BRIEFING NOTE

LEZ POST-COVID UNCERTAINTY

LEZ UNCERTAINTY SUMMARY NOTE

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1. EXECUTIVE SUMMARY

1.1 Aims and Objectives

1.1.1 The Covid-19 pandemic has had a dramatic impact on travel across all modes and specifically travel in Scotland's city centres. As the Low Emission Zone (LEZ) designs are currently progressing across the four cities; Glasgow, Edinburgh, Dundee and Aberdeen, further evidence is required by applying the principals of modelling to consider the uncertainty over what travel will look like after the pandemic has ended. This evidence will help inform decision makers for the LEZ schemes.

1.1.2 A key focus is to understand the uncertainty faced by the cities in a post-Covid environment and how policies required to address these could interface with LEZ proposals. The aim is to set out a framework for embracing uncertainty by consulting with stakeholders on 'what will travel look like post COVID-19'. This framework sets out the rationale for any additional modelling required to provide supporting evidence relating to uncertainty which would enhance the acceptability of the modelling work undertaken to date.

1.2 Scenario Planning Workshops

1.2.1 To assist this process, workshops were held with the respective authorities to agree the key metrics to measure against the current LEZ objectives and Identify the key disruptors which are likely to have the greatest impact on travel activities within each city centre.

1.2.2 The agreed output metrics informed from the stakeholder workshops are the change in emissions and traffic volumes as a result of the LEZ. A review of the disruptors for each city combined with the discussions surrounding them within the workshops concluded with a generic list including commute travel demand and changes in fleet composition.

1.3 Uncertainty (Scenario Planning)

1.3.1 The Scenario Planning Process allows a range of plausible future scenarios to be defined using important and likely disruptors. These scenarios, or a subset of, are used as a reference case where a scheme or in this case, the LEZ, is applied to understand how it performs in the context of each scenario.

1.3.2 The impact of the LEZ is quantified by understanding and predicting the impact (quantitative or qualitative) it will have on each scenario. The Scenario Planning Tool quantifies the impact of the LEZ scheme and the metrics from the Scenario Planning Tool are then translated back into an output narrative to complement the input narrative.

1.3.3 A total of 40 plausible future scenarios were created which was sifted to four concise scenarios encompassing a range of emissions and trip making relationships shown below. Each scenario provides an insight into what a future could look like in terms of differing outcomes. The narrative which defines the four plausible futures are:

- A1: 'Bounce Back' - Increased commuting and retail travel demand, improved bus operations and more buoyant economy along with a suppressed enthusiasm for compliant vehicles.
- H4: 'Coping as Best We Can' - A poorly performing economy results in delayed infrastructure investment, a lack of shift to healthier modes and fleet, and a lack of appetite for additional air quality measures

- G1: ‘Brave New World’ - Following Covid there has been a reduction in office space which has transferred to other uses. With this a general reduction in traffic in the city centre for both commuting and shopping, however the uptake in compliant vehicles continues.
- B4: ‘It Could Have Been Worse’ - Increased retail travel demand resulting in increased congestion however public appetite for further Air Quality measures, which supports further policy shift towards more sustainable measures including a zero-Carbon fleet.

1.3.4 The outcome of testing the LEZ against each future is summarised below.

- Scenario A1 ‘Bounce Back’: With the introduction of the LEZ the volume of non-compliant vehicles have reduced which has demonstrated a marked improvement in the NOX levels within the city centre however, traffic will re-route around the city centre. The volume of vehicles within the LEZ area has reduced and active travel has increased as a result.
- Scenario H4 ‘Coping as Best We Can’: The LEZ has reduced the emissions within the LEZ area to an acceptable level however there is still re-routeing vehicles. The reduction in vehicular traffic has reduced below current levels however limited active travel increases have been achieved.
- Scenario G1 ‘Brave New World’ & B4 ‘It Could Have Been Worse’: The emission levels are still at acceptable levels with little change as a result of the LEZ scheme.

1.3.5 Whilst the LEZ may achieve a consistent goal in terms of NOX emissions, it is important to understand that the consequences of a LEZ may vary e.g. re-distribution of traffic effects.

1.4 Conclusions & Recommendations

1.4.1 This process demonstrates that the impact of the Low Emission Zones will vary between each city depending on their specific traffic levels and fleet composition. But importantly, the LEZ will protect the city centres by preventing non-compliant vehicles from entering them. Whilst the impact of the LEZ may vary across each city in terms of NOX emissions, the outcome is likely to be very similar with the level of emissions limited to a reduced value compared to pre-LEZ levels.

1.4.2 For each of the four LEZ cities, the four identified plausible futures have been considered against the model assessments undertaken to date. From this, to address uncertainty, further sensitivity testing of the proposed LEZ schemes is proposed. Each city has different characteristics and strategies which defines the further testing and the sensitivity tests are to be consistent with the core testing background scenario year (2022-2024).

1.4.3 The objectives of undertaking the proposed sensitivity tests are to provide evidence that the LEZ schemes are robust to variations in network conditions that may occur in a post-pandemic world. Each city may undertake different sensitivity scenarios, but they will have all considered plausible futures under a consistent framework.

2. INTRODUCTION

2.1 Aims and Objectives

2.1.1 The Covid-19 pandemic has had a dramatic impact on travel across all modes and specifically travel in Scotland's city centres. As the Low Emission Zone (LEZ) designs are currently progressing across the four cities; Glasgow, Edinburgh, Dundee and Aberdeen, further evidence is required by applying the principals of modelling to consider the uncertainty over what travel will look like after the pandemic has ended. This evidence will help inform decision makers for the LEZ schemes.

2.1.2 Jacobs and SYSTRA have been commissioned by Transport Scotland to prepare a report on key drivers of uncertainty and narratives around plausible futures. A key focus is to understand the uncertainty faced by the cities in a post-Covid environment and how policies required to address these could interface with LEZ proposals. The aim is to set out a framework for embracing uncertainty by consulting with stakeholders on 'what will travel look like post COVID-19'.

2.1.3 This framework sets out the rationale for any additional modelling required to provide supporting evidence relating to uncertainty which would enhance the acceptability of the modelling work undertaken to date.

2.2 Stakeholder Workshops

2.2.1 To assist this process, workshops were held with the respective authorities with the following objectives:

- Agree the key metrics to measure against the current LEZ objectives
- Identify the key disruptors which are likely to have the greatest impact on travel activities within each city centre.

2.2.2 The Dundee, Aberdeen and Glasgow workshops were chaired by Vincent McInally (Transport Scotland) with Boris Johansson and Malcolm Neil (SYSTRA) acting as workshop facilitators. The Edinburgh workshop was chaired by Vincent McInally (Transport Scotland) with Keith Gowenlock and Grant Davidson (Jacobs) acting as workshop facilitators.

2.2.3 The team would like to thank all attendees for their participation in what were very constructive and collaborative sessions.

2.2.4 Following the workshops, the information received was collated and used to inform a scenario planning exercise. This process defined a series of future scenarios, which were sifted down to a manageable number. The current Low Emission Zone concept was tested against the various futures to understand if the scheme still meets its objectives.

2.2.5 The workshop attendees and organisation/groups they were representing are tabulated in Appendix A.

2.2.6 The agenda followed the following format:

- Introduction
- Scene setting
- Output measures

- Input drivers
- Summing up, reflections and next steps

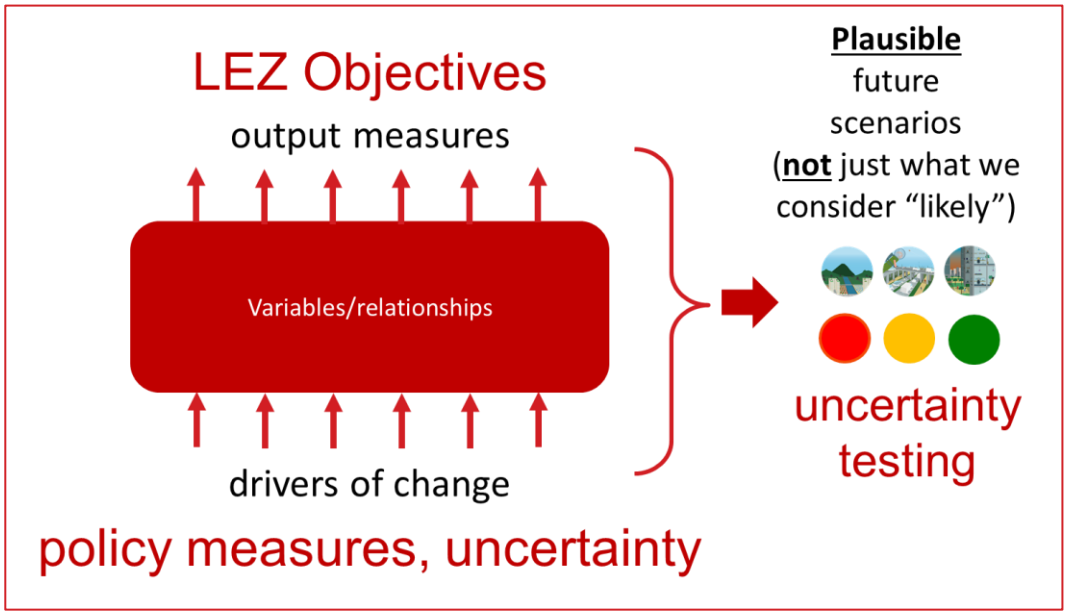
2.3 Scene Setting

2.3.1 The scene setting to the workshop was provided with an introduction to the objectives of the exercise:

> 'To understand:
>
> The issues faced by cities in a post-Covid-19 environment over the next 5 (or so) years
>
> How policies required to address this interface with LEZ proposals
>
> To inform decision makers and assist with potential future examination'

2.3.2 Throughout the presentation, the following was also highlighted:

- The process is embracing uncertainty by consulting with key stakeholders on 'what travel could look like post-Covid-19'
- The same questions are being asked across all cities
- A degree of consensus is being sought on the key metrics and disruptors to enable post-Covid plausible future scenarios to be derived, whilst exploring any key variations between the cities that would need to be taken into account.
- Traditional modelling of these futures is too time consuming so a simplified process will be developed
- This process will cut back on the richness of detail but run times are significantly reduced
- Further modelling may or may not be required to investigate impacts of one or more scenarios.



2.3.3 To summarise:

- Input drivers and output measures need to be quantifiable and may reflect proxies for more complex aspects of transport and society

- The scenario planning process's purpose is the development of richer interpretation of future states through stakeholder dialogue
- The process should not feel constrained by a focus upon only the scenario planning process. Focus should be upon the envisaged needs (i.e. the wider process).

3. OUTPUT METRICS

3.1 Introduction

3.1.1 As an introduction to the first session, workshop attendees were reminded that, for the output metrics:

1. A manageable number of output metrics are needed that best help inform judgement of the consequences of policy measures and contribution towards National Transport Strategy (NTS) outcomes
2. The more output metrics there are, the greater the likely number of input drivers that would be needed
3. Output metrics may themselves be interrelated and ordered – e.g. traffic levels impacting upon air pollution impacting upon public health.

3.1.2 For each workshop the relevant LEZ objectives were presented as a reminder. These objectives are set out in Table 1.

Table 1. LEZ Objectives by City

CITY	OBJECTIVES
Dundee	Primary Objectives: • Protect public health through improving air quality in Dundee and achieving air quality compliance for NO2, PM10 and PM2.5 • Develop an environment that helps to promote more active and sustainable travel choices in Dundee • Contribute to the ongoing transformational change in Dundee and help promote the city as an inclusive and desirable place to live, invest, visit and learn
Aberdeen	Primary Objectives: • Improve air quality in Aberdeen by reducing harmful emissions from transport and delivering on the Scottish Government's statutory air quality objectives. • Support climate change targets by reducing road transport's contribution to emissions. Supplementary Objectives: • Protect public health and wellbeing; • Support local and regional transport strategies by contributing to the development of a vibrant, accessible, and safe city centre, where the volume of non-essential traffic is minimised and active and sustainable transport movements are prioritised; and • Contribute to ongoing transformational change in Aberdeen, helping promote the city as a desirable place to live, visit and invest in.
Edinburgh	Primary Objectives: • Achieve air quality compliance • Use an evidence-based approach to identify interventions that reduce impact of air pollution on human health • Reduce congestion, promote sustainable forms of transport, and achieve placemaking outcomes across Edinburgh
Glasgow	Primary Objectives: • Protect public health through tackling poor air quality in the city centre • Ensure that Glasgow moves more rapidly towards meeting Scottish and EU air quality objectives for nitrogen dioxide and improve air quality standards within the city • Contribute to broader objectives and vision by the City Government to lower vehicle emissions and promote active travel, thereby improving urban liveability and supporting a vibrant and thriving city centre offer to residents, visitors, business and tourists

3.1.3 The output metrics, identified from the modelling work that had been undertaken to date, were presented at each workshop as detailed in Table 2.

