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Contents

Executive Summary

Jacobs was commissioned by Transport Scotland to investigate the potential cost implications of introducing Low Emission Zones (LEZs) in Scotland. At present, the number, location and type of LEZs that may be implemented in Scotland is unknown. However, the Scottish Environment Protection Agency (SEPA), in collaboration with Transport Scotland, undertook a significant traffic data collection exercise in Glasgow in 2015 and created an Air Quality Model of NOx emissions for Glasgow using this data, along with observed air quality concentration monitoring results. Given the usefulness of this previous work to this current commission, Jacobs worked in collaboration with SEPA to use the Glasgow Emissions Model to test various scenarios for a 'hypothetical Glasgow LEZ'.

The results of these hypothetical tests were used to provide an indication of the scale and type of LEZ that may likely improve air quality in Glasgow, allowing this to be used as a proxy for LEZs in other Scottish cities for cost estimation purposes. Jacobs also worked in close collaboration with Strathclyde Partnership for Transport (SPT) to assess the number, and engine type composition, of buses within Glasgow which would potentially be affected by a hypothetical LEZ to assess potential grant costs.

The costs of designing, constructing and operating the hypothetical Glasgow LEZ were estimated in both standard 2010 prices and current 2017 prices, using available costs for the Low Emission Zone in London. Costs for a hypothetical Public Transport Potential Operator Grant which may be used to support improvement in bus fleets anticipated to be affected by an LEZ, were estimated based on figures for the number of buses which may be affected in Glasgow (from SPT) and cost estimates to either retrofit existing Euro 4 or 5 buses or offer an incentive to scrap older buses that cannot be effectively retrofitted. Approximate costs for this were gathered through discussions with SPT, Transport Scotland and a bus operator, and given the potential variability of these, low, medium and high cost bands were used to quantify potential grant support at the request of Transport Scotland. Grant costs were not extended to other parts of the vehicle fleet as hypothetical test results for Glasgow identified limited success in targeting sections of the fleet such as HGVs. Should further testing reveal this not to be the case in Glasgow or elsewhere in Scotland, additional grant costs may need to be investigated further.

To provide scalability for use for other potential LEZs in Scotland, the estimated costs for the hypothetical Glasgow LEZ were scaled based on the area of the LEZ, with 0.5km^2 assumed for a small sized zone, 1.5km^2 for a medium sized zone and 3km^2 (the size of the chosen hypothetical Glasgow zone) for a large sized zone.

Estimated costs were calculated as both total costs for year 1 of implementation and also for a 10 year period (based on 2010 prices), as recommended by DfT's WebTAG Databook (March 2017) which is used by the Scottish Transport Appraisal Guidance (STAG). A discount rate of 3.5% was used as recommended by HM Treasury and prices were also provided for current day 2017 for ease of reference.

The resulting breakdown of costs for LEZ implementation are shown in Table 1a[1], and this table should be viewed with the following caveats:

1. Design costs include LEZ design and implementation staff costs, marketing + communications, Air Quality (AQ) modelling and AQ monitoring

2. Implementation costs include signage costs, camera purchase, camera installation (post, sign, wiring, and labour), IT equipment, and accommodation

3. Grant costs are isolated to a hypothetical Public Transport Potential Operator Grant and are calculated based pro-rata on the costs calculated for Glasgow based on the estimated number of buses affected by a hypothetical LEZ there. The numbers are unique to Glasgow and so will require additional location specific analysis when locations and types of other LEZs are known

4. Operating costs include monitoring, camera operation and staffing costs

[1] Table 1a shows 2010 prices, Table 1b shows 2017 prices

Table 1a: LEZ Cost Summary Table, risk and optimism bias applied, 2010 prices

#	Local Authority	LEZ Area	Possible Size of Scheme (LEZ)	Design Costs Undiscounted & (Discounted)	Implementation costs Undiscounted & (Discounted)	Grant costs Undiscounted & (Discounted)	Operating Costs (first year) Undiscounted & (Discounted)	Risk (Year 1)	Total Costs (Year 1) Undiscounted & (Discounted)	Total Costs (10 year period) Undiscounted & (Discounted)
		(km2)	(S/M/L)	(£)	(£)	(£)	(£)	(£)	(£)	(£)
1	Unknown	0.5	Small (low grant)	386,224 (293,303)	620,188 (470,978)	1,528,940 (1,161,095)	441,337 (335,187)	297,673 (226,056)	3,274,402 (2,486,619)	7,644,036 (5,003,097)
2	Unknown	0.5	Small (medium grant)	386,224 (293,303)	620,188 (470,978)	2,267,982 (1,722,332)	441,377 (335,187)	371,577 (282,180)	4,087,348 (3,103,979)	8,456,982 (5,620,458)
3	Unknown	0.5	Small (high grant)	386,224 (293,303)	620,188 (470,978)	3,057,880 (2,322,189)	441,377 (335,187)	450,567 (342,166)	4,956,236 (3,763,823)	9,325,870 (6,280,301)
4	Unknown	1.5	Medium (low grant)	503,085 (382,049)	837,753 (636,199)	4,586,820 (3,483,284)	767,549 (582,886)	669,521 (508,442)	7,364,728 (5,592,860)	14,963,467 (9,968,984)
5	Unknown	1.5	Medium (medium grant)	503,085 (382,049)	837,753 (636,199)	6,803,945 (5,166,994)	767,549 (582,886)	891,233 (676,813)	9,803,566 (7,444,941)	17,402,305 (11,821,066)
6	Unknown	1.5	Medium (high grant)	503,085 (382,049)	837,753 (636,199)	9,173,639 (6,966,568)	767,549 (582,886)	1,128,203 (856,770)	12,410,230 (9,424,472)	20,008,969 (13,800,596)
7	Glasgow	3	Large (low grant)	503,085 (382,049)	1,034,381 (785,521)	9,173,639 (6,966,568)	1,052,006 (798,906)	1,176,311 (893,304)	12,939,423 (9,826,347)	23,354,282 (15,824,279)
8	Glasgow	3	Large (medium grant)	503,085 (382,049)	1,034,381 (785,381)	13,607,890 (10,333,989)	1,052,006 (798,906)	1,619,736 (1,230,046)	17,817,098 (13,530,510)	28,231,958 (19,528,442)
9	Glasgow	3	Large (high grant)	503,085 (382,049)	1,034,381 (785,381)	18,347,279 (13,933,135)	1,052,006 (798,906)	2,093,675 (1,589,906)	23,030,426 (17,489,571)	33,445,285 (23,487,504)

Table 1b: LEZ Cost Summary Table, risk and optimism bias applied, 2017 prices

#	Local Authority	LEZ Area	Possible Size of Scheme (LEZ)	Design Costs Undiscounted & (Discounted)	Implementation costs Undiscounted & (Discounted)	Grant costs Undiscounted & (Discounted)	Operating Costs (first year) Undiscounted & (Discounted)	Risk (Year 1)	Total Costs (Year 1) Undiscounted & (Discounted)	Total Costs (10 year period) Undiscounted & (Discounted)
		(km2)	(S/M/L)	(£)	(£)	(£)	(£)	(£)	(£)	(£)
1	Unknown	0.5	Small (low grant)	428,323 (325,274)	687,791 (522,316)	1,695,600 (1,287,658)	444,990 (337,930)	325,670 (247,318)	3,582,375 (2,720,497)	7,987,775 (5,548,453)
2	Unknown	0.5	Small (medium grant)	428,323 (325,274)	687,791 (522,316)	2,515,200 (1,910,072)	444,990 (337,930)	407,630 (309,559)	4,483,935 (3,405,152)	8,889,336 (6,233,109)
3	Unknown	0.5	Small (high grant)	428,323 (325,274)	687,791 (522,316)	3,391,200 (2,575,316)	444,990 (337,930)	495,230 (376,084)	5,447,535 (4,136,921)	9,852,935 (6,964,877)
4	Unknown	1.5	Medium (low grant)	557,923 (423,693)	929,071 (705,547)	5,086,800 (3,862,975)	773,832 (587,657)	734,763 (557,987)	8,082,389 (6,137,860)	15,743,326 (11,055,640)
5	Unknown	1.5	Medium (medium grant)	557,923 (423,693)	929,071 (705,547)	7,545,600 (5,730,216)	773,832 (587,657)	980,643 (744,711)	10,787,069 (8,191,825)	18,448,006 (13,109,606)
6	Unknown	1.5	Medium (high grant)	557,923 (423,693)	929,071 (705,547)	10,173,600 (7,725,949)	773,832 (587,657)	1,243,443 (944,285)	13,677,869 (10,387,132)	21,338,806 (15,304,913)
7	Glasgow	3	Large (low grant)	557,923 (423,693)	1,147,132 (871,145)	10,173,600 (7,725,949)	1,060,617 (805,445)	1,293,927 (982,623)	14,233,200 (10,808,856)	24,733,307 (17,549,185)
8	Glasgow	3	Large (medium grant)	557,923 (423,693)	1,147,132 (871,145)	15,091,200 (11,460,432)	1,060,617 (805,445)	1,785,687 (1,356,072)	19,642,560 (14,916,787)	30,142,667 (21,657,115)
9	Glasgow	3	Large (high grant)	557,923 (423,693)	1,147,132 (871,145)	20,347,200 (15,451,899)	1,060,617 (805,445)	2,311,287 (1,755,218)	25,424,160 (19,307,401)	35,924,267 (26,047,729)

1. Introduction

The Programme for Government 2016 stated that the Scottish Government would take forward the actions set out in 'Cleaner Air for Scotland' – Scotland's first distinct air quality strategy – to reduce air pollution further, and with the help of local authorities, would identify and put in place the first low emission zone by 2018, to create a legacy on which other areas could build. As such, Transport Scotland is seeking to provide answers to the following questions for Ministerial consideration:

1. How much funding is required to design, procure, implement, operate and maintain Scottish LEZs, incorporating both capital costs and operating costs for back-office services?

