Derby-Nottingham Future Mobility Zone Scheme Evaluation Plan

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1. Introduction

1.1 Derby-Nottingham Future Mobility Zone scheme

The Derby-Nottingham Future Mobility Zone scheme (referred to as the FMZ scheme in this document) builds on the Transforming Cities Fund schemes, knitting them together to pilot the delivery of innovative approaches to enhancing mobility. This builds on the councils' strong reputation as national leaders for integrated transport planning and delivery, and their position at the forefront of electric mobility. The Future Mobility Zone (FMZ) covers the Derby and Nottingham urban areas and associated travel to work areas.

Two FMZ projects (1: Open access Mobility as a Service (MaaS) platform and 2: Data sharing platform) stand to benefit the whole 1,600 km2 area. They will augment and enhance existing mobility services that cover the Amber Valley, Ashfield, Broxtowe, Derby, Erewash, Gedling, Nottingham, Rushcliffe, and South Derbyshire local authority areas. These interventions seek to integrate information and payment options to support the uptake of new and existing mobility services. Uniquely, Derby and Nottingham City Councils will act as coordinators, building atop existing multi-operator fare products and fulfilling a trusted data owner role. The MaaS platform's phased implementation will enable people to learn more about current mobility habits and spending, thus increasing awareness and knowledge of MaaS benefits, whilst enabling a growing partnership of mobility service providers to develop tailored account based payment and subscription offers that meet individuals' needs. The aim is to encourage more widespread uptake of public transport, bike hire, car club, electric vehicle (EV) charging and other services.

Project 3 will develop and pilot dedicated e-mobility hubs that exploit the area's rapid rollout of electric vehicle (EV) charging and Ultra Low Emission Vehicle (ULEV) support services – building on the Go Ultra Low City investments that come to fruition in spring 2020. Physical hubs will be trialled across local Enterprise Zones and employment growth sites, university campuses, in residential communities, and at council vehicle depots supported by the learning from the Local Sustainable Transport Fund (LSTF) and Access Fund programmes on successful behaviour change. As with Projects A and B, the aim will be to develop a set of blueprints from which the successful elements can be replicated elsewhere and act as exportable demonstrators.

1.2 Derby-Nottingham Future Mobility Zone scheme objectives

The FMZ scheme objectives are:

1. Provide a "customer first" experience using new technological solutions to facilitate seamless travel.
2. Improve equality of access to transport for lower income and key target groups.
3. Deliver a clean, green transport network to support air quality and carbon neutral objectives.
4. Support the local economy and business by reducing congestion and improving accessibility leading to increased productivity and lower production costs.
5. Facilitate innovation and investment in new mobility marketplaces, in particular support local industry and academia through new skills and employment opportunities.

The FMZ scheme objectives are related to both FMZ fund programme objectives as well as local LTP objectives. How each project facilitates the Programme and local LTP objectives is discussed comprehensively in the strategic case. However, it is useful to understand how achieving the FMZ Scheme objectives will contribute to the FMZ Programme objectives and relevant local LTP objectives. For clarity, in the subsequent discussion of this issue, the

programme objectives have been suffixed with a P, FMZ scheme objectives with an O and the LTP objectives with an L.

P1 - Trial new mobility services to combine new and traditional modes - the FMZ scheme objectives O1 and O5 correlate with this programme objective. O1 will require innovation in the field of automated data collection and processing and the development of the MaaS in order for the objective to be fully achieved. O5 identifies this innovation as an objective in its own right

P2 -Improve integration of services – This programme objective will be facilitated by achieving the FMZ scheme objective O1 through the provision of MaaS

P3 - Increase the availability of real time data – As noted in the Strategic Case, the Data Platform Meets this objective, it is also implicit in achieving the FMZ scheme objective O4 as this increased availability of data facilitates the congestion constraint measures and provides opportunities for business and academia.

P4 - Provide access to digital planning and payment options - This programme objective is directly aligned with the FMZ scheme objective O1 through the provision of the MaaS project.

P5 - Providing mobility credits or other low-cost option - This programme objective is directly aligned with the FMZ scheme objective O2 through the provision of Mobility Credits for low income and other target groups via the MaaS project.

P6 - Trial new mobility services to combine new and traditional modes – FMZ scheme objectives O5 and O1 align to this Programme objective through the provision of MaaS as a new mobility service and the E mobility Hubs which provide innovative solutions in combining new and traditional modes as well as trialling new ones such as the Autonomous shuttle buses on the E Campuses.

The following discusses how the LTP objectives will be facilitated by the FMZ scheme objectives being met.

L1 - Deliver world class infrastructure and connectivity – The FMZ scheme will contribute to this broad objective by achieving O1, O2 and O3 by providing better access to the transport system, especially for low income groups and increasing the use of non car and electric travel options.

L2 - Make transport more accessible through electronic information – This is directly aligned with the FMZ scheme objective O1 which aims to increase access to transport via the MaaS and the enhanced Nottingham City Council transport website providing better visibility of options and more convenient ways of paying and accessing these.

L3 - Improve efficiency of the network - FMZ scheme objective O4 will contribute to this by reducing/constraining congestion while the innovative solutions required to meet O5 will also increase efficiency.

L4 – Encourage sustainable alternatives - The FMZ scheme will contribute to this broad objective by achieving O1, O2 and O3 by promoting mode switch away from private ICE powered cars to electric vehicles, public transport and active travel modes

L5 - Improve air quality and minimise transport's contribution to climate change – This is directly related to FMZ scheme objective O3.

2. Evaluation Background

2.1 Evaluation purpose

Process and impact evaluation will be a cornerstone to the FMZ scheme, as the way in which the programme fits together and is evaluated will determine the learning, legacy and real world large-scale replicability of the FMZ scheme.

2.2 Derby-Nottingham Future Mobility Zone scheme – Key research questions

The following are the overarching scheme level research questions that this evaluation will address:

- **Can public policy led MaaS achieve greater uptake of greener transport services?** – as outlined in the strategic case the MaaS developed as part of the FMZ scheme will be publicly led, unlike other applications of MaaS, in the West Midlands for example. As this is a unique feature of the package it will require a thorough evaluation.

- **How does the future mobility package make electric mobility more accessible? –** a key theme of the FMZ scheme is to electrify the transport system.

- **How do different parts of a multi-centred region respond to different Future Mobility Zone interventions? –** the FMZ area covers two medium sized cities with different transport provision and differing economies and also multiple subsidiary centres of economic activity. This provides an important opportunity to learn how FMZ interventions act differently in different settings. Understanding this will increase the transferability of the approach.

- **How effective is new technology in delivering the benefits of the Future Mobility Zone scheme? –** testing new transport technologies is inherent in the FMZ fund's objectives and for the FMZ scheme specifically.

- **How effective is the Future Mobility Zone scheme approach in constraining congestion? –** as a key cost to the economies in urban areas across the world it is important to understand how a FMZ can contribute to mitigating this problem.

- **How effective is the Future Mobility Zone approach in enhancing the local economy? – s**upporting economic growth is a key objective for both Derby and Nottingham City Councils, the FMZ fund and the FMZ scheme.

These questions have been developed to cover the main topics addressed by the FMZ scheme with respect to the FMZ objectives and the objectives of the Future Mobility Zones Fund.

A suite of scheme level research questions will support these package level questions and have been developed as part of the logic mapping and Theory of Change evaluation approach described in Section 4. These are discussed in the Evaluation Summary Panels in Section 4.9.1 and in Tables 4.7 to 4.9 also in Section 4.9.2.

2.3 Monitoring and evaluation resources and expertise

Nottingham City Council has a proven in-house monitoring and evaluation capability which will deliver the evaluation for this scheme. The Highways Metrics Team is led by Peter Warren a technical expert in monitoring and evaluation with over 40 years' experience in the

field. The evaluation of this scheme will be designed and managed by Dr Simon Dale who works within the Highway Metrics team. As well as extensive industry experience in monitoring and evaluation (over 20 years), Dr Dale has an Engineering Doctorate (equivalent of a PhD) in the field of impact evaluations for major transport interventions and has published several peer reviewed journal papers in that field and is a Visiting Research Fellow at Loughborough University. He has been responsible for numerous evaluation projects including major evaluations for the Workplace Parking Levy[1] and the Nottingham Ring Road Improvement (NRIS) and The Nottingham Go Ultra Low Package which utilises a Realistic Evaluation approach. The evaluation approaches were tailored for the individual schemes

The WPL evaluation was based around a hybrid Theory of Change/Realistic Evaluation[2] 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[3]. The NRIS evaluation conformed to the DfT's Standard Monitoring as mandated for schemes of this value while the ongoing evaluation of the Go Ultra Low Package is based on Realistic Evaluation.

Thus, the Highway Metrics team has a proven track record in delivering complex evaluations using a variety of different approaches.

Loughborough University (LU) has indicated (via a letter of support) that it will act as academic partners in the evaluation of the Derby-Nottingham Future Mobility Zone scheme including providing a PhD student to carry out a relevant PhD project which will contribute to this evaluation. This builds on the previous successful partnership in similar evaluations. Dr Matthew Frost will lead the project for LU. Dr Frost has published numerous academic papers in the field of evaluating transport interventions.[1]

3. Process Evaluation

3.1 Introduction

Process evaluations examine how a scheme is delivered in practice and they are particularly valuable when delivered alongside impact evaluations. They monitor whether the scheme remains on track to deliver the anticipated outputs and initial outcomes. Process evaluations

[1] Dale,S.J. 2017. *Evaluating The Impacts On Traffic Congestion And Business Investment Following The Introduction Of A Workplace Parking Levy And Associated Transport Improvements*. EngD Thesis, Loughborough University https://dspace.lboro.ac.uk/dspace-jspui/bitstream/2134/26052/1/Thesis-2017-Dale.pdf

[2] Dale, S. J., Frost M.W., Ison S. G. and Warren, P., 2015. Evaluating Transport Demand Management Interventions using Theoretical Evaluation. *Transportation Research Board 94th Annual Meeting Compendium of Papers 2015 DVD.* Washington: Transport Research Board.

[3] Department for Transport (DfT), 2012. *Monitoring and Evaluation Framework for Local Authority Major Schemes*. London: Department for Transport.

also explore in depth what lessons have been learnt and why the scheme is on track or not. This evidence can be used to feed into project management and assurance activities.

3.2 Process evaluation approach

For the Derby-Nottingham Future Mobility Zone scheme a robust process evaluation will be particularly important due to the previously untested nature of the interventions with regards to their deliverability, especially the technological aspects of these.

Data will be collected and analysed during the implementation stages to offer real-time feedback which can contribute to continuous improvement in delivery. This fits particularly well with the staged provision of MaaS. It will also gather evidence which contributes to the analysis and interpretation of the impact and economic evaluations.

The process evaluation will use a range of qualitative and quantitative research methods, drawing on data on performance and financial management, and feedback from the project management team, delivery team and wider stakeholders.

Table 3.1 below illustrates the evidence that will be collected for process evaluation of the FMZ scheme. This helps to set out the distinction between the sets of activities, but also highlights how they can complement each other.

Table 3.1 Outline of the Future Mobility Zone process evaluation

Types of process information	Data Collection Tasks
Was the scheme implemented as planned?	
Scheme planning	Check point assessment that the scheme plan is on track. This will identify any issues or delays as part of the management process. Retrospective assessment of scheme delivery against originally planned timeframes. To analyse why delays / changes to the plan were encountered, whether they were, or could have been, foreseen / mitigated, the knock-on effects to the overall delivery of the scheme and cost, and the lessons to be learnt for future delivery.
Delivery context	Explore whether factors external to the scheme have impacted on implementation and, if so, in what way?
Costs	Ongoing financial monitoring and contingency planning. Report on staff costs/expertise and specific tools required to deliver the scheme Report on outturn investment costs, the use of contingency budgets, any cost savings or overruns, outturn operating, maintenance or other capital costs.
What has worked more or less well?	
Stakeholder management	Ongoing review of the stakeholder management plan Reporting what stakeholder management approaches were actually adopted and identifying lessons learnt from these approaches. Collect evidence directly from the stakeholders about their experiences.
Risk management	Review of effectiveness of risk management processes including an assessment of which risks were realised and with what impact and what factors were critical to successful risk management, how challenges were overcome and the implications of any unforeseen risks.

Mitigation measures	Description of how proposed mitigation measures have changed during / following implementation and the reasons for the changes. Explore how effective mitigation measures were built into the scheme and whether these delivered the intended effects and whether any unintended issues arose which required additional mitigation.
Is the package delivering the expected outputs and outcomes?	
Scheme outputs	Asses to what extent outputs comply with agreed quality criteria and have been delivered within a defined quality assurance process. Describe actual scheme outputs and identify any changes to these since funding approval and any changes to ongoing operational assumptions (e.g. fare levels and provision of services). Assessing whether the outputs have been delivered to the required quality standard.
Benefits	An assessment of which of the desired outcomes have been realised during implementation and whether the scheme is on track to deliver all anticipated benefits. An assessment of whether the scheme has reached the intended beneficiaries. Explore the experience of service users, wider members of the target population and delivery partners during implementation.

Source: Best Practice Guidance for planning the Fuller Evaluations of Local Authority Major Schemes DfT 2013

3.3 Research questions

A series of research questions have been developed to assist in the process evaluation for the FMZ scheme. These are as follows:

1 How was the scheme delivered*?* – An account of the methods used to deliver the scheme are important in transferability especially when combined with the following question
2 What lessons need to be learnt to improve future delivery of similar FMZ schemes? – what worked well and what didn't.
3 What are the technical barriers to delivering real time transport data across a diverse multi-centred city region? - this question tests the assumption that this is possible/practical. The diverse nature of the Derby-Nottingham FMZ scheme provides a test bed that should cover most scenarios where the approach is likely to be applied in the future in other locations.
4 What were the experiences of FMZ service users, delivery partners, service providers, local businesses, and other stakeholders? - addressed through stakeholder surveys, but also need feedback from delivery partners and service providers.
5 How complete are current data collection processes? Are the proposed schemes likely to need tailored data collection? – addressed through specific survey design, e.g. stakeholder surveys, supplemented by existing monitoring data in the FMZ.
6 Which aspects of the delivery process are innovative or untested – The process evaluation will need to highlight these aspects of the FMZ delivery process and how successful they were.

4. Impact Evaluation

4.1 Impact evaluation approach

A Theoretical approach is proposed for the Derby-Nottingham Future Mobility Zone scheme impact evaluation based on a hybrid Theory of Change (ToC) evaluation approach which also contains aspects of Realistic Evaluation. This approach will fully document the mechanisms which acted to achieve the desired outcomes and impacts and how the effectiveness of these were influenced by national and local context. This approach was previously successfully applied to the evaluation of the Nottingham Workplace Parking Levy Package as described and referenced in Section 2.3 of this document.

The Future Mobility Zone scheme is similar to the WPL in being highly innovative and untested prior to its implementation in Derby - Nottingham. Such interventions are highly suited to Theoretical Evaluation approaches. The approach taken builds on the traditional application of the ToC approach and enhances it by inserting individual mechanisms of change into ToC logic maps at key points to explain why particular linkages occur. A ToC will show each step on the causal pathway from scheme implementation to eventual desired impacts, these mechanisms explain how progress from one step to the next is to be achieved.

