

# Leicester ZEBRA Bid

## Monitoring and Evaluation

August 2021



# **Monitoring and Evaluation Report**

## **Contents**

### **Page Area**

3.	Overview
3.	Project Objectives
5.	Data Collection
12.	Data Measurement
18.	Data Disclosure
20	Resourcing, Governance and Milestones
20.	Conclusions
	Appendices
21.	Appendix 1 Zenobe Vehicle Diagnostics Report Examples
24.	Appendix 2 ZEBRA Stakeholder Consultation

## Overview

1. All local and national partners within the ZEBRA programme and associated electric bus investment have a shared interest in evaluating funding effectiveness and measuring its impact on local areas and bus operations.
2. Leicester City Council, Arriva and First Bus are fully committed to participating in programme level monitoring and evaluation across all ZEBRA-funded areas in order to better understand this evolving discipline and market, to better learn for future investment decisions. To this end, they are fully prepared to share relevant monitoring data and participate in all programme-level evaluation activities through both the ZEBRA funding period and beyond.
3. Set out below is a summary of some of the local monitoring and evaluation activity that will take place in Leicester – across all relevant partners - to support the proposed ZEBRA investment business case.

## Project Objectives

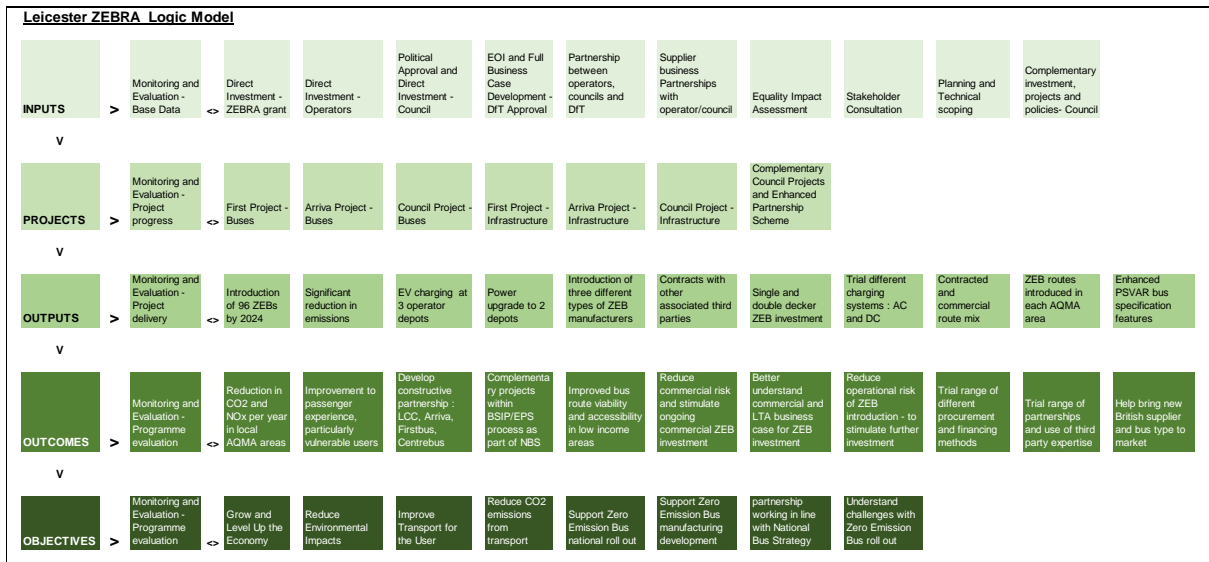
4. The overall objectives of the ZEBRA funding schemes are shown below.

<b>Objectives</b>	
<b>DfT Overall</b>	
1	Grow and Level Up the Economy
2	Reduce Environmental Impacts
3	Improve Transport for the User
<b>ZEBRA Funding</b>	
4	Reduce CO2 emissions from transport
5	Support ZEB national roll out
6	Support ZEB manufacturing development
7	Support local partnership working - NBS
8	Understand challenges with ZEB roll out

5. The outputs and outcomes set out within the Leicester bid proposal are summarised below, together with the relevant objective/s to be met for each.

<b>Leicester Zebra</b>		
<b>Output</b>		<b>Objective</b>
1	Dft and local investment in ZEB	1,7,5,8
2	Introduction of 96 ZEBs by 2024	1,2,4,5,6,7,8
3	Reduction in tail pipe exhaust emissions	2,4
4	EV charging equipment at 3 different operator depots	1,6,8
5	Power upgrade to 2 depots	1,6,7,8
6	Introduction of three different types of ZEB manufacturers	1,6,8
7	Contracts with other associated third parties	5,6,7,8
8	Single and double decker ZEB investment	5,6,8
9	Different charging systems : AC and DC	5,6,8
10	Contracted and commercial route mix	5,6,7,8
11	ZEB routes introduced in each AQMA area	2,3
12	Enhanced PSVAR bus specification features	3,7
<b>Outcome</b>		<b>Objective</b>
1	Reduction in CO2 and NOx per year in local AQMA areas	2,7
2	Improvement to passenger experience, particularly vulnerable users	3,7
3	Develop constructive partnership : LCC, Arriva, Firstbus, Centrebus	3,7
4	Complementary projects within BSIP/EPS process as part of NBS	3,7
5	Improved bus route viability and accessibility in low income areas	1,8
6	Reduce commercial risk and stimulate ongoing commercial ZEB investment	1,7,8
7	Better understand commercial and LTA business case for ZEB investment	1,7,8
8	Reduce operational risk of ZEB introduction - to stimulate further investment	1,7,8
9	Trial range of different procurement and financing methods	1,6,7,8
10	Trial range of partnerships and use of third party expertise	1,6,7,8

6. The whole process is shown in the logic model below:



## Data Collection

7. Below is a list of relevant measurements that will be taken for each output, together with proposed data collection frequency and duration. It is proposed that this information will also be shown in trend form for each area through use of graphs as the projects progress.

