Station and Bulwell Interchange upgrades.
- Improvements to Robin Hood Multi-Operator Smart Ticketing and Contactless fare Payment systems.

2.67 All of the improvements detailed above are being implemented along the core arterial corridors across the network and will directly benefit the ZEBRA Routes outlined in this bid delivering zero and low emission bus corridors with comprehensive bus priority, advanced digital information, improved passenger waiting facilities and state of the art integrated ticketing and payment.

### **ZEBRA funding bid implications**

Quieter, zero-emission buses will deliver secondary benefits for NCC’s more people-focused approach to redesigning its urban street networks. Their operation will help to create

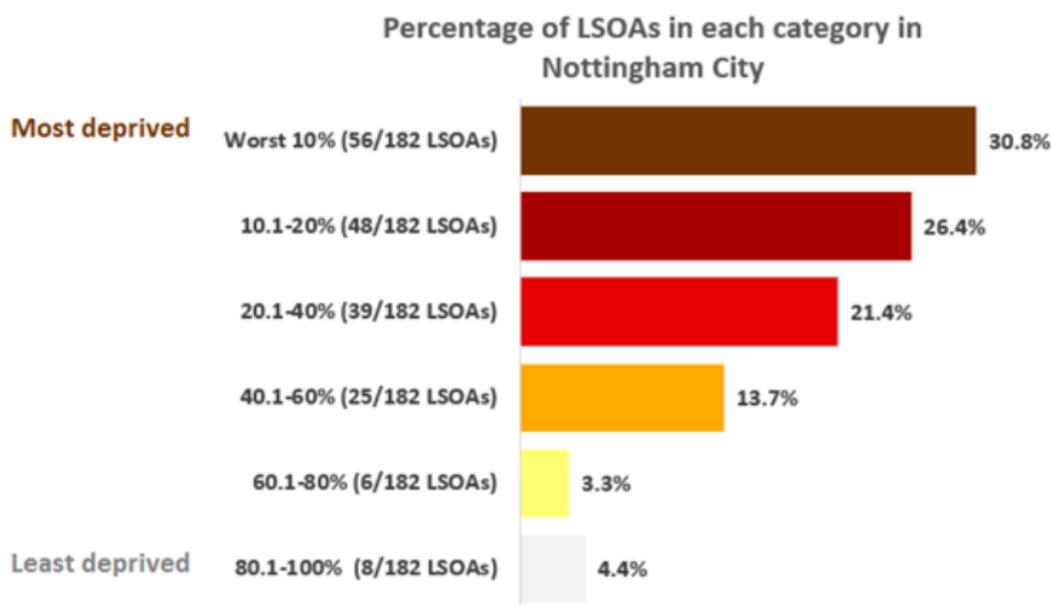
environments that are better-suited to higher levels of every-day walking, cycling and public transport trip-making. The lower noise associated with zero emission buses supports NCC's BSIP aspirations to extend operating hours in some residential areas without disruption.

The new vehicles we intend to purchase will benefit from urban traffic control centrally triggered priority at traffic signals and key routes, and our back-office investments in real-time information and smart fare payment technologies.

### *Economic growth and levelling-up*

- 2.68 The Indices of Deprivation measure relative deprivation in 32,844 neighbourhood areas, called Lower Super Output Areas (LSOAs), in England. Each area is given a score and a rank for seven distinct metrics of deprivation, which are combined to calculate the overall Index of Multiple Deprivation (IMD). Summaries are also provided at a Local Authority district level (aggregating LSOAs to match administrative boundaries).
- 2.69 Nottingham ranks as the 11th most-deprived of the 317 districts in England using the Average Score measure. Figure 2-13 shows that over half (57.2%) of the city's LSOAs fall into the lowest IMD quintile (lowest 20%) for the whole of England, and less than one-in-ten (8%) of Nottingham's LSOAs are in the top quintile (top 20%).

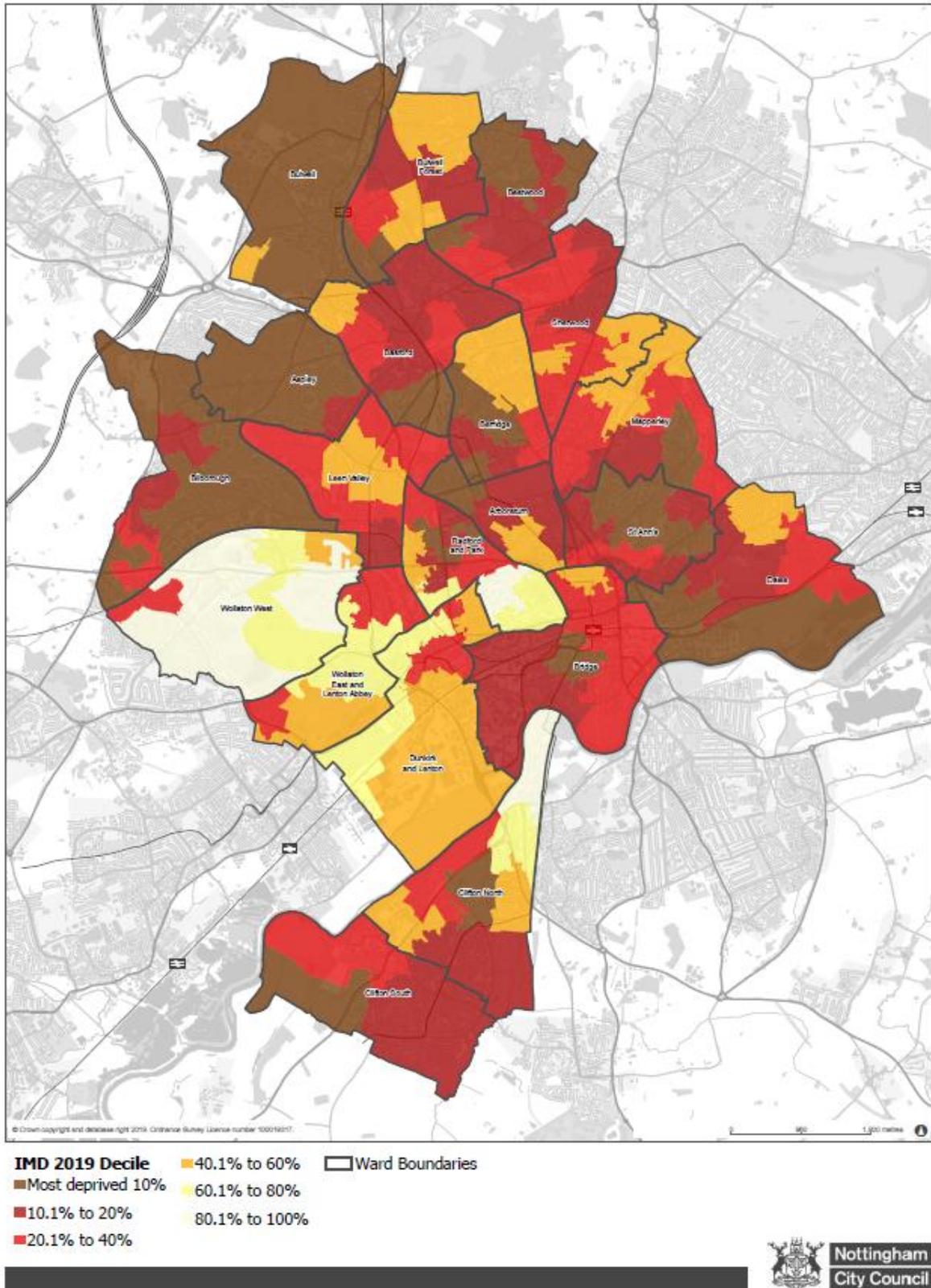
Figure 2-13: Index of multiple deprivation for Nottingham



Source: <https://www.nottinghaminsight.org.uk/themes/deprivation-and-poverty/indices-of-deprivation-2019/>

- 2.70 While these trends are comparable with a number of other East Midlands' cities, and also reflect Nottingham City's tightly drawn administrative boundary, they underline the critical importance of levelling-up the local economy and providing access to employment opportunities for Nottingham's residents.
- 2.71 Figure 2-14 shows how these LSOAs are distributed across the City. The proposed ZEBRA routes to be electrified will serve communities around Nottingham, providing connections to the City Centre and key employment areas. Connections will benefit communities in the most deprived areas of the city including in Cillfton, to the south of the river, and on corridors to the north of the city, towards Bulwell and Bestwood.

Figure 2-14: Index of Multiple Deprivation for Nottingham (map)



Source: <https://www.nottinghaminsight.org.uk/d/a8AgQEL>

## Zero emission agglomeration and retention of jobs

- 2.72 Recognising the Levelling-Up challenge, this proposal will continue Nottingham's progress as a national incubator and international model for zero emission vehicle technology. The alternative fuel mix deployed across the city's public transport network will yield useful comparative operational data that can inform wider adoption of BEV bus technologies in other towns and cities, feeding into wider monitoring and evaluation reports. It will simultaneously drive economic growth and improving the liveability and attractiveness of the city and district centres through significant reductions in air and noise pollution.
- 2.73 The electrification of Trent Bridge garage, which is located within The Meadows residential area, will significantly reduce the noise impact of the garage. Increasing the available power infrastructure within this residential area also opens up scope to create a neighbourhood mobility hub. The bus depot on Turney Street could support co-located e-bike/e-scooter stabling, electric vehicle charging points and an electric car share scheme. All of these would benefit from the strengthened local energy grid delivered by the ZEBRA funding, whilst affording new travel options for NCT staff and local residents alike.

## Skills and jobs

- 2.74 The investment will also have an agglomeration effect on the local economy and skills base. Engineers and mechanics working for NCT will become skilled in maintaining and servicing electric vehicles, enhancing their employability.
- 2.75 Local colleges are already interested in offering courses in the maintenance and servicing of electric vehicles, and would be able to develop pathways into skilled local employment with the possibility of local bus companies offering apprenticeships and work experience connected directly to this new technology. Academic institutions such as Nottingham University's recently formed Centre for Advanced Propulsion are well placed to benefit from close proximity to a real-world testbed.
- 2.76 [Nottingham Electric Vehicle Services](#) (NEVS) was created in 2020 and is the first publicly owned MOT and maintenance centre exclusively for ultra-low emission vehicles. It is an early indicator of the type of agglomeration benefit that previous investment in zero emission technologies has helped to trigger locally. A letter of their support of our ZEBRA bid is included in Appendix I. It highlights their aspirations to create apprenticeship opportunities, on-going engagement with other local garages to advise on staff training and local colleges to develop new course for EV maintenance.



- 2.77 Investment in electric buses will continue to protect jobs in the UK bus industry nationally, whilst ensuring the attractiveness of bus travel on a local level by delivering a state-of-the-art bus fleet which in turn protects jobs within the sector.

#### **ZEBRA funding bid implications**

The receipt of ZEBRA funding creates scope for local bus operators to enrich local skills and offer more jobs focused around the city's burgeoning zero emission centre of excellence status – in doing so contributing to Levelling-Up the Midlands.

It will build the practical opportunities on offer locally, to work on electric vehicles and learn with NEVS, local colleges and Nottingham University.

#### *Improve transport for the user*

- 2.78 The new electric bus vehicles will upgrade the full single deck midi bus fleet operated by NCT in Nottingham. This will improve public transport options for all current users and any new users by delivering the latest in accessibility standards and user technology.
- 2.79 NCT fleet specification standards will directly mirror those outlined in the scheme guidance in relation to accessibility and will be applied to the procurement of any new buses. All buses procured will be compliant with the Public Service Vehicles Accessibility Regulations (PSVAR, 2000). They will meet the enhanced accessibility requirements and will have:
- Audio and Visual equipment visible and audible from priority seats and wheelchair space
  - Induction loops in priority seats and the wheelchair space
  - provide an induction loop to aid direct communication between drivers and passengers who use a hearing aid
  - Provide an additional flexible space in addition to the mandatory wheelchair space, suitable for a second wheelchair user and/or at least two unfolded pushchairs or prams.
- 2.80 Passengers and drivers will also benefit from the inclusion of CCTV on board, as installation of CCTV will be included on all of the buses delivered within this project.
- 2.81 In addition, electric vehicles offer passengers an improved physical quality of journey compared to their diesel counterparts. With quieter and smoother motors, journeys are more comfortable and involve reduced vibrations. This particularly benefits passengers moving

around the bus to find a seat or standing where any turbulence particularly impacts user experience. Drivers also benefit from this improved journey experience.

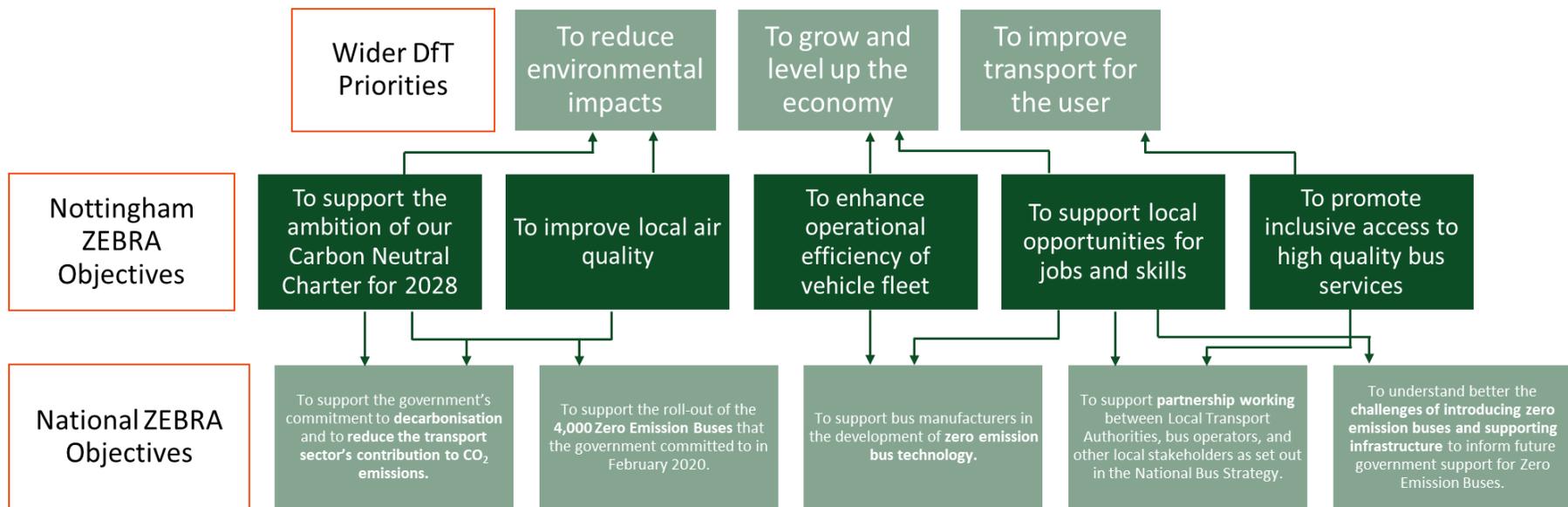
- 2.82 Other road users can also benefit from electric vehicles on the road. Cyclists and pedestrians experience reduced tailpipe emissions from buses, improving their journey quality from reduced smell and exposure to harmful air borne pollutants.
- 2.83 Our proposal will deliver significant reductions in emissions (down 3,800 tonnes CO<sub>2</sub>e per annum) from buses operating within the City Air Quality Management Area (AQMA), which covers the full administrative area, and across the wider conurbation - including AQMAs in County Council districts of Gedling and Rushcliffe.

# Scheme Objectives

## Nottingham ZEBRA objectives

2.84 Recognising the issues and opportunities defined above, our proposal has been developed to address a set of 'Nottingham-specific' objectives that relate to those defined in DfT's funding programme guidance. These are presented side-by-side in Figure 2-15 alongside wider DfT priorities – demonstrating their clear alignment and appropriate strategic fit.

Figure 2-15: The relationship between our local ZEBRA objectives and those published by DfT



### Policy alignment: summary

2.85 As detailed throughout this chapter our ambitions for transport in Nottingham, and specifically the bus operations set out in this proposal, align with local plans and policies, regional strategies and wider national agendas. The policies and strategies listed below are ones which directly relate, and align, with the aims and impacts of our ZEBRA proposals.

Figure 2-16: Key policy and strategy documents

National	Regional	Local
<ul style="list-style-type: none"> <li>•National Bus Strategy</li> <li>•Transport decarbonisation plan</li> </ul>	<ul style="list-style-type: none"> <li>•Midlands Engine / Connect</li> </ul>	<ul style="list-style-type: none"> <li>•Nottingham Bus Decarbonisation Strategy</li> <li>•Nottingham Bus Strategy</li> <li>•Nottingham BSIP</li> <li>•Nottingham Carbon Neutral</li> <li>•Nottingham Local Air Quality Plan</li> </ul>

2.86 Plans for bus directly complement the city’s wider “Go Ultra Low Nottingham” transport decarbonisation programme. This has delivered a comprehensive network of 400 charge points for Ultra Low Emission Vehicles across the Derby – Nottingham area, electrification of the Hackney Carriage fleet, conversion of the local public sector fleet including the UK’s first electric Refuse Collection Vehicle and the city’s first dedicated ULEV only service and repair centre. Work related to the local Future Transport Zone programme has also seen wireless taxi charging and the initiation of a citywide E-Scooter trial with Wind Mobility. This ZEBRA funding bid complements our ongoing decarbonisation work by adding power infrastructure to NCT’s Trent Bridge depot – thereby establishing potential for an electric neighbourhood mobility hub adjacent to the bus garages on Turney Street in Nottingham’s Meadows area.

2.87 Many active travel projects, including those being delivered through Transforming Cities and identified in the Local Cycling Walking Infrastructure Plan are integrated with bus priority corridors with dedicated bus lanes complemented with parallel cycle lanes and secure bicycle parking hubs. Improved pedestrian facilities and links to support better access to bus stops are also being delivered locally.

2.88 This proposal forms part of a 360-degree approach to improving bus services in Nottingham as highlighted in the Nottingham 2020-25 Bus Strategy and is a key aspect of improving the passenger experience through quieter, comfortable, modern buses which fit better with a Healthy Streets approach to our neighbourhoods where public transport, walking and cycling are prioritised.

2.89 Table 2-2 illustrates the key themes of the strategic case, the direct relationships between local and national objectives and how the Nottingham proposal will meet these aims.

### **Monitoring performance**

2.90 These objectives and outcomes have been selected with a view to ensure effective monitoring and evaluation is undertaken to review the impact of the scheme and wider policies that it contributes to, such as Air Quality and Carbon Neutral Plans.

2.91 Further details on the approach to monitoring and evaluation, including partnership working with the DfT in the wider national ZEBRA reviews, are set out within the Management Case (Section 6).

Table 2-2: Map of policy objectives relative to Nottingham's ZEBRA scheme aims

Scheme Objectives	Map to most relevant DfT Strategic Priority	Map to most relevant ZEBRA Objectives	Alignment to other relevant local / regional objectives / policies	How do the outcomes of the scheme meet the objective?
<b>To support the ambition of our Carbon Neutral Charter for 2028</b>	Reduces the negative environmental impacts of transport	Support the government's commitment to decarbonisation and to reduce the transport sector's contribution to CO <sub>2</sub> emissions Supports the roll out of zero emission buses across the country	In line with decarbonisation plans and climate emergency declarations across all levels of authority. It also builds on the other sustainable transport schemes being implemented and developed across the City.	New buses will remove an average of 3,800 tonnes of CO <sub>2</sub> e per year, total of 64,605 over the appraisal period <sup>22</sup>
<b>To improve local air quality</b>	Reduces the negative environmental impacts of transport	Support the government's commitment decarbonise transport Supports the roll out of zero emission buses across the country	The Nottingham wide AQMA will monitor the impact of the scheme. Proposals will support the Local Air Quality Action Plan and align with other sustainable transport schemes across the City.	New buses will remove 31 tonnes of NO <sub>x</sub> and 777 kilograms of PM <sub>2.5</sub> during the appraisal period <sup>22</sup>  Links with existing AQMA and Air Quality strategy monitoring
<b>To enhance operational efficiency of vehicle fleet</b>	Support wider priorities to grow and level-up the economy	Supports the development of zero emission bus technology Supports the roll out of zero emission buses across the country	The proposal supports efficient business practices that provide stable operations and employment opportunities for the future.	New buses will reduce maintenance costs by minimising the regular servicing that diesel engines require
<b>To support local opportunities for jobs and skills</b>	Support wider priorities to grow and level-up the economy	Support the development of zero emission bus technology Improves understanding of the challenges involved in delivering ZEBs Supports the roll out of zero emission buses across the country and the NBS	The proposal supports the aims of the Midlands Engine to build a strong skills and employment base for the future. There is potential to link operations to local colleges, offering students hands on experience	NCT employees to be trained in EV maintenance and servicing Local college interest in delivering related course will be able to develop new local pathways into employment and apprenticeship opportunities
<b>To promote inclusive access to high quality bus services</b>	Support the wider DfT priority to improve transport for the user	Supports priorities set out in the National Bus Strategy – raising the quality of and patronage on public transport Supports the roll out of zero emission buses across the country	This supports the National Bus Strategy by being a greener and more accessible and inclusive mode of transport	All new buses will be compliant with the Public Service Vehicles Accessibility Regulations 2000 and delivered to the Nottingham City Transport Specification which includes, luxury seating, led lighting, next stop audio and visual announcements, USB charging and wifi, generous legroom, two pushchair / buggy spaces to complement wheelchair space provision.

<sup>22</sup> (see 'O – Summary' sheets of the GBM in Appendix D)

## Option Appraisal & Preferred Option

### *Options considered in this business case*

- 2.92 One main 'do something' scenario has been considered and compared to a 'do minimum'/no investment situation. This preferred 'do something' option is to purchase 78 new BEV buses to replace existing vehicles operating on the commercial (NCT-operated) network. This would be part funded by the DfT and the operator, NCT. Further information can be found within the Financial Case chapter.
- 2.93 The 'do minimum' alternative would see the continued operation of existing Euro VI vehicles on NCT's commercial network.
- 2.94 Hybrid vehicles were not considered the optimal solution for NCT operations in Nottingham; the reasoning behind this decision is set out in this section.
- 2.95 In addition, a leasing option was previously considered. The annual lease cost from Zenobē for an ADL/BYD E200EV based on a total vehicle price of £[REDACTED] was [REDACTED] PA over 10 years totalling £[REDACTED]. This is higher than the overall vehicle purchase and infrastructure cost set out in this bid and was thus discounted from consideration on cost-effectiveness grounds. This option did include a battery management option which guaranteed that there will always be an eBus battery that meets the minimum capacity requirements for the agreed route. However, it was felt that the 7-year manufacturer warranty would be sufficient to cover a midlife battery replacement.

### *Preferred option - our ZEBRA funding proposal*

- 2.96 This option assumes that NCC secures the full ask associated with this ZEBRA proposal. It covers NCT's commercial operation with **78 new BEV buses**, replacing 78 existing diesel vehicles which will serve radial routes across the city. These represent the total existing midi bus fleet, operated by NCT in Nottingham. Replacement of the midi bus fleet on the routes selected is the most expedient way to roll out electric buses at a scale on the commercial network locally, due to shorter route lengths and lighter frequencies than those delivered by NCT's double decker operation.

The total cost of the proposal is £[REDACTED]; this is made up of £15,228,028 ZEBRA funding ask and £[REDACTED] private sector contribution. This spend is planned across two years with £[REDACTED] in 2022 and £[REDACTED] in 2023.

### **Proportion of electric buses to be operated within the proposal area**

- 2.97 Discounting NCC's non-commercial fleet (29 bus vehicles), 17% of Nottingham's commercially operated bus fleet will be electrified as a result of this option. This equates to 26% of NCT's entire fleet, which reflects a significant proportion of buses in service given their local market share and operated mileage across Nottingham.

The average annual distance covered by the NCT midi buses that are to be replaced was 58,616 km<sup>23</sup>. Therefore, this would represent 4,572,048 annual km being electrified by the proposal.

### **Area covered by Nottingham's ZEBRA proposal**

- 2.98 This option will see full conversion of NCT's single decker fleet to BEV bus operation. Electrical supply infrastructure will be upgraded at NCT's Trent Bridge Depot to facilitate charging of the new buses, with a sustainable energy supplier set to be secured.
- 2.99 Figure 2-17 details the routes that will be covered and the Local Transport Authority areas across Greater Nottingham that will be served by the new BEV buses, while Appendix H gives a high-resolution version. These extend beyond the Nottingham City (NCC) administrative area into a number of neighbouring districts and boroughs within the Nottinghamshire County Council administrative area. All of these services operate into Nottingham City Centre and serve a number of key destinations, including the city's two hospitals, both league football grounds, Trent Bridge cricket ground, local college and university sites, centres of employment, district centres, parks and open spaces, suburban residential areas and key interchange points between heavy and light rail.

### **Why the routes proposed?**

- 2.100 These routes have been chosen as they are currently operated with NCT's single deck fleet that are proposed to be replaced. These routes align with other areas of public transport investment and improvement across the City, building on investments in bus priority and digital information which are being progressed as part of the TCF programme and BSIP schemes.