Table 2. Output Metrics

CITY	OBJECTIVES
Dundee, Aberdeen, Edinburgh, Glasgow	○ Change in emissions in the LEZ area: ● NOX / PM / CO2 (from AQ Modelling) ○ Change to traffic volume (every vehicle classification)

3.2 Discussion

3.2.1 The stakeholders were offered an opportunity to discuss the output metrics which is summarised below for each city workshop. Naturally, the discussion did consider other related topics and the key elements have been summarised in the notes below for completeness.

Dundee

Objectives have climate change element due to changes in the Transport Act. An additional objective was added to help meet the climate change programme.

'Develop an environment that helps promote more active and sustainable travel choices in Dundee and contributes to meeting emission reduction targets set out in Part 1 of the Climate Change (Scotland) Act 2009'.

Data collected in Glasgow focused on NOXs and CO2. Initial LEZ objectives was air quality improvements but CO2 is a useful metric. It is important to include traffic volume as well. LEZ objectives are primarily focused on air quality objectives and not necessarily to climate change. The air quality metric is local and Carbon is a globalised metric. The primary focus is the air quality. If we ignore carbon then this could increase as a result changes to the travel patterns.

Are we aiming to identify what the outcomes are e.g. high and low? Do we want to identify the future we want? This will be discussed in the disruptors session.

We should consider specifically the bus service changes (volumes) and the economic impacts on the city centre. Again this can be discussed in the disruptors session.

Could the output measures have layers to enhance the metrics relevance to the LEZ. For example, could we measure the total number of people going into and out of Dundee City Centre e.g. by mode?

In summary is that there is no significant change in the metrics proposed.

Aberdeen

Have we distinguished between the output and outcomes? Yes, we deal with this through the narrative.

There is a link between the LEZ and the wider economy. Should there be wider economic measures? Are there specific outputs which relate to the economy? Aberdeen is an international energy city. We need to consider that there may not be a link between economy and traffic volumes, when considering Aberdeen City Centre as a place. Reference to the economy would be covered in the narrative of each scenario.

What will a post Covid world look like with the significant reduction in Public transport (PT) usage?. The scenarios will look at plausibility when looking at future scenarios.

The city centre is the major pollution hot spot and Aberdeen City Council have been progressing an LEZ scheme. These have been public consultation on different options and hope to committee in 2021 working towards a final scheme in 2022.

The assessment is mainly considering the car and HGV vehicle fleet and it is anticipated that this will be an all-vehicle LEZ although other option may be considered.

The significant drop in bus patronage levels should be captured within this exercise.

Edinburgh

LEZ will be implemented in 2022 with enforcement from 2023. The focus is around a 5 year horizon – 2025, therefore there is a need to consider short / to medium term disruptors.

The economic impact – How would this be measured?. Businesses will see the LEZ as detrimental, but more enlightened businesses will see the benefits of a healthy and clean environment. How do we quantify against the measures?. Qualitative survey of businesses.

How will footfall be affected?– the number of people coming into the city centre.

Annual survey – monitoring the number of people coming into the city centre so that you can understand the wider impacts of LEZ. Success factors – is it being successful in driving people on to bus / active travel? It does need to be a monitoring exercise – work ongoing will help understand success factors.

Think about mode split and proportions. Impact of Covid – 50% of employment within region in the city, acceleration in changes in retail. Maybe not quite as busy as before. Might skew impacts of monitoring. i.e. a reduction in footfall is due to Covid and changing retail, not the LEZ.

Demand level, Covid has had a significant impact. Do we still need an LEZ, will air quality still be an issue? Need to justify why we are proceeding with an LEZ.

Covid scenarios – potential reduced PT.

Need to consider fleet composition. Fleet turn-over slowdown so improvements take place more slowly or else a reduced fleet size means the withdrawal of older vehicles. Could go either way.

Important to reference a no LEZ scenario.

Fleet composition – an output or an input to the different scenarios.

Other views from different groups – business, equality.

Total travel demand – similar if not more, albeit by different modes.

Only a third of particulates come from the exhaust pipe. Diesel and electric cars are heavier, increasing tyre wear. Making the fleet cleaner is important, but there is a need to reduce traffic volumes as well.

Glasgow

Should the LEZ parameters be reviewed as a result of the pandemic? If we are successful in reducing emissions to acceptable levels, can the restrictions be extended further? We still need a scheme to implement with the current fleet/emissions. We should consider the future changes and how they impact on the case for the LEZ.

LEZ useful to ringfence the City Centre. We need to consider what is throttling the use of new initiatives. Considering normal working patterns, should we look at transition points such as travel hubs and parking strategies?.

The LEZ main purpose is to reduce NOX emissions and we need to meet the transport targets. Euro 3 buses will have to be replaced as they cannot be retro-fitted. Meeting Euro 6 bus fleet needs significant investment from the bus companies. The movement towards low emissions targets requires a number of initiatives.

Is the LEZ out of date with the new emerging technologies? Do we have the opportunity to move to zero emission zones? Do we review in the future or introduce more stricter restrictions?. At this time, there is no mechanism to introduce zero emission zones although there are discussions on this concept. There is still a case for the LEZ and it is acknowledged that the future is uncertain post-Covid with journeys to work and retail. There is a risk of challenge if uncertainty has not been considered.

GCC have been working with the taxi fleet to meet the LEZ requirement. With taxi being small businesses this is a huge investment and they have been hit hard post-Covid. Taxi fleet is needed to transport vulnerable users, so they are essential to the public transport network.

Given the unprecedented improvement in air quality during travel restrictions, could we increase the standards that are required to improve air quality?. This improvement could be short lived as the restrictions are lifted.

Complimentary measures will be needed to support the LEZ to reduce travel into the city centre. This improves the city centre environment and maintains high air quality.

3.2.2 The resulting output metrics that have been informed from the stakeholder workshops and the consultants involved in the LEZ business case activities are presented in Table 3. This includes Carbon which is a requirement of the Transport Act and recognises the importance of all people including active travel trips travelling into and within the city centres.

Table 3. Output Metrics

CITY	METRICS
Dundee, Aberdeen, Edinburgh, Glasgow	○ Change in emissions in the LEZ area: ● NOX / PM ● Carbon ○ Change to traffic volume: ● Active Travel ● Cars ● Taxis ● LGVs ● HGVs ● Buses

4. INPUT DISRUPTORS

4.1 Scene Setting

4.1.1 As an introduction to the second break-out session, workshop attendees were reminded that for the input disruptors:

- The drivers of change of immediate interest are those disruptors that most influence the output measures that we prioritise
- Some disruptors will be external e.g. population change, and others will be internal i.e. within the control or influence of the Council. This process considers more of a spectrum ranging from truly external to ones totally in control of council with many being a combination of both
- Some disruptors will be more uncertain than others
- Some candidate disruptors are themselves a product of others e.g. an increase in e-shopping and an increase in homeworking contribute as drivers of declining person trip rate
- It is helpful to have confidence that some evidence exists concerning how a disruptor's value has been changing over time to date (and any existing attempts to project forward in time).

4.1.2 The initial list of drivers presented are shown in Table 4.

Table 4. Initial Disruptors

CITY	DISRUPTORS
All 4 Cities	• Travel demand to/from existing premises – commute (e.g. reduced employment) • Travel demand to/from existing premises – commute (e.g. more home working) • Car travel demand to/from existing premises - shopping (e.g. more on-line and out-of-town shopping) • Impact on proposed bus fleet upgrades (existing fleet conversions) • Bus users switch to private car • Impact on bus patronage (related to social distancing factors) • Public appetite for Air Quality measures post-Covid?

4.2 Discussion

4.2.1 Throughout the workshops, there were periods of collective discussion on what the future may look like and the associated factors that could influence a particular outcome. In the same vein, there was also an insight into the future which stakeholders wanted to see.

4.2.2 These discussions were important in understanding the sort of futures which appear plausible and the factors, outside transport, which may influence them. Below is a summary of the observations from each group.

Dundee

Travel Demand to and from existing premises – commute. It's not just reduced employment it's a change in use or type of shops. There will be change in the city centre but uncertain what form it will take. Within the council, there is a drive to working from home and this has been accelerated and will continue. The type of employment may change .e.g. the percentage of office employment differs across different cities e.g. Edinburgh ~42% and Dundee ~20%. People working from home impacts on footfall in city centre.

People who work closer to work will be more inclined to commute and those further away will commute less/work from home more.

DCC has an objective to increase the number of people living, working and visiting Dundee. How this materialises is unknown. There could be increased residential within City centres to help improve the vitality of the city centre.

We have policies on reducing the need to travel however, now we have lots of people working from home. The question to answer is what do you want the city to look like? There are lots of pushes and pulls.

Online shopping could be a significant driver as people want to avoid busy city centres. Less so for the out of town shopping, however, there are out of town food shopping outlets.

'Twenty minutes neighbourhood' is a developing concept where people have access to all amenities they need, however, this is not necessarily developed enough to considered in this exercise.

This information will be used to shape the range of plausible futures scenarios, for example, scenarios with high levels to and from existing retail, or the opposite. These will consider the issues discussed through the scenario narrative within this process.

One consideration is the number of bus services may reduce within Dundee, so the ability to use the bus could be impacted i.e. the bus network. Bus operations may be more important that the fleet upgrade. Buses are still a major contributor of air pollution.

There is a boom in 2nd hand car sales just now and in time more people will be able to buy compliant vehicles. People may switch to the private car in the short term but in the longer term it is uncertain.

We should be cautious of what disruptors we use because the design life of the LEZ is limited. The earlier years of the post-Covid impacts could include a hangover from Covid impacts for example, social distancing/usage on buses.

We should be mindful of the different sectors of the population, specifically more vulnerable people who need to travel and its impact on buses and taxis, for example, considering taxi usage within the disruptors.

We should be ensure that the plausible scenarios include shift in travel, which is plausible within the time horizons we are considering.

Things will not go back to normal after Covid and the future will be different, moving forward.

Post Covid, the public appetite will affect the public in different ways, for example, the business community will be against anything that reduces footfall, however local residents may support LEZ's. The relevance of this as a disruptor is it could be used to describe the narrative which will influence the direction of travel.

Road user charging has featured in the media due to loss in taxation revenue with the uptake in electric vehicles. Is this not a disruptor?.

What are the timescales for this exercise? In 10 years' time an LEZ will not be required. We are trying to consider the impact of uncertainty on the process within the short to medium term e.g. 2-6 years. An outcome will be informing the lifespan of the LEZ.

General agreement that we should capture the uncertainty in fleet changes over the period being considered.

Aberdeen

The city centre could return to pre-Covid conditions, however, there could be reduced traffic and increased pedestrians in in the city centre. This is accompanied with a change in the city centre economy, however, the focus should be on a vibrant and attractive place to visit which is not car dominated.

The City Centre Masterplan (CCMP) may not arrive in time to impact on the LEZ and improve the air quality. Aberdeen is not significantly exceeding air quality levels and it is not clear on the confidence we have on the decision making process.

A concern is the strength of the recovery may not be sufficient to realise the vision of the City Centre Masterplan i.e. less people going into the city centre. The policy interventions as a result may not be as radical as is necessary.

With an LEZ in place, the city centre could provide a calmer environment with quieter traffic. This results in a better place to visit. The CCMP communication could be strengthened to let everyone know that it is coming.