This stage in the evaluation is crucial in terms of the provision of an exportable template for the interventions trialled by the FMZ, because it provides a detailed explanation of change. The ToC will then be tested by a range of relevant indicators and refined as necessary producing a fully tested exportable template for applying such an intervention elsewhere. Contextual differences could make exporting the approach more or less effective than that demonstrated in Nottingham and Derby 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 zones.

4.2 Achieving attribution

An evaluation requires an assessment of to what extent the change observed in the indicators can be attributed to the intervention which is being evaluated.

The change observed in the indicators will, therefore, be subject to further research to take into account exogenous changes which could impact the ability of the scheme to meet its objectives and thus to determine if the observed changes can truly be attributed to the scheme. While this will need to be considered more carefully in conjunction with our academic partners and as part of the post submission co-development with the DfT Evaluation Centre of Excellence, it is expected that the following methods will be employed to achieve attribution:

1. A quasi experimental approach whereby indicators in the area subject to the scheme are compared to those from other similar urban areas. For example, this would be appropriate for indicators such as the take up of EVs in the Travel to Work areas of Derby and Nottingham benchmarked against other urban areas.
2. An experimental approach whereby the impact of the FMZ scheme measures on a randomly assigned group are compared to the outcomes for a similar randomly assigned control group. This approach could be suitable for testing the impact of mobility credits on low income groups.

3. Time series analysis – subject to data ability it could 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.
4. Direct interview surveys of stakeholders where they are asked if they have changed their travel behaviour over the evaluation period and why. These surveys are detailed in Section 4.5. They will form an integral part of this evaluation, but will be augmented by indicators.
5. A comparison of actual change with change expected according to the logic map.

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 scheme has met its objectives.

4.3 Process used to identify the Theory of Change for the Future Mobility Zone

The FMZ scheme ToC has been developed by consulting with key internal and external stakeholders to arrive at a consensus as to how the FMZ will achieve its stated objectives. Initially, the ToC, including the logic maps and supporting tables, was drafted by the council evaluators and then subsequently refined by other key internal stakeholders. The ToC has subsequently been shared with the DfT Centre of Excellence for Evaluation and NCC's academic partners in this evaluation at Loughborough University who have both now input into the ToC. The ToC has also been circulated to the Connected Places Catapult and the British Standards Institute who will comment in due course, but possibly not prior to the final submission of the bid.

The FMZ ToC has been strengthened by individual mechanisms of change inserted into the ToC logic maps at key points to explain why particular linkages occur. Tables 4.2 to 4.4 identify these mechanisms for change while Table 4.1 itemises the exogenous contextual factors which could impact on the efficiency of the mechanisms. Tables 4.2 to 4.4 then identify which contexts may impact on which mechanisms.

Figures 4.1 to 4.3 present the FMZ ToC logic maps. The maps are chronological in nature and identify the stages and linkages flowing from the initial context to the inputs, outputs, outcomes and eventual longer term impacts. They also show which outcomes and impacts contribute towards the FMZ scheme objectives. The key outcomes for achieving these objectives are highlighted.

The mechanisms for change from Tables 4.2 to 4.4 are integrated into the FMZ scheme ToC logic maps. The mechanisms that have been identified try to balance the need for them to be defined and discrete with recognition, that if they were broken down into the smallest units, there could be double or triple the number. Thus, individual mechanisms occur at more than one place within the map.

The exogenous contextual factors which may change over the evaluation period and could impact on the efficiency of the mechanisms, are not specifically included in the logic maps, but are represented in Table 4.1 and discussed in the 'Evaluation Summary Panels' for the individual FMZ projects later in this section (pages 11 to 13).

It is also important to note that the above is an initial approach and that, upon scheme approval, the logic maps will be reviewed, redeveloped and optimised, and the data collection methodologies validated, if necessary, to give the appraisal key focus.

Figure 4.1 Derby-Nottingham Future Mobility Zone scheme: Logic Map for Mobility as a Service (MaaS) Application

Context

The Midlands Engine identifies Derby-Nottingham as a priority area with the potential to drive forward the Midlands' economy. It attracts global businesses, with significant out-of-town employment growth hubs emerging between the cities, driving plans to build ~50,000 new homes.

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The workday population is 1.4 million[1], the fifth largest outside London. The conurbation's 425,000 daily commutes are forecast to increase by 11% to 2033, with 55% of trips being into/out of Derby and Nottingham, generating significant congestion. This is estimated to cost the East Midlands £825 million p.a., with over half falling to business. Both cities have areas exceeding European air quality limits for Nitrogen Dioxide (NO_2).

The unemployment rate is 2.1% but there are pockets where this is significantly higher, up to 5.7%. Many Nottingham residents do not own or have access to a car (0.76 cars per person). Derby has higher ownership (1.06 cars per person)

Nottingham already has a comprehensive and well integrated public transport system. It has three tram lines, a publically owned bus company and an integrated ticketing system, the Robin Hood Card, covering bus, tram and rail. This is underpinned by the UKs only Workplace Parking Levy (WPL) which acts as a transport demand management measure.

There is a need to maximise benefit from existing transport interventions by integrating them into a larger pan conurbation framework. These complimentary schemes are:

Go Ultra Low (brief explanation of what this is)

Behavioural Change Programme to promote cycling and walking.

Nottingham Cycle City Ambition Programme (NCCAP)

WPL Package , including public transport improvements

Further integration of transport services across the wider travel to work areas will make it easier for people to be mobile, participate in society and access employment and services

Inputs

Develop MaaS across the Future Mobility Zone

Develop MaaS platform through competitive procurement.

Staff project management resources.

Monitoring and evaluation costs including staff time and equipment.

Knowledge sharing activities and events

Communications resources

Commitment from transport operators

FMZ Scheme objectives

O1 - Provide a "customer first" experience using new technological solutions to facilitate seamless travel

O2 – Improving equality of access to transport for lower income and key target groups.

O3 – Deliver a clean, green transport network to support air quality and carbon neutral objectives.

O4 - Support the local economy and business by reducing congestion and improving accessibility leading to increased productivity and lower production costs.

O5 - Facilitate innovation and investment in new mobility marketplaces, in particular support local industry and academia through new skills and employment opportunities

Outputs

MaaS -Stage 1 - Free app to record and link user spend on transport – links to the user's bank account. User's spend on all travel would be grouped and itemised

Data from MaaS generated for **Future Mobility Zone Data Platform**

MaaS Stage 2 – App is enhanced using the data provided from Stage 1 to include in-app payments, incentives, discounts and mobility credits for lower income households. This includes pre trip cost estimates

Contactless Payment Capability developed as part of Stage 2

MaaS Stage 3 – Further development of the app to provide refined payment options with pre paid packages based on the user's previous travel patterns

Mobility Credits: provide credits for low income groups that can be redeemed through the MaaS app, developed in parallel with Stage 2

Evaluation of the Nottingham FMZ

Short and Medium Term Outcomes

Travelling public are better informed of the relative costs of their transport choices – **O1**

Travelling public are better informed of transport options which are tailored to individuals – **O1**

Electric travel options – E-bike hire and availability of car charging, are more visible – **O1**

Planning and paying for travel options journey becomes simpler and more convenient – **O1,O5**

Decrease in cost of journeys utilising public transport. "Best fare guarantee" – **O1, O2, O5**

Agglomeration of research, skills and development for MaaS occurs within the FMZ, **O5**

Easier to travel around the Future Mobility Zone **– O1**

Increase in the number and trips using non car based modes made- **O2, O3**

WPL

~~Key~~ outcome: Mode switch away from the car to public transport – reduced car dependency **O3, O4**

Increase in the use of electric vehicles and bikes **- O3**

NCCAP

Increased use of active modes as a component of a journey

Improved equality of access to transport for lower income/target groups **O2**

Reduced transport costs to business– **O4**

Improved access to labour and employment **– O4**

Key outcome: Congestion constraint – **O4**

Go Ultra Low

Key outcome: Decrease in levels of CO_2 and NO_2 and particulates **O3**

Cleaner air **O3**

Improved access to employment **O2**

Key outcome: Reduced unemployment , especially in deprived areas **O2**

Knowledge and experience from the scheme is disseminated as an exportable template for good practice

Longer Term Impacts

Key impact: Contributes to economic growth **– O4**

Key impact: Supports local industry **– O4**

Key impact: Improves productivity– **O4**

Key impact: Contributes to making Nottingham a better place to live and work **O2. O3**

Key impact: Improved public health

Key impact: Improved social inclusion and reduction in inequality **– O2, O4**

Other local authorities take up similar options, contributing to national transport, emissions and environmental objectives

Key:

= Environmental/health outcome or impact

= Key transport demand management outcome or impact

= Economic outcome or impact

= Socio-economic outcome or impact

= Current NCC scheme which also contributes to FMZ outcomes/impacts

= Key outcome

= Key impact

= Initial outcome

= Outcome or impact related to evaluation activities

M11 = Mechanism that facilitates change

O1 – O5 = Identifies FMZ objectives to which outcome/impact contributes

External factors: National and local economic conditions, cost of running a car, public transport costs, national and local trends in congestion, demographic factors, technological changes

Core assumptions: Probability of population growth, desirability of economic growth, no additional road capacity for private traffic, current levels of transport funding, moving towards carbon neutrality

Figure 4.2 Derby-Nottingham Future Mobility Zone scheme: Logic Map Nottingham and Derby E-mobility Hubs

Context

The Midlands Engine identifies Derby-Nottingham as a priority area with the potential to drive forward the Midlands' economy. It attracts global businesses, with significant out-of-town employment growth hubs emerging between the cities, driving plans to build ~50,000 new homes.

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The workday population is 1.4 million[1], the fifth largest outside London. The conurbation's 425,000 daily commutes are forecast to increase by 11% to 2033, with 55% of trips being into/out of Derby and Nottingham, generating significant congestion. This is estimated to cost the East Midlands £825 million p.a., with over half falling to business. Both cities have areas exceeding European air quality limits for Nitrogen Dioxide (NO2).

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Nottingham already has a comprehensive and well integrated public transport system. It has three tram lines, a publically owned bus company and an integrated ticketing system, the Robin Hood Card, covering bus, tram and rail. This is underpinned by the UKs only Workplace Parking Levy (WPL) which acts as a transport demand management measure.

There is a need to maximise benefit from existing transport interventions by integrating them into a larger pan conurbation framework. These complimentary schemes are:

Go Ultra Low (brief explanation of what this is)

Behavioural Change Programme to promote cycling and walking.

Nottingham Cycle City Ambition Programme (NCCAP)

WPL Package , including public transport improvements

Further integration of transport services across the wider travel to work areas will make it easier for people to be mobile, participate in society and access employment and services

Inputs

Develop E-Mobility Hubs

Competitive procurement process for infrastructure and services

Input from the University of Nottingham to develop concepts and assist in evaluation

Input from private sector partners,

Staff time to run events

Project management resources.

Monitoring costs including staff time and equipment.

FMZ scheme objectives

O1 - Provide a "customer first" experience using new technological solutions to facilitate seamless travel

O2 – Improving equality of access to transport for lower income and key target groups.

O3 – Deliver a clean, green transport network to support air quality and carbon neutral objectives.

O4 - Support the local economy and business by reducing congestion and improving accessibility leading to increased productivity and lower production costs.

O5 - Facilitate innovation and investment in new mobility marketplaces, in particular support local industry and academia through new skills and employment opportunities

Outputs

Neighbourhood of the Future in Trent Basin and existing Derby residential area

Secure cycle parking
e-bike & e-cargo bike hire.
Electric vehicle (EV) and e-bike charging facilities.
Car club EV hire.

Smart bus stops featuring real time displays, wifi hotspots

Mobility credit packages for the elderly and vulnerable

Campuses of the Future – East Midlands Gateway, University campuses and business parks

Autonomous shuttle buses

EV and e-bike charging facilities

Smart bus stops featuring real time displays, wifi hotspots

Personalised travel planning events and mobility experiences

Depots of the Future – Eastcroft Depot in Nottingham

EV Service and Repair Centre Specialist electrical vehicles

Development of telematics to research EV performance

Shared fleet recharging network with other public sector partners

Apprenticeships, Graduate placements

Evaluation of the Nottingham FMZ

Short and Medium Term Outcomes

E1 Residents and employees have better awareness or electric mobility options – **O1, O3**

E2 EVs are now more accessible for residents and employees – **O1,O3**

Go Ultra Low Programme

E3 EVs and ebikes are now easier/ more practical to use **– O1, O3**

MaaS

E4 E-bikes are now more accessible for residents and employees **O1, O3**

E6 Autonomous shuttle buses increase mobility around smart campuses **O1**

E7 Residents and employees have better awareness and access to active travel options – **O1**

MaaS

E8 Residents and employees of hub areas have better access to public transport – **O1**

E5 Agglomeration of research and development for electric mobility centred around depots and campuses**, O5**

E9 E9 E10 E10 E11 E11 E12 E12 E16 E14 E17

Increase in the use of electric cars and vans – **O3**

Increase in the use of e-bikes – **O3**

NCCAP

Key Outcome: Reduced car dependency - Mode switch away from the car to public transport and active modes. – **O2, O3, O4**

Improved equality of access to transport for lower income/target groups **O2**

E20 E15 E13 E18 E19 E21 E21

Key outcome: Decrease in levels of CO2 and NO2 and particulates **O3**

Key Outcome: Easier to travel in FMZ **O1**

Key outcome: Congestion constraint **O4**

WPL

E22 E32 E29 E29 E25 E31 E33

Cleaner air **O3**

Reduced transport costs to business - **O4**

Improved access to labour **O4**

Reduced unemployment especially in deprived areas **O2**

Improved access to employment **O2**

E26 E25 E23 E24

Longer Term Impacts

Key impact: Improved public health

Key impact: Contributes to making Nottingham a better place to live and work

Key impact: Supports local industry **O4**

Key impact: Improves productivity **O4**

E30 E27 E28 E28 E28

Key impact: Contributes to economic growth **O4, O5**

Key impact: Improved social inclusion and reduction in inequality **O2**

Knowledge and experience from the Nottingham scheme is disseminated as an exportable template for good practice

Other local authorities take up similar options contributing to national transport, emissions and environmental objectives

Key:

= Environmental/health outcome or impact

= Key transport demand management outcome or impact

= Economic outcome or impact

= Socio-economic outcome or impact

= Current NCC scheme which also contributes to FMZ outcomes/impacts

= Key outcome

= Key impact

= Initial outcome

= Outcome or impact related to evaluation activities

E11 = Mechanism that facilitates change

O1 – O5 = Identifies FMZ objectives to which outcome/impact contributes

External factors: National and local economic conditions, cost of running a car, public transport costs, national and local trends in congestion, demographic factors, technological changes

Core assumptions: Probability of population growth in Nottingham, desirability of economic growth, no additional road capacity for private traffic, current levels of transport funding, moving towards carbon neutrality

Figure 4.3 Derby-Nottingham Future Mobility Zone Scheme: Logic Map for The Data Platform Application

Context

The Midlands Engine identifies Derby-Nottingham as a priority area with the potential to drive forward the Midlands' economy. It attracts global businesses, with significant out-of-town employment growth hubs emerging between the cities, driving plans to build ~50,000 new homes.

