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Energy & Environment

# Distributional Analysis Methodology Report (E3)

Southampton    Clean    Air    Zone    feasibility    study

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Report for Southampton City Council

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# 1 Introduction

Southampton has been named as one of many cities in the UK that will not be compliant with nitrogen dioxide regulations by 2020 (which have been set in line with EU air quality targets). As a result, DEFRA's air quality action plan named Southampton as having to implement a Clean Air Zone (CAZ).

Each city must develop a Business Case which explores viable options for a CAZ and present the case to support the preferred CAZ option. The Business Cases are being developed in line with guidance issued by the Joint Air Quality Unit (JAQU), which in turn is based upon HMT's five case model<sup>1</sup>.

JAQU have shared with the cities detailed guidance around the methodologies and assumptions to adopt when appraising the CAZ options<sup>2</sup>. This guidance stipulates that deliverables to be provided by the Local Authority are:

1. SOC: options appraisal - within the SOC, detailing the case for change and a high-level assessment of the options being considered.
2. Economic Appraisal Methodology Report (E1)
3. The Economic Model (E2) and any linked documents (linked spreadsheets or user guide)
4. Write-up of the economic appraisal and results
5. Distributional Analysis Methodology Report (E3).

Ricardo Energy & Environment supported Southampton City Council on the Economics Business Case, which is one of the five cases constituting the overall Business Case. As part of the Economics Case a qualitative analysis of the distributional impacts was included.

This report sets out the methodology and analysis of the distributional impacts of the CAZ options following the requirements of the deliverable E3. The aim of the distributional analysis is to explore how the impacts of the policy options are distributed amongst the different socio-economic groups (such as children, different income groups, and disabled). It also sheds light into whether any key amenities such as schools, hospitals etc. are adversely affected through changes in access or surrounding air quality. This can inform measures to mitigate the impact of the policy on those groups or amendment of the policy itself.

The distributional analysis inherently relies on other areas of the modelling undertaken to support the assessment of CAZ options, specifically the transport modelling undertaken by Systra and air quality modelling undertaken by the Ricardo team. This paper clearly references where the economic analysis has used the outputs of other modelling and describes how these outputs are used. However, it does not set out a detailed account of how this supporting modelling has been undertaken, which has been provided elsewhere (e.g. through the Modelling Needs Assessment reports).

The JAQU Guidance stipulates that distributional analysis is necessary for local feasibility studies in two respects:

1. to investigate the distributional impacts of measures proposed to achieve compliance with air quality limits, thereby fulfilling the public-sector equality duty;
2. to show how mitigation measures alleviate those impacts.

This is the second version of this report produced. The first version presented distributional analysis of the four options included on the initial shortlist. Subsequently in light of updates to the baseline air quality modelling, SCC revised the shortlist to two options: a city-wide CAZ B and an updated non-charging measure. This report sets out the distributional analysis of the two options on this revised shortlist.

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<sup>1</sup>

[https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/469317/green\\_book\\_guidance\\_public\\_sector\\_business\\_cases\\_2015\\_update.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/469317/green_book_guidance_public_sector_business_cases_2015_update.pdf)

<sup>2</sup> Latest version issued 27/11/17

## 2 Methodology

### 2.1 Overview

JAQU have provided detailed guidance regarding the appraisal of CAZ options. This provides a steer for many of the key data inputs and assumptions that have framed the analysis undertaken.

The key guidance documents include:

- Options Appraisal – Guidance (2017)<sup>3</sup> (and preceding versions of this guidance)
- National data inputs for Local Economic Models (2017)<sup>4</sup>.

With respect to distributional analysis, the JAQU Guidance strongly leans on supporting Webtag guidance issued by Department for Transport, DfT<sup>5</sup>.

The methodology used to undertake the distributional analysis is based on this guidance. In some cases, we have sought alternative methods, or elaborated additional steps and assumptions where the study team felt that such approaches were warranted to facilitate or improve the analysis. In particular, this is the case where additional output metrics were deemed useful to convey the distributional impacts of the CAZ options.

As such, our approach has adopted and followed the three steps defined by Webtag: Screening, assessment and appraisal.

Throughout the development of the approach to the distributional analysis, the proposed methodology was presented to Southampton and JAQU through a series of Scoping Papers. The methodology followed is consistent with the final version of this paper submitted (version 3)<sup>6</sup>.

### 2.2 Selecting options for assessment

The first iteration of the analysis appraised 4 options which made up the initial shortlist:

1. Option 1 City Wide CAZ B
2. Option 1A City Wide HGV charging only, combined with bus and taxi incentives
3. Option 2 City centre CAZ A Plus LES HGV
4. Option 3 Non-charging CAZ with LES HGV and bus and taxi incentives.

Following the submission of the draft OBC in spring 2018, several factors contributed to SCC refining the shortlist of measures for assessment from four to two CAZ options:

1. SCC further reflected on the feasibility and analysis of the options included in the initial shortlist.
2. transport and air quality modelling of the baseline and CAZ options was updated to reflect several improvements in the underlying evidence base.
3. Due to the confirmation of funding for bus retrofit through the CBTF, this measure was moved from CAZ option to baseline

**The revised shortlist retains one charging CAZ option (a city-wide CAZ B, similar to ‘Option 1’ under the initial shortlist) and a revised non-charging option (similar in principle to ‘Option 3’ of the initial shortlist, but with different sub-measures). These options are presented in detail in**

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<sup>3</sup> Unpublished – provided directly by JAQU to cities

<sup>4</sup> Unpublished – provided directly by JAQU to cities

<sup>5</sup> DfT (2015): ‘WebTAG: TAG unit A4-2 distributional impact appraisal, December 2015’; <https://www.gov.uk/government/publications/webtag-tag-unit-a4-2-distributional-impact-appraisal-december-2015>

<sup>6</sup> Ricardo (2018): ‘CAZ Distributional Analysis – Proposed Approach v3.0 – Southampton (unpublished)

Table 1.

**Table 1 – Revised shortlist option construction**

Option	Details
<b>City Wide Class B Clean Air Zone (CAZ B)</b>	<ul style="list-style-type: none"> <li>• Introduced in 2020</li> <li>• CAZ operating along but excluding the motorways around Southampton city area (M27 and M271 of Southampton)</li> <li>• CAZ applies to Taxis, Private Hire Vehicles (PHV), Buses, HGVs and Coaches. <ul style="list-style-type: none"> <li>○ However, no scheduled buses operating services in Soton are anticipated to be affected given CBTF funding for retrofit will cover all buses</li> </ul> </li> <li>• Also includes taxi-licence in 2023: in 2023, licencing conditions are tightened such that only Euro VI vehicles can operate a licence</li> </ul>
<b>Non-charging Clean Air Zone (NCH CAZ)</b>	<ul style="list-style-type: none"> <li>• Introduced in 2020</li> <li>• Option is comprised of four sub-measures: <ul style="list-style-type: none"> <li>○ Taxi-licence in 2023: in 2023, licencing conditions are tightened such that only Euro VI vehicles can operate a licence</li> <li>○ Shore-side power: Facilities installed at 1 berth in Southampton port to allow cruise ships to 'plug-in' and use mains electricity when at berth (rather than using auxiliary engines to provide power)</li> <li>○ Port booking system: a peak hour £5 charge is implemented at the container port terminal for non-Euro VI HGVs accessing the port</li> <li>○ Sustainable distribution centre (SDC): Implementation of a Delivery Service Plan (DSP) and channelling of deliveries through the SDC for the General Hospital <ul style="list-style-type: none"> <li>▪ This is consistent with the SDC Option 1 as presented in the Finance Case where the programme achieves successful implementation of a DSP at one site by 2020</li> </ul> </li> </ul> </li> </ul>

The analysis in this report focuses on the assessment of the two options on the revised shortlist. A summary of the analysis undertaken on the initial shortlist is included in Appendix 1 – Summary assessment of initial shortlist.

## 2.3 Screening of impacts

We have undertaken the screening process on the basis of the list of impacts listed in the Webtag A4.2 taking into account the likely local issues of the proposed CAZ options. A summary of the screening is included Table 2 below.

Based on the screening, the following effects have been 'scoped-in':

1. Air quality - changes in concentrations of NO<sub>2</sub>
2. Affordability – including user benefits, considering both residents and local businesses

In the analysis of the initial shortlist, 'Traffic impacts' (considered as changes in traffic as a proxy for noise and safety/accidents; and accessibility impacts through changes in journey times) were also screened in. For the analysis of the revised shortlist, these impacts have been screened out as there were no significant effects observed in the analysis of the initial shortlist. Furthermore, the options have not changed in a way that would lead these impacts to become significant under the revised shortlist – i.e. CAZ B is the same as the initial shortlist Option 1, and the NCH CAZ includes sub-measures which focus on a narrower subset of traffic feeding the port.

**Table 2 – Screening of impacts**

	Description of impact	Screening assessment	Include in detailed analysis?
<b>User benefits</b>	<ul style="list-style-type: none"> <li>• changes in travel time</li> <li>• changes in user charges, including fares, tariffs and tolls; and</li> <li>• changes in vehicle operating costs met by the user (i.e. for private transport).</li> </ul>	<p>There will be a distributional impact, (in some cases positive)</p> <p>Given these are financial costs, there is an overlap with affordability</p>	<p>Yes – group under affordability</p>
<b>Noise</b>	<p>Changes in noise levels – move in line with traffic on roads</p>	<p>Possible distributional impacts where large changes in traffic on individual links</p>	<p>No – insignificant in analysis of initial shortlist</p>
<b>Accidents</b>	<p>Changes in accident rates – move in line with traffic / speed on roads</p>	<p>Possible distributional impacts where large changes in traffic on individual links</p>	<p>No – insignificant in analysis of initial shortlist</p>
<b>Air quality</b>	<p>Change in emissions</p>	<p>Will have varying impact between areas</p>	<p>Yes</p>
<b>Security</b>	<p>Any change in public transport waiting/interchange facilities including pedestrian access expected to affect user perceptions of personal security.</p>	<p>Charging CAZ will not impact on security. Could be impact if indirect impact on public transport provision</p>	<p>No</p>
<b>Severance</b>	<p>Introduction or removal of barriers to pedestrian movement, either through changes to road crossing provision, or through introduction of new public transport or road corridors.</p>	<p>CAZ will not impact on physical road crossings</p>	<p>No</p>
<b>Accessibility</b>	<ul style="list-style-type: none"> <li>• Changes in routings or timings of current public transport services, any changes to public transport provision, including routing, frequencies, waiting facilities (bus stops / rail stations) and rolling stock, or any indirect impacts on accessibility to services (e.g. demolition &amp; re-location of a school).</li> <li>• Accessibility impacts should consider changes in services, routings or timings</li> </ul>	<ul style="list-style-type: none"> <li>- Charging CAZ will not put up physical barriers which will impact on access to services</li> <li>- Charging CAZ does not plan to remove / change public transport services,                             <ul style="list-style-type: none"> <li>o Only placing additional costs on vehicle users – so any accessibility impacts will overlap with affordability</li> <li>o CAZ proposes no change to services / locations, only change to upgrade to buses,</li> </ul> </li> </ul>	<p>No – insignificant in analysis of initial shortlist</p>

	Description of impact	Screening assessment	Include in detailed analysis?
	of current public transport services within the impact area.	<ul style="list-style-type: none"> <li>○ As long as same provision for wheelchairs / low floors</li> <li>- Unlikely that there will be any impact on provision of services through changes in demand                             <ul style="list-style-type: none"> <li>○ most people upgrade/pay charge, only a very small fraction 'cancel' so unlikely to significantly change demand for services</li> <li>○ Even if did, it would be very difficult to pinpoint from existing models which services would be affected given scope of CAZ areas</li> </ul> </li> <li>- Only additional and significant impact could be through changes in congestion, which impact on travel time to amenities</li> </ul>	
<b>Affordability</b>		Charging CAZ will have significant impact on costs which will vary by vehicle ownership	Yes



## 2.4 Defining the geographic scope

To capture the majority of those who could be impacted by the introduction of the Southampton CAZ, a study domain covering a large geographical area is required for the distributional analysis. We used commuter information from the 2011 census<sup>7</sup> to identify the distributional analysis domain. This data was not available at lower layer super output area (LSOA) level and therefore we used the most detailed spatial information available, which was provided for each middle super output area (MSOA).

The commuting data provides information about the commuting destination (in terms of MSOA) of those who live in each MSOA. Hence this provides a picture of the spread of households who could be impacted by a CAZ implemented in Southampton. We identified the number of individuals from each MSOA that travelled to the Southampton area - this was assumed to be the area covered by the air quality modelling domain and included the following 38 MSOA's<sup>8</sup>.

The MSOA's with 40 or greater commuters travelling to Southampton were retained in the distributional analysis domain. This cut-off value was selected to ensure that commuters from the nearby conurbations, including Bournemouth for example, were included in the distributional analysis geographical scope. This domain covered 97% of all commuters to Southampton. This domain also covers the areas of the transport model domain with > 10 % of car trips to/from the CAZ.

The social characteristics data were available at the LSOA level, which is more spatially detailed. Therefore, the boundary of the distributional analysis domain identified from the MSOA commuters was used to identify the LSOA within the same domain in Geographical Information System (GIS) by selecting those LSOA that fell within the domain extents. A map showing the CAZ, air quality modelling, and distributional analysis domains (LSOA) is shown in Figure 1.

For each of the socioeconomic datasets collected, the quintile rankings for the whole dataset for England were calculated. The associated quintile ranking for each socioeconomic characteristic in each LSOA in the Southampton distributional analysis domain was then assigned. Plots demonstrating the quintiles for each characteristic in the Southampton distributional analysis domain are shown in Figure 2 and Figure 3. The quintile maps suggest the Southampton distributional analysis domain contains largely elderly population of white ethnicity with relatively low levels of deprivation and disability in relation to the rest of England and Wales.

This is the domain used for the household affordability assessment and traffic impacts. Air quality impacts are assessed only for the air quality domain. With regards to impacts on businesses the team is using different data sets and domains to include all businesses affected wherever possible.

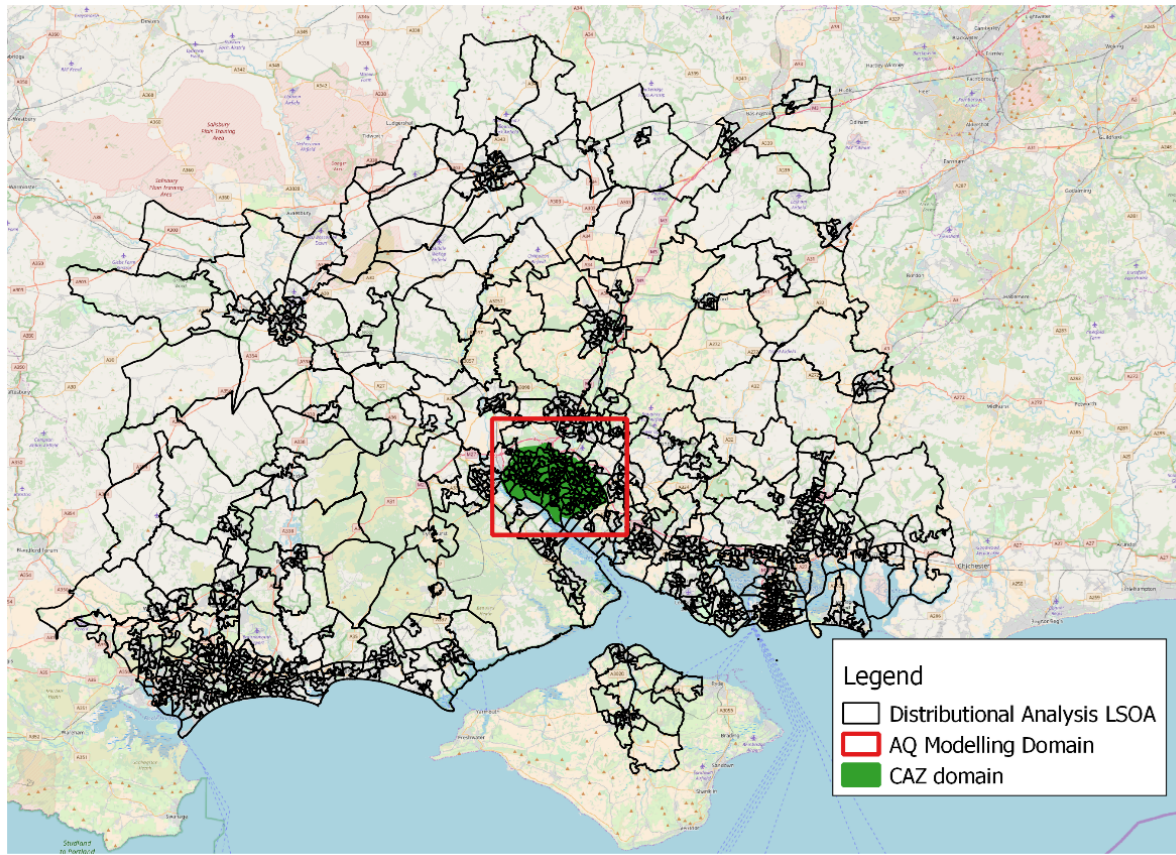
A map of sensitive receptors in the air quality modelling domain has also been developed. This is presented in Figure 4. Sensitive receptors in this context have been selected as educational establishments, hospitals, care homes, outdoor play spaces, playing fields and public parks or gardens. The location of these sites was obtained from OS Open Data Functional Sites (education and medical facility locations), and Green Spaces (parks and garden locations) data. The location of community centres within Southampton were obtained from AddressBase Plus (Class CC04).

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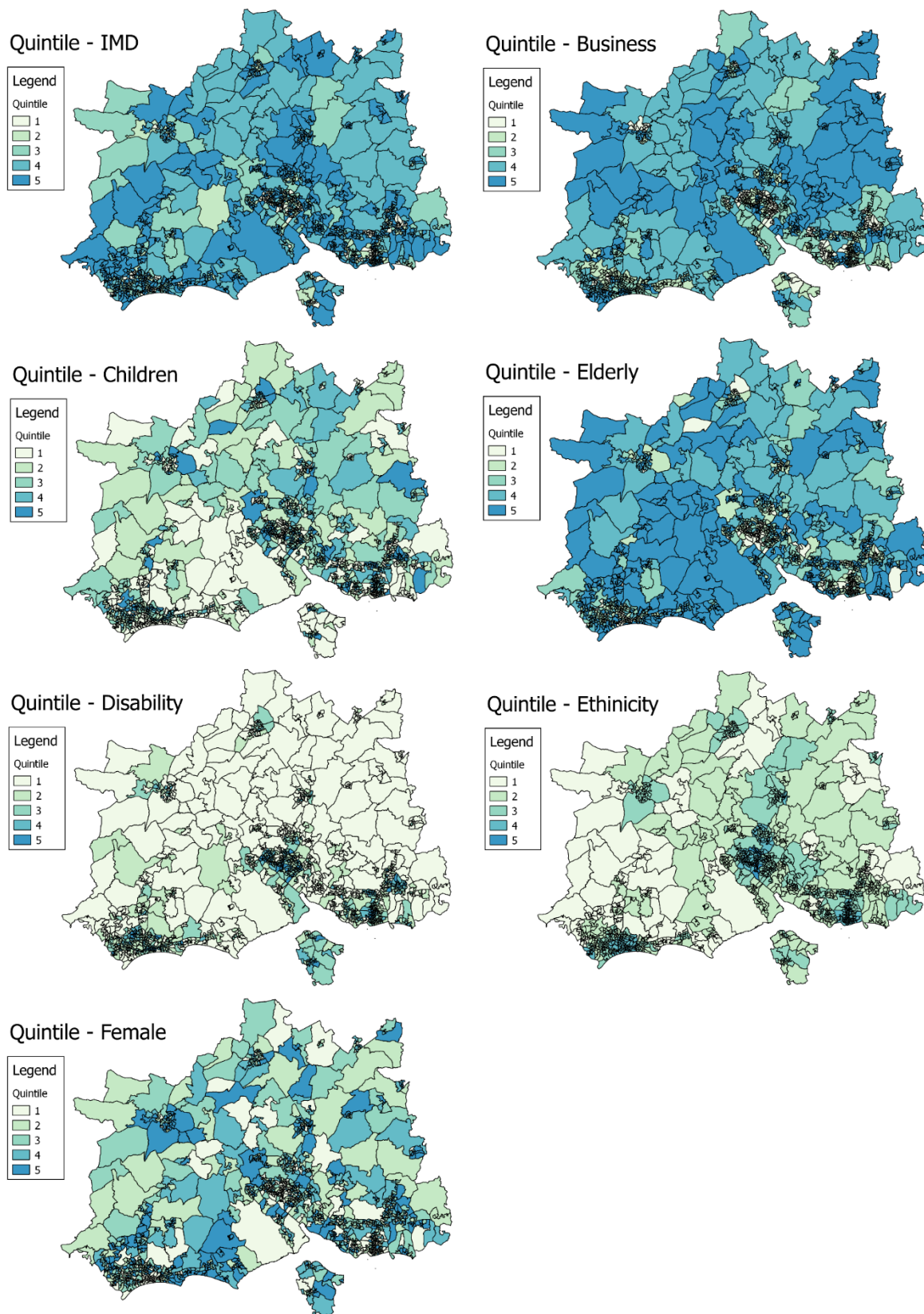
<sup>7</sup> Available from the UK Office for National Statistics nomis website: <https://www.nomisweb.co.uk/census/2011/wu03ew>