We need to be aware of unintended consequences with online shopping, so the city centre will become more leisure and entertainment based. The change in culture could impact on social inclusion.

There still needs to be accessibility to the city centre and Covid has impacted on public transport, which has been an alternative method of access. The long term impact on PT could impact on PT provision and confidence in public transport.

Cities will adapt in the post-Covid world. Office working will change and as a result footfall and office rents will fall, which results in potential change in use. The fleet composition would impact on the LEZ. Need to make Aberdeen an attractive place to visit for leisure and retail, noting that it has a regional draw.

Nervous of the worst case scenario where traffic levels have return close to pre-Covid levels but this is not reflected in the city centre activity. With increase in online shopping, this could increase delivery trips. If all offices return to normal, what will happen to the trip levels?

The long term vision is clear however there may be some short term pain. For the LEZ to work the supporting infrastructure must be in place to support it e.g. bus lanes, cycling.

Edinburgh

Changes were happening but Covid has accelerated the process. Increase density of office use.

Retail already moving to online but more experiential type offer.

May be a city centre renaissance – keen to get back to enjoy the social activities and cultural life that has been missing. What does the city need to do to reflect that?.

Not a lot, the city was already geared up to cater for large numbers of people.

Place and place management – how do we continue to have a very attractive place for people to be in and how do we continue to manage – a busy animated city centre?.

Children and young families tend to go the Fort / Gyle. It's about having a day out. Retail food, cinema in a good environment, easy to access. City centre is a fantastic arena but Princes St is pretty scruffy really and the public realm is poor. Level of bus activity means that on a warm day, air quality really is an issue.

Better access – tram and active travel promote it as somewhere good to go and a relaxing experience.

Use City Mobility Plan, City Centre Transformation and the LEZ to encourage change. Big chain stores are closing or moving online, there is a need to encourage a broader mix of businesses. Could buildings be specialist stores rather than one big store?.

Piece of work around Princes St – what is the right use of the buildings going forward?.

Christmas markets could be split up more. Tourism is all so concentrated. Use events to draw people to different parts of the city centre.

Create the environment. Deal with busyness of the traffic, dealing with the accessibility, dealing with the air quality, would really underpin the city centre.

Way people travel to city centre may change – public transport to leisure.

A lot investment is going on the city centre – Edinburgh St James, tram and Haymarket which should help support growth.

LEZ is one of the many tools to create the environment that people want to come to the city more attractive.

Edinburgh St James with 1,500 spaces is a concern.

Traffic diversion – where does it go?. Impact on the LEZ boundary. Better planning within the city centre – interface between traffic and PPZ.

Strong policy provision.

Improve the environment, if the shops and attractions aren't there people won't go. The LEZ needs to help create a better environment.

Tourism is important but need to provide a balance with local residents. City centre needs to remain relevant to everyone, young and old.

Night life currently gone but needs to be encouraged to return.

Impact on offices and shops.

Glasgow

Taxi trade has been decimated by Covid, and this may change the landscape of how the city centre will look like. The city centre will recover to a degree as we are creatures of habit. People may look at alternative methods of travel e.g. active travel, and reallocation of road space, and public transport should support this and provide connectivity to get to and from the city centre.

Very uncertain, and beyond the LEZ, reduced vehicle travel in the city centre is needed. The temporary spaces for people measures may become permanent and people will realise that there are alternatives to the private car.

Following Covid, there is likely to be a reduced workforce (and resulting office space) in the city centre with more working from home. This space needs to be reallocated to other uses. The knock-on effect of reduced office space will impact on supporting businesses e.g. food retail. There may be a reduction in cars in the city centre, however, there should be more spaces for the disabled. Promoting car clubs in the city to dissuade owning a car.

There will be a degree of returning to city centre working. There should be reductions in parking in the city centre and the urban villages. More priority should be given to bus provision especially from the urban villages as they provide a service for the vulnerable. Reductions in bus services would have a disproportionate impact on vulnerable people.

The population will not give up their car (ownership) but hopefully for longer journeys. The reallocation of road space (e.g. avenues) will restrict cars but bus service provision is required to maintain the vitality of the city centre.

Covid is accelerating what is everyone is trying to achieve in Glasgow.

A decline in retail post-Covid with an increased social activity in the city centre. We need to keep the city centre vibrant and easy to get to. Reallocation of road space has helped make progress. Need to get people onto public transport.

Following a downturn, there is usually an explosion of activity, for example, the retail centre. The office space will be taken up by others business and finance centres will remain. There will still be residential and the universities will remain. There are more shared surfaces which are not clogging up the network but restricting vehicle movements. Capping the M8 and providing car parking spaces. The city will recover but it will likely be different.

Looking towards a Carbon neutral city by 2030. Retail unit may be replaced by start-up companies and a regeneration of the city will be actioned. Transport Hubs will have a massive part to play and innovated approaches to travel within the city and looking at the last mile deliveries.

There will be a massive reduction in parking spaces in the city centre e.g. spaces for people impacts. There may be more bus gates, electric vehicle and car club parking. There may be an emissions based parking permit scheme to manage demand to the city centre.

Don't want the city centre to back to the way it was. The temporary measures for spaces for people are not attractive, however once they are made permanent they can be made more attractive. The priorities in the future will reflect the travel hierarchy. Difficult decisions ahead for the local authorities. Last mile deliveries and bus service provision are very important. What happens after bus current Covid bus services subsidies are removed? Fearful of the risk to deprived areas and vulnerable people.

Should be asking economic development and retail representatives to get the opinion from other organisations. We have input from economic development in other cities and we are seeing common opinions which apply to Glasgow.

Considering Covid and climate change the LDP want to deliver an increase in residents within the city. These resident need access to transport so a car free city centre is a challenge. Safe and secure parking hubs outside the centre? Retail and office space will continue in the city centre, especially where money is involved. Young people will be desperate to get back into society.

Less traffic, more pedestrianisation and safe route activity within the city. Concerned about more working from home and the effect this will have on the city centre.

Higher priority for walking and cycling with spaces for people and cleaner buses in the future with lower private car use.

4.3 Shortlisting of Input Drivers

4.3.1 Prior to the workshop, a list of 54 possible input drivers, separated into eight themes, were identified by both SYSTRA and Jacobs staff, who are directly involved in the detailed LEZ modelling and appraisal.

4.3.2 This list was circulated to the stakeholders ahead of each workshop, where they were requested to review the list of disruptors and add any they felt were missing, then score each disruptor in terms of likelihood and impact (1-lowest and 10 highest). The purpose of this task was to sift out the most important drivers of uncertainty from the stakeholders' perspectives and present these at the workshop for refinement and confirmation.

4.3.3 It was acknowledged that the period in which the current LEZ would remain applicable is uncertain, but limited, given the continued uptake of compliant vehicles within the vehicle fleet. As such, the disruptors should be considered within a three to ten year time horizon.

4.3.4 During the workshop, the disruptors presented in Table 5 were agreed. Further post-workshop feedback on the disruptors within the workshop has resulted in the following additions to the list of disruptors:

Dundee
- Changes to the function of office space (shared offices / hired office space)

Aberdeen
- Impact on bus patronage (related to social distancing factors)

Edinburgh
- Changing balance between visitors and residents
- Speed of transition to electric cars, taxis and LGVs

Glasgow
- No changes proposed

Table 5. Agreed Disruptors

CITY	DISRUPTORS
Dundee	• Travel demand to/from existing premises – commute (e.g. reduced employment) • Travel demand to/from existing premises – commute (e.g. more home working) • Car travel demand to/from existing premises - shopping (e.g. more on-line and out-of-town shopping) • Impact on proposed bus fleet upgrades (existing fleet conversions) • Bus users switch to private car • Impact on bus patronage (related to social distancing factors) • Public appetite for air quality measures post-Covid?
Aberdeen	• Travel demand to/from existing premises – commute (e.g. more home working) • Travel demand to/from existing premises – commute (e.g. more internet-based) • Car travel demand to/from existing premises - shopping (e.g. more on-line and out-of-town shopping) • Impact on proposed bus fleet upgrades (existing fleet conversions) • Changes to the function of office space (shared offices / hired office space) • Impact on economy
Edinburgh	• Travel demand – change in commuting patterns (e.g. more home working / internet based) • Car travel demand – change in shopping patterns, convenience and comparison goods (e.g. more on-line and out-of-town shopping) • Changing balance between visitors and residents • Impact on proposed bus fleet investment (including fully electric vehicles e.g. Service 30) • Speed of transition to electric cars, taxis and LGVs • Changes to the function of office space (shared offices / hired office space)
Glasgow	• Impact on proposed bus fleet upgrades (existing fleet conversions) • Increase in new purchase of low carbon vehicles • Decrease in purchase of diesel vehicles • Impact on bus patronage (related to social distancing factors) • Changes to the function of office space (shared offices / hired office space) • Shift in policy (further) towards sustainable/healthier modes (walk/cycle) • Delay on committed infrastructure schemes

4.3.5 A full list of the disruptors is presented in **Appendix B** along with the average stakeholder scoring. The highlighted scores indicated the highest ranking disruptors which have been considered.

4.3.6 The feedback received on the disruptors has resulted in the following changes to the list of disruptors. The final list of Drivers are presented in the following tables. This list broadly aligns with the scoring in Appendix B:

Dundee

- Changes to the function of office space (shared offices / hired office space)
- Impact on proposed bus operations
- Changes in fleet composition

Table 6. Final Dundee Disruptors

CITY	DISRUPTORS
Dundee	• Travel demand to/from existing premises – commute • Car travel demand to/from existing premises - shopping • Impact on proposed bus operations • Changes in fleet composition • Impact on bus patronage related to social distancing factors • Public appetite for Air Quality measures post-Covid?

Aberdeen

- Impact on bus patronage (related to social distancing factors)
- Impact on wider economy rather than specifically oil

Table 7. Final Aberdeen Disruptors

CITY	DISRUPTORS
Aberdeen	• Travel demand to/from existing premises – commute • Car travel demand to/from existing premises - shopping • Impact on bus patronage • Impact on proposed bus fleet upgrades • Changes to the function of office space • Impact on wider Aberdeen economy

Edinburgh

Table 8. Final Edinburgh Disruptors

CITY	DISRUPTORS
Edinburgh	• Travel demand to/from existing premises – commute • Car travel demand to/from existing premises - shopping • Changing balance between visitors and residents • Impact on proposed bus fleet investment • Speed of transition to electric cars, taxis and LGVs

Glasgow

- Decrease in new diesel cars not specifically due to Covid but will be maintained.

Table 9. Final Glasgow Disruptors

CITY	DISRUPTORS
Glasgow	• Impact on proposed bus fleet upgrades • Increase in new purchase of low carbon vehicles • Decrease in purchase of diesel vehicles • Impact on bus patronage • Changes to the function of office space • Shift in policy (further) towards sustainable/healthier modes • Delay on committed infrastructure schemes

4.4 Workshop Remarks

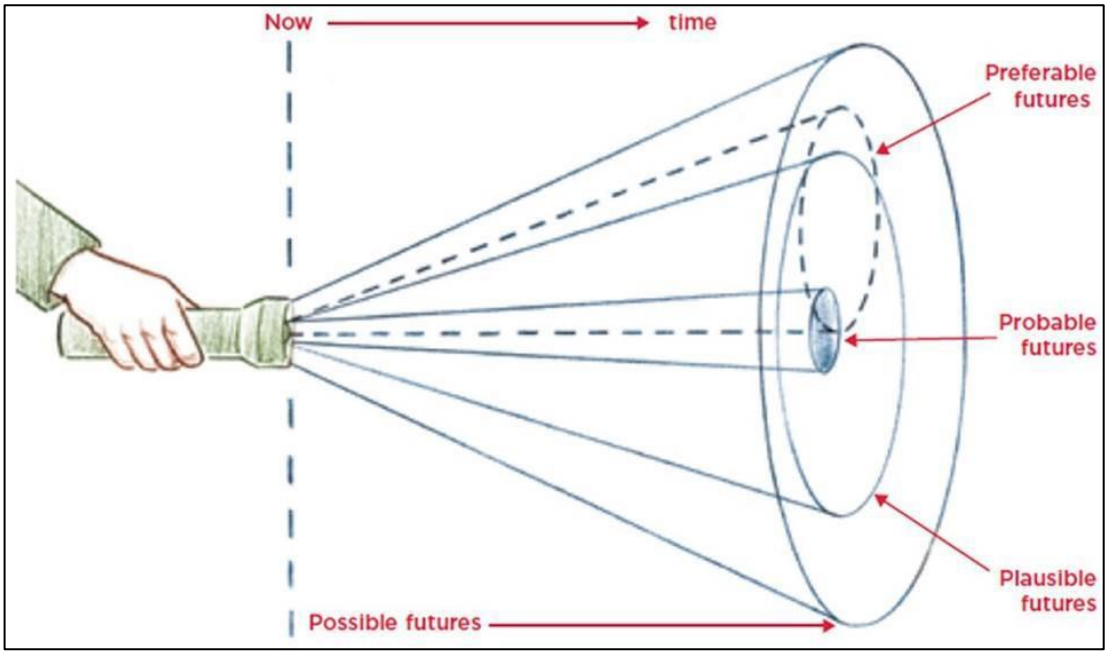
4.4.1 The general view was that the workshops have been valuable in understanding the factors that are important to each city and the different views shared on how Cities may look post-Covid. It is important that contact with each local authority is maintained throughout the process.