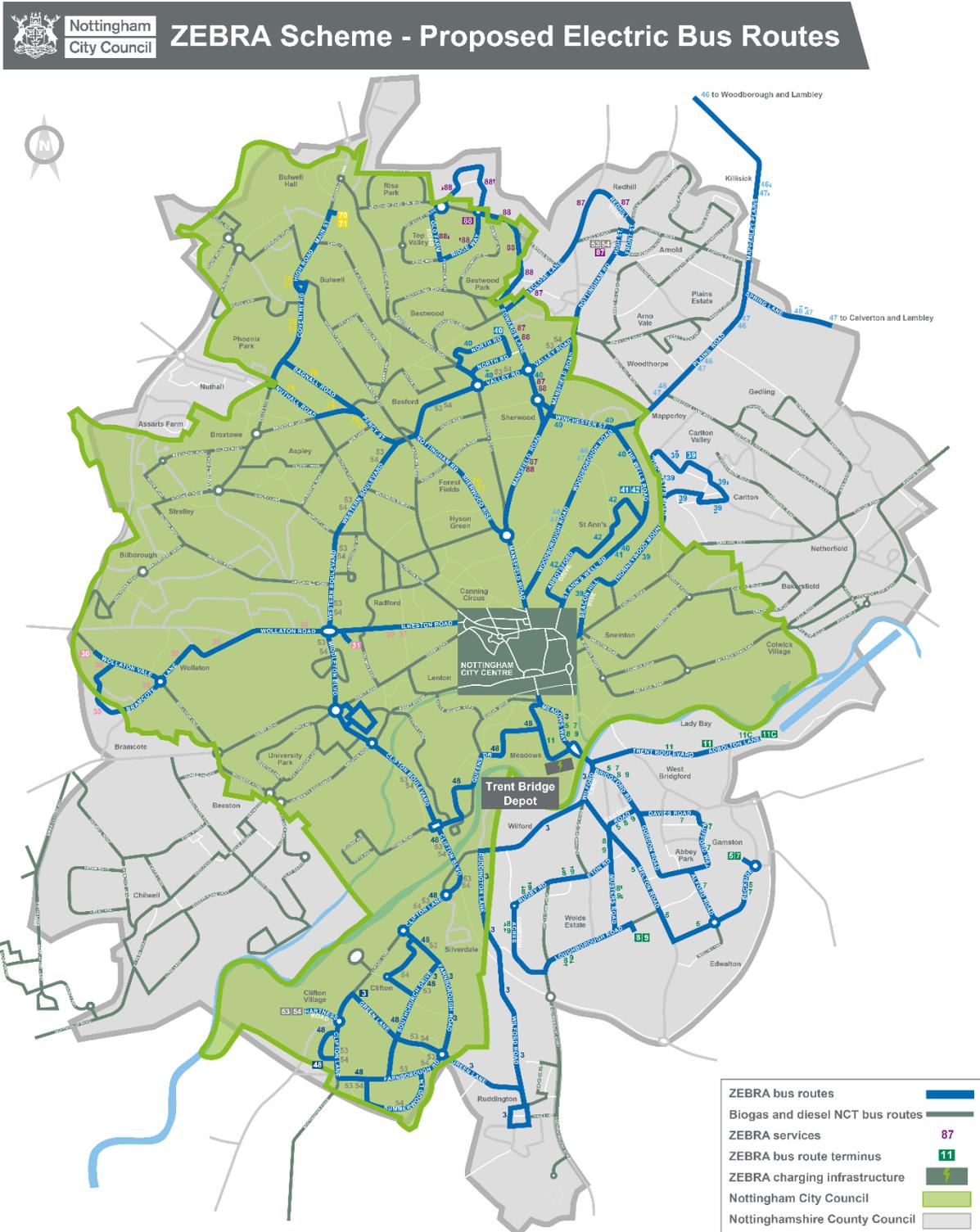
### **Why the number of buses proposed?**

- 2.101 78 vehicles have been chosen for the proposal as they represent the entire single deck fleet operated by NCT.

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<sup>23</sup> NCT data - weekly scheduled mileage from November 2019 (both live and dead miles) and converted to an annual equivalent per bus. This also excludes any unscheduled mileage (e.g. engineering dead miles) but these will be small in comparison.

Figure 2-17: Proposed Electric Bus Routes



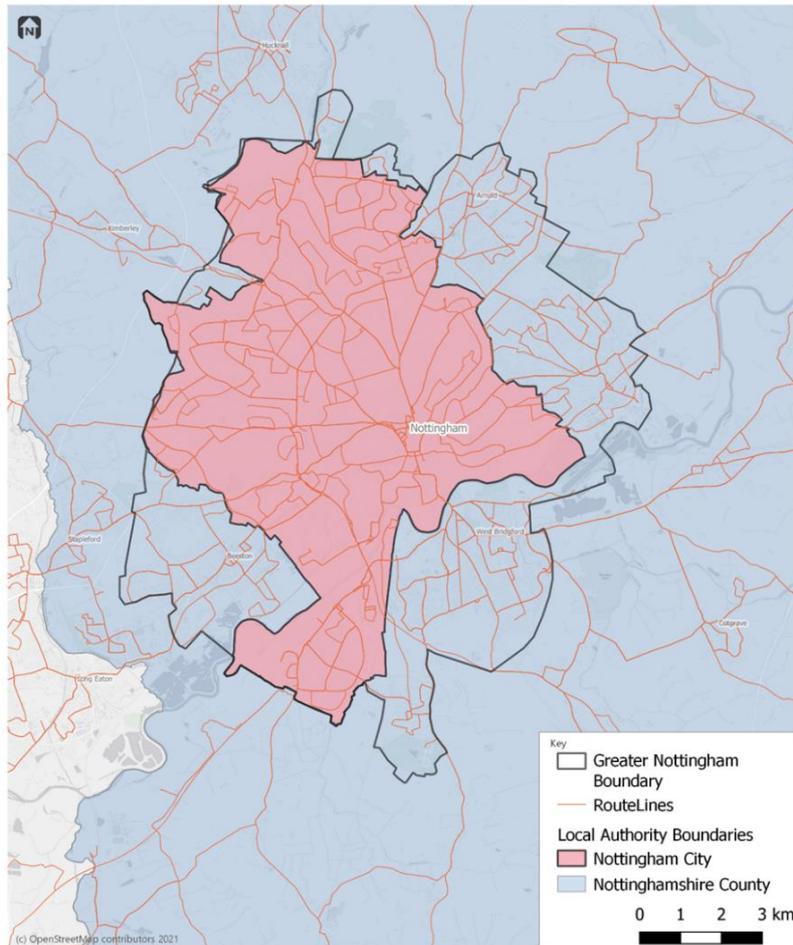
### **Why only single deck buses chosen?**

- 2.102 This proposal focuses on single BEVs as the range specification of currently available double deck vehicles are not at the level that NCT would require to effectively operate BEVs on their double deck routes.
- 2.103 In addition, the single deck vehicles were chosen as the optimum vehicles to be replaced as they are nearing the end of their operational life (NCT usually operate vehicles up to around 12 years), and the average age of the fleet to be replaced is 10 years. This makes for a more financially acceptable proposal for NCT to invest at this stage, as investment in new fleet is only brought forward slightly from their usual practice.
- 2.104 Furthermore, the single deck vehicles are all operated from NCT's Trent Bridge depot. This grade 2 listed depot has already undergone £500,000 worth of extensive renovation works, fully funded by NCT, in readiness for electric bus operations. Focusing the electrification of fleet on one depot simplifies operations and reduces the per bus cost of infrastructure investment. It also lays the foundations for other routes, operated by double deck vehicles, to be operated from the Trent Bridge depot in the future as some of the key infrastructure, such as the grid connection, will be in place to facilitate this.

### **Changes to preferred option since Eol**

- 2.105 There have been some changes in the proposed preferred option since our Expression of Interest, including:
- **Removal of the NCC Linkbus upgrade element** – the City Council scheme to replace 16 Optare Solo buses with eight longer range new BEVs and the associated upgrade existing chargers has been removed. This is following advice from DfT and Ernst & Young as well as understanding that the aims and objectives of the scheme were focused on environmental outcomes derived from the change in energy source, which the investment in new EVs for the Linkbus network would have limited benefit on.
  - **Removal of the extended warranty** – Based on updated vehicle and component replacement quotes, and the longer standard warranty offered by some suppliers the financial risk of not taking out the extended warranty no longer outweighs the additional cost.
- 2.106 Figure 2-18 shows the Local Transport Authority areas that the buses will operate in.

Figure 2-18: Nottingham LTA boundary



2.107 Our proposal will deliver significant reductions in emissions (down 3,800 tonnes CO<sub>2</sub>e per annum) from buses operating within the City Air Quality Management Area (AQMA), which covers the full administrative area, and across the wider conurbation - including AQMAs in County Council districts of Gedling and Rushcliffe.

### Vehicle specification

2.108 All vehicles will be operated and managed by NCT, who were the only operator locally who wanted to take forward a ZEBRA bid at this point when we consulted our local bus partnership. A vehicle specification has been developed based on NCC's experience with operating electric vehicles and NCT's industry experience and research into the technology. This will ensure the supplier will deliver vehicles to at least as high a specification as the existing fleet to be replaced. Key elements include:

- 12 single deck electric buses with 40 seats and 66 single deck electric buses with 33 seats
- Compliant with the Public Service Vehicles Accessibility Regulations 2000
- The buses are expected to be maintained and operated for a minimum of 17 years

- Minimum battery size of 420kWh, providing a worst-case minimum range of 300 km
- Battery life is expected to be between 12 and 24 hours (subject to the same operating conditions set out above).
- Minimum standard warranty coverage on parts, including battery life and health – different suppliers have different lengths of coverage for these

2.109 The first batch of buses will be procured via the Crown Commercial Service framework. Based on the suppliers on this framework and NCT's range requirements, Yutong and ADL- BYD are the current front runners, subject to a fully compliant public procurement exercise

2.110 NCC's existing Optare Solos, which will not be replaced as part of this ZEBRA bid, have a range of 70 miles, whereas the new buses proposed to be purchased have a range of around 180 miles. Longer range buses would mean vehicles would not have to be swapped during the middle of the day, as is this case with shorter-range first-generation electric buses. We would therefore not have to rely as heavily on rapid charging, which quickly degrades batteries and their range capabilities, making it difficult to maintain service levels.

2.111 This accrued knowledge and skills across the NCC – NCT partnership (which may not be as well-developed elsewhere in the UK), is grounded in 10 years of technical experience of operating electric buses. This provides foresight and ability to pre-empt challenges which will support the efficient delivery of the roll-out of the technology.

### **Charging schedule and power**

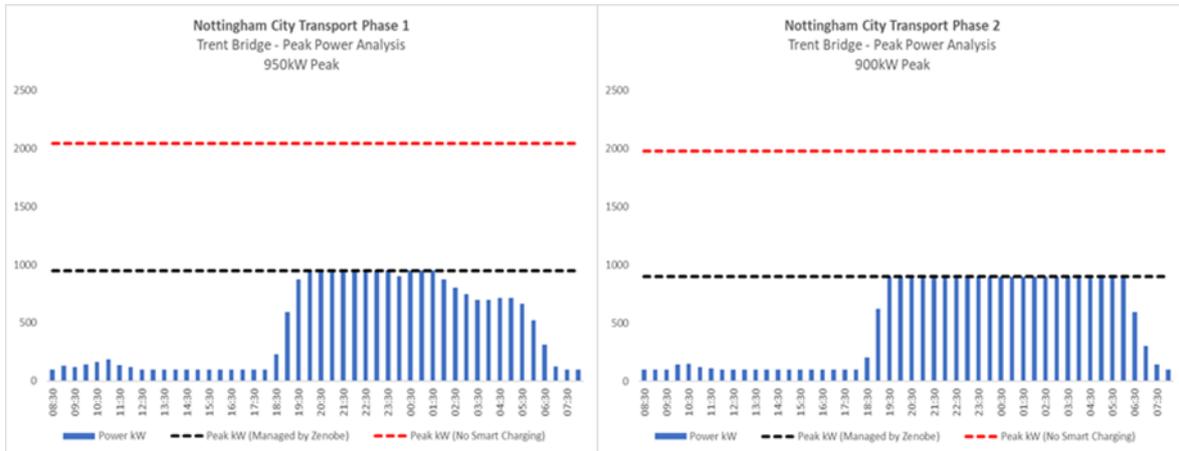
2.112 An infrastructure proposal has been drawn up by Zenobē. The layout of chargers in the depot is shown in Appendix K, and associated costs presented in the financial case chapter.

2.113 The proposed infrastructure supplier will deliver 41 150kW DC Chargers which will be operated by specialist grid management software. This optimises charging rates across the fleet depending on vehicle operational times and running order, electricity rates and grid capacity to maximise efficiencies in the charging schedule.

2.114 Vehicle charging would largely take place from 18:30 in the evening to 07:00 in the morning, when vehicles are not in frequent operation. This would also take advantage of the lower rate electricity which is in effect between 00:00 and 07:00, based on NCT's current electricity deal. Further details on the specification are include in the Commercial Case.

2.115 Zenobē's estimated power analysis in Figure 2-19 illustrates the likely charging schedule. A high voltage grid connection is included as part of the supporting infrastructure required to support the operation of electric vehicles.

Figure 2-19: Peak power analysis



2.116 In current operations NCT seeks to obtain fixed price agreements on fuel resource costs for their bus operations. This currently applies to both their diesel and bio-methane providers and, once the electric infrastructure is installed and their electricity provider has observed data on the amount of power that is being used at the depot, NCT will investigate the potential for a fixed price agreement for electricity. This will be considered in relation to wider market uncertainties and volatilities to achieve an optimum outcome for NCT. This could further bring the costs of operating electric vehicles down and enhance the case for investment in BEVs. Only the default BEIS for electricity resource cost as no more detailed information is currently available.

**Decommissioned vehicles**

2.117 NCT currently operates a model based on running a fleet of buses up to about 12 years of age, having purchased them when new (first registration). As an award-winning operator with a primarily urban bus network, maintaining the most efficient vehicles is an important part of NCT’s business model – hence they have a track record of retiring vehicles with retained value.

2.118 The existing 78 single deck vehicles that will be replaced will not be at the end of their operational life and all have been converted to Euro VI emission standard. It is therefore intended to sell all of the replaced buses for further service use elsewhere. NCT will follow their established and previously successful route to sourcing buyers for their vehicles. NCT will seek to obtain the best price for the vehicles through utilising their list of UK operators who have purchased vehicles from them in the past.

2.119 However, it is likely that these vehicles will not have fully depreciated, therefore the demand and, in turn, market value, for second hand single decker buses is such that they are unlikely to sell for their residual net book value. This will result in a loss on disposal in NCT’s Profit & Loss account which will be written off; no provision has been made for this loss in the ZEBRA submission.

### *Omitted option - hydrogen*

- 2.120 Replacing some of the fleet with new hydrogen buses was not considered a suitable option for Nottingham.
- 2.121 At present hydrogen vehicles are only 'zero emission' at the tailpipe. When considering 'well to wheel', the greenhouse gas emissions of hydrogen buses can be quite high depending on the source of the hydrogen<sup>24</sup>. Limitations in the supply of 'green hydrogen' mean that the potential environmental benefits of adopting this technology may be hampered. While any electric buses would rely on the UK's national grid reducing its carbon footprint to truly deliver 'zero emission' services, this is an established network that has growing momentum in green energy. Furthermore, pursuing an electric fleet offers NCT the potential future opportunity to invest in solar energy generation locally, at the depot, to reduce reliance on the grid connection in future.
- 2.122 The initial purchase cost of a new hydrogen single decker bus is around £100,000 higher than a comparable electric vehicle (for example the Caetano Citygold H2 is £495,000). With the in-vehicle technology largely similar to BEVs (using drive motors etc.), there are no particular cost savings anticipated in relation to maintenance and vehicle parts that would outweigh this additional expense.
- 2.123 The lack of mains power supply for hydrogen would mean NCT would be reliant on hydrogen deliveries to the depot by truck. This would come with a number of reliability and risk factors including truck and driver availability and journey time reliability in addition to potentially undermining the environmental objectives of the scheme.
- 2.124 While range concerns for electric vehicles may prompt interest in the hydrogen alternative in some areas, the inner-city bus network in Nottingham could be comfortably served with the latest BEV technology.
- 2.125 NCT aims to be forward thinking and driven towards their net zero target, but also seeks to minimise risk in commercial operations and ensure that the needs of the customer are paramount. Therefore, the benefits of investing in a technology that is more understood and has a proven track record locally and across the UK is a further reason that NCT is seeking to purchase electric vehicles.

### *Situation without investment*

- 2.126 In the event that Nottingham is unable to secure DfT's support, through our ZEBRA funding proposal, this option reflects the potential situation whereby foreseeable maintenance costs

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<sup>24</sup> Hydrogen Vehicle Well-to-Wheel GHG and Energy Study, ZEMO, October 2021 <https://www.zemo.org.uk/news-events/news,new-study-shows-most-promising-welltotank-routes-for-hydrogen-to-help-deliv-4262.htm>

are endured by NCT to continue operating their current fleets along the Nottingham urban bus route network, albeit sub-optimally in both environmental and cost terms.

- 2.127 With the private sector unable to meet the costs of acquiring new electric vehicles without support, and NCC budgets unable to deliver the quantum of finance needed, it is impossible for the scale of vehicle improvements that the ZEBRA fund offers without central government support. Thus, the existing 78 Euro VI diesel single-decker buses will remain in service for NCT operations for the foreseeable future. In doing so they will continue to emit Greenhouse Gasses through tailpipe exhausts, and have a relatively detrimental impact on local air quality and Nottingham’s contribution to global climate change.

## Summary

### *Case for change*

- 2.128 The Nottingham ZEBRA proposal aligns with the:
- National Bus Strategy and Transport Decarbonisation Plan
  - Midland Connect Strategy and Midlands Engine ambitions
  - City Council’s ambition to become the first carbon neutral city in the UK by 2028
  - Nottingham 2020-2025 Bus Strategy and Bus Service Improvement Plan (BSIP), with electric buses operating on routes benefiting from wider bus priority and technology investment
  - Targets of the City AQMA and AQMAs in the neighbouring County Council districts
  - The economic growth and levelling-up agenda – advancing local skills in this growing sector and the city’s burgeoning zero emission centre of excellence status
  - Operator’s (NCT) ambition to become the UK’s first carbon neutral bus operator

### *Outcomes delivered by the scheme*

- 2.129 The proposal aims to achieve a:
- Reduction of 3,800 tonnes of CO<sub>2</sub>e each year on average
  - Reduction in 1,829 kilograms of NO<sub>x</sub> emissions each year
  - Reduction in 46 kilograms of PM<sub>2.5</sub> emissions each year
  - Strengthened public transport patronage, aiding post-covid recovery – with high quality fleet and accessibility standards (in line with the PSVAR, 2000 and the enhanced requirements)

*Preferred scheme and scheme objectives*

2.130 Table 2-3 summarises why the preferred solution identified is the most suitable for meeting the scheme objectives.

Table 2-3: Summary of preferred option rationale

Scheme Objectives	How does the preferred option meet the objective?
<b>To support the ambition of our Carbon Neutral Charter for 2028</b>	<ul style="list-style-type: none"> <li>• New buses will remove an average of 3,800 tonnes of CO<sub>2</sub>e per year, total of 64,605 over the appraisal period<sup>25</sup></li> <li>• Location of routes builds on TCF and BSIP scheme investment locations</li> </ul>
<b>To improve local air quality</b>	<ul style="list-style-type: none"> <li>• New buses will remove 31 tonnes of NO<sub>x</sub> and 777 kilograms of PM<sub>2.5</sub> during the appraisal period<sup>22</sup></li> <li>• Routes with BEVs will operate within the City AQMA, and benefit AQMAs of neighbouring districts</li> <li>• Trent Bridge depot is located within a residential area which will benefit from improved air quality (as well as noise reduction)</li> </ul>
<b>To enhance operational efficiency of vehicle fleet</b>	<ul style="list-style-type: none"> <li>• New buses will reduce maintenance costs by minimising the regular servicing that diesel engines require</li> <li>• New buses will have lower per km operation costs than the existing diesel fleet</li> <li>• Single deck fleet are nearing their usual end of life within NCT operations</li> <li>• Potential of new infrastructure, including grid connection, is maximised by serving numerous vehicles in one location</li> <li>• Single deck specification available to serve selected route efficiently (e.g. suitable battery range)</li> <li>• Purchasing in batches enables best use of procurement arrangements and the latest models to be purchased</li> <li>• All in-depot charging makes use of night time electricity rates</li> </ul>
<b>To support local opportunities for jobs and skills</b>	<ul style="list-style-type: none"> <li>• NCT employees to be trained in EV maintenance and servicing - Buses procured in batches to further facilitate this</li> <li>• Local college interest in delivering related course will be able to develop new local pathways into employment and apprenticeship opportunities</li> </ul>
<b>To promote inclusive access to high quality bus services</b>	<ul style="list-style-type: none"> <li>• All new buses will be compliant with the PSVAR 2000 and enhanced requirements and delivered to the Nottingham City Transport Specification which includes, luxury seating, led lighting, next stop audio and visual announcements, USB charging and wifi, generous legroom, two pushchair / buggy spaces to complement wheelchair space provision</li> <li>• Lower operational costs will support the commercial viability of routes and support the longevity of the services for users</li> </ul>

<sup>25</sup> (see 'O – Summary' sheets of the GBM in Appendix D)

### 3. Economic Case: Value for Money

- 3.1 This section presents the Economic Case for funding our ZEBRA Proposal. It sets out a brief description of the methodology and assumptions used to evaluate the proposal and includes a summary of economic appraisal values for the preferred option.
- 3.2 The ZEBRA funding requirement for this scheme is £15.2 million<sup>26</sup> across two years, which covers █% of the total vehicle purchase cost and 75% of the infrastructure cost. Private sector bus operator contributions of £█million make up the remaining scheme funding, with additional maintenance costs covered in future years by the operator.
- 3.3 Operational information, such as routes to be electrified and likely charging regimes can be found within the Strategic Case, while specification details on charging infrastructure and vehicles can be found within the Commercial Case.

#### Overview

- 3.4 The economic appraisal work undertaken in relation to our ZEBRA proposal, using DfT’s provided Greener Buses Model indicates that a Benefit: Cost Ratio of 1.21 : 1 could be achieved in the core scenario. This reflects a ‘Low Value’ investment under DfT’s [Value for Money framework](#).
- 3.5 Vehicles will mainly be charged in the evening and overnight. Infrastructure and vehicles will be maintained by the operator, Nottingham City Transport (NCT).

Table 3-1: Economic summary (PV, 2021 prices)

Economic Indicator	Core scenario
Carbon Savings	-64,605 (tonnes CO <sub>2e</sub> )
Present Value of Benefits (PVB)	£█
Present Value of Costs (PVC)	£█
Net Present Value (NPV)	£█
<b>Benefit Cost Ratio (BCR)</b>	<b>1.21</b>
<b>VfM category</b>	<b>Low</b>
<b>Cost Effectiveness Indicator (CEI)</b>	<b>190.2</b>

- 3.6 In addition to the monetised benefits, the scheme is also expected to generate additional key benefits on noise, local landscape, journey quality and jobs and skills, that have not been

<sup>26</sup> These values include an allowance for quantified risk but exclude optimism bias, in line with the suggested presentation of the funding profile for the Zebra scheme, as provided to our bid team by EY on 5<sup>th</sup> November 2021.

quantified and monetised within the Greener Buses Model analyses. These further strengthen the monetised benefits and move the scheme towards a 'medium' value for money category.

- **Noise: beneficial impact** – scheme is expected to have a beneficial impact, with the reduced noise from electric propulsion, compared to diesel, particular with routes operating in residential areas.
- **Jobs and skills: beneficial impact** – Investment will support job opportunities and our local skills base in this rapidly growing technology.
- **Journey quality: beneficial impact** – The scheme proposes to replace existing vehicles before they would otherwise have been replaced, following NCT's standard operations. With the latest technology and accessibility standards, this will have a beneficial impact on passenger journey quality and may lead to an uplift in patronage on some routes.
- **Landscape: beneficial impact** – As well as BEVs being quieter to operate, attractive town buildings can discolour through soot generated by traffic pollution. Diesel vehicles can have oil and fuel leaks which can damage road surfaces over time which BEVs will not.

3.7 Sensitivity tests were undertaken using the Greener Buses Model (GBM) based on the guidance document and identified key risks and uncertainties.

## Methodology

3.8 The economic impact of the ZEBRA investment has been appraised using the DfT's Greener Buses Model (GBM), with local values entered where possible.

3.9 All costs / values are presented in this Methodology section are in nominal prices and excluding VAT and optimism bias, as entered into the GBM, unless stated otherwise.

## Key Assumptions

### *Investment, operational and maintenance costs*

3.10 Vehicle costs assume:

- 26 new electric buses purchased in 2022, 52 purchased in 2023
- 66 new 33 seat single deck battery electric buses (equivalent replacement for existing fleet) at a base cost of £[REDACTED] per bus (*quotation can be found within Appendix N*)
- 12 new 40 seat single deck battery electric buses (equivalent replacement for existing fleet) at a base cost of £[REDACTED] per bus (*quotation can be found within Appendix N*)

- Costs of add-on technology (Induction loop and INIT passenger communication and real-time equipment) is £[REDACTED] per vehicle (*quotations can be found within Appendix N*)
- 3.11 A single round of battery replacement is assumed to be covered by the standard level of warranty offered by the manufacturer. Given the procurement process to be taken for acquiring the fleet, no specific details on what the warranty will cover can be provided at this stage. However soft market testing undertaken to date has provided NCT and NCC with assurance that a suitable level of cover is available from the shortlisted manufacturers. It is understood that any further battery / part replacements will be borne by the operator, NCT.
- 3.12 The cost of an equivalent diesel bus is £[REDACTED], which includes an allowance of £[REDACTED] for additional technology elements (CMS, Induction loop and INIT passenger communication and real-time equipment) so that a like for like vehicle specification is compared to the electric vehicle costs for the purpose of estimating funding share.
- 3.13 This proposal does not anticipate any notable difference in patronage levels between the case with ZEBRA investment and without.
- 3.14 Infrastructure costs totalling £[REDACTED] (reflecting £[REDACTED] per bus) assumes:
- High voltage grid connection costs of £[REDACTED]
  - £[REDACTED] (roughly 11% of capital expenditure) allowance for infrastructure quantified risk (see QRA for further breakdown)
  - Phase 1 Garage Side works totalling £[REDACTED]
  - Phase 2 Workshop Side works totalling £[REDACTED]
- 3.15 The impact of the super deduction announced in March 2021 has been reviewed, but is not considered applicable for NCT, as a majority publicly owned organisation.

### *Economic appraisal assumptions*

- 3.16 All costs have been evaluated and are consistent with the values presented in the Financial Case. In line with the guidance in TAG Unit A1.2, the base costs have been adjusted in our economic appraisal, so as to allow for:
- 3% Optimism bias has been used as cost estimates, with the additional quantified risk, are deemed to be robust.
  - [REDACTED]% of capital expenditure allowance for on-going infrastructure maintenance costs. This is considered a robust estimate based on experience from NCC as a BEV operator, whereby only limited costs of regular servicing and minor parts replacements have occurred. A breakdown of NCC maintenance costs incurred can be found in Appendix M.