2. How much funding is required to provide incentives for bus fleet operators to either adapt existing fleet or replace existing fleet (or both) to LEZs?

3. How much funding is required to support a communications strategy around LEZ implementation?

In order to provide this, Transport Scotland commissioned Jacobs to undertake an economic assessment of LEZs in Scotland. This commission consisted of two tasks; Task 1 focusing on the high level costs likely to be associated with the delivery of LEZs in Scotland and Task 2 focussing on preparing an Outline Business Case for LEZs in Scotland for Investment Decision Makers (IDM).

This report outlines the findings of Task 1, specifically; scaling indicative costs based on the size, location and type of a hypothetical LEZ which could potentially be implemented in Glasgow to improve air quality to below the annual mean of 40 µgm-^{3} limit for NO^{2}, in line with the requirements of the forthcoming National Low Emission Framework (NLEF).

The size, location and type of a hypothetical LEZ for Glasgow was considered in collaboration with the Scottish Environment Protection Agency (SEPA). SEPA have constructed an Emissions Model for Glasgow that has the ability to test the effectiveness of various access criteria (i.e. LEZ standard and what type / engine class of vehicle) scenarios to identify which may be successful in reducing NOx emission concentrations to below the required levels (40 µgm-^{3}).

Cost estimates for implementing the selected hypothetical LEZ area for Glasgow were prepared using information on the selected scale and type of LEZ (i.e. enforcement regime, vehicles focussed on and so on) with costs scaled from available data on the costs of implementing the Low Emission Zone in London. Costs for the grant element were focussed on support for bus fleet improvement as the class of vehicle in Glasgow city centre shown to have the single highest impact on emissions. Grant costs are therefore for a hypothetical Glasgow Public Transport Potential Operator Grant which could support 'cleaning' of the Glasgow bus fleet and were calculated based on cost estimates to either retrofit or scrap non-Euro 6 buses . To assist with the applicability of this, Jacobs worked with Strathclyde Partnership for Transport (SPT) to estimate the total number of buses (and their Euro standard) which would potentially be affected by the chosen hypothetical Glasgow LEZ area, i.e. buses in the existing Glasgow fleet that are below Euro 6 standard. There was some variability around the exact costs of retrofitting or scrapping buses (which could be based on the specific age of the vehicle) and so low, medium and high cost bands were created at the request of Transport Scotland. Costs were categorised as follows:

Table 1.1: Agreed Cost Summary Table

#	Local Authority	LEZ Area (km2)	Possible Size of Scheme (LEZ) (S/M/L)	Design Costs (£)	Implementation costs (£)	Grant costs (£)	Operating Costs (£)	Total Costs (£)
1	Glasgow							

2. Assessment of Low Emission Zone Characteristics

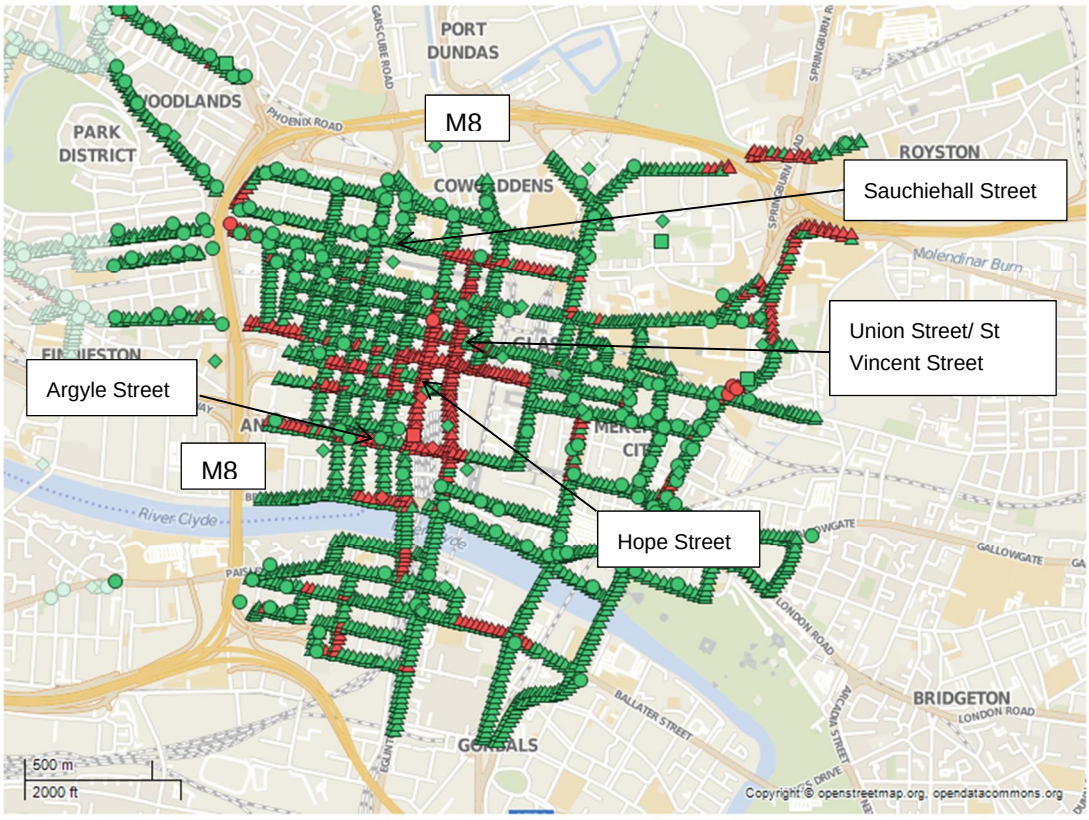
2.1 Background

In order to provide tools to accurately assess the impact on air quality of Low Emission Zones in Scotland, SEPA has been engaged with the Cleaner Air Scotland National Modelling Framework and under this have created a series of detailed Air Quality Models for various locations in Scotland.

At the time of commissioning the Jacobs task that this report is the subject of, an Emissions Model for Glasgow created by SEPA under the framework was operational and deemed by SEPA as a reliable base upon which to test scenarios of potential hypothetical LEZs for Glasgow. The model was created using detailed traffic data collected for Glasgow in 2015, consisting of traffic volumes, by vehicle type, for a significant number of road links within and into Glasgow city centre, as well as details of the vehicle type engine type makeup. Vehicle engine type was ascertained from Automatic Number Plate Recognition (ANPR) records and subsequent cross referencing with the DVLA database.

The resulting model produced a variety of data for a number of road links in / around Glasgow city centre and this was compared with observed air quality monitoring observations to check for calibration / validation. Figure 2.1 shows the visual representation of NOx emissions in Glasgow City Centre modelled for the year of 2015. Red colouring shows locations where NOx levels exceed a limit of 40 μgm^{-3} limit, while green colouring shows locations where these levels are below this limit.

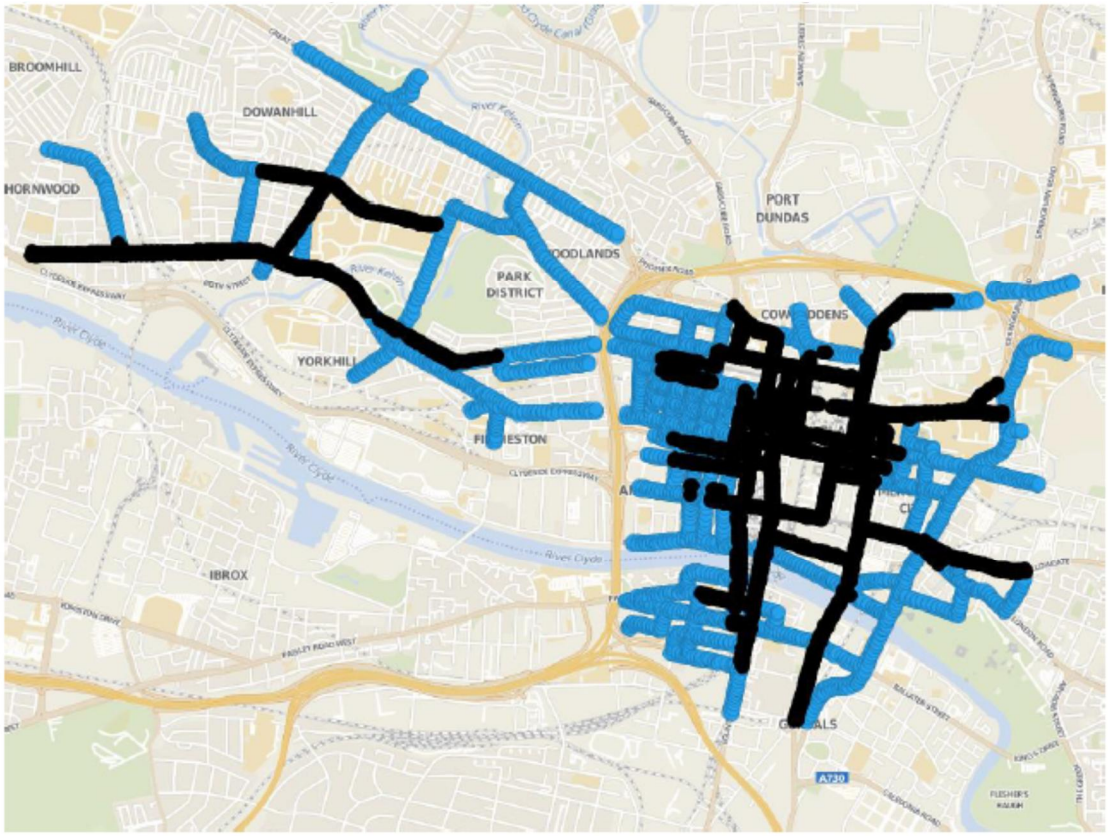
Figure 2.1 - Glasgow Emissions Model Results Based on 2015 Observed Traffic Data



As can be seen in Figure 2.1, the main concentrations of exceedances are located within the central city centre area, for example around Hope Street, Argyle Street, Union Street / Renfield Street and St Vincent Street. To further understand the main contributors to these high concentration of exceedances, SEPA provided Jacobs with information on vehicle type proportions at these locations and a breakdown of the main contributors to total emission concentrations in these areas. The analysis undertaken by SEPA found that buses were the single

largest contributing vehicle type to emission concentrations in these areas of Glasgow. Figure 2.2 shows links identified in blue where buses contribute less than 40% to emissions and black showing links where buses contribute to greater than 40% of emissions.