5. SCENARIO PLANNING APPROACH

5.1 Scenario Planning Principles

5.1.1 The high level requirement of the Scenario Planning Process and Tool is to provide a means by which the impacts of the LEZ can be gauged within the context of various uncertain plausible futures.

5.1.2 To understand uncertainty within the context of the LEZ, multiple plausible futures were developed with knowledge of the variables and relationships but not necessarily the confidence in the magnitude of the uncertainty. The different types of future that have been considered and where Scenario Planning flourishes is illustrated below[1].



5.1.3 The inputs to the Tool i.e. the make-up of the plausible futures, were defined by the uncertainty drivers defined and agreed by the stakeholders. The Tool functions by using information and known relationships from complex models, such as the traffic and urban air quality models, to predict how well (or otherwise) the outputs of a potential LEZ scheme might align with the LEZ objectives.

5.1.4 It should be recognised that the Process and Tool attempts to use current understanding and relationships to predict answers to qualitative, future-facing questions. There are different possible approaches that could influence how a Scenario Planning Process and Tool is developed and this is discussed further in the process adopted for the Nation Transport Strategy[2].

5.1.5 The work undertaken to date on the LEZ schemes point towards a *'preferred future'*. Scenario Planning can allow for the identification of those *probable*, *plausible* or *possible futures* which overlap with the *'preferred future'*.

[1] Image reproduced from https://media.nesta.org.uk/documents/dont_stop_thinking_about_tomorrow.pdf

[2] https://www.transport.gov.scot/publication/scenario-planning-process-report/

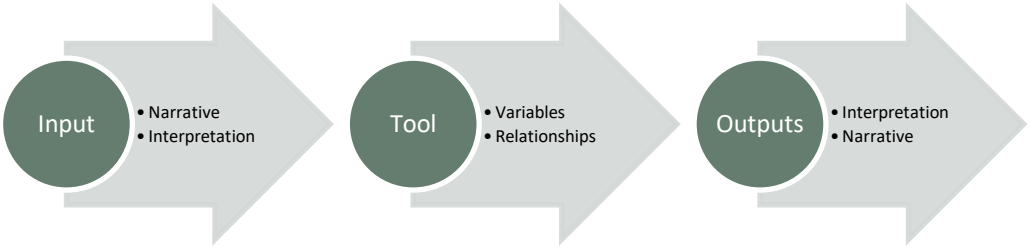
5.2 Scenario Planning Process and Tool

5.2.1 The Scenario Planning Process allows a range of plausible future scenarios to be defined using various important and likely disruptors. Each scenario is defined using a range of inputs (whether quantitative or qualitative) derived from an input narrative which are applied to the Scenario Planning Tool. The Scenario Planning Tool is a simple spreadsheet model that links the inputs and metrics using known relationships. Outputs for each scenario are generated by the tool and these are integrated into the scenario narrative. These scenarios, or a subset of, are used as a reference case where a scheme or in this case, the LEZ, is applied to understand how it performs in the context of each scenario.

5.2.2 The impact of the LEZ is quantified by understanding and predicting the impact (again, quantitative or qualitative) it will have on each scenario. The Scenario Planning Tool quantifies the impact of the LEZ scheme and the metrics from the Scenario Planning Tool are then translated back into an output narrative to complement the input narrative.

5.2.3 The process, illustrated below provides an opportunity to think through:

- Who will be impacted on by the LEZ and how will they be affected;
- Which of the outcomes will the LEZ support
- Whether the LEZ likely presents any tensions/negative impacts on the outcomes.



5.2.4 The process includes an opportunity to document any evidence to support the conclusion that the LEZ will have an impact on the agreed outcomes in the manner intended or if any further detailed modelling is required.

5.2.5 The Scenario Planning Tool is designed to complement the work undertaken to date and understand if any further modelling of the LEZ schemes is required to consider uncertainty.

6. PLAUSIBLE FUTURES TESTING

6.1 Disruptors

6.1.1 A review of the disruptors for each city combined with the discussions surrounding them within the workshops confirmed that whilst there were subtle differences between the cities the themes were common. With this in mind, a generic list of disruptors was defined (A to L) which are seen as suitably representative to be used for all the cities. This is presented in Table 10.

Table 10. Generic Disruptors

Derived Disruptors (Dundee)	Derived Disruptors (Aberdeen)	Derived Disruptors (Glasgow)	Derived Disruptors (Edinburgh)	Final Generic Disruptors	
Travel demand to/from existing premises – commute	Travel demand to/from existing premises – commute		Travel demand – change in commuting patterns (e.g. more home working / internet based)	**Travel demand to/from existing premises – commute**	**A**
Car travel demand to/from existing premises - shopping	Car travel demand to/from existing premises - shopping		Car travel demand – change in shopping patterns, convenience and comparison goods (e.g. more on-line and out-of-town shopping)	**Travel demand to/from existing premises - shopping**	**B**
Impact on proposed bus operations				**Impact on proposed bus operations**	**C**
Changes in fleet composition	Impact on proposed bus fleet upgrades	Impact on proposed bus fleet upgrades	Speed of transition to electric cars, taxis and LGVs	**Changes in fleet composition**	**D**
		Increase in new purchase of low carbon vehicles	Impact on proposed bus fleet upgrades		**E**
		Decrease in purchase of diesel vehicles			**F**
Impact on bus patronage related to social distancing factors	Impact on bus patronage	Impact on bus patronage		**Impact on bus patronage**	**G**
Public appetite for Air Quality measures post-Covid?				**Public appetite for Air Quality measures post-Covid?**	**H**
	Changes to the function of office space	Changes to the function of office space	Changes to the function of office space (shared offices / hired office space)	**Changes to the function of office space**	**I**
	Impact on wider Aberdeen economy		Changing balance between visitors and residents	**Impact on wider economy**	**J**
		Shift in policy (further) towards sustainable/healthier modes		**Shift in policy (further) towards sustainable/healthier modes**	**K**
		Delay on committed infrastructure schemes		**Delay on committed infrastructure schemes**	**L**

6.2 Output Metrics

6.2.1 The output metrics are used to understand the performance of the city centre in each of the plausible future scenarios with consideration of the LEZ objectives. The two broad categories are: emissions and vehicular traffic, which represents the indicators for the LEZ objectives for each city; Aberdeen, Dundee, Edinburgh and Glasgow, presented in Table 1.

6.3 Scenario Planning Tool

6.3.1 An important aspect of the tool is that there is a level of judgment when populating inputs and interpreting the outputs. The tool is designed to inform the likely LEZ outcomes, not precisely measure the impact of an LEZ. The tool has been tested in advance of active use to ensure it is producing intuitive results which are credible, coherent and comprehensible. Examples are discussed in Section 5.5.3.

6.3.2 As discussed previously, the structure of the tool comprises three core elements:

- Inputs;
- Impacts; and
- Metrics.

6.3.3 Again, the application of the tool uses these elements to form a more comprehensive structure:

- Plausible Future Inputs;
- Plausible Future Assessment;
- LEZ Inputs; and
- LEZ Future Assessment.

6.4 Plausible Scenarios

6.4.1 The most likely disruptors (A to L in Table 10) which will have the biggest impact, are individually scored using a 7 point scale (from -3 to 3) to understand any change will have on emissions and travel demand .

6.4.2 The next stage is to consider the relationships between each disruptors, e.g. what disruptors are linked with other disruptors? For example, changes to travel demand for commuting could be linked with changes to bus operations and travel demand for shopping, amongst others. Table 11 details the proposed relationships (1 denotes a relationship, 0 denotes no plausible relationship) identified between the disruptors which have been used to derived the plausible future scenarios.

6.4.3 An example of the relationships between the disruptors being used to derive plausible scenarios is starting with Disruptor A. Table 11 confirms that A could be linked with B, B is linked with C, C is linked with H. This linkage creates a plausible scenario, with a narrative: *Increased travel demand (commuting) resulting in increased travel demand (shopping), improved bus operations and more buoyant economy.* Different plausible scenarios can be developed from each disruptor or 'Driver' (Driver being the initial disruptor that drives the scenario).

Affector	Affected →	A	B	C	D	E	F	G	H	I	J
↓ Variant	Disruptor Relationship 0 = No, 1 = Yes	Increased Travel demand to/from existing premises – commute	Increased Travel demand to/from existing premises - shopping	Reduced proposed bus operations	Improved in fleet composition/compliance level	Impact of social distancing on bus patronage	Improved Public appetite for Air Quality measures post-Covid?	Changes to the function of office space e.g. Reduced office space tranferred to residential/Retail	Boyant wider economy	Further Shift in policy towards sustainable/healthier modes	Delay on committed infrastructure schemes
A	Increased Travel demand to/from existing premises – commute	0	1	1	0	0	1	1	0	0	0
B	Increased Travel demand to/from existing premises - shopping	1	0	1	0	0	1	0	0	0	0
C	Reduced proposed bus operations	1	1	0	1	0	0	0	1	1	0
D	Improved in fleet composition/compliance level	0	0	0	0	0	1	0	0	1	0
E	Impact of social distancing on bus patronage	1	1	1	0	0	0	1	1	0	0
F	Improved Public appetite for Air Quality measures post-Covid?	0	0	0	0	0	0	0	0	1	1
G	Changes to the function of office space e.g. Reduced office space tranferred to residential/Retail	1	1	1	0	0	1	0	0	1	1
H	Boyant wider economy	1	1	1	1	0	0	0	0	0	1
I	Further Shift in policy towards sustainable/healthier modes	0	0	1	1	0	1	0	0	0	1
J	Delay on committed infrastructure schemes	0	0	0	0	0	1	0	0	1	0

Table 11. Disruptor Relationships

6.4.4 A total of 40 plausible future scenarios were created (10 Drivers with 4 variations in direction) with a short descriptive narrative and a corresponding set of input parameter values for each. Each plausible future was fed into the Scenario Planning Tool to confirm the logical nature of their metrics.

6.4.5 For example, for Driver A being the primary influence, the 4 scenario variants were:

- **A1**: 'Optimistic Outcome' –
  A buoyant economy increases travel demand (commuting) resulting in increased travel demand (shopping), improved bus operations and continued investment in network infrastructure improvements
- **A2**: 'Realistic Downturn' –
  Following an economic downturn, decreased travel demand (commuting) resulting in decreased travel demand (shopping), results in reduced bus operations
- **A3**: 'Placemaking Outcome'-
  Post-Covid, decreased travel demand (commuting) results in reduced office space. This change in city centre function from office to retail / residential helps placemaking in the city centre area. From this, the public appetite for air quality measures becomes more important, which may lead to further shift in policy for sustainable transport and fast-tracking of sustainable transport schemes
- **A4**: 'Alternative Impact of Increase in Commuting'
  Increased travel demand (commuting) resulting in normal or increased function of office space (not working at home as much as during COVID). Bus demand (& operations) would be retained with non- compliant buses remaining on the network, resulting in poorer air quality out-with core city centre area. This may force Local Authories/Government to shift policy further to more healthier modes / improve fleet

6.4.6 The scenario planning tool calculates a score for each scenario, using the 7 point scale score (-3 to 3) for each disruptor.