<b>Monitoring and Measuring Outputs</b>						
<b>Output</b>	<b>Leicester ZEBRA outputs</b>	<b>Measurement</b>	<b>Frequency</b>	<b>Duration</b>		
1	Dft and local investment in ZEB	Capital investment by each party per project	Quarterly	Whole life		
		Revenue investment by each party over project life	Quarterly	Whole life		
		Total costs by area - buses, power upgrade, charger, depot cabling, civils - by project	Quarterly	Whole life		
		Battery replacement costs by project	Quarterly	Whole life		
2	Introduction of 96 ZEBs by 2024	Numbers purchased	Quarterly	Zebra funding period		
		Manufacturer	Quarterly	Zebra funding period		
		Model type	Quarterly	Zebra funding period		
		Charging method (overnight/in service)	Quarterly	Zebra funding period		
		Charging rate	Quarterly	Zebra funding period		
		Charge current	Quarterly	Zebra funding period		
		Battery Capacity by bus type	Quarterly	Zebra funding period		
		Expected mileage range	Quarterly	Zebra funding period		
		Nos implemented	Quarterly	Zebra funding period		
		Dates commissioned	Quarterly	Zebra funding period		
3	Reduction in tail pipe exhaust emissions	Dates implemented	Quarterly	Zebra funding period		
		Operated mileage	Quarterly	Whole life		
		ZEB emissions certificated saving : Euro 6 eqvt	Quarterly	Whole life		
		By emission type	Quarterly	Whole life		
4	EV charging equipment at 3 different depots	Yearly emissions saving per km operated per emission type	Quarterly	Whole life		
		Depot locations	Quarterly	Zebra funding period		
		Charger nos	Quarterly	Zebra funding period		
		Charger types	Quarterly	Zebra funding period		
		Dates commissioned	Quarterly	Zebra funding period		
		Dates implemented	Quarterly	Zebra funding period		
		5	Power upgrade to 2 depots	Locations	Quarterly	Zebra funding period
				Scale of power upgrade	Quarterly	Zebra funding period
				Date commissioned	Quarterly	Zebra funding period
				Dates implemented	Quarterly	Zebra funding period
6	Contracts with different types of manufacturers	Manufacturer name and details	Quarterly	Zebra funding period		
		Dates commissioned	Quarterly	Zebra funding period		
		Dates implemented	Quarterly	Zebra funding period		
7	Contracts with other associated third parties	Company name and details	Quarterly	Zebra funding period		
		Dates commissioned	Quarterly	Zebra funding period		
		Dates implemented	Quarterly	Zebra funding period		
8	Single and double decker ZEB investment	Numbers purchased	Quarterly	Zebra funding period		
		Capacity of each	Quarterly	Zebra funding period		
		Length and weight	Quarterly	Zebra funding period		
		Dates commissioned	Quarterly	Zebra funding period		
9	Different charging systems : AC and DC	Dates implemented	Quarterly	Zebra funding period		
		Number at each depot	Quarterly	Zebra funding period		
		Nos of buses at each	Quarterly	Zebra funding period		
		Date commissioned	Quarterly	Zebra funding period		
10	Contracted and commercial route mix	Date implemented	Quarterly	Zebra funding period		
		Nos of routes of each type	Quarterly	Zebra funding period		
		Nos buses per route type	Quarterly	Zebra funding period		
		Operated mileage per route type	Quarterly	Zebra funding period		
11	ZEB routes introduced in each AQMA area	Date commissioned	Quarterly	Zebra funding period		
		Number of routes in each local AQMA corridor	Quarterly	Zebra funding period		
		% of total routes electric per local AQMA corridor	Quarterly	Zebra funding period		
		Date commissioned	Quarterly	Zebra funding period		
12	Enhanced PSVAR bus specification features	Date implemented	Quarterly	Zebra funding period		
		Nos of features implemented and nos buses	Quarterly	Zebra funding period		
		Passenger views on each feature	Quarterly	Zebra funding period		
		Date commissioned	Quarterly	Zebra funding period		
		Date implemented	Quarterly	Zebra funding period		

8. For each outcome, there will also be a series of continuous measurements taken over either the lifetime of the bus or the ZEBRA funding period. Again, this will be

illustrated by trend graphs over time.

<b>Monitoring and Measures Outcomes (1-6)</b>				
<b>Outcome</b>		<b>Measurement</b>	<b>Frequency</b>	<b>Duration</b>
1	Reduction in CO2 and NOx per year in local AQMA areas	Roadside Emissions by type	yearly	Zebra fund period
2	Improvement to passenger experience, particularly for those with varying disabilities	Trips numbers by operator and route - across ZEB fleet over time	quarterly	Zebra fund period
		Trips by ticket type (elderly, disabled, child, scholars, adults) by operator and route	quarterly	Zebra fund period
		Passenger Satisfaction of buses against other similar areas - report from Transport Focus	yearly	Zebra fund period
		Report from Bus User Panel	half yearly	Zebra fund period
		On-line tailored electric bus user survey	yearly	Zebra fund period
3	Develop constructive, ongoing partnership LCC, Arriva, Firstbus, Centrebus	Documented meetings	quarterly	Zebra fund period
		Progress report of each project plan to timescales and specification	yearly	Zebra fund period
4	Complementary measures, within BSIP/EPS process as part of NBS	Documented meetings	various	Zebra fund period
		Transforming Cities Fund reporting process	half yearly	Zebra fund period
		Bus Service Improvement Plan reporting	half yearly	Zebra fund period
		Enhanced Partnership Scheme reporting	half yearly	Zebra fund period
5	Improved bus route viability and accessibility in low income areas	Service levels on relevant route over time	half yearly	Zebra fund period
		Profitability of these routes over time	half yearly	Zebra fund period
6	Reduce commercial risk and stimulate ongoing commercial ZEB investment	Operator capital and revenue investment level in this ZEBRA bid	yearly	Whole life
		Operator overall investment in future Zebra bids - locally	yearly	Whole life
		Operator overall investment in future Zebra bids - nationally	yearly	Whole life

<b>Monitoring and Measures Outcomes (7-10)</b>							
<b>Outcome</b>	<b>Measurement</b>	<b>Frequency</b>	<b>Duration</b>				
7	Better understand commercial and LTA business case for ZEB investment	Actual full ZEB costs vs diesel : full capital project costs, including battery replacement	quarterly	Whole life			
		Actual full capital and revenue depot costs - on a year by year basis	quarterly	Whole life			
		Warranty details - minimum and extended by supplier	quarterly	Whole life			
		Depot construction - how well to timescales and issues encountered	quarterly	Whole life			
		Bus procurement - how well to timescales and issues encountered	quarterly	Whole life			
		Pre-Delivery Inspections of new buses : % items meet minimum specification by supplier	quarterly	Whole life			
		Bus reliability - % of scheduled buses that operated full service	quarterly	Whole life			
		Charger reliability - % of buses with 100% charge at start of day over a given period	quarterly	Whole life			
		Battery performance - state of charge at start and end of operation against operated miles	quarterly	Whole life			
		Battery reliability - variance of performance over time	quarterly	Whole life			
		Driver efficiency - % of regenerative braking energy by driver over time	quarterly	Whole life			
		Smart Charging management - energy pull over time of day and over year	quarterly	Whole life			
		Maintenance cost and issues : compared to diesel	quarterly	Whole life			
		Cleaning costs and issues : compared to diesel	quarterly	Whole life			
		Warranty reliability - in relation to contractual KPIs set in the procurement process	quarterly	Whole life			
		Power costs - costs per km operated across time in relation to diesel.	quarterly	Whole life			
		Other costs - eg insurance : compared to diesel	quarterly	Whole life			
			Passenger revenue per route over time	quarterly	Whole life		
		8	Reduce operational risk of LEB introduction - to stimulate further investment	Bus reliability - % of scheduled buses that operated full service	quarterly	Whole life	
				Charger reliability - % of buses with 100% charge at start of day over a given period	quarterly	Whole life	
Battery performance - state of charge at start and end of operation against operated miles	quarterly			Whole life			
Battery reliability - variance of performance over time	quarterly			Whole life			
Driver efficiency - % of regenerative braking energy by driver over time	quarterly			Whole life			
Smart Charging management - energy pull over time of day and over year	quarterly			Whole life			
Maintenance issues : compared to diesel	quarterly			Whole life			
Cleaning issues : compared to diesel	quarterly			Whole life			
Warranty reliability - in relation to contractual KPIs set in the procurement process	quarterly			Whole life			
9	Trial range of different procurement and financing methods			Review and report of each method by operator	yearly	Zebra fund period	
		10	Trial range of partnerships and use of third party expertise	Review and report of each method by operator	yearly	Zebra fund period	