Figure 2.2 - Links shown in black where buses contributed to over 40% of NOx emissions



As can be seen in Figure 2.2, on the key exceedance streets such as Hope Street, Argyle Street, Union Street / Renfield Street and St Vincent Street buses are the vehicle class that contribute most to the emissions problem. In terms of the breakdown of contributions to emissions by all vehicle types on these key links, Table 2.1 outlines this:

Table 2.1: Vehicle Type v Proportion Contribution to Air Quality Emissions Concentrations

Vehicle Type	Contribution to Emissions On City Centre Links with High Emission Concentrations*
Bus	50%
Car	36%
LGV	12%
Motorcycle	0%
HGV	3%

**Percentages are rounded to nearest whole number and therefore may not sum to 100%*

2.2 Assessment Results

As previously identified, the results of the SEPA modelling show that the concentrations of emissions in the city centre area are some of the highest in Glasgow (based on 2015 data). For the purposes of this study this area (i.e. the area of the existing Air Quality Management Area – the area within the M8, the River Clyde and High Street) was therefore chosen as the focus of a hypothetical Glasgow LEZ. In line with the forthcoming NLEF, the main objective of the LEZ was to achieve sufficient reductions in NOx emissions to ensure the mean level is estimated to be below the 40 μgm^{-3} limit level for the majority of locations over a shorter time span than could be achieved with natural vehicle fleet renewal. Outwith the city centre area, the results of modelling show that the limit level may be met in a number of locations in a significantly shorter period of time than the city centre with natural vehicle fleet renewal. Given the lead-in times and associated costs to design and implement an LEZ, this study therefore did not consider these wider areas further.

A variety of scenarios, a full list of which is included in the Appendix, were tested using the SEPA Glasgow Emissions Model as a basis for assessing the likely impact of different types of LEZ (i.e. targeting different vehicle engine types) on city centre air quality. A number of these scenarios were shown to potentially be successful in reducing emissions in most areas of the city centre to below the mean limit. A blanket engine type-restriction LEZ covering all vehicle classes entering the city centre area, in line with forthcoming NLEF standards for each vehicle engine type, was shown to achieve the largest reduction overall. However, in practice, the large number of vehicles that would potentially be affected by this blanket restriction could cause significant disruption; therefore for the purposes of costings for this study, the hypothetical LEZ selected for Glasgow applies engine type restrictions to buses only, that operate within the city centre AQMA. This decision was made as buses were the class of vehicle identified as the single largest contributor to emissions in much of the city centre area, and they are relatively low in number in comparison to all vehicles accessing the city centre. The overall impact of this LEZ was therefore considered to be lower than focussing on all vehicles, while the SEPA Emissions Model test results show this scenario could be successful in reducing emission concentrations to below the limit level in most city centre locations by 2019 and all in 2023.

The capital costs associated with implementing this hypothetical LEZ for Glasgow are assumed to remain the same regardless of the vehicle type and engine class focussed on, because the infrastructure is likely to remain the same. It is the impact on the wider vehicle fleet and the potential grant costs that may change if other vehicle classes were focussed on.

It should be noted that analysis was based on there being no background growth factors applied to future scenario tests, as analysis of historic data from city centre traffic counts shows little to no city centre traffic growth over the last 5 years. Additionally, the engine type makeup across the vehicle fleet was varied for future scenarios based on EMIT factors from DfT and Defra's Emission Factor Toolkit [2].

The results of the scenario testing undertaken by SEPA of the hypothetical LEZ for Glasgow focussing on buses are shown in Figures 2.3 and 2.4.

[2] EMIT is a comprehensive emissions inventory toolkit http://www.cerc.co.uk/environmental-software/EMIT-tool/data.html

Figure 2.3 - Glasgow Emissions Model Results, 2019 with Buses either Retrofitted or Euro 6

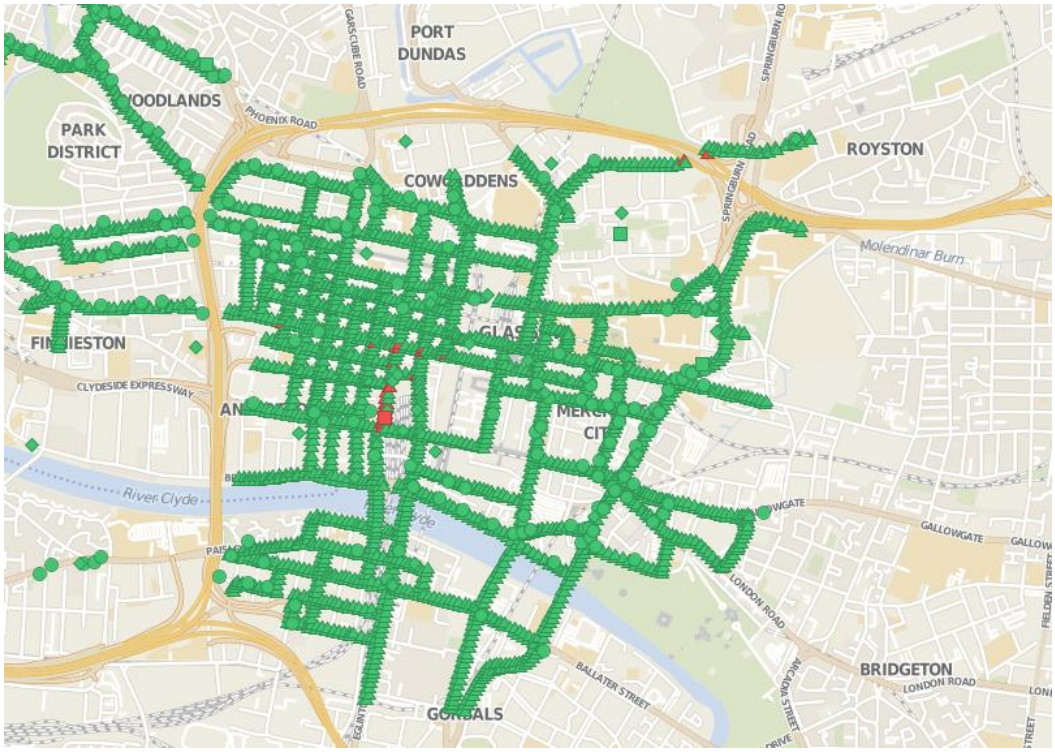


Figure 2.3 shows that the majority of monitoring locations in the city centre area are estimated to be below the 40 µgm-^{3} limit level for this scenario. Some exceedances are still estimated to occur on Hope Street and Argyle Street.

Figure 2.4 - Glasgow Emissions Model Results, 2023 with Buses either Retrofitted or Euro 6

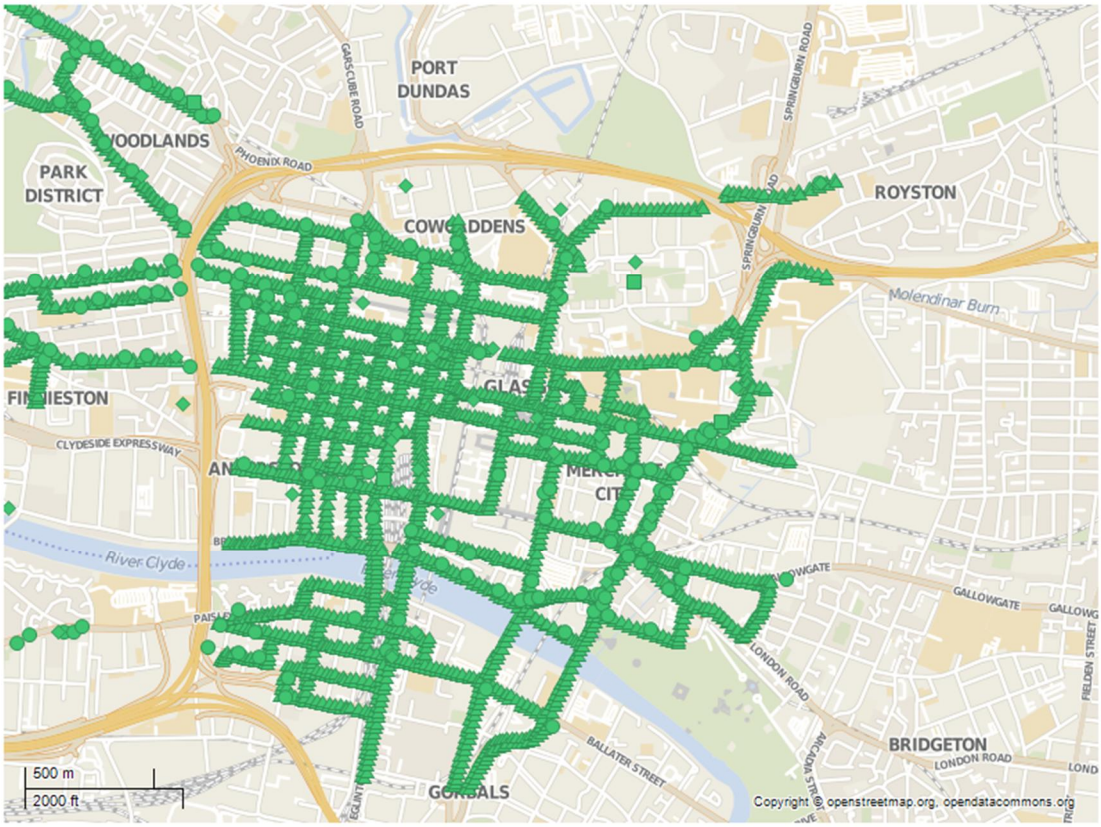


Figure 2.4 shows that for this scenario, with natural background fleet renewal of other vehicle classes by 2023, emissions concentrations in all city centre locations are estimated to be below the 40 µgm-^{3} limit level.