- The high voltage grid connection will become an asset of Western Power Distribution and as such will not attract any maintenance costs for NCC nor NCT post installation. A formal letter of quotation from WPD is included within Appendix Q.
- Evidence from NCC's experience maintaining existing EV charging infrastructure is included within Appendix M. This shows a breakdown of the post installation spend on rapid and BYD chargers to average £[REDACTED] per year per charger. Factored up to 41 chargers included in this proposal, this equates to about [REDACTED]% of the total infrastructure cost.

3.17 The proposal included the following assumptions entered into the 'I-User Proforma' and 'I-User parameters' sheets within the GBM:

- 17-year life expectancy of zero emission buses, as the standard length
- 58,616 km annual average per bus – this has been calculated from NCT operation information on the routes that the new buses will operate on, using pre-covid (November 2019) timetables to best reflect average operations for the appraisal period. Evidence is included in Appendix O.
- Average age of vehicles to be replaced is 10 years, as of 2023 when the majority of existing diesel vehicles will be replaced
- Standard BEIS values for electricity resource cost have been used
- Cost inflation set at GDP deflator rate as integrated in the GBM for all elements
- 'Road Transport Urban Big' selected as the geography
- 'Basic BSOG rate + LCEB, AVL and Smartcard Uplifts' – do minimum BSOG
- 'Zero emission bus BSOG rate - 22p' – do something BSOG
- Vehicle maintenance cost technologies 'ICE – Diesel' for current fleet and 'Battery electric' for ZEBRA funded scenario
- 16.15 km/h – local average bus speed during operation, from NCT data
- Databook percentages of emissions as GBM defaults

## Economic Appraisal and Value for Money

- 3.18 The resulting values from the GBM are set out in Table 3-1 (repeated below); the spreadsheet models are included in Appendix D.

Table 3-2: Economic summary (PV, 2021 prices)

Economic Indicator	Core scenario
Carbon Savings	-64,605 (tonnes CO <sub>2</sub> e)
Present Value of Benefits (PVB)	£ [REDACTED]
Present Value of Costs (PVC)	£ [REDACTED]
Net Present Value (NPV)	£ [REDACTED]
<b>Benefit Cost Ratio (BCR)</b>	<b>1.21</b>
<b>VfM category</b>	<b>Low</b>
<b>Cost Effectiveness Indicator (CEI)</b>	<b>190.2</b>

### Sensitivity testing

- 3.19 Sensitivity tests were undertaken using the GBM. These were developed based on the guidance document and explore some key risks presented below. The results are presented in Table 3-3 and these show a largely stable BCR, with the alternative carbon scenarios having the biggest influence.

Table 3-3: Sensitivity test results (full results appendix D)

Scenario	Benefit Cost Ratio (BCR)
Proposal – ‘core’ scenario	<b>1.21</b>
Sensitivity Test 1 - Forecast ZEB vehicle mileage increased by 10%	<b>1.37</b>
Sensitivity Test 2 - Forecast ZEB vehicle mileage decreased by 10%	<b>1.06</b>
Sensitivity Test 3 – 50% of additional round of battery replacement costs (£ [REDACTED] per bus) incurred by NCT at vehicle age 10	<b>1.01</b>
Sensitivity Test 4 – 100% of additional round of battery replacement costs (£ [REDACTED] per bus) incurred by NCT at vehicle age 10	<b>0.80</b>
Sensitivity Test 5 – BSOG based sensitivity, BSOG at 6p	<b>1.41</b>
Sensitivity Test 6 – High Carbon values	<b>1.71</b>
Sensitivity Test 7 – Low Carbon values	<b>0.72</b>
Sensitivity Test 8 – Optimism Bias included at 6%	<b>1.18</b>
Sensitivity Test 9 – 5% annual infrastructure maintenance cost	<b>1.04</b>

## Key Risks and Uncertainties

3.20 This section details key risk and uncertainties that have been considered in the development of economic sensitivity tests. More information on the approach to risks throughout the project is included in the relevant chapters of this business case. The Management Case includes details on risk management including the recording of project risks using the Risks, Issues, Actions and Decisions (RIAD) log, risk owners and The Commercial Case includes a review of key procurement risks.

3.21 The full Risk Register is included in Appendix J.

### *1: electric vehicle experience*

3.22 The key risk in regard to this proposal, subject to a successful funding award, is that this will be Nottingham City Transport's first foray into the delivery and operation of electric buses and the associated infrastructure.

3.23 **Mitigation:** This risk is mitigated by the pioneering experience and knowledge accrued by NCC, in relation to the operation and delivery of infrastructure for one of the UK's oldest electric bus projects. Furthermore, NCT's engineering department has invested in longstanding research, groundwork and trials in relation to the technology. They have been researching electric buses for a number of years and have advanced conversations with a number of the main Original Equipment Manufacturers.

3.24 The operator, NCT, have also been active participants in the ZEMO partnership (formerly Low Carbon Vehicle Partnership) bus working group with knowledge exchange on the subject of electric buses between engineering directors being a key aspect of that discussion forum. Further evidence of the experience and suitability of the project team is included within the Management Case.

3.25 This coupled with the survey work carried out at Trent Bridge Garage identifying power and infrastructure requirements, alongside information from Nottingham City Council's Electric Bus Project team on the pitfalls and benefits of this technology and advice from their contemporaries within the bus industry, NCT are ideally placed to deliver a successful project, and this key risk is fully mitigated.

### *2: Maintenance costs*

3.26 The cost of replacing electric vehicle batteries is high, both in terms of sourcing them and the financial cost.

3.27 Particularly as the vehicle gets older, there is a risk that the manufacturer goes out of business and alternatives need to be sourced. This can increase the time taken to acquire the parts

needed and have knock-on implications for operations (Increasing use of back up diesel vehicles or removal of services) while the vehicle needing a part is out of service.

3.28 **Mitigation:** This has been partly mitigated with the standard warranty period offered by some manufacturers, covering the first years of operation. The NCT vehicle specification, included in Appendix N, sets out minimum warranty periods for key elements of the vehicle. It also states that:

- Any warranty repairs undertaken by NCT engineers/ technicians will be charged to the vehicle supplier at a pre-agreed hourly rate; and
- The vehicle supplier will be responsible for all vehicle recovery costs if the identified fault is covered by the manufacturer warranty.

3.29 These reduce the risk that NCT will encounter large maintenance bills within the warranty period.

3.30 The remaining risk has been accounted for in the sensitivity analysis, namely tests 3 and 4 which consider the impact of NCT funding the cost of replacing 50% of the fleet batteries and a full replacement of batteries on the economic forecasts. These show that the BCR is likely to sit between 0.80 and 1.01, should more than half of the barriers need replacing in order to continue to run the vehicles at the proposed rate for the full 17-year vehicle life.

3.31 An additional test (9) considers the impact of increasing the expected infrastructure maintenance costs ten-fold, to 5% of the capital expenditure annually. This illustrates that significant increases in costs here will still result in a BCR over one.

### *3: Post COVID recovery is slow and patronage is affected*

3.32 As a result of the impact of Covid-19 and new travel demand and work patterns have influenced bus patronage. A service led economy with workers more likely to be able to work from home has contributed to a reduction in bus use as has “Learning from Home” which has impact on Student use. Prior to the reintroduction of Covid-19 restrictions, patronage had returned to 75% of normal and was growing as working and learning from home reduced and leisure and hospitality had re-opened. Providing confidence that sustainable levels of patronage will be achieved to support the operation of the new fleet.

3.33 **Mitigation:** New ticketing products to better reflect new travel demand and working patterns have been implemented and will continue to be developed alongside a range of marketing campaigns targeted at various passenger segments to “Get Back on Board” to help grown the market further and provide reassurance to travellers that public transport is safe post-covid. Investment will and is being made into the network via the transforming cities programme and

Bus Service Improvement Plan initiative to further enhance the efficiency and attractiveness of the network which will support the control of costs by local bus operators.

- 3.34 Therefore, we expect that, subject to forthcoming announcements, with the gradual removal of restrictions mitigating the impact of the omicron variant, patronage levels will quickly return to these autumn levels and continue to strengthen over time.
- 3.35 There is a risk that timetables need to be reduced for longer than anticipated, this would impact the vehicle mileage and in turn the operation costs. This has been accounted for in the sensitivity analysis, namely tests 1 and 2 which consider the impact of a 10% increase and decrease in average vehicle mileage on the economic forecasts. These show that the scheme BCR is likely to sit between 1.06 and 1.37. This is due to the comparatively low running costs of a BEV compared to the existing diesel fleet.

#### *4: Supply chain issues impact procurement*

- 3.36 There is a risk that national supply chain issues impact the delivery of infrastructure and vehicles and increase costs.
- 3.37 **Mitigation:** Staff at NCT are well experienced in managing the delivery of large projects. They will be supported by NCC, with their electric vehicle experience. The implementation of the project will follow clear and monitored timescales and processes so that early warnings can be identified, and mitigations put in place where necessary to reduce the impact on delivery.
- 3.38 New vehicles will be ordered in batches, and potentially from multiple suppliers, spreading risks to supply chain issues. Existing fleet are within their NCT life and are owned by the operator, therefore suitable vehicles will be available to maintain route operation to passengers should delays to new fleet be experienced.
- 3.39 A delay in delivery of either infrastructure or vehicles will mean that the new fleet will start operation later than planned. Where possible vehicles can be stored at the supplier until the NCT depot is ready to receive them. Although this will delay the realisation of benefits of electrification, the overall economic benefit of investment will not be compromised as the life of the scheme will still provide the forecast level of benefits.
- 3.40 There is a level of risk built into the cost estimates, in addition to the sensitivity analysis, namely test 8, which considers the impact of an optimism bias rate double that of the guidance level, at 6%, on the economic forecasts. This shows a BCR of 1.18.

## Non-Monetised Impacts

- 3.41 As the Greener Buses Model does not capture every possible impact from a proposed investment, some wider expected impacts from the proposal have been set out in Table 3-4, following the headings of the TAG Appraisal Summary Table.
- 3.42 With no negative impacts, the net non-monetised benefit is considered to have a positive impact on the PVB. These further strengthen the monetised benefits and move the scheme towards a 'medium' value for money category.

Table 3-4: Non-monetised impacts

Headings	Impact
<b>Environment</b>	
Noise	Beneficial – see additional information below
Air Quality	Beneficial – monetised within GBM, benefits observed within the AQMA (where routes operate, and depot is located) and monitored
Greenhouse Gases	Beneficial – monetised within GBM
Landscape	Beneficial – BEVs are quieter to operate, attractive town buildings can discolour through soot generated by traffic pollution. Diesel vehicles can have oil and fuel leaks which can damage road surfaces over time
Townscape	
Historic Environment	
Biodiversity	Neutral
Water Environment	Neutral
<b>Social</b>	
Commuting and Other Users	Neutral – although users will benefit from wider bus priority programmes being planned and delivered in the area, such as those within the TCF Programme
Reliability Impact on Commuting and Other Users	
Physical activity	Slight benefit / neutral – cleaner buses will make the roads more attractive to active modes such as cyclists
Journey quality	Beneficial – users will benefit from the interior specification of the new buses, and associated passenger information technology. Electric vehicles can offer a physically smoother journey, particularly benefitting passengers moving around the bus to find a seat, or standing where any turbulence particularly impacts user experience.
Accidents	Neutral – see section on noise below for review of the impact of reduce noise levels for safety of disabled groups in particular
Security	Neutral – installation of CCTV on all of the buses delivered within this project will benefit passengers and drivers
Access to Services	Neutral
Affordability	Neutral
Severance	Neutral
Option and Non-Use Values	Neutral – service remains running as currently

## Noise

- 3.43 Electric vehicles generate lower levels of noise when operating. Estimates suggest that electric cars are 4-5 dB quieter than similar ICEs at low speeds<sup>27</sup> for buses this could be 14 dB(A)<sup>28</sup>. The impact of this depends on the conditions of the road, where the buses operate and at what time of day. In quiet residential areas, where the majority of these buses will be operated, particularly those in lower trafficked roads, the average noise reduction when using electric buses could be as high as 5 dB(A)<sup>26</sup>. A number of studies have linked noise pollution, particularly in urban areas, to increased levels of anxiety, depression<sup>29</sup>, high blood pressure, heart disease, and stroke<sup>30,31</sup>.
- 3.44 The electrification of Trent Bridge garage will significantly reduce the noise impact of the garage following the transition away from diesel fleet. This will be particularly effective as the depot is located within 'The Meadows' residential area and NCT has been approached by the council's Environmental Health department in the past in relation to noise negatively affecting residents during late shifts at the depot. Therefore, this proposal will have a **beneficial** impact on the local community, particularly residents.
- 3.45 During consultation with Disabled Groups in the past in relation to previous implementation of electric buses, concerns have been raised particularly in relation to the blind and hard of hearing. This particularly concerns the reduced noise emitted by electric buses, which may make it more likely for people in these groups to be at risk of being involved with accidents with the new buses.
- 3.46 As part of current driver training packages, drivers are advised to pay special attention to those with sight and hearing dogs and canes given the low noise of the buses. The council has operated its electric bus fleet since 2012 and there have been no recorded accidents with the visually or hearing impaired.
- 3.47 As discussed further in the Equality Impact Assessment (EqIA) in section 7, Nottingham City Council is committed to involving disabled communities at multiple stages of this project to better understand the needs and preferences of disabled people. The council will also engage with stakeholders, including the Disability Inclusion Group (DIG), about the use of an acoustic

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<sup>27</sup> <https://www.toi.no/getfile.php/1340825-1434373783/mmarkiv/Forside%202015/compett-foredrag/Lykke%20-Silent%20Urban%20Driving.pdf>

<sup>28</sup> Modelling noise reductions using electric buses in urban traffic. A case study from Stuttgart, Germany (2019) <https://www.sciencedirect.com/science/article/pii/S2352146518306227>

<sup>29</sup> Residential Road Traffic Noise and High Depressive Symptoms after Five Years of Follow-up: Results from the Heinz Nixdorf Recall Study. <https://ehp.niehs.nih.gov/doi/10.1289/ehp.1409400>

<sup>30</sup> <http://www.brainfacts.org/thinking-sensing-and-behaving/diet-and-lifestyle/2018/noise-pollution-isnt-just-annoying-its-bad-for-your-health-062718> [retrieved 07.01.2022]

<sup>31</sup> <https://cleantechnica.com/2019/01/27/another-ev-benefit-less-noise-pollution%E2%80%A8%E2%80%A8%E2%80%A8/> [retrieved 07.01.2022]

alert system and other measures to support mitigation such as activation at particular speeds and/or in particular locations.

### *Jobs & skills*

- 3.48 The investment will also have a **beneficial** agglomeration effect on the local economy and skills base. Engineers and mechanics working for NCT will become skilled in maintaining and servicing electric vehicles, enhancing their employability. Local colleges already interested in offering courses in the maintenance and servicing of electric vehicles will now be able to develop local pathways into employment with the possibility of the local bus companies offering apprenticeships and work experience connected directly to this new technology. Academic institutions such as the newly formed Nottingham University's Centre for Advanced Propulsion are well placed to benefit from close proximity to a real-world test bed and creation of the Nottingham Electrical Vehicle Service Centre (see letter of support in Appendix I) are early indicators of the type of agglomeration benefits that previous investment in zero emission technologies has helped to trigger locally.
- 3.49 Investment in electric buses will continue to protect jobs in the bus industry nationally whilst ensuring the attractiveness of bus travel on a local level by delivering a state-of-the-art bus fleet which in turn protects jobs within the sector.
- 3.50 Users of electric bus services will also benefit from journey quality improvements. Many bus passengers will use these services to commute, and having more pleasant journeys and smoother, quieter ride to and from work will have a positive impact for them. This will improve health and wellbeing, but also have ripple effects on their productivity at work as a result, improving the performance of economy more widely.

### *Use of charging infrastructure*

- 3.51 With the increase in power infrastructure set out in this proposal, there is potential for an electric neighbourhood mobility hub to be developed adjacent to the bus garages on Turney Street in the future. This could create wider mobility **benefits** for local residents and workers, providing increased economic and social opportunities for local communities.

### *Further opportunities for decarbonisation*

- 3.52 By electrifying the fleet, NCT has the **beneficial opportunity** in future to investigate potential for local energy generation, such as solar PV. This would further reduce the vehicle operation costs, reducing reliance on grid power prices, and increase operation efficiency as well as contributing to further reductions in decarbonisation. This opportunity would not be a future option without the ZEBRA support to electrify the fleet.

## Distributional Analysis of Forecast Benefits

- 3.53 The anticipated benefits from our ZEBRA proposal will accrue primarily to transport network users in the Nottingham area, benefitting from reduced pollutants (both noise and air). As well as noise and air quality benefits, there are expected to be improvements associated with a reduction in CO<sub>2</sub> emissions, benefitting both the local communities and environment and the wider global climate emergency agenda.
- 3.54 It is anticipated that there will be a largely even spread of social impacts, with bus routes proposed to be operated by electric vehicles, spread across Nottingham, with routes focused within the Air Quality Management Area.

## Summary – Value for Money

- 3.55 Considering the calculated Benefit: Cost Ratio, sensitivity test results, non-monetised impacts and the level of risk and uncertainty identified (summarised below), an overall value for money for the proposal has been estimated.
- Core Benefit: Cost Ratio – 1.21 : 1
  - Sensitivity test results shows the range of the BCRs that likely to result from the scheme. These show that, accounting for the potential impact of risks and uncertainties, the scheme is likely to achieve a 'low' value for money under most scenarios.
  - Non-monetised impacts – are considered to have an overall beneficial impact on the economy, the environment and society, in addition to the monetised impact.
  - The level of risk and uncertainty identified is low, particularly given the mitigation measures implemented/proposed
- 3.56 The value for money category has been determined as set out in the DfT's [Value for Money framework](#). The Nottingham ZEBRA funding proposal is expected to represent a 'low' monetised value for money investment to DfT.
- 3.57 In addition to the monetised benefits, the scheme is also expected to generate further key benefits, that have not been quantified and monetised within the Greener Buses Model. These further strengthen the monetised benefits and move the scheme towards a 'medium' value for money category.

## 4. Financial Case: Scheme costs

### Overview

- 4.1 The financial case sets out a breakdown of the £[REDACTED] total scheme cost and £15,228,028 ZEBRA funding ask. £[REDACTED] covers the purchase of 78 electric buses, and £[REDACTED] for charging infrastructure. No additional warranty costs have been included, nor additional battery replacement costs.
- 4.2 The level of funding ask has been calculated to align with the ZEBRA fund guidance and reflects 75% of the infrastructure cost (grant ask of £[REDACTED]) and 75% of the difference between the average cost of a new electric vehicle (£[REDACTED]<sup>32</sup>) and an equivalent diesel bus (£[REDACTED]<sup>33</sup>) (£[REDACTED] grant ask).
- 4.3 An assessment of the financial risk has been undertaken, and a quantified risk allowance of £[REDACTED] has been included in the total costs (representing approximately 2% of the total scheme cost). The proposal has been developed to minimise the risks and present an investment that is viable for the long term.

### Project Costs

- 4.4 The total cost of the proposal is £[REDACTED]. This is made up of £15,228,028 ZEBRA funding ask and £[REDACTED] private sector contribution from the operator, Nottingham City Transport (NCT)<sup>34</sup>. This spend is planned across two years with about 35% in 2022 and 65% in 2023. The spend is staggered to account for operational practicalities in receiving vehicles, training staff and operating an effective bus service. The funding sought by this proposal aligns with the guideline proportions; the DfT funded element is equal to 75% of the infrastructure cost and 75% of the difference in vehicle cost between diesel and electric.
- 4.5 Additional maintenance and battery replacement costs will be borne by the operator and have not been included in the ZEBRA scheme ask, nor total scheme cost.
- 4.6 The scheme is strongly supported by key stakeholders, including the operator Nottingham City Transport (NCT), Sustainable Transport Nottingham, the Local Enterprise Partnership (D2N2) and the University of Nottingham and letters of support are included in Appendix I.

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<sup>32</sup> Based on quotes received from suppliers included in Appendix N, includes CMS, Induction loop and INIT Passenger communication and Realtime equipment. Reflects a weighted average of the two vehicle specifications

<sup>33</sup> Estimated based on the 2019 quote received and included as Appendix P, includes CMS, Induction loop and INIT Passenger communication and Realtime equipment

<sup>34</sup> (all including a quantified risk allowance but excluding any optimism bias).

4.7 With the level of funding requested by this proposal, Nottingham City Council and operators (NCT) are confident that our scheme is affordable and viable and that our scheme objectives can be met.

4.8 We have put together this proposal understanding the maintenance cost of electric vehicles, our aim is to minimise this through procuring reliable new vehicles and securing longer term warranties. This will help to ensure that we maximise the lifespan of our proposal.

## Funding Profile

4.9 Table 4-1 sets out a breakdown and profile of the funding for the project. Prices are presented in 2021 prices and are broken down by element, year, funder and risk allowance.

4.10 Quotes from infrastructure providers Zenobē and Western Power Distribution can be found in Appendix Q. The calculations used to apply quantified risk and proportion the costs can be found in Appendix M.

Table 4-1: Funding breakdown (£, 2021 prices)

<b>Vehicles</b>		<b>2022</b>	<b>2023</b>	<b>TOTAL</b>
Number of Zero Emission Buses delivered		26	52	78
ZEBRA Grant required from Government	Base Cost			
	Risk Allowance			
	<b>Total</b>			
Bus Operator contribution	Base Cost			
	Risk Allowance			
	<b>Total</b>			
<b>Total cost of Zero Emission Buses</b>	<b>Base Cost</b>			
	<b>Risk Allowance</b>			
	<b>Total</b>			
<b>Supporting Infrastructure</b>				
ZEBRA Grant required from Government	Base Cost			
	Risk Allowance			
	<b>Total</b>			
Bus Operator contribution	Base Cost			
	Risk Allowance			
	<b>Total</b>			
<b>Total cost of supporting infrastructure</b>	<b>Base Cost</b>			
	<b>Risk Allowance</b>			
	<b>Total</b>			
<b>Total</b>				
ZEBRA Grant required from Government	Base Cost			
	Risk Allowance			
	<b>Total</b>			
Bus Operator contribution	Base Cost			
	Risk Allowance			
	<b>Total</b>			
<b>Total cost of scheme</b>	<b>Base Cost</b>			
	<b>Risk Allowance</b>			
	<b>Total</b>			

4.11 These levels of aid intensity are in line with those set by the Department. Additional information is provided within the Commercial Case to demonstrate compliance with the TCA principles and subsidy control advice.

### *Changes since EoI*

4.12 There have been some changes, and a costing update, since our Expression of Interest which influence the financial element of the proposal. These are listed below, along with their implications on the financial case. The total funding ask has reduced by approximately £8.7 million and total scheme costs reduced by £11.5 million.

- **Removal of the NCC Linkbus upgrade element** – the City Council scheme to replace 16 Optare Solo buses with eight longer range new BEVs and the associated upgrade existing chargers has been removed. This is following advice from DfT and Ernst and Young as well as understanding that the aims and objectives of the scheme were focused on environmental outcomes derived from the change in energy source, which the investment in new EVs for the Linkbus network would have limited benefit on.

This removes the previously quoted £3,753,608 vehicle cost and £180,000 infrastructure cost is removed from the bid – removing £1,948,206 from the ZEBRA fund ask.

- **Removal of the extended warranty** – Based on updated vehicle and component replacement quotes, and the longer standard warranty offered by some suppliers the financial risk of not taking out the extended warranty no longer outweighs the additional cost. This reduces the initial vehicle purchase cost by £[REDACTED] per bus.
- **Additional cost allowance for on-board technology** – The progression of market engagement and gathering of quotes and vehicle specifications has increased understanding of on-board technology. This increases the cost per bus by about £[REDACTED] (excluding quantified risk and optimism bias). This is funded by the operator, NCT as it represents an equivalent cost for the replacement of diesel alternatives. *Quotes for the INIT and AV equipment can be found in Appendix N.*
- **Update to infrastructure costs** – This includes the removal of Solar PV and battery storage from the infrastructure element. This remains our aspiration for the Trent Bridge depot but is considered to be more suited to an alternative funding stream at this time. We have progressed conversations with potential infrastructure providers and thus have updated the associated costs; providing more cost certainty as these are more recent and more detailed in terms of work to be undertaken (*infrastructure quotes are included in Appendix Q*). These reduces our infrastructure cost ask by approximately £1.5million.
- **Inclusion of more refined quantified risk allowance** – This has added approximately £[REDACTED] to the total scheme cost. *The RAID log is Appendix J and QRA calculations can be found in Appendix M.*

## Vehicle costs

4.13 The cost of bus purchase is estimated based on quotes (*included within Appendix N*) received from suppliers:

- 66 new 33 seat single deck battery electric buses (equivalent replacement for existing fleet) at a base cost of £ [REDACTED] per bus
- 12 new 40 seat single deck battery electric buses (equivalent replacement for existing fleet) at a base cost of £ [REDACTED] per bus
- Additional technology elements outside the EV specification – Induction loop and INIT Passenger communication and Realtime equipment, totalling £ [REDACTED] per vehicle

4.14 The funding split for the initial vehicle purchase cost, based on quotes included in Appendix N, has been calculated in Table 4-2 and reflects contributions of:

- 40% ZEBRA grant from the DfT for electric buses
- 60% Bus Operator, NCT, investment

Table 4-2: Vehicle purchase cost (2021 prices, excluding quantified risk)

Vehicle Purchase Costs and Funding (exc. OB)	32/33 Seat (66 vehicles) - per bus	40 Seat (12 vehicles) - per bus	TOTAL	Average per bus (across 78 vehicles)
Electric Vehicle Cost*	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
Diesel Vehicle	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
CMS	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
Induction loop	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
INIT Passenger communication and Realtime equipment	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
Electric Vehicle Cost (inc. tech)	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
Equivalent Diesel Vehicle (inc. tech)	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
Difference	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
ZEBRA Funding (75% of the difference)	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
Outstanding Amount (NCT Contribution)	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
Total ZEBRA Funding	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
Total NCT Contribution	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
<b>Total Scheme Vehicle Cost</b>	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]

\* includes CMS

4.15 The savings from the decommissioning of the existing diesel fleet will offset a small proportion of the electric vehicle costs by:

- **Selling the vehicles** – The buses that will be replaced will not be at the end of their operational life (they will be at most, 12 years old) and all have been converted to Euro VI emission standard. It is therefore intended to sell all of the displaced buses for further service use elsewhere. Although vehicles will not be fully depreciated and therefore sale value is unlikely to cover their residual net book value.