<sup>8</sup> E02003549, E02003550, E02003551, E02003552, E02003553, E02003554, E02003555, E02003556, E02003557, E02003558, E02003559, E02003560, E02003561, E02003562, E02003563, E02003564, E02003565, E02003566, E02003567, E02003568, E02003569, E02003570, E02003571, E02003572, E02003573, E02003574, E02003575, E02003576, E02003577, E02003578, E02003579, E02003580, E02004720, E02004723, E02004724, E02004725, E02004726, E02004828

**Figure 1: Location of LSOA included in geographical scope of distributional analysis. Also shown is the location of the air quality modelling domain, and the area within Southampton covered by the CAZ.**



**Figure 2: Quintile plots of characteristics in the Southampton distributional analysis domain**



Notes: Characteristics investigated: Index of Multiple Deprivation, number of businesses, number of children (under age of 16), number of elderly (over age of 65), disability, ethnicity and number of females. Note: larger quintile represents a larger share of the socio-economic group in question

Figure 3: Quintile plots for IMD (quintiles derived from values from distributional analysis domain)

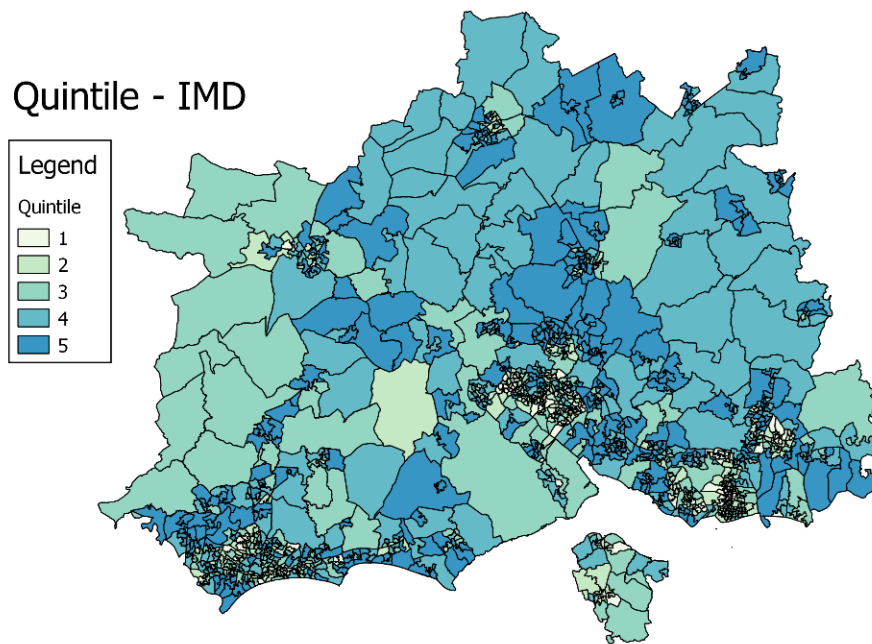
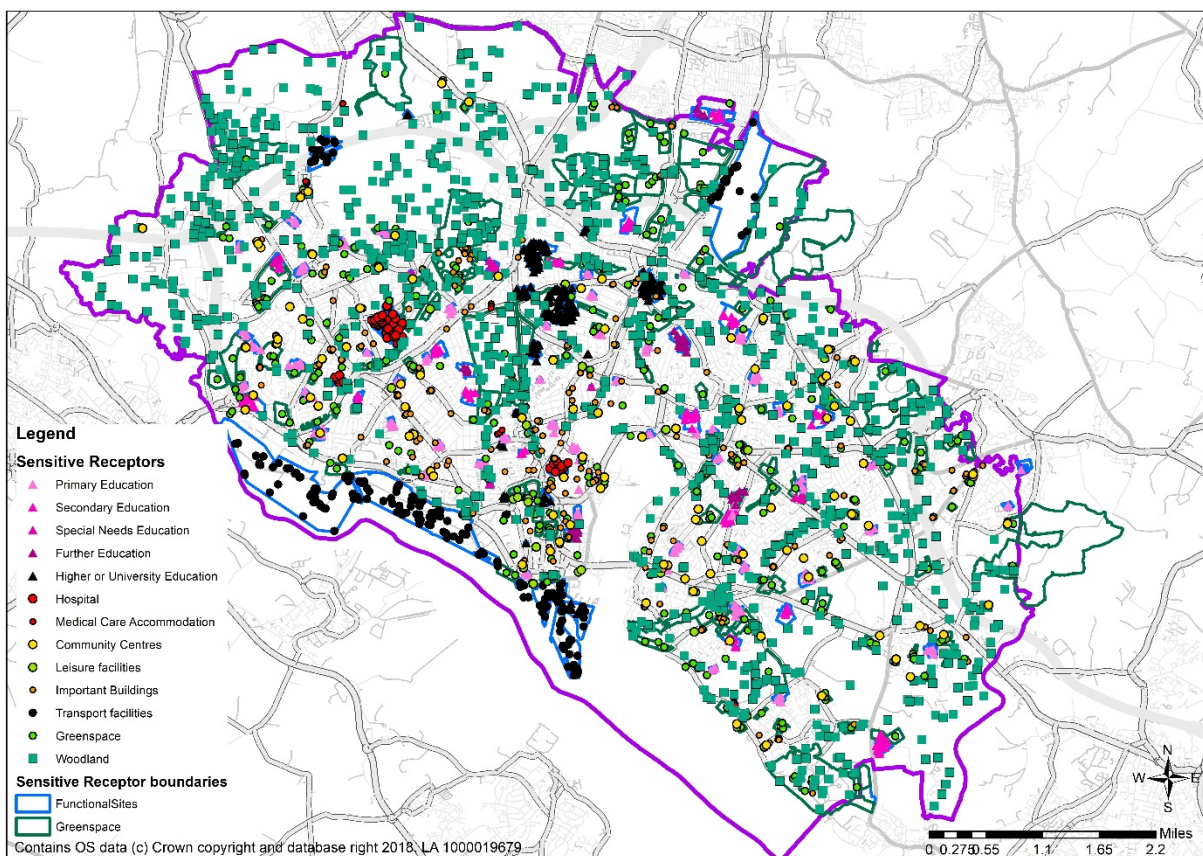


Figure 4: Map of sensitive receptors



## 2.5 Approach to assessing impacts

The approach to appraising each of the impacts closely follows the methodology set out in the JAQU and supporting Webtag guidance. Namely, the 'impact variables' (describing how the impacts vary or are distributed across a geographic area) are overlaid with the 'grouping variables' (describing how different societal groups are distributed across the same area).

The appraisal is then made based on splitting both the grouping and impact variables into quintiles, and then judging whether the impact on a given population group is proportionate to the representation of that group in the wider population (this type of analysis is referred to as 'quintile analysis' throughout this document).

Not all the impacts need to be appraised for each grouping variable. Table 3 indicates the impacts that should be appraised for each group.<sup>9</sup>

**Table 3: Impact categories in scope**

Group	Air quality	Affordability
Deprivation / income	✓	✓
Children	✓	
Businesses		✓

The overlay of impacts and groups was undertaken on a LSOA basis, as defined in the guidance.

Table 5 sets out the appraisal approach for each of the impacts screened-in. In some cases, we have also produced alternative output metrics to help further explore and present the distributional nature of some of the impacts. E.g. alongside the 'quintile analysis' for air quality, we also produce average changes in concentration by grouping variable quintile and present the average changes in concentration at sensitive receptors.

Businesses could be affected by a CAZ through several pathways, including:

- a. Direct effects where they own non-compliant vehicles and travel into the CAZ
- b. indirect effects on deliveries
- c. indirect impacts via commuting employees
- d. indirect effect on their supply chains, either upstream or downstream.
- e. Indirect effect via impacts on customers and footfall.

Hence, its likely fair to say all businesses located in and around the CAZ will be affected to some extent. That extent will be determined by several parameters, including both the location of the business but also the type of business (which in turn determines the likelihood of it operating vehicles, its reliance on deliveries, and potential impact on its supply chain).

The spatial distribution of costs is not modelled as part of the economic analysis, hence impacts on businesses must be assessed 'indirectly' using proxies to illustrate where costs could fall.

Drawing on the JAQU guidance, we undertook the following analysis to help give a sense of how many businesses (in particular local businesses) may be affected by the CAZ:

1. Overlaying spatial data on business location/LGV ownership with CAZ areas. From this a count of affected businesses was derived based on:
  - a. Those inside the CAZ are assumed to be affected directly (if they own vehicles) and indirectly through impacts on deliveries (although the extent will depend on how reliant on deliveries the business is), commuters (assume its employees are in some way affected) and demand (where potential customers are affected)
  - b. Those near the CAZ are assumed directly affected (if they own vehicles). In this case we assume there is less potential for indirect effects due to opportunity to travel around the CAZ
2. Overlaying spatial data on key routes used by LGVs/ HGVs with CAZ area. Where more 'key routes' are covered by the CAZ, the greater the assumed business impacts.

We combined this analysis with information gathered through literature review and stakeholder engagement to explore what type of businesses may be affected and how. In particular: literature review

<sup>9</sup> We present some summary results also for air quality impacts for old, disability, sex, ethnicity and old people but these are not as detailed as for the children and income groups.

included reviewing studies on the local economy and impact assessments and evaluations which have considered the business effects of CAZ or similar zones (such as LES or WPL). This sought to illustrate the sectors of the economy in which affected businesses operate. Reviewing existing studies of impacts helped identify avenues through which businesses will be affected, and potential size of these effects.

To assess the impacts of the CAZ study on the population, several datasets were obtained to identify the social characteristics of the population within the study area. These datasets provided information on several characteristics at the LSOA level. A description of the characteristics obtained, and their data source is provided Table 4 below.

The geospatial boundaries of each LSOA is available to download as a shapefile from the Office for National Statistics (<http://geoportal.statistics.gov.uk/datasets/lower-layer-super-output-areas-december-2011-full-extent-boundaries-in-england-and-wales>). The datasets collected describing the social characteristics were joined to the spatial representation of the LSOA's to allow geospatial analysis of the social characteristics using a Geographical Information System (GIS).

**Table 4: Key data sources**

Dataset	Description
Index of Multiple Deprivation (IMD)	The IMD gives an indication of the overall levels of deprivation in each LSOA and takes into consideration several factors including crime and employment deprivation. Lower IMD values correspond to areas with higher deprivation. This data is available from the Department for Communities and Local Government: English Indices of Deprivation 2015.
Number of businesses	The number of businesses located in each LSOA are available, where a larger number represents a greater number of businesses located within the LSOA in question. This data is available from the Office for National Statistics nomis website, from the 2011 census data (UK Business Counts – local units by industry and employment band size).
Number of children, elderly and data on gender	The number of individuals of each individual age, split by gender, are available for each LSOA. The larger values for this characteristic represent a larger number of individuals of this characteristic in the total population. This data was available from the Office of National Statistics (Table SAPE19DT1: Mid-2016 Population Estimates for Lower Layer Super Output Areas in England and Wales by Single Year of Age and Sex). The data for 2016 was the most recent population data set available at the time of writing. The number of children was identified as the sum of those aged 16 or below, while the number of elderly was identified the sum of those aged 65 or over. The proportion of females was identified by dividing the number of females in the population by the total population in each LSOA.
Disability	The comparative illness and disability ratio indicates the numbers of individuals in the LSOA that receive benefits due to the inability to work. This information is gathered from the UK Department for Work and Pensions and a higher value indicates a higher level of deprivation. The data is available from the Department for Communities and Local Government: English Indices of Deprivation 2015.
Ethnicity	The ratio of the number of non-white to white individuals in each LSOA was calculated to obtain an estimate of ethnicity in the area. The larger the ratio the greater the number of non-white individuals in the population. The data on the number of individuals classifying themselves in each ethnic class was available from the Office for National Statistics nomis website (Table LC2101EW – Ethnic group by sex by age).
Sensitive receptor data	Shapefiles showing the location of education establishments, hospitals and parks was obtained from OS Open Data. The location of community centres was obtained from OS Address Base Plus as this was not available through Open Data.
Operator license	The location (post codes) of businesses with HGV operator licences was obtained from data.gov.uk (Traffic Commissioners: goods and public service vehicle operator license records). Last updated Sept 2014.

**Table 5: Appraisal approach for each impact**

Impact	Proposed Method	Notes	Outputs
<b>Air quality</b>	<ul style="list-style-type: none"> <li>Overlay NO<sub>2</sub> concentrations (from supporting air quality modelling) with population data to calculate change in population-weighted concentrations<sup>10</sup></li> <li>Concentrations will be produced for weighted household centroid for each LSOA</li> <li>Overlay mapping of concentrations with mapping of different groups at LSOA level</li> <li>Groups covered: deprivation/income and children</li> <li>Calculate average change in concentration by IMD / average children per household quintile</li> <li>Calculate change in population weighted concentrations at sensitive receptors: Schools, Playgrounds, Parks, Hospitals, Care homes, Community centres</li> <li>Quintile analysis for up/down changes</li> </ul>	<ul style="list-style-type: none"> <li>Concentrations will be produced for weighted household centroid for each LSOA given resource / time required to model all household receptors</li> </ul>	<ul style="list-style-type: none"> <li>Average change in concentration by income decile / quintile of households with children</li> <li>Count of LSOA and average change in concentration for those experiencing improving and worsening air quality, split by income decile / quintile of households with children</li> <li>Average change in concentration at sensitive receptors</li> <li>Quintile analysis (as described in Webtag)</li> </ul>
<b>Affordability for households</b>	<ul style="list-style-type: none"> <li>Travel pattern data will be drawn from census data and using origin/destination matrices from model<sup>11</sup></li> <li>Income is only characteristic to be explored</li> <li>Map amenities in CAZ area – a higher count of schools and hospitals could mean a greater number of households with children / disabilities respectively could be affected</li> </ul>	<ul style="list-style-type: none"> <li>Cost / user benefit data is not available split spatially by LSOA to do a detailed analysis.</li> <li>Propose to look at distribution of non-compliant vehicles and frequency of travel to CAZ as a proxy for where costs will fall</li> </ul>	<ul style="list-style-type: none"> <li>Count of amenities in CAZ area</li> <li>Draw conclusions and implications from the business sector analysis</li> </ul>

<sup>10</sup> Air quality modelling will be drawn from wider modelling around the CAZ options. Hence domain of distributional analysis will match that of wider AQ modelling. This will cover intervention area and surrounding area to capture potential diversionary routes

<sup>11</sup> Using OD matrices are more uncertain (than link flow data) and will not include 'through' trips. However, in this case the analysis only applies to ORR CAZ D (other options assumed to have only indirect effect on households) – through trips less important for ORR options and car OD data is viewed as more robust than commercial vehicle OD data which suffers from small initial sample sizes. So, looking at OD matrices could be informative in this instance

Impact	Proposed Method	Notes	Outputs
<p><b>Affordability for businesses</b></p>	<ul style="list-style-type: none"> <li>Overlaying spatial data on business location/LGV ownership with CAZ areas</li> <li>Overlaying spatial data on key routes used by LGVs/ HGVs with CAZ area</li> <li>Literature review</li> </ul>	<ul style="list-style-type: none"> <li>There will be a large level of uncertainty around any inferences drawn from mapping. Just because a business is located in/around the CAZ, does not necessarily mean it will be impacted.</li> <li>Nor can we tell how a business will be impacted, or whether the impacts will be 'affordable'</li> </ul>	<ul style="list-style-type: none"> <li>Count of businesses with propensity to be directly / indirectly affected by CAZ</li> <li>Count of key freight routes covered by CAZ</li> <li>Narrative of what type of businesses will be affected and pathways of impacts</li> <li>Narrative around how businesses will be affected, and affordability of effects explored through case studies</li> </ul>



## 3 Appraisal and results

### 3.1 Air quality

The air quality modelling carried out to evaluate the CAZ scenarios modelled NO<sub>2</sub> concentrations across Southampton at a 3m resolution. The average modelled NO<sub>2</sub> concentration for each LSOA falling within the air quality modelling domain for the 2020 Baseline, 2020 Non-Charging CAZ (NCH CAZ) and 2020 City-wide Class B CAZ (CAZ B) was calculated using the zonal statistics function in GIS. The number of LSOAs within the air quality modelling domain, for which concentrations could be calculated, was 173 (only those LSOAs with greater than half of their area in the modelling domain were included).

The LSOA average NO<sub>2</sub> concentration was then converted to a population-weighted concentration for use in the distributional analysis. The population for each LSOA was available from census data, collected describing the age-breakdown of the population e.g. number of children. The population-weighted concentration was calculated using the formula below:

$$Pop_n Conc = \frac{Conc_{LSOA} * Popn_{LSOA}}{Popn_{Tot}}$$

Where  $Pop_n Conc$  is the population-weighted NO<sub>2</sub> concentration in the LSOA;  $Conc_{LSOA}$  is the average modelled NO<sub>2</sub> concentration in the LSOA ( $\mu\text{g}/\text{m}^3$ ),  $Popn_{LSOA}$  is the population in the LSOA and  $Popn_{Tot}$  is the total population in all the LSOAs in the air quality modelling domain (equal to 295,310 people).

To evaluate the impact of the CAZ options on each LSOA, the change in the population-weighted NO<sub>2</sub> concentrations was calculated by subtracting the CAZ Option from the 2020 Baseline (i.e. population-weighted NO<sub>2</sub> concentrations without CAZ implementation). If the resulting change is *positive*, this means there is an *improvement* in air quality because of the introduction of the CAZ scheme.

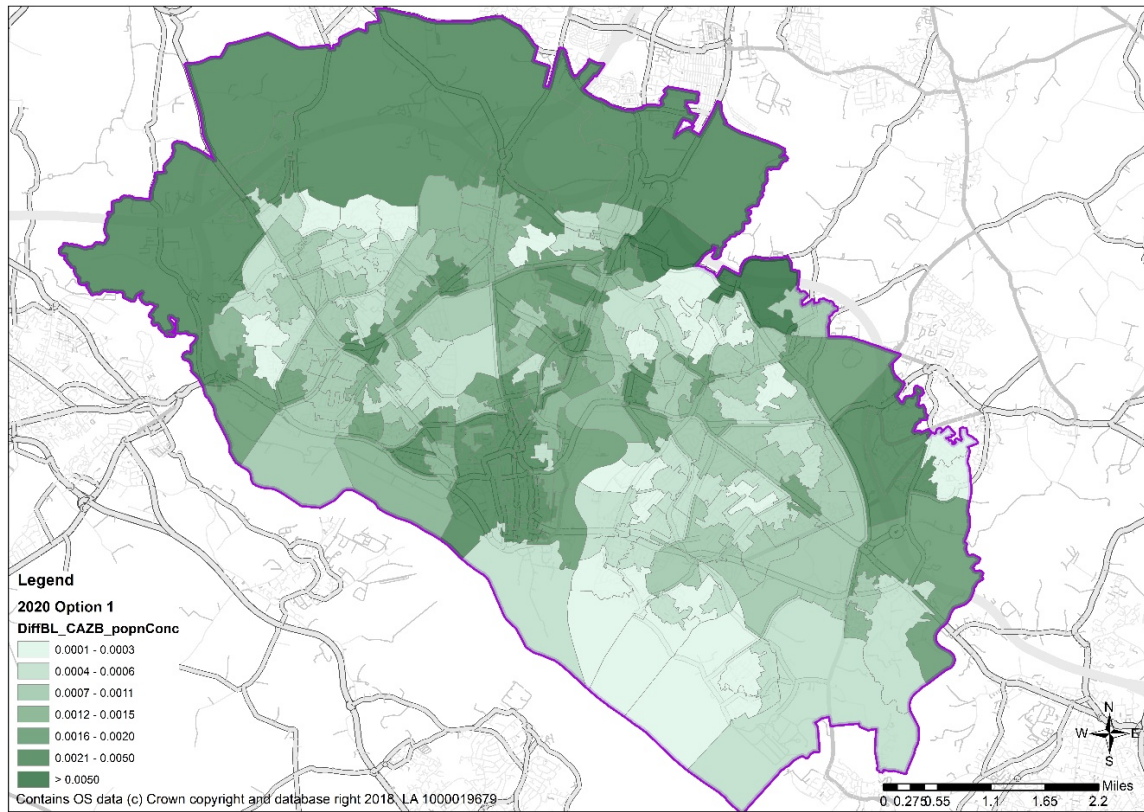
There is an overall improvement in air quality following the introduction of the city-wide Class B CAZ. In no LSOA does air pollutant concentrations get worse. The North-western area of the city, as well as the city-centre experience greatest air quality improvements due to implementation.

In contrast, NCH CAZ shows improving air quality in the majority of LSOAs, but also limited deterioration in a handful of LSOAs (predominantly at the outskirts of the assessment domain). As the average NO<sub>2</sub> concentrations in these LSOAs are relatively low ( $< 20 \mu\text{g}/\text{m}^3$ ), this is likely to be due to general noise in the traffic model, which is causing slight increases in LSOA average concentrations. Through NCH CAZ, the largest improvements in air quality are observed in the city centre of Southampton and to the north eastern edge of the city.