6.4.7 Using the above example Scenario A1, the cumulative impact score was calculated as detailed in Table 12. Note the polarity application (or direction of travel) to the score for each disruptor. The resulta score for scenario A1 was 12 for emissions and 17 for traffic volumes, with a combined total of 29.

6.4.8 Each scenario Driver with four plausible future is illustrated in Table 13 along with the respective scoring for emissions and travel volumes.

Table 12. Example of Scenario Scoring (Scenario A1)

Polarity		Scenarios	NOX emissions in the LEZ area:	Carbon	Active Travel	Cars	Taxis	LGVs	HGVs	Buses
1	1	Increased Travel demand to/from existing premises – commute	3	1	1	2	1	0	0	0
1	2	Increased Travel demand to/from existing premises - shopping	3	1	1	2	1	0	0	0
-1	3	Reduced proposed bus operations	-2	-1	1	1	1	0	0	-2
1	8	Boyant wider economy	2	1	1	2	1	2	2	1
-1	10	Delay on committed infrastructure schemes	1	1	-2	1	1	0	0	-1
		Sum	**9**	**3**	**4**	**4**	**1**	**2**	**2**	**4**
		Emissions Total		**12**						
		Travel Volumes								**17**

Table 13. Extended List of Plausible Futures

SCENARIO			CUMULATIVE IMPACT		
Scenario Driver	Scenario Detail	Scenario Variant	Emissions	Travel Volumes	TOTAL
A	Increased Travel demand to/from existing premises – commute	A1	12	17	29
		A2	-12	-17	-29
		A3	-12	-1	-13
		A4	9	2	11
B	Increased Travel demand to/from existing premises - shopping	B1	6	13	19
		B2	-7	2	-5
		B3	-12	-16	-28
		B4	-2	5	3
C	Reduced proposed bus operations	C1	-9	2	-7
		C2	1	5	6
		C3	-11	-1	-12
		C4	0	15	15
D	Improved in fleet composition/compliance level	D1	-8	2	-6
		D2	-7	-3	-10
		D3	2	-2	0
		D4	-2	-8	-10
E	Impact of social distancing on bus patronage	E1	3	6	9
		E2	1	-3	-2
		E3	1	8	9
		E4	-11	0	-11
F	Improved Public appetite for Air Quality measures post-Covid?	F1	-6	1	-5
		F2	6	-1	5
		F3	-5	3	-2
		F4	-7	-3	-10
G	Changes to the function of office space e.g. Reduced office space tranferred to residential/Retail	G1	-11	-8	-19
		G2	1	0	1
		G3	-5	1	-4
		G4	3	4	7
H	Boyant wider economy	H1	-3	11	8
		H2	2	9	11
		H3	9	18	27
		H4	3	-11	-8
I	Further Shift in policy towards sustainable/healthier modes	I1	-8	2	-6
		I2	-7	-9	-16
		I3	-6	2	-4
		I4	6	-2	4
J	Delay on committed infrastructure schemes	J1	6	-2	4
		J2	-4	0	-4
		J3	-7	-8	-15
		J4	-8	2	-6

6.4.9 Any With-LEZ scenario can then be compared with its corresponding without-LEZ plausible future, to understand the predicted its impact.

6.4.10 In order to sift the above list of plausible scenarios into a more concise set of scenarios which encompass the range of emissions and travel relationships, Figure 1 illustrates the criteria for selection (one scenario for each quadrant).

Emissions	Trips
+	+
+	-
-	+
-	-

Figure 1. Scenario Sifting Criteria

6.4.11 Four short listed scenarios were identified to reflect the different viewpoint in terms of both emissions and trip making i.e. one scenario from each quadrant, (illustrated in Figure 2). The specific scenario selected does not necessarily have to be the worst case in each quadrant, only the direction of travel is important at this stage e.g. low emissions and reduced trips.

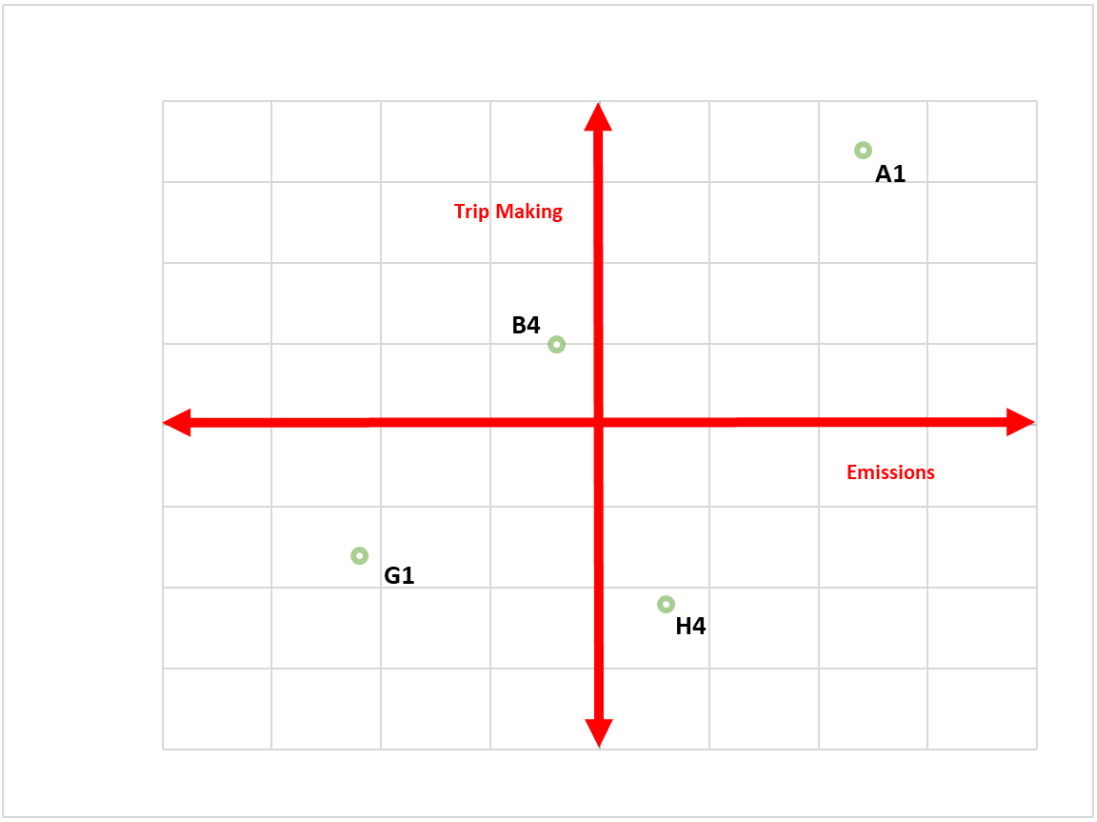


Figure 2. Four Short-listed Futures

6.4.12 The scenario names detailed in Figure 2 correspond with the variants listed in Table 13.

6.4.13 Each scenario provides an insight into what a future could look like in terms of differing outcomes. The narrative which defines the four plausible futures therefore were:

- A1: 'Bounce Back' - Increased commuting and retail travel demand, improved bus operations and more buoyant economy along with a suppressed enthusiasm for compliant vehicles.

- H4: 'Coping as Best We Can' - A poorly performing economy results in delayed infrastructure investment, a lack of shift to healthier modes and fleet, and a lack of appetite for additional air quality measures
- G1: 'Brave New World' - Following Covid there has been a reduction in office space which has transferred to other uses. With this a general reduction in traffic in the city centre for both commuting and shopping, however the uptake in compliant vehicles continues.
- B4: 'It Could Have Been Worse' - Increased retail travel demand resulting in increased congestion however public appetite for further Air Quality measures, which supports further policy shift towards more sustainable measures including a zero-Carbon fleet.

6.4.14 Each of the four pre-defined plausible futures have been run through the tool in preparation for testing the LEZ. The performance of each scenario against transport policy has been illustrated in RBG in Figure 3 and Table 14 as follows:

- Red – Negative effect (Score <-1)
- Blue – Neutral i.e. little change (Score of -1 to 1)
- Green – Positive effect (Score >1)

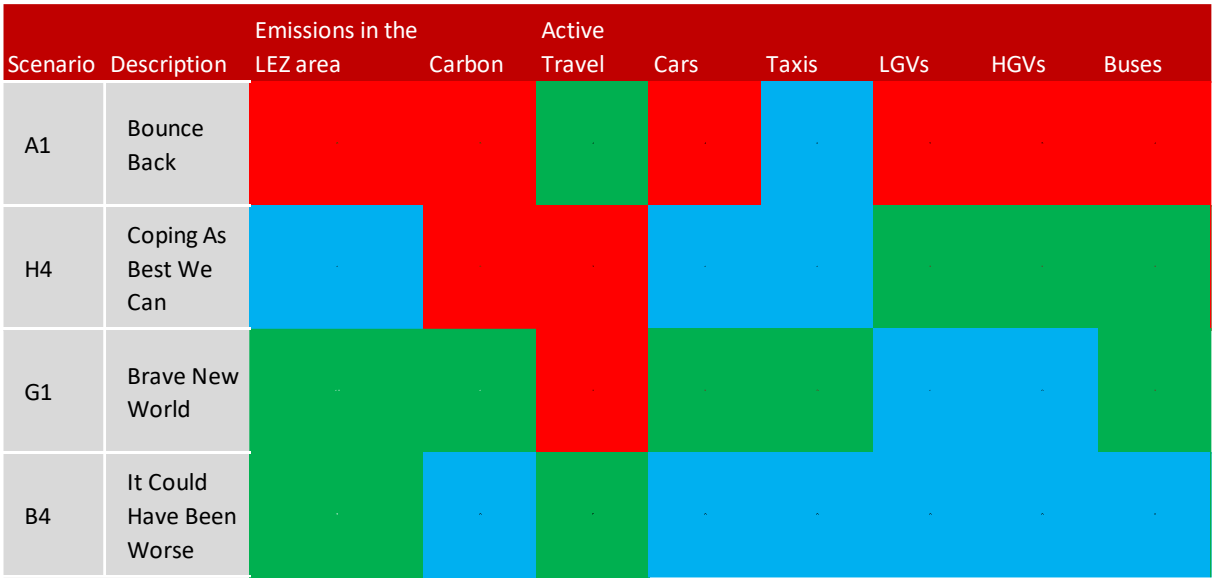


Figure 3. RBG Plausible Without-LEZ Scenarios

Table 14. Plausible Without-LEZ Scoring

Scenario	NOX emissions in the LEZ area:	Carbon	Active Travel	Cars	Taxis	LGVs	HGVs	Buses
A1	9	3	4	4	1	2	2	4
H4	1	2	-7	1	1	-2	-2	-2
G1	-10	-1	-3	-2	-2	1	0	-2
B4	-2	0	5	0	0	0	0	0

6.5 Testing of LEZ on Different Futures

6.5.1 Following the definition of the without-scheme scenarios, the LEZ scheme will be tested against each scenario. The LEZ Scenario is assumed to deliver the following benefits to the city centres however it is recognised that the impact will vary depending on each scenario:

- Reduction in Emissions
- Increase in Active Travel
- Reduction in car trips
- No change to LGVs, HGVs and Buses (assumed to be compliant)

6.5.2 It is recognised that the LEZ proposals have specific legislation with respect to compliant and non-compliant vehicles. This results in the impact of an LEZ varying depending on each specific scenario.

6.5.3 Table 15 summarises the weighted scoring applied to each of the four scenarios, as a result of the LEZ scheme.

Table 15. Impact of LEZ on Scenario Scoring

Scenario	NOX emissions in the LEZ area:	Carbon	Active Travel	Cars	Taxis	LGVs	HGVs	Buses
A1	-9	2	2	-6	-3	-2	-2	0
H4	-2	1	1	-2	-1	0	0	0
G1	-1	0	0	-1	0	-1	-1	0
B4	-1	0	0	-1	0	-1	-1	0

6.5.4 Table 15 shows, for example, that the LEZ will have a significant impact on NOX emissions in scenario A1 (increased travel demand and emissions) but less so in the other scenarios (where trips or emissions are reduced).