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The workday population is 1.4 million[1], the fifth largest outside London. The conurbation's 425,000 daily commutes are forecast to increase by 11% to 2033, with 55% of trips being into/out of Derby and Nottingham, generating significant congestion. This is estimated to cost the East Midlands £825 million p.a., with over half falling to business. Both cities have areas exceeding European air quality limits for Nitrogen Dioxide (NO_2).

The unemployment rate is 2.1% but there are pockets where this is significantly higher, up to 5.7%. Many Nottingham residents do not own or have access to a car (0.76 cars per person). Derby has higher ownership (1.06 cars per person)

Nottingham already has a comprehensive and well integrated public transport system. It has three tram lines, a publically owned bus company and an integrated ticketing system, the Robin Hood Card, covering bus, tram and rail. This is underpinned by the UKs only Workplace Parking Levy (WPL) which acts as a transport demand management measure.

There is a need to maximise benefit from existing transport interventions by integrating them into a larger pan conurbation framework. These complimentary schemes are:

Go Ultra Low (brief explanation of what this is)

Behavioural Change Programme to promote cycling and walking.

Nottingham Cycle City Ambition Programme (NCCAP)

WPL Package , including public transport improvements

Further integration of transport services across the wider travel to work areas will make it easier for people to be mobile, participate in society and access employment and services

Inputs

Develop a Data Platform

Appoint external provider to develop the data hub, and website.

Appoint Vivacity Labs Ltd to develop ANPR and traffic flowsensor scheme

Capital to buy Vivacity sensors

Buy in floating data from HERE/Google

Staff project management resources.

Monitoring costs including staff time and equipment.

FMZ scheme objectives

O1 - Provide a "customer first" experience using new technological solutions to facilitate seamless travel

O2 – Improving equality of access to transport for lower income and key target groups.

O3 – Deliver a clean, green transport network to support air quality and carbon neutral objectives.

O4 - Support the local economy and business by reducing congestion and improving accessibility leading to increased productivity and lower production costs.

O5 - Facilitate innovation and investment in new mobility marketplaces, in particular support local industry and academia through new skills and employment opportunities

Outputs

Existing real time data sources

Data generated from Mobility as a

Google/HERE journey time data

Vivacity ANPR and traffic flow Sensors

Open Access API

Data Hub – Platform which stores and analyses real time transport data

Average journey time – cars

Average journey time – bus

Average journey time – tram

Average journey time – train

Traffic flow

Public transport departures and arrivals

Other data

Public facing website displaying real time transport data, particularly comparative travel times and costs between modes

'Smart Junction' Treatment for the key sections of the network

Short and Medium Term Outcomes

Commercial opportunities for business **O5**

Research opportunities for academia **O5**

Key outcome: Real time data required for function of MaaS (see MaaS logic map) - **O1**

Better informed appraisal, evaluation and formulation of local transport policies, and interventions.

Travelling public are better informed of transport options and become aware of the comparative cost and travel times

Electric travel options – E-bike hire and availability of car charging points are more visible.

Decrease in average journey times on the network

Key Outcome: Easier to travel around the Future Mobility Zone **O1**

More effective transport interventions **O2**

Key outcome: Reduced car dependency - Mode switch away from the car to public transport and active modes. – **O2,O3,O4**

Increased use of active modes

Increase in the use of electric vehicles and bikes

Key Outcome: Improved equality of access to transport for lower income/target groups **O2**

Key outcome: Congestion constraint **O4**

Key Outcome: Decrease in levels of CO_2 and NO_2 and particulates **O3**

Reduced transport costs to business **O4**

Improved access to labour **O4**

Cleaner air **O3**

Go Ultra Low Programme

Reduced unemployment especially in deprived areas **O2, O3**

Longer Term Impacts

Key impact: Contributes to economic growth **O4**

Key impact: Support local industry **O4**

Key impact: Improved productivity **O4**

Key impact: Contributes to making Nottm a better place to live and work

Key Impact: Improved public health

Key impact: Improved social inclusion and reduction in inequality – **O2**

Evaluation of the Nottingham FMZ

Knowledge and experience from the scheme is disseminated as an exportable template for good practice

Other local authorities take up similar options contributing to national transport, emissions and environmental objectives

Key:

- = Environmental/health outcome or impact
- = Key transport demand management outcome or impact
- = Economic outcome or impact
- = Socio-economic outcome or impact
- = Current NCC scheme which also contributes to FMZ outcomes/impacts
- = Key outcome
- = Key impact
- = Outcome or impact related to evaluation activities
- D11 = Mechanism that facilitates change
- = Initial outcome
- **O1 – O5** = Identifies FMZ objectives to which outcome/impact contributes

External factors: National and local economic conditions, cost of running a car, public transport costs, national and local trends in congestion, demographic factors, technological changes

Core assumptions: Compliments and enables MaaS, probability of population growth in Nottingham, desirability of economic growth, no additional road capacity for private traffic, current levels of transport funding, moving towards carbon neutrality

Table 4.1 Exogenous contextual factors that may impact the Derby-Nottingham Future Mobility Zone Theory of Change

Ref	Context	Evidence base to support context
C1	Socio-economic characteristics	The workday population of the FMZ area is 1.4 million, the fifth largest outside London. The conurbation's 425,000 daily commutes are forecast to increase by 11% to 2033, with 55% of trips being into/out of Derby and Nottingham. The overall unemployment rate is 2.1% but ranges from 5.7% to 0.2%.Pockets of Derby and Nottingham have above average levels of unemployment. Many Nottingham residents do not own or have access to a car (0.76 cars per person), and although Derby has higher ownership (1.06 cars per person) there is lower public transport use. The population demographics are also varied with a significant young student population contrasted with an aging population. Derby and Nottingham have developed economies worth over £30bn per annum, that are complementary rather than operating in competition. They have distinct high value sectors; Derby is a UK centre of excellence for transport equipment manufacturing accounting for 30% of its GVA, and Nottingham increasingly grows jobs in niche sectors such as life sciences, digital and FinTech. There are a range of business and professional services, with many in both cities. Lower productivity sectors (e.g. retail, health and care, visitor) provide significant local employment, and jobs growth is forecast over the next decade.
C2	Relevant local transport policies	The local transport policy background features extensive measures to encourage mode switch away from the car and the take up of more sustainable travel options. These initiatives include the Go Ultra Low (GUL) programme, the UK's first ULEV lane, the Workplace Parking Levy (WPL) package and the Nottingham Cycle City Ambition Programme (NCCAP). Clearly, the success of these initiatives will impact on the effectiveness of the FMZ. The FMZ evaluation will need to refer to evaluation work being carried out for these initiatives and refer to them for context.
C3	Population growth and demographic change	This will partly determine trends in the demand for travel as well as mode choice and health issues. It will also impact on the response to technological solutions to journey planning such as Mobility as a Service (MaaS).
C4	National & local economic conditions	Economic growth is linked to an increase in demand for transport and this will, therefore, impact on congestion and air quality in Nottingham.
C5	Local trends in the cost of public transport	Clearly the trend upon which the planned discounts and mobility credits are super imposed will be important context with respect to the demand for travel by public transport.

Ref	Context	Evidence base to support context
C6	Cost of travel by car	This influences the attractiveness of car use compared with other modes. This includes fixed costs such as the cost of buying a car, the cost of insurance and tax, as well as non-fixed costs such as fuel prices.
C7	Local congestion issues	Nottingham City Council estimates, based on an independent study by WS Atkins, that congestion in the AM peak period costs the City's economy £160m pa (NCC 2011).This will manifest itself as a cost to business in lost time, increased transport costs, difficulties in access for the workforce and difficulty in accessing suppliers/customers.
C8	Local arrangements for the provision of public transport	This will influence the ability to negotiate with the bus, tram and train companies for discounts etc. Nottingham City Council owns the largest local bus company, Nottingham City Transport, and enjoys a good working relationship with other public transport operators.
C9	National trends in congestion levels	Since 2011, DfT measures of congestion have seen a steady rise and this has impacted the ability of transport demand management interventions to realise a reduction in congestion.
C9a	National air quality trends	It is assumed that air quality will gradually improve due to the fleet becoming 'cleaner' and this context will need to be taken into account within the evaluation.
C9b	National/regional health trends	These local trends will need to be used to benchmark changes to health indicators.
C10	Suppressed demand for travel by private car	This is released by road space becoming free due to a reduction in congestion or, alternatively, by an increase in household disposable income.
C11	National trends in the take up of EVs	Government policy and technological advances increasingly make EVs a practical option for motorists, leading to an increase of these vehicles in the national fleet.

Ref	Context	Evidence base to support context
C12	Technological progress towards addressing the cost and practicality of EVs	As research and development accelerates in the field of EVs, it is likely that the range and charging time for EVs will improve removing some of the barriers to use.
C13	Cost of EVs and e bikes	This is a straightforward pricing mechanism that will determine demand. It could impact directly by influencing the decision to buy, but also indirectly by determining the viable hire cost.

Table 4.2 Derby-Nottingham Future Mobility Zone - MaaS mechanisms for change

Ref	Mechanism for change: Mobility as a Service	Evidence to assess if mechanism is active	Relevant Contextual Factors
M1	**Improved visibility of transport costs –** transport users can see, via the app, their expenditure on each mode	User surveys asking about experience of the app will be carried out. Number of MaaS users.	None
M2	**Improved visibility of transport options –** transport users can see, via the app and website, transport options open to them, including less traditional options such as e bikes, car share and charging options for electric and plug in electric hybrid vehicles.	User surveys asking about their experience of the app/website will be carried out. Number of MaaS users.	None
M3	**Nottingham & Derby City Council provide discounts and incentives via the app** - leads to an overall reduction in the cost of using non-car based modes.	User surveys asking about experience of the app will be carried out. Before and after pricing data for journeys on the app will be compiled including data on mobility credits. Survey of recipients and non-recipients of mobility credits in low income/target groups	C5, C8
M4	**Journeys become easier to plan and pay for –** this is especially true for journeys which use multiple modes.	User surveys asking about experience of the app will be carried out.	None
M5	**Pricing mechanism** – a reduction in the cost of travel by non-car based modes delivered via the app via primarily M2, but also by M1 and M3, leads to an increase in the demand for travel by non-car based modes. This effect is likely to be felt disproportionately in lower income areas with lower car ownership.	User surveys asking about experience of the app will be carried out. Before and after pricing data for journeys on the app will be compiled including data on mobility credits. Before and after counts of pedestrians, cyclists and public transport users in key areas. Survey of recipients and non-recipients of mobility credits in low income/target groups.	C4, C5, C6
M6	**Convenience mechanism –** as the app will make it easier to plan and execute a trip this leads to different travel decisions with public transport only and, particularly multimodal trips, becoming more attractive.	User surveys asking about user experience of the app will be carried out, with additional questions regarding changes to travel behaviour and the causes of this.	C2, C3, C4, C5, C6, C7

Ref	Mechanism for change: Mobility as a Service	Evidence to assess if mechanism is active	Relevant Contextual Factors
		Pricing data from the MaaS app.	
M7	**Active travel incorporated within multimodal journeys -** app reveals convenience/cost advantages of multimodal options utilising a component of active travel.	Trip data from the app including mode, predicted journey times and cost. Before and after cycle and pedestrian counts from around the FMZ User surveys asking about user experience of the app will be carried out, with additional questions regarding changes to travel behaviour and the causes of this.	C4, C5, C6
M8	**Cost and convenience of active travel modes becomes more visible -** app is likely to show time advantages and will always demonstrate cost effectiveness of these modes	Trip data from the app including mode, predicted journey times and cost. Before and after cycle and pedestrian counts from around the FMZ User surveys asking about user experience of the app will be carried out, with additional questions regarding changes to travel behaviour and the causes of this.	C4, C5, C6
M9	**Cleaner vehicles in service for public transport and taxis** – Nottingham has extensively electrified these modes, thus trips utilising them are effectively reducing pollution over and above using a private car.	Modelled NO2, PM 2.5 and CO2 savings from observed/estimated mode switch to electric vehicles.	C8, C9a
M10	**Reduction in demand for travel by car -** constrains traffic growth and congestion	Delay per vehicle mile and journey time reliability calculated from GPS data. Modal share of travel across cordons in Derby and Nottingham Traffic flow data. Estimate number of car trips saved due to observed attributed mode switch.	C9, C10
M11	**Improved air quality** - a reduction in nitrogen dioxide (NO2) and particulate matter, reduces the impacts of transport on people's health, leading to a lower incidence of episodes of poor health, especially respiratory and cardiovascular conditions.	Number of health episodes linked to poor air quality. NCC sickness records Modell NO2, PM 2.5 and CO2 savings from	C9a, C9b

Ref	Mechanism for change: Mobility as a Service	Evidence to assess if mechanism is active	Relevant Contextual Factors
		observed/estimated mode switch to electric vehicles, etc	
M12	**Increased physical activity due to active travel –** provides health benefits which tackle obesity, heart disease, diabetes and also provide mental health benefits	Data from the app regarding the volume of active travel Before and after cycle and pedestrian counts from around the FMZ User surveys asking about user experience of the app/website will be carried out, with additional questions regarding changes to travel behaviour and the causes of this. Sickness records from partner employers	None
M13	**An improvement in public health leads to a reduction in the number of days taken off sick within the workforce -** leads to an increase in productivity, a significant advantage of a low emissions economy. Health impacts upon people of working age have economic effects, for instance if they have to take days off work. It is estimated that in 2012, poor air quality had a total cost of up to £2.7 billion through its impact on productivity.	Number of health episodes linked to poor air quality. Sickness records from partner employers	C9b
M14	**More efficient/greater use of non-car based modes by the workforce -** makes new employment opportunities viable due to greater accessibility.	User surveys asking about user experience of the app/website will be carried out, with additional questions regarding changes to travel behaviour and the causes of this. Modal share of travel across cordons in Derby and Nottingham	C4
M15	**Greater mobility connects people to jobs.**	User surveys asking about user experience of the app/website will be carried out, with additional questions regarding changes to travel behaviour and the causes of this. Survey of recipients and non-recipients of mobility credits in low income/target groups	C4

Ref	Mechanism for change: Mobility as a Service	Evidence to assess if mechanism is active	Relevant Contextual Factors
M16	**Higher levels of employment -** stimulates economic growth due to an increase in household income	Employment and unemployment data GVA	C4
M17	**Labour force effects -** improved accessibility leads to an increase in the quantity and quality of labour and associated productivity improvements. This will also potentially lead to an increase in wage levels and disposable income as the existing labour pool seeks to use the new transport options to maximise their earnings and save on travel costs.	Survey of local businesses and their views on the supply of labour GVA Productivity measures	C4
M18	**General equilibrium effects -** increased productivity, time and cost savings associated with increased transport capacity with increased usage of PT and active modes and shorter journey times cause a general economic improvement as a new equilibrium of increased economic activity is achieved. This change may be initiated by M17.	Productivity measures GVA	C4
M19	**Mobility credits for low income households** - make transport cheaper for these groups	Surveys of mobility credit recipients asking their experience will be carried out, with additional questions regarding changes to travel behaviour and the causes of this.	C5
M20	**The percentage of vehicles in the overall fleet that are electrically powered** – this increases and reduces tail pipe emissions	DfT hold data sets that show the percentage of vehicles registered in the Nottingham and Derby Travel to work area that are EVs	C4, C11
M21	**Reduction in journey time and increased reliability -** reduces costs of transport from suppliers and to customers and lowers business costs	Delay per vehicle mile and journey time reliability calculated from GPS data and real time feeds Business survey	C9
M22	**Improved access to a larger pool of labour -** makes Nottingham a more attractive place to do business	Survey of businesses	C4
M23	**Agglomeration of MaaS technology companies, skills and relevant research activities within the FMZ leads to an increase in economic activity and jobs**	Survey of businesses Number of jobs created in the e-mobility hubs Inward investment case studies	C4
M24	**Reduction in journey time and increased reliability –** makes travel around the FMZ easier	Delay per vehicle mile and journey time reliability calculated from GPS data and real	C9

