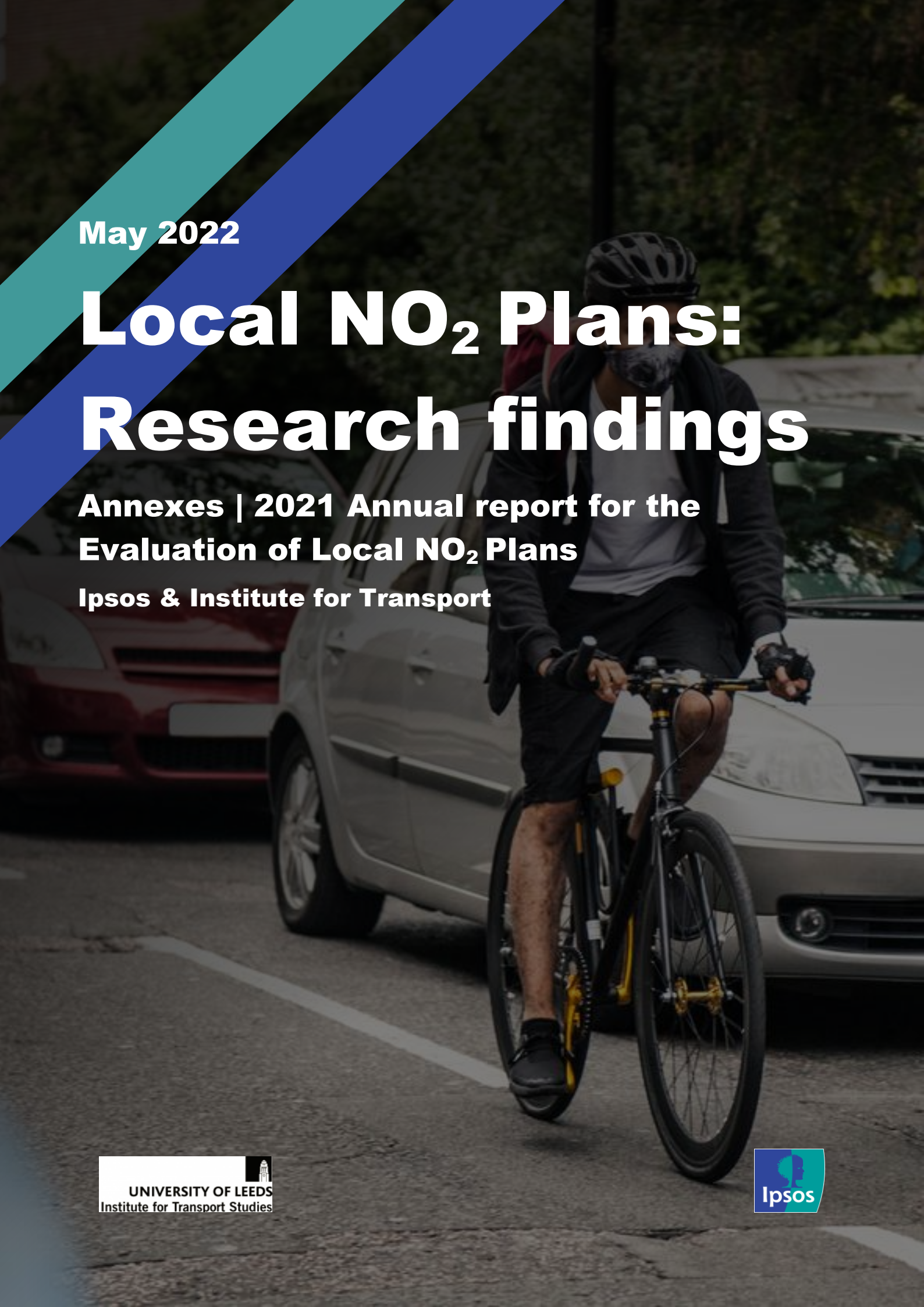

May 2022

Local NO_2 Plans: Research findings

Annexes | 2021 Annual report for the Evaluation of Local NO_2 Plans

Ipsos & Institute for Transport

UNIVERSITY OF LEEDS
Institute for Transport Studies

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1 Evaluation framework

This Annex covers the evaluation framework including the intended impacts and expected outcomes of the Local Plans, the overall theory of change for the NO_2 Local Plans, and the theory of change for charging CAZs.