6.5.5 The outcome of this testing of the LEZ, results in impacts against emissions and vehicles as illustrated in Figure 4 and Table 16.

Scenario	Description	Emissions in the LEZ area	Carbon	Active Travel	Cars	Taxis	LGVs	HGVs
A1	Bounce Back							
H4	Coping As Best We Can							
G1	Brave New World							
B4	It Could Have Been Worse							

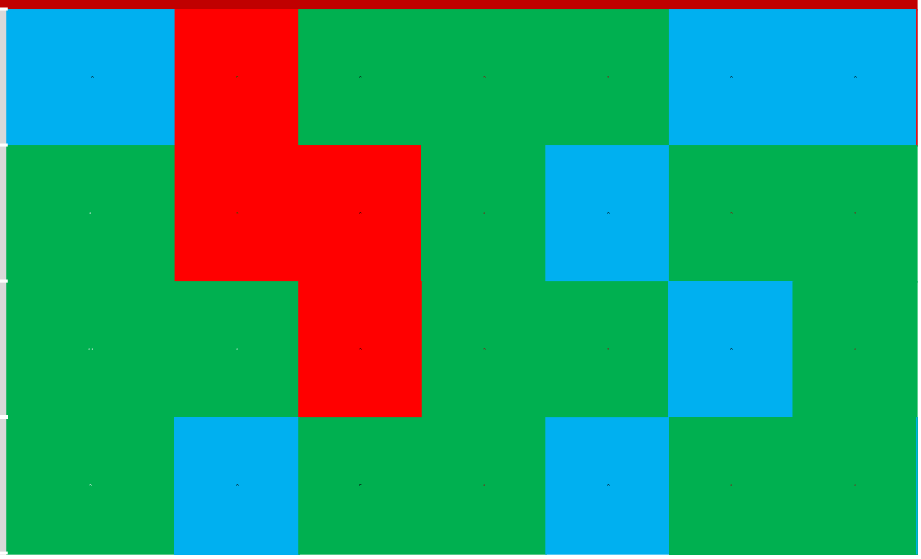


Figure 4. RGB Plausible With-LEZ Futures

Table 16. Plausible With-LEZ Scoring

Scenario	NOX emissions in the LEZ area:	Carbon	Active Travel	Cars	Taxis	LGVs	HGVs	Buses
A1	0	5	6	-2	-2	0	0	4
H4	-1	3	-6	-1	0	-2	-2	-2
G1	-11	-1	-3	-3	-2	0	-1	-2
B4	-3	0	5	-1	0	-1	-1	0

6.5.6 The narrative of the outcome of testing the LEZ against each future is summarised below.

- Scenario A1 'Bounce Back': With the introduction of the LEZ the volume of non-compliant vehicles have reduced which has demonstrated a marked improvement in the NOX levels within the city centre however, traffic will re-route around the city centre. The volume of vehicles within the LEZ area has reduced and active travel has increased as a result.
- Scenario H4 'Coping as Best We Can': The LEZ has reduced the emissions within the LEZ area to an acceptable level however there is still re-routeing vehicles. The reduction in vehicular traffic has reduced below current levels however limited active travel increases have been achieved.
- Scenario G1 'Brave New World' & B4 'It Could Have Been Worse': The emission levels are still at acceptable levels with little change as a result of the LEZ scheme.

6.5.7 Whilst the LEZ may achieve a consistent goal in terms of NOX emissions, it is important to understand that the consequences of a LEZ may vary e.g. re-distribution of traffic effects.

7. CONCLUSIONS & RECOMMENDATIONS

7.1 Conclusions

7.1.1 This note sets out the consideration of uncertainty to assist decision makers. Through stakeholder engagement, the most likely disruptors that will have the highest impact have been identified and used to shape plausible futures. In addition, the key metrics have been set out to measure the impact of the LEZ against the objectives.

7.1.2 A scenario planning tool has been developed and has explored the scenarios which have resulted in an increase/decrease in emissions and trip making. These scenarios have been used to understand the impact of an LEZ scheme.

7.1.3 This process demonstrates that the impact of the Low Emission Zones will vary between each city depending on their specific traffic levels and fleet composition. But importantly, the LEZ will protect the city centres by preventing non-compliant vehicles from entering them.

7.1.4 Whilst the impact of the LEZ may vary across each city in terms of NOX emissions, the outcome is likely to be very similar with the level of emissions limited to a reduced value compared to pre-LEZ levels. It is acknowledged that the LEZ will have greater impact in specific future scenarios compared to others, examples of which are discussed below:

- With high levels of compliance and reduced traffic levels, the LEZ may have a limited effect however the LEZ protects the desired outcome with a reduced level of emissions in the city centres. The LEZ does also maintain the momentum of applying legislation to protect the environment.
- With lower uptake of compliant vehicles, the LEZ provides the mechanism to secure the reduced emissions levels in the future and protect the city centre environment; however, there may be consequences of vehicle re-routeing.
- With higher traffic levels and the likely increase in volumes of non-compliant vehicles, the LEZ manages the number of non-compliant vehicles entering the city centres, however again there may be consequences of vehicle re-routeing as would be expected of a scheme that prohibits access for non-compliant vehicles.

7.1.5 It is acknowledged that where significant traffic re-routing may occur as a result of the LEZ scheme, there may be an increase in the local Carbon footprint. However, this marginal negative consequence of the LEZ proposals should be viewed in the context of the more significant benefits of the scheme for the local air quality.

7.1.6 A significant amount of work has been undertaken to date developing models and using one future scenario. The role of the LEZ is clear, as is the understanding of what it may achieve for a city centre, however each future scenario will have varying consequences as a result of the LEZ. To that end, it is suggested that each city should consider modelling alternative scenarios and Section 6.2 sets out potential sensitivity test scenarios that could be considered by each of the four cities.

7.1.7 The LEZ objectives across all four cities includes references not only to emissions but other supporting strategies which promote reducing traffic levels, active/sustainable travel, and improving the city centre as a place to visit. This was a consistent theme discussed throughout the consultation workshops and is consider very important when considering uncertainty over what city centres will look like post-Covid. This reiterates the hypothesis that the LEZ should

not be considered in isolation, but is part of an overall strategy to meet the national, regional and local visions for the city centres.

7.2 Recommendations

7.2.1 For each of the four LEZ cities, the four identified plausible futures (with varying traffic demand and vehicle compliance levels) have been considered against the model assessments undertaken to date. From this, to address uncertainty, recommendations for further sensitivity testing of the proposed LEZ schemes, under alternative future scenarios, are provided.

7.2.2 It should be noted that the future network which the primary LEZ model testing has been undertaken ('core testing') varies between each city. For example, Aberdeen LEZ testing has assumed growth to 2024, whereas Dundee and Edinburgh model testing has assumed a baseline network demand level for the scheme assessment.

7.2.3 These different compliance and growth assumptions for each city are each valid and robust approaches to the assessment of the LEZ schemes. What is critical, is that each city considers the potential impact of the alternative future scenarios within their assessment.

7.2.4 It should also be noted that there are significant differences in the traffic network conditions within each city which have defined the testing strategies to date, and will also define what alternative plausible future scenarios are considered for sensitivity testing. These include:

- Glasgow and Edinburgh LEZ areas include demand management measures to restrict traffic growth (e.g. car parking strategies). Aberdeen and Dundee LEZ areas have capacity to accommodate traffic and economic growth.
- Dundee and Glasgow LEZ assessments are primarily concerned with the impact of displaced traffic from originating and destinating within the LEZ area. Edinburgh and Aberdeen LEZ assessments include the impact of through routing traffic relocation
- Dundee LEZ does not need to consider the parallel impact of other proposed infrastructure measures. Glasgow LEZ needs to consider measures which conflict with the impact of the LEZ, whilst Aberdeen LEZ needs to consider complimentary measures.
- Each city has subtly varying objectives for the LEZ, including the requirement to specifically achieve the air quality compliance levels or more generally to reduce emissions.

7.2.5 Tables 17 to 20 outlines the consideration of scenario planning to each of the four cities in turn. Each city list four scenarios which have been derived through this process. The scenarios listed (See 5.4.7) should be modelled using the following guide:

1. Scenario B4 'It Could Have Been Worse': The fleet projections follow pre-Covid trends provided by SEPA and the traffic growth is in line with current Local Development Plan Allocations/uptake.
2. Scenario H4 'Coping as Best We Can': Following an economic downturn, the fleet projections are lower than pre-Covid trends provided by SEPA and traffic shrinkage is experienced, similar to the 2010 downturn. Where appropriate, reduce bus demand should be accounted for as a sensitivity test, as set out in section 6.2.7.

3. Scenario G1 'Brave New World': The fleet projections follow pre-Covid trends provided by SEPA however behavioural change results in traffic levels remaining consistent with pre-Covid levels.
4. Scenario A1 'Bounce Back': The fleet projections are lower than pre-Covid trends provided by SEPA and the traffic growth continues due to Increased commuting and retail travel demand, similar to Scenario B4.

Table 17. Scenario Planning Application to Aberdeen LEZ

Scenario Planning Scenarios			Scenario Detail		Traffic Modelling		
No.	Emmissions	Trips	Fleet Compliance	Traffic Flow	Core Testing	Sensitivity Testing	Rationale
1	-	+	High Level uptake	High Growth	✓		This is the 2024 Ref Case scenario from which the initial 8 LEZ scenarios are to be assessed
2	+	-	Low Level uptake	Network Shrinkage		✓	Supporting evidence
3	-	-	High Level uptake	Low Growth		✓	Supporting evidence
4	+	+	Low Level uptake	High Growth		x	Scenario 1 suggests network capacity issues so any additional traffic demand from a lower compliance level would restrict availability for growth. Therefore, Scenario 4 is not plausible for Aberdeen

Table 18. Scenario Planning Application to Dundee LEZ

Scenario Planning Scenarios			Scenario Detail		Traffic Modelling		
No.	Emmissions	Trips	Fleet Compliance	Traffic Flow	Core Testing	Sensitivity Testing	Rationale
1	-	+	High Level uptake	High Growth		x	Scenario 4 is the worst case scenario for Dundee in terms of traffic displacement from the city centre
2	+	-	Low Level uptake	Network Shrinkage		✓	Consideration of a shriking economy and the potential lower benefits of a LEZ
3	-	-	High Level uptake	Low Growth		x	This is an intermediate scenario that would not provide any more information to Scenario 4
4	+	+	Low Level uptake	High Growth	✓		This is the future year scenario that the proposed LEZ options have been tested on to date

Table 19. Scenario Planning Application to Glasgow LEZ

Scenario Planning Scenarios			Scenario Detail		Traffic Modelling		
No.	Emmissions	Trips	Fleet Compliance	Traffic Flow	Core Testing	Sensitivity Testing	Rationale
1	-	+	High Level uptake	Pre-COVID Levels	✓		Testing undertaken to date includes traffic growth with a variation in low and high levels of fleet uptake
2	+	-	Low Level uptake	Network Shrinkage		✓	Demand management in Glasgow (via car parking strategies) are likely to restrict growth so lower growth sensitivity testing deemed a plausible scenario
3	-	-	High Level uptake	Low Growth		✓	As per Option 2
4	+	+	Low Level uptake	Pre-COVID Levels	✓		As per Option 1

Table 20. Scenario Planning application to Edinburgh LEZ

Scenario Planning Scenarios			Scenario Detail		Traffic Modelling		
No.	Emmissions	Trips	Fleet Compliance	Traffic Flow	Core Testing	Sensitivity Testing	Rationale
1	-	+	High Level uptake	Pre-COVID Levels		x	Not required, as demand management (via car parking strategies) should restrict increased traffic growth
2	+	-	Low Level uptake	Network Shrinkage	✓		As per Option 3 but zero growth tested as opposed to traffic network shrinkage
3	-	-	High Level uptake	Low Growth	✓		Testing undertaken to date includes no growth with a variation in low and high levels of fleet uptake
4	+	+	Low Level uptake	Pre-COVID Levels		x	As per Option 1

7.2.6 As detailed in the above tables, there are suggested alternative future scenarios to be considered by each local authority for potential sensitivity testing of their proposed LEZ measures.