Ref	Mechanism for change: Mobility as a Service	Evidence to assess if mechanism is active	Relevant Contextual Factors
		time feeds	

Table 4.3 Derby-Nottingham Future Mobility Zone - Data platform mechanisms for change

Ref	Mechanism for change: Data Platform	Evidence available to assess if mechanism is active	Relevant Contextual Factors
D1	**Improved visibility of transport options –** transport users can see, via the website, transport options open to them, including less traditional options such as e bikes, car share and charging options for electric and plug in electric hybrid vehicles.	User surveys asking about their experience of the app/website will be carried out. Website usage measures	None
D2	**Richer, more complete and contemporaneous data -** enhances policy and commercial decision making.	Log of use of API, log of input into transport appraisals.	None
D3	**Information mechanism –** website makes it easier to plan and execute a trip and this leads to different travel decisions with public transport, active modes and multimodal trips becoming more attractive.	User surveys asking about user experience of the website will be carried out, with additional questions regarding changes to travel behaviour and the causes of this. Website usage measures	C2, C3, C4, C5, C6
D4	**Cost and convenience of active travel modes becomes more visible -** website highlights cost benefits and convenience of active travel modes.	Trip data from the app including mode, predicted journey times and cost. User surveys asking about user experience of the website will be carried out, with additional questions regarding changes to travel behaviour and the causes of this.	C4, C5, C6
D5	**Increase in % and number of cleaner vehicles in general traffic fleet** –thus trips effectively reducing pollution over and above using a private car.	Modelled NO2, PM 2.5 and CO2 savings from observed/estimated mode switch to electric vehicles.	C9a

Ref	Mechanism for change: Data Platform	Evidence available to assess if mechanism is active	Relevant Contextual Factors
D6	**Reduction in demand for travel by car -** constrains traffic growth and congestion	Delay per vehicle mile and journey time reliability calculated from GPS data. Traffic flow data. Estimate number of car trips saved due to observed attributed mode switch.	C9, C10
D7	**Improved air quality** - a reduction in nitrogen dioxide (NO2) and particulate matter, reduces the impacts of transport on people's health, leading to a lower incidence of episodes of poor health, especially respiratory and cardiovascular conditions.	Number of health episodes linked to poor air quality. NCC sickness records Modelled NO2, PM 2.5 and CO2 savings from observed/estimated mode switch to electric vehicles	C9a C9b
D8	**Increased physical activity due to active travel Increased physical activity due to active travel –** provides health benefits which tackle obesity, heart disease, diabetes and also provide mental health benefits	Data from the app regarding the volume of active travel User surveys asking about user experience of the app/website will be carried out, with additional questions regarding changes to travel behaviour and the causes of this. Sickness records from partner employers	None
D9	**An improvement in public health leads to a reduction in the number of days taken off sick within the workforce -** leads to an increase in productivity, a significant advantage of a low emissions economy. Health impacts upon people of working age have economic effects, for instance if they have to take days off work. It is estimated that in 2012, poor air quality had a total cost of up to £2.7 billion through its impact on productivity.	Number of health episodes linked to poor air quality. Sickness records from partner employers	C9b
D10	**Greater mobility connects people to jobs.**	User surveys asking about user experience of the app/website will be carried out, with additional questions regarding changes to travel behaviour and the causes of this.	C4
D11	**Higher levels of employment -** stimulates economic growth due to an increase in household income	Employment and unemployment data GVA	C4

Ref	Mechanism for change: Data Platform	Evidence available to assess if mechanism is active	Relevant Contextual Factors
D12	**Labour force effects -** improved accessibility leads to an increase in the quantity and quality of labour and associated productivity improvements. This will also potentially lead to an increase in wage levels and disposable income as the existing labour pool seeks to use the new transport options to maximise their earnings and save on travel costs.	Survey of local businesses and their views on the supply of labour GVA Productivity measures	C4
D13	**General equilibrium effects -** increased productivity, time and cost savings associated with increased PT capacity and shorter journey times cause a general economic improvement as a new equilibrium of increased economic activity is achieved. This change may be initiated by M16.	GVA Productivity measures	C4
D14	**Optimisation of traffic signal timings –** this results from additional data, machine learning and enhanced detection of traffic conditions around junctions.	Journey times and journey time reliability on the Ring Road across key junctions, measured using GPS data and real time data feeds. Reduced delays from bus priority AVL data.	C9
D15	**Decrease in journey times -** expands the radius within which employees can access jobs, thus increasing the choice of employment	Delay per vehicle mile and journey time reliability calculated from GPS data and real time feeds	C9
D16	**Increased activity in the commercial sector -** based on more information to formulate business proposals, e.g. traffic flow, leads to economic growth	GVA Survey of businesses who access the API	C4
D17	**Nottingham becomes a centre for transport research -** due to availability of data leading to economic growth	Business survey Record of research activity at the two universities and usage of API/website	C4
D18	**Reduction in journey time and increased reliability -** reduces costs of transport from suppliers and to customers and lowers business costs	Delay per vehicle mile and journey time reliability calculated from GPS data and real time feeds Business survey	C9
D19	**Improved access to a larger pool of labour -** makes Nottingham a more attractive place to do business	Survey of businesses	C4

Ref	Mechanism for change: Data Platform	Evidence available to assess if mechanism is active	Relevant Contextual Factors
D20	**Less queueing traffic and less traffic overall -** lowers emissions of NO2, carbon and PM2.5	NCC air quality monitoring network Modelling based on observed mode shift Delay per Vehicle Mile	C9a
D21	**Decrease in average journey time and increase in journey time reliability**	Delay per vehicle mile and journey time reliability calculated from GPS data and real time feeds	C9

Table 4.4 Derby-Nottingham Future Mobility Zone - E-mobility Hubs mechanisms for change

Ref	Mechanism for Change: E-mobility hubs	Evidence available to assess if mechanism is active	Relevant Contextual Factors
E1	**Residents and employees are exposed to a range of electric mobility options through proximity and promotional activities**	Survey of hub users Participant numbers	None
E2	**EV hire options made available through the car club**	Number of EVs made available to hire	C4, C5, C6, C11, C12
E3	**E bike and EV use made more practical by better charging facilities in hubs and fleet recharging shared network**	Maintenance cost savings Survey of EV and e bike users Participant numbers Location number and duration of charging events	C4, C5, C6, C13
E4	**E bike hire available in hubs**	Number of e bikes made available to hire	C4, C5, C6
E5	**EV Service and Repair Centre, specialist electrical vehicles and research and development in conjunction with the University of Nottingham into EV performance -** stimulates agglomeration of private sector industry in this field	Inward investment monitoring Log of academic activities related to the hub Number of jobs created in relevant sectors in or near hub Survey of businesses in the FMZ	C4
E6	**Autonomous shuttle buses made available for free on campuses of the future**	Shuttle bus operating details/timetables	None

Ref	Mechanism for Change: E-mobility hubs	Evidence available to assess if mechanism is active	Relevant Contextual Factors
E7	**Availability of e bikes and travel planning highlights the active travel options**	Survey of e bike users Survey of hub users, including questions asking if they have changed their travel behaviour and why. Number of e bike hires	None
E8	**Smart bus stops, and availability of personalised travel planning -** improves the public transport offer	Number of smart bus stops provided	None
E9	**Increase in awareness stimulates demand for e-mobility**	Survey of hub users, including questions asking if they have changed their travel behaviour and why. Number of e bike and EV hires	C4, C5, C6, C11, C12, C13
E10	**Increased supply and lower cost of e-mobility stimulates demand**	Number of EV hires Number of e bike hires Survey of hub users, including questions asking if they have changed their travel behaviour and why.	C4, C5, C6, C11, C12, C13
E11	**Availability of hire schemes and enhanced charging facilities -** makes e bikes and EVs more practical to use which stimulates demand	Number of EV hires Number of e bike hires Survey of hub users, including questions asking if they have changed their travel behaviour and why. Before and after cycle counts around the FMZ	C4, C5, C6, C11, C12, C13
E12	**Shuttle buses make it easier to travel within large sites** – this connects with the existing PT network, removing an incentive to travel by car and making PT more convenient	Survey of shuttle bus users, including questions asking if they have changed their travel behaviour and why Patronage on shuttle buses	C4, C5, C6,

Ref	Mechanism for Change: E-mobility hubs	Evidence available to assess if mechanism is active	Relevant Contextual Factors
E13	**E bikes make longer range cycle journeys a more viable option** - this prompts a mode switch to e bikes	Survey of e bike users, including questions asking if they have changed their travel behaviour and why Number of e-bike hires	C5, C6
E14	**Hub users have greater information and better interchange facilities for public transport options - leads to an increase in demand for travel by public transport**	PT Patronage Bespoke before and after modal share surveys around the e-mobility hubs Survey of hub users, including questions asking if they have changed their travel behaviour and why Number of e bike and EV hires	C4, C5, C6
E15	**A switch to e bikes from other ICE powered modes leads to a reduction in tail pipe emissions**	Survey of hub users Number of e bike hires Modelled emissions reductions based on survey of e bike users Before and after cycle counts at key locations around the FMZ	C9a
E16	**Information mechanism – hub users are made aware of travel options making it easier to plan and execute a trip and this leads to different travel decisions with public transport, active modes and multimodal trips becoming more attractive.**	Hub user surveys asking about user experience will be carried out, with additional questions regarding changes to travel behaviour and the causes of this.	C2, C3, C4, C5, C6
E17	**Increased access to more affordable transport options – Active modes and Pubic Transport are cheaper option than owning and running a car**	Survey of hub users Bespoke before and after modal share surveys around the e-mobility hubs	C5, C6
E18	**Cleaner vehicles in service for public transport and taxis** – Nottingham has extensively electrified these modes, thus trips utilising them are effectively reducing pollution over and above using a private car.	Modelled NO2, PM 2.5 and CO2 savings from observed/estimated mode switch to electric vehicles.	C9a

Ref	Mechanism for Change: E-mobility hubs	Evidence available to assess if mechanism is active	Relevant Contextual Factors
E19	**Reduction in demand for travel by car -** constrains traffic growth and congestion	Delay per vehicle mile calculated from GPS data. Traffic flow data. Estimate number of car trips saved due to observed attributed mode switch.	C10
E20	**The percentage of vehicles in the overall fleet that are electrically powered – this increases and reduces tail pipe emissions**	DfT hold data sets that show the percentage of vehicles registered in the Nottingham and Derby Travel to work area that are EVs	C4, C11
E21	**Decrease in journey times and increase in journey time reliability - expands the radius within which employees can access jobs, thus increasing the choice of employment**	Delay per vehicle mile and journey time reliability calculated from GPS data and real time feeds	C9
E22	**Increased physical activity due to active travel**	Data from the app regarding the volume of active travel User surveys asking about user experience of the app/website will be carried out, with additional questions regarding changes to travel behaviour and the causes of this. Number of e bike hires Before and after cycle and pedestrian counts around the FMZ	None
	An improvement in public health leads to a reduction in the number of days taken off sick within the workforce - leads to an increase in productivity, a significant advantage of a low emissions economy. Health impacts upon people of working age have economic effects, for instance if they have to take days off work. It is estimated that in 2012, poor air quality had a total cost of up to £2.7 billion through its impact on productivity.	Number of health episodes linked to poor air quality. NCC sickness records	C9b
E23	**More efficient/greater use of non car based modes by the workforce - makes new employment opportunities viable due to greater accessibility.**	User surveys asking about user experience of the app/website will be carried out, with additional questions regarding changes to travel behaviour and the causes of this.	C4

Ref	Mechanism for Change: E-mobility hubs	Evidence available to assess if mechanism is active	Relevant Contextual Factors
E24	**Agglomeration of electric mobility technology companies - this is a well-tested, classical economic mechanism, whereby firms operating within a sector of production cluster together to cut the costs of production by sharing suppliers and labour etc.**	Inward investment monitoring in and around depots and campuses of the future. Log of academic activities related to the hub Number of jobs created in relevant sectors in or near hub Survey of businesses in the FMZ	C4
E25	**Greater mobility connects people to jobs.**	User surveys asking about user experience of the app/website will be carried out, with additional questions regarding changes to travel behaviour and the causes of this.	C4
E26	**Higher levels of employment - stimulates economic growth due to an increase in household income**	Employment and unemployment data GVA Measure of productivity	C4
E27	**Labour force effects - improved accessibility leads to an increase in the quantity and quality of labour and associated productivity improvements. This will also potentially lead to an increase in wage levels and disposable income as the existing labour pool seeks to use the new transport options to maximise their earnings and save on travel costs.**	Survey of local businesses and their views on the supply of labour GVA Measure of productivity	C5, C6, C7
E28	**General equilibrium effects - increased productivity, time and cost savings associated with increased PT capacity and shorter journey times cause a general economic improvement as a new equilibrium of increased economic activity is achieved. This change may be initiated by M16.**	GVA Measure of productivity	C4
E29	**Reduction in journey time and increased reliability - reduces costs of transport from suppliers and to customers and lowers business costs**	Delay per vehicle mile and journey time reliability calculated from GPS data and real time feeds Business survey	C9
E30	**Improved access to a larger pool of labour - makes Nottingham a more attractive place to do business**	Survey of businesses	C4

Ref	Mechanism for Change: E-mobility hubs	Evidence available to assess if mechanism is active	Relevant Contextual Factors
E31	**Decrease in average journey time and increase in journey time reliability**	Delay per vehicle mile and journey time reliability calculated from GPS data and real time feeds	C9
E32	**Improved air quality - a reduction in nitrogen dioxide (NO2) and particulate matter, reduces the impacts of transport on people's health, leading to a lower incidence of episodes of poor health, especially respiratory and cardiovascular conditions.**	Number of health episodes linked to poor air quality. NCC sickness records Model NO2, PM 2.5 and CO2 savings from observed/estimated mode switch to electric vehicles, etc.	C9a
E33	**Less queuing traffic and less traffic overall - lowers emissions of NO2, carbon and PM2.5**	NCC air quality monitoring network Modelling based on observed mode shift	C9, C9a

4.4 Scheme indicators

In order to test the FMZ scheme ToC, a basket of indicators has been identified capable of tracking progress towards the outcomes and impacts identified within the logic maps, as well as the activation of the mechanisms which facilitate the causal pathway. Table 4.5 presents a monitoring framework by matching indicators to the FMZ scheme objectives to which they are relevant and also to the mechanisms for change which they are capable of testing.