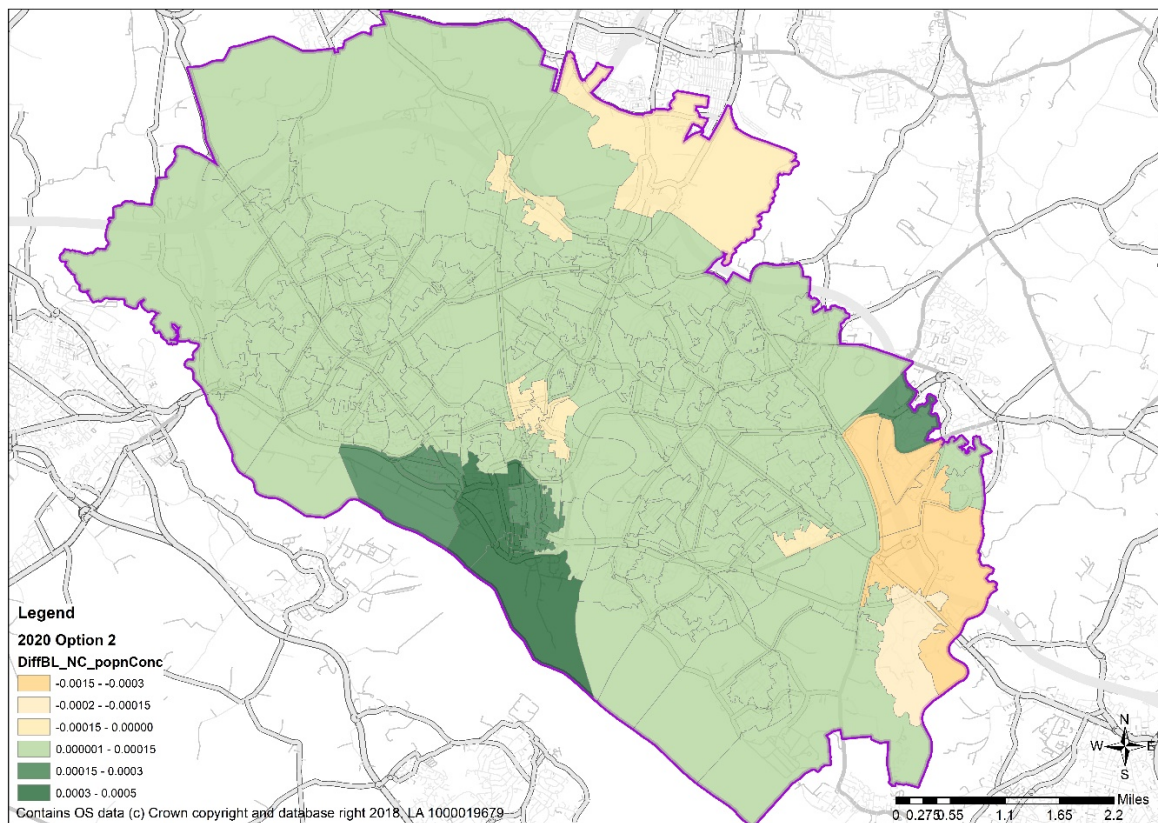
The CAZ options investigated focus on improvements in air quality, because of reduced road traffic emissions. Therefore, it is not surprising there are LSOAs where minimal changes in air quality were observed. The LSOAs experiencing limited change are in the outskirts of the city, where the majority of the NO<sub>2</sub> concentrations are attributed to background concentrations, rather than road sources. As such, the impacts of CAZ implementation are spatially diverse, and strongly linked to concentration of road traffic emissions (Figure 5).

Figure 5: Change in LSOA population-weighted NO<sub>2</sub> concentrations for CAZ Options compared to the 2020 Baseline model.

City-wide Class B CAZ



Non-charging CAZ



### 3.1.1 Socio-economic characteristics

The average population-weighted NO<sub>2</sub> concentration, and average change in concentration under each CAZ scenario, relative to the 2020 baseline is presented in Table 6 and Table 7 respectively. This is shown split by change for different IMD and number of children quintiles.

The improvement in air quality is much greater improvement for the CAZ B option. Most groups on average see an improvement in air quality (in terms of population-weighted NO<sub>2</sub> concentrations) because of the CAZ options.

Under CAZ B, all quintiles see an average improvement in NO<sub>2</sub> concentrations. IMD quintile number 2 has the highest population-weighted NO<sub>2</sub> concentrations; however, it also experiences the (equally) lowest percentage reduction in air pollution because of the introduction of the city-wide Class B CAZ. In addition, IMD quintile number 3, with the lowest number of LSOAs experiences the highest reductions in population-weighted NO<sub>2</sub> concentrations.

Under the NCH CAZ, again most quintiles on average observe an improvement in pollutant concentrations. However, areas in IMD quintile 3, experiencing moderate deprivation, will bear a small increase in air pollution of 0.06% on average.

In relation to demographic concentrations, based on average changes in population-weighted concentrations, CAZ B benefits a range of IMD scores due to its spatially diverse impact. In contrast, as NCH CAZ primarily benefits the city centre, which hold a greater proportion of LSOAs with lower IMD scores – hence lower income individuals benefit more from the targeted improved air quality.

**Table 6: Modelled population-weighted NO<sub>2</sub> concentration differentiated by IMD quintile (reference whole model domain) for all the scenarios**

Option	Income IMD Quintile domain					
		1	2	3	4	5
<b>LSOA</b>	Number of LSOA in each quintile	42	33	17	22	59
<b>2020 BASELINE</b>	Average Population-weighted NO <sub>2</sub> concentration (µg/m <sup>3</sup> )	0.0886	0.0960	0.0914	0.0831	0.0848
<b>2020 CAZ B</b>	Average Population-weighted NO <sub>2</sub> concentration (µg/m <sup>3</sup> )	0.0873	0.0947	0.0900	0.0820	0.0835
	Absolute difference in Population-weighted NO <sub>2</sub> concentration to baseline (µg/m <sup>3</sup> )	0.0013	0.0013	0.0014	0.0011	0.0013
	Relative difference in NO <sub>2</sub> Population-weighted concentration to baseline (%)	1.5	1.3	1.5	1.3	1.5
<b>2020 NCH CAZ</b>	Average Population-weighted NO <sub>2</sub> concentration (µg/m <sup>3</sup> )	0.0886	0.0959	0.0915	0.0830	0.0848
	Absolute difference in Population-weighted NO <sub>2</sub> concentration to baseline (µg/m <sup>3</sup> )	0.00004	0.00002	-0.00006	0.00003	0.00000
	Relative difference in Population-weighted NO <sub>2</sub> concentration to baseline (%)	0.05	0.02	-0.06	0.04	0.00

As observed in the results split by IMD quintile, the improvements in population-weighted NO<sub>2</sub> concentrations for quintiles of numbers of children are greater for the CAZ B compared to NCH CAZ.

The areas with lower proportions of children have the greatest population-weighted NO<sub>2</sub> concentration and also experience the largest improvements after introduction of both CAZ options (Table 7). This is likely to be due to families choosing to live in suburban areas, on the outskirts of the city, which are likely to benefit less from improvements in air quality.

The NCH CAZ will also negatively impact air quality for areas with a low to medium proportion of children. Therefore, although there are negative impacts on air quality in some LSOAs through NCH CAZ option, the LSOAs with highest proportions of children do not witness disproportionate impacts.

**Table 7: Modelled population-weighted NO<sub>2</sub> concentration differentiated by “Under 16s” quintile for all the scenarios**

Option	Income IMD Quintile domain	Lowest proportion ← <span style="margin-left: 100px;">→</span> Highest proportion 1                      2                      3                      4                      5				
		<b>LSOA</b>	Number of LSOA in each quintile	48	27	35
<b>2020 BASELINE</b>	Average Population-weighted NO <sub>2</sub> concentration (µg/m <sup>3</sup> )	0.1024	0.0893	0.0792	0.0834	0.0813
<b>2020 CAZ B</b>	Average Population-weighted NO <sub>2</sub> concentration (µg/m <sup>3</sup> )	0.1006	0.0877	0.0783	0.0825	0.0804
	Absolute difference in Population-weighted NO <sub>2</sub> concentration to baseline (µg/m <sup>3</sup> )	0.0018	0.0016	0.0009	0.0009	0.0009
	Relative difference in Population-weighted NO <sub>2</sub> concentration to baseline (%)	1.8	1.8	1.1	1.1	1.2
<b>2020 NCH CAZ</b>	Average Population-weighted NO <sub>2</sub> concentration (µg/m <sup>3</sup> )	0.1023	0.0893	0.0792	0.0834	0.0813
	Absolute difference in Population-weighted NO <sub>2</sub> concentration to baseline (µg/m <sup>3</sup> )	0.00006	-0.00006	-0.00002	0.00002	0.00002
	Relative difference in Population-weighted NO <sub>2</sub> concentration to baseline (%)	0.06	-0.07	-0.02	0.03	0.02

Table 8 displays the number of LSOAs that will observe either an improvement or worsening of air pollutant concentrations under the CAZ Options, split by IMD quintile. All LSOAs are observed to benefit from improved air quality under the city-wide Class B CAZ. In contrast, the non-charging CAZ will result in worsening of air quality in 11 LSOAs, of which four are in the lowest two IMD quintiles.

Table 9 displays the number of LSOAs that will observe either an improvement or worsening of air pollutant concentrations under the CAZ Options, split this time by quintile of number of children. Again, under the city-wide Class B CAZ, all areas experience improvements in air quality. Under the non-charging CAZ, the 11 LSOAs which observe worsening air quality are skewed towards areas with a lower proportion of children – 7 of the 11 LSOAs fall in the two quintiles with lowest proportion of children.

**Table 8: Number of LSOAs and population with an improvement or a deterioration of NO<sub>2</sub> concentration (relative to baseline), disaggregated by IMD quintile (reference whole England) for the domain of study.**

Option	Income IMD Quintile domain	Most deprived ← → Least Deprived				
		1	2	3	4	5
<b>LSOA</b>	Total LSOAs	42	33	17	22	59
<b>2020 CAZ B</b>	Number of LSOAs with improved air quality	42	33	17	22	59
	Population with improved air quality	70,084	60,814	29,438	36,630	98,344
	Number of LSOAs with a worsening of air quality	0	0	0	0	0
	Number of LSOAs with no change in air quality	0	0	0	0	0
<b>2020 NCH CAZ</b>	Number of LSOAs with improved air quality	41	30	15	21	55
	Population with improved air quality	68,293	54,810	25,272	35,150	91,670
	Number of LSOAs with a worsening of air quality	1	3	2	1	4
	Number of LSOAs with no change in air quality	0	0	0	0	0

**Table 9: Number of LSOAs and population with an improvement or a deterioration of NO<sub>2</sub> concentration (relative to baseline), disaggregated by “Under 16” quintile (reference whole England domain) for the domain of study.**

Option		1 2 3 4 5				
		Lowest proportion				Highest proportion
<b>LSOA</b>	Total LSOAs	48	27	35	26	37
<b>2020 CAZ B</b>	Number of LSOAs with improved air quality	48	27	35	26	37
	Population with improved air quality	88,655	45,719	57,479	43,828	59,629
	Number of LSOAs with a worsening of air quality	0	0	0	0	0
	Number of LSOAs with no change in air quality	0	0	0	0	0
<b>2020 NCH CAZ</b>	Number of LSOAs with improved air quality	44	24	34	25	35
	Population with improved air quality	81,171	40,712	55,792	41,349	56,171
	Number of LSOAs with a worsening of air quality	4	3	1	1	2
	Number of LSOAs with no change in air quality	0	0	0	0	0

### 3.1.2 Sensitive receptors

Another key distributional dimension is to investigate the impact of the CAZ on air quality around sensitive receptors. Sensitive receptors in this context have been selected as educational establishments, hospitals, care homes, outdoor play spaces, playing fields and public parks or gardens. The location of these sites was obtained from OS Open Data Functional Sites (education and medical facility locations), and Green Spaces (parks and garden locations) data. The location of community centres within Southampton were obtained from AddressBase Plus (Class CC04).

The average reduction in LSOA population-weighted NO<sub>2</sub> concentrations for each of these locations was calculated and is displayed in The average reduction in the population-weighted NO<sub>2</sub> concentration at the sensitive receptor locations are presented in Table 10.

Under CAZ B, all sensitive receptors experience a reduction in NO<sub>2</sub> concentration, with medical care accommodation experiencing the greatest impact.

Under NCH CAZ, green and community spaces experience a reduction in air quality, except for play space. However, other sites experience a minimal increase in air pollutant concentrations, but all these changes are very small (less than or equal to 0.1% change).

Figure 6.

The city-wide Class B CAZ option has the greatest impact on reductions of NO<sub>2</sub> concentrations for sensitive receptors. Most sensitive receptors showed no change or an improvement in concentrations because of introduction of the CAZ schemes. However, under the non-charging CAZ, some sensitive receptors experience a worsening of air quality.

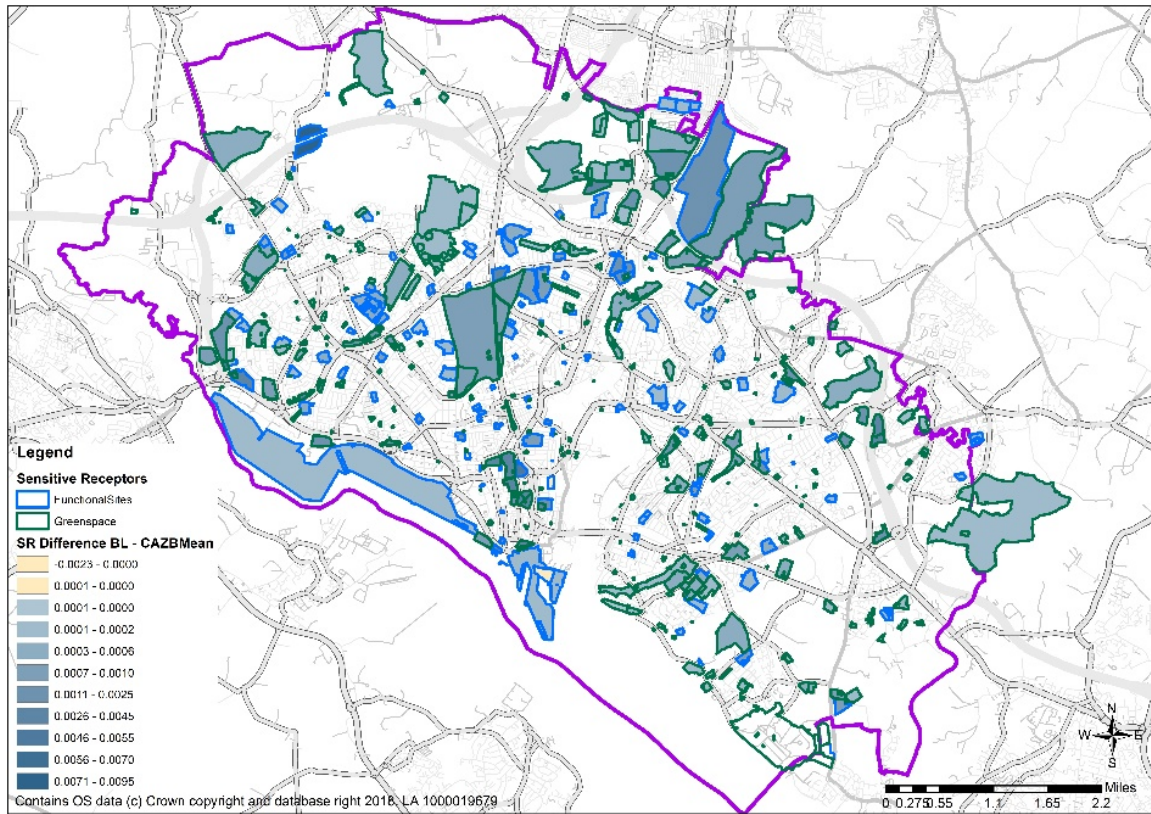
The average reduction in the population-weighted NO<sub>2</sub> concentration at the sensitive receptor locations are presented in Table 10.

Under CAZ B, all sensitive receptors experience a reduction in NO<sub>2</sub> concentration, with medical care accommodation experiencing the greatest impact.

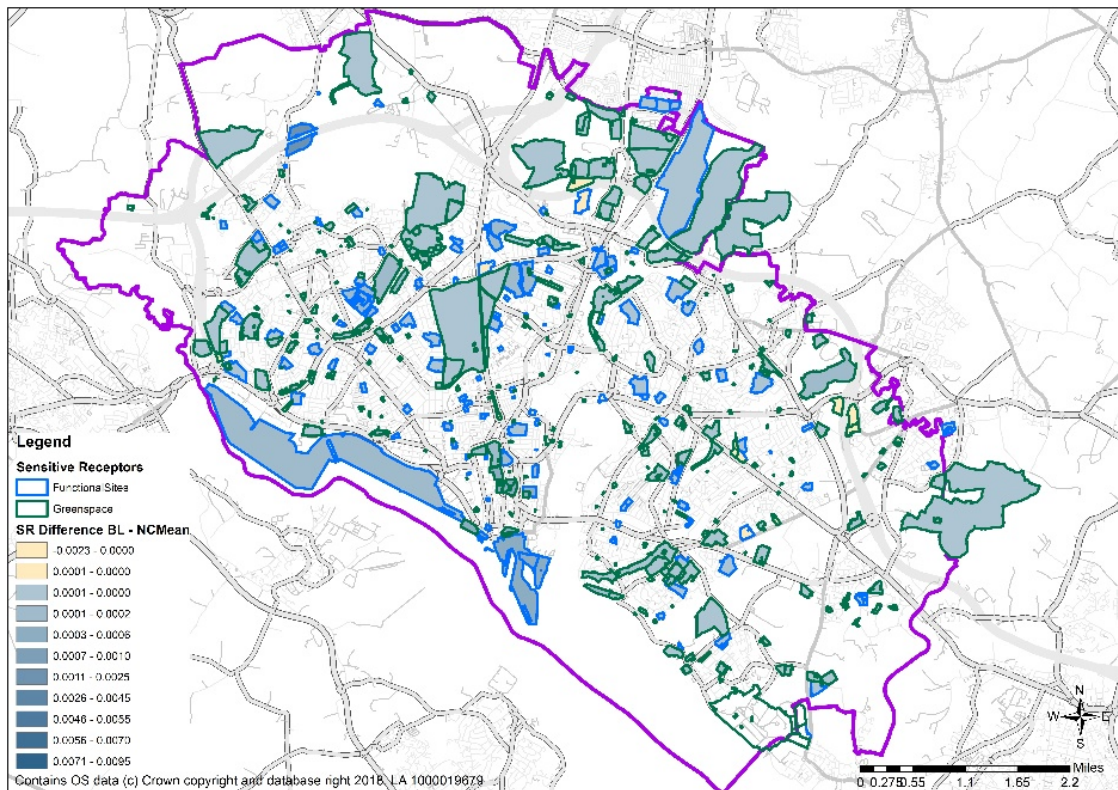
Under NCH CAZ, green and community spaces experience a reduction in air quality, except for play space. However, other sites experience a minimal increase in air pollutant concentrations, but all these changes are very small (less than or equal to 0.1% change).

**Figure 6: Reduction in population weighted average NO<sub>2</sub> concentrations at the sensitive receptor locations for NCH CAZ and CAZ B. A positive number indicate an improvement in air quality.**

City-wide Class B CAZ



Non-charging CAZ



**Table 10: Average reduction in population-weighted NO<sub>2</sub> concentrations between 2020 baseline and 2020 CAZ Options.** The % reduction for each sensitive receptor class is shown in brackets while the number of each site type is shown in the square brackets. A positive number indicates an improvement in air quality.

Site classification	Site type	CAZ B	NCH CAZ
Functional Sites	University or Higher Education	0.00213 (1.9%) [227]	0.00008 (0.1%) [227]
	Further Education	0.00164 (1.4%) [28]	0.00006 (0.1%) [28]
	Secondary Education	0.00114 (1.5%) [83]	0.00001 (0.0%) [83]
	Primary Education	0.00120 (1.4%) [324]	0.00003 (0.0%) [324]
	Special Needs Education	0.00138 (1.5%) [38]	0.00008 (0.1%) [38]
	Hospital	0.00094 (1.1%) [57]	0.00005 (0.1%) [57]
	Medical Care Accommodation	0.00163 (2.2%) [37]	0.00008 (0.1%) [37]
AddressBasePlus	Community Spaces (CC04)	0.00154 (1.9%) [218]	-0.00008 (-0.1%) [218]
Green Space	Play Space	0.00146 (1.6%) [222]	0.00006 (0.1%) [222]
	Playing Field	0.00139 (1.8%) [183]	-0.00001 (0.0%) [183]
	Public Park / Garden	0.00148 (1.6%) [234]	-0.00013 (-0.1%) [234]

**Concentration reduction magnitude:** dark green = large AQ impact (pollutant reduction >1.5%), light green = positive impact (pollutant reduction 0.5-1.5%), yellow = minor positive impact (pollutant reduction 0-0.5%), red = minor negative impact (pollutant increase 0-0.5%)

### 3.1.3 Quintile analysis

The overlay in the impact and demographic variables, following the Webtag guidance for IMD and under 16's, is shown for both CAZ options below (Table 11 to Table 14).

Under the city-wide Class B CAZ, the whole population experiences improved air quality. Therefore, although the least deprived quintile experiences the highest proportion of net winners, this is identical to the share of the population living in this impact area. As such, under the city-wide Class B CAZ, there is no one IMD or under 16's quintile that receives a higher proportion of benefits relative to its proportion of the population – i.e. there is no distributional affect.

Under the non-charging CAZ, the improvements for IMD slightly favour the lowest and highest quintiles, with quintile 1 experiencing the highest net winners relative to its proportion of the population. Quintiles 2 and 3 experience a lower proportion of net winners relative to their proportion of the population, whilst the least deprived quintiles 4 and 5 experience minimally higher benefits relative to their proportion of the population.