NCT will follow their established and previously successful route to sourcing buyers for their vehicles. NCT will seek to obtain the best price for the vehicles through utilising their list of UK operators who have purchased vehicles from them in the past.

Net book value as of June 2022 suggests that the replaced midi buses will be worth £[REDACTED] each, representing a fleet value of £[REDACTED] million.

- **Maintenance cost savings** – the average age of the diesel vehicles to be replaced is 10 years, therefore some significant maintenance and parts costs would be expected over the next few years, which would not be borne should funding for new fleet be received.

### Infrastructure costs

4.16 The **total cost of infrastructure is £[REDACTED]<sup>35</sup>** (reflecting £[REDACTED] per bus), where 25% of this is paid for by the operator (NCT) and the remaining 75% is the ZEBRA fund ask.

4.17 A breakdown of the infrastructure costs is shown in Table 4-3. The evidence behind these figures is included in quotes from Zenobē and Wester Power Distribution in Appendix Q, with the additional quantified risk calculated within Appendix M.

Table 4-3: Infrastructure breakdown

Item	Cost
Power Connection (WPD)	[REDACTED]
Phase 1 Garage Side (Zenobē)	[REDACTED]
Phase 2 Workshop Side (Zenobē)	[REDACTED]
<b>Base cost total</b>	[REDACTED]
Quantified risk allowance	[REDACTED]
<b>Risk adjusted infrastructure cost</b>	[REDACTED]

<sup>35</sup> including quantified risk and excluding optimism bias

### **Power connection**

- 4.18 The high voltage cable connection costs have been provided by WPD and cover the electricity connection requirements of two 1.8mva supplies for new bus chargers. The cost of these works is £ [REDACTED] (excluding VAT).
- 4.19 The quote included in Appendix Q shows two alternative costs. There are a number of parties interested accessing in the nearest (and therefore cheapest) high voltage connections, and a limited network capacity. Access to the connection further away from the depot is not contested to the same degree and therefore the cost of this connection has been included in the proposal. This is considered the most likely outcome and captures the risk and uncertainty of interest from other parties.

### **Depot works / charger installation**

- 4.20 A quote for charger purchase and associated installation works at the depot has been received and is broken down into two phases aligning to the parking and equipment layout shown in Appendix K. All Civil Works has been included in the proposal which includes LV works, civil works, switchgear, panel, cabling.
- 4.21 The quote (Appendix Q) shows the requirement for each phase, with 24 150kM DC chargers installed in phase 1 and 17 installed in phase 2. These phases cost £ [REDACTED] and £ [REDACTED] respectively.

### *Warranty Costs*

- 4.22 Since the expression of interest further information on major component costs has been gathered from potential suppliers. This has informed the decision to exclude the extended, 10-year, warranty from the scheme. This results in a lower initial vehicle purchase cost and potential increased maintenance / component replacement costs for the operator in the future.

Information on the warranty cover options has been gathered from BYD (based on the E200 EV) and Yutong. The coverage, warranty extension options and associated pricing is set out in Table 4-4. This shows a maximum extended battery and drivetrain warranty to total period of 10 years at a cost of £ [REDACTED] per vehicle. This additional cost was included at expression of interest but, as set out in the key changes section, is no longer considered the most appropriate way forwards.

Table 4-4: Warranty information

Supplier	Warranty Info
Yutong – standard	<ul style="list-style-type: none"> <li>• [Redacted]</li> <li>• [Redacted]</li> </ul>
ADL – BYD standard	<ul style="list-style-type: none"> <li>• [Redacted]</li> <li>• [Redacted]</li> <li>• [Redacted]</li> <li>• [Redacted]</li> <li>• [Redacted]</li> </ul>
ADL – BYD extensions (E200 EV)	<ul style="list-style-type: none"> <li>• [Redacted]</li> <li>• [Redacted]</li> <li>• [Redacted]</li> </ul>
ADL – BYD further extensions (E200 EV)	<ul style="list-style-type: none"> <li>• [Redacted]</li> <li>• [Redacted]</li> </ul>

4.23 The EY funding profile template has been completed and can be found as part of Appendix M.

## Long-term Financial Viability

4.24 NCC and NCT take responsibility for estimating and controlling all project costs. We do not expect that our ZEBRA grant will be increased post submission of the final business case. NCT as the operator, accepts financial responsibility for the project going forward and accepts that cost risk increases will not be met by increased further grant needs to be included. This is supported by their letter included in Appendix I. There are no budgetary considerations for the LTA as all risk will be transferred to the operator, NCT.

4.25 NCT will source their contribution through an established company process for procurement. A financing arrangement will be put in place, tendering from different finance providers to ensure the best deal is identified.

4.26 Comparative costs of diesel parts will offset some of the additional spend for operators, in addition to the day-to-day operation cost savings, making the long-term financial viability of the scheme more stable.

- 4.27 The operational costs of the new fleet of electric buses vs those of a diesel bus have been analysed by NCT's Engineering department in the table below. The significantly reduced costs will be critical factor in supporting the maintenance of a comprehensive bus network in Nottingham, with high frequencies as it recovers from the impact of depressed patronage during the pandemic. Table 4-5 provides an overview of the planned maintenance of both ICE and electric vehicles and compares across a 17-year vehicle lifespan; illustrating that, long term, the cost of operating an electric vehicle will be more sustainable than the diesel alternative and therefore is a viable model to operate for NCT.
- 4.28 In October patronage levels across Nottingham were about 70-75% of their pre-pandemic levels. This shows a steady increase in the last six months and provides confidence around NCT's revenue streams which will enable long term spending to maintain the new fleet.

Table 4-5: Single deck EV/diesel ownership fixed cost comparison (17 years)

***Table Redacted***

- 4.29 The midi bus routes that the new electric fleet will operate are commercially operated routes, with no subsidy support from local government, other than where a minority of routes have been requested to extend into neighbouring villages. This illustrates the viability of these routes in the long term.

## Assessment of Financial Risk / Risk Management Strategy

- 4.30 We have aimed to get up-to-date cost estimates directly from suppliers to minimise any uncertainties. Therefore, no contingency has been included in these estimates.

### *Quantified risk assessment*

- 4.31 For the financial assessment, a level of quantified risk was calculated using likelihood and impact ratings from the project Risks, Issues, Actions and Decisions (RIAD) log (Appendix J), applying an additional cost as a proportion of the base costs. The resulting cost of the risks were summed together to form an overall scheme quantified risk.
- 4.32 The **quantified risk added to the base cost is £** [REDACTED] (reflecting approximately 2% of the total base cost). This has been broken down by year, funder and scheme element within Table 4-1.

4.33 This quantification of risk has been apportioned out across the scheme elements, year of spend and funders based on considered risk and base funding profile. Where 60% of the risk lies with the infrastructure elements and 40% with the vehicle purchase.

#### *Treatment of risk across the business case*

4.34 Elements of risk and risk management have been included across the business case.

- **The Economic Case** lists key risks and uncertainties which have been used to inform the approach to sensitivity tests.

A 3% optimism bias was entered into the GBM in the 'core' scenario, with an additional sensitivity test considering the impact of a 6% rate of optimism bias (see Risk 4 in the Economic Case). This allows for an additional degree of cost contingency over the elements of the Nottingham ZEBRA programme.

Additional tests were undertaken within the economic case which assessed the impact of the inclusion of an additional round of battery replacement cost (see Risk 2 in the Economic Case). This considers the impact of NCT bearing 50% and 100% of a battery replacement in year ten of the new vehicle's lifecycle.

- **The Management Case** includes details on risk management including the recording of project risks using the Risks, Issues, Actions and Decisions (RIAD) log, risk owners.
- **The Commercial Case** includes a review of key procurement risks.

## 5. Commercial Case: Procurement and Deliverability

### Overview

- 5.1 The preferred procurement strategy will use council approved frameworks. The grant will be passed on by the Council to the operator, NCT. A multi-contractor approach will appoint suppliers separately for the delivery of a high voltage grid connection, installation of chargers at the depot and two rounds of BEVs. Following acquisition, NCT will own and operate the depot infrastructure and vehicles, while Western Power Distribution will adopt the high voltage grid connection.
- 5.2 Extensive market engagement has been carried out to date by the project team, this has informed the preferred procurement and commercial strategy, and worked to minimise the level of risk and uncertainties within the proposal. Conversations with both vehicle and infrastructure suppliers have been on-going throughout the preparation of the bid.
- 5.3 This is further supported through the continuous collaboration between NCT and the Council, who already own and operate a number of electric vehicles within Nottingham.

### Commercial Strategy

- 5.4 The project will be managed by Nottingham City Council in collaboration with Nottingham City Transport (NCT), which will manage and operate the vehicles. It is a large enterprise and NCC is a majority shareholder owning 82% of the shares in NCT<sup>36</sup>. Preparations and groundwork, both from a physical infrastructure (electrical supply upgrade) and project management perspective, are well-advanced in relation to this proposal.
- 5.5 NCC's Major Projects team is working with NCT to scope their requirements through soft market-testing dialogue with potential infrastructure partners, including SSE, SWARCO and Zenobē, as well as their shortlisted electric bus manufacturers. Whilst a decision on the preferred bus vehicles is yet to be taken, the infrastructure project associated with the electrical supply upgrade (need for vehicle charging at the depot) has been fully scoped. It builds on extensive renovations to NCT's Trent Bridge Depot which have been made in readiness for electric bus operations.
- 5.6 As set out in Table 4-1, NCT will provide a 56% contribution to the cost of acquiring the new buses. The remaining 44% will be drawn from the ZEBRA grant covered by this application.

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<sup>36</sup> <https://www.nctx.co.uk/about-nct>

NCT is best placed to own the vehicles, given they will be operated, staffed and maintained by them day-to-day.

- 5.7 The infrastructure works includes the charging points. NCT will pay 25% of the total cost of the infrastructure works. ZEBRA will fund the remaining 75% of the cost of the infrastructure works. The infrastructure will be owned and operated by NCT.
- 5.8 NCT will bear the cost of all the energy consumed through charging the vehicles (an operational cost in lieu of conventional fuels), and the vehicles will only be charged at the Trent Bridge Depot. NCT will also cover the on-going maintenance costs for vehicles and infrastructure (as incurred beyond the warranty life or scope).
- 5.9 Current commercial relationships with resource suppliers involve NCT seeking to obtain fixed price agreements on fuel resource costs for their bus operations. This currently applies to both their diesel and bio methane providers, and, once the electric infrastructure is installed and their electricity provider has observed data on the amount of power that is being used at the depot, NCT will investigate the potential for a fixed price agreement for electricity. This will be considered in relation to wider market uncertainties and volatilities to achieve an optimum outcome for NCT. This could further bring the costs of operating electric vehicles down and enhance the case for investment in BEVs.
- 5.10 The funds for the vehicles and infrastructure will be spent in the two-year period, 2022 and 2023. It is anticipated that funds will not be provided by DfT until the certificate of compliance with the current UK Bus Test Cycle procedure has been sent to NCC and the DfT. The manufacturer will be able to provide assurance on the expected performance from the UK Bus Test Cycle procedure. The shortlisted buses (Yutong and BYD) already have full ULEB Certification<sup>37</sup> so have already passed the UK Bus Cycle Certification
- 5.11 The spending profile is shown in Table 4-1. This equates to a spending profile that sees:
- 33% of vehicle costs spent in 2022, with the remainder disbursed in 2023 (when the majority of the new bus vehicles are to be delivered).
  - 62% of supporting infrastructure costs spent in 2022, with the remainder incurred in 2023.
  - 36% of total costs expected in 2022, with the remaining 64% to be incurred in 2023.
- 5.12 The spending profile has been set out in this way due to operational considerations. It allows an initial tranche of vehicles and infrastructure to bed in and for full staff familiarisation to complete in a real-world environment.
- 5.13 This reflects that the bulk of preparatory charging infrastructure works – and in particular the upgraded electrical connection to the depot – needs to be in place before the new electric bus vehicles can enter service and be charged on a daily basis.

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<sup>37</sup> <https://www.zemo.org.uk/work-with-us/buses-coaches/low-emission-buses/ultra-low-emission-bus-certificates.htm>

## Outline Procurement Strategy

- 5.14 The following shortlist of options has been considered for procurement and are detailed within this section:
- Single contract
  - Multi contract (Preferred)
    - **Vehicles** - Crown Commercial Service Vehicle Purchase Framework and/or a Nottingham City Council, Electric Vehicle Framework. Both options involve Nottingham City Council procuring the vehicles and transferring the assets to the operator, NCT, on completion of the procurement exercise.
    - **Infrastructure** - Crown Commercial Service Vehicle Charging Infrastructure Solutions dynamic purchasing system OR a Competitive Procedure with Negotiation run by the Council's Procurement Team
- 5.15 A leasing option for vehicles was also considered, but the quotes received did not present a more attractive option to purchasing. Further information is provided within the vehicle procurement section.
- 5.16 No other alternatives have been considered because external legal advice provided by Browne Jacobsen to NCC suggested that a fully compliant public procurement route would be an appropriate way of ensuring any unlawful state subsidy was avoided (See Procurement, Subsidy control and TCA compliance sub-section for further details).
- 5.17 The vehicle and infrastructure procurement routes secure the economic, social and environmental factors outlined in the strategic and economic case as they all operate through the city of Nottingham which is an Air Quality Management Area (see EQIA for further detail on social and economic factors). The buses will serve areas of high deprivation and health inequalities so will support better health outcomes and access to jobs and opportunities in areas with low car ownership and high unemployment.
- 5.18 All goods and services, including the bus fleet and infrastructure required, will be procured in full compliance with the Public Contract Regulations 2015.

### *Procurement programme*

- 5.19 Work Packages 1 – 3 set out the ambitious but realistic timeline and key milestones for procurement of vehicles and infrastructure. Figure 5-1 presents an extract of the full project programme (complete version in Figure 6-3) listing the key activities involved in procurement and the critical path elements.

Figure 5-1: Project programme (procurement extract)



Single contract

5.20 The first option considered by NCC is to appoint a single contractor responsible for the delivery of the complete project. The contractor would be responsible for engaging suitable sub-contractors to deliver clearly defined contracted packages of work:

Table 5-1: Pros and cons of single contractor engagement

Pros	Cons
<ul style="list-style-type: none"> <li>Easier to manage a single contractor than multiple ones</li> </ul>	<ul style="list-style-type: none"> <li>Using a single contractor is an 'eggs in one basket' approach; if issues arise with the contractor it may affect delivery of the entire scheme</li> </ul>
<ul style="list-style-type: none"> <li>All downstream appointments of subcontractors are the responsibility of the prime contractor</li> </ul>	<ul style="list-style-type: none"> <li>Potentially less control over appointing specialist subcontractors (though can be mitigated through the procurement and appropriate use of contract)</li> </ul>
<ul style="list-style-type: none"> <li>Overall cost may be lower if the prime contractor is managing the project efficiently</li> </ul>	<ul style="list-style-type: none"> <li>May prove to be a false economy if NCC/NCT experience issues with the preferred supplier</li> </ul>

5.21 This scenario would exceed the Public Contracts Regulations (2015) threshold, so will require a fully compliant procurement process.

## Multi-contract

- 5.22 This alternative approach would split the project into two or more component parts. The procurement of the electric bus vehicles could form one element, while the infrastructure works may take the form of one (or more) contracts.

Table 5-2: Pros and cons of split or multi contractor engagement

Pros	Cons
<ul style="list-style-type: none"> <li>• Smaller contract values allow for different options to appoint contractors, e.g. the electrical supply works could be allocated to the relevant Distribution Network Operator, with other works (including the installation of EV charging points within the depot) awarded to a specialist contractor</li> <li>• Some elements could potentially be undertaken by in-house functions (e.g. highways / electrical engineers) at NCC / NCT</li> <li>• Enables purchases from multiple bus suppliers, and flexibility in acquiring the latest technology and models as they become available</li> <li>• Smaller cost packages of work mean a wider range of procurement options are available</li> </ul>	<ul style="list-style-type: none"> <li>• More contracts to manage, therefore greater workload for the contract manager(s)</li> <li>• More interactions between contractors engaged separately could increase the chances of something going awry</li> <li>• Potentially reduced efficiencies could lead to higher costs</li> <li>• Options not involving formal tenders/quotes may fall foul of subsidy control issues</li> <li>• Compatibility considerations</li> </ul>

- 5.23 The works will be packaged below the value in which the threshold at Part 2 of the Public Contracts Regulations (PCR) 2015 applies. This allows for a wider range of options to appoint (e.g. direct awards, quotes rather than tenders, using existing NCC contracts or frameworks for some elements). Different approaches could be taken for the different elements, e.g. a direct award to Western Power Distribution for the DNO works, and a competitive tender for the Workshop/Garage installations at NCT's depot.
- 5.24 This multi-contractor approach has been selected as the preferred option because it enables the most appropriate vehicles to be selected through the most efficient channel and enables purchase from multiple bus suppliers should this be deemed the preferred option. With tight timescales to achieve the programme milestones, an efficient route to procurement will reduce the risk of costly delays.
- 5.25 Any compatibility concerns will be mitigated within the initial vehicle and infrastructure specifications, which will highlight the need for any products supplied to be compatible with other components of the scheme.

- 5.26 The selected procurement route will aid the achievement of objectives as they will enable NCT / NCC to acquire the vehicles which will be used to operate through the city of Nottingham which is an Air Quality Management Area, serving areas of high deprivation and health inequalities. These will therefore support better health outcomes and access to jobs and opportunities, particularly in areas with low car ownership and high unemployment. In addition, the selection of vehicles will support the operator's objective to be the UK's first carbon neutral bus operator as well as Nottingham's Carbon Neutral Charter for 2028.

#### *Procurement route: vehicles*

- 5.27 An Open tender exercise was considered but this would take an estimated 6 months minimum to complete in comparison to a min-competition run through the crown commercial services framework which can be completed in a much shorter 2–3-month timescale.
- 5.28 In procuring the 78 BEVs, we are looking to use the Crown Commercial Service Vehicle Purchase Framework (RM6060) Lot 5: Buses and Coaches to procure the first 26 buses.
- 5.29 The framework allows access to a full range of new motor vehicles, including those which are currently available and those being developed and brought to market during the term of the framework. It covers cars, light commercial vehicles, motorbikes, heavy goods vehicles (HGVs), buses and coaches. Customers can also obtain bespoke conversions which manufacturers are able to provide as part of a turnkey solution<sup>38</sup>.
- 5.30 There are eight bus and coach suppliers listed within this framework; including suppliers of a range of suitable electric bus vehicles including suppliers who have been able to meet NCT's bus specification and provide assurances on manufacturing.
- 5.31 The remaining 52 buses will be procured using a Nottingham City Council, Electric Vehicle Framework which will be in place from June 2022 and have additional bus manufacturers not named on the Crown Commercial Service framework. This will enable the project to maximise its procurement options after the 1<sup>st</sup> phase of bus deliveries, access any new entrants to the market and benefit from any technological advances that are realised in the next few years. Whilst also maintaining a compliant public procurement route. Suppliers such as Wrightbus, Scania, Caetano and Arrival not currently named on the CCS framework will be included in the Nottingham City Council, Electric Vehicle Framework.
- 5.32 Financing and leasing opportunities, including turnkey solutions, have also been discussed with OEMs such as BYD-ADL, Caetano, Scania, Wrightbus and Yutong, alongside organisations such as Zenobē Energy. The annual lease cost from Zenobē for an ADL/BYD E200EV based on a total vehicle price of £375,000, was £49,450 per-annum over 10-years, totalling £494,500. This is higher than the overall vehicle purchase and infrastructure cost set out in this bid and

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<sup>38</sup> <https://www.crowncommercial.gov.uk/agreements/RM6060>

has thus been discounted from consideration on cost-effectiveness grounds. Lease costs from some of the other Bus OEMs were in a similar ballpark.

- 5.33 Staggering procurement into three packages of 26 vehicles enables flexibility of supplier, spreading the risk and minimising the impact of delays from any one source. It also reflects the usual procurement approach of NCT whereby the whole fleet of 78 will not operationally be able to be received at once. Staggering purchase / delivery allows time for staff training and smooth switching of equipment ensuring service disruption is minimal to passengers.
- 5.34 On successful completion of the bus procurement exercise by NCC, full ownership of the vehicle assets will be transferred to NCT.

*Procurement routes: infrastructure*

- 5.35 Two options are being considered for the procurement of associated infrastructure. Table 5-3 identifies some of the key pros and cons of both of these routes.

Table 5-3: Pros and Cons of infrastructure procurement routes

	<b>CCS: dynamic purchasing system</b>	<b>Competitive Procedure with Negotiation</b>
<b>Pros</b>	<ul style="list-style-type: none"> <li>• Quicker route to market, with framework already established</li> <li>• Suppliers included can meet operator requirements</li> <li>• Access to a range of products and services</li> </ul>	<ul style="list-style-type: none"> <li>• Details controlled in house</li> <li>• Ability to contact suppliers not on CCS framework</li> </ul>
<b>Cons</b>	<ul style="list-style-type: none"> <li>• Appointment would be made in accordance with the terms of the framework/DPS, and could limit some of the options available</li> </ul>	<ul style="list-style-type: none"> <li>• Competition elements lengthen timescales</li> <li>• Use of in-house procurement resource</li> <li>• More limited control for operator</li> </ul>

- 5.36 The first involves using the dynamic purchasing system (DPS) marketplace, Crown Commercial Service Vehicle Charging Infrastructure Solutions (VCIS) (RM6213). The DPS provides Central Government and the Wider Public Sector the opportunity to access Vehicle Charging Infrastructure Solutions and offers suppliers a route to market which is adaptable as their capabilities develop. It includes 156 large and Small and Medium Sized Enterprise (SME) suppliers and all of the lead players in the market including but not limited to Siemens, Swarco, SSE, Veolia, Arup, Zenobē, BP Chargemaster, Centrica, EDF Energy, Hitachi, Npower, and Ubitricity.
- 5.37 It offers access to a range of products and services including, but not limited to:

- Consultancy and feasibility
  - Civil design and installation
  - Provision, installation, maintenance of hardware
  - Software and back-office solutions
  - Lease and Purchase of commoditised products
  - Full end-to-end service
- 5.38 The appointment would need to be made in accordance with the terms of the framework/DPS, which may limit some of the options available under a whole-market competitive tender.
- 5.39 The alternative option would use a tender procedure run by NCC's Procurement Team using a Competitive Procedure with Negotiation. A tender procedure executed and managed by NCC's Procurement Team would be appropriate and give more control over the appointment, including setting criteria, selection of contractors, and progress of the procedure. If this option were selected a Competitive Procedure with Negotiation would be the best approach.
- 5.40 Based on our soft market engagement, all of the infrastructure suppliers who can deliver our project are available to be appointed via the DPS Vehicle Charging Infrastructure Solutions framework. This is the route we will follow for our infrastructure procurement and will speed up the procurement process.
- 5.41 On completion of the infrastructure procurement exercise full ownership of the assets will be transferred from NCC to NCT.

### *Procurement risks*

- 5.42 This is the first project in which NCT will have delivered and operated electric buses and the associated infrastructure. However, NCT is an active participant in the ZEMO partnership (formerly Low Carbon Vehicle Partnership) bus working group, with knowledge exchange on the subject of electric buses between engineering directors being a key aspect of that discussion forum. NCT staff leading the project are actively exploring opportunities to increase their knowledge and understanding of electric bus operations across the UK; by engaging with other operators, visiting EV depots and attending EV conferences to inform their prospective electric bus purchasing decisions.
- 5.43 NCC, who have extensive experience in the field through their operation of one of the UK's longest standing electric bus fleets, is also in place to advise NCT of potential pitfalls based on their 10 year experience of operating electric buses. This experience helps to further mitigate the risks associated with this investment through its own research into electric buses, and advanced conversations with a number of the main Original Equipment Manufacturers (OEMs) over a number of years. Advice from NCC's Electric Bus Project team regarding the pitfalls and

benefits of the technology has been supplemented by insights from NCTs contemporaries within the bus industry.

- 5.44 A risk assessment summary has been undertaken which has categories, risk description, an action owner, risk mitigation, dates and status. The risks will be tracked in accordance with NCC's corporate risk management principles, which draw upon the PRINCE2 methodology. The strategy requires the identification and recording of risks, an evaluation of their likelihood and any mitigation actions. This approach ensures that all risks are captured and processed in a consistent manner. Without mitigation, these could result in increased costs to the programme, reductions in the quality of outputs and slippages in timelines, all impacting the overall benefits and outcomes the bid seeks to deliver.
- 5.45 An experienced Programme Manager will be appointed from the Council's Major Projects Team on receipt of the award; they will be responsible for maintaining the risk register. These risks will be subject to on-going monitoring and mitigated through effective programme management and partnership working, with updates reported to a joint NCC and NCT Programme Board. Issues may arise as the projects develop so their impacts, and any subsequent action to manage them, are to be discussed between the Project Leads and Programme Manager at the earliest opportunity after the issue has been identified. Issues are to be recorded (utilising a Risks, Issues, Actions and Decisions (RIAD) log, included in Appendix J) by the Programme Manager.

### *Skills and personnel implications*

- 5.46 Health and Safety is the primary concern when maintaining any vehicles but even more so when talking about Electric Vehicles and the high-voltage propulsion and charging equipment with which they are fitted. NCT and its staff will be specifically trained on first aid procedures relating to high voltage electricity. NCT will also purchase specialist equipment to maintain the buses, ensuring safe working areas for staff and clear protocols for dealing with any emergencies that may occur.
- 5.47 In procuring the new vehicles, NCT specifies that technical training should be included for all levels of engineering staff by the supplier. Training will be given to staff working across the Trent Bridge depot, covering:
- More in-depth training for technicians
  - Component training for support staff attending roadside incidents and breakdowns
  - Vehicle safety training for cleaners
- 5.48 The technical knowledge needed by NCT staff will need to migrate from being primarily mechanical to primarily electrical. As such, technicians will be retrained to better understand electrical fault diagnosis. NCT is already actively looking for an EV safety course to start sending

their engineering staff on in anticipation of the change to BEVs. There is allowance in the project programme for staff training, which is part of the critical path to delivery.