Table 4.5 The Derby-Nottingham Future Mobility Zone scheme monitoring framework

FMZ scheme objective	Indic-ator ref.	Performance indicators relevant to objective	Source	Which mechanisms /contexts does the indicator test
Objective 1: Provide a "customer first" experience using new technological solutions to facilitate seamless travel	**I_1**	Stakeholder surveys: MaaS users	NCC Highway Metrics team	M1, M2, M4, M5, M6, M7, M8
	I_2	Stakeholder surveys: NCC Transport website users	NCC Highway Metrics team	D1,D3,D4
	I_3	Stakeholder surveys: E-mobility Hub users/residents including EV and e bike hirers	NCC Highway Metrics team	E1, E3, E7, E9, E10, E11
	I_4	Stakeholder surveys: Automated shuttlebus users on e campuses	NCC Highway Metrics team	E12
	I_9	Trip data from MaaS detailing journeys made/recommended/pricing	Appointed provider of MaaS service	M5, M6, M7, M8
	I_10	Participant numbers for hub based service, e.g. numbers of EV/e bike hires	Various: NCC, appointed service	E7, E9, E11, E14

FMZ scheme objective	Indic-ator ref.	Performance indicators relevant to objective	Source	Which mechanisms /contexts does the indicator test
			providers,	
	I_11	Details of shuttle bus provision	NCC Transport Strategy	E6
	I_12	Shuttle bus patronage	Appointed shuttlebus operator	E12
	I_13	MaaS usage measures	Appointed provider of MaaS service	M1, M2
	I_14	Website usage measures	NCC Transport Strategy	D1,D3
	I_15	Number of smart bus stops provided	NCC Transport Strategy	E8
	I_16	Number of e bikes available for hire in hubs	NCC Transport Strategy	E4
	I_17	Number of EVs available for hire in hubs	NCC Transport Strategy	E2
Objective 2 –	**I_5**	Stakeholder surveys: Groups	NCC Highway	M3,M5,M8,

FMZ scheme objective	Indic-ator ref.	Performance indicators relevant to objective	Source	Which mechanisms /contexts does the indicator test
Improving equality of access to transport for lower income and key target groups		receiving mobility credits	Metrics team	M15, M19,
	I_6	Stakeholder surveys: Sample of target groups not utilising mobility credits	NCC Highway Metrics team	M3,M5,M8, M15, M19,
	I_18	Data on use of mobility credits – trip details, spending patterns etc	Data from chosen service provider	M3,M5,M8, M15, M19,
	I_3	Stakeholder surveys: E-mobility hub users/residents including EV and e bike hirers	NCC Highway Metrics team	E17
	I_19	Pricing data from the MaaS app	Data from chosen service provider	M3, M4,M5, M8, M19
	I_20	Average journey time/delay per vehicle mile	Trafficmaster data from the DfT	E21, D15,D21
	I_21	Journey time reliability	Trafficmaster data from the DfT	E21, D15, D21
Objective 3: Deliver a clean, green transport network to support air quality and	**I_22**	Modelled changes in NO2, PM2.5 and CO2 emissions based on traffic flow, observed mode shift, fleet composition and observed emissions from real time AQ analysers	NCC Environmental Health team	M9,M11,E18, E15,E33,D5, D7,D20

FMZ scheme objective	Indic-ator ref.	Performance indicators relevant to objective	Source	Which mechanisms /contexts does the indicator test
carbon neutral objectives	**I_20**	Average journey time/delay per vehicle mile	TrafficMaster data from the DfT	M10,D14,E19
	I_21	Journey time reliability	TrafficMaster data from the DfT	M10,D14,E19
	I_23	Number and % of ULEVs registered in the Derby Nottingham Travel to Work area	NCC Transport Strategy/DfT stats	E20
	I_3	Stakeholder surveys: E-mobility hub users/residents including EV and e bike hirers	NCC Highway Metrics team	E11,E13,E14 , E1,E16,E17, E22
	I_24	Modal share of travel across cordons in Nottingham and Derby	NCC Highway Metrics team	M10, D6
	I_25	Bespoke before and after modal share surveys around the e-mobility hubs	NCC Highway Metrics team	E14, E17
	I_26	Number of EV hires	Data from chosen service provider	E10,E11
	I_42	Location and volume of charging events for EV's/PHEVs	BP Chargemaster	E20,E3

FMZ scheme objective	Indic-ator ref.	Performance indicators relevant to objective	Source	Which mechanisms /contexts does the indicator test
	I_29	Number of e bike hires	Data from chosen service provider	E10,E11, E15,E22
	I_28	Before and after traffic flows around the FMZ	NCC Highway Metrics team	M10,E19,D6
	I_27	Bespoke cycle and pedestrian counts around the FMZ	NCC Highway Metrics team	M7,M8,M12, E11, E15, E22
Objective 4: Support the local economy and business by reducing congestion and improving accessibility leading to increased productivity and lower production costs	**I_28**	Before and after traffic flows around the FMZ	NCC Highway Metrics team	M10,E19,D6
	I_1	Stakeholder surveys: MaaS	NCC Highway Metrics team	M5,M6,M14, M15
	I_2	Stakeholder surveys: NCC Transport website Users	NCC Highway Metrics team	D3,D4
	I_3	Stakeholder surveys: E-mobility hub users/residents including EV and e bike hirers	NCC Highway Metrics team	E14, E16,E17,E22 , E25
	I_4	Stakeholder surveys: Automated shuttlebus users on e campuses	NCC Highway Metrics team	E12
	I_34	Estimate of car trips saved based on observed mode switch	NCC Highway Metrics team	E19
	I_20	Average journey time/delay per vehicle mile	TrafficMaster data from the	D6,D14,D18, D20,D21,

FMZ scheme objective	Indic-ator ref.	Performance indicators relevant to objective	Source	Which mechanisms /contexts does the indicator test
			DfT	M10,M21, M24 E19, E21,E29,E31
	I_21	Journey time reliability	TrafficMaster data from the DfT	D6, M10, M21,M24,E2 1 E29,E31
	I_24	Modal share of travel across cordons in Nottingham and Derby	NCC Highway Metrics team	M10, M14
	I_25	Bespoke before and after modal share surveys around the e-mobility hubs	NCC Highway Metrics team	E14
	I_7	Stakeholder surveys: Businesses within the FMZ	NCC Highway Metrics team	M17,M21, M22,M23, D16,D17,D18 ,D19,E24,E2 7,E29, E30
	I_30	GVA by local authority area, sectoral analysis	ONS	M16, M17, M18, D11,D12,D13 , E26,E27,E28
	I_31	Productivity metrics by Local Authority area	ONS	M16, M17, M18, D11,D12,D13

FMZ scheme objective	Indic-ator ref.	Performance indicators relevant to objective	Source	Which mechanisms /contexts does the indicator test
				,D16, E26,E27,E28
	I_32	Health episodes related to poor air quality	Nottingham City Council annual air quality reports	D7,D9
	I_33	Sickness records from partner employers	Nottingham and Derby City Councils	M11,M12, M13,D7,D8, D9
	I_8	Employment and unemployment data	ONS	M16,D11,E26
	I_35	Shuttle bus operating details and timetable	Data from chosen service provider	E6
	I_36	PT patronage on key bus and tram services	NCC Public Transport team and bus operators	E14
Objective 5: Facilitate innovation and investment in new mobility marketplaces, in	**I_7**	Stakeholder surveys: Businesses within the FMZ	NCC Highway Metrics team	M23, E5, E24
	I_37	Number of jobs created in e-mobility hubs	Invest in Nottingham	M23
	I_38	Inward investment case studies in	Invest in	M23, E5, E24

FMZ scheme objective	Indic-ator ref.	Performance indicators relevant to objective	Source	Which mechanisms /contexts does the indicator test
particular support local industry and academia through new skills and employment opportunities		e-mobility sector	Nottingham	
	I_1	Stakeholder surveys: MaaS	NCC Highway Metrics team	M3, M4
	I_9	Trip data from MaaS detailing journeys made/recommended/cost, etc	Appointed provider of MaaS service	M3
	I_39	Log of academic activities in relation to the FMZ	University of Nottingham, Nottingham Trent University, Loughborough University. ATHENS, Google Scholar	E5, D17
	I_40	EV Service and Repair Centre usage	Data from chosen service provider	E5
	I_41	Log of use of API from data hub	Data from chosen service provider	D2, D16

Table 4.6 itemises these indicators, also showing the data source and providing a brief data collection methodology. For the indicators which are more complex, further methodological explanation is provided in the text following the table.

Table 4.6 Indicators for monitoring the Derby-Nottingham Future Mobility Zone scheme

Ref	Performance Indicators	Data source	Summary of data collection methodology
I_1	Stakeholder surveys: MaaS users	NCC Highway Metrics team	See Section 4.5
I_2	Stakeholder surveys: NCC Transport website users	NCC Highway Metrics team	See Section 4.5
I_3	Stakeholder surveys: E-mobility hub users/residents including EV and e bike hirers	NCC Highway Metrics team	See Section 4.5
I_4	Stakeholder surveys: Automated shuttlebus users on e campuses	NCC Highway Metrics team	See Section 4.5
I_5	Stakeholder surveys: Groups receiving mobility credits	NCC Highway Metrics team	See Section 4.5
I_6	Stakeholder surveys: Sample of target groups not utilising mobility credits	NCC Highway Metrics team	See Section 4.5
I_7	Stakeholder surveys: Businesses within the FMZ	NCC Highway Metrics team	See Section 4.5
I_8	Employment and unemployment data	Office for National Statistics	Monthly data published by Department of Work and Pensions
I_9	Trip data from MaaS detailing journeys made/recommended/pricing	Appointed provider of MaaS	Trip data collated from the app via the service provider
I_10	Participant numbers for hub based service, e.g. number of EV/e bike hires	Various: NCC and appointed service providers	Hire and usage data from service providers
I_11	Details of shuttle bus provision	Appointed shuttlebus operator	Fleet details from service provider
I_12	Shuttle bus patronage	Appointed shuttlebus operator	Passenger numbers from service provider
I_13	MaaS usage measures	Appointed provider of MaaS	Usage data from service provider
I_14	Website usage measures	NCC Transport Strategy	Usage data from councils

Ref	Performance Indicators	Data source	Summary of data collection methodology
I_15	Number of smart bus stops provided	NCC Transport Strategy	Council records
I_16	Number of e bikes available for hire in hubs	NCC Transport Strategy	Council records
I_17	Number of EVs available for hire in hubs	NCC Transport Strategy	Council records
I_18	Data on use of mobility credits – trip details, spending patterns, etc.	Appointed service provider	Mobility credit data from service provider
I_19	Pricing data from the MaaS app	Appointed service provider	Pricing data collated from the app via the service provider
I_20	Average journey time/delay per vehicle mile	Trafficmaster data from DfT	See Section 4.6
I_21	Journey time reliability	Trafficmaster data from DfT	See Section 4.7
I_22	Modelled changes in NO2, PM2.5 and CO2 emissions based on traffic flow, observed mode shift, fleet composition and observed emissions from real time AQ analysers	NCC Transport Strategy	See Section 4.8
I_23	Number and % of ULEVs registered in the Derby Nottingham travel to work area	Office for National Statistics	Quarterly data provided by DfT derived from published data
I_24	Modal share of travel across cordons in Derby and Nottingham	NCC Highway Metrics team	Annual manual count surveys of people movements across defined cordons in Derby and Nottingham by mode of travel
I_25	Bespoke before and after modal share surveys around the e-mobility hubs	NCC Highway Metrics team	Manual count surveys of people movements across defined cordons around hubs by mode of travel. Surveys of FMZ businesses employees.
I_26	Number of EV hires	Appointed service provider	Hire data from service provider
I_27	Before and after cycle and pedestrian counts around the FMZ	NCC Highway Metrics team	Manual and automatic counts of cyclists and pedestrians from council monitoring sites
I_28	Before and after traffic flows around the FMZ	NCC Highway Metrics team	Manual and automatic counts of traffic from council monitoring sites

Ref	Performance Indicators	Data source	Summary of data collection methodology
I_29	Number of e bike hires	Appointed service providers	Hire data from service provider
I_30	GVA by Local Authority area, sectoral analysis	Office for National Statistics	Annual data published by ONS
I_31	Productivity metrics by Local Authority area	Office for National Statistics	Annual data published by ONS, analysed by council Economic Research officer
I_32	Health episodes related to poor air quality	Public Health England	Health data from Public Health England
I_33	Sickness records from partner employers	Derby and Nottingham City Councils	Sickness records held by councils
I_34	Estimate of car trips saved based on observed mode switch	NCC Highway Metrics team	Analysis of mode share and stakeholder user surveys to calculate change
I_35	Shuttle bus operating details and timetable	Appointed shuttlebus operator	Timetable details from service provider
I_36	Public transport patronage on key bus and tram services	NCC Public Transport team and bus operators	Passenger data analysis using data from bus operators
I_37	Number of jobs created in e-mobility hubs	Invest in Nottingham	Survey of businesses in hubs
I_38	Inward investment case studies in e-mobility sector	Invest in Nottingham	Survey of business activity in e-mobility sector
I_39	Log of academic activities related to the FMZ	University of Nottingham, Nottingham Trent University, Loughborough University. ATHENS, Google Scholar	Academic records
I_40	EV Service and Repair Centre usage	Appointed service provider	Usage data from service provider

Ref	Performance Indicators	Data source	Summary of data collection methodology
I_41	Log of use of API from data hub	Appointed service provider	Usage data from service provider
I_42	Location and volume of charging events for EVs/PHEVs	BP Chargemaster	Inventory of charging locations and usage data from service provider

4.5 Stakeholder survey methodology

Surveys of stakeholders who are impacted by the FMZ scheme will be a critical component of the monitoring and evaluation programme. Essentially the approach is to assess changes in behaviour and causality in these groups with respect to the FMZ. The NCC Evaluation team, along with academic partners at Loughborough University and Nottingham Trent University, have developed significant expertise in delivering stakeholder surveys for transport interventions. These include the Workplace Parking Levy package, where a survey of 2500 commuters was carried out to ascertain if they had switched mode of travel to work following its implementation and, if so why, with respect to attribution of cause and effect to the intervention[1]. This approach was also applied to the Nottingham Ring Road Improvement Scheme (NRIS) evaluation. The year 1 evaluation report containing this research was recently supplied to the DfT and also included a survey of businesses to gauge accessibility improvements. The most recent application was in the evaluation of the Western Cycle Corridor, part of the Nottingham Cycle City Ambition Programme and in this case the research was carried out in partnership with the Nottingham Trent University Business School.

The key groups to be surveyed for the FMZ scheme are as follows and the basic survey approach is summarised for each.

1. **MaaS users**
    a. General users - users of MaaS will be asked to indicate if they are prepared to participate in this survey at the time they register. Those that say yes will be invited to participate in an online survey. In addition to this, it is intended to conduct a randomised control trial with employees within participating employers and target groups, whereby some are given MaaS to use at each stage of its development and they are compared to a control group of non-users. This could also be followed up by focus groups to assist with a more detailed understanding of mechanisms by which MaaS is meeting the stated objectives and outcomes.
    b. Lower income/target groups receiving mobility credits – this survey will be paired with the one below to apply an experimental approach. It is hoped that these groups can be selected at random, although this may result in some equity issues and prove unacceptable, in which case demographic differences between individuals taking up the mobility credits and those choosing not to, may need to be taken into account at the analysis stage.
    c. Lower income/target groups not receiving mobility credits.

2. **NCC Transport website users** – all users will be incentivised to take part in an online survey.