9. There is already good recorded base data from which to measure changes in both outputs and outcomes. This is set out within the Strategic Case – Bus Network Overview. Some examples are shown below.

<b>Bus routes on Each AQMA</b>						
<b>Air Quality Management Area:</b>	<b>Electric</b>	<b>Electric</b>	<b>Diesel</b>		<b>Zebra</b>	<b>All</b>
	<b>Committed</b>	<b>Zebra</b>	<b>Euro 6</b>	<b>Total</b>	<b>Electric</b>	<b>Electric</b>
City Centre/Inner Ring Road	5	20	29	54	37%	46%
Ring Rd - Glenhills Way/Braunstone Way	1	1	0	2	50%	100%
Ring Rd - New Parks Way	0	1	0	1	100%	100%
Ring Rd - Colchester Rd/Goodwood Rd	1	2	0	3	67%	100%
Abbey Lane	1	2	0	3	67%	100%
Melton Rd	0	3	7	10	30%	30%
Dysart Way	0	0	0	0	0%	0%
Humberstone Rd/Uppingham Rd	0	2	3	5	40%	40%
London Rd	1	3	4	8	38%	50%
Welford Rd	0	2	1	3	67%	67%
Saffron Lane	0	2	3	5	40%	40%
Aylestone Rd	0	3	2	5	60%	60%
Narborough Rd/Braunstone Gate	1	2	0	3	67%	100%
Hinckley Rd	1	1	3	5	20%	40%
Northgate	0	3	1	4	75%	75%
<b>Total</b>	<b>11</b>	<b>47</b>	<b>53</b>	<b>111</b>	<b>42%</b>	<b>52%</b>
* not a bus corridor						

<b>Leicester Fleet and Market Share by Operator</b>						
	Fleet Nos	Fleet share	Type		Market share - trips	
			Single	Deckers	Whole route	City boarding
Arriva	205	51%	100	105	49%	45%
First	75	19%	36	39	35%	40%
Centrebus	54	14%	51	3	6%	10%
Kinch	17	4%	17	0	5%	2%
Stagecoach	34	9%	34	0	3%	1%
Roberts	15	4%	15	0	2%	1%
	400	100.0%	253	147	100%	100%

<b>Passengers Travelling on Electric buses by 2024</b>			
All routes coming into Leicester			
Bus Type	Status	Passengers pa	% passengers
Electric	Already Committed	2,811,266	7.4%
Electric	ZEBRA Fast Track	15,995,884	42.2%
Diesel Euro 6	In place	19,074,760	50.4%
		37,881,910	
Electric			49.6%



<b>Euro 6 compliance</b>						
		Jan-20		Sep-21		
	Fleet Nos	Nos buses Euro 6	%	Nos buses Euro 6	%	
Arriva	205	205	100%	205	100%	
First	75	75	100%	75	100%	
Centrebus	54	47	87%	49	91% *	
Kinch	17	17	100%	17	100%	
Stagecoach	34	25	74%	34	100%	
Roberts	15	12	80%	15	100%	
<b>Total</b>	<b>400</b>	<b>381</b>	<b>95%</b>	<b>395</b>	<b>99%</b>	

\* includes x5 buses converted to Euro V standard through previous CVT funds

10. Below is a simplified 'tick sheet' of the expected bus outputs of ZEBRA proposal.

<b>Broad Specification by project</b>			
	Council	First	Arriva
<b>Supplier</b>	Pelican Yutong		
<b>Model</b>	E12		
<b>Type</b>	Saloon		
<b>Length</b>	12.17m		
<b>Weight</b>	13.7 tonnes		
<b>Seating</b>	36		
<b>Battery</b>	Lithium Ion Phosphate		
<b>Battery capacity</b>	422KWh		
<b>Battery warranty</b>	8 years or life		
<b>Battery range</b>	187.5 miles - 214 miles		
<b>Battery degradation (yr 8)</b>	80% max		
<b>Charger</b>	2x60 KW		
<b>Charging type</b>	DC		
<b>Air Con</b>	yes		
<b>Heating</b>	yes		
<b>Glazing</b>	single		
<b>Enhanced PSVAR</b>	yes		

11. The following is a draft list of the base information sets already available.

<b>Base Data Available for ZEBRA monitoring.</b>	
Buses at each depot	Emission standard
	Number
	Age
	Route employed
	Size
	Make
	Specification and peripherals
Depot information	Current power
	Charging area
	Location
	Service from each and times
Routes/Services	Yearly number
	Split by user type
	Punctuality by route
	Reliability by route
	Registration details
	Automated vehicle location information
	CCTV information
	Peak vehicle requirement per routes
	Spares per route
	Operating miles per route
	Dead mileage per route
	Rosters per driver
	Predicted end service State of Charge per route
Roadside	Real time information at displays - data
	Pollution monitoring equipment - data
	Traffic control cameras
	UTC information - road/junction delays
	AQMA areas
Costs	Capital costs of current buses
	Operating costs of each service
	Maintenance cost of each service
	Fuel costs of each service
	Cleaning costs of each service

12. It should be noted the following two outcomes require significant monitoring across a broad range of financial and other measures focus on the overall commercial and operational business case of each project :

- Better understand commercial and LTA business case for ZEB investment
- Reduce operational risk of LEB introduction - to stimulate further investment

13. The Leicester proposal will be able to compare this across three projects operating in the same market with the same overall partnership arrangements and set of complementary measures. In all cases this data will be compared against recent similar data relating to Euro 6 diesel buses operating in the same market.