- 5.49 It is anticipated that the current frequency of safety inspections will be maintained (every 4 weeks), despite electric buses may require less maintenance than the current diesel buses. They will also create less waste from lubricating oils than generated from diesel vehicles, making for a cleaner and safer workshop and enabling NCT to make savings from reduced levels of waste disposal.

## Market Engagement

- 5.50 A number of soft market testing and project scoping discussions have taken place with Energy companies including both Distribution Network Operators (DNO), Energy Suppliers, turnkey solution providers and smart charging providers. The range of potential project partners engaged include Scottish and Southern Electricity, Swarco, Western Power Distribution, Zenobē Energy and BYD. This has included site visits to the Trent Bridge Garage to consider technical feasibility, with a particular focus on power requirements and charger layouts. Copies of letters of support are contained within Appendix I.
- 5.51 In developing the expression of interest, all members of the local bus partnership were engaged to see whether they wanted to take a project forward but other operators declined at this time. We hope to work with other local operators on future rounds of ZEBRA.
- 5.52 We will be open to engaging with potential bus manufacturers and infrastructure providers, and invite them, and any other parties, to continue provide (at their expense) information to support our evaluation of tenders in our oversight role.
- 5.53 NCT's staff are actively exploring opportunities to increase their knowledge and understanding of electric bus operations across the UK; engaging with vehicle and power/energy providers as well as other operators and attending EV conferences. The NCT team leading the project to date, Gary Mason (Director of Engineering) and Liam O'Brien (Head of Engineering) have:
- Visited National Express depot at Yardley wood where they operate 19 ADL double deck electric vehicles and had discussions with their project manager to better understand the challenges they have faced in implementing and operating EVs
  - Received EV demonstrations from Yutong, ADL, Caetano and Mercedes and NCT's driver training team have carried assessments for each vehicle. Additional trial vehicles from ADL and Yutong are planned for autumn 2021.
  - Attended a ZEMO conference in Glasgow hosted by McGills, who operate a large EV fleet and are in the process of receiving over 60 new EVs, speaking to their MD and senior managers about their EV experience so far.

- Participate in a quarterly EV forum where operators of electric vehicles from all over the country share information on EV vehicle and infrastructure to better understand common problems being faced by the industry.
- Attended an IRTE (Institute of Road Transport Engineers) northern region engineering committee meeting at the ADL factory in Scarborough and had the opportunity to see their EV single and double deck vehicles in build and had various presentations from their sales and engineering teams on their EV journey.
- Planned visits for November 2021 to Wrightbus, Optare and Pelican Engineering (Yutong). NCT is in constant contact with ADL as they are the main vehicle supplier currently.
- Had extensive discussions on infrastructure with Zenobē energy and have detailed parking and charging plans for the Trent Bridge depot using 41 150kw Pihong DC chargers and a charging management system to monitor and balance the charging of the vehicles overnight.
- Had conversations with SSE, Swarco and Siemens (less advanced than the Zenobē discussions).

5.54 NCC can also draw upon considerable organisational experience and capacity from similar public transport rolling stock purchases, including specification, infrastructure design and delivery. This includes the procurement and operation of numerous types of BEVs (Optare and BYD) and supporting infrastructure at the Queens Drive depot.

5.55 The 'go to market' approach will utilise both the Crown Commercial Service Vehicle Purchase Framework (RM6060) and the Nottingham City Council Electric Vehicle Framework. This will shape future market engagement, with purchase of the first batch of buses focused on manufacturers included in the CCS framework, and the subsequent batches open to other additional manufacturers. This will enable the project to make best use of the speed that the CCS framework can be enacted, enabling the ambitious but realistic programme to be met, and the range of manufacturers and latest models that could be procured under the Nottingham framework.

## Specification

### *Vehicle specification*

5.56 This proposal will see full conversion of NCT's single decker fleet to electric bus operation. In order to replicate the existing provision, 12 of the new buses will have 40 seats and be approximately 12 meters long, while 66 vehicles will have 33 seats and be approximately 10.8 meters long. The actual length of the vehicles will depend on the chosen supplier, but seating capacity will remain the same.

- 5.57 The two seat capacity specifications reflect the different route requirements. Smaller buses have more manoeuvrability which is required on certain routes, particularly through residential areas where on-street parking is problematic. All vehicles will be operated and managed by NCT.
- 5.58 The vehicle specification requirements developed by NCT (Appendix N) specifies that all buses procured will need to be compliant with the Public Service Vehicles Accessibility Regulations (PSVAR) 2000 and the enhanced requirements and will be fitted with:
- INIT Passenger communication and Realtime equipment / Audio Visual route and next stop announcements, at a cost of approximately £[REDACTED] per vehicle (*quote in Appendix N*)
  - Induction loops to support driver – passenger interactions on boarding and in wheelchair and priority seating, at a cost of approximately £[REDACTED] per vehicle (*quote in Appendix N*)
  - Supplementary space in addition to the mandatory wheelchair space, suitable for a second wheelchair user and/or at least two unfolded pushchairs or prams
- 5.59 The impact of these specifications has been reviewed as part of the Equality Impact Assessment (EqIA) form included within section 7.
- 5.60 The buses are expected to be maintained and operated for a minimum of 17 years. Given the procurement route to be taken, a definitive electric vehicle specification cannot be detailed at this stage. Appendix N details the specification requirements for the electric buses that will be sought which comprises:
- 12 single deck electric buses with 40 seats and 66 single deck electric buses with 33 seats
  - Compliant with the Public Service Vehicles Accessibility Regulations 2000
  - Minimum battery size of 420kWh
  - Battery life is expected to be between 12 and 24 hours (subject to the same operating conditions set out above).

### Route requirements

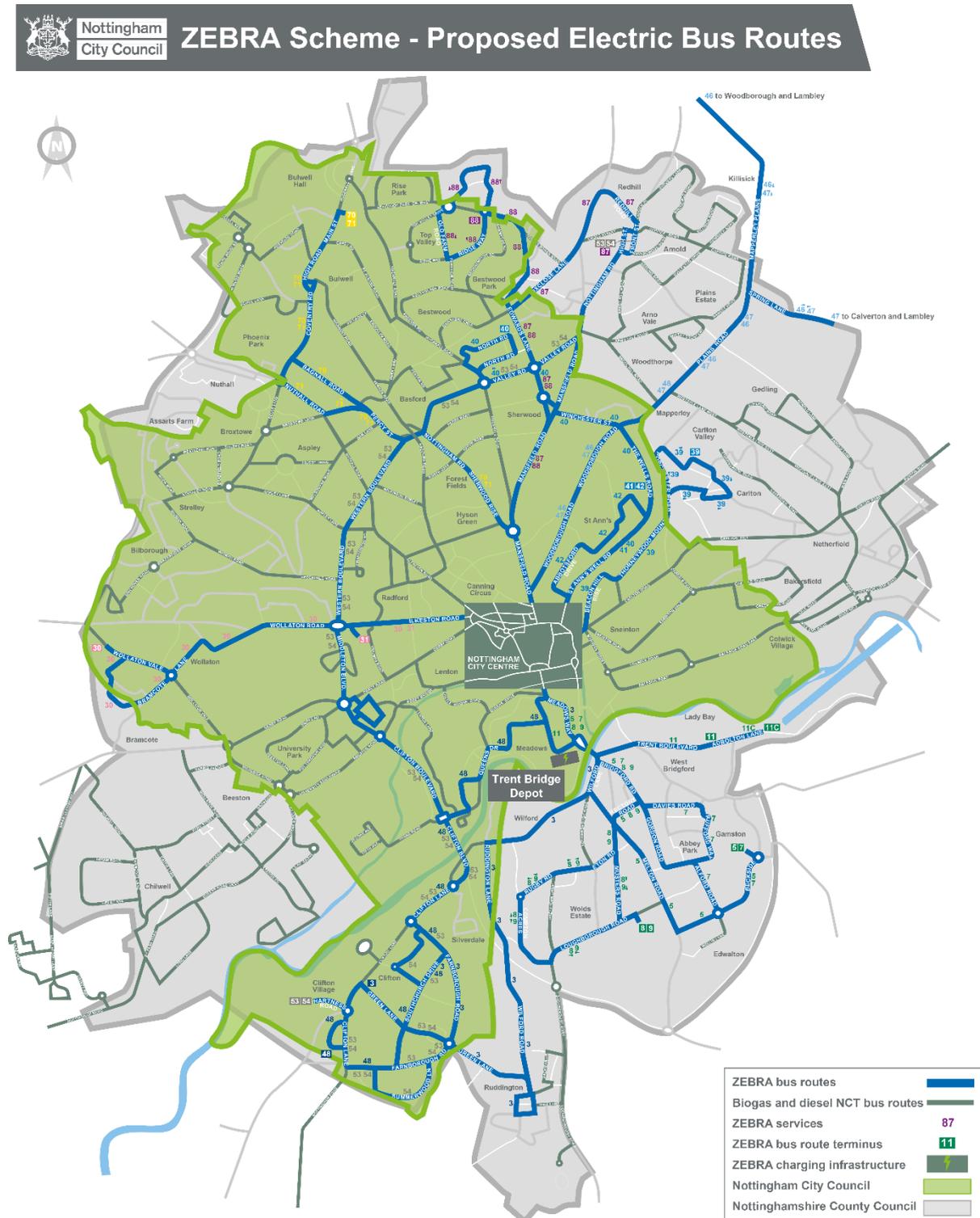
5.61 The area coverage and bus services that will be covered by the ZEBRA bid are indicated in Table 5-4 and Figure 5-2. They all operate through the city of Nottingham which is an Air Quality Management Area (see EQIA for further detail on social and economic factors). The buses will serve areas of high deprivation and health inequalities so will support better health outcome and access to jobs and opportunities in areas with low car ownership and high unemployment.

Table 5-4: Bus routes to be electrified

Route(s)	Connecting	Time taken (into Nottingham)		Roughly every:	Frequency: (into Nottingham)			Hours of operation (time of first and last service to Nottingham)
		Monday 9am	Monday 1pm		Monday AM (07:00-08:59)	Monday BP (09:00-15:59)	Monday EP (16:00-17:59)	
3,5,7,8,9	3 Clifton to Nottingham via Wilford Lane, Ruddington	41mins	41mins	30mins	5	14	4	7:00-18:07
	5 Gamston (Morrisons) to Nottingham via West Bridgford, Melton Road	26mins	26mins	30mins	4	14	3	6:52-17:37
	7 7B Gamston (Morrisons) to Nottingham via West Bridgford, Abbey Park	26mins	26mins	30mins	4	14	4	6:39-23:17
	8 8B Wilford Hill & Compton Acres to Nottingham via West Bridgford	33mins	33mins	30mins	5	13	4	6:17-22:44
	9 9B Compton Acres & Wilford Hill to Nottingham via West Bridgford	21mins	21mins	30mins	1	14	3	8:57-23:44
11, 11C	Lady Bay to Nottingham via Meadows	23mins	23mins	12mins	10	34	9	6:12-23:42
30, 31, 39	30: Wollaton to Nottingham via Ilkeston Road	30mins	29mins	15mins	7	28	6	6:18-22:33
	39: Carlton Valley to Nottingham via Thorneywood	31mins	31mins	10mins	12	42	12	5:59-23:33

Route(s)	Connecting	Time taken (into Nottingham)		Roughly every:	Frequency: (into Nottingham)			Hours of operation (time of first and last service to Nottingham)
		Monday 9am	Monday 1pm		Monday AM (07:00-08:59)	Monday BP (09:00-15:59)	Monday EP (16:00-17:59)	
40, 41, 42, 46, 47, 48	40 40B 40X Edwards Lane Estate to Nottingham via City Hospital, Sherwood, Winwood Heights, St Ann's	42mins	42mins	30mins	5	15	3	5:09-22:02
	41 St Ann's to Nottingham via St Ann's Well Road	13mins	13mins	10mins	13	42	12	06:35-23:46
	42 St Ann's to Nottingham via Abbotsford Drive	15mins	15mins	30mins	5	14	3	06:38-22:18
	46 47 Woodborough & Lambley to Nottingham via Mapperley Plains	30 / 33mins respectively	30 / 33mins respectively	30mins	3	14	4	05:52-22:16
	48 48X Clifton (Nobel Road) to Nottingham via Meadows, Electric Avenue	35mins	34mins	10mins	12	43	11	04:53-23:14
53, 54	53 53B 54 54B Clifton to Arnold via QMC, Ring Road	59mins	59mins	30mins	5	16	4	05:13-18:48
70, 71	70 70B 71 71B Bulwell (Morrisons) to Nottingham via Norwich Gardens, Old Basford, Sherwood Rise	37mins	37mins	15mins	9	28	7	05:36-23:16
87, 88	87 87B Arnold to Nottingham via Edwards Lane, Redhill	33mins	33mins	15mins	9	29	6	06:12-22:45
	88 Top Valley & Warren Hill to Nottingham via Edwards Lane	37mins	37mins	15mins	8	29	6	06:22-23:09

Figure 5-2: Proposed electric bus routes <sup>39</sup>



<sup>39</sup> Higher quality image available in Appendix H

### *Infrastructure specification*

- 5.62 Infrastructure will be installed in the Trent Bridge depot to support the operation of the 78 new BEVs. This includes charger installation, high voltage grid connection, lighting and software systems.
- 5.63 Opportunity charging on route was considered but does not meet NCT's operational requirements and layover locations around the network do not lend themselves to its installation. NCT schedulers and dispatchers have also determined that overnight depot charging would be the most effective way to manage the fleet operationally.
- 5.64 A quote to upgrade the incoming power supply has been provided by Western Power Distribution (WPD) (see details in Appendix Q). This will connect the depot to a high voltage cable that will support the needs of charging the full midi bus fleet.
- 5.65 Alternative power options were considered such as battery storage and PV but were not progressed as an appropriate High Voltage connection could be procured which meets the needs of the depot, with two 1.8mva supplies for new bus chargers.

### **Charging specification**

- 5.66 Following market engagement, a proposed specification and quote for charging infrastructure to support the delivery of 78 battery electric buses at the Trent Bridge depot has been prepared by Zenobē (see details in Appendix Q). This includes:
- On-Site HV Works
  - Main LV Panels
  - 41 150kW DC Chargers
  - EV charging systems, comms and software
  - Lighting (HV + Charger Lighting)
- 5.67 The bus operating schedule has been assessed to understand charging requirements and the period of time available overnight to recharge each bus vehicle, based on the length of each buses working duty cycle. The time taken to charge the fleet of vehicles will depend on a number of factors. The proposed charging schedule will be operated by specialist grid management software which optimises charging rates across the fleet depending on:
- Vehicle operational times and running order – prioritising vehicles that leave first in the morning
  - Electricity rates – maximising energy use overnight when rates are lower
  - Grid capacity – managing power supply and promoting slower charges to maintain battery health and grid function

Figure 5-3: Charger specification

## DS series

# 150kW DC Fast Charger



**Features**

- Simultaneously 2 DC and 1 AC charging (AC will be available in 2020/Q4)
- Multi-Standard: CCS, CHAdeMO and GB/T
- Network or Standalone operation
- User authentication
- Optional cable management accessories
- Support Smart charging and Load Balancing
- Efficiency > 94% ; PF > 0.99(APFC)
- 7 inches LCD screen with user friendly interface
- OCPP1.6 J2013
- IK10, IP55
- Customization available

**Applications**

- Highway gas/service station
- Parking garage
- Commercial fleet operators
- EV infrastructure operators and service providers
- EV dealer workshops

**Accessory**

Please refer to page 35 for accessory information.



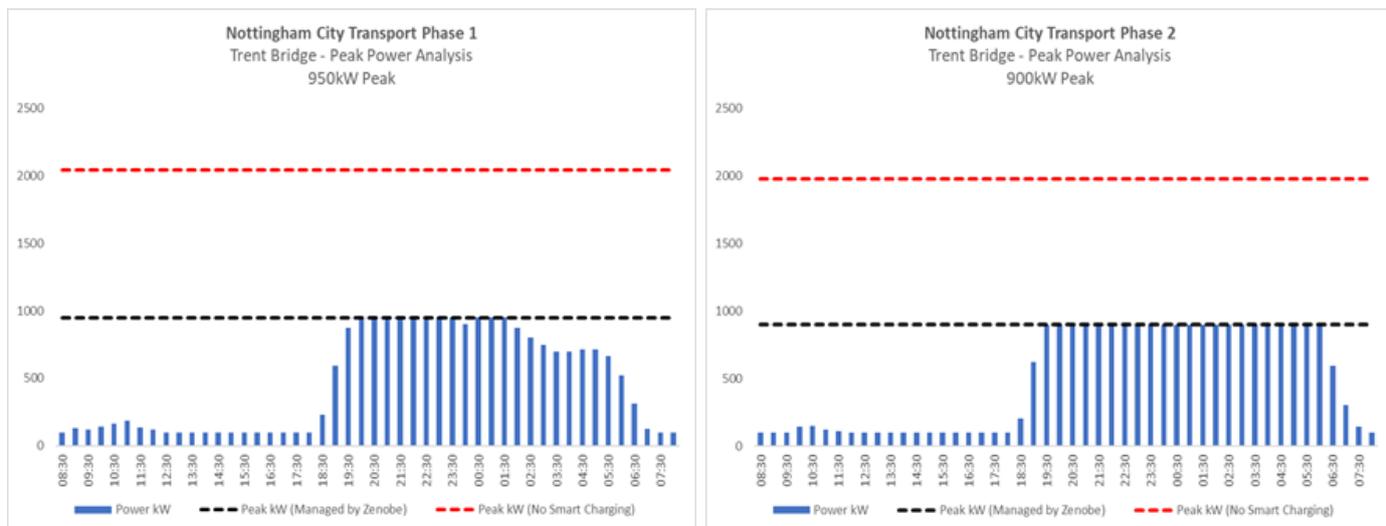


Simultaneously 2 DC and 1 AC charging (AC will be available in 2020/Q4)

DS Series			
Model Name	CE, DS 150 Series	UL, DS 150 Series	
Picture			
Power Specification			
AC Input	Input Rating	3Φ_380-415Vac (±15%)	3Φ_480Vac (+10%, -15%)
	AC Input Connection	3P+N+PE (Wye configuration), TN/TT/IT	3P+N+PE (Wye configuration), TN/TT
	Max. Input Current	DC System:3Φ270A(Typ.±1%) AC module(43kW):3Φ43A(±1%) or AC module(22kW):3Φ32A(±1%)	DC System:3Φ228A(Typ.±1%) AC module(19.2kW):1Φ80A(±1%)
	Frequency	50Hz/60Hz	
	Power Factor	>0.99 @ full load	
Efficiency	≥94%		
DC Output	Output Voltage Range	CCS2/GBT:150-950Vdc CHAdeMO:150-500Vdc AC(CE):3Φ_380-415Vac (±15%)	CCS1/GBT:150-950Vdc CHAdeMO:150-500Vdc AC(UL):1Φ_240Vac (+10%, -15%)
	Max. Output Current	CCS2/GBT:158A@950Vdc CCS2/GBT:200A@900Vdc CHAdeMO:120A@500Vdc AC(CE 43kW):3Φ43A@230Vac or AC(CE 22kW):3Φ32A@230Vac	CCS1/GBT:158A@950Vdc CCS1/GBT:200A@900Vdc CHAdeMO:120A@500Vdc AC(UL 19.2kW):1Φ80A@240Vac
	Max. Output Power	DC System:180kW + AC module:Three Phase 43kW or 22kW	DC System:180kW + AC module:Single Phase 19.2kW
	Voltage Accuracy	±2%	
Current Accuracy	±2%		
User Interface & Control			
Display	7" TFT-LCD		
Push Buttons	Operation button/Emergency stop button		
User Authentication	RFID: support ISO 14443A/B, ISO 15683, FelIca Lite-S (RCS966) OCPP, 2D barcode, APP, Mobile Payment		
Communication			
External	Ethernet/4G, optional Wi-Fi		
Internal	CAN bus/RS485		
Environmental			
Operating Temperature	-30°C~50°C		
Humidity	5%~95% RH, non-condensing		
Altitude	≤2000m		
IP Level	IP55/IK10 (not including screen and RFID module)		
Cooling method	Fan cooling		
Mechanical			
Dimension(W x D x H)	1070 x 650 x 1900mm ±1%		
Weight	≤ 480kg ±1%		
Cable Length	Dual DC Plugs CCS2 Combo and GB/T(4m), + AC Socket or Plug(4m)	Dual DC Plugs CCS1 Combo and GB/T(4m), + AC Plug of J1772(4m)	
Protection			
Input Protection	OVP, OCP, OPP, OTP, UVP, RCD, SPD		
Output Protection	OCP, OVR, UVP, OTP, IMD		
Regulation			
Certificate	IEC 61851-1, IEC 61851-23, IEC 61851-21-2	UL 2202, UL 2231-1/-2	
Safety	CB, CE, cTUVus		
Charging Interface	CHAdeMO V1.2, DIN 70121, GB/T 20234.3, (ISO15118:2020/Q4)		

5.68 As set out in the Strategic Case, Zenobē’s estimated power analysis in Figure 5-4 illustrates the likely charging schedule and indicates that there is sufficient charging capacity to recharge all 78 bus batteries before the start of the new day.

Figure 5-4: Peak power analysis



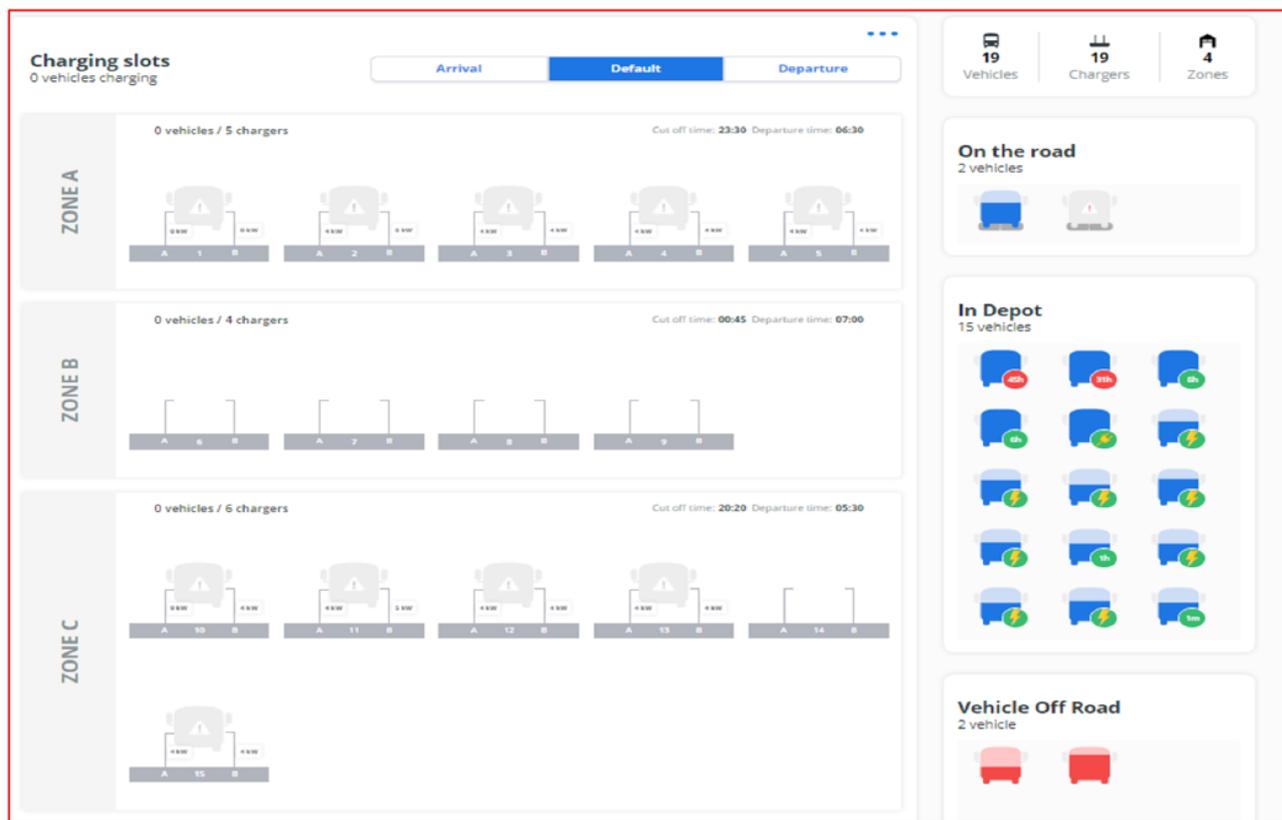
- 5.69 The potential to support other businesses to operate electric vehicles has been considered. The new infrastructure provides opportunities for other public sector fleet such as city council electric refuse collection vehicles, local logistics firms etc. to charge their fleet where there is spare network capacity.
- 5.70 An additional cost to upgrade the incoming power supply has been provided by Western Power Distribution (WPD) (see details in Appendix Q). This will connect the depot to a high voltage cable that will support the needs of charging the full midi bus fleet.

### Mitigating charging risks

#### Vehicles not being fully charged overnight

- 5.71 An infrastructure supplier will be appointed that can supply a remote monitoring system. This system would alert the operator if there are any charging issues with any of the buses. For example, Zenobē Energy provides a remotely monitored solution where a call centre monitors charging through the night and contacts the depots directly should an issue occur.
- 5.72 NCT staff would also be monitoring the charging through the night. This will minimise the impact of a problem with the charging infrastructure, by raising warnings early when there is an issue. It will also reduce the likelihood that the depot would open on a morning to an uncharged fleet of buses, given NCT staff can respond to any issue promptly, when discovered.
- 5.73 Charging would be controlled through a depot management system that charges the vehicles in blocks, depending on which buses are first to run out in the morning. This system ensures that the right buses are fully charged ready for service – thereby optimising the flow of available electricity into the depot. The example in Figure 5-5 illustrates the zonal charging system at another operator.

Figure 5-5: Zonal charging example



5.74 NCT will seek a service level agreement that guarantees the operation of the infrastructure and has financial penalties should an infrastructure failure lead to buses not being ready for service, placing the ownership of the risk with the infrastructure supplier.

5.75 Should a total power cut occur then the vehicles would not be able to be charged and would miss service until they could be sufficiently charged. Fortunately, power cuts are rare and the electricity supply to the depot is quite stable. This is a risk that is currently endured by the depot, as the diesel pumps are powered by electricity and so the proposal does not increase the impact of a significant power cut. Longer term, this risk could be further mitigated by the installation of locally generated and stored energy, with solar power cells installed on the dept roof, thereby reducing reliance on grid connection.