7.2.7 In addition to the above, a further future scenario (within Scenario 2, with a poorly performing economy) with a potential reduction in public transport service provision. Traffic services may reduce due to a lower patronage resulting from COVID-19 however the magnitude of this may vary by city depending on the local conditions. There is applicable functionality within the public transport element of SEPA's National Framework Air Quality Model. This feature can assess the potential impact to emission levels if the volume of public transport within the LEZ area is reduced from pre-COVID levels. It is proposed that this is the most suitable tool and should be used instead of detailed traffic modelling.

7.2.8 In terms of a timeline, these sensitivity tests are proposed to be consistent with the core testing background scenario year (2022-2024). It is recognised that the LEZ adherence criteria will only provide impact to the network for a finite period of time. The consideration of scenario planning is not therefore to consider how the network will change in the longer term, but to consider the potential plausible futures over the short (Post-COVID) to medium term.

7.2.9 The objectives of undertaking the proposed sensitivity tests are to provide evidence that the LEZ schemes are robust to variations in network conditions that may occur in a post-pandemic world. Each city may undertake different sensitivity scenarios, but they will have all considered plausible futures under a consistent framework.

APPENDIX A

A.1 Dundee Workshop Attendees

NAME	ORGANISATION
Malcolm Neil	SYSTRA
Grant Davidson	Jacobs
Boris Johansson	SYSTRA
Keith Gowenlock	Jacobs
Christopher Shaw	SYSTRA
Ewan Gourlay	Dundee City Council
Iain Black	Dundee City Council
Tom Stirling	Dundee City Council
John Berry	Dundee City Council
David Gray	Dundee City Council
Jamie Landwehr	Dundee City Council
Vincent McInally	Transport Scotland
Stephen Cragg	Transport Scotland
Colin Gillespie	SEPA
Nicola Ferguson	Dundee City Council
Niall Gardiner	Tactran

A.2 Aberdeen Workshop Attendees

NAME	ORGANISATION
Malcolm Neil	SYSTRA
William Hekelaar	Aberdeen City Council
Boris Johansson	SYSTRA
Grant Davidson	Jacobs
Keith Gowenlock	Jacobs
Callum Guild	SYSTRA
Tony Maric	Aberdeen City Council
Gale Beattie	Aberdeen City Council
Vincent McInally	Transport Scotland
Colin Gillespie	SEPA
Joanna Murray	Aberdeen City Council
Aileen Brodie	Aberdeen City Council
Paul Finch	Nestrans
Tom Walsh	Aberdeen City Council
Jenny Anderson	Nestrans
Richard Sweetnam	Aberdeen City Council
David Dunne	Aberdeen City Council

A.3 Edinburgh Workshop Attendees

NAME	ORGANISATION
Grant Davidson	Jacobs
Keith Gowenlock	Jacobs
Vincent McInally	Transport Scotland
Alan McDonald	SEPA
Boris Johansson	SYSTRA
Ewan Kennedy	City of Edinburgh Council
Iain McFarlane	City of Edinburgh Council
David Cooper	City of Edinburgh Council
Gavin Brown	City of Edinburgh Council
Will Garrett	City of Edinburgh Council
Shauna Clarke	City of Edinburgh Council
Andrew Smith	City of Edinburgh Council
Jim Stewart	SEStran

A.4 Glasgow Workshop Attendees

NAME	ORGANISATION
Malcolm Neil	SYSTRA
Dom Callaghan	Glasgow City Council
Grant Davidson	Jacobs
Keith Gowenlock	Jacobs
Boris Johansson	SYSTRA
Vincent McInally	Transport Scotland
Julie Robertson	Glasgow City Council
Mic Ralph	Glasgow City Council
Andy MacGibbon	Glasgow City Council
Collin Little	Glasgow City Council
Donald Booth	SPT
Julie Evans	Glasgow City Council
Graeme Dewar	Glasgow City Council
Lewis Douglas	Glasgow City Council
John Sharkey	Glasgow City Council
Andrew Malby	SEPA
Emil Laiolo	Glasgow City Council
Eric Stewart	Glasgow City Council
Chris Shaw	SYSTRA
Gillian Dick	Glasgow City Council
Derek Barry	Glasgow City Council
Paul Morris	Glasgow City Council

APPENDIX B

B.1 Dundee Disruptors

Travel Demand	Score Pre-Consultation	Score Post-Consultation
CAR		
● Travel demand to/from existing premises – commute (e.g. reduced employment)	52	48
● Travel demand to/from existing premises – commute (e.g. more home working)	62	57
● Travel demand to/from existing premises – business travel (e.g. economic downturn)	42	40
● Travel demand to/from existing premises – business travel (e.g. more internet-based)	48	46
● Travel demand to/from existing city-centre premises - shopping (e.g. economic downturn)	44	44
● Car travel demand to/from existing premises - shopping (e.g. more on-line and out-of-town shopping)	51	48
● Travel demand to/from existing premises - other leisure (e.g. economic down-turn and reduced city centre businesses)	38	30
LGV		
● Increase in volume of LGV on network as a result of increase in on-line shopping	44	43
● Reduction in volume of LGV on network as a result of economic downturn	24	26
HGV		
● Reduction in volume of HGV on network as a result of economic downturn	22	25
Taxi		
● Change in taxi demand due to reduction in bus/rail demand	27	24
● Change in taxi demand due to reduction in leisure trips	28	26
● Change in taxi demand due to reduction in business trips	33	32
● Changes to type of new car due to trip purpose changes	16	18

Fleet Composition	Score Pre-Consultation	Score Post-Consultation
PT		
● Impact on rail patronage (related to services and fares)	22	33
● Impact on proposed bus fleet upgrades (existing fleet conversions)	62	55
CAR		
● Increase in New Purchase of Low Carbon Vehicles	33	34
● Decrease in New Purchase of Diesel Vehicles	42	45
● Change in the overall number of people buying new cars	50	36
LGV		
● Increase in EURO 6 new vehicle purchases	25	31
● Change in the overall number of people buying new LGV	37	32
HGV		
● Increase in EURO 6 new vehicle purchases	21	27
● Change in the overall number of people buying new HGV	31	29
● Reduction in volume of HGV on network as a result of economic downturn	25	25

Behavioural Response	Score Pre-Consultation	Score Post-Consultation
Walk / Cycle		
● Proportion of people who have changed mode to walk / cycle during COVID period	35	37
● Proportion of people who are walking / cycling now, who will continue to do so, post-covid	18	20
PT		
● Bus users switch to private car	60	54
● Impact on bus patronage (related to social distancing factors)	52	56
● Impact on bus patronage (related to services and fares)	41	45
Rail		
● Rail passengers switch to private car	42	42
● Impact on rail patronage (related to social distancing factors)	28	40
Car		
● Car occupancy levels reduce as people travel in separate cars	42	41
● Car occupancy levels increase as car share increases due to switch from bus / rail	31	36
Taxi		
● Bus and rail passengers switch to Taxi e.g. vulnerable members of the public	20	15

LEZ Concept	Score Pre-Consultation	Score Post-Consultation
● Public appetite for Air Quality measures post covid?	53	42
● Public acceptance post-implementation?	34	35

Travel pattern	Score Pre-Consultation	Score Post-Consultation
Potential changes to Parking Policy	42	45
Changes to LGV trips across the whole network (residential deliveries)	39	41
Changes to the function of office space (shared offices / hired office space)	48	48
Impact on local University Applications	9	16
Impact on local airport Patrons	19	24
Trip frequency changes as a result of trip purposes changing (proportion commute/business vs leisure)	41	44
Time of day changes as a result of trip purposes changing (proportion commute/business vs leisure)	43	43

National Economy / Policy	Score Pre-Consultation	Score Post-Consultation
Gov financial incentives to affected industries	31	35
Potential tax changes (income / VAT) to finance cost of Covid	31	37
Climate change incentives	44	44
Brexit	26	33
Shift in policy (further) towards sustainable/healthier modes (walk/cycle)	48	40

Local Economy / Policy	Score Pre-Consultation	Score Post-Consultation
Impact on Oil Industry now	21	23
Impact of Oil industry recovery post 2020	21	25
Impact on Fishing industry / Harbour Economy	14	13
Delay on committed infrastructure schemes	32	31
Delays in committed/assumed LDP development coming forward	33	33
Shift in policy (further) towards sustainable/healthier modes (walk/cycle)	29	28

Any Further Disruptors?	Score Pre-Consultation	Score Post-Consultation
. The supply of diesel, which I believe we are a net importer of?	12	7
. Trade deals (you reference Brexit, but this not the same thing, we can have Brexit without trade deals)	14	8
. Price of fuel – reductions in cost of fuel due to global demand reducing can lead to changes in vehicle use	16	9
. Passenger capacity – public transport may be operating with significantly limited capacity due to physical distancing for some time to come	12	7
. COVID-19 restrictions and regional differences affecting ability to travel	12	7
Shift in policy based on cities meeting AQ objectives without LEZ intervention in advance of enforcement phase	0	4

B.2 Aberdeen Disruptors

Travel Demand	Score Pre-Consultation	Score Post-Consultation
CAR		
● Travel demand to/from existing premises – commute (e.g. reduced employment)	41	38
● Travel demand to/from existing premises – commute (e.g. more home working)	61	55
● Travel demand to/from existing premises – business travel (e.g. economic downturn)	36	32
● Travel demand to/from existing premises – business travel (e.g. more internet-based)	48	48
● Travel demand to/from existing city-centre premises - shopping (e.g. economic downturn)	37	35
● Car travel demand to/from existing premises - shopping (e.g. more on-line and out-of-town shopping)	53	46
● Travel demand to/from existing premises - other leisure (e.g. economic down-turn and reduced city centre businesses)	25	28
LGV		
● Increase in volume of LGV on network as a result of increase in on-line shopping	34	36
● Reduction in volume of LGV on network as a result of economic downturn	33	29
HGV		
● Reduction in volume of HGV on network as a result of economic downturn	22	22
Taxi		
● Change in taxi demand due to reduction in bus/rail demand	15	18
● Change in taxi demand due to reduction in leisure trips	16	18
● Change in taxi demand due to reduction in business trips	24	26
● Changes to type of new car due to trip purpose changes	12	14

Fleet Composition	Score Pre-Consultation	Score Post-Consultation
PT		
● Impact on rail patronage (related to services and fares)	22	27
● Impact on proposed bus fleet upgrades (existing fleet conversions)	53	55
CAR		
● Increase in New Purchase of Low Carbon Vehicles	33	32
● Decrease in New Purchase of Diesel Vehicles	44	40
● Change in the overall number of people buying new cars	36	31
LGV		
● Increase in EURO 6 new vehicle purchases	28	30
● Change in the overall number of people buying new LGV	34	30
HGV		
● Increase in EURO 6 new vehicle purchases	28	28
● Change in the overall number of people buying new HGV	27	26
● Reduction in volume of HGV on network as a result of economic downturn	26	22

Behavioural Response	Score Pre-Consultation	Score Post-Consultation
Walk / Cycle		
● Proportion of people who have changed mode to walk / cycle during COVID period	30	30
● Proportion of people who are walking / cycling now, who will continue to do so, post-covid	16	16
PT		
● Bus users switch to private car	42	43
● Impact on bus patronage (related to social distancing factors)	43	48
● Impact on bus patronage (related to services and fares)	31	38
Rail		
● Rail passengers switch to private car	35	34
● Impact on rail patronage (related to social distancing factors)	29	33
Car		
● Car occupancy levels reduce as people travel in separate cars	34	35
● Car occupancy levels increase as car share increases due to switch from bus / rail	22	23
Taxi		
● Bus and rail passengers switch to Taxi e.g. vulnerable members of the public	10	13

LEZ Concept	Score Pre-Consultation	Score Post-Consultation
● Public appetite for Air Quality measures post covid?	42	37
● Public acceptance post-implementation?	32	32