## Data Measurement

14. The table below sets out the proposed measurement method for output areas, together with the relevant owner, source and measurement device.

Output Measures - measurement				
Area	Measurement	Owner	Source	Method
Bus	Numbers purchased over time	Project managers	Fleet managers	Project Records
Bus	Manufacturer details	Project managers	Fleet managers	Project Records
Bus	Model types	Project managers	Fleet managers	Project Records
Bus	Charging method (overnight/in service etc)	Project managers	Fleet managers	Project Records
Bus	Charging rate	Project managers	Fleet managers	Project Records
Bus	Charge current type	Project managers	Fleet managers	Project Records
Bus	Battery Capacity	Project managers	Fleet managers	Project Records
Bus	Expected and measured mileage ranges	Project managers	Fleet managers	Project Records
Bus	Dates commissioned	Project managers	Fleet managers	Project Records
Bus	Dates implemented	Project managers	Fleet managers	Project Records
Bus	Operated mileages over time	Project managers	Fleet managers	Project Records
Bus	Numbers purchased	Project managers	Fleet managers	Project Records
Bus	Capacity of each	Project managers	Fleet managers	Project Records
Bus	Length and weight	Project managers	Fleet managers	Project Records
Bus	Nos of enhanced PSVR features implemented and nos buses	Project managers	Fleet managers	Project Records
Bus	Passenger views on each PSVAR feature	Programme Manager	Online Survey and Transport Focus	Project Records
Chargers	Depot locations	Project managers	Fleet managers	Project Records
Chargers	Nos installed	Project managers	Fleet managers	Project Records
Chargers	Types installed	Project managers	Fleet managers	Project Records
Chargers	Dates commissioned	Project managers	Fleet managers	Project Records
Chargers	Dates implemented	Project managers	Fleet managers	Project Records
Charging systems	Types at each depot	Project managers	Fleet managers	Project Records
Charging systems	Dates implemented	Project managers	Fleet managers	Project Records
Charging systems	Dates commissioned	Project managers	Fleet managers	Project Records
Contracts	Dates commissioned	Project managers	Fleet managers	Project Records
Contracts	Dates implemented	Project managers	Fleet managers	Project Records
Costs	Capital investment by each party per project	Project managers	LCC & Operator Finance Sections	Project Records
Costs	Revenue investment by each party over project life	Project managers	LCC & Operator Finance Sections	Accounts system
Costs	By area - buses, power upgrade, charger, depot cabling, civils - by project	Project managers	LCC & Operator Finance Sections	Accounts system
Costs	Battery replacement costs by project	Project managers	LCC & Operator Finance Sections	Accounts system
Emissions	ZEB emissions certificated saving : Euro 6 eqvt by manufacturer	Project managers	Fleet managers	Spreadsheet calculator
Emissions	Savings by emission type by bus type pa	Project managers	Fleet managers	Spreadsheet calculator
Emissions	Saving per km operated per emission type	Project managers	Fleet managers	Spreadsheet calculator
Power increase	Locations	Project managers	Fleet managers	Project Records
Power increase	Scale of upgrade	Project managers	Fleet managers	Project Records
Power increase	Date commissioned	Project managers	Fleet managers	Project Records
Power increase	Dates implemented	Project managers	Fleet managers	Project Records
Routes	Nos of electric routes of each type (single/decker)	Project managers	Fleet managers	Project Records
Routes	Nos buses per route type	Project managers	Fleet managers	Project Records
Routes	Operated mileage per route type	Project managers	Fleet managers	Project Records
Routes	Number of routes in each local AQMA corridor electric	Programme Manager	Cross ref AQMA Plan	Project Records
Routes	% of total routes electric per local AQMA corridor	Programme Manager	Cross ref AQMA Plan	Project Records
Third parties	Company name and details	Project managers	Fleet managers	Project Records
Third parties	Dates implemented	Project managers	Fleet managers	Project Records
Third parties	Dates commissioned	Project managers	Fleet managers	Project Records

15. The table below set out the proposed measurement approach for outcome areas, including the relevant owner, source and measurement device.

Output Measures - measurement				
Area	Measurement	Owner	Source	Method
Emissions	Roadside Emissions by type	Programme Manager	AQM Team LCC roadside monitoring units	Mobile Roadside monitoring
Passenger views	Trips numbers by operator and route - across ZEB fleet over time	Programme Manager	Operator Commercial Teams	Ticket machine data
Passenger views	Trips by ticket type (elderly, disabled, child, scholars, adults) by operator and route	Programme Manager	Operator Commercial Teams	Ticket machine data
Passenger views	Passenger Satisfaction of buses against other similar areas over time	Programme Manager	Public Transport Team LCC -	Transport Focus reporting tool
Passenger views	Report from Bus User Panel on views of buses	Programme Manager	Public Transport Team LCC	Coordination meetings
Passenger views	On-line tailored electric bus user survey	Programme Manager	Operator Commercial Teams	Online survey tool
Partnership working	Scale and depth of BSIP/EPS programme	Programme Manager	LCC Bus Strategy and Programme Manager	Online survey tool of users and DfT feedback
Partnership working	Progress report of each project plan to timescales and specification	Programme Manager	LCC Bus Strategy and Programme Manager	Project management reports
Partnership working	Delivery report and effectiveness of other bus measures in TCF	Programme Manager	LCC Bus Strategy and Programme Manager	TCF quarterly report
Partnership working	Combined BSIP/EPS/TCF/ZEBRA programme	Programme Manager	LCC Bus Strategy and Programme Manager	Quarterly report
Accessibility to low income groups	Service levels on relevant route over time	Programme Manager	LCC Public Transport Team	Registration data
Accessibility to low income groups	Profitability of these routes over time	Programme Manager	Operator Finance Director	Internal reports
Commercial risk of ZEB investment reduced	Operator capital and revenue investment level in this ZEBRA bid	Programme Manager	Operator Finance Director	Feedback from MDs
Commercial risk of ZEB investment reduced	Operator overall investment in future Zebra bids - locally	Programme Manager	Operator Finance Director	Feedback from MDs
Commercial risk of ZEB investment reduced	Operator overall investment in future Zebra bids - nationally	Programme Manager	Operator Finance Director/ Project Manager	Feedback from MDs
Improved ZEB understanding	Actual full ZEB costs vs diesel : full capital project costs, including battery replacement	Programme Manager	Operator Finance Director/ Project Manager	Accountancy systems
Improved ZEB understanding	Actual full capital and revenue depot costs - on a year by year basis	Programme Manager	Operator Finance Director/ Project Manager	Accountancy systems
Improved ZEB understanding	Warranty details - minimum and extended by supplier	Programme Manager	Operator Finance Director/ Project Manager	Project management reports
Improved ZEB understanding	Depot construction - how well to timescales and issues encountered	Programme Manager	Operator Finance Director/ Project Manager	Project management reports
Improved ZEB understanding	Bus procurement - how well to timescales and issues encountered	Programme Manager	Operator Project Managers	Project management reports
Improved ZEB understanding	Pre-Delivery Inspections of new buses : % items meet minimum specification by supplier	Programme Manager	Operator Project Managers	Project management reports
Improved ZEB understanding	Bus reliability - % of scheduled buses that operated full service	Programme Manager	Fleet Managers	Dedicated diagnostics system
Improved ZEB understanding	Charger reliability - % of buses with 100% charge at start of day over a given period	Programme Manager	Fleet Managers	Dedicated diagnostics system
Improved ZEB understanding	Battery performance - state of charge at start and end of operation against operated miles	Programme Manager	Fleet Managers	Dedicated diagnostics system and AVL systems
Improved ZEB understanding	Battery reliability - variance of performance over time	Programme Manager	Fleet Managers	Dedicated diagnostics system
Improved ZEB understanding	Driver efficiency - % of regenerative braking energy by driver over time	Programme Manager	Fleet Managers	Dedicated diagnostics system
Improved ZEB understanding	Smart Charging management - energy pull over time of day and over year	Programme Manager	Fleet Managers	Dedicated diagnostics system
Improved ZEB understanding	Maintenance cost: compared to diesel	Programme Manager	Operator Finance teams	Accountancy systems
Improved ZEB understanding	Cleaning costs: compared to diesel	Programme Manager	Operator Finance teams	Accountancy systems
Improved ZEB understanding	Warranty reliability - in relation to contractual KPIs set in the procurement process	Programme Manager	Fleet Managers - diagnostics system	Internal recording
Improved ZEB understanding	Power costs - costs per km operated across time in relation to diesel.	Programme Manager	Operator Finance Teams	Diagnostics system
Improved ZEB understanding	Other costs - eg insurance : compared to diesel	Programme Manager	Operator Finance Teams	Accountancy systems
Improved ZEB understanding	Passenger revenue per route over time	Programme Manager	Operator commercial teams	Accountancy systems
Improved ZEB understanding	Maintenance issues : compared to diesel	Programme Manager	Fleet Managers - records	Internal recording
Improved ZEB understanding	Cleaning issues : compared to diesel	Programme Manager	Fleet Managers - records	Internal recording
Improved ZEB understanding	Warranty reliability - in relation to contractual KPIs set in the procurement process	Programme Manager	Fleet Managers - diagnostics system	Internal recording
Financing methods	Review and report of each method by project	Programme Manager	LCC and Operator Finance Directors	Quarterly report
Partnerships	Review and report of each method employed by project - including third parties used	Programme Manager	Operator MDs	Quarterly report