The improvements for under 16's are experienced more greatly by quintiles 3 to 5, relative to their proportion of the population. The areas with the lower proportion of children experience a lower proportion of benefits relative to the size of their population. As such it appears NCH CAZ could have a progressive distributional effect in favour of households with children.



**Table 11: Webtag ‘quintile’ analysis for city-wide Class B CAZ – IMD overlay with air quality**

Income IMD	Most deprived					Least deprived	Total	
	←							→
	0%-20%	20%-40%	40%-60%	60%-80%	80%-100%			
	1	2	3	4	5			
Number of population with improved air quality	70,084	60,814	29,438	36,630	98,344	295,310		
Number of population with no changes	0	0	0	0	0	0		
Number of population with deteriorating air quality	0	0	0	0	0	0		
<b>Total Population</b>	<b>70,084</b>	<b>60,814</b>	<b>29,438</b>	<b>36,630</b>	<b>98,344</b>	<b>295,310</b>		
Net winners*	70,084	60,814	29,438	36,630	98,344	295,310		
Net winners in each area	23.73%	20.59%	9.97%	12.40%	33.30%			
Share of the total population in the impact area	23.73%	20.59%	9.97%	12.40%	33.30%			

\* In scenarios of net losers, negative figures are used

**Table 12: Webtag ‘quintile’ analysis for city-wide Class B CAZ B – Under 16’s overlay with air quality**

Under 16	Lower proportion				Higher Proportion	Total
	←				→	
	0%-20%	20%-40%	40%-60%	60%-80%	80%-100%	
	1	2	3	4	5	
Number of population with improved air quality	88,655	45,719	57,479	43,828	59,629	295,310
Number of population with no changes	0	0	0	0	0	0
Number of population with deteriorating air quality	0	0	0	0	0	0
<b>Total Population</b>	<b>88,655</b>	<b>45,719</b>	<b>57,479</b>	<b>43,828</b>	<b>59,629</b>	<b>295,310</b>
Net winners*	88,655	45,719	57,479	43,828	59,629	295,310
Net winners in each area	30.02%	15.48%	19.46%	14.84%	20.19%	
Share of the total population in the impact area	30.02%	15.48%	19.46%	14.84%	20.19%	

\* In scenarios of net losers, negative figures are used

**Table 13: Webtag ‘quintile’ analysis for non-charging CAZ – IMD overlay with air quality**

Income IMD	Most deprived					Least deprived
	←					→
	0%-20%	20%-40%	40%-60%	60%-80%	80%-100%	Total
	1	2	3	4	5	Total
Number of population with improved air quality	68,293	54,810	25,272	35,150	91,670	275,195
Number of population with no changes	0	0	0	0	0	0
Number of population with deteriorating air quality	1,791	6,004	4,166	1,480	6,674	20,115
<b>Total Population</b>	<b>70,084</b>	<b>60,814</b>	<b>29,438</b>	<b>36,630</b>	<b>98,344</b>	<b>295,310</b>
Net winners*	66,502	48,806	21,106	33,670	84,996	255,080
Net winners in each area	26.07%	19.13%	8.27%	13.20%	33.32%	
Share of the total population in the impact area	23.73%	20.59%	9.97%	12.40%	33.30%	

\* In scenarios of net losers, negative figures are used

**Table 14: Webtag ‘quintile’ analysis for non-charging CAZ – Under 16’s overlay with air quality**

Under 16	Lower proportion				Higher Proportion	
	←				→	
	0%-20%	20%-40%	40%-60%	60%-80%	80%-100%	Total
	1	2	3	4	5	Total
Number of population with improved air quality	81,171	40,712	55,792	41,349	56,171	275,195
Number of population with no changes	0	0	0	0	0	0
Number of population with deteriorating air quality	7,484	5,007	1,687	2,479	3,458	20,115
<b>Total Population</b>	<b>88,655</b>	<b>45,719</b>	<b>57,479</b>	<b>43,828</b>	<b>59,629</b>	<b>295,310</b>
Net winners*	73,687	35,705	54,105	38,870	52,713	255,080
Net winners in each area	28.89%	14.00%	21.21%	15.24%	20.67%	
Share of the total population in the impact area	30.02%	15.48%	19.46%	14.84%	20.19%	

\* In scenarios of net losers, negative figures are used

### 3.1.4 Summary

Distributional analysis of air quality impacts was performed relative to two characteristics: IMD and number of children. Alongside the Webtag quintile analysis, we also analyse several other metrics to try and discern whether the options will have a distributional impact.

The city-wide Class B CAZ delivers largest reductions in NO<sub>2</sub> concentrations and delivers reductions across all areas. However, the impacts associated with NCH CAZ are generally smaller, and for some LSOAs negative with increasing concentrations in some areas.

CAZ B delivers an air quality improvement in all LSOAs in the modelling domain. Hence, for both IMD and children grouping variables in the Webtag analysis, all quintiles on average see an improvement in air quality in terms of NO<sub>2</sub> concentrations. Hence all areas experience equal benefit relative to their population.

However, under NCH CAZ, eleven LSOAs experience a worsening of air pollution and the general magnitude of improvements is small relative to CAZ B. Hence the NCH CAZ displays a more varied impact. Relative to IMD, the most deprived quintile benefiting most but the least deprived also benefit disproportionately to their population distribution. Regarding the impact on children, areas with higher proportions of children (quintiles 3-5) experience greater benefits relative to the proportion of their population for the NCH.

It is important to note that although this analysis displays whether quintiles have a higher proportion of people benefiting/losing, it gives no indication of the magnitude of the effect they are experiencing.

Reviewing the other metrics assessed, the highest average concentration reductions are felt by areas with a lower proportion of children under the city-wide Class B CAZ. Concentrations under NCH display a more mixed pattern, as quintile 1 benefits from the highest reduction, but air quality worsens in quintiles 2 and 3. That said, looking at a basic count of LSOAs, slightly more LSOAs in quintiles with fewer children experience an increase in concentrations under NCH CAZ.

In reference to sensitive receptors, CAZ B delivers more for vulnerable groups due to greater overall improvements in air quality. In contrast, the NCH CAZ delivers a more mixed scenario, with some receptors experiencing a minor worsening of air quality.

In summary, CAZ B delivers greater overall improvements in air quality. However, across the metrics the results are mixed and do not suggest a very clear pattern of distributional impact. Even where a clear pattern could be observed (e.g. average concentration changes under CAZ B are higher for households with fewer children), such results are not significant. In other words, both policy options are neither particularly progressive nor regressive in distributional terms.

**Table 15 – Summary of air quality distributional analysis**

Scenario	Summary assessment
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<p><b>City-wide CAZ B</b></p>	<p>-</p> <ul style="list-style-type: none"> <li>• Delivers largest reductions in NO2 concentrations and reductions across all areas</li> <li>• IMD             <ul style="list-style-type: none"> <li>○ Webtag shows no distributional impact as all areas benefit</li> </ul> </li> <li>• Children             <ul style="list-style-type: none"> <li>○ Webtag shows no distributional impact as all areas benefit</li> <li>○ Delivers large benefits at all sensitive receptors</li> <li>○ Average changes in concentrations are higher for areas with lower numbers of children</li> </ul> </li> </ul>
<p><b>Non-charging measures</b></p>	<p>-</p> <ul style="list-style-type: none"> <li>• Delivers smaller reduction in NO2 concentrations, and in some cases concentrations increase</li> <li>• IMD             <ul style="list-style-type: none"> <li>○ Webtag shows no significant impact, but least and most deprived areas benefit more</li> </ul> </li> <li>• Children             <ul style="list-style-type: none"> <li>○ Webtag shows no significant impact, but areas with most children benefit more</li> <li>○ Delivers small benefit at most sensitive receptors, but at some concentrations increase</li> <li>○ Slightly more LSOAs with fewer children see increases in concentrations</li> </ul> </li> </ul>

Notes: '-' means no significant or neutral effect, 'x' denotes a small negative effect, 'xxx' denotes large negative distributional effect

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## 3.2 Affordability for businesses

### 3.2.1 Impacts of the policy options

#### 3.2.1.1 Direct and indirect effects

The two policy options considered will have impacts of varying scope and scale on businesses operating in Southampton.

It is likely that the majority of local businesses will be affected to some extent, either directly or indirectly. In fact, policy implementation will impact businesses operating within the port, the wider city and region (including the Isle of Wight) and the UK more broadly, due to the national network of freight operations. The nature of the impacts will largely depend on the location of businesses, their reliance on transport services, the composition of company fleets and the size of their operations.

The analysis focuses on impacts which influence profitability, as well as considering broader costs to businesses. But it is also important to note the indirect benefit of improved air quality, which engenders fewer employee absences and greater productivity, through enhancing the health of the workforce<sup>12</sup>. These benefits are not considered in as much detail in this section, which focuses more so on costs.

The key impacts for the two policy options are summarised in Table 16 and Table 17, which encompass all of the potential impacts which might arise in response to the implementation of a non-charging Clean Air Zone or a city-wide Class B Clean Air Zone.

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<sup>12</sup> Wider impacts on these businesses are considered in a separate analysis Ricardo is conducting for Southampton City Council.

**Table 16: Relevant policy options for business and their direct impacts**

Impact Categories	City-wide Class B Clean Air Zone	Non-charging Clean Air Zone
Relevant measures for HGVs	Access charging for non-compliant vehicles	Delivery service plans / SDC Port booking system Shore-side power
Direct impacts on HGVs	Cost of paying the charge (↓ - 4) Upgrading non-compliant vehicles (↑/↓↓ - 3) Welfare loss of diverted / cancelled trips, capturing reduced economic activity (including at the port) (↓↓ - 2) Administrative costs of upgrading fleet (↓ - 3)	Cost of designing / implementing DSP (↓ - 4) Driver time, fuel and opex savings from DSP (↑↑ - 3) Welfare loss of changing time of port trips (↓ - 2) Cost of paying the port booking charge (↓ - 4) Investment in and opex of shore-side power (↓ - 4)
Relevant measures for Buses/Coaches	Access charge for non-compliant vehicles Funding for retrofit	Funding for retrofit
Direct impacts on Buses/Coaches	Cost of paying the charge – coaches and buses accessing service depot (↓ - 4) Upgrading non-compliant coaches (↑/↓↓ - 3) Welfare loss of diverted / cancelled trips - coaches and buses accessing service depot (↓ - 3) Administrative costs of upgrading fleet / retrofitting (↓ - 3) Service interruption as bus fleet retrofitted (↓ - 3) Higher bus breakdown and opex following retrofit (↓ - 1)	Service interruption as bus fleet retrofitted (↓ - 3) Vehicle breakdown following retrofit (↓ - 1) Higher operating costs following retrofit (↓ - 1)
Relevant measures Taxis/PH	Access charging for non-compliant vehicles Licence changes which plans for all taxis to be CAZ-compliant by 2023	Licence changes which plans for all taxis to be CAZ-compliant by 2023
Direct impacts on Taxis/PH	Cost of paying the charge (↓ - 4) Upgrading non-compliant vehicles (↑/↓↓ - 3) Welfare loss associated with cancelled trips (↓ - 2)	Upgrading non-compliant vehicles (↑/↓↓ - 2)

**Impact** - ↑ = minor positive impact, ↑↑ = positive impact, ↓ = minor negative impact, ↓↓ = negative impact  
↑/↓ = mixed impact.

**Confidence** - 1-5 = low confidence – certainty.

**Table 17: Relevant policy options for business and their indirect impacts**

Impact Categories	City-wide Class B Clean Air Zone	Non-charging Clean Air Zone
Relevant measures for HGVs	Access charging for non-compliant vehicles	Delivery service plans / SDC Port booking system Shore-side power
Indirect impacts on HGVs	Reduction in freight volumes carried, impacting deliveries (↓ - 1) Increase in cost for freight volumes carried (↓ - 3) Reduction in demand for businesses supporting HGV traffic e.g. wholesalers, HGV servicing, etc. (↓↓ - 2) Improved productivity and wellbeing of workforce (↑ - 2)	Change in cost for freight volumes carried (↑/↓ - 2) Improved productivity and wellbeing of workforce (↑ - 2)
Relevant measures for Buses/Coaches	Access charge for non-compliant vehicles Funding for retrofit	Funding for retrofit
Indirect impacts on Buses/Coaches	Increase in number of people taking public transport (↑ - 2) Reduction in demand for businesses supporting coach traffic e.g. coach servicing depots, etc. (↓↓ - 2)	-
Relevant measures Taxis/PH	Access charging for non-compliant vehicles Licence changes which plans for all taxis to be CAZ-compliant by 2023	Licence changes which plans for all taxis to be CAZ-compliant by 2023
Indirect impacts on Taxis/PH	Customer attitudes may shift which results in preference for businesses operating cleaner vehicle fleet (↑/↓ - 1)	Customer attitudes may shift which results in preference for businesses operating cleaner vehicle fleet (↑/↓ - 1)

**Impact** - ↑ = minor positive impact, ↑↑ = positive impact, ↓ = minor negative impact, ↓↓ = negative impact  
↑/↓ = mixed impact.

**Confidence** - 1-5 = low confidence – certainty.

The public consultation mirrors the impacts summarised above. Figure 7 displays that only 20% of respondents believe a CAZ would have a positive economic impact on the Port or city of Southampton, relative to 64% which suggest the impact is likely to be negative. As displayed by Figure 8<sup>13</sup>, a main concern across respondents is the negative impact on businesses and the economy (1,221 of 3,199 written responses). There was also specific mention of the economic impact on the Port and smaller businesses, as well as the potential for businesses to relocate. There is also concern for the impact on tourism, which could be the case due to the impact on bus and coach fare prices; however, improved air quality may subsequently attract more tourists to visit the city.

<sup>13</sup> Figure 3 comprises all written feedback from the public consultation on expected negative economic impacts of the CAZ.

Figure 7: Public Consultation opinions on the negative economic impact of CAZ implementation

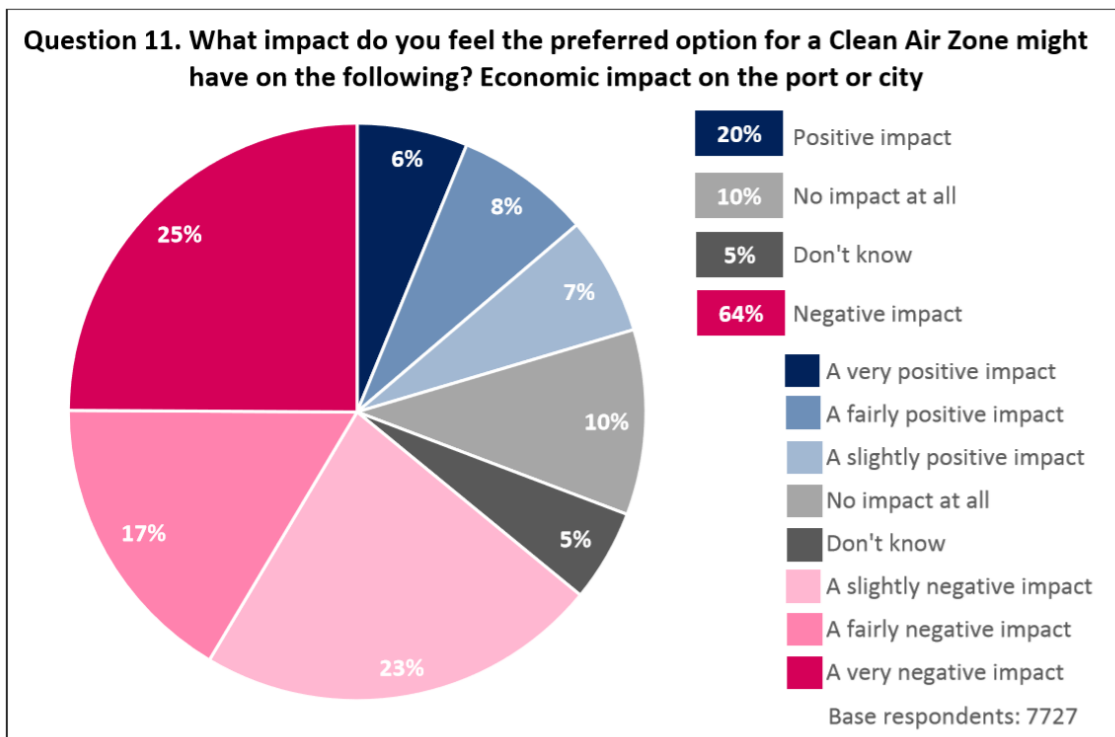
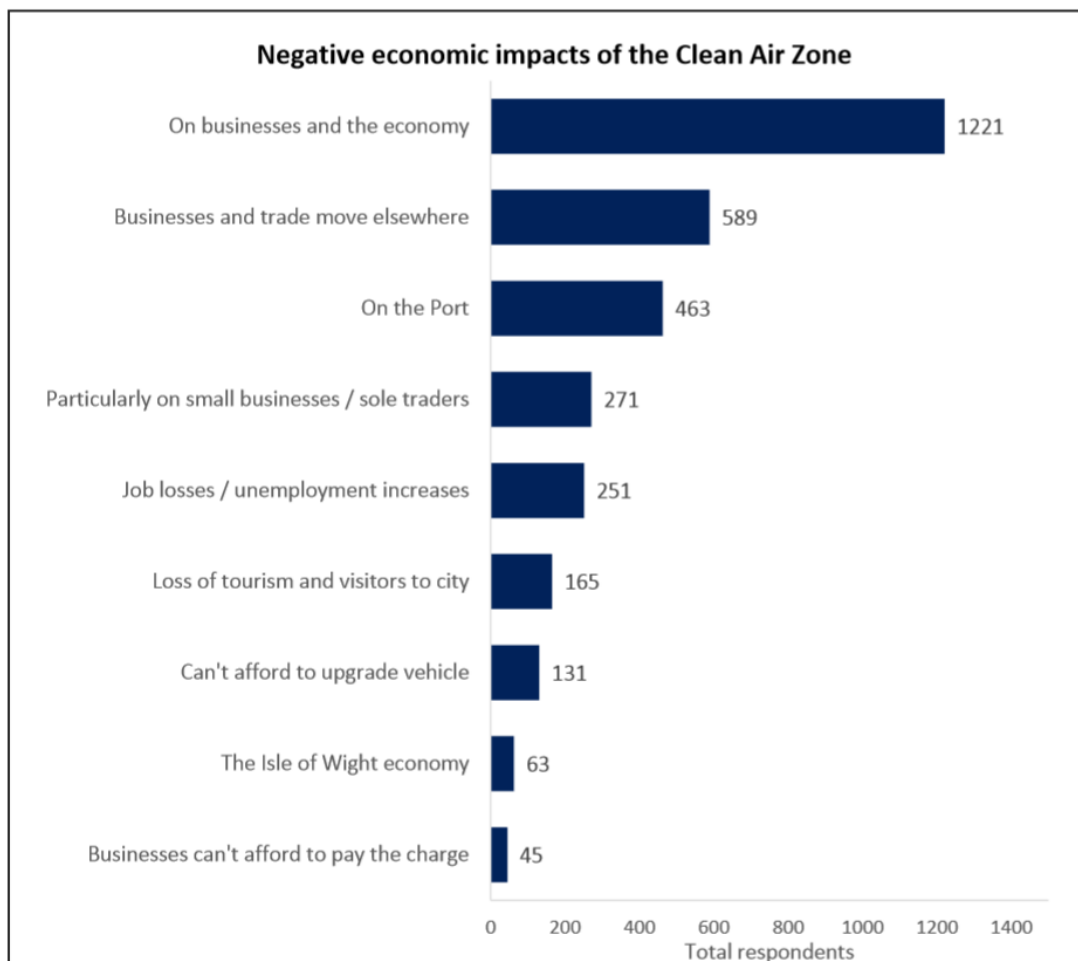


Figure 8: Public Consultation opinions on the negative impacts of CAZ implementation



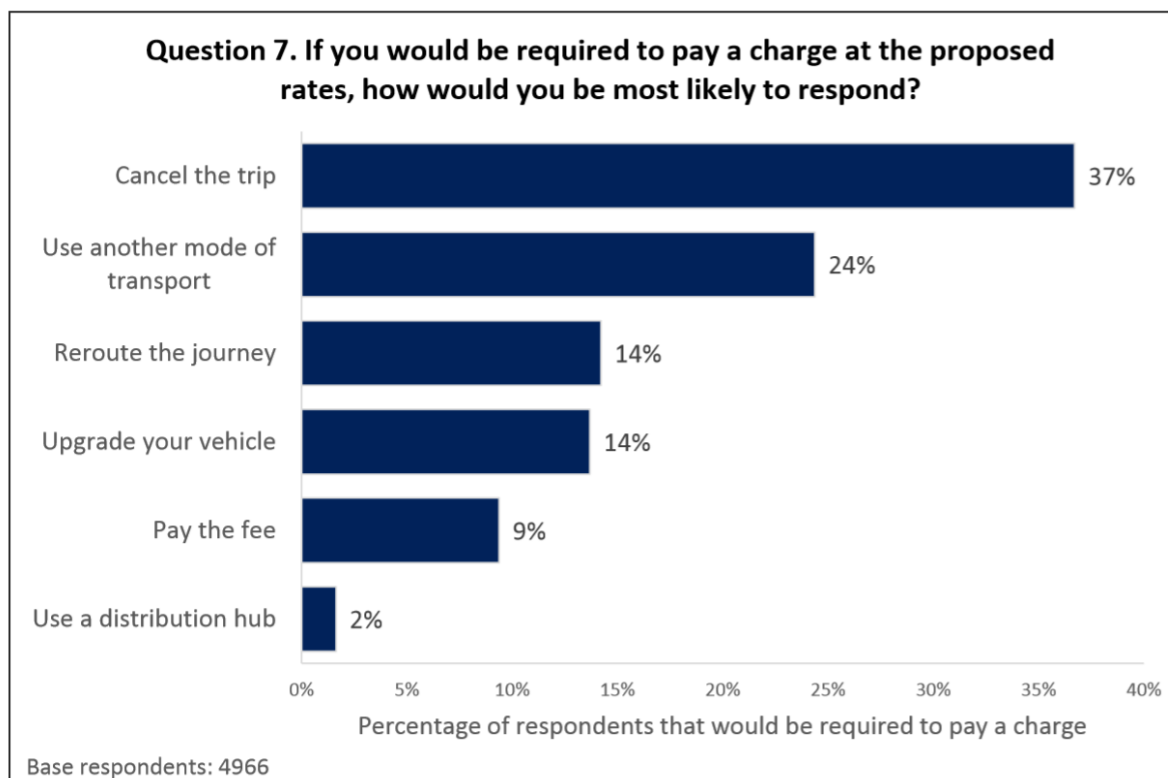


The magnitude of these impacts will largely depend on the current state of play of company fleets. Cleaner fleets, which are compliant with the proposed CAZ, will bear costs of lower magnitude, as they will not be subjected to any mandatory charges. Therefore, direct compliance cost is likely to be greatest for businesses which own and operate non-compliant vehicles. Indirect effects are likely to be spread across a greater number of actors. This analysis will focus on the direct impacts which we can identify with more certainty, although indirect effects are also explored, where these are deemed potentially significant.