The results outlined in Figures 2.3 and 2.4 justified the decision to base costings for a hypothetical LEZ for Glasgow on the city centre area and to focus on buses as the vehicle class for which access would be controlled.

2.3 Basis used for LEZ Cost Estimates

As the results of the emissions modelling by SEPA indicate that a hypothetical LEZ focussing on ensuring Glasgow city centre buses meet Euro 6 emissions will potentially result in the majority of locations seeing emission concentrations drop below the 40 µgm-^{3} limit by 2019, and all locations by 2023, cost assumptions were based on this type of LEZ for Glasgow. It should be noted however that the capital costs associated with implementing this hypothetical LEZ for Glasgow would remain the same regardless of the vehicle type and engine class for which access control focussed on, because the infrastructure would largely remain the same. It is the impact on the wider vehicle fleet and the potential grant costs that may change if other vehicle classes were targeted.

While the majority of Glasgow city centre bus services operate along a small number of key corridors, and therefore could be controlled by relatively few entry ANPR cameras; in order to form robust cost estimates that would be applicable if focussing on other vehicle classes across the whole city centre (should that decision be made at a later date), this study has assumed entry control would be implemented on all vehicular entry points to the Glasgow Air Quality Management Area (AQMA).

3. Economic Assessment

3.1 Capital Costs

The cost of implementing the aforementioned hypothetical LEZ scheme for Glasgow city centre was calculated based mainly on available costs associated with the London LEZ. The implementation (i.e. capital) costs of the scheme comprise of three mains components:

1. Design and marketing;
2. Implementation (installation of ANPRs, modelling, enforcement etc.); and
3. Hypothetical Public Transport Potential Operator Grants.

The costs for design, marketing and implementation are relatively well-defined and scalable from other schemes, i.e. the London LEZ. The process by which costs were scaled down from the London LEZ scheme is set out in greater detail in Appendix B but in summary, the size of the hypothetical Glasgow LEZ was compared to the London LEZ and a scaling factor was determined. This scaling factor was then applied to the London LEZ cost to estimate a cost for the hypothetical Glasgow LEZ. This was repeated for each individual cost, and these were then grouped into the main components of design and implementation[3].

However, the grant costs, i.e. funds to be made available by Government to support users of the scheme, are unique to the specific scheme. As was previously identified, the hypothetical LEZ for Glasgow focusses on buses, therefore the grant cost element for this will be related to the costs associated with supporting bus operators to either retrofit or update their bus fleets that are anticipated to operate within the LEZ area to a required standard.

Jacobs worked in collaboration with SPT to identify the number, and engine type make-up, of the Glasgow bus fleet that could be affected by the hypothetical LEZ for Glasgow. It was estimated that 683 out of a total 808 buses could be affected, based on figures provided by SPT on the ages / Euro standards of the Glasgow bus fleet operating within the city centre area that are below Euro 6. Based on information provided by SPT, it was assumed that Euro 4 and 5 buses could be retrofitted to meet the access requirements of the hypothetical LEZ, while Euro 3 or older buses could not be retrofitted satisfactorily and so an assumption has been made that these would be scrapped.

As part of this study Jacobs obtained information from SPT and an unnamed major bus supplier on their assumptions of the estimated costs to either retrofit or scrap a bus. There was no clear consensus on these costs, with a range being provided. This is due to the large-scale exercise that would be required to retrofit several hundred buses, and this may or may not lead to economies of scale. Equally, as there are a wide variety of vehicle ages, and approaches adopted, in terms of the number of years over which a bus is operated, there will be a wide range of residual values of buses which may be scrapped. This therefore makes it difficult to conclude exactly what the scrappage grant value should be to incentivise bus operators to renew their bus fleets.

Based on this, Jacobs agreed with Transport Scotland that low, medium and high costs bands could be used for the purposes of this study for retrofitting and scrapping buses. This approach allows for the uncertainty of these costs, i.e. the medium cost for retrofitting may be considered the most likely cost estimate to what it may be in reality, while the low cost allows for significant economies of scale. The high cost estimate allows for the potential that commercial retrofitting organisations cannot offer sufficient capability locally to retrofit the number of buses anticipated, and so buses may need to be moved to other locations for retrofitting, thus potentially increasing the overall costs. Scrappage costs assume that there will be some residual value left within vehicles to be scrapped, and the total value of this will be dependent on the age of the vehicle, i.e. how many years' service it may have left, and its make and model. The value for each year of life left in a bus is highly variable, although discussions with SPT and an unnamed major bus supplier identified this may reasonably be assumed to be between £5,000 - £15,000. As there are a wide variety of residual values, to ensure robust account is

[3] Also Operating Cost but this is addressed in section 3.2

taken of this, the upper end of this estimate was used as the low cost scrappage cost and the high twice this. The medium value was chosen to sit between these two values.

The specific costs for each grant cost category are shown in Table 3.1.

Table 3.1: Assumed Grant Costs per Bus

Cost Category	Retrofit (£)	Scrappage Grant (£)
Low	7,500	15,000
Medium	12,500	20,000
High	15,000	30,000

The costs for design, marketing and implementation were based on an approximate hypothetical LEZ area for Glasgow city centre of 3KM^2 as this was the calculated area of the Glasgow AQMA area used for the hypothetical LEZ zone modelling for Glasgow. Costs for Glasgow were factored from the available costs for London and, as agreed with Transport Scotland, costs were additionally scaled for small (0.5KM^2) and medium (1.5KM^2) LEZs based on the costs for Glasgow.

Table 3.2 presents the detailed breakdown of the estimated costs derived for this study in 2010 prices. For all options, capital costs have been assumed to be incurred the same year the scheme is expected to open, 2018. For capital cost estimation in 2017 prices, please refer to Appendix C.

As can be seen, the level of grant provision to support renewal of the bus fleet comprises a substantial contribution to the overall level of cost of an LEZ. A detailed breakdown of the specific contributors to costs is provided in Appendix B.

Table 3.2: Breakdown of capital costs with no optimism bias and no discount factor applied, 2010 prices

Option	LEZ Area (km2)	Grant cost level (Low/Medium/ High)	Design cost, £	Implementation cost, £	Grants cost, £	Risk (10%), £	Total Capital Cost, £
1	0.5	Low	268,211	430,686	1,061,764	176,066	1,936,727
2	0.5	Medium	268,211	430,686	1,574,988	227,388	2,501,273
3	0.5	High	268,211	430,686	2,123,528	282,242	3,104,667
4	1.5	Low	349,365	581,773	3,185,291	411,643	4,528,072
5	1.5	Medium	349,365	581,773	4,724,962	565,610	6,221,710
6	1.5	High	349,365	581,773	6,370,583	730,172	8,031,893
7	3	Low	349,365	718,320	6,370,583	743,827	8,182,095
8	3	Medium	349,365	718,320	9,449,923	1,051,761	11,569,369
9	3	High	349,365	718,320	12,741,166	1,380,885	15,189,736

Table 3.3 presents the same detailed breakdown as Table 3.2 but with optimism bias and discount factor applied.

Table 3.3: Breakdown of capital costs with optimism bias and discount factor applied, 2010 prices

Option	LEZ Area (km2)	Grant cost level (Low/Medium/ High)	Design cost, £	Implementation cost, £	Grants cost, £	Risk (10%), £	Total Capital Cost, £
1	0.5	Low	293,303	470,978	1,161,095	192,538	2,117,914
2	0.5	Medium	293,303	470,978	1,722,332	248,661	2,735,274
3	0.5	High	293,303	470,978	2,322,189	308,647	3,395,117
4	1.5	Low	382,049	636,199	3,483,284	450,153	4,951,685
5	1.5	Medium	382,049	636,199	5,166,994	618,524	6,803,766
6	1.5	High	382,049	636,199	6,966,568	798,482	8,783,298
7	3	Low	382,049	785,521	6,966,568	813,414	8,947,552
8	3	Medium	382,049	785,521	10,333,989	1,150,156	12,651,715
9	3	High	382,049	785,521	13,933,135	1,510,071	16,610,776

Table 3.4 presents the cost values outlined in Table 3.2 for an opening year of 2018 but with an optimism bias of 44% applied and a discount factor of 3.5%, as recommended by DfT's WebTAG unit A1.1, March 2017, which is used by the Scottish Transport Appraisal Guidance (STAG).