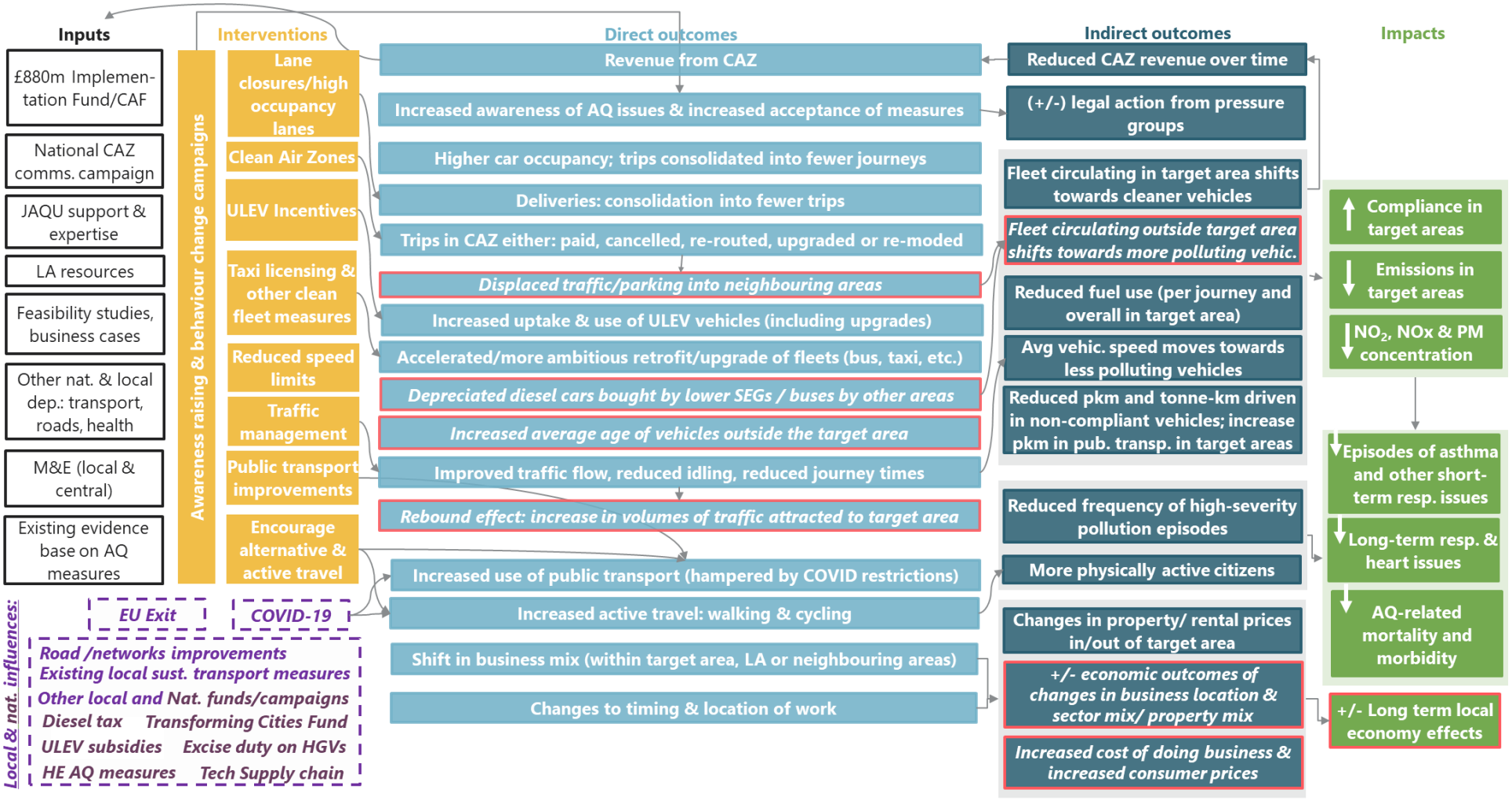
The NO_2 Local Plans outline the measures proposed by local authorities to bring NO_2 concentrations to statutory levels in the shortest time possible. The three high-level intended impacts of the Plans are:

- Reduced emissions of NO_2 from road transport, which is then expected to lead to;
- Improved air quality, in particular ambient NO_2 concentrations against three baselines, namely: (i) the concentrations expected within the LA's business case; (ii) the concentration levels occurred in control areas, and; (iii) the modelled trend under business-as-usual conditions (that is, no Local Plan).
- Improvements to health, particularly in terms of respiratory health, with associated effects on wellbeing.

The implementation of the Local Plans will involve a range of charging and non-charging measures to reduce NO_2 emissions and, hence, concentrations of NO_2 in the target areas. These measures and their intended outcomes are represented in Figure 1.1: and further detailed in Table 1.1:. The outcomes include a shift towards cleaner vehicles circulating in the plan area, increased vehicle occupancy and consolidation of deliveries into fewer trips, increased active travel and so on. Beyond the intended consequences of the NO_2 measures, these are also expected to drive unintended consequences, such as increases or decreases on property prices, changes to business mix within the plan area, uptake of more polluting, lower cost vehicles in areas outside the CAZ (with uptake of these lower cost vehicles potentially higher among lower social economic groups), effect on composition of traffic on roads just outside target area, increased parking just outside area and so on. The possible detrimental effects from Local Plans should be mapped and local authorities can propose measures to mitigate some of these effects on those most impacted through funds from the Clean Air Fund (CAF). This evaluation will be monitoring both the intended and unintended effects from NO_2 mitigation measures.