The response of a business to the city-wide Class B CAZ or non-charging CAZ is another contributing factor to the magnitude and type of costs encountered. If companies reshape their fleet to comply, they will experience the upfront compliance cost of upgrading to new vehicles and / or the administrative burden of redistributing their fleet. However, businesses which invest in vehicle upgrades are also likely to experience reductions in operating costs, due to lower fuel costs associated with newer, typically more efficient vehicles. It is also important to consider that responses to the proposed policies may engender welfare losses to the business, as they are no longer able to choose their preferred option (most likely the status quo), and instead may cancel journeys in response which a potential impact on economic activity and employment (both for the HGV operator and the businesses using their services).

Prior to a focus on vehicle types, it is important to highlight the expected responses of businesses to the implementation of a city-wide Class B Clean Air Zone. Assumptions were made regarding response levels in the economic assessment to enable analysis. Therefore, responses may differ in practice; the public consultation offers a different insight into the potential response of non-compliant vehicle owners<sup>14</sup>. The opinions expressed in the public consultation are displayed in Figure 9<sup>15</sup>. In addition to this, there is also potential for businesses to redistribute fleet between cities, shifting compliant vehicles for use in Southampton and moving non-compliant vehicles for use elsewhere. There is also the potential for businesses to exit the market completely. Of the businesses involved in the consultation, 44.8% stated they would cancel the trip, with only 9.6% paying the fee.

**Figure 9:** Public consultation responses to city-wide CAZ charge



<sup>14</sup> However, it is also worth noting that public consultations tend to exhibit a negative bias, as individuals often exaggerate responses to reduce the likelihood of undesired policy outcomes.

<sup>15</sup> Figure 1 comprises all responses to Question 7, rather than just business responses.

Responses by owners of non-compliant vehicles will also have second-order effects on the wider economy. Second-order impacts can be negative, such as lowering business profitability and impacting jobs. They can also be positive, such as creating a market demand for more businesses that retrofit emissions technology for existing vehicles.

More broadly, it may be difficult to attribute impacts on businesses to the CAZ due to the rapidly-changing landscape regarding air quality awareness and willingness to tackle the issue. For example, in the coming years, businesses are more likely to favour low-carbon vehicles regardless of policy implementation, as they become more aware of the impacts of poor air quality. As the policy options attempt to encourage behavioural change, through incentivising or charging, it is likely that policy updates will further alter market conditions. However, it is likely that despite increasing action in the absence of policy, the city-wide Class B CAZ or non-charging CAZ will enhance action beyond the baseline.

### 3.2.1.2 Link from impacts to affordability risk

Whether a policy option is affordable or unaffordable determines its effectiveness, depending on the policy goals. In general terms, a subsidy or financial incentives should make a desired outcome affordable, while a charge should be sufficiently large to change behaviour.

Where the CAZ places a cost on businesses (as set out in the impacts explored in the section above), there is an inherent risk as to whether the business can 'afford' these costs. In some cases, it is not certain that the business can simply internalise these costs, as there may be further ramifications for the operation of the business, which may result in the impact being greater than the initial cost burden placed by the CAZ. If costs are unaffordable, a business may respond by cancelling trips, shifting location to outside the CAZ or leaving the market altogether.

If businesses choose to 'pay the charge' or upgrade in response, it could be assumed that the business can 'afford' the compliance costs placed on it, at least in the short-run. These responses will still carry additional direct costs for businesses, but they are deemed 'affordable' as businesses can either:

1. Pass through to customers
2. Internalise the costs with limited risk to the ongoing viability of the business

There may also be affordability risks associated with these responses in the longer term, but this is difficult to assess. Furthermore, these responses could still have some impact on the local economy or jobs, but these are likely to be smaller and play-out over a longer period.

Where firms can pass on the costs of complying with the CAZ to their customers, this limits the risks to the ongoing operation of the business itself. Costs are passed onto customers through higher prices. Firms may be able to pass through costs if:

- **Price increases are marginal:** customers do not notice or care about price increases, relative to overall budget.
- **Service users have few alternatives / competition for service is low:** customers do notice the price increase, but do not have access to more competitive options.
- **Demand for good is fairly unresponsive to price:** this could be due to the cases above, or because of another reason (e.g. strong emotional attachment to the good/service)

Where firms can pass on costs, it is worth noting that in some cases this may create risks through the supply chain. This could arise in the case where all costs are passed through to a single customer, such as a builder's merchant supplied by a limited number of suppliers.

Where firms cannot pass costs onto their customers, they will consider whether they can 'internalise' the burden. This is typically a short-term strategy in response to an effect which is not anticipated to last into the long term (i.e. reduce profit in the short term due to higher costs, with the expectation that profit will increase again in the future). In the case of CAZ, this may be the strategy adopted by some businesses given the baseline fleet is eventually expected to draw closer to the CAZ scenario: firms are simply bringing forward costs they would have incurred anyway later.

However, internalising costs will still impact the viability of the business, increasing the susceptibility to other risks, but can offer a short-term solution rather than a complete closure or shift of the business. Firms may be able to internalise costs through: reducing profit (for a certain time with expectations that this will increase again in future); reducing other costs to compensate (but not scale); holding large cash reserves and planning for costs and bringing these forward a short period.

Analysis of the capability of businesses to either internalise or pass on the CAZ-related costs to consumers is challenging due to the variance in situation across different firms and given a better picture can only be gained from access to commercially sensitive data. Table 18 presents some broad conclusions based on consideration of the customer base and pricing structure for different firms affected by the CAZ options. We have excluded the analysis on bus operators because the CBTF funding is expected to bring the whole bus fleet into compliance.

**Table 18:** Summary of Ricardo cost pass through and internalisation analysis<sup>16</sup>

Operator	Can firms pass through costs to customers?	Can firms internalise costs?
<b>HGV operator</b>	HGVs operate in a sector of intense competition with more economically-active customers. In 2020, there will already be many HGVs which are CAZ compliant. Hence strong competition in sector severely limits ability to pass through costs.	Low profit margins (1-4%) significantly reduce ability to internalise – for a non-compliant vehicle, CAZ charge could be greater than margin on trip. That said, larger operators may be able to spread the costs of the charge over a larger fleet and operations or redistribute fleet to reduce the burden.
<b>Coach operator</b>	Competition from compliant coaches (40% in 2020) and non-marginal impact for frequent travellers will reduce the capacity for some to pass through costs. For those carrying infrequent customers, this may allow some pass through of the costs.	National operators have higher profits and wider operations across which the costs of the CAZ can be spread. But local operators with smaller fleets are less able to internalise.
<b>Taxi driver</b>	Customer base and lack of alternatives may allow some pass through (but will affect regular customers, e.g. people with disabilities).	The comparison between costs and margins is different to other businesses: given the ownership profile, the comparison is relative to household income, rather than profit, which limits ability to internalise. CAZ charges could represent a significant proportion of take-home pay of taxi drivers, in particular those lower on the income distribution.

### 3.2.1.3 Smaller firms are at greater risk

Smaller firms are more likely to face greater affordability risks through their operation as described above (e.g. they tend to operate older vehicles and enter the CAZ more frequently). The nature of them being smaller businesses itself further increases the risk facing these businesses, in particular smaller firms:

- do not have large fleets which can be redistributed, reducing the response options available to them to respond to the CAZ charge
- are likely to have smaller cash reserves to fund upgrades
- have smaller operations over which costs can be spread
- may also find it more difficult to access capital or may face higher borrowing charges.

In response to the introduction of the London LEZ, an impact monitoring report noted that HGV owners with large fleets serving large geographical areas tended to react by conducting an in-depth analysis of how they organised their transport activities. Fleets were then redistributed so that the newest and cleanest vehicles were used in the Greater London region, while older vehicles were operated in zones without charging schemes. HGV owners with smaller fleets or those serving smaller geographical areas were not able to adapt by redistributing their fleet. These businesses needed to put money aside ahead of time in order to purchase newer vehicles or retrofit existing vehicles. Where these options were not feasible due to financial constraints, these businesses rented newer vehicles, paid the charge or left the market<sup>17</sup>.

The risk for smaller coach operators may also be exaggerated by the nature of the customers they serve. If smaller coach operators are more likely to serve regular routes within the city (e.g. school

<sup>16</sup> Data is limited across the HGV and coach sectors, limiting the ability to form useful comparisons of charging to operating cash flows. Data is also limited on profit margins.

<sup>17</sup> Cecilia Cruz and Antoine Montonen, "Implementation and impacts of low emission zones on freight activities in Europe: Local schemes versus national schemes",

buses), they will have a lower capacity to pass costs through to their customers. This is because the total cost passed through per customer will be much higher than a national operator, which sees a greater variance in its customer base. Some larger coach operators, such as National Express, have policies requiring its coach operators to use vehicles that are no more than seven years old, and would therefore be relatively well-positioned to adapt to the implementation of a charging zone<sup>18</sup>. In addition, some commuter services run by national operators, especially those on long-distance service lines, may be able to re-route their services to avoid passing through a charging zone.

The disproportionate impact on smaller businesses is shared by public consultation respondents. Although 64% of respondents expressed the opinion that a CAZ would have a negative impact on larger businesses, 75% believed there would be a negative impact on small businesses and sole traders. Therefore, although respondents expect a negative impact on businesses of all sizes, the greater concern for smaller firms is clear.

#### 3.2.1.4 Wider market response

For those vehicle operators affected by the CAZ which operate in competitive markets, it is worth noting that in theory there will be further knock-on effects that will limit the total impact of affordability risk.

For example, if one HGV driver, coach operator or taxi driver cancels a trip, or at worst ceases trading, the demand for that trip still exists. In theory, another taxi, bus, or coach that is willing to pay the charge or upgrade their vehicle will step in to serve that demand. They may do so at a higher price, given there are fewer supply options. To a certain extent, this market response will limit any adverse knock-on effects on the local economy. This is not to say there will not be any impacts on the local economy, who will e.g., need to invest time finding new suppliers, etc.

Any price increase will depend on the number of alternatives available and the subsequent competition for the trip. Furthermore, this market response will make trips in Southampton more profitable, encouraging more compliant taxis, HGVs and coach firms back into the market. Alternatively, there could be a greater incentive for existing suppliers to upgrade. However, it is not guaranteed that this activity, or any associated jobs, will be retained in Southampton.

For operators based outside of Southampton, the most likely response to the CAZ will be to reduce the number of trips into the CAZ, rather than closing business completely. Again, theory would suggest that if an operator based outside Southampton will not serve demand for a trip, then another operator will. In turn, this could provide a benefit to operators based (or operating predominantly) in Southampton, who have already incurred the CAZ charge or upgraded to become compliant if these firms were able to capture this unserved demand.

Even where markets can respond in this way, there will be an impact on jobs and economic activity associated with the primary trip cancellation, or complete closure of the non-compliant taxi driver, HGV or coach firm. Nevertheless, this market response of other suppliers to meet the unmet demand will limit any knock-on effect on the wider economy.

There may also be a further response from the local labour market. Depending on the flexibility and spare capacity in the labour market locally, some of the initial job impacts may be mitigated by employees being able to find new employment elsewhere. Although, there will still be a cost associated with the time and effort required to find a new post, as well as potential re-training costs.

This theory will also apply to wider businesses affected by the CAZ. For example, where garages or builder's merchants cease to trade, in theory this demand will be served by another operator. This will allow the activity which is served by these businesses to continue. If businesses opt to shift outside the CAZ, where Southampton still contributes a significant proportion of their business, they may choose to shift just outside the CAZ area. This will limit the impact on jobs and local economic activity as these may still be accessible for employees. Where the business serves customers with a wider distribution nationally, the shift may be further afield.

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<sup>18</sup> Jacobs, "Ultra Low Emission Zone: Integrated Impact Assessment", and associated documents, prepared for Transport for London, October 2014, [https://consultations.tfl.gov.uk/environment/air-quality-consultation-phase-3b/user\\_uploads/integrated-impact-assessment.pdf](https://consultations.tfl.gov.uk/environment/air-quality-consultation-phase-3b/user_uploads/integrated-impact-assessment.pdf), accessed 24/04/2018.

## 3.2.2 Focus on vehicle types

### 3.2.2.1 Impacts on heavy goods vehicles

#### Overview/Numbers of vehicles

The HGV fleet is split between hire and reward vehicles, used to transport goods in return for payment (e.g. couriers, furniture removers, etc.), and vehicles used to transport the vehicle owner's goods. Within the UK, the latter category is comprised mostly of rigid HGVs and constitutes a larger fleet size in terms of number of vehicles. The former category is comprised mostly of articulated HGVs, which tend to be larger vehicles undertaking longer journeys and account for the majority of freight carried.

HGV fleet owners encompass a wide range of business types and sizes, including a relatively small number of large fleet operators with thousands of vehicles, and a relatively large number of single vehicle operators. Based on information from the Office of the Traffic Commissioners, there is an ongoing trend in the industry towards consolidation, as demonstrated by a decline in the number of HGV operators over time.

A HGV operator's mode of operation and renewing of their vehicle fleets tends to be aligned with the size of the operator. The sector can be broadly divided into the following categories of operator:

- **Large fleet operators** – operating nationally with 100+ vehicles. Typically purchase HGVs new and run intensively on motorways for 3 years. As a result, by 2020 the vast majority of these fleets would be Euro 6 and CAZ-compliant.
- **Medium fleet operators** – operating with 10-100 vehicles. Purchase these relatively new 2nd hand vehicles and run for 3-5 years. Currently operating Euro 5 vehicles, the majority of these will be transitioning to Euro 6 in the next 1-3 years.
- **Small fleet operators** – operating <10 vehicles. Typically buy 2nd hand at 8 years old typically doing short local/regional journeys. These vehicles can be run for many years. Currently operating Euro 2-4 vehicles.
- **Specialist vehicle operators** – operating vehicles that are highly specialised and have both a significant lead-in time on production (6-18 months), and additional expense due to specificity e.g. waste vehicles, concrete mixers. Small operators operate Euro 2-4 vehicles. Some of these vehicles such as cement mixers have a relatively low mileage and a longer life span (up to 12 years).

There are several sources of data from which we can draw insights around the size of impacts, and on whom these might fall.

From the traffic models used as inputs to the air quality dispersion model, the annual average daily traffic of HGVs along the main roads in Southampton was calculated for the CAZ domain and areas falling outside the CAZ domain. These vehicles are split by vehicles which would be in compliance with the CAZ and those that would be non-compliant and directly impacted. As displayed in Table 19, within the CAZ domain, the CAZ could affect around 42,000 HGV trips each day.

**Table 19: Annual average daily traffic numbers of HGVs in the city-wide CAZ B**

Vehicle Type	Zone	Total Vehicle Trips	Total Compliant	Total Non-Compliant	Ratio Non-Compliant: Compliant
HGV	Rest of AQ domain	693,151	604,301	88,850	0.147
	CAZ domain	581,746	539,836	41,910	0.078

Inputs to the economic analysis are also informative here. The economic analysis is based on an assumed number of vehicles that would be affected by the CAZ. The data is originally sourced from a week's worth of ANPR data from 2016 for HGVs and coaches, and taxi and bus operator licence data. This is then scaled up (to an annual figure) and projected forward to 2020 to provide an insight on the number of vehicles that might face the CAZ charge. The fleet data is presented in Table 20.

**Table 20: Numbers of vehicles in the economic model –city wide CAZ**

	Input data		Derived 2020 baseline (after applying uplift factors)		Number of non-compliant vehicles
	No. of vehicle; 2016; ANPR one-week data;	% compliant	No. of vehicles; 2020; per year / total	% compliant (2020)	No. of vehicles; 2020; per year / total
Bus (licence)	275	30%	275	77%	64
HGV (ANPR)	14,420	45%	36,050	80%	7,080
Taxi – HC (licence)	530	20%	850	47%	402
Tax - PH (licence)	1415	20%	2,269	47%	1,073
Coaches (ANPR)	1,982	30%	3,964	77%	926

Although the data above gives an idea of the number of trips and vehicles affected, it does not tell us how many businesses may be affected.

O-Licence data contains licensing information for goods and public service vehicle operators. Table 21 highlights the number of businesses and registered vehicles within the larger Southampton area (covered by the air quality modelling domain) and the city-wide CAZ zone. Overall, there are approximately 100 O-Licence operators in Southampton, with close to 1,800 registered vehicles. Of these, 83 operators are located within the city-wide CAZ area (operating 1,300 vehicles).

**Table 21: O-Licence data for HGV operators based in Southampton<sup>19</sup>**

	No. of licensed companies		No. of licensed companies	
	Southampton area		Southampton city-wide CAZ area	
<b>0 to 5</b>	65	114	49	90
<b>6 to 10</b>	9	71	10	73
<b>11 to 15</b>	5	65	3	35
<b>16 to 20</b>	0	0	2	35
<b>21 to 30</b>	9	223	7	178
<b>31 to 50</b>	6	221	6	235
<b>51 to 100</b>	7	480	5	360
<b>&gt;100</b>	3	555	1	294
<b>Total</b>	<b>104</b>	<b>1,729</b>	<b>83</b>	<b>1,300</b>

The CAZ area covers a larger number of smaller businesses: of the 83 operators in the CAZ, 62 operators (75%) have 15 or less registered vehicles and the majority of companies (54%) operate only small fleets, i.e. 0-5 vehicles. For these companies, it may be difficult to access capital or source

<sup>19</sup> It is important to note that this only shows where vehicles are registered, not where they travel.

sufficient resources to upgrade vehicles. Also, small companies are unlikely to have the same opportunity to redistribute their fleets, i.e. increasing the number of compliant vehicles in the CAZ area.

### Impact of CAZ options

It is likely that the city-wide Class B Clean Air Zone will have the greatest impact on HGVs. It will affect a greater quantity of vehicles (given the much broader geographic scope of the zone and trips affected) and places greater costs of compliance on HGV operators. Fewer vehicles (if any) are anticipated to upgrade under the non-charging CAZ, with more limited action specifically targeting those servicing the port.

By 2020, the baseline modelling underpinning the CAZ assessment suggests that many HGVs will already be Euro VI. However, it is likely that the vehicles owned and operated by national companies, who tend to upgrade vehicles more often, will comprise the majority of upgrades.

Smaller HGV operators could be placed at greater risk, due to:

- operating older fleets
- undertaking a greater proportion of trips in CAZ<sup>20</sup>
- upgrading vehicles less often.

These smaller firms are also more likely to be locally based by nature: they have small fleets operating in a defined geographic area. This increases the risk to these firms, as they are likely to undertake a greater proportion of trips in the CAZ, and any knock-on effect on local jobs and the economy could be higher as a consequence.

With respect to HGVs, it is also worth noting the following points, which will impact on the affordability risk:

- There is currently no accredited retrofit option available, reducing the options available to HGV operators to respond to the CAZ (in particular retrofit typically carries a lower upfront cost).
- The CAZ introduction itself may increase the cost of upgrading to compliant vehicles: Lack of availability and increased demand has inflated Euro 6 HGV prices due to simultaneous CAZ implementation across cities, with Euro VI vehicles now exceeding £150,000 in value. Further, the CAZ may also suppress the value of Euro IV and V vehicles, increasing the financial challenges to replacing vehicles.
- There may often be long lead-in times to upgrading fleet, particularly for specialist vehicles, which need to be adapted for a specific requirement. Therefore, the short timeframe of CAZ implementation may be a challenge for many, with 24 months from proposal to charging implementation a challenging timescale for HGV operators. To highlight the issue, for companies with specialist vehicles, replacement cycles tend to be 3-12 years.

The response adopted by the owner of a non-compliant vehicle will be complex, unique to the operator and dependent on a wide range of factors. Businesses may adopt different approaches at different times, paying the charge first before upgrading at a later date when they have greater certainty around their compliance costs. For some businesses, 'avoiding the zone' is not an option. As such, operators based inside the CAZ are likely to be affected to a greater extent than those based outside the CAZ, as they may be unable to re-route trips to avoid the area.