Table 3.4: Summary of capital costs with optimism bias, risk and discount factor applied, 2010 prices

Option	LEZ Area (km2)	Grant cost level (Low/Medium/ High)	Capital Cost, £	Optimism Bias, £ (44%)	Total Undiscounted Capital Cost, £	Total Discounted Capital Cost, £
1	0.5	Low	1,936,727	852,160	2,788,887	2,117,913
2	0.5	Medium	2,501,273	1,100,560	3,601,833	2,735,274
3	0.5	High	3,104,667	1,366,054	4,470,721	3,395,117
4	1.5	Low	4,528,072	1,992,352	6,520,424	4,951,685
5	1.5	Medium	6,221,710	2,737,552	8,959,262	6,803,767
6	1.5	High	8,031,893	3,534,033	11,565,926	8,783,297
7	3	Low	8,182,095	3,600,122	11,782,217	8,947,551
8	3	Medium	11,569,369	5,090,522	16,659,891	12,651,714
9	3	High	15,189,735	6,683,484	21,873,219	16,610,775

3.2 Operating Costs

The operating costs of the various sizes of LEZ investigated were estimated based on the available operating costs associated with the running of the London LEZ. The main components of the operating costs are staff costs, maintenance of ANPRs and supporting air quality monitoring. The annual operating costs were discounted over the 10 year appraisal period by 3.5%, again as recommended by DfT's WebTAG Databook (March 2017). For consistency and robustness of approach, an optimism bias of 44% and a risk factor of 10% has been applied to the operating costs.

Table 3.5: Summary of Operating Costs, 2010 prices

Option	LEZ Area (km2)	Grant cost level (Low/ Med/ High)	Operating Cost per annum[4], £	Operating Cost (10 year appraisal period), £	Optimism Bias, £ (44%)	Total Undiscounted Operating Cost (10 year appraisal period) £	Total Discounted Operating Cost (10 year appraisal period), £
1	0.5	Low	306,512	3,065,119	1,348,652	4,413,772	2,885,184
2	0.5	Medium	306,512	3,065,119	1,348,652	4,413,772	2,885,184
3	0.5	High	306,512	3,065,119	1,348,652	4,413,772	2,885,184
4	1.5	Low	533,020	5,330,204	2,345,290	7,675,494	5,017,299
5	1.5	Medium	533,020	5,330,204	2,345,290	7,675,494	5,017,299
6	1.5	High	533,020	5,330,204	2,345,290	7,675,494	5,017,299
7	3	Low	730,560	7,305,597	3,214,463	10,520,060	6,876,728
8	3	Medium	730,560	7,305,597	3,214,463	10,520,060	6,876,728
9	3	High	730,560	7,305,597	3,214,463	10,520,060	6,876,728

3.3 Summary of Combined Cost Estimates

The following table summarises the total costs (given in 2010 prices) of the hypothetical scheme in Glasgow and schemes scaled from that, over a 10 year appraisal period, starting in the opening year 2018. Optimism bias of 44% has been applied and discounted to the base year 2010, using 3.5% as recommended by DfT's WebTAG Databook (March 2016).

[4] Includes risk of 10%

Table 3.6: Summary of Total Costs, 2010 prices

Option	LEZ Area (km^2)	Grant cost level (Low/Medium/High)	Undiscounted Costs[5], £ (10 year appraisal period)		Discounted Costs, £ (10 year appraisal period)		
			Capital Costs	Operating Costs	Capital Costs	Operating Costs	**Total Costs**
1	0.5	Low	2,788,887	4,413,772	2,117,913	2,885,184	5,003,097
2	0.5	Medium	3,601,833	4,413,772	2,735,274	2,885,184	5,620,458
3	0.5	High	4,470,721	4,413,772	3,395,117	2,885,184	6,280,301
4	1.5	Low	6,520,424	7,675,494	4,951,685	5,017,299	9,968,984
5	1.5	Medium	8,959,261	7,675,494	6,803,767	5,017,299	11,821,066
6	1.5	High	11,565,925	7,675,494	8,783,297	5,017,299	13,800,596
7	3	Low	11,782,216	10,520,060	8,947,551	6,876,728	15,824,279
8	3	Medium	16,659,891	10,520,060	12,651,714	6,876,728	19,528,442
9	3	High	21,873,219	10,520,060	16,610,775	6,876,728	23,487,503

For cost estimation in 2017 prices, please refer to Appendix C.

[5] Both undiscounted and discounted costs include optimism bias

Appendix A. LEZ Scenario Assessment

The specific scenarios tested by SEPA using the Glasgow Emissions Model are shown in Table A1. EMIT includes road traffic emission factors from DfT and from Defra's Emission Factor Toolkit. The results of the tests are shown on Figures A1 – A3:

Table A1 –Glasgow City Centre LEZ Scenario Tests

Scenario	Description	Buses and Coaches	Taxis and Private Hire	HGVs	LGVs	Cars	Motorcycles
1	2018 do-nothing, i.e. natural fleet renewal projections from 2015 to 2018 using Emit factors	Standard emit assumption at 2018	Standard emit assumption at 2018	Standard emit assumption at 2018	Standard emit assumption at 2018	Standard emit assumption at 2018	Standard emit assumption at 2018
2	2028 do-nothing, i.e. natural fleet renewal projections from 2015 to 2028 using Emit factors	Standard emit assumption at 2028	Standard emit assumption at 2028	Standard emit assumption at 2028	Standard emit assumption at 2028	Standard emit assumption at 2028	Standard emit assumption at 2028
3	2018 partial spec from day one, i.e. LEZ in place but entry criteria initially relatively low to limit the initial number of vehicles affected	Euro IV	Euro 3 (diesel)	Euro 4	Euro 3 (diesel)	Euro 3 (diesel)	Euro 3
4	2018 full spec to forthcoming NLEF standards from day one, i.e. strict entry criteria from opening day focussing on all vehicle classes to forthcoming NLEF standards	Euro VI	Euro 6 (diesel) Euro 4 (petrol)	Euro VI	Euro 6 (diesel) Euro 4 (petrol)	Euro 6 (diesel) Euro 4 (petrol)	Euro 3
5	As scenario 4 but not introduced until 2023	Euro VI	Euro 6 (diesel) Euro 4 (petrol)	Euro VI	Euro 6 (diesel) Euro 4 (petrol)	Euro 6 (diesel) Euro 4 (petrol)	Euro 3
6	2019 Bus LEZ, i.e. bus minimum standard Euro-6 or retrofitted. All other vehicle fleets renewed using emit factors to 2019	Euro VI or retrofitted	Standard emit assumption at 2019	Standard emit assumption at 2019	Standard emit assumption at 2019	Standard emit assumption at 2019	Standard emit assumption at 2019
7	As scenario 4 but the actual zone it applies being isolated to only Hope Street and Renfield / Union Street (only on section between Argyle Street and West Regent Street). EMIT factors for 2018 applied to vehicles in all other areas	Euro VI	Euro 6 (diesel) Euro 4 (petrol)	Euro VI	Euro 6 (diesel) Euro 4 (petrol)	Euro 6 (diesel) Euro 4 (petrol)	Euro 3
8	As scenario 6 but rolled on to 2023	Euro VI or retrofitted	Euro 3 (diesel)	Euro 4	Euro 3 (diesel)	Euro 3 (diesel)	Euro 3
9	As scenario 7 but for 2023	Euro VI	Euro 6 (diesel) Euro 4 (petrol)	Euro VI	Euro 6 (diesel) Euro 4 (petrol)	Euro 6 (diesel) Euro 4 (petrol)	Euro 3