Travel pattern	Score Pre-Consultation	Score Post-Consultation
● Potential changes to Parking Policy	42	39
● Changes to LGV trips across the whole network (residential deliveries)	38	37
● Changes to the function of office space (shared offices / hired office space)	49	46
● Impact on local University Applications	16	17
● Impact on local airport Patrons	32	34
● Trip frequency changes as a result of trip purposes changing (proportion commute/business vs leisure)	45	41
● Time of day changes as a result of trip purposes changing (proportion commute/business vs leisure)	44	40

National Economy / Policy	Score Pre-Consultation	Score Post-Consultation
● Gov financial incentives to affected industries	31	31
● Potential tax changes (income / VAT) to finance cost of Covid	38	36
● Climate change incentives	32	33
● Brexit	37	36
● Shift in policy (further) towards sustainable/healthier modes (walk/cycle)	35	37

Local Economy / Policy	Score Pre-Consultation	Score Post-Consultation
● Impact on Oil Industry now	41	37
● Impact of Oil industry recovery post 2020	37	32
● Impact on Fishing industry / Harbour Economy	26	27
● Delay on committed infrastructure schemes	35	36
● Delays in committed/assumed LDP development coming forward	42	42
● Shift in policy (further) towards sustainable/healthier modes (walk/cycle)	34	30

Any Further Disruptors?	Score Pre-Consultation	Score Post-Consultation
● The supply of diesel, which I believe we are a net importer of?	8	6
● Trade deals (you reference Brexit, but this not the same thing, we can have Brexit without trade deals)	8	6
● Price of fuel – reductions in cost of fuel due to global demand reducing can lead to changes in vehicle use	9	6
● Passenger capacity – public transport may be operating with significantly limited capacity due to physical distancing for some time to come	7	5
● COVID-19 restrictions and regional differences affecting ability to travel	7	5
● Uncertainty of air quality changes and likelihood and extent of exceedance of air quality objectives	9	6
● Road space reallocation for public transport or active travel (ie infrastructure rather than just policy)	0	6

B.3 Edinburgh Disruptors

Travel Demand	Score Pre-Consultation	Score Post-Consultation
CAR		
● Travel demand to/from existing premises – commute (e.g. reduced employment)	17	17
● Travel demand to/from existing premises – commute (e.g. more home working)	26	26
● Travel demand to/from existing premises – business travel (e.g. economic downturn)	18	18
● Travel demand to/from existing premises – business travel (e.g. more internet-based)	24	24
● Travel demand to/from existing city-centre premises - shopping (e.g. economic downturn)	19	19
● Car travel demand to/from existing premises - shopping (e.g. more on-line and out-of-town shopping)	24	24
● Travel demand to/from existing premises - other leisure (e.g. economic down-turn and reduced city centre businesses)	17	17
LGV	0	0
● Increase in volume of LGV on network as a result of increase in on-line shopping	26	26
● Reduction in volume of LGV on network as a result of economic downturn	7	7
HGV	0	0
● Reduction in volume of HGV on network as a result of economic downturn	7	7
Taxi	0	0
● Change in taxi demand due to reduction in bus/rail demand	24	24
● Change in taxi demand due to reduction in leisure trips	17	17
● Change in taxi demand due to reduction in business trips	18	18
● Changes to type of new car due to trip purpose changes	17	17
	0	0

Fleet Composition	Score Pre-Consultation	Score Post-Consultation
PT		
● Impact on rail patronage (related to services and fares)	18	18
● Impact on proposed bus fleet upgrades (existing fleet conversions)	22	22
CAR	0	0
● Increase in New Purchase of Low Carbon Vehicles	20	20
● Decrease in New Purchase of Diesel Vehicles	20	20
● Change in the overall number of people buying new cars	26	26
LGV	0	0
● Increase in EURO 6 new vehicle purchases	23	23
● Change in the overall number of people buying new LGV	22	22
HGV	0	0
● Increase in EURO 6 new vehicle purchases	18	18
● Change in the overall number of people buying new HGV	14	14
● Reduction in volume of HGV on network as a result of economic downturn	11	11

Behavioural Response	Score Pre-Consultation	Score Post-Consultation
Walk / Cycle		
● Proportion of people who have changed mode to walk / cycle during COVID period	19	19
● Proportion of people who are walking / cycling now, who will continue to do so, post-covid	18	18
PT		
● Bus users switch to private car	26	26
● Impact on bus patronage (related to social distancing factors)	28	28
● Impact on bus patronage (related to services and fares)	18	18
Rail	0	0
● Rail passengers switch to private car	21	21
● Impact on rail patronage (related to social distancing factors)	27	27
Car	0	0
● Car occupancy levels reduce as people travel in separate cars	26	26
● Car occupancy levels increase as car share increases due to switch from bus / rail	14	14
Taxi	0	0
● Bus and rail passengers switch to Taxi e.g. vulnerable members of the public	8	8

LEZ Concept	Score Pre-Consultation	Score Post-Consultation
● Public appetite for Air Quality measures post covid?	14	14
● Public acceptance post-implementation?	16	16

Travel pattern	Score Pre-Consultation	Score Post-Consultation
● Potential changes to Parking Policy	18	18
● Changes to LGV trips across the whole network (residential deliveries)	28	28
● Changes to the function of office space (shared offices / hired office space)	19	19
● Impact on local University Applications	22	22
● Impact on local airport Patrons	13	13
● Trip frequency changes as a result of trip purposes changing (proportion commute/business vs leisure)	18	18
● Time of day changes as a result of trip purposes changing (proportion commute/business vs leisure)	20	20

National Economy / Policy	Score Pre-Consultation	Score Post-Consultation
● Gov financial incentives to affected industries	19	19
● Potential tax changes (income / VAT) to finance cost of Covid	16	16
● Climate change incentives	19	19
● Brexit	18	18
● Shift in policy (further) towards sustainable/healthier modes (walk/cycle)	23	23

Local Economy / Policy	Score Pre-Consultation	Score Post-Consultation
● Impact on Oil Industry now	16	16
● Impact of Oil industry recovery post 2020	14	14
● Impact on Fishing industry / Harbour Economy	20	20
● Delay on committed infrastructure schemes	18	18
● Delays in committed/assumed LDP development coming forward	25	25
● Shift in policy (further) towards sustainable/healthier modes (walk/cycle)	24	24

B.4 Glasgow Disruptors

Travel Demand	Score Pre-Consultation	Score Post-Consultation
CAR		
● Travel demand to/from existing premises – commute (e.g. reduced	42	36
● Travel demand to/from existing premises – commute (e.g. more	46	41
● Travel demand to/from existing premises – business travel (e.g.	38	33
● Travel demand to/from existing premises – business travel (e.g.	38	34
● Travel demand to/from existing city-centre premises - shopping (e.g.	39	34
● Car travel demand to/from existing premises - shopping (e.g. more	44	39
● Travel demand to/from existing premises - other leisure (e.g.	37	32
LGV		
● Increase in volume of LGV on network as a result of increase in on-lir	34	33
● Reduction in volume of LGV on network as a result of economic dow	16	14
HGV		
● Reduction in volume of HGV on network as a result of economic dow	10	9
Taxi		
● Change in taxi demand due to reduction in bus/rail demand	25	22
● Change in taxi demand due to reduction in leisure trips	38	33
● Change in taxi demand due to reduction in business trips	35	31
● Changes to type of new car due to trip purpose changes	12	10

Fleet Composition	Score Pre-Consultation	Score Pre-Consultation
PT		
● Impact on rail patronage (related to services and fares)	24	23
● Impact on proposed bus fleet upgrades (existing fleet conversions)	54	51
CAR		
● Increase in New Purchase of Low Carbon Vehicles	43	37
● Decrease in New Purchase of Diesel Vehicles	49	42
● Change in the overall number of people buying new cars	42	36
LGV		
● Increase in EURO 6 new vehicle purchases	29	26
● Change in the overall number of people buying new LGV	23	20
HGV		
● Increase in EURO 6 new vehicle purchases	20	18
● Change in the overall number of people buying new HGV	23	20
● Reduction in volume of HGV on network as a result of economic dow	13	13

Behavioural Response	Score Pre-Consultation	Score Pre-Consultation
Walk / Cycle		
● Proportion of people who have changed mode to walk / cycle during	30	28
● Proportion of people who are walking / cycling now, who will continu	28	25
PT		
● Bus users switch to private car	46	44
● Impact on bus patronage (related to social distancing factors)	57	53
● Impact on bus patronage (related to services and fares)	30	30
Rail		
● Rail passengers switch to private car	34	31
● Impact on rail patronage (related to social distancing factors)	30	27
Car		
● Car occupancy levels reduce as people travel in separate cars	34	31
● Car occupancy levels increase as car share increases due to switch fr	18	17
Taxi		
● Bus and rail passengers switch to Taxi e.g. vulnerable members of the	19	16

LEZ Concept	Score Pre-Consultation	Score Pre-Consultation
● Public appetite for Air Quality measures post covid?	40	35
● Public acceptance post-implementation?	37	34

Travel pattern	Score Pre-Consultation	Score Pre-Consultation
● Potential changes to Parking Policy	49	46
● Changes to LGV trips across the whole network (residential deliveries	32	31
● Changes to the function of office space (shared offices / hired office	54	47
● Impact on local University Applications	15	15
● Impact on local airport Patrons	33	29
● Trip frequency changes as a result of trip purposes changing (proporti	46	39
● Time of day changes as a result of trip purposes changing (proportion	49	41

National Economy / Policy	Score Pre-Consultation	Score Pre-Consultation
● Gov financial incentives to affected industries	45	43
● Potential tax changes (income / VAT) to finance cost of Covid	44	37
● Climate change incentives	48	42
● Brexit	46	42
● Shift in policy (further) towards sustainable/healthier modes (walk/cy	53	47

Local Economy / Policy	Score Pre-Consultation	Score Pre-Consultation
● Delay on committed infrastructure schemes	47	41
● Delays in committed/assumed LDP development coming forward	36	33
● Shift in policy (further) towards sustainable/healthier modes (walk/cy	40	35
● Impact on Investment	41	40
● Impact on retail	46	47
● Impact on tourism - resident v visitor	37	34

Any Further Disruptors?	Score Pre-Consultation	Score Pre-Consultation
● Increased use of e-transport: e-cargo, e-bikes etc	11	11
● Increased use of sustainable energy generation	15	15
● Business resistance to LEZ measures	15	15
● Leadership commitment	10	10
● Delays / Lack of Policy Impact on Public Health	15	15
● Incentives to Change	1	1
● Leadership Clarity	0	0
● Move towards 20minute neighbourhoods or LTN's	4	4
● Lack of Public Confidence in Government\Local Authorities	0	7
● Current and future car tax levels (£40000=extra 350 per year) &	0	0
● Require improved public transport system to be choice (peak issues f	0	1
● How would current PT cope with required 30% car reduction = 25,000	0	1
● Lack opf progress in electric car development (necessity may speed p	0	1

APPROVAL					
Version	**Name**		**Position**	**Date**	**Modifications**
1	Author	Malcolm Neil/ Grant Davidson/ Callum Guild		18/12/2020	
	Checked by	Keith Gowenlock/Grant Davidson		19/12/2020	
	Approved by	Boris Johansson		21/12/2020	
2	Author	Malcolm Neil/ Grant Davidson/ Callum Guild		20/01/2021	Updated following feedback
	Checked by	Keith Gowenlock/Grant Davidson		20/01/2021	
	Approved by	Malcolm Neil		20/01/2021	
3	Author	Grant Davidson/ Callum Guild		21/01/2021	Updated following comments
	Checked by	Malcolm Neil		22/01/2021	
	Approved by	Malcolm Neil		22/01/2021	
4	Author	Callum Guild		28/01/2021	Updated following comments
	Checked by	Malcolm Neil		28/01/2021	
	Approved by	Malcolm Neil		28/01/2021	
5	Author	Callum Guild		29/01/2021	Executive Summary Added
	Checked by	Malcolm Neil		29/01/2021	
	Approved by	Malcolm Neil		29/01/2021	