Buses not having sufficient charge to complete a full day's operation

5.76 The buses will each require telematics systems that actively monitor them during the day's operations. Upon procurement, NCT have specified a minimum battery size of 420kWh (see vehicle specification in Appendix N). At an average of 1 kWh/km this will allow most midi bus routes to run all day on an overnight charge. Buses on the remaining routes will be swapped over mid-operation to allow the rest of day's timetable to be completed.

5.77 Zenobē also offers this system and an example from another operator is shown in Figure 5-6. This detailed information will allow the operator to make informed decisions as to when the

buses need to be changed over and reduce any impact charging schedules have on their service to customers.

Figure 5-6: Example telematics system



### Specification summary

5.78 Table 5-5 sets out a summary of NCT’s BEV bus specification / requirements in relation to the scheme objectives and desired outcomes defined in the Strategic Case for this bid.

Table 5-5: Specification outcomes

<b><i>Scheme Objectives</i></b>	<b><i>How specification achieves the strategic case outcomes</i></b>
<b>To support the ambition of our Carbon Neutral Charter for 2028</b>	<ul style="list-style-type: none"> <li>• Further opportunities to decarbonise with potential for local energy generation</li> <li>• Electric vehicles will reduce the carbon emissions from NCT operations by 3,800 tonnes CO<sub>2</sub>e per year over the appraisal period</li> </ul>
<b>To improve local air quality</b>	<ul style="list-style-type: none"> <li>• Improvements in carbon efficiency of electric energy compared to diesel fuel</li> <li>• Electric vehicles will reduce the emissions from NCT operations by New buses will remove 31 tonnes of NO<sub>x</sub> and 777 kilograms of PM<sub>2.5</sub> during the appraisal period<sup>22</sup></li> </ul>
<b>To enhance operational efficiency of vehicle fleet</b>	<ul style="list-style-type: none"> <li>• Improvements in vehicle energy efficiency compared to diesel fuel</li> <li>• Reduce per km operation cost of energy</li> </ul>
<b>To support local opportunities for jobs and skills</b>	<ul style="list-style-type: none"> <li>• Increase skills of NCT staff - maintaining and servicing electric vehicles.</li> <li>• Opportunities for local pathways into employment for colleges interested in offering courses in the maintenance and servicing of electric vehicles</li> <li>• Build on agglomeration benefits that previous investment in zero emission technologies has helped to trigger such as Nottingham University’s Centre for Advanced propulsion</li> </ul>
<b>To promote inclusive access to high quality bus services</b>	<ul style="list-style-type: none"> <li>• Vehicles adhered to the requirements of the <a href="#">Public Service Vehicle Accessibility Regulations (PSVAR) 2000</a></li> </ul>

## Marketing Strategy

- 5.79 The provision of new electric buses is an important component in tackling climate change and reducing GHG emissions from transport. NCC wants residents and businesses to be made aware of the measures being introduced to tackle climate change, raise awareness of the sustainable transport options available and increase bus use patronage, which would result from a clear and proactive marketing strategy.
- 5.80 The marketing of the electric buses and associated infrastructure benefits from a partnership approach between the City Council and the operator, NCT. The marketing strategy requires clear communication objectives and messages. How those messages are to be communicated to achieve the objectives is an important factor.
- 5.81 Time is included in the project programme for the development of a full marketing and communication strategy by NCC and NCT. This will be undertaken between January and March 2023, and delivered ahead of the electric bus operations commence in autumn 2023. This section outlines the likely approach to the development of such as strategy.
- 5.82 The communication strategy objectives are to:
- Reach 705,000 social media accounts with details of successful funding announcement
  - Obtain local press coverage with the successful funding announcement
  - Obtain national press coverage with the successful funding announcement
  - Obtain trade press coverage regarding successful funding announcement
  - Reach 705,000 social media accounts with details of delivery and introduction of first electric buses
  - Obtain local press coverage when first new buses are delivered and become operational
  - Obtain trade press coverage when first new buses are delivered and become operational
- 5.83 The key messages of the strategy are to:
- The electric buses will support the ambition of to become Carbon Neutral Charter for 2028
  - The electric bus will help improve local air quality
  - The new electric buses will enhance operational efficiency of vehicle fleet
  - The new buses will support local opportunities for jobs and skills
  - The new buses promote inclusive access to high quality bus services
  - New electric vehicle charging points are being installed
  - The project is being funded by the Department for Transport, NCC and NCT
  - The project is in line with the Bus Service Improvement Plan and the Enhanced Partnership

- The increase in sustainable transport will aid Nottingham's economy, environment and visitor experience.

5.84 The way those messages will be communicated are:

- Local/regional people – media engagement, social media campaigns, council web pages
- National audience – partnership with DfT and other Government departments
- Trade audience – engagement of trade press
- Council staff and Councillors – direct email, websites, publication, intranet
- Businesses and staff – e-newsletter

## Procurement, Subsidy Control and TCA Compliance

5.85 NCC has taken advice from its legal advisers (Browne Jacobson LLP) in respect of potential subsidy control and compliance issues associated with the UK-EU Trade and Cooperation Agreement (TCA) and NCC's proposed use of the ZEBRA grant. As documented elsewhere in this Business Case:

- The grant will cover 75% of the cost of the infrastructure and 75% of the cost difference between an electric and diesel bus, which will be applied to the purchase of 78 electric buses if the grant is secured.
- In addition to the 78 electric buses, the grant will be applied to associated infrastructure for NCT, which will consist of any required upgrades to substations, high/low voltage grid connections and associated civil engineering works. NCT will own all the infrastructure installed on their premises.
- All local bus operators were afforded an opportunity to participate in this bid, through discussion at Nottingham Bus Quality Partnership group meetings. Only NCT expressed a desire to participate.

5.86 The summary advice provided by Browne Jacobson LLP is appended to this Business Case (Appendix L) and is being disclosed to the DfT on a non-reliance basis for the purposes of verifying the subsidy control position. The summary advice confirms the following key views in relation to the TCA's conditions regarding how a subsidy is considered to arise:

- If this ZEBRA funding application is successful, NCC's proposed pass through of the grant to NCT is considered to confer an economic advantage on the bus operator – reflecting its current status as a large enterprise and major commercial bus operator in the Nottingham urban area and certain surrounds, with approximately 85% market share.
- It is considered prudent to assume there is a low possibility the pass through of grant funding to NCT may give rise to a form of subsidy, therefore necessitating that the Council considers the impact of the subsidy in light of the provisions of the TCA.

- The provision of grant funding to NCT is not a prohibited subsidy within the meaning of Article 367 of the TCA. However, its relation to energy and environment requires NCC and NCT to demonstrate compliance with Article 367 (14) of the TCA, which in turn requires the subsidy to be aimed at, and incentivise enhanced environmental protections compared to what would otherwise occur without the subsidy.
- This is clearly achieved through NCT's proposed replacement of diesel fuelled buses with zero emission electric buses funded through the grant – an outcome that would not otherwise be achieved without the subsidy. It is also recognised that NCT will make a significant match-funding contribution in addition to the grant.
- NCC's analysis of the subsidy's compliance with the six principles set out in Article 366 of the TCA is set out in Annex A to Appendix L. Coupled with the points discussed above, it confirms NCC's view that the prospective subsidy to NCT can be granted without having a material effect on trade or investment between the parties.

5.87 The summary and conclusion of the legal guidance with respect to NCC receiving the grant from DfT (as sought by NCC is): 'The receipt of grant funding by NCC on behalf of NCT will not give rise to a subsidy to NCC because the funding will be passed through to NCT and therefore no benefit which could amount to an advantage within the meaning of the TCA will be retained by NCC. Accordingly, the receipt of grant funding by NCC will not give rise to a subsidy.'

## 6. Management Case: Governance, Risks, Monitoring and Evaluation

### Overview

- 6.1 Experienced staff from NCC and NCT form the project team, with identified roles and responsibilities. Clear governance arrangements form effective reporting lines for delivery, operation, monitoring and evaluation of the project.
- 6.2 A project plan sets out the timelines for the project, with a critical path and key milestones identified. Suppliers for the infrastructure and vehicles will be appointed in spring 2022, with installation of depot charging infrastructure complete in spring 2023 and vehicles ready to commence operation from September 2023.
- 6.3 Contracts will be arranged using council approved frameworks and managed in accordance with the NEC4.
- 6.4 The project team regularly review the risks and dependencies and identify suitable mitigations, utilising a Risks, Issues, Actions and Decisions (RIAD) log shown in Appendix J.

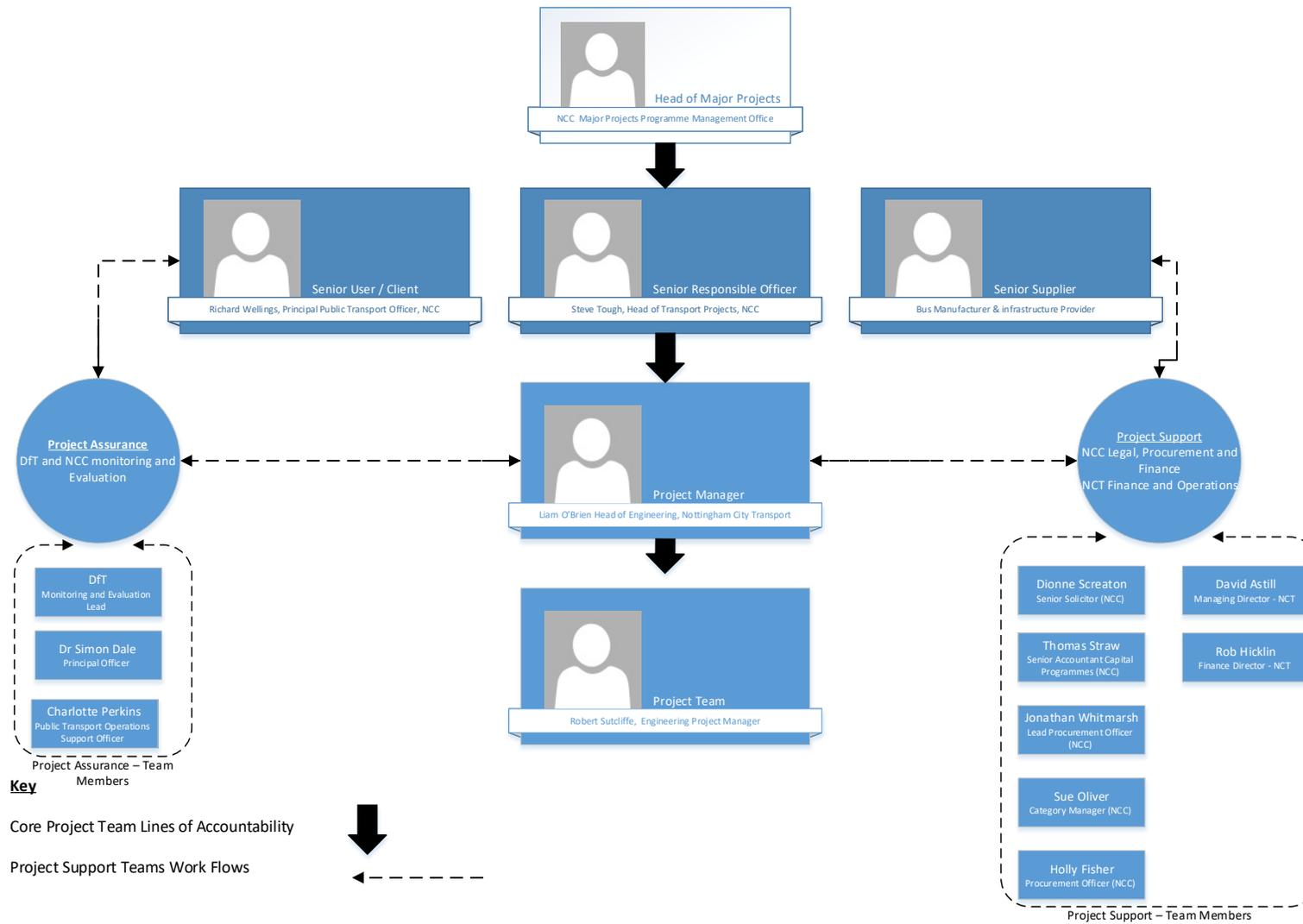
### Deliverability / Governance

- 6.5 The project will be led by Steve Tough of NCC, who will be the Senior Responsible Officer (SRO) and will report to the Head of Major Projects in NCC's Major Projects Programme Management Office. The Project Manager will be Liam O'Brien of NCT. A project organisation organogram is indicated in Figure 6-1 and within Table 6-1
- 6.6 The Senior Supplier responsible for the buses and infrastructure is not known at this stage. Once the Senior Supplier is appointed details will be provided. Project support will be provided by NCC legal, procurement and finance officers. As the operator and owner of the buses and infrastructure, NCT will provide finance and operations support. Project Assurance will be provided by NCC undertaking the monitoring and evaluation.

Table 6-1: project team members and their role

Name	Role	Responsibilities
NCC, Major Projects Programme Management Office	Head of Major Projects	<ul style="list-style-type: none"> <li>Review progress and co-ordination with wider council programmes</li> </ul>
Steve Tough, Head of Transport Projects, NCC	Senior Responsible Officer	<ul style="list-style-type: none"> <li>Reporting to Head of Major Projects</li> </ul>
Richard Wellings, Principal Public Transport Officer, NCC	Senior User/Client	<ul style="list-style-type: none"> <li>Responsible for liaison with consultants and DfT</li> <li>Reporting to Head of Transport</li> <li>Stakeholder engagement and co-ordinating communication strategy</li> <li>Co-ordinating monitoring and evaluation</li> </ul>
Bus Manufacturer & Infrastructure Provider(s) - TBC	Senior Supplier(s)	<ul style="list-style-type: none"> <li>Responsible for production and delivery of fleet vehicles</li> <li>Responsible for design and installation of charging infrastructure</li> </ul>
Liam O'Brien, Head of Engineering, NCT	Project Manager	<ul style="list-style-type: none"> <li>Approving contractor work in depot and infrastructure installation</li> <li>Operator contribution and covering on-going budgets / maintenance costs</li> <li>Reporting to NCT management and co-ordinating with NCC</li> </ul>
Robert Sutcliffe, Engineering Project Manager, NCT	Project Team	<ul style="list-style-type: none"> <li>Market engagement</li> <li>Appointing and overseeing contractor work and infrastructure installation</li> <li>Organising appropriate NCT depot and driver staff training</li> <li>Responsible for data sharing with NCC evaluation team</li> </ul>

Figure 6-1: Project organisation organogram



- 6.7 The relevant experience / credentials of some key team members are outlined below, providing assurance and rationale behind why these are the best people to support the delivery of the ZEBRA proposal.

**Steve Tough - SRO**

- 6.8 Head of Transport Projects and Operations at Nottingham City Council, remit covers public transport operations, management of the NET tram Concession, and the project management of transport project delivery.
- 6.9 Steve has had major roles as a project manager in the development and implementation of NET Phase Two, which involves 17km of new tramlines in the south and west of the City (2000 – 2018), and the Robin Hood Line railway line between Nottingham, Mansfield and Worksop, which opened in phases between 1993 and 1998 were carried out. In between these major projects, Steve played a major role in the production of Nottinghamshire County Council's first Local Transport Plan.
- 6.10 With earlier stints working in bus tendering at Oxfordshire and Essex County Council's, Steve has experience across all the main modes in the public transport market.

**Richard Wellings – Senior User / Client**

- 6.11 Principal Public Transport Officer at Nottingham City Council with a remit that covers bus strategy, partnerships and zero and low emission buses.
- 6.12 Currently the lead and client for the public transport work packages within Nottingham's Transforming Cities Programme, which includes roll-out of traffic light priority for late running buses, new bus lanes, upgrades to digital real-time information and enhancements to smart ticketing and contactless payment. Richard has also led on the development of the Greater Nottingham Bus Service Improvement plan.
- 6.13 With a strong working relationship with Nottingham City Transport, Richard has been involved over a number of years with several major projects, delivered in partnership with the bus operator including the Low Emission Bus Fund and Ultra Low Emission Bus Fund supported Biogas bus project, which delivered 120 Biogas double deckers and infrastructure, and the Clean Bus Technology Fund which saw the remaining diesel buses within the NCT fleet upgraded to Euro VI.

**Liam O'Brien –Project Manager**

- 6.14 Head of Engineering at Nottingham City Transport with a remit that covers all company engineering operations and new vehicle purchase
- 6.15 Liam has been in the motor industry for 27 years with roles at Volvo, Mercedes-Benz, Optare, First Bus and Arriva before joining Nottingham City Transport in 2018.

- 6.16 Liam planned the introduction of 67 new Biogas buses in 2019 along with 10 single deck low emission diesels. Liam also oversaw a project that saw the implementation of 188 exhaust retrofits making Nottingham City transports fleet fully Euro VI compliant. Liam has recently been involved in the specification and ordering of a further 23 Biogas buses due for delivery in 2022.
- 6.17 Two big technology projects were undertaken by Liam in 2020 that saw all engineering operations digitised with the Freeway fleet maintenance system and Tranzaura providing digital driver defect reports. At the same time Liam ran a £500k regeneration project on NCT's grade 2 listed Trent Bridge depot to improve operational efficiency and create room to enable electric vehicle infrastructure to be installed.

### **Robert Sutcliffe – Project Lead**

- 6.18 Robert is the newly promoted Engineering Project Manager at Nottingham City Transport with a remit covering all engineering projects.
- 6.19 Robert has been a part of the NCT family for 18 years starting with the company as an apprentice straight out of school and qualifying as a Vehicle Technician. Rob rose to the role of Technician team leader where he excelled in running the workshop teams.
- 6.20 Robert assisted in the introduction of the first Biogas buses into Nottingham and oversaw the introduction of all 120 currently in service. Rob has assisted the Head of Engineering in the implementation of the digital workshop systems and in the latest order of 23 Biogas buses.
- 6.21 His dedication to his role at Nottingham City Transport saw Robert promoted to Engineering Project Manager in the autumn of 2021.

### **Council experience**

- 6.22 NCC can draw upon considerable organisational experience and capacity from similar public transport rolling stock purchases, including specification, infrastructure design and delivery. Examples include:
- Nottingham Express Transit which opened in March 2004. The project included the design and delivery of tram infrastructure including power supply and the specification and purchase of rolling stock.
  - Optare solo buses purchased in 2012. The four buses use trickle chargers at the Sherwood depot.
  - Optare solos and Versas electric buses. Ten of each type of bus were purchased in 2014. 7 double trickle chargers, 10 single trickle chargers and three rapid chargers were also installed at the Queens Drive compound.

- 17 Optare solos were purchased in 2015 at an expanded EV compound at Queens Drive. The infrastructure works included the conversion of seven single trickle chargers to doubles and four additional rapid chargers.
- In 2016 13 BYD and four Optare solos were purchased. The infrastructure works included a new EV compound at Queens Drive, 12 BYD fast chargers and 4 rapid chargers.
- In 2019 the park and ride services were commercialised. Working with NCT the electric bus network was reconfigured.

### **Lessons learnt from council projects**

- 6.23 A number of lessons have been learnt from the delivery of NCC'S electric bus project, which is one of the longest running in the UK. The most important is that limited range electric buses that require rapid charging during the day are not suitable for deployment on a high frequency commercial network. As such they add a layer of complication to scheduling and dispatching that can be avoided if longer range buses, with overnight charging, are deployed. This has been central to the specification of the vehicles that has been developed for the proposal, it has also shaped the scope of the proposal, to focus on the single deck fleet.
- 6.24 Access to a high voltage power supply is also key to the delivery of the charging infrastructure for a project of the magnitude of an electric bus installation. Furthermore, reinforcement of parking and charging bays within the depot is required due to the increased weight of the electric buses compared to a standard diesel.
- 6.25 Communication protocols between the vehicles and chargers can be problematic, so time should be spent at the commissioning phase of the vehicles and infrastructure to get this absolutely right. This is something the ZEBRA proposal has considered in the development of the project timeline and plan.
- 6.26 NCC has also discovered the importance of good battery management and ensuring batteries remain balanced is essential to maintain battery range. Telematics systems are vital for managing the buses operationally, they help massively in allaying both driver and dispatcher range anxiety as State of Charge can be monitored in real-time. This ZEBRA proposal has sought this type of system and detailed conversations have taken place with a supplier, Zenobē, on the implementation of this type of system within NCT operations.

### *Stakeholder project support*

- 6.27 NCT indicated their support for the opportunity to work with NCC to operate new electric buses and convert the Trent Bridge depot to electric bus operation. NCT recognise the benefits

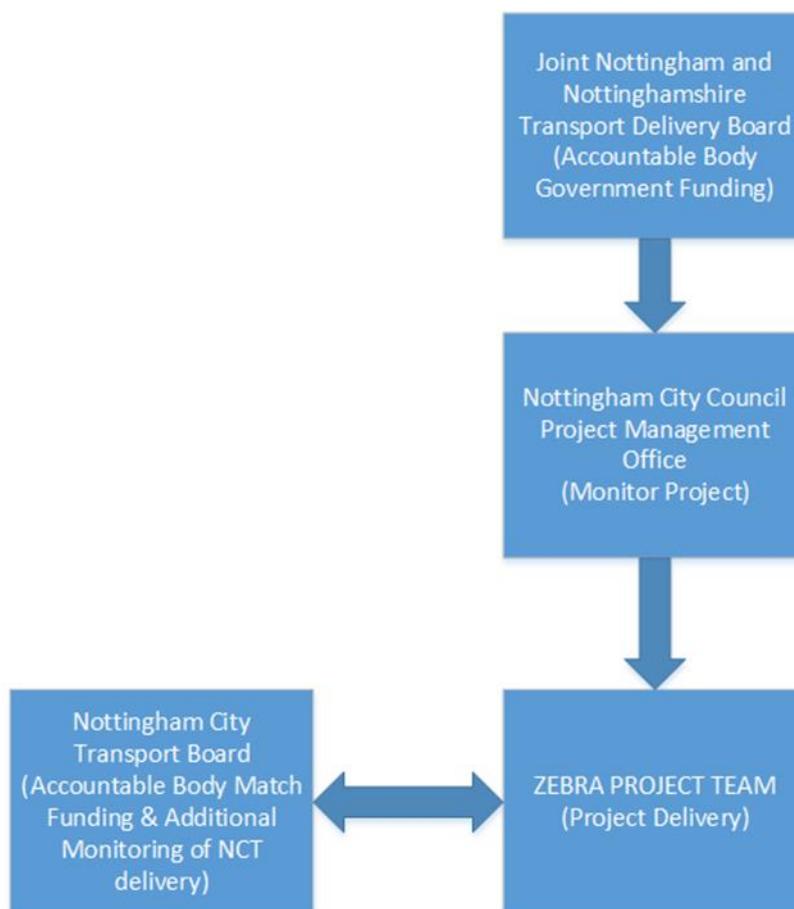
of the electrification to the city's ambition to become carbon neutral by 2028. As a bus operator their mission is to become the UK's first carbon neutral bus operator. A copy of the letter is contained within Appendix I.

- 6.28 The project has received support from the D2N2 Local Enterprise Partnership (see Appendix I). The Chief Executive Officer indicated in a letter of support, that the LEP would work collaboratively with Nottingham to enable delivery of the project and assist where possible. The LEP recognise the benefits of the scheme and that it compliments to the funding they have granted and provides added value.
- 6.29 Joint Nottingham and Nottinghamshire Transport Delivery board will meet on a quarterly basis. The meeting will be attended by Transport Cabinet / portfolio holders (who are councillors), the Senior Officers (Nottingham City and Nottinghamshire Councils), the project SRO and Project Manager. As well as reporting on progress and issues requiring senior intervention, the board will be able to provide any necessary direction to enable successful delivery.

### *Project reporting*

- 6.30 The Project Management Office group would meet on a monthly basis. The meeting would be attended by the SRO, Project Manager, Senior Users and monitoring officers. A monthly monitoring report to update on progress and current spend, alongside a RAG rating for project's progress in terms of time, cost and scope, and include a section on lessons learned will be produced. This information will be consolidated into a programme report, which will be circulated to Board members each month.
- 6.31 As part of the project approvals and assurance process, in the event of an exception occurring the Programme/Project Manager will produce an exception report to provide information about any issues or risks that could affect the delivery of the programme or reputation of the councils. Any change will need to be considered in terms of its impact on time, cost and quality, and its effect on other interdependent elements within the programme. The report will be tabled at the Board and depending on the scale of the exception; these reports may be escalated to the Joint Nottingham and Nottinghamshire Transport Delivery board or through the approved delegated decision makers or individual Council Transport Delivery Board(s)/Infrastructure Board/Executive Board(s)/Cabinet as appropriate.
- 6.32 The NCT Board would also meet on a monthly basis to exercise project oversight. NCT is part funding the project and would monitor expenditure and scheme delivery. The Transport board is comprised of Company Directors and representatives of NCC and Transdev, who are the shareholders.

Figure 6-2: Project governance structure



6.33 The reporting arrangements are listed in Table 6-2.

Table 6-2: project reporting – roles and responsibilities

Group	Attendees	Frequency
Joint Nottingham and Nottinghamshire Transport Delivery board	Transport Cabinet / portfolio holders (Cllrs) Senior Officers (Nottingham City and Nottinghamshire Councils) SRO and PMO	Quarterly
Project Management Office	SRO, Senior User and PMO Monitoring Officers	Monthly
NCT Board	Company Directors, Shareholders representatives (NCC and Transdev)	Monthly

## Contract Management

- 6.34 The project is split into two distinct elements; the specification and purchase of 78 electric buses and the necessary infrastructure which will consist of any required upgrades to substations, high/low voltage grid connections and associated civil engineering works. The project is likely to be delivered in two contracts, one for the purchase of the buses and the others for the infrastructure works. The SRO is responsible for the successful execution of the organisations engaged under the signed terms and conditions of both contracts.
- 6.35 The contract will include penalty clauses set against delivery milestones to minimise the likelihood and impact of delays within the programme. It will also aim to maximise operational performance by including provision for infrastructure “uptime” guarantees alongside agreed timescales for parts delivery for both the buses and the charging unit alongside provision of a dedicated service centre function by all suppliers involved in the project. This will maximise financial performance and reduce the financial risk of the project
- 6.36 The purchase of the first batch of 26 buses will be undertaken using the CCS RM6060 Vehicle Purchase framework (Lot 5). The remaining 52 will be purchased using the Nottingham City Council Electric Vehicle Framework which will be in place by June 2023 and will include manufacturers such as Wrightbus, Caetano, Scania, Mellors and Arrival that are currently not included on the CCS framework. This will allow new entrants to market to be considered and provide the opportunity for NCC and NCT to take advantage of superior technologies that may be introduced to the market during the lifetime of the project. The infrastructure will be procured either through the CCS DPS Vehicle Charging Infrastructure Solutions or a Competitive Procedure with Negotiation run by the Council’s Procurement Team.
- 6.37 Contracts will be managed by NCC in line with the NEC4. NEC4 is a well-known and used form of contract on infrastructure schemes. The NEC contracts are designed using the following three key unique characteristics:
- to stimulate the good management of the relationship between the two parties to the contract and, hence, of the work involved in the contract;
  - the ability to be used on a wide variety of commercial situations, for a wide variety of types of work and in any location; and
  - Clear, simple and written in plain English using language and a structure which is straightforward and easily understood.