Figure A1 - Glasgow Emissions Model Results: 2015 Observed & Scenarios 1 - 3

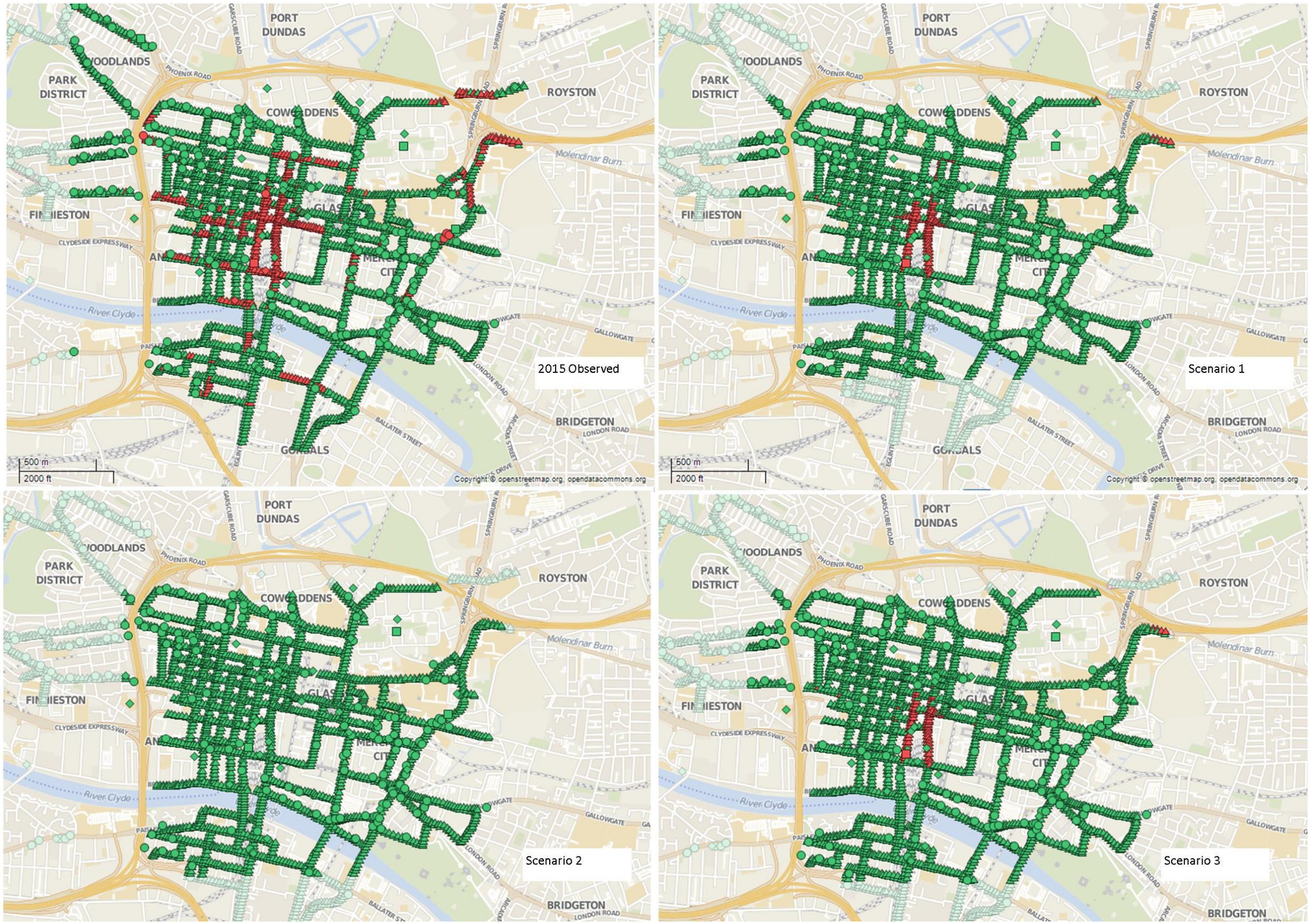


Figure A2 - Glasgow Emissions Model Results: Scenarios 4 - 7

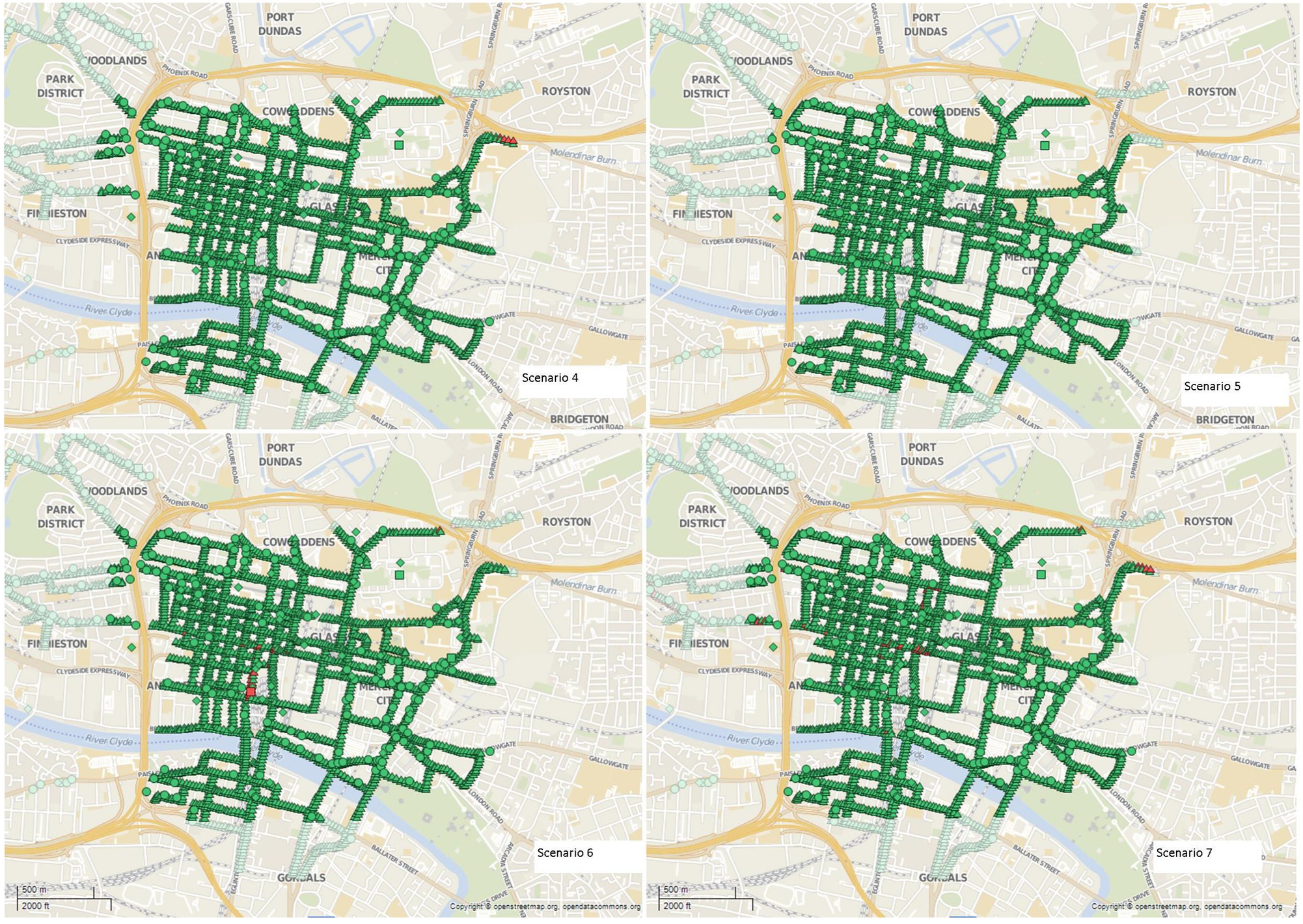
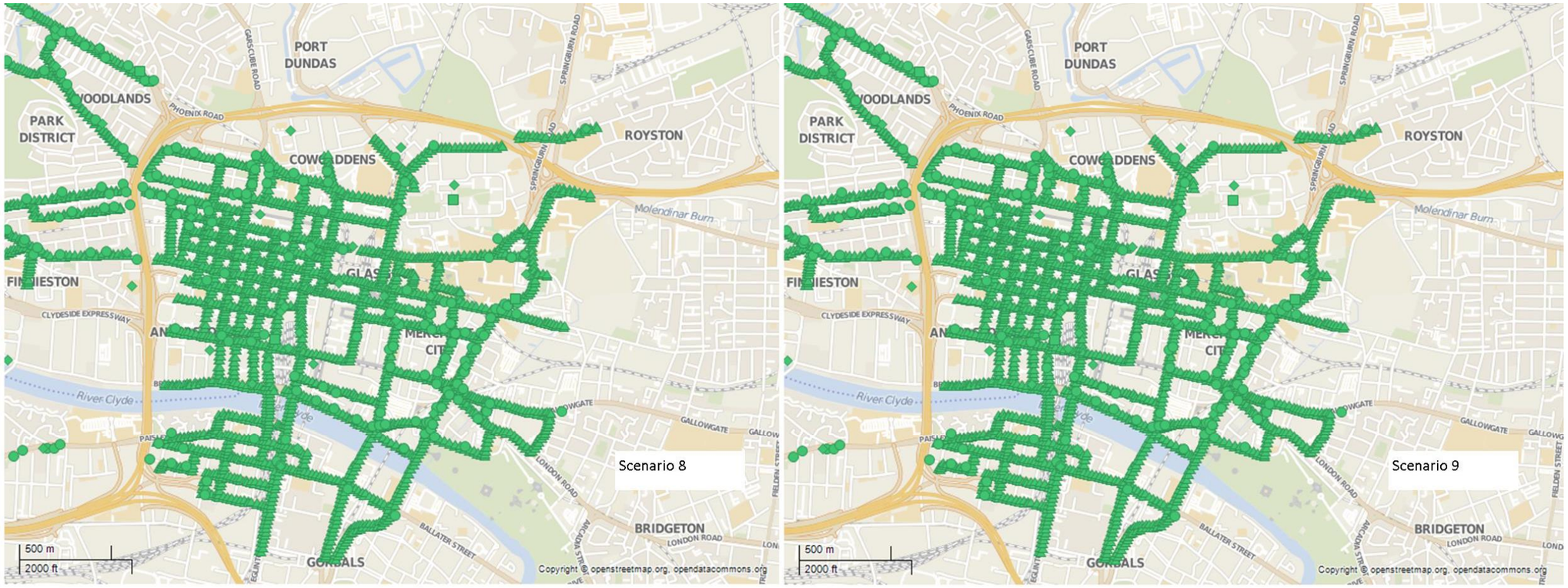


Figure A3 - Glasgow Emissions Model Results: Scenarios 8 & 9



Appendix B. Methodology

B.1 Options

The economic assessment has considered 9 options which varies depending on the following:

- Area size of the LEZ
- Level of grant cost

The following table presents the characteristics of each option under assessment.

Table B1: LEZ Options

Option	LEZ Area (m2)	Level of Grant (Low/Medium/High)
1	0.5	Low
2	0.5	Medium
3	0.5	High
4	1.5	Low
5	1.5	Medium
6	1.5	High
7	3.0	Low
8	3.0	Medium
9	3.0	High

The scope of this Task is based on Glasgow, however the methodology employed to obtain the cost of implementing and operating a LEZ should be applicable to other cities in Scotland, therefore allowing similar estimations of cost to be carried out, subject to certain data being obtained.

B.2 Basis of Cost

The financial costs of LEZ implementation in Scotland includes costs associated with the design, implementation, and maintenance of the LEZs, resource costs for back-office support, cost of a communication strategy, along with the potential costs for grant or incentive schemes.