16. Some example reports relating to operational performance (outcome 8) from the current diagnostic software already employed in Leicester via Zenobe and Pelican/Yutong software are shown in the Appendix 1, excerpt below.

<b>Overall Summary</b>				
Metric	Value			
Total km	37259			
Average kWh/km	0.88			
Average Regen Rate	-0.49			
Average SOC Usage	36.00			
<b>Summary by Daily Distance</b>				
Daily Distance Range	Total km	Avg kWh/km	Avg Regen Rate kWh/km	Avg SOC Usage
(-0.001, 50.0]	501	1	0	4
(50.0, 100.0]	405.00	0.89	-0.47	26.20
(100.0, 150.0]	4291.00	0.86	-0.51	33.69
(150.0, 200.0]	21366.00	0.88	-0.52	45.70
(200.0, 250.0]	8047.00	0.86	-0.51	56.77
Analysis on how metrics vary depending on how far a vehicle has driven in a day				
<b>Summary by Date</b>				
Metric	Date	Value		
Highest Tot km	21/04/2021	1601		
Lowest Tot km	04/04/2021	499.00		
Best Avg kWh/km	25/04/2021	0.69		
Worst Avg kWh/km	07/04/2021	1.06		
Best Avg Regen Rate	27/04/2021	0.55		
Worst Avg Regen Rate	05/04/2021	0.37		
Highest Avg SOC Usage	07/04/2021	48.89		
Lowest Avg SOC Usage	04/04/2021	13.78		
Metrics measured as the total or average for all vehicles on each day				

Energy Usage Report - Park and Ride (July 2021)							
	Bus						
	1	2	3	4	10	11	Fleet
Duration(h)	269.54	296.34	334.99	344.84	312.2	346	3481.12
Distance(km)	4581.55	5172.76	6039.56	6121.49	5958.56	5862.5	62108.35
Energy consumption per 100 km(kW-h/100km)	77.64	79.48	79.13	80.29	74.57	79.82	78.37
Total net output energy consumption(kW-h)	3556.9	4111.5	4779.1	4914.7	4443.3	4679.2	48677.2
Regenerated energy(kW-h)	1898.5	2168	2471.1	2894.6	2529.3	2352.5	26352.4
Total output energy consumption(kW-h)	5455.4	6279.5	7250.2	7809.3	6972.6	7031.7	75029.6
Motor(kW-h)	4793.8 (87.87%)	5471.3 (87.13%)	6411 (88.43%)	6773.3 (86.73%)	6171.5 (88.51%)	6063.5 (86.23%)	65657.5 (87.51%)
Defroster(kW-h)	17.6 (0.32%)	19.5 (0.31%)	11.4 (0.16%)	93.8 (1.2%)	31.6 (0.45%)	29.6 (0.42%)	371.9 (0.5%)
Driver cab AC(kW-h)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Cabin AC(kW-h)	180.6 (3.31%)	250.4 (3.99%)	238.8 (3.29%)	251.2 (3.22%)	156.2 (2.24%)	288 (4.1%)	2428.8 (3.24%)
Heater(kW-h)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Steering machine(kW-h)	142.7 (2.62%)	159.1 (2.53%)	172.7 (2.38%)	202.3 (2.59%)	166.2 (2.38%)	180.4 (2.57%)	1876.9 (2.5%)
Air compressor(kW-h)	53.9 (0.99%)	62.5 (1%)	63.5 (0.88%)	67.3 (0.86%)	69.5 (1%)	63.9 (0.91%)	702.7 (0.94%)
DCDC(kW-h)	162.1 (2.97%)	187 (2.98%)	224.3 (3.09%)	220.1 (2.82%)	186.8 (2.68%)	218.5 (3.11%)	2217.5 (2.96%)
Others(kW-h)	104.7 (1.92%)	129.7 (2.06%)	128.5 (1.77%)	201.3 (2.58%)	190.8 (2.74%)	187.8 (2.66%)	1774.3 (2.35%)

17. It should also be noted that the City Council manages its own real time information and bus tracking system, from which it is able to monitor operational performance relating to the buses in terms of punctuality and reliability.