## Project Plan

- 6.38 We are confident that buses and infrastructure can be delivered by quarter 4 of 2023. To achieve this a set of realistic key milestones, based on conversations with internal procurement teams and engagement with suppliers, have been set out and are detailed in Table 6-3.
- 6.39 The required infrastructure will be implemented during 2022/2023, which is to align with the phased manufacture and delivery of the buses from the third quarter of 2022/2023 through to the third quarter of 2023/2024.
- 6.40 Given the current levels of preparedness at the Trent Bridge depot (garage reconfiguration works complete) and discussions with bus manufacturers on their order fulfilment timescales, we are assured that this proposal is deliverable within the scheme timescales. Assurances have been received from bus manufacturers to deliver the buses on time. We also have assurances from UK Power Networks, our local Distribution Network Operator (DNO) that it will be able to expedite delivery of power connection upgrades. Letters of support from these organisations are included in Appendix I.
- 6.41 Market engagement has indicated that our timeline is achievable, and procurement will ensure contractual financial penalties are in place if milestones are not achieved. Use of frameworks will also allow for bus procurement to expedited quickly. Contingency has been built into the project plan and NCT has previously delivered this type of DfT-funded major project to time and budget as evidenced by their previously delivery of the Biogas bus and infrastructure project which was funded by both the Low and Ultra Low Emission Bus Schemes.

Table 6-3: Key milestones linked to successful delivery

Milestone	Date	Organisation
ZEBRA Fund announcement	February 2022	DfT
NCC Exec Board and Capital Board approval secured to accept grant funding and commence procurement	March 2022	NCC
Bus Manufacturer Appointed	April 2022	NCC - NCT
Infrastructure Provider Appointed	May 2022	NCC - NCT
Training of operations and engineering staff delivered	January 2023	NCT
Bus driver training delivered	March 2023	NCT
Installation of depot charging infrastructure complete	April 2023	NCT
Delivery of 78 Electric Buses (in batches of 26)	April 2023 June 2023 September 2023	NCT
Buses enter service	September 2023	NCT
Agree Reporting mechanisms and Schedule	October 2023	NCC-NCT

### *Key risks and dependencies*

- 6.42 A series of key dependencies are noted relating to the projects which, if missed or not realised in time, could impact the delivery programme tolerances of cost, time or quality. Impacts may be felt in delays to implementation, compromised quality outputs, resource not in place in time to realise maximum benefits or missed opportunities.
- 6.43 As there will be multiple parties involved in delivering the project, interdependencies among all these parties have been identified and management techniques of such interdependencies should be reviewed on an on-going basis through-out the project. Table 6-4 sets out a few initial dependencies involving external parties and identifies ways in which the project team will manage these. These dependencies also reflect the risks include in the Risk Log (included as part of Appendix J).
- 6.44 Risks in relation to this project have been split into three categories and reviewed at a programme level, scheme level and scheme specific level using a PESTLE (Political, Economic, Sociological, Technological, Legal, Environmental) categorisation methodology. The log captures the Political, Economic, Sociological and legal risks that Nottingham City Council will mitigate and the Economic and Technological risks that NCT will need to mitigate as the project delivery partner.
- 6.45 The 3 key scheme-specific risks in relation to this project have been identified as follows:
- **First time implementation of Electric Bus Technology at scale by commercial operators with little or no experience of operating this type of bus.** This risk is mitigated by the pioneering experience and knowledge accrued by NCC in relation to the operation and delivery of infrastructure for one of the UK's oldest electric bus projects. Coupled with NCT's engineering department's longstanding research, groundwork and trials in relation to the technology.
  - **Inadequate power supply.** Work with Western Power Distribution has established that there are two points of High Voltage power supply that can be connected into the Trent Bridge Depot which will house the new fleet and infrastructure.
  - **Insufficient patronage to support future operating and maintenance costs.** Prior to the reintroduction of Covid-19 restrictions, patronage had returned to 75% of normal and was growing as working and learning from home reduced and leisure and hospitality had re-opened. This provides confidence that sustainable levels of patronage will be achieved to support the operation of the new fleet. New ticketing products to better reflect new travel demand and working patterns have also been implemented and will continue to be developed alongside a range of marketing campaigns targeted at various passenger segments to "Get Back on Board" to help grown the market further and

provide reassurance to travellers that public transport is safe post-covid. Investment will and is being made into the network via the transforming cities programme and Bus Service Improvement Plan initiative to further enhance the efficiency and attractiveness of the network which will support the control of costs by local bus operators.

Table 6-4: Key dependencies

Independent variable	Dependent variables	Involved parties	Interdependency measures
Large number of stakeholder interests at play	Need to consider needs of each stakeholder and the impact of the scheme, management of expectations, risk of failing to meet objectives	NCC / NCT Internal and external Stakeholders	Co-development of communications plan, with clear responsibilities and action owners
Number of potential suppliers to co-ordinate and manage	Management of suppliers and engagement activities, Potential for knock-on impacts of delays from one stage of work to another	NCC / NCT Suppliers / contractors	Collaborative working between delivery partners, with regular meetings and updates, one clear project programme shared with all parties
Internal resources	Potential delays if NCC / NCT teams are not sufficiently resourced to manage the project	NCC / NCT Suppliers / contractors	Collaborative working between delivery partners, maintaining live risk log and early warnings of potential issues

- 6.46 The critical path has been identified within the Project Programme, Figure 6-3. This links the ZEBRA funding announcement, appointment of a bus manufacturer and infrastructure provider, delivery of the infrastructure and delivery of staff training. A delay to any of these elements could have direct implications for achieving operation of the new electric buses by quarter 4 of 2023.
- 6.47 If infrastructure delivery is delayed or any early warnings are issued by the project manager in relation to the delivery of this work package discussions will be had immediately with the OEM about the bus manufacturing schedule and provisions will be built into the contract with the OEM to allow for this eventuality. Conversations and plans are well advanced with NCC's procurement team which should ensure appointment of bus and infrastructure manufacturers can be delivered in a timely fashion. Similarly, NCT is already gearing up their staff across a range of disciplines in preparation for the operation of the electric bus fleet.
- 6.48 The start of the forward project critical path is dependent on ZEBRA funding award; the remaining timeline runs up to the new buses entering service in 2023.



6.49 Table 6-5 details how the Work Packages outlined above will be delivered and by whom.

Table 6-5: Work packages

Work Package	Work Package Delivery Team	
1. Project initiation	Richard Wellings, Transport Strategy, NCC	Formal political sign-off will be sought to accept the grant funding from DfT and proceed with the delivery project and proceed with the procurement exercise for the buses and infrastructure. This will be achieved via the submission of an Exec Board report and sign off by NCCs Capital Programmes Board.
2. Procurement and Delivery of 78 Electric Buses	Holly Fisher, Procurement, NCC.  Liam O'Brien, Head of Engineering, NCT  Richard Wellings, Transport Strategy, NCC	Initial batch of 26 buses will be procured by NCC via the existing Crown Commercial Services framework with ownership of the Asset transferring to NCT upon delivery. The remaining buses will be procured via a Nottingham City Council Electric Vehicle Framework which NCT and other local bus operators will be named on. This will allow manufacturers that are not on the crown commercial services framework to be appointed compliant with public procurement rules.
3. Procurement and Delivery of HV Grid Connection and Charging Infrastructure	Jonathan Whitmarsh, Procurement, NCC  Liam O'Brien, Head of Engineering, NCT  Richard Wellings, Transport Strategy, NCC	Infrastructure will be procured using the Crown Commercial Services Dynamic Purchasing System
4. Nottingham City Transport Staff Training and Orientation	Liam O'Brien, Head of Engineering, NCT	Through Liaison with NCTs Workforce Development and Training Team and the bus and infrastructure OEMs a complete package training and orientation programme will be developed for both the engineering and operations team.
5. Marketing and Communications	Anthony Carver-Smith, Marketing Manager, NCT  Catherine Middleton, Transport Strategy, NCC	A joint comms and marketing plan will be developed using multiple channels to disseminate updates on the progress of the delivery of the project, benefits of the technology, and outcomes / outputs of the full roll-out of the fleet to both stakeholders and local citizens.

Work Package	Work Package Delivery Team	
6. Monitoring and Evaluation	Dr Simon Dale, Transport Strategy, NCC  Richard Wellings, Transport Strategy, NCC  Charlotte Perkins, Public Transport Operations, NCC	Data collection protocols will be put in place to collate information from vehicle telematics systems to support local monitoring and evaluation and feedback to DfT.
7.Operational Delivery	Liam O'Brien, Head of Engineering, NCT  Robert Sutcliffe, Engineering Project Manager, NCT	Will oversee the final commissioning stages of both vehicles and charging infrastructure in line with all relevant safety protocols.

6.50 If possible, we aim to deliver the project earlier than planned. The following factors will enable the delivery of the project and provide the benefits at the earliest opportunity:

- The governance structure will ensure clear, unambiguous assignment of accountabilities and responsibilities of the multiple parties involved in this project, and timely and transparent reporting of progress, risks and issues
- A common single project plan will be provided that provides one source of truth to align all delivery activities to identify and manage dependencies
- Risk management will ensure that problems are identified early and that they can be comprehensively managed and mitigated by all the delivery organisations
- The approach adopted will incorporate opportunity and value management, placing opportunities to deliver faster, better, and more cost-efficient outcomes at its heart.
- The Stakeholder engagement not only has secured support for the scheme but will be used to aid delivery where possible. The stakeholder engagement will also be used to identify and address any potential issues.
- The Councils successful delivery of other electric bus scheme, which is an important component to meet the projects timelines

6.51 Confidence in delivery is supported by commitments from potential private sector suppliers of vehicles and infrastructure suppliers to meet the project deadline. A combination of Executive Board and Capital Board sign-off will form the key assurances / gateways and be

required in relation to gaining political approval to accept the grant award and grant capital funding to NCT.

## Communications and Stakeholder Engagement Strategy

- 6.52 As set out in the EQIA (see section 7), at this stage, Nottingham City Council will contact key stakeholders, to explain the funding for which we are applying and that involvement from groups would be appreciated to better understand the diverse preferences of stakeholders. Nottingham City Council already work closely with the Disability Involvement Group (DIG) to identify any areas of concern with ongoing and upcoming projects. The same will take place with the ZEBRA project.
- 6.53 Included in the project programme is time allocated for the development of a full marketing and communication strategy by NCC and NCT. This will be undertaken between January and March 2023 and delivered ahead of the electric bus operations commence in autumn 2023. This section outlines the likely approach to the development of such as strategy.
- 6.54 The communications strategy will identify target audiences for information about the project and facilitate dialogue and feedback between the project team and the local community and other affected stakeholders. To do this the following exercises will need to be carried out:
- Stakeholder mapping to identify others not already known or engaged as part of the scheme development;
  - Geographical mapping of affected area – this includes those properties directly affected or potentially affected, either negatively or as beneficiaries;
  - Consultation exercises on the proposals;
  - Formal engagement and dialogue with key stakeholders; and
  - Follow-up surveys using social media and bus user groups to ascertain how the BEV buses have been received by bus users.
- 6.55 The communications plan should have the following objectives:
- To disseminate information and foster an understanding of the scheme.
  - Ensure that the public can discuss the scheme through a range of communication formats.
  - To ascertain whether the principles of the scheme is supported or not by the public.
  - To provide the executive board with public feedback regarding the scheme.
- 6.56 It is envisaged the project team will lead stakeholder engagement and consultation for the project; this will be the responsibility of the Senior User at Nottingham City Council, Richard Wellings. The plan aims to identify key stakeholders, recognise their respective influence and

requirements, plan to keep relevant stakeholders informed and engaged, help maintain consistent communications and plan activities and drive structured continuous improvement.

6.57 Table 6-6 lists the wider group of stakeholders and their involvement in the project. Coordination of input, consultation and feedback will be sought from these groups on a regular basis, defined for each stakeholder within the communications plan according to key project milestones and aligned with existing regular meetings / reporting where possible / appropriate. Discussions have already taken place with stakeholders as part of the development of this bid, details of which are included in the Strategic Case.

6.58 This framework of stakeholder management and engagement will be continued throughout the programme to inform the communications and dissemination activities. Offering a flexible, collaborative approach, our work will be directed to involving and communicating with stakeholders to become more interested if it can add to the success of the project.

**Table 6-6: Wider stakeholders and their involvement in the ZEBRA programme**

Stakeholders	Involvement
D2N2 Investment Board	Provides linkages with the D2N2 Strategic Economic Plan including business representation, with potential to enhance the reach of local investment announcements in respect of the low carbon economy impacts associated with our ZEBRA funded BEV bus investments.
Public Transport Integration Board (PTIB)	The PTIB is made up of senior officers of the council, the local bus, coach and tram operators. The purpose of the group is to set the strategic vision and action plan for investment in public transport for the area.
Bus Quality Partnerships	Coordination of the bus quality partnership initiatives, which are made up of the local bus operators. The purpose of the group is to coordinate public transport provision and support the delivery of bus priority measures, electronic information, integrated ticketing, services and interchange of modes.
Robin Hood Operators Group	Public transport operator and stakeholder partnerships that oversees the work of the bus partnership and multi-operator smart-ticketing.
Transport Focus	Represent transport user interests and will be interested in the delivery of public transport interventions.
Disability, Older people and inclusion groups	Represent Nottingham’s disabled community and support groups. Will be consulted to ensure inclusion and accessibility considerations for disabled and older people are fully embedded within the BEV bus rollout – notably around silent vehicle operations and detecting the approach of a BEV bus.

Stakeholders	Involvement
Neighbourhood Managers	Coordination of Council delivery within local areas, liaising with community representatives and the public.
Nottingham EV Owners Club	Following the award of the Go Ultra Low City funding, a number of EV drivers have gradually reached out to support initiatives and participate in organised vehicle showcases. As a result a number of drivers have formed a EV Owners Club currently with over 150 members with the aim of organising events, meet ups and encouraging the growth of EV ownership.
Infrastructure provider	Promotion of any highway/electrical works in advance, and any communication with members of the public / local stakeholders who may be affected by the works. Statutory liaison with NCC in relation to any works carried out in the public highway/footway, and passing over/beneath privately owned land.
Vehicle Supplier	Promotion of new vehicles and engagement with Council officers / potential bus users / NCT technical staff, coupled with contractual liaison with NCT in respect of the manufacture and supply of agreed bus vehicles. Instruction to NCT technical staff on appropriate care and maintenance of the vehicles.
NCT (and its shareholders)	Dialogue with passengers about new vehicles, liaison with NCC over disbursement of grant funding received from DfT and appropriate documentation of investment outputs and outcomes associated with the new EV bus fleet.
NCT Staff	The drivers, engineers, cleaners etc. who will work to run the new buses shall be engaged through training and good practice materials from the manufacturer and NCT (as a responsible employer) in respect of the due care and diligence required to maintain and operate the new bus vehicles.

6.59 Besides local passenger groups, we receive regular communications from local school children and others asking what the Council is doing to advance the cause of electric buses and decarbonisation more widely in Nottingham. Regular enquiries are also made to elected members formally via Councillor Casework and through engagement on social media. The public interactions with the Council indicate that there is popular support for electric buses.

6.60 The method of engagement with stakeholders and the public is contained within Table 6-7.

Table 6-7: Method of engagement with stakeholders and the public

Consultee	Method of Engagement	Key messages
<b>Political:</b>		
DfT	Regular progress reports, emails	Focused on key milestones linked to the delivery of EV bus charging infrastructure and the roll-out of new vehicles.  Successes and lessons learnt, key installation, procurement and operational experiences.
Public Transport Integration Board (PTIB)	Reports at key milestones; Chair stakeholder email; one-to-ones.	
Bus Quality Partnership	Reports at key milestones; Chair stakeholder email; one-to-ones.	
<b>Stakeholders:</b>		
Robin Hood Operators Group	One-to-ones; stakeholder meetings.	Focused on key milestones linked to the delivery of EV bus charging infrastructure and the roll-out of new vehicles.  Successes and lessons learnt, key installation, procurement and operational experiences.
Transport Focus	e-comms; stakeholder newsletter	
Disability Inclusion Groups	One-to-ones; stakeholder meetings.	Focused on key milestones linked to the roll-out of new EVs. Highlighting the benefits of the fleet's high accessibility standards
Neighbourhood Managers	One-to-ones; stakeholder meetings.	Focused on key milestones linked to the roll-out of new EVs. Highlighting the benefits of the fleet's high accessibility standards and AQ benefits
Nottingham EV Owners Club	One-to-ones; stakeholder meetings.	Focused on key milestones linked to the roll-out of new EVs.
Trade Press and Media	Publicity at key milestones; press releases.	Focused on key milestones linked to the roll-out of new EVs. Highlighting the benefits of the fleet's high accessibility standards and AQ benefits and forecast carbon reduction

Consultee	Method of Engagement	Key messages
NCT	Ongoing engagement through BQP meetings, monthly ZEBRA programme progress meetings, and regular reporting to DfT.	Focused on more detailed milestones linked to the delivery of EV bus charging infrastructure and the roll-out of new vehicles.  Including reporting and engagement activities.
NCT Staff	Training from manufacturers coordinated by NCT leadership team.	Information on driving experience, training requirements and key milestones, including any depot disruption and additional safety considerations during installation.
<b>Public:</b>		
Bus Users	Social media, press release local media and radio, posters and leaflets with distribution to include local travel centres, local community groups, council website	Focused on key milestones linked to the roll-out of new EVs. Highlighting the benefits of the fleet’s high accessibility standards and AQ benefits and forecast carbon reduction
Visually impaired	Through disability inclusion groups, social media, press release local media and radio, local community groups, council website	Focused on key milestones linked to the roll-out of new EVs. Highlighting the benefits of the fleet’s high accessibility standards
Local schools and colleges	Leaflets, social media, posters, newsletters	Focused on key milestones linked to the roll-out of new EVs. Highlighting the benefits of the fleet’s high accessibility standards and AQ benefits and forecast carbon reduction
Local residents and businesses	Press release, Council website, social media, posters and leaflets distributed along key bus routes including health and community centres	Focused on key milestones linked to the roll-out of new EVs. Highlighting the benefits of the fleet’s high accessibility standards and AQ benefits and forecast carbon reduction
Local Press and Media	Publicity at key milestones, press releases, editor briefings	Focused on key milestones linked to the roll-out of new EVs. Highlighting the benefits of the fleet’s high accessibility standards and AQ benefits and forecast carbon reduction

## Risk Management

- 6.61 The management of risk is an essential part of NCCs programmes and project management processes. The approach to managing risk is to establish an iterative and on-going cycle of risk management activity, covering the identification, assessment, mitigation, reporting (including escalation) and reviewing risk. Issues are to be recorded (utilising a Risks, Issues, Actions and Decisions (RIAD) log shown in Appendix J) by the Programme Manager. The RAID log includes the likelihood and severity of the risk, identifies a risk owner, how each risk will be monitored and identified mitigation.
- 6.62 To support the effective management of risks, issues and opportunities, NCC uses a systematic approach collecting a database for all risk information including risk mitigation actions, pre-and-post mitigation assessments, qualitative and quantitative cost, time and other impacts.
- 6.63 Going forward, the common principles of risk management will be followed:
- Risks are identified and recorded;
  - Responsibility for risk management is assigned to the relevant party;
  - Risks are analysed and evaluated in terms of their likelihood and impact estimates. This assessment covers – cost, schedule, reputation, and magnitude. This will be supported by the regular production of quantitative risk assessments;
  - Relevant action is taken to mitigate, treat, or accept the risks; and
  - Risks are monitored and updated through project development.
  - An important principle is that the risk owner should be the person best able to manage the risk. This is often the person, with the appropriate accountability, that is closest to the risk. Where an individual does not have accountability, the risk will need to be escalated and managed at a higher level. Risks may also require escalation if they cannot be resolved within the delivery team or if the risk has wider impacts beyond the scope of the project or programme area.
- 6.64 Risk escalation levels are shown below. Risks flow upwards from 1-4: The project at this stage has not required formal or informal risk escalation to be required.
1. Project Manager;
  2. Senior Responsible Owner and Scheme Sponsor;
  3. Programme Board; and
  4. Client Representative Level.
- 6.65 Once the scheme reaches the point of delivery, the project risk team will support the delivery manager to ensure the most effective management of risk. The Risk Register will be in place

by this point and NCCs team has a proven track-record of overseeing risk management activity for all projects delivered by the organisation.

- 6.66 The Risk Manager assists the Project Manager in the co-ordination and facilitation of the Risk Management process. The identified Risk Owner has the overall responsibility for managing the overall risk and can suggest and implement mitigation measures. They will assign an Action Owners to ensure that specific risk mitigation actions and activities deemed necessary are implemented. Risk Owners are responsible for raising any need for support for the Action Plan activities with the Risk Manager, Work stream Manager or overall Project Manager.
- 6.67 The general principal in risk management is that risks should be passed to the party best able to manage them. This project's risks lie between NCC, Nottingham Transport and the stakeholders and suppliers (contractors).

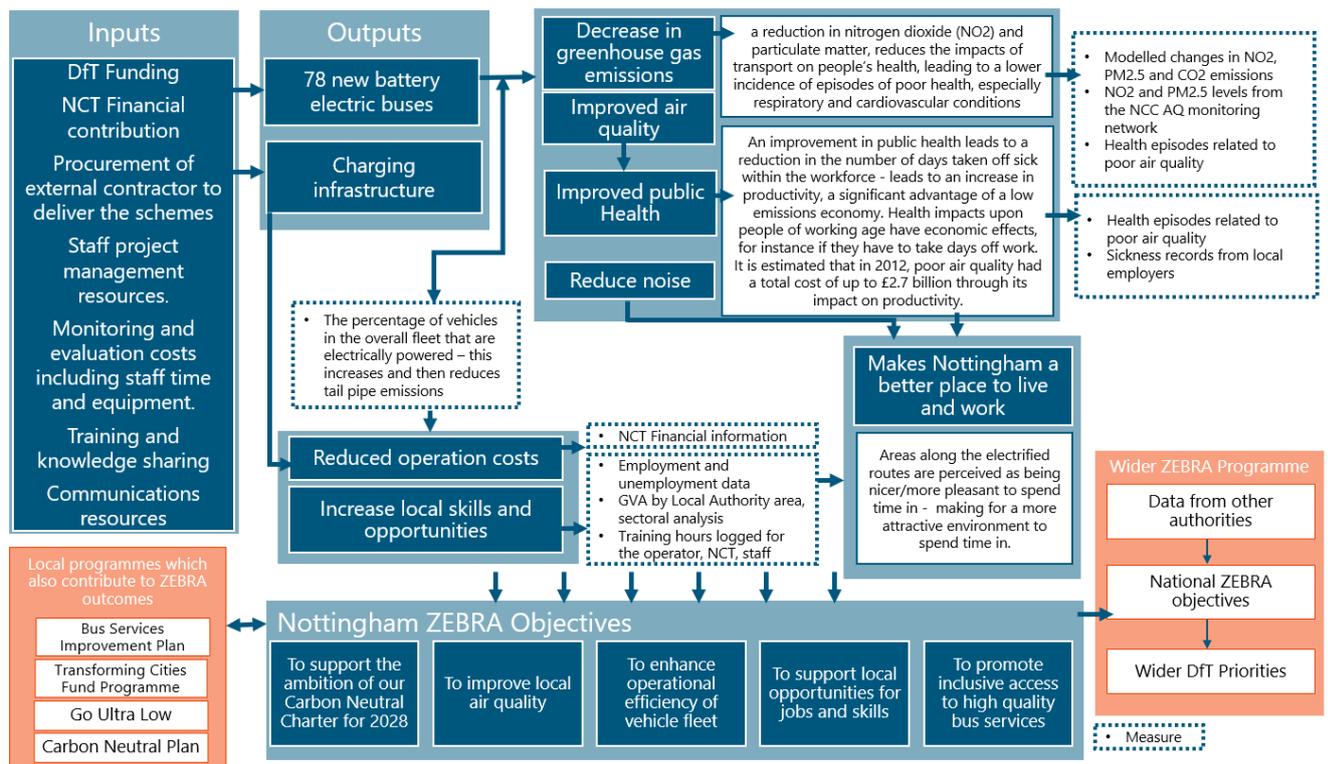
## Monitoring and Evaluation

- 6.68 An outline evaluation plan is presented in this section. It is recognised that this will be co-developed into a full evaluation plan with the DfT colleagues, post-funding award.

### *Project objectives*

- 6.69 Our ZEBRA objectives have been developed in accordance with the national programme aims and wider DfT priorities, as well as local strategies and policies. They are set out within the Strategic Case and aim to:
- Support the ambition of Nottingham's Carbon Neutral Charter for 2028.
  - Improve local air quality.
  - Enhance operational efficiency of vehicle fleet.
  - Support local opportunities for jobs and skills.
  - Promote inclusive access to high quality bus services.
- 6.70 A logic diagram that links project objectives to outputs and shows existing monitoring / evaluation processes for each output is included in Figure 6-4.