The cost of the scheme was calculated based on the financial cost of the London LEZ, comprising:

- Design – includes the design and implementation, staff costs, marketing and communication costs
- Air Quality Testing – includes air quality and traffic modelling
- Signage
- Automatic Number Plate Recognition [6] (ANPR) – includes cost of devices, installation, maintenance, enforcement and back-office costs

[6] This cost was not scaled down purely using the LEZ perimeter; instead analysis concluded that 25 cameras would be sufficient to cover all entry and exit points for the largest Glasgow city centre LEZ. This analysis can be carried out by local authorities implementing an LEZ.

- Grants[7]

B.3 Scaling Factor

The available cost estimates for the London LEZ scheme provides the basis (i.e. proxy) for calculating the costs of various sizes of LEZs in Scotland. To provide a more realistic forecast of the financial implication of the LEZ in Scotland, costs derived from the London LEZ scheme were adjusted using a scaling factor.

The scaling factor varies across the different type of costs, whereby two main scaling factors were calculated based the following:

Table B2: Scaling Factor for hypothetical Glasgow Low Emission Zone (area 3km^2)

	Motorway perimeter (km)	Population[8]
London (M25)	188	8,174,000
Glasgow (M8)	6	593,245
Glasgow as % of London	3.2%	7.3%

The length of the M25 orbital motorway is approximately 188km, while the perimeter of the Glasgow orbital motorway is calculated using GIS. The population was sourced from the 2011 Census.

Table B3 below presents the London LEZ costs and hypothetical Glasgow LEZ costs that are estimated via the scaling factors presented in Table B2. For example, “Design and implementation staff” costs for the London LEZ were £1.5m, therefore for the hypothetical Glasgow LEZ (3km^2) it is estimated to cost 3.2% of the London cost which is £47,872 in 2017 prices. To calculate the rest of the costs, either of the two scaling factors was applied, with the “Scaling Method” column in Table B3 presenting which scaling factor was used for each cost element.

After being scaled from the London costs to hypothetical Glasgow costs, each individual cost element was then brought together into the groups shown in Table B3: design costs, implementation costs[9], and operating costs. It should be noted that the costs presented in Table B3 do not include Optimism Bias, Risk, or discounting.

[7] This cost was not based upon London figures; instead it was calculated based upon data from SEPA and SPT in terms of traffic flows, the composition of transport, and cost of upgrading/retrofitting buses.
[8] Source: Census 2011
[9] As mentioned previously, Grant cost was not calculated from London LEZ costs and therefore not included in Table B3. Design, Implementation, and Grant costs are brought together under Capital costs as reported in table 3.4.

Table B3 - Detailed breakdown of costs and scaling for hypothetical 3km^2 LEZ[10] (no OB, no risk, no discounting)

Cost element	London LEZ (2017 prices)	Hypothetical Glasgow LEZ (3km^2) (2017 prices)	Hypothetical Glasgow LEZ (3km^2) (2010 prices)	Scaling method
Design costs				
Design and implementation staff costs (£)	1,500,000	47,872	43,167	Size of motorway perimeter relative to London perimeter
Marketing and communications costs (£)	5,000,000	159,574	143,890	Size of motorway perimeter relative to London perimeter
Air quality modelling costs (£)	40,000	30,000	27,051	Based on the size of a hypothetical Glasgow LEZ instead of the size of hypothetical Glasgow LEZ relative to London
Traffic modelling costs (£)	40,000	30,000	27,051	Based on the size of a hypothetical Glasgow LEZ instead of the size of hypothetical Glasgow LEZ relative to London
Air quality monitoring set up cost (£)	150,000	120,000	108,205	Based on the size of a hypothetical Glasgow LEZ instead of the size of hypothetical Glasgow LEZ relative to London
Implementation costs				
Number of motorway signs	38	1	-	Size of motorway perimeter relative to London perimeter
Cost per motorway sign[11] (£)	40,000	40,000	-	-
Motorway signage costs (£) (includes costs of traffic disruption)	1,520,000	48,511	43,743	Size of motorway perimeter relative to London perimeter
Number of non-motorway signs	750	24	-	Size of motorway perimeter relative to London perimeter

[10] These costs reflect scenarios 7, 8, and 9
[11] 2010 price is not calculated on a per item basis, instead it is applied to the total cost of that item

Cost per non-motorway sign[12] (£)	2,000	2,000	-	-
Non-motorway signage cost (£)	1,500,000	47,872	43,167	Size of motorway perimeter relative to London perimeter
Number of cameras	342	25	-	Analytical decision based on entry/exit points of hypothetical Glasgow LEZ
Cost per camera[13] (£)	10,000	10,000	-	-
Total cost of cameras (£)	3,420,000	250,000	225,428	Analytical decision based on entry/exit points of hypothetical Glasgow LEZ
Installation cost per camera[14] (£) (post, sign, wiring, and labour)	10,000	10,000	-	-
Total installation cost of cameras (£)	3,420,000	250,000	225,428	Analytical decision based on entry/exit points of hypothetical Glasgow LEZ
IT equipment (£)	4,000,000	127,660	115,112	Size of motorway perimeter relative to London perimeter
Accommodation cost (£)	1,000,000	72,577	65,443	Size of population relative to London population
Operating costs				
Air quality monitoring (£) (annual running cost)	20,000	16,000	14,427	Based on the size of a hypothetical Glasgow LEZ instead of the size of hypothetical Glasgow LEZ relative to London
Annual running cost per camera[15] (£)	8,500	8,500	-	-
Total annual running cost per camera (£)	2,907,000	212,500	191,613	Analytical decision based on entry/exit points of hypothetical Glasgow LEZ

[12] 2010 price is not calculated on a per item basis, instead it is applied to the total cost of that item
[13] 2010 price is not calculated on a per item basis, instead it is applied to the total cost of that item
[14] 2010 price is not calculated on a per item basis, instead it is applied to the total cost of that item
[15] 2010 price is not calculated on a per item basis, instead it is applied to the total cost of that item

Staff costs – front office (annual running cost) (£)	3,250,000	235,875	212,691	Size of population relative to London population
Staff costs – back office (annual running cost) (£)	3,750,000	272,164	245,413	Size of population relative to London population

B.4 Risk

At this preliminary stage, a quantified risk analysis has not been undertaken for the Outline Business Case. As a result, an assumption of 10% has been applied to account for risks.

B.5 Optimism Bias

HM Treasury Supplementary Green Book Guidance advises a recommended adjustment range of 3% at the lower band up to 44% at the higher band for Optimism Bias on Standard Civil Engineering Projects as detailed in Table 3.5.

Table B4: Optimism Bias Guidance

Recommended Adjustment Ranges

Project Type	Optimism Bias (%)[2]			
	Works Duration		Capital Expenditure	
	Upper	Lower	Upper	Lower
Standard Buildings	4	1	24	2
Non-standard Buildings	39	2	51	4
Standard Civil Engineering	20	1	44	3
Non-standard Civil Engineering	25	3	66	6
Equipment/Development	54	10	200	10
Outsourcing	N/A	N/A	41*	0*

DfT Treasury Analysis Guidance (see TAG Unit A1.2 Scheme Costs, section 3.5.6) recommends that estimates at stage 1 are uplifted by 44% for Optimism Bias.

Allowance of 44% has therefore been included in line with DfT guidelines.

B.6 Inflation

At this preliminary stage, inflation has not been accounted for and the cost estimates are presented in 2010 prices as recommended by DfT's TAG, Unit A1.2.

B.7 Value Added Tax (VAT)

Value Added Tax (VAT) is assumed to be included for this cost estimate.

B.8 Assumptions

The following assumptions have been made in the preparation of this cost estimate:

- General:
    - Opening year is 2018
    - Implementation of the scheme will start in the year 2018
    - This is based on Scottish Government commitment to implement LEZ by 2018[16].
- Scaling
    - Acceptable to use Glasgow wide population estimate due to realistic costs obtained and the basis that it is likely this population will interact with LEZ.
    - One camera per entry/exit point is sufficient.
    - Scaling to smaller Glasgow LEZ using basis of changing the area of a circle (km^2) and resulting change in perimeter (km) is used to scale costs from the $3km^2$ to $1.5km^2$ and $0.5km^2$.
- Glasgow already has a system in place that restricts movement in bus lanes and certain areas of the city centre with the threat of fines being imposed. Therefore, Glasgow's costs could be significantly less than estimated here as it would be less costly to expand a system already in place than to install a completely new system in a local authority that has no experience in this area. Due to the necessity of this work being scalable to other cities in Scotland, we thought it prudent to assume that Glasgow City Council would not be able to fully utilise their current system and would have to put in place the maximum amount of new cameras, staff, etc.
- Staff costs will include enforcement costs.
- Hypothetical Public Transport Potential Operator Grant costs were estimated on the basis of 683 buses requiring either retrofitting or scrappage. Euro 4 and 5 buses were assumed to be retrofitted to meet the access requirements of the LEZ, whilst Euro 3 or older buses would be scrapped. Low, medium and high cost ranges were created based on discussions with SPT and an unnamed major bus supplier. Rates used were as below:

[16] http://www.gov.scot/Publications/2017/06/2881/4

Table B5: Grant Cost Bandings

Cost Category	Retrofit (£)	Scrappage Grant (£)
Low	7,500	15,000
Medium	12,500	20,000
High	15,000	30,000

The composition of the bus fleet was assumed to be as follows:

Table B6: Glasgow Bus Fleet Makeup

Engine Class	Number of Buses	Proportion Fleet[17]
Euro II (from 1998)	6	1%
Euro III (from 2000)	253	31%
Euro IV (from 2005)	60	7%
Euro V (from 2008)	364	45%
Euro VI (from 2014)	125	15%

B.9 Complete Summary of Costs

A complete summary of discounted costs (2010 prices), both 1 year and 10 year, is outlined in Table B7