3. **E-mobility hub users**
    a. E bike users – these will be conducted at the point of hire/pick up.
    b. EV hirers – these will be conducted at the point of hire/pick up.
    c. Smart bus stop users - a before survey will be carried out in and around the hubs and those that engage will be asked if they are willing to take part in a follow up survey at a later date. The after survey will, therefore have a matched panel

[1] Budd, L., Dale, S., Frost, M. W. and Ison. S.G., 2019, The Impact of the Nottingham Workplace Parking Levy on Travel to Work Mode Share pending publication in Case Studies on Transport Policy, Available on request from Loughborough University or Nottingham City Council

sample and also a non-matched sample and the two different questionnaires will be designed to accommodate this and the results triangulated.

d. Cyclists – survey approach as for smart bus stop users.
e. Pedestrians - survey approach as for smart bus stop users.
f. Residents - survey approach as for smart bus stop users.

4. **Shuttle bus users on e campuses** – these will be conducted on board and at bus stops.

5. **FMZ businesses**
    a. Businesses located in or near the e-mobility hubs – a before survey will be carried out regarding accessibility and then an after survey will be conducted to assess if attitudes have a changed as a result of the FMZ schemes.
    b. Businesses engaged in the delivery or development of the FMZ schemes – this will be an after survey of businesses that have been involved in the delivery of the FMZ schemes to assess attitudes.
    c. Sample of other city businesses – this will be a before and after survey focused on accessibility for the businesses' needs and if the FMZ has improved these. It is recognised that achieving this evaluation aim will be challenging, however, it is worth attempting as, if successful, it would be powerful evidence for future applications of the FMZ concept.

Essentially the approach is to assess changes in behaviour and causality in the above groups with respect to the FMZ. To provide a further methodological statement the surveys aimed at individual service users are discussed in the Section 4.5.1 below, while the surveys of the businesses are discussed separately Section 4.5.2.

4.5.1 Methodology for surveying attitudes and behaviour of individual groups of transport users

The detailed design of the above suite of surveys will be carried out post submission of the final bid with our academic partners at Loughborough University. However, it is possible to describe the broad approach and examples of how the approach has been successfully applied in previous similar evaluations.

The surveys that look for behavioural change will be a mixture of interviews and self-completion questionnaires (either completed online or returned by post). The questions will differ depending on the mode surveyed and/or the specific stakeholder group. A mix of structured interview and self-completion survey methods of data collection is unavoidable given the nature of the recipients groups and the physical constraints of the survey, so it will be necessary to consider issues such as response bias where self-completion is adopted and that there may be other forms of bias which could occur because people might answer questions differently in a structured interview compared with a self-completed questionnaire. These issues will need to be addressed at the analysis stage.

The questionnaires will be screened to try to minimise bias due to the wording of individual questions and question sequence effects, both problems commonly associated with their design. A key design consideration will be to formulate the question which asks why respondents have changed their behaviour, especially with regard to mode switch.

The surveys which look for this behaviour change in users of the services provided by the FMZ schemes will have two principle elements to be considered in the design of the key questions:

The Dimension: – a set or 'battery' of attitudes chosen to represent issues prompting behaviour change. Some of the statements will be specific to the FMZ intervention, while

others will be related to other possible reasons for the change in behaviour, thus the statements provide the opportunity for respondents to state the relative importance of factors in their decision. The non FMZ statements will be devised by cross referencing established dimensions from other NCC travel surveys, together with consulting with our academic partners.

The Scale – the scale chosen will be based on other similar successful travel surveys carried out by the councils and will be based on a 5 point scale indicating increasing importance, with a sixth option to indicate not applicable or not important. This form of scale could equally be described as a sematic differential or a form of Likert scale, but either way it has proven a successful approach in evaluations of the Nottingham Workplace Parking Levy package and the Nottingham Cycle City Ambition Programme.

Thus, adopting this methodology, the line of questioning that could be employed to research decisions to change behaviour could be as follows:

Have you changed your usual main mode of travel since [relevant date, month year}? If you have changed more than once tell us about the most recent.

What was your previous usual main mode of travel?

Thinking about why you made the decision to [change of travel behaviour] please indicate how important each of the following reasons were in making that decision by rating its level of importance. Please indicate if the reason is not applicable (NA) to you.

	Very Important	***Important***	***Moderately Important***	***Slightly Important***	***Not Important***	***NA/ Don't Know***
Statement 1						
Statement 2						
Statement 3						
Statement (n)						
Other – please specify						

This approach is primarily aimed at asking individuals how they have responded post scheme implementation. However, it is hoped, where possible, to carry out a pre implementation survey within some groups where practical as previously indicated. This will have two advantages, firstly it will establish a base line of travel behaviour and secondly it will hopefully be possible to identify individuals who will be willing to follow up in the more detailed after survey and also who may be willing to participate in focus groups to further drill down into causality.

4.5.2 The business surveys

The general approach will be to interview representatives from businesses using a semi structured approach. This was successful in a recent evaluation of the Nottingham Ring Road Improvement Scheme in order to assess accessibility improvements by various modes. In this case the FMZ surveys will also ask about jobs created and future recruitment plans in relation

to accessibility and other business factors. As discussed above, there are three different groups of businesses relevant to the FMZ; those located in or near the e-mobility hubs, those engaged in delivering the FMZ projects and the general business population of the FMZ. The structure of the survey will need to be different for each group as they will be subject to differing benefits from the FMZ scheme.

While the FMZ partners and city business surveys will be conducted post scheme implementation, as was the case with the above mentioned survey for the NRIS evaluation, the survey of businesses located in or near the hubs will also benefit from a pre-scheme implementation base line travel survey.

The intention is to design the stakeholder surveys in detail in conjunction with our academic partners post bid submission. At that point it will be determined if further consultancy support is required.

4.6 Average journey time per vehicle mile and delay per vehicle mile

Journey time per vehicle mile (JTVM) will be calculated using average journey time data generated from the Trafficmaster (TM) satellite navigation system, fitted in many fleet and private vehicles in the UK and provided to the councils by the DfT. This data source is also used by the DfT to generate national journey time statistics in preference to other similar data sources. It is envisaged that this metric will cover the AM and PM peak periods and a representative inter-peak period

Delay per vehicle mile will be generated from JTVM by subtracting night time reference journey times from those of the day time periods.

4.7 Journey time reliability

The Coefficient of Variation[1] (CoV) is used in this evaluation as a measure of journey time reliability. Such variation could come from recurring congestion at the same time each day, day-to-day variability (DTDV), or from non-recurring events, such as incidents[2]. It is defined as the ratio of the standard deviation of journey time to the average journey time. Normally one would use the variation of individual journey times within 10 minute time slots; however, this information is not available from the Trafficmaster data. A key assumption is that each observation of average journey time for each link in any given 10 minute time period is independent of the adjacent links. Whilst this assumption is questionable, twinned observations are not possible within the Trafficmaster data in the form that it is supplied to local authorities, i.e. individual journeys cannot be identified, and, therefore, it is not possible to calculate co-variance. Despite this deficiency, it is considered that the indicator will be sufficiently robust to demonstrate before and after changes to journey time reliability.

4.8 Modelling changes in NO2, PM2.5 and CO2 emissions based on traffic flow, observed mode shift, fleet composition and observed emissions from real time Air Quality analysers

This approach will be developed in partnership with Nottingham University and will use Vivacity traffic count sensors in locations adjacent to real time air quality analysers to

[1] TAG Unit A1.3 User and Provider Impacts
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/313222/webtag-tag-unit-a1-3-user-and-provider-impacts.pdf

[2] Department for Transport (DfT), 2009a, *The Reliability Sub-Objective TAG Unit 3.5.7,* Transport Analysis Guidance (TAG), Department for Transport, [Online], London: Department for Transport, Available at http://www.dft.gov.uk/webtag/documents/expert/unit3.5.7.php

establish what traffic conditions relate to differing air quality with respect to NO2 and PM2.5. The weather conditions and street morphology will also need to be taken into account using existing tools developed by DEFRA. Once the relationship has been established it is hoped that air quality can be estimated in real time based on traffic conditions, site morphology and weather conditions, without the need to deploy the expensive real time air quality analysers, and near future (3-24 hour) local air quality predictions can then be made in order to influence local travel behaviour and mode choices through a number of information/media channels. This is an untested metric and should it prove successful, it will be an important and transferable output from the FMZ scheme.

With regards to CO2 emissions, savings due to the FMZ interventions will be calculated based on observed mode switch from the stakeholder surveys, and mode share surveys at key locations around the FMZ. A similar approach could be taken for estimating the savings in NO2 and PM 2.5, should the modelling approach described above prove unsuccessful.

4.9 Summary of the key outcomes, mechanisms and associated research questions

The ToC and logic mapping presented in this evaluation plan is complex and it is important to focus the evaluation on the key outcomes within each scheme which facilitate the FMZ scheme objectives and explain the causal pathway to the key outcomes and the key mechanisms which facilitate that. In addition, it is important to identify the most important indicators which monitor progress towards these outcomes.

In order to provide this focus, three evaluation summary panels have been developed which summarise the causal pathway to the key outcomes, linking these with the FMZ scheme objectives and identifying the most relevant mechanisms that will facilitate this outcome. In parallel with this the indicators that will be used to test this are also identified. The panels then summarise the mechanisms and indicators so that they can be readily referenced back to the relevant tables. These panels also summarise how exogenous contextual change could impact the effectiveness of the ToC. Finally, from this information a number of research questions are presented which can test the assumptions within the ToC and address key knowledge gaps concerning MaaS, real time transport data and the innovative concept of e-mobility hubs.

Beyond the causal pathways to the desired key outcomes shown within the evaluation summary panels, the longer term economic, socio economic and environmental/health outcomes and impacts resulting from the FMZ scheme are illustrated in the three logic maps. Generally, while the outputs and shorter term outcomes differ between the three schemes, these longer term outcomes and impacts are similar. This demonstrates that the schemes are well aligned and contribute to the broader policy objectives of the FMZ fund and Derby and Nottingham City Councils. The logic behind this is well illustrated in the ToC and this evaluation is designed to monitor indicators to test this. However, it is recognised that as the impacts become broader, it will become more difficult to attribute changes to these higher level indicators that track progress towards the longer term outcomes and impacts for the FMZ projects. This is particularly true for the wider economic impacts, but it will also be difficult to attribute observed changes to air quality to the FMZ scheme and then to wider public health benefits. Nevertheless, this evaluation will report on indicators relevant to these impacts.

However, it is important to focus the available evaluation resources on the more medium term outcomes and important mechanisms that facilitate these because, not only are they the most important elements in the ToC, but also because it will be possible to generate robust evaluation conclusions for these aspects of the ToC by effectively attributing observed change and accounting for contextual change. Therefore, it is these elements of the FMZ schemeToC which are the focus of the evaluation summary panels (Tables 4.7 to 4.9).

4.9.1 Evaluation summary panels

Table 4.7 Mobility as a Service - Evaluation Summary Panel

Commentary on logic to achieve key outcomes

- Of the three schemes that make up the FMZ scheme, Mobility as a Service (MaaS) will be most significant in achieving **Objective 1** and **Objective 2** as it will be available FMZ wide and aims to make travel within the area more convenient, easier to plan and pay for and cheaper. Thus the design, delivery and marketing of the MaaS app will be critical in delivering this.

- Therefore, the key mechanisms and outputs as illustrated by the logic map are initially **M1** and **M2** which raise the visibility of options and costs through the app. These mechanisms will activate as Stage 1 and Stage 2 of the app become available. The key indicator for monitoring this process will be **I_1,** a questionnaire survey of those using the app at each stage of development to ask their views as to how useful it is and if it's changed their behaviour. This indicator will involve an experimental approach in partner employers whereby a control group of non MaaS users will be surveyed and compared with MaaS users in the same employers.

- Once the app is fully completed it will offer discounts to all users and mobility credits to key target groups. This will activate the pricing mechanism **M5.** This process can be tracked by indicator **I_1** combined with data from the app**, I_9** about pricing of journeys and the discounts offered. **M5** should increase the demand for travel on modes where the app has reduced the cost. This will be measured using evidence from the survey **I_1** regarding behavioural change, backed up by time series data regarding for the number of cyclists, pedestrians, public transport patronage and mode shift, **I_24, 25, 27** and **36**. This time series data must be viewed as corroborative evidence for that from **I_1** and **I_9,** as attribution for these will be difficult.

- **M19,** mobility credits for lower income and other target groups, reinforces the general pricing mechanism **M5** and impacts lower income groups specifically. It is important to evaluate the impact of this on these groups. **I_5** is a survey of those receiving mobility credits while **I_6** will survey those in those groups who did not receive the mobility credits. These indicators when combined will measure the impact on those groups with respect to changes in their travel behaviour and also the access to employment. This causal pathway if active as suggested by the Theory of Change will result in the key outcome: **Improved equality of access to transport for lower income/target groups** (**Objective 2**).

- In addition to pricing**,** the app will activate **M6,** the convenience mechanism, whereby the app will make it easier to plan and execute a trip, leading to more travel options with public transport, active travel and, particularly multimodal trips, becoming more attractive, thus facilitating mode switch away from travel by private car. As with **M5** the activation of this mechanism will be tracked primarily by indicators **I_1** and **I_9.**

- The role of active travel as an alternative to travel by private car is important within the logic for this intervention. The app will highlight the cost and convenience advantage of active travel options, **M8**. The mechanism **M7** anticipates that MaaS will reveal the advantages of utilising active modes within multimodal trips, further enhancing the take up of these modes. Again **I_1** and **I_9** will be key indicators for monitoring this.

- The logic map shows that the combined outcomes from **M5, M6, M7 and M8** will facilitate the two key outcomes **Easier to travel around the FMZ** (**Objective 1**) and **Mode switch away from the car – reduced car dependency** (critical outcome in meeting **Objective 4**). The contribution of this causal path on the key outcome of **Congestion constraint** via **M10,** a reduction in demand for travel by, will be difficult to quantify using the traditional indicators, average journey time per mile, **I_20** and **I_21**, journey time reliability, as it could be difficult to

achieve attribution of cause and effect.

- **M5** and **M6** will also act to emphasise the advantages of e-mobility options by identifying hire options for these and it is anticipated this will increase the use of these modes. This will be monitored by the number of EV and e bike hires, **I_26, I_29,** combined with the number of EVs registered in the Nottingham and Derby travel to work area, **I_23.** This will contribute, via **M20,** an increase in the % of EVs in the fleet**,** to the key outcome, **Decreased levels of CO2, NO2 and particulates** (a critical outcome for **Objective 3**). This outcome will be monitored using **I_22,** modelled changes in NO2, PM2.5 and CO2 emissions based on traffic flow, observed mode shift, fleet composition and observed emissions from real time AQ analysers.
- The key outcome **Agglomeration of research, skills and businesses related to the development of MaaS** will be facilitated by **M23**. **The** agglomeration of MaaS technology companies, skills and relevant research activities within the FMZ scheme will lead to an increase in economic activity and jobs**.** This will primarily be monitored by **I_7,** a survey of businesses asking about recent investment decisions prompted by the FMZ scheme interventions**.** This contributes to **Objective 5**.