Figure 6-4: Logic diagram



*Data requirements and collection*

- 6.71 Table 6-8 sets out the monitoring data that will be employed to gather and report to be shared with the Department on a quarterly basis and collated by the programme-level evaluator. Data will be collected on a monthly basis and collated into quarterly and annual reports.
- 6.72 Baseline data on fleet performance will be gathered by NCT and NCC for the period up to the operation of the new EV fleet. This will be used to provide an up-to-date picture of the metrics before operation and allow evaluation of future data to be compared against the situation without the scheme. A full year of data will enable evaluation to allow for seasonal differences when reporting by month or quarter.
- 6.73 All required data will be reported to DfT in an electronic format, using a common format such as CSV or Microsoft Excel.

Table 6-8: Data requirement and collection

Theme	Data Requirement	Collection Method / Data Source	Frequency
<b>ZEBs and charging infrastructure outputs</b>	Number of ZEBs purchased	NCT procurement records / supplier invoice	At milestones
	Number of ZEBs in operation	NCT operation records	At milestones
	Number and type of internal combustion engine (ICE) buses replaced	NCT fleet records	At milestones
	Number (and capacity) of charging facilities introduced	NCT procurement records / supplier invoice	At milestones
	Performance of charging methodology (in-depot)	NCT procurement records / supplier invoice	Initially daily within NCT, reported quarterly
	DC charging	NCT procurement records / supplier invoice	At milestones
<b>Scheme costs</b>	Purchase cost per ZEB	NCT procurement records / supplier invoice	At milestones
	Purchase cost per equivalent ICE bus	NCT procurement records / past diesel invoices	At milestones
	Average operational cost (incl. maintenance and infrastructure) per ZEB (£ per month)	NCT financial records	Monthly
	Average operational cost (incl. maintenance and infrastructure) per ICE (£ per month) (if ICE buses operational in fleet)	NCT financial records (historical comparisons) or comparative during EV roll-out where single deck fleet is a mix	Monthly from past records
	Cost of electric fuelling infrastructure	NCT financial records	At milestones
<b>Data to inform analysis of carbon impacts</b>	Average daily ZEB mileage	NCT fleet records	Daily, reported annually or as requested
	Average daily ZEB energy consumption	NCT electricity usage / on board telematics	Daily, reported annually or as requested
	Average daily diesel mileage and fuel consumption for each route (i.e. baseline / comparator data)	NCT previous records (historical comparisons)	Daily, reported annually or as requested
	Average ZEB well-to-wheel greenhouse gas emissions	NCT / NCC calculations based on ZEB operational mileage	Calculated annually, or a requested
	Average battery state of charge before / after charging	NCT fleet records	Collected regularly, reported quarterly
	Time of day ZEB charged and electricity tariff (including electricity generation source)	Electricity supplier information and telematics information	Collected regularly, reported quarterly

### *Resourcing and governance*

- 6.74 Reporting will flow from the monthly project meetings through the governance structures set out above. A monthly report will go to the NCC Project Management Office covering operation costs, finance, carbon / air quality, passenger satisfaction reporting, with the intention being to issue quarterly and annual reports based on that monthly reporting to the joint Nottingham – Nottinghamshire Transport Delivery Board. These reports will also be issued to the NCT Board for completeness

### *Expected milestones*

- 6.75 Co-design of monitoring and evaluation data capture using vehicle telematics and back-office charging systems will be developed ahead of electric bus operations in September 2023. A complete reporting mechanism and schedule will be agreed with NCT, NCC and DfT in line with this also.
- 6.76 As set out in the Project Programme, formal monitoring and evaluation will take place quarterly and annually from October 2023. This will be followed up with annual and three-yearly consolidated monitoring and reporting.

### *Proposed evaluation approach*

- 6.77 The logic map, above, provides a framework for evaluation as well as supporting the business case. This approach is suited to the Nottingham ZEBRA programme as it provides an efficient way for information to flow from the data source, to all stakeholders.
- 6.78 The indicators are designed to track progress towards the Nottingham ZEBRA Bid and wider national ZEBRA programme objectives. The data will also be analysed with a view to assessing the value for money of the scheme and are itemised and cross referenced to the relevant objectives.
- 6.79 Such interventions are highly suited to Theoretical Evaluation approaches as they take into account temporal contextual change, as well as allowing for causal attribution, i.e. they demonstrate to what extent observed change is due to the implementation of an intervention rather than exogenous factors. The suggested approach builds on the traditional application of the ToC approach and enhances it by inserting individual mechanisms of change into the logic maps at key points to explain why particular linkages occur. The ToC approach thus identifies a theory of change for the intervention being evaluated, which will show each step on the causal pathway from scheme implementation to the eventual desired impacts, and the mechanisms explain how progress from one step to the next is to be achieved.
- 6.80 This evaluation approach provides a more detailed explanation of change. Contextual differences could make exporting the approach more or less effective than that demonstrated in Derby-Nottingham and thus, an understanding of the interaction of the mechanisms by which change is achieved and the impact of context on their effectiveness, is crucial in the design of future similar interventions.
- 6.81 The change observed in the indicators will be subject to further research to take into account exogenous changes which could impact the ability of the package to meet its objectives and thus to determine if the observed changes can truly be attributed to the ZEBRA fund. While this will need to be considered more carefully in the evaluation plan and co-developed with

the DfT, techniques that could be employed to achieve this with schemes of this nature are as follows:

- **Quasi experimental approaches** – indicators in the area subject to this scheme are compared to those from other similar urban areas or other parts of the D2N2 area isolated from the scheme.
- **Time series analysis** – subject to data availability, it should be possible to use a simple time series model to establish a statistical link between a relevant dependent variable and other independent variables, including one which acts as an intervention variable.
- **Direct interview surveys of public transport users** – to ask if they have changed their travel behaviour over the evaluation period and why. This will be essential to evidence improved access to employment and attribute any observed mode switch to the scheme.
- **A comparison of actual change** – as measured by wider transport trends, public transport patronage, and other metrics that may be influenced by TCF programme interventions, according to the logic map.

6.82 The evidence from one or more of the above research methods, together with the changes to the indicators, will be triangulated to generate robust conclusions as to whether the package has met its objectives, which will then be detailed in the quarterly and annual monitoring reports.

### *Monitoring and evaluation internal resources and expertise*

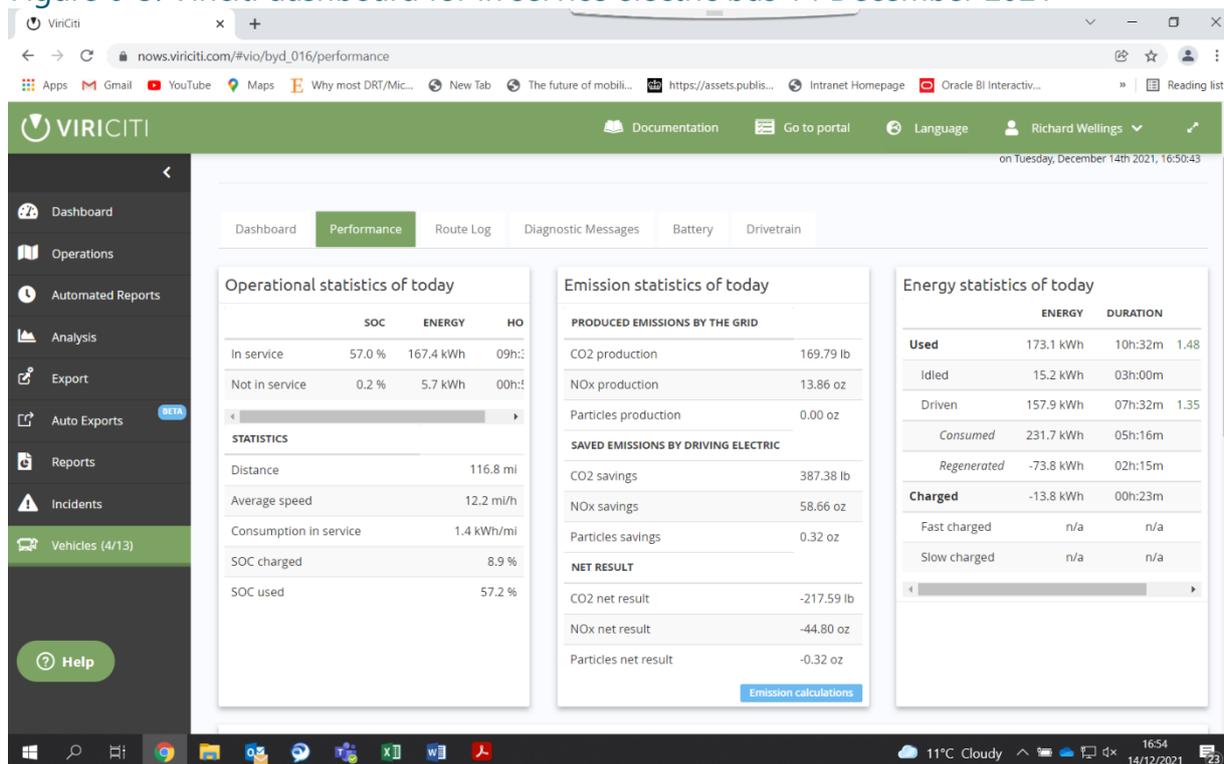
6.83 NCC will coordinate the monitoring and evaluation activities alongside colleagues at NCT. It has a proven in-house monitoring and evaluation capability having been responsible for numerous evaluation projects including two major evaluations for the Workplace Parking Levy (WPL) and the Nottingham Ring Road Improvement Scheme (NRRIS).

6.84 The WPL evaluation was based around a hybrid Theory of Change/Realistic Evaluation approach, but also used quasi experimental components and was conducted in partnership with Loughborough University with oversight from the DfT. The NRIS evaluation conformed to the DfT's Standard Monitoring as mandated for schemes of this value and outlined in the 2012 DfT Guidance, Monitoring and Evaluation Framework for Local Authority Major Schemes, published in September 2012.

6.85 Leading the coordination will be the Highway Metrics team with over 40 years' experience in delivering evaluations following both standard DfT guidance but also, in the case of the WPL, producing high quality evaluation projects based on bespoke evaluation frameworks satisfying academic standards of rigour.

6.86 An annual resource budget of £25,000 will be allocated to monitoring and evaluation. This felt sufficient due to the sophisticated level of data that can now be provided by vehicle telematics and back-office charging infrastructure systems, which can be easily analysed and collated into any number of reporting templates. The Viriciti telematics system deployed in Nottingham’s current electric bus fleet, for example, can provide a wealth of information and reports on operations, emissions and energy usage (as shown in Figure 6-5).

Figure 6-5: Viriciti dashboard for in service electric bus 14 December 2021



### *Commitment to Department for Transport programme level monitoring and evaluation*

6.87 We are fully committed to participating in all Monitoring and Evaluation activity as required by the Department of Transport and have a long track record of doing so in relation to previous low and ultra –low emission bus funding awards. We will also fully engage with any DfT information exchange forums and network and with other local transport authorities and operators to share knowledge and experience to support the roll-out of zero emission bus technology.

## 7. Equality Impact Assessment Form

### Document Control

Title: <b>If this is a budget EIA please ensure the title is the same as the title used within the budget booklet</b>	Zero Emission Regional Bus Areas (ZEBRA) – Electric Bus Project
Author:	Richard Wellings
Director:	Sajeeda Rose
Department:	Development and Growth
Service Area:	Transport Strategy, Major Projects
Contact details:	
Strategic Budget EIA: Y/N  (Does this EIA have an impact on the budget) <b>If yes, please include the reference number</b>	N
Exempt from publication: Y/N  (All EIAs are published on Nottingham Insight for public viewing unless specified. Exemption criteria is available on the EIA section on the Intranet)	N

### Document Amendment Record:

Version	Author	Date	Approved
V1-0	CP	January 2022	RW

### Contributors/Reviewers (Anyone who has contributed to this document will need to be named):

Name	Position	Date
Richard Wellings	Principal Public Transport Officer	
Charlotte Perkins	Public Transport Operations Projects Support Officer	

### Glossary of Terms

Term	Description
Zero Emission Bus Regional Areas (ZEBRA)	Government Funding Scheme for Electric Buses

## Summary and Aims

Nottingham City Council is currently bidding for circa £20m of funding to support the delivery of 78 electric buses and supporting infrastructure across both Nottingham City Transport's and Nottingham City Council's bus fleets.

If the bid is successful, 78 electric buses will enter Nottingham City Transport's commercial bus fleet, replacing all of the bus operator's diesel single decker buses. Electric bus charging infrastructure will be installed at the company's Trent Bridge Depot to support the operation of the new buses.

Improvements to the quality of public transport in Nottingham will support the delivery of equality outcomes. These will be delivered through increased accessibility, improvements in the quality of transport to places of work and education, improvements in air quality for the citizens of Nottingham, and will strongly support the Carbon Neutral Nottingham 2028 ambitions. The investment could also support strengthening communities, sustainable town centres within the Greater Nottingham area, and connect disabled and isolated people.

## Information used to Analyse the Effects on Equality

A number of transport surveys carried out by the local authority have indicated support for the deployment of electric buses locally, citing decarbonisation and improvements in air quality. The most recent survey carried out in relation to Nottingham's Bus Service Improvement Plan indicated that 61% of those surveyed supported the adoption of this technology a "great deal" or "to some extent." Of those surveyed, 19% considered themselves disabled, 8% BAME, 58% were women and 1% gender neutral with support for the technology from these respondents slightly higher than overall average at 63%. Whilst this survey indicates some general support for electric buses from a number of impacted groups, it is necessary to engage locally with groups such as the Disability Involvement Group (DIG) and representatives of the BAME and LGBTQ+ community to ensure any concerns or unrecognised impacts of the electric bus proposal will be captured. This will be achieved by engaging with local stakeholders and citizen groups via Nottingham City Council's Equalities team and the ZEBRA proposal will be added to upcoming meeting agendas so it can be fully discussed.

More generally, there is also a wealth of [published data](#) available demonstrating the benefits for those experiencing health inequalities and particularly respiratory illness that the move to electric vehicles and the resultant cleaner air deliver. This data echoes the benefits the technology delivers in relation to decarbonisation and climate change for all citizens and the environment generally.

Investment in the buses will have wider benefits to the residents of Nottingham as a whole. As the local bus network recovers from the impact of the Covid-19 pandemic over the next couple of years, the rollout of state of the art of the buses will act as an incentive to draw people back onto public transport. Coupled with the operational cost savings that can be achieved through the operation of electric buses, the local bus network, its commercial viability and access to jobs and opportunities for some of the city's most vulnerable residents, will be protected further. Electric bus rollout will also, due to operational efficiencies, help to protect local jobs in the bus industry and foster new pathways to employment and skills in relation to maintenance and operation of the technology.

## Relevant Research/Data

### **Age –**

Nottingham City age group demographics:

- Under 15 – 18.1%
- 16-24 – 21.7%
- 25-44 – 28.7%
- 45-59 – 15.6%
- 60+ - 15.9%

Older people are at a higher risk of poverty, which increases the likelihood of this age group travelling by bus. For example, [in 2019](#), people in the lowest real income quintile made more local bus trips on average than any other income quintile. Those in the highest income quintile made the least number of local bus trips.

[Car ownership](#) in Nottingham is also significantly lower than the average in England, with the 2011 Census suggesting that only 43.7% of households in the city have access to a car, compared to 25.8% in England. Car ownership is also particularly low amongst pensioners living alone as well as lone parents. With car ownership or access to car low in the city, importance is placed upon buses to provide access to work and education, and to [limit levels of social isolation](#).

### **Disability –**

In Nottingham City, 18.1% of people have long-term health problems that limit day-to-day activities. Data collected by [Transport Statistics \(2019\)](#) found that people with a disability make fewer trips by car. Simultaneously, disabled people are also less likely to be a car driver, placing further importance on accessible public transport to instil independence. [Better employment outcomes](#) for disabled people can also be achieved by the provision of accessible buses.

### **Sex –**

The population of Nottingham City is comprised of 51% females and 49% males. Lone parents are predominantly female, which affects socioeconomic status and access to their own cars. As previously mentioned, car ownership amongst lone parents tends to be low. There are also a higher proportion of female carers when compared to male carers. This makes both pushchair and wheelchair spaces particularly relevant on-board buses.

With women more likely to report concerns for safety on public transport, CCTV will be installed as standard on all of the buses delivered within this project. In a 'Perception of Safety' survey carried out by the council in 2020, 80% of respondents cited feeling safety as a result of the presence of CCTV on-board buses in Nottingham. Of these respondents, 64% identified themselves as female.

### **Race –**

27.2% of the total resident population of Nottingham belong to BAME communities. BAME groups more frequently face socioeconomic disadvantages, which can correlate with living in more densely populated areas where air quality is poor. Densely populated areas could include St Ann's, The Meadows, Forest Fields and Hyson Green, where BAME communities represent 50.4%, 48.2%, 52.3% and 49.6% respectively. Some proposed bus routes that would be electrified during the ZEBRA project operate through the aforementioned areas.

The ZEBRA project also has the potential to complement the BAME Inequalities place-based approach for Nottingham City. Within this place-based approach, there are ambitions to reduce health inequalities amongst BAME communities of Nottingham, some of which could arise as a result of poorer air quality in some urban areas.

### **Gender Reassignment –**

There is currently no robust data about the number of transgender people in the United Kingdom.

### **Religion or Belief –**

In Nottingham City, the percentage of the population belonging to religious or spiritual belief groups are as follows: -

- Christian – 44.2%
- Buddhist – 0.4%
- Hindu – 1.5%
- Jewish – 0.3%
- Muslim – 8.8%
- Sikh – 1.4%
- Other religion – 0.5%
- No religion – 35%

### **Sexual Orientation –**

Currently, there is no robust data about the number of LGB people in the UK. However, Stonewall estimates that one in 10 people identify as LGB.

### **Other evidence which might be relevant –**

There is emerging [evidence](#) that suggests air pollution can be associated with poorer mental health conditions. This includes potential links between air pollution exposure and increased rates of both depression and anxiety disorders.

## Impacts and Actions

	Could particularly benefit X	May adversely impact X	No significant impact X
<u>People from different ethnic groups (race).</u>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Men	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
<u>Women</u>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Trans people (gender reassigned)	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
<u>Disabled people or carers.</u>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<u>Pregnancy/ Maternity</u>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
People of different faiths/ beliefs and those with none.	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Lesbian, gay or bisexual people (sexual orientation).	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
<u>Older</u>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<u>Younger</u>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other (e.g. marriage/ civil partnership, looked after children, cohesion/ good relations, vulnerable children/ adults). <b><i>Please underline the group(s) /issue more adversely affected or which benefits.</i></b>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

## Potential Positive Equality Impacts

In line with the ZEBRA funding requirements all of the buses procured will be expected to comply with the Bus and coach accessibility and the [Public Service Vehicle Accessibility Regulations \(PSVAR\) 2000](#). This compliance will ensure that all buses that are delivered as part of this project will have:

- a space for a wheelchair with suitable safety provisions
- a boarding device to enable wheelchair users to get on and off vehicles
- a minimum number of priority seats on buses for disabled passengers
- the size and height of steps handrails to assist disabled people
- colour contrasting of features such as handrails and steps to help partially sighted people
- easy to use bell pushes throughout
- a bus audible and visual signals to stop a bus or to request a boarding
- device equipment to display the route and destination

In addition, the PSVAR requires that bus drivers or conductors provide reasonable assistance to disabled people, including wheelchair users, to board and alight. These requirements are incorporated within the existing bus partnership scheme, which governs bus services in Nottingham, alongside a commitment by all bus operators to be fully trained to meet the needs of all passengers.

### **Young people –**

The air quality gains realised by this implementation of the electric buses as part of a wider package of measures to support increased use of public transport and improve Nottingham's air quality are particularly beneficial to the young and old. Poor air quality is known to impact on lung development of younger people.

Bus charging infrastructure implemented as part of this project will enable future further deployment of electric buses locally, which will extend the benefits both to younger and older people as full electrification of the bus fleet locally is completed. The savings realised as a result of decreased maintenance costs on the electric buses when compared to the previous diesel fleet will strengthen the viability of existing commercial services, and enable Nottingham City Transport to sustain the connections that young people have to jobs and opportunities.

Young people under the age of 19 currently have access to cheaper fares, whether that be through season cards, pay-as-you-go cards or on-bus tickets, directly from the operator or through the Robin Hood network. Through other work streams, the Council is working with operators on the feasibility of introducing cheaper fares for young people under the age of 22, and the savings achieved through cheaper vehicle maintenance will provide further momentum to this.

**Older people –**

People within this group may see benefits linked to improved air quality and subsequent improvement to lung function of older people, particularly those with respiratory illness or asthma. Poor air quality has also been directly linked to [Alzheimer's](#).

Older people will also benefit from the on-board screens that show the next three bus stops, the audio stop announcements and on-board route information. This will instil confidence into older users who may not have experience using the bus frequently, or lack confidence when travelling alone.

**Women (particularly lone parents or carers) –**

Safety provisions on the single deck electric buses will improve the confidence that women have to be able to use the bus. Reliable bus services will also enable lone parents, who are statistically more likely to be women, to instil trust into the buses to take their children to school and travel to their place of work.

Wheelchair spaces and other means of accessibility such as on-board departure screens and priority seats will positively impact female carers and those who are in their care. These measures will make travelling on the bus to medical appointments, places of leisure and the shops easier. The savings realised as a result of decreased maintenance costs on the electric buses when compared to the previous diesel fleet will strengthen the viability of existing commercial services, and enable Nottingham City Transport to sustain the connections that women have to jobs and opportunities.

**Pregnancy/Maternity –**

People within this group may experience benefits from the pushchair spaces on the buses, as well as the priority seats at the front of the vehicle that are prioritised for those with limited mobility, which extends to those who are pregnant. For those who do not have access to a car, the bus could provide vital links to medical appointments and healthcare facilities.

**Disabled people or carers –**

Disabled people and the people who care for them will benefit from the requirements of Bus and coach accessibility and the [Public Service Vehicle Accessibility Regulations \(PSVAR\) 2000](#). In addition to these measures, on-board screens showing the next three bus stops, and other on-board route information will be of particular benefit to this group. The services that will be operating will also provide important links to medical appointments, leisure facilities and allow for socialisation.

The savings realised as a result of decreased maintenance costs on the electric buses when compared to the previous diesel fleet will strengthen the viability of existing commercial services in a post-Covid climate and enable Nottingham City Transport to sustain the connections that disabled people have to jobs, opportunities and healthcare facilities.

**Race –**

Health inequalities amongst BAME communities that live in densely populated urban areas will improve following the reduction in air pollution that will result from having cleaner, electric buses operating on the routes that serve these areas. Such benefits could include reduction in NO<sub>x</sub> and PM pollutants that can have a significant impact on individuals living with asthma and other respiratory conditions.

The introduction of electric buses to NCT's fleet will result in decreased maintenance costs when compared to their current diesel fleets. The savings realised by this will strengthen the viability of existing commercial services, particularly in a post-Covid climate where recovery of bus patronage remains uncertain, and enable Nottingham City Transport to sustain the connections that all of the above groups have to jobs and opportunities.

## Potential Negative Equality Impacts

**Disabled people or carers –**

During consultation with Disabled Groups in the past in relation to previous implementation of electric buses, concerns have been raised particularly in relation to the blind and hard of hearing. Particularly in regard to the reduced noise emitted by electric buses which may make it more likely for people in these groups to be at risk of being involved with accidents with the new buses.

## Mitigations to Negative Impacts

### **Disabled people or carers –**

As part of current driver training packages, drivers are advised to pay special attention to those with sight and hearing dogs and canes given the low noise of the buses. The council has operated its electric bus fleet since 2012 and there have been no recorded accidents with the visually or hearing impaired. Nottingham City Council are committed to involving disabled communities at multiple stages of this project to better understand the needs and preferences of disabled people. The council will also engage with stakeholders, including the Disability Inclusion Group (DIG), about the use of an acoustic alert system and other measures to support mitigation such as activation at particular speeds and/or in particular locations.

## How the impact on equality will be monitored throughout the lifetime of the proposal

Regular passenger surveys will be undertaken, and air quality and carbon saving data will be made publicly available to assess the impact of the buses. Regular consultation with groups with protected characteristics will continue via Nottingham City Council's equalities teams and their scheduled meetings and existing relationships that public transport team has with the local Disability Involvement Group (DIG) will be maintained to ensure any unforeseen issues that arise following roll-out are addressed in a timely fashion. Continuous evaluation and engagement with other stakeholders will be maintained to ensure that any queries or concerns about the project are addressed quickly. Current information systems such as complaints and feedback received through the council's travel centre as well as through Nottingham City Transport's travel centre will provide crucial insight into the public's opinion of the project as it is rolled out across the network.

## Engagement with Stakeholders

At this stage, Nottingham City Council will contact key stakeholders, to explain the funding for which we are applying and that involvement from groups would be appreciated to better understand the diverse preferences of stakeholders. Nottingham City Council already work closely with the Disability Involvement Group (DIG) to identify any areas of concern with ongoing and upcoming projects. The same will take place with the ZEBRA project.

Other stakeholders that Nottingham City Council will engage with and seek feedback from will include, but is not limited to:

- [Disability Nottinghamshire](#)
- [My Sight Nottinghamshire](#)
- [Reach Learning Disability](#)
- [Nottingham BAME Counselling Hub](#)
- [Nottingham Community and Voluntary Service](#)
- [Turning Point Nottingham](#)
- [Age UK Nottingham](#)
- [BAME Climate Champions](#)
- [LGBT+ Service Nottinghamshire](#)
- [Notts LGBT+ Network](#)
- [Nottingham Women's Centre](#)
- [Nottinghamshire Clubs for Young People](#)
- [Nottinghamshire Women's Aid](#)

Outcome(s) of equality impact assessment:

<input checked="" type="checkbox"/>	No major change needed	<input type="checkbox"/>	Adjust the policy/proposal
<input type="checkbox"/>	Adverse impact but continue	<input type="checkbox"/>	Stop and remove the policy/proposal

Approved by (manager signature) and Date sent to equality team for publishing:

<p><b>Approving Manager:</b> The assessment must be approved by the manager responsible for the service/proposal. Include a contact tel &amp; email to allow citizen/stakeholder feedback on proposals.</p>	<p><b>Date sent for advice:</b> Send document or Link to: <a href="mailto:equalities@nottinghamcity.gov.uk">equalities@nottinghamcity.gov.uk</a></p>
<p><b>Approving Manager Signature:</b></p>	<p><b>Date of final approval:</b></p>

Prepared by:



With support from:



January 2022