The list of measures in Table 1.1: is not exhaustive but aims to reflect the main measures being proposed as part of the NO_2 Local Plans. Table 1.2: also maps the key outcomes against key stakeholders of interest according to the ITT underlying this evaluation. These are: transport users, private vehicle owners, businesses, public transport providers and public bodies.

Figure 1.1: Overall theory of change for the NO_2 Local Plans



Source: Ipsos & ITS, based on inputs gathered during the Theory of Change Workshop, 25 March 2019.
Note: This Theory of Change does not depict all existing links between the various elements, but only the links between the interventions and their key direct outcomes. Red bounds around boxes depict unintended outcomes.

Table 1.1: Key outcomes per plan measure

Measure	Anticipated behavioural responses and outcomes of measure (both direct & indirect)
Charging CAZ	Increased awareness of the charging CAZ and of Air Quality issues and the need to take action. 5 typical behavioural responses: Journeys will be **paid for** (through the charge), **cancelled**, **re-routed**, **upgraded** (through use of a cleaner vehicle) or **re-moded** (for example, through active travel or use of public transport). Key outcome: **Cleaner vehicles in CAZ area.** Other outcomes: Reduced journey times (minus rebound effect that reduced journey times can attract further traffic), increased active travel & public transport use. Fleet circulating outside target area shifts to more polluting vehicles (unintended).
Reduced speed limits	Reduced speed limits lead to reduced average speed and to increased perception of non-motorised travel being safer. Key outcome: **Average speed of vehicles in target area move towards the 'bottom' of the speed-emissions curve.** Other outcomes: Changes (+/-) in journey times, increased active travel.
Lane restrictions: High-occupancy lanes, Bus lanes, and so on.	Drivers adapt their travel: increasing their vehicle occupancy & frequency of trips/ deliveries, or switching to an alternative route, destination or mode of transport. Key outcome: **Reduced vehicle person-kilometre (pkm) in target area / Reduced frequency of high-severity pollution episodes associated with traffic congestion (through reduction of traffic and idling at peak times) / Increased pkm in public transport.** Other outcomes: Change (+/-) in journey times, increased active travel & public transport use.
Other traffic management	Improved operation of junctions & rearrangement of existing roads lead to smoother flow of traffic, reduced speed variation and reduced idling. Key outcome: Improved traffic flow, leading to decreased idle emissions. Other outcomes: Changes (+/-) in journey times.
Taxi licensing, bus reforms, HGV restrictions	Accelerated/ more ambitious retrofit/upgrade of fleets (bus, taxi, HGVs, and so on.). Key outcomes: **Cleaner vehicles in target area.**

Measure	Anticipated behavioural responses and outcomes of measure (both direct & indirect)
Public transport route improvements and encouragement	Increased public transport use as an alternative to private vehicles as a result of improved journey times & punctuality of public transport & better information about timetables & travel options. Key outcome: **Reduced pkm driven and increased pkm ridden in public transport in target area, reduced frequency of high-severity pollution episodes associated with traffic congestion** (through reduction of traffic and idling at peak times). Other outcomes: Increased active travel; more physically active citizens moving between public transport.
Encourage alternative & active travel	Increased use of non-motorised modes of transport, including walking, cycling (electric or not) through provision of better cycle infrastructure and as perception of cycle safety within urban area improves. Key outcome: **Reduced pkm driven and increased pkm ridden in public transport or through other non-motorised modes of transport (for example, Cycle counts) in target area.** Other outcomes: More physically active citizens.
ULEV incentives for example, expanded charging point network, subsidies to businesses/ general public	Increased uptake of ULEV's as becomes more practical option. Key outcome: **Increase in clean journeys as % of all journeys, Reduced fuel consumption overall in target area.**