18. It should also be noted that the on-line electric bus user survey will be undertaken each year using the same process as has already been undertaken for the EIA bid consultation – effectively the base year. This employs the online email database and social media channels of First Bus and is shown on the weblink below:

[https://forms.office.com/Pages/ResponsePage.aspx?id=udIGGZV0HESkXg3itI7XpbtLH\\_cIN2JNozhAoydh0VtUNE42OVg0S1VKSfJSVUhQM0c4SzIwOFY5Ni4u](https://forms.office.com/Pages/ResponsePage.aspx?id=udIGGZV0HESkXg3itI7XpbtLH_cIN2JNozhAoydh0VtUNE42OVg0S1VKSfJSVUhQM0c4SzIwOFY5Ni4u)

More details of this process are shown in Appendix 2.

19. It is also proposed that a yearly report is produced which:

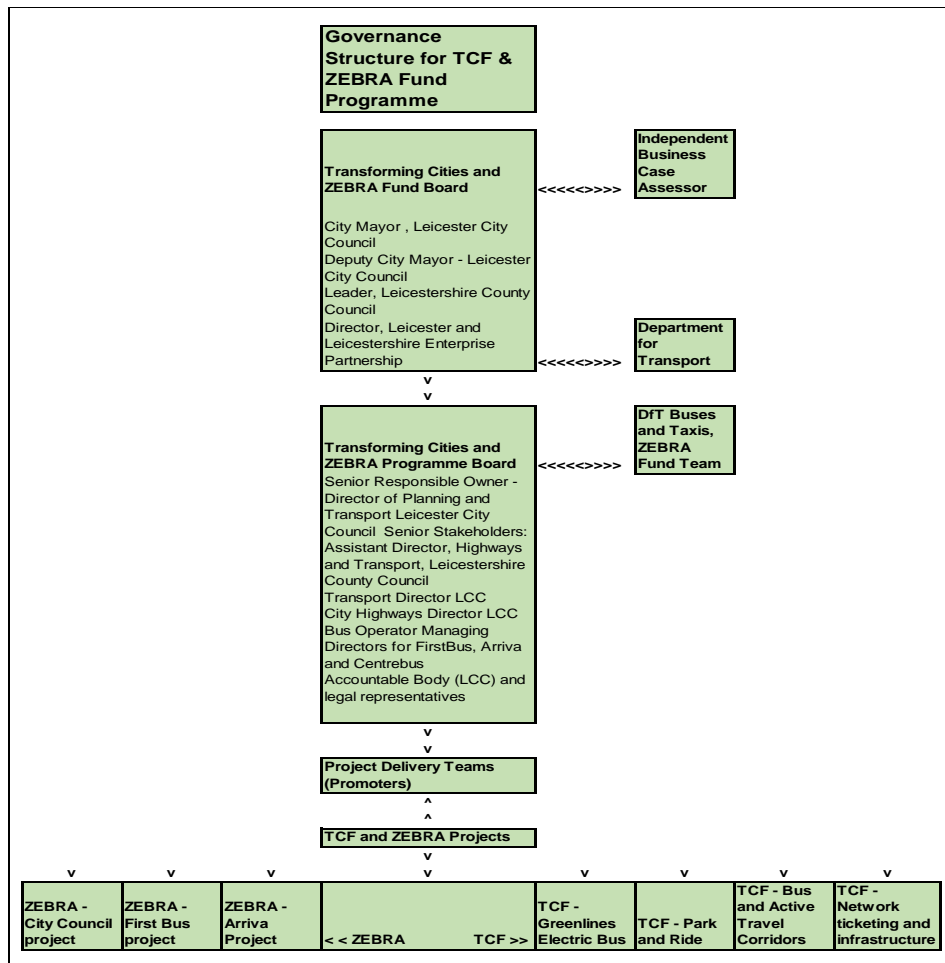
- Summarises the monitoring information in relation to the impact on the scheme objectives.
- Provides commentary on problems, issues and changes which have taken place over the previous year.
- Updates on the overall procurement and project plans.
- Updates on the risk register for each project.
- Updates on spend and output delivery to budgeted and planned profile.
- Provides trend information.

## **Data Disclosure**

20. All Outputs data and reporting will be open to public reporting and can be published on open-data platforms.
21. All Outcomes data and reporting is subject to individual operator confidentiality disclosure. An agreement will be signed between the Leicester City Council, Arriva and First Bus to disclose this to DfT as part of ZEBRA funding process under given conditions.
22. It is likely that this is on the basis that the data is not disclosed to any other party at a granular level and can only be disseminated at a wider level in aggregated form, such that the information cannot be identified at operator and route level.

## **Resourcing, Governance and Milestones**

23. All monitoring and evaluation will be undertaken within the existing Transport Strategy section in Leicester City Council, using staff already doing similar work for the monitoring of other bus projects and related operational and partnership work.
24. This can be efficiently done using existing budgeted staff and associated resources, including those already assigned for external data collection and reporting from Transport Focus. The Council is prepared bolster this resource if required.
25. This includes continuous liaison with First Bus and Arriva relating to the collection and analysis of data recorded from their relevant in-house systems
  - Ticketing data
  - Financial data
  - Vehicle diagnostics data
26. Vehicle tracking data and operational mileage can be obtained directly from the all-operator VIX system managed Leicester City Council.
27. There will be dedicated person within the Transport Strategy team assigned to collate and report on all this data, sitting alongside the Programme Manager for the ZEBRA programme.
28. The governance structure will sit within that outlined in the Management section. The M&E reporting information will go to the overall TCF & ZEBRA Programme Board and then to the TCF & ZEBRA Funding Board and DfT at quarterly intervals.



29. As well as providing the granular data shown above, the quarterly report will also:
- summarise the monitoring information in relation to the impact on the relevant objectives.
  - provide commentary on problems, issues and changes which have taken place over the previous quarter.
  - update on the overall procurement and project plans.
  - update on the risk register for each project.
  - date on spend and output delivery to budgeted and planned profile.

30. It is noted that DfT is currently procuring a research contractor to coordinate programme-level M&E for ZEBRA. It is confirmed that Leicester's project-level M&E plan will cooperate with this programme-level evaluation and provide the required data as and when required.

### Conclusions

31. The Monitoring and Evaluation report sets out that the Council, working with its partners:
- Understands the methods for assessing the effectiveness of the ZEBRA investment in meeting its objectives.
  - Has planned data collection/reporting metrics, methods and frequencies relating to the proposed scheme.



- Has established and well-resourced processes in place to record, analyse and report appropriately on a continuous basis on the outputs and outcomes of the ZEBRA investment.
- Is committed to working alongside the Department to leverage data and learnings from ZEB investment to assist decision making at a programme level.