In addition to the private businesses, SCC owns and operates a HGV fleet mainly, primarily related to refuse collection. It is estimated that 17 of these vehicles are non-compliant and therefore SCC would need to either pay for the upgrades or the CAZ charge for these vehicles.<sup>21</sup> CAZ B would therefore have implications on the SCC budget, as funding to either pay the charge or upgrade vehicles would need to be taken from other Council funds. This in turn could impact on other services provided by SCC or put pressure on the council tax rate.

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<sup>20</sup> If based in Southampton, it is also more likely that a greater proportion of their total fleet or trips will be affected by the CAZ, relative to a larger national operator which also serves destinations outside Southampton.

<sup>21</sup> Personal communication with SCC

The NCAZ CAZ consists of several sub-measures, two of which will have implications for HGVs operators and will affect them in different ways.

1. The objective of the DSP/SDC measure is to create an incentive for vehicles to reduce vehicle kilometres by rationalising deliveries.
2. The port booking measure places a small charge on older vehicles at peak times which may drive some vehicles to upgrade their vehicles in response and bear the cost, however, this is likely to be limited (and much more so relative to the CAZ B).

There will be other costs for HGV operators, such as scoping and implementing delivery contracts through the SDC, welfare costs of shifting trips or paying the charge under the port booking measures. However, there will also be benefits for the freight operators, including driver time, fuel and operating cost savings through dropping deliveries off 'early' at the SDC.

### 3.2.2.2 Impacts on buses and coaches

#### Overview/Numbers of vehicles

SCC data suggests there are around 280 scheduled buses in Southampton, split across four operators: First; Bluestar; Wheelers and Xelabus. These vary in size of operation in Southampton, with Bluestar and Xelabus operating fleets of 143 and 4 respectively. The operators also vary in company size, with First being a subsidiary of the nation-wide FirstGroup, which operates in multiple cities across the UK. In the economic model, adjustment factors were applied to assume a total operating fleet of 275 buses serving scheduled routes in 2020, of which 77% were anticipated to be compliant in the baseline. To note, Southampton has been successful in securing funding from CBTF to update all vehicles. In addition, buses and coaches operating outside Southampton visit the FirstGroup depot for MOT testing and driving tests<sup>22</sup>.

There is limited data available on coaches operating in and around Southampton, both in terms of quantities of coaches and operators, and the nature of the operators<sup>23</sup>. The estimated number of coaches entering the city-wide CAZ area per year in the economic modelling is around 4,000 by 2020, with around 77% exhibiting compliance. Coach operators are likely to serve several different routes: serving regular routes (e.g. school buses); large national firms serving regular but less frequent inter-city routes (e.g. National Express) and one-off coaches serving visitor attractions or events (such as the football stadium) and transportation to the port. This could also capture vehicles operated by charities and community groups (e.g. providing transport to and from the hospitals).

#### Impact of CAZ options

For buses and coaches, the largest impact is expected to be under the city-wide CAZ B.

Unlike other vehicle modes, an accredited retrofit option is available for buses which will help to reduce the compliance costs for affected operators. Southampton has successfully secured just over £2.6m of funding from the CBTF, which will bring all buses to Euro 6 compliance under both CAZ options<sup>24</sup>.

This retrofitting activity will have several impacts under both options. First, bus companies have committed to provide match funding of approximately £816k for the CBTF grant, which could have impact their cash flow, with the potential to be passed on to consumers. Second, bus operators are concerned about the possible negative impacts of retrofitting buses. These concerns include the need to take buses out of operation, increased likelihood of breaking down following retrofit and potentially higher operating costs.

CAZ B will have a separate and additional impact on buses through vehicles accessing the servicing depot in Southampton. The location of the FirstGroup depot is presented in Figure 10. It is estimated that four buses visit the depot per week for MOT testing and the majority of these vehicles (73%) are non-compliant. Buses using the depot would be impacted by the CAZ B. The non-compliant buses are

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<sup>22</sup> Private communication from the First Group

<sup>23</sup> ANPR data provided information on the total number of scheduled buses and coaches, but it was not possible to differentiate between the two. Therefore, we subtracted the number of buses operating scheduled services within Southampton from the ANPR data to get an estimate for the number of coaches accessing the CAZ areas.

<sup>24</sup> <https://www.southampton.gov.uk/modernGov/documents/s35505/Clean%20Bus%20Technology%20Fund.pdf>



likely to either cancel their journey or pay the CAZ charge. The size of the impact will be influenced by the extent to which these buses are able to access CBTF funding. As FirstGroup is a national company, the impact of the CAZ charge is unlikely to be a major concern. However, if the Group decides to relocate the depot then the local jobs associated with the depot might be at risk. These vehicles will not be affected by the NCH CAZ.

**Figure 10: Location of the FirstGroup Bus Depot**



The CAZ charging zone will also place costs on coach operators. Some vehicles, and particularly minibuses, are owned and operated by community organisations that mainly provide voluntary and charitable services. These organisations tend to have small fleets comprised of older vehicles, and they may have a lack of transport alternatives. Such organisations are likely to have a more difficult time adapting to the implementation of a charging zone, due to cash and fundraising constraints<sup>25</sup>, and restrictions in the ability to pass costs onto their customers. As with HGVs, smaller operators are likely to be more at risk, as they typically operate ageing vehicles, alongside working to tighter margins (i.e. with less contingency) and possessing limited capacity to replace vehicles external to planned replacement cycles. Coaches operators will not be affected by the NCH CAZ as there is no non-charging measure affecting these vehicles.

### 3.2.2.3 Impacts on taxi drivers and operators

#### Overview/Numbers of vehicles

Out of a total 1,945 vehicles currently registered as taxi and private hire vehicles in Southampton, New Forest and Eastleigh<sup>26</sup>, only 20% would presently be compliant with the CAZ. The economic model projects forward and assumes the fleet is 47% compliant by 2020, leaving 402 taxis and 1,073 private hire vehicles which will be non-compliant and accessing the CAZ area in 2020 (including a small uplift for taxis entering the zone from out of area).

#### Impact of CAZ options

Given the majority of the taxi fleet will be requested to access the CAZ area, it is expected that all locally licenced vehicles will be affected by the introduction of the CAZ. CAZ charges will be faced equally by operators licensed in Southampton and elsewhere. However, assuming those licensed in Southampton will operate in the city centre more often, it is likely that they will bear a greater cost burden.

<sup>25</sup> Transport for London, "London Low Emission Zone: Impacts monitoring baseline report", July 2008, <http://content.tfl.gov.uk/lez-impacts-monitoring-baseline-report-2008-07.pdf>, accessed 03/04/2018.

<sup>26</sup> Excluding diesel and petrol hybrids, with these the numbers total to 1945.

Taxis could also be uniquely affected due to their ownership structure: unlike other modes, taxis tend to be owned and operated by single driver, rather than by larger businesses. In Southampton, nearly all of the taxi and private hire vehicles are owned and managed by individual drivers<sup>27</sup>. Hence, the cost burden of the CAZ is faced by an individual, rather than a business. This has two impacts:

1. An individual inherently has lower capacity to spread any cost burden across multiple operations or revenue streams
2. The impacts on taxi operators will impact directly on household income, rather than business revenue. Indeed, the London ULEZ impact assessment recognised that virtually all taxi drivers are self-employed and therefore, would need to bear the cost of new vehicle purchase themselves.

Matching taxi licence data to lower layer super output areas (LSOAs), and assessing demographic data associated with the LSOA, the distribution of taxi drivers across the index of multiple deprivation (IMD) appears to be highly skewed towards more deprived LSOAs. In fact, 40% of the taxi operators are registered in the most deprived LSOAs (quintile 1) and 79% in the three lowest quintiles.

A survey by Insuretaxi reported that average weekly income of a taxi driver in South-East England is around £430 per week<sup>28</sup>, corresponding to an annual income of around £22,400 (assuming 52 weeks worked). The weekly income is the highest reported in the country amongst taxi drivers and is roughly similar to the median personal income in the UK in 2015-2016, £23,200<sup>29</sup>. Although the evidence suggests that taxi drivers in South East England receive a relatively higher income compared to their colleagues in other parts of the country and their estimated annual income is proximate to the national median, it also suggests they are less likely to have the cash available to purchase a new vehicle in a short space of time.

Affordability concerns are also reflected in the Taxi Operators Survey conducted by the SCC, where 78% of the respondents stated that the cost of purchasing a low-emission vehicle is the key barrier.

Other specific issues affecting taxis include:

- In some circumstances, taxis are also subject to other operator and consumer demands. For example, Uber London drivers must use hybrid or electric vehicles by 2020. Hence, taxi operators may face other requirements which impact their vehicle operation and upgrade behaviour.
- Taxi and private hire vehicles are typically run for 6-7 years. As a result, a large proportion of drivers would not purchase a new vehicle until after 2020, should they have the choice. Hence the speed of implementation may be a challenge for taxi operators.
- Drivers who have recently purchased vehicles may be tied into loan repayments beyond 2020.

CAZ B is likely to affect the largest number of taxis as the charging zone will affect taxis licensed in Southampton, but also taxi and private hire vehicles travelling in from (and registered in) areas outside Southampton. The NCH CAZ licence restriction will only apply to taxis licensed in Southampton.

Furthermore, CAZ B will place a greater cost on taxi operators given the CAZ will be implemented in 2020, sooner than the underlying step-up in licensing requirements. Hence, although the SCC fleet will need to upgrade at some point, these costs will be faced sooner under CAZ B. As such, they may also be higher, as licence changes in 2023 allow further natural turnover of the fleet to occur before these requirements come into place.

Under the non-charging CAZ, a smaller number of vehicles will be affected, both as the licensing policy only relates to taxis registered in Southampton, and as natural turnover between 2020 and 2023 will reduce the number of vehicles affected. That said, the licence changes, which plan for all taxis to be

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<sup>27</sup> 100% hackney carriage vehicles are self-employed/sole traders and almost all private hire drivers are self-employed/sole traders with the exception of a few vehicles for the major operators and limo drivers (estimated 5%). Source: Personal communications with SCC.

<sup>28</sup> <https://www.insuretaxi.com/2016/08/taxi-driver-survey-2016/>

<sup>29</sup> ONS: Percentile points from 1 to 99 for total income before and after tax, available at: <https://www.gov.uk/government/statistics/percentile-points-from-1-to-99-for-total-income-before-and-after-tax>

CAZ-compliant by 2023, could still affect a significant proportion of the taxi and private hire vehicle population. SCC estimate that there may be around 150 taxis which are 'non-compliant' with the licensing standards in 2023.

### 3.2.2.4 Impacts on wider businesses

#### Impact of a city-wide Class B Clean Air Zone

Other businesses may be significantly affected by the CAZ, even where they do not directly operate non-compliant vehicles. These businesses include:

- Businesses located within the CAZ: potentially serving/receiving a large amount of non-compliant vehicles from outside the CAZ.
- Businesses operating business-to-business services: impacts may be limited for businesses serving households, as it is anticipated that patterns of household consumption will not change significantly with the implementation of the CAZ. However, b2b services are likely to experience greater impacts.

Several businesses from a variety of sectors could be affected, including: garages; warehouses; depots for vehicle storage; wholesale distributors; goods freight handling sites (e.g. builder's merchants) and recycling plants. An ex-ante assessment of the London ULEZ identified retail, wholesale distribution and construction as the key sectors served by HGVs in central London. Niche sectors also felt the impacts, including: exhibition services; media support; theatre and music industries; waste collection and breakdown and removal.

Businesses involved in the sale of vehicles will also feel the impacts of a CAZ. Following implementation, there is likely to be a period of higher than average fleet turnover, as was the case for the London LEZ. New vehicle sales, and associated businesses, are very likely to see increased activity. The second-hand vehicle market may also become more active, as used non-compliant vehicles are sold by businesses affected by the CAZ and potentially purchased by businesses outside of the CAZ domain. Businesses that develop, fit and service emissions abatement equipment are likely to see increased activity. However, as charging schemes become more common, it is increasingly likely that used non-compliant vehicles will become obsolete, and therefore, challenging to sell. As the demand for second-hand non-compliant vehicles decreases in response to a growing number of charging schemes, this will affect the profitability of businesses which primarily sell second-hand vehicles.

Finally, the impact assessment for the London ULEZ anticipates that the ULEZ may be a potential benefit to restaurants and cafes within the CAZ, as improvements in air quality may encourage customers to use on-street seating.

A sense of the overall impact on businesses can be gained from looking at the total number of businesses operating inside and external to the CAZ region, as well as the number of compliant and non-compliant HGVs. The number of businesses located within the distributional analysis, air quality and CAZ domains were obtained from the 2011 census data, at the LSOA level. These are presented in Table 22.

**Table 22: Businesses operating within DA, AQ and CAZ domains**

Zone	Number of businesses
Distributional analysis domain	486,000
Air quality domain	52,140
CAZ domain	46,540

Table 23 displays a breakdown of the businesses, by type, which could be affected by CAZ implementation<sup>30</sup>.

<sup>30</sup> Available via AddressBase Plus.

**Table 23: OS data for categories of business potentially indirectly affected by the CAZ**

Receptor Code	Receptor Name	Number of sites	
		Southampton AQ boundary	CAZ boundary
CI03	Commercial, Industrial, Workshops and Light Industrial	1,593	1,467
CI04	Warehouses, Stores and Storage Depots	360	310
CI05	Wholesale Distribution	18	15
CI06	Recycling Plant	1	1
CS01	Commercial, Storage Land, General Storage Land	39	20
CS02	Commercial, Storage Land, Builders' Yards	2	2
CT03	Commercial, Transport, Car Parks and Park & Ride sites	169	161
CT04	Good Freights Handling	16	14
CT10	Vehicle Storage	17	10

The Commercial, Industrial, Workshops and Light Industrial businesses are likely to experience the greatest impacts, with the largest number of sites falling within the AQ boundary. However, these businesses could comprise many car and LGV servicing garages, as it was not possible to disaggregate by vehicle type. The second largest category, with significantly fewer businesses affected, is Warehouses, Stores and Storage Depots, but this could include many domestic-facing stores (e.g. post, fuel, etc). Therefore, if these categories include several sites serving households or modes not covered by the CAZ, the number of sites facing indirect risks because of the CAZ could be less substantial. It is also worth noting that this data simply represents the number of sites affected, rather than reflecting the number of individual firms or jobs at risk.

### Impact of non-charging Clean Air Zone

The type and magnitude of costs experienced will vary significantly under the non-charging scenario and will differ by different sub-measure.

Businesses will face costs in relation to the implementation of shore-side power, both in terms of investment, operation and administrative costs associated with implementation. Cruise lines are also expected to experience changes in fuel costs, benefiting from cheaper fuel as they switch from diesel to mains electricity.

Furthermore, the SDC will deliver, greater co-ordination of deliveries and reduction in need for on-site storage for those using its services.

### Impacts on port businesses

Southampton is intrinsically distinct from other cities due to the location of the Port, which possesses a strong influence on the local economy, tourism and transportation more broadly. Therefore, it is important to consider the specific impact on businesses operating at or through the Port, alongside the more general impacts on businesses. Ricardo Energy & Environment conducted a complementary

socio-economic assessment of six port operators<sup>31</sup>, from the key trades of Southampton: cruise; automotive; containers and bulks, to investigate the potential economic impact of a CAZ charging zone on the port and its operators. This section summarises the results.

Largely, the CAZ presents a negative risk to the port and its operators, and the adverse effects of the CAZ could either be in the form of direct or indirect impacts. For each business interviewed, the CAZ would impact at least one activity within their operations, and it is clear that the risks for some businesses, particularly smaller operators, are not inconsequential.

The key risk is that economic activity will shift away from the Port. For many businesses, there are alternative ports that could be considered. Any additional costs associated with operating through the Port of Southampton will inherently lead alternatives to become more attractive. Business will naturally reconsider their operations, with the possible outcome that some may relocate away from Southampton leading to a loss of employment (direct and indirect) in the City: 5 out of 6 interviewees indicated that alternative locations would be assessed if HGV charging was implemented.

In addition, a significant number (1,221 out of 9,309) of public consultation respondents expressed concern over the negative economic impact on businesses. In particular, 589 respondents displayed concerns that businesses and trade might move away from the area, with 463 respondents specifically mentioning a potential negative economic impact on the Port.

At this stage it is not possible to say with certainty whether operations and economic activity will shift away from Southampton. If this were to happen then there will be consequent negative impacts on employment and economic activity on the port and its related businesses. Although the effects of the CAZ may only last a few years (given turnover of the vehicle fleet), once business is lost it may be difficult to attract it back. Ultimately, the response of port businesses and their downstream customers to the CAZ, and whether to shift away from Southampton, will result from comparing the costs of the different options available to each business and the benefits of staying at Southampton.

To illustrate the potential size of cost burden on the port and its operators, the Ricardo port study estimated potential costs of a city-wide Class B Clean Air Zone on vehicle operators. The direct costs of compliance across the six operators interviewed as part of the Ricardo port study (including a selection of their key partners, assuming all non-compliant vehicles pay the £100/day charge and based on vehicle movement information provided through the interviews) range from £17m to £22m in the first year of CAZ implementation<sup>32</sup>. High-level estimates of the costs of CAZ compliance for all port operators, which use an alternative approach and data sources (again assuming all non-compliant vehicles were to pay the charge), are around £10m in the first year of CAZ implementation. Both estimates assume all vehicles will pay the charge, so are likely to overstate the costs. Drawing on assumptions regarding the likely behavioural responses of operators<sup>33</sup>, the costs to haulage operators in the first year of CAZ operation were estimated to be substantially lower, at around £1.5m. This illustrates that costs could be lower for some operators, in cases where the CAZ simply encourages them to bring forward planned upgrades, advancing efficiency savings through the use of newer vehicles. Although it is clear the risks are not insignificant, it is difficult to gauge the level of risk associated with these possible costs.

Although it is clear the risks are not small, it is difficult to gauge the level of risk associated with these possible costs. To illustrate, the costs have been placed in the context of the wider cash-flows and costs for the six businesses that were interviewed. In the context of wider cash-flows and costs associated with port activities, the upper end of the cost estimate (£22m) represents around 0.9% of profit generated by the port and its businesses. For containerised cargo, where freight is shipped by a non-compliant vehicle, the CAZ charge could represent a significant increase (up to 33%) of a container's port-to-end transport costs in the UK. For the cruise sector, the cost increment per passenger would be unlikely to affect the number of passengers, regardless of whether the passengers arrive by coach or taxi. For ferries to the Isle of Wight, the additional costs for tourists travelling by coach would be small

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<sup>31</sup> There are some limitations to be noted with these findings, due to the limited sample size and potential selection bias. It also does not include the potential benefits of the CAZ. Furthermore, the scope of the study did not include estimating impacts on employment or loss of business as a consequence of a CAZ.

<sup>32</sup> This only represents the cost to the sample of interviewees and not to the port as a whole.

<sup>33</sup> Sourced by Defra/DfT Joint Air Quality Unit (JAQU), that overseas CAZ appraisals across the UK.

compared to their overall trip costs. HGV operators would be expected to pass on their costs spread across multiple deliveries.

### 3.2.3 Summary and need for complementary measures

Businesses could be affected by a CAZ through many different pathways. The type and magnitude of impacts will differ depending on the CAZ option implemented, although it is likely that HGV operators will face the greatest impacts under both options.

The various opportunities and risks for transport services and businesses associated with the CAZ options are summarised in Table 24. Many of the impacts associated with behavioural response and resultant market conditions are very uncertain in scope and scale.

**Table 24: Summary of business affordability distributional impacts**

Scenario	Summary assessment
<b>City-wide Class B Clean Air Zone</b>	<p>***</p> <ul style="list-style-type: none"> <li>Mandatory charges will affect all non-compliant vehicles operating in the CAZ. It places a direct cost on businesses using vehicles included in the charging scope, and indirect impacts for connected businesses</li> <li>The direct impacts will fall on HGV, bus and coach operators (although SCC have been successful in securing CBTF funding for local buses) and taxi drivers.</li> <li>Smaller coach and HGV operators are likely to face greater costs, due to operation of older vehicles, smaller cash reserves and lack of capacity to redistribute fleets. It is expected that larger operators of HGVs will be able to redistribute fleets or are in a better position to upgrade vehicles, whereas smaller operators will face difficulty.</li> <li>Bus operators face concerns over retrofitting and the potential of higher operating costs and cancellation of services due to taking buses out of operation. In addition, those entering the city to use the service depot will be affected</li> <li>CAZ presents a negative risk to the port and its operators. The key risk is that economic activity will shift away from the Port. For many businesses, there are alternative ports that could be considered, and any additional costs associated with operating through the Port of Southampton will inherently lead alternatives to become more attractive</li> </ul>
<b>Non-charging Class B Clean Air Zone</b>	<p>x</p> <ul style="list-style-type: none"> <li>Direct impacts on taxis, buses, HGVs and wider businesses, but all smaller than CAZ B</li> <li>Bus operators still face concerns over retrofitting and the potential of higher operating costs and cancellation of services due to taking buses out of operation.</li> <li>A non-charging CAZ will still impact some HGV operators who are charged through the port booking system, but these will be much smaller in number than under CAZ B.                     <ul style="list-style-type: none"> <li>Some measures (e.g. fleet consolidation centre) can bring significant savings and benefits to HGV operators and linked businesses.</li> </ul> </li> <li>Although taxis will also be required to upgrade their licences by 2023 (as is the case for the CAZ), this burden is placed later, and total burden may be lower due to natural upgrades between 2020-23.</li> <li>No impact on coach firms that are not impacted by a NCH measure</li> <li>Some impact on port, instead through need to invest in shore-side power</li> </ul>

Notes: '-' means no significant or neutral effect, 'x' denotes a small negative effect, '\*\*\*' denotes large negative distributional effect

The response of businesses to the CAZ, and the risk to whether they can 'afford' the costs could have subsequent impacts on employment and economic activity in the local area. Analysis suggests that some affected operators would have some ability to pass through or internalise costs, namely national coach operators, as they could spread costs across wider business activities. However, several operators could struggle to afford additional costs, including HGV operators, more local coach services and taxi drivers. These effects will be greater under the CAZ B relative to NCH CAZ option (Scaling with the size of the direct impacts).