[17] Figures do not sum due to rounding

Table B7: Cost Summary Table with Optimism Bias and Discount Factor Applied, 2010 prices

#	Local Authority Area	LEZ Area	Possible Size of forthcoming NLEF Scheme (LEZ)	Design Costs[18]	Implementation costs[19]	Grant costs	Operating Costs (year 1)[20]	Risk (year 1)	Total costs (year 1)	Total costs (10 year period)
		(km2)	(S/M/L)	(£)	(£)	(£)	(£)	(£)	(£)	(£)
1	Unknown	0.5	Small (low grant)	293,303	470,978	1,161,095	335,187	226,056	2,486,619	5,003,097
2	Unknown	0.5	Small (medium grant)	293,303	470,978	1,722,332	335,187	282,180	3,103,980	5,620,458
3	Unknown	0.5	Small (high grant)	293,303	470,978	2,322,189	335,187	342,166	3,763,823	6,280,301
4	Unknown	1.5	Medium (low grant)	382,049	636,199	3,483,284	582,886	508,442	5,592,860	9,968,984
5	Unknown	1.5	Medium (medium grant)	382,049	636,199	5,166,994	582,886	676,813	7,444,941	11,821,066
6	Unknown	1.5	Medium (high grant)	382,049	636,199	6,966,568	582,886	856,770	9,424,472	13,800,596
7	Glasgow	3	Large (low grant)	382,049	785,521	6,966,568	798,906	893,304	9,826,348	15,824,279
8	Glasgow	3	Large (medium grant)	382,049	785,521	10,333,989	798,906	1,230,046	13,530,511	19,528,442
9	Glasgow	3	Large (high grant)	382,049	785,521	13,933,135	798,906	1,589,961	17,489,572	23,487,504

[18] Includes: LEZ design, implementation staff costs, marketing & communications, air quality modelling and air quality monitoring.
[19] Includes: Signage costs, camera, camera installation (post, sign, wiring and labour), IT equipment and accommodation.
[20] Operating Costs: Annual cost for air quality monitoring, staff and camera maintenance.

Appendix C. Cost Estimation (2017 prices)

Table C1: Summary of capital costs, 2017 prices (including OB, risk and discounted prices)

Option	LEZ Area (km^2)	Grant cost level (Low/Medium/High)	Capital Cost, £	Optimism Bias, £ (44%)	Total Undiscounted Capital Cost, £	Total Discounted Capital Cost, £
1	0.5	Low	2,147,837	945,048	3,092,885	2,348,773
2	0.5	Medium	2,773,921	1,220,525	3,994,446	3,033,429
3	0.5	High	3,443,087	1,514,958	4,958,045	3,765,197
4	1.5	Low	5,021,649	2,209,525	7,231,174	5,491,437
5	1.5	Medium	6,899,899	3,035,955	9,935,854	7,545,402
6	1.5	High	8,907,399	3,919,255	12,826,654	9,740,709
7	3	Low	9,073,973	3,992,548	13,066,521	9,922,867
8	3	Medium	12,830,473	5,645,408	18,475,881	14,030,798
9	3	High	16,845,473	7,412,008	24,257,481	18,421,412

Table C2: Summary Operating Costs, 2017 prices (including OB, risk and discounted prices)

Option	LEZ Area (km2)	Grant cost level (Low/ Med/ High)	Operating Cost per annum[21], £	Operating Cost (10 year appraisal period), £	Optimism Bias, £ (44%)	Total Undiscounted Operating Cost (10 year appraisal period) £	Total Discounted Operating Cost (10 year appraisal period), £
1	0.5	Low	339,923	3,399,229	1,495,661	4,894,890	3,199,680
2	0.5	Medium	339,923	3,399,229	1,495,661	4,894,890	3,199,680
3	0.5	High	339,923	3,399,229	1,495,661	4,894,890	3,199,680
4	1.5	Low	591,122	5,911,216	2,600,935	8,512,151	5,564,203
5	1.5	Medium	591,122	5,911,216	2,600,935	8,512,151	5,564,203
6	1.5	High	591,122	5,911,216	2,600,935	8,512,151	5,564,203
7	3	Low	810,193	8,101,935	3,564,851	11,666,786	7,626,317
8	3	Medium	810,193	8,101,935	3,564,851	11,666,786	7,626,317
9	3	High	810,193	8,101,935	3,564,851	11,666,786	7,626,317

[21] Includes risk of 10%

Table C3: Summary of total costs, 2017 prices

Option	Size of LEZ (km^2)	Grant cost level (Low/Medium/High)	Undiscounted Costs[22], £ (10 year appraisal period)			Discounted Costs, £ (10 year appraisal period)		
			Capital Costs	Operating Costs	**Total Costs**	Capital Costs	Operating Costs	**Total Costs**
1	0.5	Low	3,092,886	4,894,889	7,987,775	2,348,773	3,199,680	5,548,453
2	0.5	Medium	3,994,446	4,894,889	8,889,335	3,033,429	3,199,680	6,233,109
3	0.5	High	4,958,046	4,894,889	9,852,935	3,765,197	3,199,680	6,964,877
4	1.5	Low	7,231,174	8,512,151	15,743,325	5,491,437	5,564,203	11,055,640
5	1.5	Medium	9,935,854	8,512,151	18,448,005	7,545,402	5,564,203	13,109,605
6	1.5	High	12,826,654	8,512,151	21,338,805	9,740,709	5,564,203	15,304,912
7	3	Low	13,066,521	11,666,786	24,733,307	9,922,867	7,626,317	17,549,184
8	3	Medium	18,475,881	11,666,786	30,142,667	14,030,798	7,626,317	21,657,115
9	3	High	24,257,481	11,666,786	35,924,267	18,421,412	7,626,317	26,047,729

Table C4: Cost Summary Table with Optimism Bias and Discount Factor applied, 2017 prices

#	Local Authority Area	LEZ Area (km2)	Possible Size of forthcoming NLEF Scheme (LEZ) (S/M/L)	Design Costs[23] (£)	Implementation costs[24] (£)	Grant costs (£)	Operating Costs (year 1)[25] (£)	Risk (year 1) (£)	Total costs (year 1) (£)	Total costs (10 year period) (£)
1	Unknown	0.5	Small (low grant)	325,274	522,316	1,287,658	337,930	247,318	2,720,496	5,548,453
2	Unknown	0.5	Small (medium grant)	325,274	522,316	1,910,072	337,930	309,559	3,405,151	6,233,109
3	Unknown	0.5	Small (high grant)	325,274	522,316	2,575,316	337,930	376,084	4,136,920	6,964,877
4	Unknown	1.5	Medium (low grant)	423,693	705,547	3,862,975	587,657	557,987	6,137,859	11,055,640
5	Unknown	1.5	Medium (medium grant)	423,693	705,547	5,730,216	587,657	744,711	8,191,824	13,109,606
6	Unknown	1.5	Medium (high grant)	423,693	705,547	7,725,949	587,657	944,285	10,387,131	15,304,913
7	Glasgow	3	Large (low grant)	423,693	871,145	7,725,949	805,445	982,623	10,808,855	17,549,185
8	Glasgow	3	Large (medium grant)	423,693	871,145	11,460,432	805,445	1,356,072	14,916,787	21,657,115
9	Glasgow	3	Large (high grant)	423,693	871,145	15,451,899	805,445	1,755,218	19,307,400	26,047,729

[22] Both undiscounted and discounted costs include optimism bias
[23] Includes: LEZ design, implementation staff costs, marketing & communications, air quality modelling and air quality monitoring.
[24] Includes: Signage costs, camera, camera installation (post, sign, wiring and labour), IT equipment and accommodation.
[25] Operating Costs: Annual cost for air quality monitoring, staff and camera maintenance.

Appendix D. Cost Estimation (2019 prices)

Table D1: Cost Summary Table with Optimism Bias and Discount Factor applied, 2019 prices

#	Local Authority	LEZ Area	Possible Size of forthcoming NLEF Scheme (LEZ)	Design Costs[26]	Implementation costs[27]	Grant costs	Operating Costs (year 1)[28]	Risk (year 1)	Total costs (year 1)	Total costs (10 year period)
	Area	(km2)	(S/M/L)	(£)	(£)	(£)	(£)	(£)	(£)	(£)
1	Unknown	0.5	Small (low grant)	338,083	542,885	1,338,366	206,239	242,557	2,668,131	4,394,030
2	Unknown	0.5	Small (medium grant)	338,083	542,885	1,985,291	206,239	307,250	3,379,747	5,105,647
3	Unknown	0.5	Small (high grant)	338,083	542,885	2,676,732	206,239	376,394	4,140,333	5,866,233
4	Unknown	1.5	Medium (low grant)	440,379	733,332	4,015,099	481,681	567,049	6,237,539	10,268,466
5	Unknown	1.5	Medium (medium grant)	440,379	733,332	5,955,872	481,681	761,126	8,372,390	12,403,317
6	Unknown	1.5	Medium (high grant)	440,379	733,332	8,030,197	481,681	968,559	10,654,148	14,685,075
7	Glasgow	3	Large (low grant)	440,379	905,451	8,030,197	837,163	1,021,319	11,234,509	18,240,271
8	Glasgow	3	Large (medium grant)	440,379	905,451	11,911,743	837,163	1,409,474	15,504,210	22,509,972
9	Glasgow	3	Large (high grant)	440,379	905,451	16,060,395	837,163	1,824,339	20,067,726	27,073,488

[26] Includes: LEZ design, implementation staff costs, marketing & communications, air quality modelling and air quality monitoring.
[27] Includes: Signage costs, camera, camera installation (post, sign, wiring and labour), IT equipment and accommodation.
[28] Operating Costs: Annual cost for air quality monitoring, staff and camera maintenance.