# Appendix 1

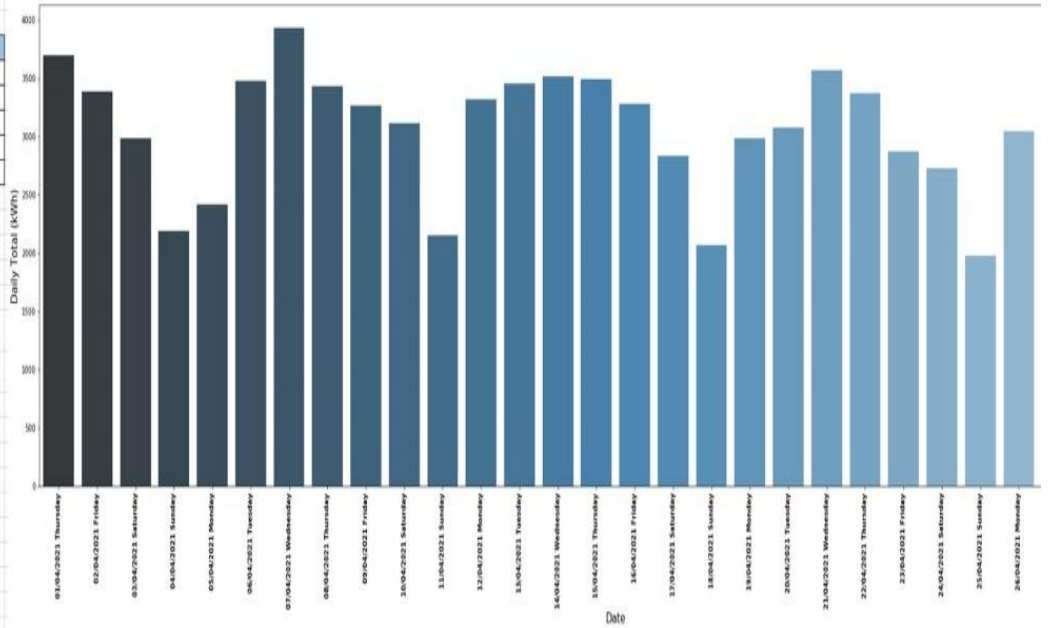
## Vehicle Diagnostics Report Examples - Zenobe.

	01/04/2021 Thursday	02/04/2021 Friday	03/04/2021 Saturday	04/04/2021 Sunday	05/04/2021 Monday	06/04/2021 Tuesday	07/04/2021 Wednesday	08/04/2021 Thursday	09/04/2021 Friday	10/04/2021 Saturday	11/04/2021 Sunday	12/04/2021 Monday	13/04/2021 Tuesday	14/04/2021 Wednesday	15/04/2021 Thursday	16/04/2021 Friday	17/04/2021 Saturday	18/04/2021 Sunday	19/04/2021 Monday
Depot Load	1751	1561	1335	1389	1525	1931	1833	1868	1518	1181	1353	1832	1812	1847	1809	1547	1235	1321	
Charger Load	1947	1826	1646	790	889	1344	2099	1564	1347	1932	796	1481	1638	1668	1679	1733	1597	750	
Total Load	3698	3387	2981	2188	2414	3474	3932	3432	3265	3113	2149	3314	3450	3514	3488	3280	2832	2071	
Day	2578	2549	2040	1214	1191	2405	2067	2608	2105	1892	1226	2418	2573	2587	2505	2502	2152	1063	
Night	1120	838	941	973	1223	1070	1265	824	1100	1221	923	895	877	928	922	778	680	1007	

	Demand (kWh)	(%)
Depot Energy	47736	52
Chargers Energy	44818	48
Total Energy	92553	100
Total Day	63926	69
Total Night	28606	31

Note - Calculations based on estimates, invoice may differ

Metric	Value
Total km	37259
Average kWh/km (As measured from grid consumption)	1.203



Date	1	2	3	4	5	6	7	8	9
01/04/2021	166.81	57.04	169.18	217.01	151.75	188.14	104.12	178.2	119.42
02/04/2021	125.02		173	3.37	104.22	219.9	180.13	125.04	133.76
03/04/2021	152.89		170.55	122.06	170.74	163.54	134.31	96.76	156.72
04/04/2021	195.51				202.8				
05/04/2021	225.68		174.22		261.89	21.4			22.08
06/04/2021	34.1	241.56	182.38	158.91	200.88	189.1	202.26	14.77	173.73
07/04/2021	275.37	43.19	189.31	220.1	131.67	170.89	177.23	6.46	167.59
08/04/2021	151.51	144.31	42.6	164.7	196.1	141.19	127.13	3.05	173.07
09/04/2021	174.18	135.37	143.28	20.27	141.99	218.04	154.39	84.4	151.08
10/04/2021	153.45	111.8	116.59	147.7	38.44	190.1	217.73	209.94	
11/04/2021				7.03		238.77	239.89	19.5	
12/04/2021	148.02	176.6	130.14	164.71	223.1	44.1	147.28	151.89	58.7
13/04/2021	109.78	134.95	201.36	179.86	144.62	112.91	39.82	154.62	138.62
14/04/2021	98.43	196.67	156.81	150.01	113.93	222.95	107.38	27.83	165.09
15/04/2021	104.8	137.09	156.52	172.86	167.75	155.66	216.64	133.19	21.79
16/04/2021	169.15	124.63	121.06	150.16	141.91	146.64	57.46	146.76	135.83
17/04/2021	146.05	108.83	99.25	140.22	128.94	163.46		167.49	
18/04/2021	10.11	127.61	5.5		210.99	216.35		17.81	
19/04/2021	150.25	233.46	164.9	142.29	140.1	155.05	33.27	137.36	108.61
20/04/2021	82.37	125.33	138.68	120.95	129.3	132.93	120.63	167.23	201.88
21/04/2021	157.76	139.44	152.15	222.5	113.45	170.63	193.07	169.54	143.06
22/04/2021	176.62	9.73	36.67	142.81	114.99	217.54	143.6	144.59	135.39
23/04/2021	136.26	110.99	3.23	8.65	33.85	134.48	125.17	183.72	149.95
24/04/2021	91.5	138.84	150.48	93.84	82.59	100.76	131.52	127.29	137.23
25/04/2021	12.02	193.07				16.7		154.85	112.1

▶ Summary **Daily Energy** Daily Distance Daily Eff Daily Regen Rate Daily SOC Usage Summary Dis ... ⊕ ⋮ ◀

### Overall Summary

Metric	Value
Total km	37259
Average kWh/km	0.88
Average Regen Rate	-0.49
Average SOC Usage	36.00