Although the key impacts of a charging zone are anticipated to be negative, there will be some mitigating influences. The key impact of the CAZ is to bring vehicle upgrades forward. As such, the baseline is anticipated to 'catch-up' with the CAZ at some point, increasing the potential for more firms can internalise costs. For larger firms, it is worth emphasising that risks are lessened by the ability to redistribute fleets between different geographical areas. In the longer-term, balancing forces in the economy will limit the knock-on effects and potentially mitigate some of the short-term impacts. Therefore, there will be shorter and longer-term impacts, and the latter will depend on how Southampton's economy adjusts to the structural changes.

### 3.2.3.1 Identification of complementary measures

In addition to the core CAZ options, SCC is also considering opportunities for additional measures to help businesses to adjust and cope with the change and therefore also helping protect local jobs and economic activity.

The air quality and cost-benefit analysis has identified NCH CAZ as the potential preferred CAZ option. This section sets out the proposed complementary measures which will seek to mitigate the risks posed by NCH CAZ to businesses.

#### Buses and coaches

Southampton is continuing to offer its MyJourney measure to respond to the concerns bus operators have raised regarding retrofitting.

**Table 25: Summary of complementary measures for buses**

Steps	Summary/Risk	Response
<b>MyJourney</b>	<ul style="list-style-type: none"> <li>Southampton has successfully secured £2,677,835 funding from the CBTF which will bring nearly all buses up to Euro 6 compliance. However, some bus companies have expressed concerns around the retrofit process.</li> <li>Concerns are: need to take buses out of operation; increased likelihood of breaking down following retrofit and potentially higher operating costs.</li> </ul>	<ul style="list-style-type: none"> <li>Additional funding will be directed towards bus campaigns, aiming to encourage the use of public transport and shift users away from private vehicles, supporting air quality improvements.</li> <li>This measure will complement the retrofit subsidy support buses receive, through encouraging the public to use public transport (and hence the revenue of bus companies) and counteracting the time buses spend out of service whilst retrofitting takes place (and any additional cost impacts).</li> <li>73% of respondents from the public consultation agreed or strongly agreed that engagement with schools and local businesses to promote active and sustainable travel through the My Journey brand would improve air quality in Southampton, suggesting that the measure will effectively tackle the issue of retrofitting by encouraging more people to use public transport.</li> </ul>

#### Taxis

Southampton is considering the following options to encourage the uptake of CAZ-compliant vehicles (Euro 6 diesel/Euro 4 petrol) within Southampton's CAZ.

**Table 26: Summary of complementary measures for taxis**

Steps	Summary/Risk	Response
<b>Expanded low emission incentive scheme</b>	<ul style="list-style-type: none"> <li>To incentivise taxi drivers to upgrade to LEVs and ULEVs, an extension of the current scheme was deemed necessary.</li> </ul>	<ul style="list-style-type: none"> <li>Expanded to also include offering euro 6 diesel for Wheelchair Accessible Vehicles (WAVs), and continued support to full SCC licenced taxi fleet.</li> <li>Possesses the same delivery model as the existing low emission scheme. Offering funding</li> </ul>

Steps	Summary/Risk	Response
	<ul style="list-style-type: none"> <li>• Taxis are uniquely affected due to their ownership structure: unlike other modes, taxis tend to be owned and operated by single drivers, rather than by larger businesses. This has two impacts:                             <ul style="list-style-type: none"> <li>○ lower capacity to spread any cost burden across multiple operations or revenue streams</li> <li>○ The impacts will affect household income.</li> </ul> </li> <li>• Taxi drivers are amongst the lowest earners and poorest households in society: 40% of the taxi operators are registered in the most deprived LSOAs (quintile 1) and 79% in the three lowest quintiles. Thus, it also suggests they are less likely to have the cash available to purchase a new vehicle in a short space of time.</li> <li>• Affordability concerns are also reflected in the Taxi Operators Survey conducted by the SCC, where 78% of the respondents stated that the cost of purchasing a low-emission vehicle is the key barrier.</li> <li>• Drivers who have recently purchased vehicles may be tied into loan repayments beyond 2020.</li> </ul>	<p>reduces affordability risk for some of lowest earning households in society.</p> <ul style="list-style-type: none"> <li>• Based on estimates for vehicles that remain non-compliant in 2023 after existing low emission scheme funding and natural fleet turnover is accounted for, approximately £250k is required.</li> <li>• Support is of particular importance for taxi drivers, as individuals rather than larger businesses.</li> <li>• The public consultation highlighted ‘make it more affordable’ as a potential incentive to support drivers to purchase low-emission vehicles. Therefore, there is potential for the expansion of the scheme to deliver impact.</li> </ul>
<b>Try-before-you-buy ULEV scheme</b>	<ul style="list-style-type: none"> <li>• To address taxi driver concerns over purchasing ULEVs, which could be linked to insufficient range or several other concerns, this scheme aims to tackle driver perceptions of EVs and encourage greater uptake by taxi drivers.</li> </ul>	<ul style="list-style-type: none"> <li>• This scheme will provide funding for consultants to offer electric vehicle trials to taxi drivers, to encourage uptake of ULEVs, in anticipation of licensing changes.</li> <li>• Approximately £24k will be on offer over 2 years, to encourage taxi drivers to take advantage of the scheme prior to policy implementation and hasten the shift towards a low-carbon taxi fleet.</li> </ul>
<b>Funding for 2 rapid chargers</b>	<ul style="list-style-type: none"> <li>• The necessary charging infrastructure is essential to support the uptake of low-emission vehicles. Therefore, this scheme aims to encourage taxi drivers to purchase EVs by addressing the issue of a lack of supporting infrastructure.</li> </ul>	<ul style="list-style-type: none"> <li>• To support the uptake of ULEVs in the taxi fleet, a measure will be introduced for funding 2 rapid chargers, costing approximately £100k.</li> <li>• This will ensure that the infrastructure is in place to support the uptake of EVs, with the aim to lessen the barriers to low-carbon vehicle purchase.</li> </ul>



## 3.3 Affordability for households

### 3.3.1 Impacts of the policy options

The two policy options proposed for Southampton are unlikely to affect households directly, as cars do not fall within the scope of the city-wide CAZ B or the non-charging measures.

However, both options could have an indirect impact where additional costs placed on businesses will feed through to households, potentially impacting employment opportunities and through effects on travel options, through higher prices or through reduced services. The potential indirect impacts on households are summarised in Table 27.

**Table 27: Relevant policy options for households and their indirect impacts**

Impact Categories	City-wide CAZ B	Non-charging CAZ
<b>Relevant measures</b>	Charges for non-compliant vehicles Funding for bus retrofit	License changes which plans for all taxis to be CAZ-compliant by 2023 Funding for bus retrofit Sustainable distribution centre Port booking charge and shore-side power
<b>Commuting/travel</b>	Individuals who regularly use taxis and buses may need to find alternative modes should taxi services become more limited or interrupted, and/or face higher costs where taxi fares increase (↓↓ - 1)	Individuals who regularly use taxis and buses may need to find alternative modes should taxi services become more limited or interrupted, and/or face higher costs where taxi fares increase (↓ - 2)
<b>Employment</b>	Reduction in low-wage employment if vehicle operators reduce workforce to compensate for costs (↓↓ - 1)	Reduction in low-wage employment if vehicle operators / port reduce workforce to compensate for costs (↓ - 1)
<b>Cost of goods and services</b>	Taxi / private hire services may increase cost (↓ - 3) Consumer goods may increase in price if businesses pass through upgrade, charge or other CAZ costs (↓↓ - 1) Reduction in resale values of non-compliant vehicles (↓ - 3)	Taxi / private hire services may increase cost. (↓ - 3) Consumer goods may fall in price if HGV businesses pass through reduction in operating costs (↑ - 1) Reduction in resale values of taxi / private hire vehicles (↓ - 3)

**Impact** - ↑ = minor positive impact, ↑↑ = positive impact, ↓ = minor negative impact, ↓↓ = negative impact  
↑/↓ = mixed impact.

**Confidence** - 1-5 = low confidence – certainty.

It is difficult to anticipate the likelihood and magnitude of the impacts on households at this stage. The impacts will depend on:

- The type and magnitude of the costs which fall on businesses. This will in turn depend on the wider support and finance available to businesses and the capacity to which businesses access this support.
- The responses of businesses to any additional costs. This will include the extent and method of cost internalisation, as well as the extent to which costs are passed through to consumers.

The capacity of businesses to pass through costs to consumers is explored as part of the assessment of business affordability in Section 3.2.1.2.

For taxis in particular, the summary assessment implies that vehicle operators have some opportunity to pass costs through to consumers. For example, in cases where the cost increases are faced by infrequent travellers or travellers that do not bear the costs of travel directly (e.g. business trips), there

is substantial potential to pass through costs. On average, individuals only take 11 taxi trips per annum<sup>34</sup> and the majority of people rarely use a taxi (86% use taxis less than once a month), suggesting a large proportion of customers make very few trips. In addition, the bus network offers an alternative mode of travel and some shorter distances could be travelled by bicycle.

However, costs will accumulate for the 8% of individuals who travel by taxi on a regular basis (once a week).<sup>35</sup> To the extent that businesses do pass on any additional costs to consumers, there may be a disproportionate impact on poorer households. Taxis are often relied upon by people with disabilities, who are unable to drive and are likely to face a disproportionate share of any costs passed through. Taxi or private hire vehicle usage comprises 3% of all trips made by people with mobility difficulties, relative to just 1% of people without these difficulties<sup>36</sup>. This also highlights that alternatives (such as bus or active travel modes) are less likely to be an alternative, further compounding the issue of increases in costs of travel (however, given the low percentage of overall trips, this suggests there are alternatives available to those with mobility difficulties).

Within the CAZ region, there are five hospitals, as well as educational services and other health-related amenities. Households are likely to use these amenities and may travel from within or outside the CAZ to access them. Individuals who travel to hospital via taxi could be adversely affected if taxi companies increase the price of journeys. However, most people use hospitals infrequently, so the overall impact is expected to be minimal. The exception are individuals with chronic illnesses, elderly people, expectant mothers and individuals with disabilities, where it may be necessary to travel to the hospital more regularly.

As a cheaper mode of transport, buses are used more often by poorer households<sup>37</sup>, the young (0-16) and the elderly (60+)<sup>38</sup>. Therefore, it is likely that these more vulnerable persons will shoulder a greater proportion of any knock-on effects of service provision.

An impact assessment for the London ULEZ<sup>39</sup> found that coaches are typically used for scheduled long-distance and commuter services, as well as for sightseeing, tourist and leisure trips. In addition, coaches are often used for frequent travel by more vulnerable groups: e.g. school coaches for state schools. Indeed, the public consultation around the Leeds CAZ proposals suggested many state schools with smallest budgets would not be able to afford costs of compliance with CAZ - these schools are also likely to serve the most deprived areas, and in many cases school trips offer the only opportunity for children from vulnerable households to access educational amenities. Some vehicles, and particularly minibuses, are owned and operated by community organisations that mainly provide voluntary and charitable services. These organisations tend to have small fleets comprised of older vehicles, and they may have a lack of transport alternatives. Such organisations are likely to have a more difficult time adapting to the implementation of a charging zone, due to cash and fund-raising constraints. CAZ costs could comprise a high proportion of coach trip fares, which will be particularly detrimental for individuals, such as students, travelling frequently by coach. However, this will depend on the capacity of coach operators to pass costs onto customers, as well as the costs incurred by operators for vehicle upgrades.

### 3.3.2 Impact of city-wide CAZ B

The indirect impacts are expected to be largest under the city-wide CAZ B.

Under this option, taxis will face the CAZ charge from 2020. Although taxis will still face licence changes which plan for all taxis to be CAZ-compliant by 2023 as under the non-charging option, the introduction of the charging zone will place a burden on taxi operators earlier, and potentially bring forward costs.

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<sup>34</sup> [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/642759/taxi-private-hire-vehicles-2017.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/642759/taxi-private-hire-vehicles-2017.pdf)

<sup>35</sup> *ibid*

<sup>36</sup> [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/642759/taxi-private-hire-vehicles-2017.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/642759/taxi-private-hire-vehicles-2017.pdf)

<sup>37</sup> <https://www.ucl.ac.uk/transport-institute/pdfs/transport-poverty>

<sup>38</sup> [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/666759/annual-bus-statistics-year-ending-march-2017.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/666759/annual-bus-statistics-year-ending-march-2017.pdf)

<sup>39</sup> Office of the Transport Commissioner, "Traffic Commissioners' Annual Reports", 2016-2017, <https://www.gov.uk/government/collections/traffic-commissioners-annual-reports>, accessed 23/04/2018.

As under NCH CAZ, SCC is considering the provision of incentives for taxi companies to upgrade their vehicles, but the extent to which this reduces the burden on taxi operators will depend on the timing and extent of support provided. Therefore, the CAZ charge, alongside the need to upgrade vehicles, is likely to have possible knock-on effects on households.

As buses and coaches are also affected by the CAZ, it is likely that public transport users will see a rise in travel costs or possible interruption to services.

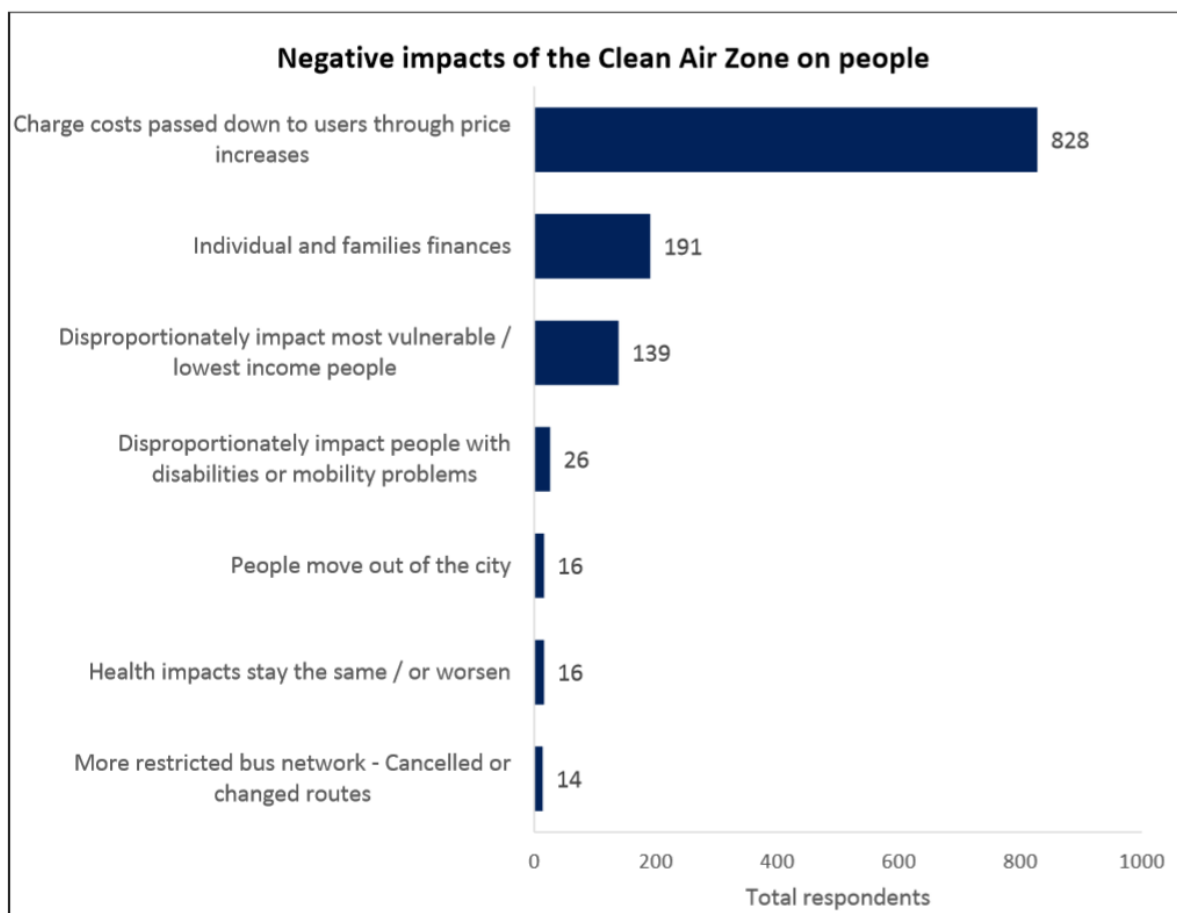
For buses, given the provision of funding for retrofit, the concern is less that bus companies will face a high cost burden (although there is concern there will be some increase in operating costs), the risk is more that buses will be taken out of service for retrofit and may be more susceptible to breaking down, which would impact more so on service provision than cost.

Under the city-wide CAZ B, the impacts will be more significant for HGVs, as a greater number of vehicles are affected, and the operators do not benefit from the non-charging measures, which aim to reduce operating costs. Therefore, it is expected the potential impact of HGV operators passing on CAZ charges to customers through increasing the consumer goods prices will be greater under this option. It is also expected that any reduction in low-wage employment (as HGV operators seek areas to cut costs to compensate for increasing operating costs) will also be greater under this option.

The expected impacts are mirrored by the public consultation responses. Regarding the expected effects, 59% of respondents believe a CAZ will have a negative impact on individuals and families, relative to 24% and 13% suggesting no or positive impact respectively.

Figure 11 displays the negative impacts on individuals which consultation respondents expressed through qualitative written feedback. Cost pass through is the primary concern for respondents, with 828 of respondents who answered the question noting price increases as an expected negative impact of the CAZ. The indirect impact on family finances and the regressive impact of the CAZ are also noted frequently by public consultation respondents.

**Figure 11 : Public consultation responses to the expected negative impacts on people**



### 3.3.3 Impact of non-charging CAZ

Under the non-charging measures scenario, taxis will also face the licence changes which plan for all taxis to be CAZ-compliant by 2023. Therefore, there is potential for taxi businesses to pass on the costs of upgrading vehicles to consumers through higher fares. In addition, there is potential for some taxi companies to leave the market, leaving consumers with less choice. Hence, the nature of the risks for taxi drivers are similar to the risks under the CAZ charging option. However, these risks fall later, as taxi drivers are only required to be Euro 6 by 2023 under the NCH CAZ, but face CAZ charges from 2020 under CAZ B. Furthermore, the overall burden may be lower under NCH CAZ as natural turnover from 2020 to 2023 reduces the number of vehicles that upgrade (and hence reduce costs) in response to the policy measure.

As the non-charging measures are largely focused on incentivising HGV drivers, the impact on households is likely to be minimal. However, there is potential for HGV businesses to pass on reduced operating and fuel costs to consumers (achieved through savings associated with the SDC), through reducing the price of consumer goods in order to increase their competitiveness. However, given the ambition included in the modelled scenario targets, funnelling NHS trips through the SDC, the potential for any cost pass through to benefit Southampton residents is minimal.

Given proposals under NCH CAZ are the same as CAZ B relating to buses, the impacts will be the same, with concern that buses will be taken out of service for retrofit and may be more susceptible to breaking down, which would impact more so on service provision than cost.

NCH CAZ proposes no measures affecting coaches, hence there will be no impact on coaches or their users under this measure.

### 3.3.4 Summary assessment

Households could be affected by the policy options through several pathways; however, the impacts are largely dependent upon the impacts on businesses and their subsequent responses to the effects of the CAZ or non-charging measures.

The impacts are likely to fall most significantly upon lower-income households or more vulnerable population groups, who are more reliant on public transportation and taxi services. Although most of impacts are negative, it is important to consider the health benefit to local households following policy implementation as well as the new business and employment opportunities a shift towards low-carbon vehicle infrastructure could bring to the city.

Several the complementary measures, previously outlined in Section 3.2.3.1, will also benefit households indirectly, through providing the funding and support for businesses to invest in less emission vehicles. Table 28 summarises the household affordability distributional impacts, displaying the proportionally larger impact on households from the CAZ, in relation to the non-charging measures.

**Table 28: Summary of household affordability distributional impacts**

Scenario	Summary assessment
<b>City-wide CAZ B</b>	<p><b>**</b></p> <ul style="list-style-type: none"> <li>• There are no direct impacts on households, given cars are not included in the scope.</li> <li>• There will be indirect impacts on households through costs on bus, coach and taxi operators being passed through.</li> <li>• Buses are used proportionately more by lower income households, the young and the old. Taxis are used proportionately more by persons with mobility issues. Hence any costs passed through are likely to have a regressive impact (impacts could in part be mitigated where support is provided to bus and taxi operators to comply).</li> <li>• Bus impacts same as NCH CAZ but impacts on taxi operators will come sooner through a city-wide CAZ B, as non-compliant vehicles will face the charge from 2020. It is also possible that the costs will be greater.</li> <li>• A city-wide CAZ B will affect HGVs more significantly, with potential knock on effects on employment and the prices of consumer goods.</li> </ul>
<b>Non-charging measures</b>	<p><b>*</b></p> <ul style="list-style-type: none"> <li>• There are no direct impacts on households, given cars are not included in the scope.</li> <li>• Buses are used proportionately more by lower income households, the young and the old. Taxis are used proportionately more by persons with mobility issues. Hence any costs passed through are likely to have a regressive impact (impacts could in part be mitigated where support is provided to bus and taxi operators to comply).</li> <li>• There will be indirect impacts on households through costs on bus and taxi operators being passed through. However, coach users will not be affected. And impacts through taxis will be smaller and occur later</li> <li>• Consumers may benefit from a reduction in the price of goods, if HGV businesses pass through reduction in operating costs through the DSP.</li> </ul>

Notes: '-' means no significant or neutral effect, '\*' denotes a small negative effect, '\*\*' denotes large negative distributional effect

## 4 Summary and conclusions

### 4.1 Air quality

Distributional analysis of air quality impacts was performed relative to two characteristics: IMD and number of children. Alongside the Webtag quintile analysis, we also analyse several other metrics to try and discern whether the options will have a distributional impact.