Key outcomes from MaaS

- **Easier to travel around the FMZ**
- **Mode switch away from the car – reduced car dependency**
- **Congestion constraint**
- **Improved equality of access to transport for lower income/target groups**
- **Agglomeration of research, skills and businesses related to the development of MaaS in the FMZ**

Summary of key mechanisms
M1 M2 M5 M6 M7 M8 M19 M20 M23

Summary of how exogenous contextual change could impact the MaaS Theory of Change

C1 and **C3**, the demographic and socio economic characteristics of the FMZ, will be important context as if these change they will most likely impact the take up of the travel options inherent in MaaS as well as MaaS itself. The underlying trends in the cost of travel by various modes, **C5** and **C6**, could also influence the effectiveness of MaaS in reducing car dependency and achieving beneficial mode switch. The ability of the intervention to constrain congestion will be influenced by national trends in congestion **C9,** local congestion issues **C7** and local supressed demand for travel by car **C10. C9a,** national trends in air quality is likely to show decreasing emissions and this needs to be taken into account when evaluating the possible impact of MaaS on local air quality, although the approach of modelling using observed mode shift rather than attempting to directly measure air quality should mitigate this.

Summary of Key Indicators
I_1 I_5 I_6 I_7 I_9 I_20 I_21 I_22 I_23 I_26 I_27 I_29

What will we learn from this: Key Research Questions

1. **What is the take up of MaaS over time and which socio-economic groups are more/less likely to engage?** – this tests the critical assumption within the Theory of Change that MaaS will be used by a sufficient number of people across and in a sufficient diversity of socio-economic groups to activate the ToC.

2. **What is the most effective way to market MaaS to maximise take up?** – this is a critical research question within the process of delivering MaaS.
3. **How effective is MaaS in eliciting modal shift away from ICE powered private cars?** – this tests the assumption that greater visibility of transport options, combined with greater convenience of planning and paying for journeys delivered by MaaS, will combine with cost savings to initiate mode switch away from the private car.
4. **How does the effectiveness of MaaS, with regard to meeting the FMZ scheme objectives, vary across the diverse multi-centred city region comprising the FMZ? -** the diverse nature of the Derby-Nottingham Future Mobility Zone provides a test bed that should cover most scenarios where the approach is likely to be applied in the future in other locations.
5. **To what extent does MaaS encourage the uptake of active travel including e bikes? –** this will test the assumption within the ToC that MaaS will encourage the uptake of these modes via increased visibility and cost effectiveness.
6. **What are the most effective ways of working with target low income groups? -** particularly those we haven't previously supported or engaged with before for transport e.g. care leavers, young carers, food bank users.
7. **How does the provision of mobility credits influence travel patterns in target groups and how does this differ across the groups? -** This will inform future similar initiatives by providing knowledge as to what works best and for whom.
8. **To what extent does the provision of mobility credits improve access to employment for target groups?** – This tests the assumption within the ToC that the provision of these credits will improve access to employment opportunities within the target groups.
9. **What are the beneficial elements of a publicly lead MaaS that would not be possible using commercial MaaS products? –** The user survey and process evaluation should help answer this important question regarding the unique feature of the FMZ MaaS product.
10. **How does MaaS impact on mass transit and public transport ridership in a medium sized city? -** This tests the assumption that MaaS will increase ridership.

Table 4.8 Data Platform - Evaluation Summary Panel

Commentary on logic to achieve key outcomes

- While the data platform primarily underpins the proper functioning of MaaS, a key outcome for **Objective 1**, and also to some extent the e-mobility hubs, it is also significant in achieving **Objective 4** via the 'Smart Junction' treatments and thus **Objective 3**, via improved air quality.

- The key mechanism initiated by the availability of the website is initially **D1,** which raises the visibility of travel options and their relative merits. The key indicators for monitoring this process will be **I_2,** a questionnaire survey of those using the website to ask their views as to how useful it is and if it's changed their behaviour, along with **I_14**, which tracks the usage of that website. As with MaaS the evaluation of this mechanism using **I_2** could involve an experimental approach in partner employers whereby a control group of non-website users will be surveyed and compared with users in the same employers.

- Equipped with a higher level of visibility, mechanism **D3** will activate, whereby journeys become easier to plan and execute, making non car based and multi modal journeys more attractive. This then contributes to the key outcome of **reduced car dependency – mode switch to PT and active modes,** a critical outcome for achieving **Objective 4**. **D3** acts to enable the key outcome, **Easier to travel around the FMZ,** an important outcome for meeting **Objective 1,** as the detailed information the website provides facilitates this. Parallel with this and more specifically, **D4** should activate, whereby active travel modes are highlighted as convenient and cost effective, again contributing to this key outcome. This will be monitored by **I_2.**

- The data collated in the data hub will be used by the activation of mechanism **D2,** the provision of a richer more complete and contemporaneous data, to achieve the key outcome, the provision of **Real time data required for the function of MaaS**. This outcome and mechanism is best monitored via the evaluation of MaaS (see Table 4.7). **D2** will also facilitate the provision of data from the hub to academia and business via a free access API. **I_41,** a log of the use of this API, will monitor the activation of **D2** in this respect. **D2** will also enable better informed appraisal, evaluation and formulation of local transport policy and thus result in more effective transport interventions, and the real time availability of this data will facilitate day to day network management.

- The 'Smart Junction' treatment for key sections of the Nottingham Ring Road is a key output from the data platform as via mechanism **D14,** optimisation of traffic signals, it will lead to a decrease in journey times on key sections of the highway network**.** This will be monitored using **I_20**, average journey time per mile and **I_21,** journey time reliability. This will in turn contribute to the key outcome of **Constraining congestion** via mechanism **D21,** which is an overall decrease in average journey time per mile and improvement in journey time reliability. This will be monitored using **I_20** and **I_21**. Constraining congestion is a key outcome for achieving **Objective 4.**

- The logic map shows that the **Congestion constraint** contributes to two further key outcomes. Firstly, mechanism **D20**, less queuing traffic and less traffic overall, lowers emissions and contributes to the key objective **Decreased levels of CO2, NO2 and particulates,** (a critical outcome for **Objective 3**). This outcome will be monitored using **I_22,** modelled changes in NO2, PM2.5 and CO2 emissions based on traffic flow, observed mode shift, fleet composition and observed emissions from real time AQ analysers; while **I_20,** delay per vehicle mile and **I_22** will monitor **D20**. Secondly, the reduction in congestion will make it **Easier to travel around the FMZ,** a key outcome**. D21** acts to achieve this via the reduction in average journey times and improved journey time reliability, monitored, again, by **I_20** and **I_21.**

- The website also has the potential via mechanism **D1** to emphasise the advantages of e-mobility options by identifying hire options for these and it is anticipated this will increase the use of these

modes. This will be monitored by the number of EV and e bike hires, **I_26, I_29,** combined with the number of EVs registered in the Nottingham and Derby travel to work area **I_23.** This will contribute, via **D5,** an increase in the % of EVs in the fleet**,** to the key outcome, **Decreased levels of CO2, NO2 and particulates** (a critical outcome for **Objective 3**).

- The website will present users with information and options that highlight travel options by non-car based modes via mechanisms **D3**, the information mechanism, and **D4**, which acts through the website highlighting the cost and convenience of active travel options. These two mechanisms enable the key outcome **Improved equality of access to transport for lower income and target groups (Objective 2)** as they inform lower income groups of more cost effective travel options. **D3** and **D4** will be monitored by **I_2**, the website user surveys. The logic map also shows that as described in the paragraph above, **D1** is expected to act to inform users of hire options for e bikes and EVs. As this is clearly cheaper than purchasing these vehicles it is more open to lower income groups thus contributing to the above key outcome via **D3**, the information mechanism.

Key outcomes from the Data Platform

- **Facilitates MaaS**
- **Easier to travel around the FMZ**
- **Mode switch away from the car – reduced car dependency**
- **Congestion constraint**
- **Improved equality of access to transport for lower income/target groups**

Summary of key mechanisms
D1 D2 D3 D4 D5 D14 D20 D21

Summary of how exogenous contextual change could impact the MaaS Theory of Change

The most important contextual factors that impact the data platform's ability to achieve the FMZ scheme objectives are broadly the same as those that impact MaaS. **C1** and **C3**, the demographic and socio economic characteristics of the FMZ will be important context as if they change they will most likely impact the take up of the travel options presented by the website. The underlying trends in the cost of travel by various modes, **C5** and **C6**, could also influence the effectiveness of the data platform in reducing car dependency and achieving beneficial mode switch. The ability of the intervention to constrain congestion will be influenced by national trends in congestion **C9,** local congestion issues **C7** and local supressed demand for travel by car **C10. C9a,** national trends in air quality is likely to show decreasing emissions and this needs to be taken into account when evaluating the possible impact of MaaS on local air quality, although the approach of modelling using observed mode shift, rather than attempting to directly measure air quality, should mitigate this. **C4** national and local economic conditions could be significant in how and to what extent the data generated by the hub is used by businesses via the free access API.

Summary of Key Indicators
I_2 I_14 I_20 I_21 I_22 I_23 I_26 I_29 I_41

What will we learn from this: Key Research Questions

1. **What are the technical barriers to delivering real time transport data across a diverse multi-centred city region? –** This is primarily a question to be addressed by the process evaluation. The question tests the assumption that this is possible/practical. The diverse nature of the Derby-Nottingham Future Mobility Zone provides a test bed that should cover most scenarios where the approach is likely to be applied in the future in other locations.

2. **How effective is the website and other digital information in promoting mode switch away from the car to public transport, shared, electric and active modes? -** This tests the assumption that greater visibility of transport options will promote beneficial mode switch.
3. **How effective is the 'Smart Junction' approach in addressing real world local congestion issues and delivering an improvement to journey times and reliability? -** This is an important next step in examining the effectiveness of this approach which is currently being trialled on a test bed of junctions in Manchester. The Nottingham Ring Road, in particular, has issues with congestion, documented in the recent Nottingham Ring Improvement Scheme Year 1 Evaluation Report, which this technology has the potential to address.
4. **Can the provision of real time transport data be used by academia and business to generate research and business opportunities?** – This tests the assumption that the availability of this data will be used by academia and businesses for commercial and research purposes.
5. **Does better information on travel options presented on the website and via other channels promote better access to transport and thus employment in lower income and target groups? -** This tests the assumption that these groups will respond to the website in this way, clearly because it offers discount via the mobility credits and is also more interactive and is likely to be more effective.

Table 4.9 E-mobility Hubs - Evaluation Summary Panel

Commentary on logic to achieve key outcomes

- Of the three schemes that makes up the FMZ scheme, the e-Mobility hubs are expected to have the most impact on the electrification of the transport network. Once operational, the hubs will activate a number of mechanisms. Mechanism **E1** will be the exposure of hub users, employers and residents to a range of electric mobility options, while **E2** and **E4** build on this by facilitating cost effective access via hire schemes for EVs and e bikes. **E3** makes the use of these modes more practical by utilising the enhanced charging facilities available in the hubs. These four mechanisms will be monitored using the hub user surveys, **I_3,** supported by the number of EVs, **I_26** and e bike hires, **I_29**. Data for charging events' location and duration, **I_42,** will monitor the use of these facilities. These services all contribute to **Objective 1.** **E7**,the availability of e bikes, also encourages active travel.

- The provision of autonomous electric shuttle buses on e campuses acts as mechanism **E6** to increase mobility around these hubs. This removes a potential reason for travelling to these hubs by car by connecting the external stops on the public transport networks with locations within these large sites. This is mechanism **E12** and facilitates the key outcomes; **Mode switch away from the car – reduced car dependency** and **Easier to travel around the FMZ,** which contribute to **Objectives 1, 3 and 4.** These mechanisms and outcomes are evidenced by indicators **I_35** operational records and timetables from buses, and by **I_4,** a survey of shuttle bus users, as well as **I_12**, shuttle bus patronage.

- The proposed EV Service and Repair Centre in the Depot of the Future will activate **E5**, agglomeration of businesses within this sector due to the presence of the centre which locate in this and other e-mobility hubs. **Agglomeration of research and development for Electric mobility centred around campuses and depots of the future** is a key outcome and contributes to **Objective 5**.

- **E12** (Shuttle buses make it easier to travel around large sites), **E14** (Hub users have greater information and better interchange facilities for public transport options - leads to an increase in demand for travel by public transport) and **E16** (Information mechanism – hub users are made aware of travel options making it easier to plan and execute a trip) combine to facilitate the key outcome **Mode switch away from the car – reduced car dependency** (key outcome in meeting **Objective 4**). All three of these mechanisms and the key outcome can be monitored from outputs from **I_3,** the hub users surveys, backed up **I_12**, shuttle bus patronage and **I_36,** PT patronage for key services around the hubs. These outcomes will activate mechanism **E19**, a reduction in the demand for travel by car resulting in the key outcome **Congestion constraint** which further contributes towards **Objective 4.** The activation of **E19** will be monitored by **I_20**, average journey time per mile and **I_21** journey time reliability along with **I_34**, estimated car trips saved based on observed mode switch and **I_28**, before and after traffic flows.

- Clearly, with this scheme electrification of the transport system is a key aim and this is primarily to achieve the key outcome; **Decreased levels of CO2, NO2 and particulates** (a critical outcome for **Objective 3**). This outcome will be monitored using **I_22,** modelled changes in NO2, PM2.5 and CO2 emissions based on traffic flow, observed mode shift, fleet composition and observed emissions from real time AQ analysers. Mechansisms **E15, E20** and **E33** combine to achieve this. **E15**, a switch to e-bikes, leads to a reduction in tail pipe emissions which will be monitored by the number of e bike hires, **I_29. E20,** the increase in the percentage of vehicles in the overall fleet that are electrically powered, is monitored by **I_23**, the number and % of ULEVs registered in the Derby Nottingham Travel to Work Area. **E33**, less queuing traffic and less traffic overall - lowers emissions of NO2, carbon and PM2.5, will be monitored by

I_22, modelled changes in NO2, PM2.5 and CO2 emissions based on traffic flow, observed mode shift, fleet composition and observed emissions from real time AQ analysers, and also **I_28,** before and after traffic counts around the FMZ, some of which will be located in and around the hubs.

- **E17**, increased access to more affordable transport options – active modes and public transport are cheaper options than owning and running a car, is an important mechanism that is activated by the initial outcome of residents and employers having better access to public transport and active travel modes especially e bikes. This mechanism will be monitored via the hub users survey **I_3**. This mechanism facilitates the key outcome **Improved equality of access for lower income and other target groups (Objective 2)** which will be assessed via the hub users survey amongst lower income employees and residents, **I_3**.

Key outcomes from e-mobility hubs

- **Easier to travel around the Future Mobility Zone**
- **Mode switch away from the car – reduced car dependency**
- **Congestion constraint**
- **Improved equality of access to transport for lower income/target groups**
- **Agglomeration of research, skills and businesses related to the development of MaaS in the FMZ**

Summary of key mechanisms
E1 E2 E3 E4 E5 E6 E7 E8 E12 E14 E15 E16 E19 E20 E33

Summary of how exogenous contextual change could impact the e-mobility hubs Theory of Change

C4, national and local economic conditions is likely to impact the performance of the hubs by impacting a wide range of mechanisms particularly those influencing travel mode choice and the macroeconomic mechanisms leading to the longer term economic impacts. **C5** and **C6,** which represent the cost of travel by car and public transport, could also influence the effectiveness of e-mobility hubs in reducing car dependency and achieving beneficial mode switch. The ability of the intervention to constrain congestion will be influenced by national trends in congestion **C9,** local congestion issues **C7** and local supressed demand for travel by car, **C10. C9a**, national trends in air quality, is likely to show decreasing emissions and this needs to be taken into account when evaluating the possible impact of MaaS on local air quality, although the approach of modelling using observed mode shift rather than attempting to directly measure air quality should mitigate this. **C11**, national trends in the take up of EVs, **C12,** progress in EV technology and **C13** the cost of purchasing EVs and e bikes, will all impact on the mechanisms that promote the use of these vehicles and the trends in these external variables are all likely to encourage the take up of EVs and e bikes as the technology develops and becomes cheaper.