### Summary by Daily Distance

Daily Distance Range	Total km	Avg kWh/km	Avg Regen Rate kWh/km	Avg SOC Usage
(-0.001, 50.0]	501	1	0	4
(50.0, 100.0]	405.00	0.89	-0.47	26.20
(100.0, 150.0]	4291.00	0.86	-0.51	33.69
(150.0, 200.0]	21366.00	0.88	-0.52	45.70
(200.0, 250.0]	8047.00	0.86	-0.51	56.77

Analysis on how metrics vary depending on how far a vehicle has driven in a day

### Summary by Date

Metric	Date	Value
Highest Tot km	21/04/2021	1601
Lowest Tot km	04/04/2021	499.00
Best Avg kWh/km	25/04/2021	0.69
Worst Avg kWh/km	07/04/2021	1.06
Best Avg Regen Rate	27/04/2021	0.55
Worst Avg Regen Rate	05/04/2021	0.37
Highest Avg SOC Usage	07/04/2021	48.89
Lowest Avg SOC Usage	04/04/2021	13.78

Metrics measured as the total or average for all vehicles on each day

## Appendix 2

### **ZEBRA Stakeholder consultation**

#### **Leicester Electric Bus Bid**

Leicester City Council, Arriva and First Bus are together applying for government funding towards the purchase of upto 96 fully electric buses. If successful this will represent an overall investment of around £39m, with nearly £17m from Government grant.

<https://www.gov.uk/government/publications/apply-for-zero-emission-bus-funding>

These buses will be introduced on many bus corridors in Leicester within the next 3 years – all of which are designated air quality management zones. (For commercial reasons, full details of these routes cannot currently be disclosed.)

The bidding process is competitive and Leicester has been shortlisted along with five other areas following its successful outline bid submission.

The City Council now has to complete a full business case for submission by 20 August 2021. Part of this includes early consultation with different users that will be impacted by this proposed investment.

The buses will be a range of single and double decker buses similar in overall design and capacity to those already in operation within Leicester. However, they will have many additional features, like the 'Greenlines' buses recently introduced on Leicester's Park and Ride services:

1. A significant reduction in green house gas emissions, removing over 3,640 tonnes of Carbon Dioxide from the local atmosphere each year and over 1,180 kg of Nitrogen Oxide – equivalent to removing around 800 cars from our congested roads each year.
2. Quiet electric motor, powered by a set of on-board batteries, with energy efficient regenerative braking.
3. Overnight charging at each depot, with no in-service charging delays – the overnight charge will last for a full day of operation.
4. Power will be purchased from certified renewable 'green' energy tariffs. There is also potential to use solar power energy through panels installed at each bus depot in the future.
5. Enhanced accessibility features such as
  - additional room for a second wheelchair or two unfolded buggies
  - dedicated seats with leg room for an assistance dog
  - on-board screens showing next bus arrival information
  - on-board public address systems alerting passengers of oncoming stop and other route/timetable information
  - acoustic bus alert system for pedestrians when travelling at low speeds in areas of high pedestrian usage.

6. Digital contactless fare capping through tap in/ tap out, smart readers – giving the best daily or weekly fare for the trips undertaken, across any operator.
7. Distinctive eye-catching livery – both inside and out. Full high-profile marketing plan associated with the launch of each new electric service.
8. A range of other route features including
  - Additional bus priority measures – enforced bus lanes, rationalised parking etc
  - Traffic light signal priority for late running buses
  - Real time information displays at all boarding stops
  - New bus shelters

**We very much welcome your views on this exciting proposal !**

<b><u>Leicester Electric Bus Funding Bid</u></b>	<b>Jul-21</b>		
<b>Please complete in yellow boxes</b>			
<b>Do you agree with the Council making this bid?</b>	Support	No view	Don't Support
<b>Do you agree with the proposed investment in the following additional features:</b>	Support	No view	Don't Support
Additional room for a second wheelchair or two unfolded buggies			
Dedicated seats with leg room for an assistance dog			
On-board screens showing next bus arrival information			
On-board public address systems alerting passengers of oncoming stop and other route/timetable information			
Acoustic bus alert system for pedestrians when travelling at low speeds in areas of high pedestrian usage.			
Digital fare capping - to give best value day or weekly fare for trips made during that period			
Powered by certified renewable electric			
New livery and associated promotion			
<b>Do you agree with the proposed accompanying investment for these proposed electric buses:</b>	Support	No view	Don't Support
Additional bus priority measures – enforced bus lanes, rationalised parking etc			
Traffic light signal priority for late running buses			
Real time information displays at all boarding stops			
New bus shelters			
<b>Do you agree to future bids for further investment in electric buses</b>	Support	No view	Don't Support
<b>Please give any other comments related to this proposal</b>			

## Stakeholder Consultation

### Leicester Electric Bus Bid Survey – Summary Results

#### Overview

1. There were 313 responses from the First Bus Leicester electronic version of the survey – sent to their active customer database. Responses were strongly in support of the proposals and are summarized below. Questions were not set to mandatory to allow customers to comment on areas they had something to contribute.
2. It should be noted this is a sample of engaged bus users, so likely to be supportive of bus improvements and may not be representative of the broader community.

#### Response summary

3. Do you agree with the council making this bid?

**91%** rated between "4-5" for this question

Score distribution



4. In terms of the potential features on board the proposed electric buses, ratings were given between 1 (lowest) and 5 (highest) and scored as follows:

Additional room for a second wheelchair or two unfolded buggies **4.65**

Dedicated seats with leg room for an assistance dog **4.53**

On-board screens showing next bus arrival information **4.74**



On-board public address systems alerting passengers of oncoming stop and other route/timetable information **4.64**

Acoustic bus alert system for pedestrians when travelling at low speeds in areas of high pedestrian usage. **4.4**

5. In terms of complementary work to enhance these proposed electric bus routes, ratings were given between 1 (lowest) and 5 (highest) as follows:
  - Digital fare capping - to give best value day or weekly fare for trips made during that period **4.71**
  - All electric power drawn from renewable source **4.71**
  - A new identity/look and promotion of bus travel **4.47**
  - Additional bus priority measures such as enforced bus lanes, changes to parking schemes etc **4.30**
  - Traffic light signal priority for late running buses **4.41**
  - Real time information displays at all boarding stops **4.82**
  - New bus shelters **4.46**
6. Verbatim comments were broadly supportive of the bid but reflect customer requirements that on time, with a friendly driver and at a reasonable price continue to be key priorities for bus users and these developments should have a positive impact on core service delivery.
7. 90% of respondents also supported further bids.
8. EI&A information (note: some customers may fall into more than one category)

● Being an older person	90
● Having a disability that can m...	34
● A single parent with one or m...	28
● Having a low income, with lim...	102
● Being from a Black, Asian or ...	75