The city-wide Class B CAZ delivers the largest reductions in NO<sub>2</sub> concentrations, and reductions across all areas. However, the impacts associated with NCH CAZ are generally smaller, and some LSOAs show increasing concentrations.

CAZ B delivers an air quality improvement in all LSOAs in the modelling domain. Hence, for both IMD and children grouping variables in the Webtag analysis, all quintiles on average see an improvement in air quality in terms of NO<sub>2</sub> concentrations. Hence all areas experience equal benefit relative to their population.

Under NCH CAZ, eleven LSOAs experience a worsening of air pollution and the general magnitude of improvements is small relative to CAZ B. Hence the NCH CAZ displays a more varied impact. Relative to IMD, the most deprived quintile benefiting most but the least deprived also benefit disproportionately to their population distribution. Regarding the impact on children, areas with higher proportions of children (quintiles 3-5) experience greater benefits relative to the proportion of their population for the NCH.

It is important to note that although this analysis displays whether quintiles have a higher proportion of people benefiting/losing, it gives no indication of the magnitude of the effect they are experiencing.

Reviewing the other metrics assessed, the highest average concentration reductions are felt by areas with a lower proportion of children under the city-wide Class B CAZ.

Concentrations under NCH display a more mixed pattern, as quintile 1 benefits from the highest reduction, but air quality worsens in quintiles 2 and 3. That said, looking at a basic count of LSOAs, slightly more LSOAs experience an increase in concentrations in quintiles with fewer children under NCH CAZ.

In reference to sensitive receptors, CAZ B delivers more for vulnerable groups due to greater overall improvements in air quality. In contrast, the NCH CAZ delivers a more mixed scenario, with some receptors experiencing a minor worsening of air quality.

In summary, CAZ B delivers greater overall improvements in air quality. However, across the metrics the results are mixed and do not suggest a very clear pattern of distributional impact. Even where a clear pattern could be observed (e.g. average concentration changes under CAZ B are higher for households with fewer children), it is unlikely that such results are significant. In other words, both policy options are neither particularly progressive nor regressive in distributional terms.

### 4.2 Impacts on businesses

Businesses could be affected by a CAZ through many different pathways. It is likely that all businesses located in and around the CAZ will be affected to some extent. That extent will be determined by many parameters, including both the location of the business but also the type of business (which in turn determines the likelihood of it operating vehicles, its reliance on deliveries, and potential impact on its supply chain).

The impact is likely to be greatest on those who own and operate non-compliant vehicles – i.e. the direct effects – who will have to act to become compliant or pay the charge. All actions businesses can take to respond to the CAZ will place costs on the affected businesses, hence the over-arching impacts of a charging scheme are likely to be negative (although the impacts for some businesses will be positive and it is worth noting that issues posed by the CAZ to achieve compliance may not simply be financial).

Under a CAZ B, there will be direct impacts on:

1. HGV operators - which encompass a wide range of business types and sizes, serving a wider range of end-customers.

2. Coach operators - There is limited data available on coaches operating in and around Southampton, but operators range from those serving regular local routes (e.g. school buses), large national firms serving regular but less frequent inter-city routes (e.g. National Express) or one-off coaches serving visitor attractions or events.
3. Taxi drivers – who are unlike other businesses in their ownership structure, as they tend to be owned/operated by single drivers.

Other businesses may be significantly affected by the CAZ, even where they do not directly operate non-compliant vehicles. These could come from a wide range of sectors but are most commonly affected indirectly through the impacts on of HGVs. In addition, there will also be impacts on SCC who own and operate their own refuse fleet, of which several vehicles are anticipated to be non-compliant in 2020.

Smaller operators (who tend to be greater in number, but operate fewer vehicles) are likely to face greater costs given they tend to:

- operate older fleets
- undertake a greater proportion of trips in CAZ
- upgrade vehicles less often.
- do not have large fleets which can be redistributed, reducing the response options available to them
- are likely to have smaller cash reserves to fund upgrades
- have smaller operations over which costs can be spread
- may also find it more difficult to access capital, or may face higher borrowing charges
- serve repeat rather than one-off customers (e.g. coaches).

Further, any knock-on effects from smaller firms are likely to be greater given they tend to be more locally based: they have small fleets operating in a defined geographic area.

In the case of Southampton, it is also important to note that there will be knock-on effects for businesses on the Isle of White which depend on freight services through the port.

Southampton is intrinsically distinct from other cities due to the location of the Port, which possesses a strong influence on the local economy, tourism and transportation more broadly. Ricardo Energy & Environment conducted a complementary socio-economic assessment of the potential impacts of a charging CAZ on the port and its operators. This concluded that a charging CAZ presents a negative risk and the adverse effects of the CAZ could either be in the form of direct or indirect impacts. The key risk is that economic activity will shift away from the Port. For many businesses, there are alternative ports that could be considered. Any additional costs associated with operating through the Port of Southampton will inherently lead alternatives to become more attractive. At this stage it is not possible to say with certainty whether operations and economic activity will shift away from Southampton. If this were to happen then there will be consequent negative impacts on employment and economic activity on the port and its related businesses. Although the effects of the CAZ may only last a few years (given turnover of the vehicle fleet), once business is lost it may be difficult to attract it back. Ultimately, the response of port businesses and their downstream customers to the CAZ, and whether to shift away from Southampton, will result from comparing the costs of the different options available to each business and the benefits of staying at Southampton.

Where the CAZ places a cost on businesses, there is an inherent risk as to whether the business can 'afford' these costs. If a firm cannot pass through costs or internalise them, a business may:

- Cancel trip / activity (but carry on other unaffected operations) – with potential subsequent impacts on economic activity in Southampton (and potentially jobs)
- Go out of business altogether – impacting on jobs and activity in Southampton
- Shift locations outside CAZ – potentially impact on jobs and 'local' economic activity, if shift is far enough.

The response of businesses to the CAZ, and the risk to whether they can 'afford' the costs could have subsequent impacts on employment and economic activity in the local area. Analysis suggests that some affected operators would have some ability to pass through or internalise costs, namely national coach operators, as they could spread costs across wider business activities. However, several operators could struggle to afford additional costs, including HGV operators, more local coach services

and taxi drivers. These effects will be greater under the CAZ B relative to NCH CAZ option (Scaling with the size of the direct impacts).

Although the key impacts of a charging zone are anticipated to be negative, there will be some mitigating influences. The key impact of the CAZ is to bring vehicle upgrades forward. As such, the baseline is anticipated to 'catch-up' with the CAZ at some point, increasing the potential for more firms to internalise costs. For larger firms, it is worth emphasising that risks are lessened by the ability to redistribute fleets between different geographical areas. In the longer-term, balancing forces in the economy will limit the knock-on effects and potentially mitigate some of the short-term impacts. Therefore, there will be shorter and longer-term impacts, and the latter will depend on how Southampton's economy adjusts to the structural changes.

In summary, all options are likely to have an impact on businesses:

- Under CAZ B the adverse impacts are expected to be largest as the scheme will affect a much broader range of vehicles, vehicle types and hence businesses.
- NCH CAZ will still levy costs – e.g. on port to install and operate shore-side power, on HGV operators affected by a port booking scheme, and on taxi drivers. That said, several non-charging measures could bring significant cost-savings to businesses if implemented successfully – e.g. driver and opex savings through DSPs, and fuel savings from shore-side power.
- Under both options, bus operators face concerns over retrofitting and the potential of higher operating costs and cancellation of services due to taking buses out of operation.

### 4.3 Impacts on households

Households could be affected by the policy options through several pathways; however, the impacts are largely dependent upon the impacts on businesses and their subsequent responses to the effects of the CAZ or non-charging measures. Under either option, there are no direct impacts on households, given cars are not included in the scope.

Any indirect impacts are likely to fall most significantly upon lower-income households or more vulnerable population groups, who are more reliant on public transportation and taxi services. Although the majority of impacts are potentially negative, it is important to consider the health benefit to local households following policy implementation as well as the new business and employment opportunities a shift towards low-carbon vehicle infrastructure could bring to the city.

In terms of the options, CAZ B will have a greater impact on households' affordability risk than the NCH CAZ, given:

- There will be indirect impacts on households through costs on coach operators being passed through.
- Taxis are used proportionately more by persons with mobility issues. Hence any costs passed through are likely to have a regressive impact (impacts could in part be mitigated where support is provided to bus and taxi operators to comply). Both options will affect taxi operators but impacts on taxi operators will come sooner through a city-wide CAZ B, as non-compliant vehicles will face the charge from 2020. It is also possible that the costs will be greater.
- A city-wide CAZ B will affect HGVs more significantly, with potential knock on effects on employment and the prices of consumer goods.

Under both options, there may be impacts through retrofit of buses – bus companies are concerned around reliability issues and interruptions to services due to the retrofit. Buses are used proportionately more by lower income households, the young and the old.

### 4.4 Summary distributional assessment table

In summary:

- Neither option will have a significant distributional pattern to its impacts on air quality
- CAZ B will have a much greater impact on business affordability



- It places a direct cost on HGV, bus and coach operators (although SCC have been successful in securing CBTF funding for local buses) and taxi drivers, and indirect impacts for connected businesses
- Smaller coach and HGV operators are likely to face greater risk under CAZ B
- In addition, CAZ B presents a negative risk to the port and its operators. The key risk is that economic activity will shift away from the Port. For many businesses, there are alternative ports that could be considered, and any additional costs associated with operating through the Port of Southampton will inherently lead alternatives to become more attractive
- Under both options bus operators face concerns over retrofitting and the potential of higher operating costs and cancellation of services due to taking buses out of operation. In addition, under CAZ B those entering the city to use the service depot will be affected
- Neither option will have any direct impacts on households, given cars are not included in the scope of the options. That said, CAZ B will place a greater indirect burden on household affordability. In particular, impacts on taxis drivers are likely to be greater (who are amongst lowest earning households in society) and CAZ B will also capture coaches, which may be used by vulnerable groups. Also, there is potential for a greater knock-on impact to employment in Southampton as more HGVs (and hence HGV operators and linked businesses) are affected by a city-wide charging scheme

**Table 29 – Summary distributional assessment**

Scenario	Air quality	Business Affordability	Household affordability
<b>City-wide CAZ B</b>	-	***	**
<b>Non-charging measures</b>	-	x	x

Notes: ‘-’ means no significant or neutral effect, ‘x’ denotes a small negative effect, ‘\*\*\*’ denotes large negative distributional effect

# Appendices

Appendix 1      Summary assessment of initial shortlist

# Appendix 1 – Summary assessment of initial shortlist

## Methodology notes

The CBA of the initial shortlist and supporting evidence ranked Option 1a as the most preferred option, followed by Option 1. As such these options have been taken forward for more detailed distributional analysis. A third option (option 3) has been included to allow the comparison of impacts between charging and fully non-charging CAZ options. However, given availability of underlying data inputs into the distributional analysis, Option 3 can only be assessed in a lighter-touch, qualitative way for a selection of impacts.

The distributional analysis will only include limited analysis of accessibility impacts. After considering the detailed description of these impacts in the JAQU and supporting Webtag guidance, it is our perception that:

- The key impact of CAZ options will be financial, rather than placing physical barriers to travel. Hence the majority of the impacts will be explored as part of affordability analysis
- There are no proposed changes to public transport provision (other than to upgrade vehicles), hence there will be no impacts along the lines of those described in Webtag
- Given the predominant response to CAZ is to upgrade or pay charge, and there is low ‘cancel journey’, there is likely to low impact on general service provision through changes in demand
- The only additional accessibility impact (on top of those captured by affordability analysis) may be on travel time to particular amenities through congestion impacts.

## Air quality

All CAZ options assessed in this analysis (Option 1, Option 1a and Option 3) deliver a reduction in NO<sub>2</sub> concentrations. The results are very similar for Option 1 and Option 1a and therefore it is difficult to differentiate between the two options. The impacts associated with Option 3 are generally smaller.

Both Option 1 and 1a deliver an air quality improvement in almost all LSOAs in the modelling domain, only a small number (4) LSOAs do not experience a change in air quality. For Option 3 there are five LSOAs with no change in air quality. On the other hand, none of the options are associated with a worsening of air quality in any LSOA. Hence, for both IMD and children grouping variables, all quintiles on average see an improvement in air quality improved in terms of NO<sub>2</sub> concentrations with the implementation of a CAZ, regardless of the scenario. As such the WebTag quintile analysis suggests no variance in distributional impact between the CAZ options (in part as this analysis does not account for the size of impact felt by each quintile – if an LSOA sees any reduction in air pollution then all residents are counted as ‘winners’).

Looking more directly at the size of reductions, the average reduction in concentrations is fairly even across the IMD quintiles. Although the number of people benefitting from reductions in concentrations is highest for the least deprived quintile, this simply reflects the greater number of people falling into this quintile in Southampton (quintiles are defined relative to national income scale). Therefore, the results are mixed and do not suggest a very clear pattern of distributional impact. In other words, the policy is neither particularly progressive nor regressive in distributional terms.

Similarly, the results are also mixed for the quintile distribution for “Under 16”, the stronger decreases in NO<sub>2</sub> concentrations are observed for quintiles 1 and 2, namely the LSOAs with the lowest proportion of “Under 16” inhabitants in the population.

That said, areas with higher proportion of disabilities and non-white population experience a greater reduction in NO<sub>2</sub> concentrations and therefore for these categories the impact is progressive. Further, all scenarios achieve reasonable concentration reductions at all sensitive receptors.

## Impacts on businesses

Businesses could be affected by a CAZ through many different pathways. It is likely that all businesses located in and around the CAZ will be affected to some extent. That extent will be determined by many parameters, including both the location of the business but also the type of business (which in turn

determines the likelihood of it operating vehicles, its reliance on deliveries, and potential impact on its supply chain).

The impact is likely to be greatest on those who own and operate non-compliant vehicles – i.e. the direct effects – who will have to act to become compliant or pay the charge. All actions businesses can take to respond to the CAZ will place costs on the affected businesses, hence the over-arching impacts of a charging scheme are likely to be negative (although the impacts for some businesses will be positive and it is worth noting that issues posed by the CAZ to achieve compliance may not simply be financial).

Under a CAZ B, there will be direct impacts on:

1. HGV operators - encompass a wide range of business types and sizes, serving a wider range of end-customers.
2. Coach operators - There is limited data available on coaches operating in and around Southampton, but operators range from those serving regular local routes (e.g. school buses), large national firms serving regular but less frequent inter-city routes (e.g. National Express) or one-off coaches serving visitor attractions or events.
3. Taxi drivers – who are unlike other businesses in their ownership structure, as they tend to be owned/operated by single driver.

Southampton have been successful in securing CBTF funding minimising the impact on local buses.

Other businesses may be significantly affected by the CAZ, even where they do not directly operate non-compliant vehicles. These could come from a wide range of sectors but are most commonly affected indirectly through the impacts on of HGVs. In addition, there will also be impacts on SCC who own and operate their own refuse fleet, of which several vehicles are anticipated to be non-compliant in 2020.

Smaller operators (who tend to be greater in number, but operate fewer vehicles) are likely to face greater costs given they tend to:

- operate older fleets
- undertake a greater proportion of trips in CAZ
- upgrade vehicles less often.
- do not have large fleets which can be redistributed, reducing the response options available to them
- are likely to have smaller cash reserves to fund upgrades
- have smaller operations over which costs can be spread
- may also find it more difficult to access capital, or may face higher borrowing charges
- serve repeat rather than one-off customers (e.g. coaches).

Further, any knock-on effects from smaller firms are likely to be greater given they tend to be more locally based: they have small fleets operating in a defined geographic area.

In the case of Southampton, it is also important to note that there will be knock-on effects for businesses on the Isle of White which depend on freight services through the port.

Where the CAZ places a cost on businesses, there is an inherent risk as to whether the business can 'afford' these costs. If a firm cannot pass through costs or internalise them, a business may:

- Cancel trip / activity (but carry on other unaffected operations) – with potential subsequent impacts on economic activity in Southampton (and potentially jobs)
- Go out of business altogether – impacting on jobs and activity in Southampton
- Shift locations outside CAZ – potentially impact on jobs and 'local' economic activity, if shift is far enough.

All these responses could have subsequent impacts on employment and economic activity in the local area.

Analysis suggests that some affected operators would have some ability to pass through or internalise costs, namely national coach operators (could spread costs across wider business activities). However, several operators could struggle to afford additional costs: HGV operators exist in a highly competitive

market with very narrow margins, limiting the ability to pass through or internalise costs (in particular for smaller operators who are unable to spread costs across business activities). Smaller, more local coach services may struggle to pass on costs to a smaller cohort of frequent travellers and costs for taxi drivers will directly hit the take-home income of a cohort who tend to be lower on the income distribution. Affordability risk is therefore expected to be highest for smaller, local HGV and coach operators and taxi drivers.

Although the key impacts are anticipated to be negative, there will be some mitigating factors:

- the baseline is anticipated to 'catch-up' with the CAZ at some point, increasing the potential that more firms can internalise costs for a short period.
- larger firms can redistribute fleets between different geographical areas.
- longer-term balancing forces in the economy will limit the knock-on effects and potentially mitigate some of the short-term impacts.

Under Option 3, i.e. the non-charging measures also has an impact on affordability of businesses, many of which could be positive. If implemented successfully the sustainable distribution centre, 24-hour delivery, port booking system and fleet recognition schemes can in turn bring significant savings to the vehicle operators, again demonstrated in the economic model.

In summary, all options are likely to have an impact on businesses:

- Under Option 1 the adverse impacts are expected to be largest as the scope of the charging CAZ is largest.
- Under Option 1a the charging CAZ only affects the HGVs, and hence will still place a great burden on the operators of these vehicles. However, taxis and buses are expected to upgrade vehicles through incentives schemes which are less stringent compared to the CAZ.
- Option 3 will still levy costs on some HGV operators who upgrade to take advantage of the port booking system and 24-hour delivery (although fewer are anticipated to upgrade relative to the other options). That said, several non-charging measures could bring significant cost-savings to businesses if implemented successfully.

## Impacts on households

### Affordability

There are not expected to be any significant impacts on household affordability through the CAZ options proposed. This is because SCC is not considering CAZ D and because SCC has successfully secured CBTF funding to retrofit buses, limiting the potential for indirect impacts through costs passed through. The options may still have some indirect effects through costs passed through by taxi operators.

To the extent that taxis do pass on any additional costs to consumers, there may be a disproportionate impact on poorer households: Taxis are often relied upon by disabled persons who are unable to drive, and hence also could face a disproportionate share of any costs passed through.

These indirect impacts are expected under Option 1 where taxis would face the CAZ charge and potentially also impacting those households who use taxis (with the potential for impacts being greatest under option 1 with the larger CAZ area). Even though SCC is also considering providing incentives for taxi companies to upgrade, it is unlikely that the support would extend to the whole fleet. Therefore, some vehicles would face charges with possible knock-on effects to households. These adverse impacts are expected to be much smaller compared to the scenario without the incentives.

There will be no impact on taxis under Option 1a and 3, given taxis are not included in charging schemes and are incentivised to upgrade through non-charging incentives.

### Traffic impacts

The analysis of Option 1a suggests that there are some impacts on traffic associated with the CAZ, which will affect noise and accidents. These impacts are expected to be relatively small however.

The traffic modelling undertaken for Option 1a suggests that the number of links with significant changes in traffic measured as changes in the number of journeys are small in comparison to the total number of road links, only around one percent. Further motorways were not excluded in this analysis, for which

the impact on risk of noise and accidents would be smaller relative to an urban road link. In addition, the analysis could not confirm any discernible distributional impact; this is also due to the small sample size.

Option 1 is likely to have a slightly larger impact compared to option 1a, but the distribution of these impacts depends on the routes and behaviour of the coaches for which there is very little data. Regarding Option 3, the nature of the impacts is different and focus on HGVs and their key routes. Reduction in traffic and therefore accidents could be significant but on the other hand, there could be increase in noise associated with night-time deliveries.

### Accessibility

The traffic modelling undertaken for Option 1a suggests that changes in accessibility measured as changes in travel time are marginal. The vast majority of the LSOAs experience changes that are less than a second. Option 1 is expected to deliver slightly larger impacts because of coaches and also taxis (not covered by the taxi incentive scheme) will be affected and may choose to cancel/avoid the zone. But in general, the impacts are expected to be broadly similar to Option 1a.

Regarding Option 3 the nature of impacts are different because the Option focuses on non-charging measures. If the measures are implemented successfully the impacts of HGV could significantly reduce congestion on key HGV links. Therefore, a reduction in HGVs traffic is expected to deliver largest accessibility benefits to those households that use these links the most.



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