Summary of Key Indicators
I_1 I_4 I_12 I_20 I_21 I_22 I_23 I_26, I_28 I_29 I_34 I_36 I_42

What will we learn from this: Key Research Questions

1. **Do e-mobility hubs increase the uptake and use of EVs?**
2. **Do e-mobility hubs increase the use of e bikes?**
3. **Are e bikes used for journeys that would not normally be undertaken by conventional cycles, e.g. longer range journeys or by different user groups who would not consider using a normal bike? -** this tests the assumption that the availability of e bikes to

hire will increase the amount of active travel, rather than just being an alternative for those that already cycle.

4. **How effective are the e-mobility hubs in eliciting modal shift away from ICE powered private cars?** – this tests the assumption that, given access to e-mobility options and greater access to travel planning and public transport, employees and residents of the hubs will choose to take up these modes in preference to the private car.
5. **How does the impact of the hubs on mode shift differ between employees and residents and between e-neighbourhoods, e campuses and e depots? -** this takes advantage of the diverse test bed provided by the FMZ, a multi- centred city region, to test out how the impacts of the hubs differ in different circumstances so that future similar interventions can target investment.
6. **Does the provision of autonomous shuttle buses within large campuses impact the mode choice for journeys to those sites? -** this tests the assumption that if a service takes you to the door of your destination you would then choose to leave your car at home and travel by public transport as transiting across a large site from external bus or tram stops is no longer inconvenient and is time consuming.
7. **Do e campuses and e depots attract inward investment in the e-mobility sector? -** this tests the assumption that the intervention will attract inward investment.
8. **Is it possible to quantify the impact of e-mobility hubs on local air quality and carbon emissions? -** an important lesson from this research will be to develop a research methodology to establish this causality as empirically measuring change using existing air quality monitoring equipment is likely to lack the sensitivity required, therefore, the development of a hybrid modelling/monitoring approach will be of broad interest to other local authorities, academia and the DfT.
9. **Do green number plates help to increase awareness and acceptance of ULEVs? –** this will be explored as part of the suite of stakeholder surveys.
10. **Attitudes and perceptions of trust with new technologies e.g. autonomous vehicles –** this will be explored as part of the suite of stakeholder surveys.

4.9.2 Research questions

The research questions within the Evaluation Summary Panels articulate the most important lessons to be learned from the implementation of the FMZ scheme and feed into the overarching research questions presented in Section 2.2. Table 4.10 shows the relationship between these research questions.

Table 4.10 The Derby-Nottingham Future Mobility Zone scheme research questions

Scheme Level Research Questions	Scheme (M=Maas, D = Data platform, E = E-mobility hubs)	Scheme Level Research Questions
Can public policy-led MaaS achieve greater uptake of greener transport services?	**M**	What is the take up of MaaS over time and which socio-economic groups are more/less likely to engage?
	M	What is the most effective way to market MaaS to maximise take up?
	M	How effective is MaaS in eliciting modal shift away from ICE powered private cars?
	M	How does the effectiveness of MaaS with regards to meeting the FMZ scheme objectives vary across the diverse multi-centred city region comprising the FMZ?
	M	To what extent does MaaS encourage the uptake of active travel including e bikes?
	M	What are the most effective ways of working with target low income groups?
	M	How does the provision of mobility credits influence travel patterns in target groups and how does this differ across the groups?
	M	To what extent does the provision of mobility credits improve access to employment for target groups?
	M	What are the beneficial elements of publicly led MaaS that would not be possible using commercial MaaS products?
	M	How does MaaS impact on mass transit and public transport ridership in a medium sized city?
How does the Derby-Nottingham Future Mobility Zone scheme make electric mobility more accessible?	**E**	Do e-mobility hubs increase the uptake and use of EVs?
	E	Do e-mobility hubs increase the use of e bikes?
	E	Are e bikes used for journeys that would not normally be undertaken by conventional cycles, e.g. longer range journeys or by different user groups who would not consider using a normal bike?
	E	How effective are the e-mobility hubs in eliciting modal shift away from ICE powered private cars?
	E	Does the provision of autonomous shuttle buses within large campuses impact the mode choice for journeys to those sites?
How do different	**E**	How does the impact of the hubs on mode shift

Scheme Level Research Questions	Scheme (M=Maas, D = Data platform, E = E-mobility hubs)	Scheme Level Research Questions
parts of a multi-centred region respond to different Future Mobility Zone interventions?		differ between employees and residents and between e neighbourhoods, e campuses and e depots?
	M	How does the effectiveness of MaaS with regard to meeting the FMZ scheme objectives vary across the diverse multi-centred city region comprising the FMZ?
	M	How does MaaS impact on mass transit and public transport ridership in a medium sized city?
How effective is new technology in delivering the benefits of the Derby-Nottingham Future Mobility Zone scheme?	**D**	What are the technical barriers to delivering real time transport data across a diverse multi-centred city region?
	E	Attitudes and perceptions of trust with new technologies
	D	How effective is the 'Smart Junction' approach in addressing real world local congestion issues and delivering an improvement to journey times and reliability?
How effective is the Derby-Nottingham Future Mobility Zone scheme approach in constraining congestion?	**D**	How effective is the website and other digital information in promoting mode switch away from the car to public transport, shared, electric and active modes?
	D	How effective is the 'Smart Junction' approach in addressing real world local congestion issues and delivering an improvement to journey times and reliability?
	M	How effective is MaaS in eliciting modal shift away from ICE powered private cars?
	E	How effective are the e-mobility hubs in eliciting modal shift away from ICE powered private cars?
	D	Does better information on travel options presented on the website and via other channels promote better access to transport and thus employment in lower income and target groups?
How effective is the Derby-Nottingham Future Mobility Zone scheme approach in enhancing the local economy?	**D**	Can the provision of real time transport data be used by business to generate business opportunities?
	E	Do e campuses and e depots attract inward investment in the e-mobility sector?
Other	**E**	Is it possible to quantify the impact of e-mobility hubs on local air quality and carbon emissions?
	E	Do green number plates help to increase awareness and acceptance of ULEVs?

At this stage in the development of the FMZ Evaluation Plan these research questions have not been specifically linked to individual indicators or research methodologies, however, the comprehensive nature of the evaluation approach and supporting monitoring framework provides confidence that the evidence will be available to answer these research questions. It

is anticipated that the bespoke research methodologies to address these will be co-developed with the DfT Centre of Excellence for Evaluation and our academic evaluation partner, Loughborough University. It is anticipated that addressing these questions will form the research area for the PhD student who will be appointed to assist in the evaluation project.

5. Resource and Governance of the Evaluation

5.1 Monitoring and evaluation budgets

All costs associated with the FMZ scheme are expected to commence in the 2019/20 financial year, through preparatory and development work on all work projects. Delivery builds in 2020/21 with full delivery achieved from 2021/22. This financial profile is subject to change, however the indicative values presented here are based on experience of previously funded programmes.

The indicative monitoring and evaluation budget for the FMZ proposal is £0.5 million over the evaluation period 2019/20 to 2022/23. This will cover programme monitoring and evaluation costs and also those for programme coordination and dissemination activities. The indicative split by financial year is shown in Table 5.1 below.

Table 5.1: Derby-Nottingham Future Mobility Zone scheme monitoring and evaluation, programme coordination and dissemination activity costs

Work Package 4: Programme Coordination and Evaluation (£0.5 million)					
Scheme measures	**2019/20**	**2020/21**	**2021/22**	**2022/23**	**Total cost**
Programme monitoring and evaluation, programme coordination, and dissemination activities	£0.125 million	£0.125 million	£0.125 million	£0.125 million	£0.5 million

5.2 Evaluation project governance structure

The area has an established governance framework for overseeing and managing delivery of major programmes. Nottingham City Council will act as the lead partner with overall financial responsibility for the programme. A joint Derby and Nottingham Transport Board is proposed to fulfil the decision making responsibility for the Future Mobility Zone proposals. The Programme Manager and Senior Responsible Officer will meet regularly at a Derby - Nottingham Transport Board to update on progress against project timescales, spend and outputs. Project implementation will be led by the Programme Manager with technical support and expert input from project teams, including monitoring and evaluation.

5.3 Responsible personnel

As detailed in Section 2.3, Nottingham City Council has a proven in-house monitoring and evaluation capability which will deliver the evaluation for the FMZ proposal.

The Highways Metrics Team is led by Peter Warren, a technical expert in monitoring and evaluation with over 40 years' experience in the field.

The monitoring and evaluation for the FMZ scheme proposal will be managed by Dr Simon Dale who works as a Principal Officer within the Highway Metrics team and is also a Visiting Research Fellow at Loughborough University.
A Senior Transport Planner, Technical Officer and an in house team of casual survey staff will also provide support in the delivery of the evaluation.

The background and experience of the above personnel are detailed in section 2.3.

In addition, Loughborough University is a partner to this package and has confirmed its support to recruit and part fund a PhD student to assist in the evaluation of the impact of the measures. This will generate academically robust outputs in the form of peer reviewed papers and a PhD thesis, as well as a one year after Evaluation Report and a final Evaluation Report to assess if the impacts of the package have become embedded over a longer period (5 years).

As discussed in Section 2.3, the Highway Metrics team has a proven track record in delivering evaluations following both standard DfT guidance, but also, as in the case of the WPL Package, in producing high quality evaluation projects based on bespoke evaluation frameworks satisfying academic standards of rigour.

A further consideration is that, given the experience and capabilities within the Highway Metrics team, and as this is a joint bid with Derby City Council, the Highway Metrics Team will be able to offer monitoring and evaluation support to Derby City Council should that be necessary to fulfil the requirements for this bid.

5.4 Procedures for risk management

Risks to the FMZ evaluation will be tracked in accordance with the Nottingham City Council's corporate risk management principles. The risk management framework requires the identification and recording of risks, an evaluation of their potential and any mitigation actions and monitoring of ongoing progress. This approach draws upon the PRINCE2 methodology for risk management and ensures that all risks are captured and processed in a consistent manner.

Key risks for the FMZ scheme evaluation are outlined below. 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. Ownership of the risk register falls to the Programme Manager. These risks will be subject to on-going monitoring and mitigated through effective programme management and partnership working.

- **Problems with count equipment and count data**. Mitigation is to undertake regular checks of count equipment and validate survey results and then repeat surveys carried out if problems occur.
- **Problems with sample sizes for user surveys.** Mitigation is to ensure that the number of people interviewed is high enough to yield statistically robust results with respect to the overall population demographics.

- **Problems with survey bias.** Mitigation is to consider sample sizes as above and to carefully consider wording of questions in questionnaire design in conjunction with our academic partners.
- **Difficulties in achieving internal prioritisation for some key activities**. Mitigation is that this risk is internal to the City Councils and, therefore, within the remit of senior managers.
- **Difficulty with attributing impacts to specific/individual projects**. Mitigation is to use quantitative and qualitative techniques to achieve attribution alongside a developed Theory of Change model.

5.5 Quality assurance

Regular quality checks will be carried out to deliver the evaluation's objectives. The project enjoys detailed scrutiny from senior representatives in both Derby and Nottingham City Councils and Loughborough University. If the methodology and/or synthesis and conclusions are not robust then the key stakeholders will thus be made aware enabling timely remedial action. In addition to this, the councils will engage on a regular basis with the DfT's Evaluation Centre of Excellence. Crucilally the output from the evaluation will be subject to academic rigour via expert opinion from Loughborough University and other academic sources, publication of peer reviewed papers on key aspects of the evaluation and examination of the associated PhD.

6. Delivery and Dissemination Plan

6.1 Evaluation delivery timeframe

There are a number of activities upon which the success of this evaluation relies. A series of key work packages are detailed in Table 5.1 below.

Table 6.1 – Key work projects programme

Work package title	Description	Start Date	End Date
Collate baseline indicator data	Collect before scheme data for relevant indicators, using existing data sources and identifying the need for any new surveys prior to programme start	01/11/2019	31/03/2020
Develop survey methodologies	Design stakeholder surveys in conjunction with academic partners, assess survey bias when considering sample sizes, population demographics. Plan traffic flow, cycle, pedestrian and mode share surveys and analyse congestion data	01/11/2019	31/03/2020
Investigate availability of external data for assessing exogenous contextual change and providing baseline data	Investigate relevant data sources in other similar local authorities and nationally against which the Derby-Nottingham data can be assessed for exogenous contextual change. Investigate data availability from service providers and external organisations	01/11/2019	31/03/2020
Develop survey programme 2020/21 to 2024/25	Devise programme of surveys to be carried out by Highway Metrics team and other providers	01/11/2019	31/03/2020
Year 1 Annual Evaluation Report	Update this report with latest methodologies, data and findings	01/04/2020	30/06/2020
Year 2 Annual Evaluation Report	Update this report with latest methodologies, data and findings	01/04/2021	30/06/2021
Year 3 Annual Evaluation Report	Update this report with latest methodologies, data and findings	01/04/2022	30/06/2022
Year 4 Annual Evaluation Report	Update this report with latest methodologies, data and findings	01/04/2023	30/06/2023
Carry out after surveys	Programme of surveys to be carried out one year after end of FMZ scheme	01/04/2024	31/07/2024
One year after Evaluation Report	Produce Evaluation Report, one year after end of FMZ scheme programme and incorporating academic input and findings	01/04/2024	31/10/2024
Carry out after surveys	Programme of surveys to be carried out five years after end of FMZ scheme programme	01/04/2028	31/07/2028
Final Evaluation Report	Produce Final Evaluation Report, five years after end of FMZ scheme programme to assess if the impacts of the FMZ programme have become embedded over a longer period	01/04/2028	31/10/2028

6.2 Key evaluation milestones

A number of headline milestones linked to the monitoring and evaluation of the FMZ scheme are detailed in Table 6.2 below.

Table 6.2 Future FMZ scheme monitoring and evaluation milestones

Activity	Date
2019/20 Year 1 Evaluation Report	June 2020
2020/21 Year 2 Evaluation Report	June 2021
2021/22 Year 3 Evaluation Report	June 2022
2022/23 Year 4 Evaluation Report	June 2023
One year after Evaluation Report	October 2024
Final Evaluation Report	October 2028

6.3 Progress reporting back to the Department for Transport

Progress will be reported back to the DfT via project publications, including those detailed in Section 6.2 above, and via regular project meetings. The councils are also willing to participate in other DfT led best practice sharing and networking opportunities to disseminate lessons learned and feedback on outcomes.

6.4 Dissemination to other stakeholders

The results of this evaluation will be disseminated to other local authorities via the City Council and DfT websites. The PhD thesis will be available through normal academic channels, as will be any interim journal publications. Further consideration will be given to dissemination to local businesses and citizens as the evaluation progresses.