Table 1.2: Expected outcomes for key stakeholders

Affected group	Key anticipated outcome to explore with this affected group
Transport users – those whose travel choices may be affected by Local Plan measures (includes individuals and businesses).	Route choice (and factors affecting route choice), Mode of transport, Journey destination, Vehicle occupancy, Eco-driving awareness & practices.
Private vehicle purchasers – those whose purchasing behaviour may change as the result of Local Plan measures.	Factors affecting recent/planned future purchasing decisions, Fleet profile (status and trends): proportion of fleet that is Euro 4/6, ULEV, Statutory Off-road Notifications.
Businesses – whose travel/delivery related behaviours may change response to Local Plan measures; they may also be affected by the impacts of measures on their customers – for example if customer access is improved or deteriorates – and wider economic impacts, such as changes in rental prices.	Composition of vehicle fleets & factors affecting leasing choice, Fleet management, including planning of trips, Behavioural measures (for example, encouraging sustainable forms of travel to work), Business performance, Composition of local business population & relocations outside the exceedance zone, Prices of goods and services, Changes in commercial property markets.
Public transport providers – whose vehicle purchasing/leasing choices or route/schedule planning may be affected by NO_2 Local Plans; they may also be affected by the impacts of measures on their	Composition of vehicle fleets, Fares and ticket prices, Routes and frequency of services, Performance (regularity, punctuality), Customer uptake of services,

Affected group	Key anticipated outcome to explore with this affected group
customers – for example changes in customer uptake of public transport.	Changes in revenue (due to retrofitting/upgrading process).
Public bodies – branches of local government may change their behaviour as a result of Local Plan measures.	Composition of vehicle fleets & factors affecting leasing choice, Fleet management, including planning of trips, Behavioural measures (for example, encouraging sustainable forms of travel to work), Relocation to areas outside the exceedance zone, Prices of goods and services.

Theory of Change (ToC) for Charging Clean Air Zones

A CAZ is an area within a Local Plan area where targeted charging measures are introduced to improve local air quality. In a charging CAZ, minimum emission standards are established for vehicles driving within in that area. Charging CAZs vary in terms of the categories of vehicles that they cover: depending on the coverage, a charging CAZ can be Class A (buses, coaches, taxis, and private hire vehicles), B (Class A + HGVs), C (Class B + LGVs) or D (Class C + cars). Within a charging CAZ, the most polluting vehicles are charged a fee, with the aim of encouraging users to shift towards cleaner vehicles. Therefore, the key outcome targeted by a charging CAZ is a shift towards a cleaner fleet within the CAZ. Other direct and indirect outcomes can also be expected, such as mode shift or higher vehicle occupancy, and also development outcomes. The distributional effects of a charging CAZ are of interest to the evaluation, as are any displacement or spill over effects; for example, on the composition of vehicles in the adjacent area, whether journeys in more polluting cars are being diverted to other areas (rather than reduced overall), as well as potential implications for the property market both within and outside the zone.

Figure 1.2: below summarises the anticipated causal links between a CAZ and its direct and indirect outcomes and ultimate impacts. A summary narrative to accompany this ToC is provided below (for illustration, a CAZ D is considered).

Elements of the intervention. Four key elements to the establishment of a charging CAZ are:

(i) The conduct of feasibility studies to establish an appropriate design for the CAZ and the development and subsequent review and sign-off of full business cases with the support of JAQU;

(ii) The communication around its introduction; the exact nature of the information provided is likely to vary but may, for example, inform stakeholders about where the CAZ is in operation, the charging level and which vehicles it affects, the penalty risks and what can be done to minimise the impacts that the CAZ may have on journeys (in some areas, this may follow an initial public consultation phase on the design of the CAZ);

(iii) The establishment of a vehicle monitoring infrastructure and institutional framework to take appropriate action according to the monitoring data; and,

(iv) The accurate and effective charging of vehicles that drive within the zone in line with the CAZ standards.

Beyond these four core elements, the Clean Air Fund (CAF) provides funds to help minimise the impacts of introducing a charging CAZ. The fund can be used to implement a range of measures to support affected individuals and businesses, such as support to upgrade their vehicles or purchase new cleaner vehicles.

Direct outcomes. The information campaigns around the CAZ, combined with the accurate and effective charging of polluting vehicles (and potentially further helped by CAF measures), is anticipated to encourage increasingly positive perceptions of cleaner vehicles and lead to drivers shifting towards those vehicles. A shift towards clean vehicles can for instance, be facilitated through CAF subsidies to the purchase/lease of compliant vehicles, aiming at reducing the price difference between both categories. Another effect might be a behaviour shift among private vehicle owners and businesses making journeys in the area. This could include: changing their mode of travel (for example, towards public transport or non-motorised modes), changing their routes or destination (which can have the unintended effect of increasing the volume of polluting vehicles in neighbouring areas) or cancelling their trips as a whole. From the point of view of commercial vehicles and delivery vehicles, such behaviour change would be reflected in the consolidation of deliveries into a smaller number of trips. These effects can start to occur in the months leading up to the CAZ implementation, as a direct result of the communication that precedes it. CAF measures, such as subsidies for fleet/vehicle upgrade or support to active travel or public transport use, would help mitigating increased costs (to businesses) or reduced available income (for individuals).

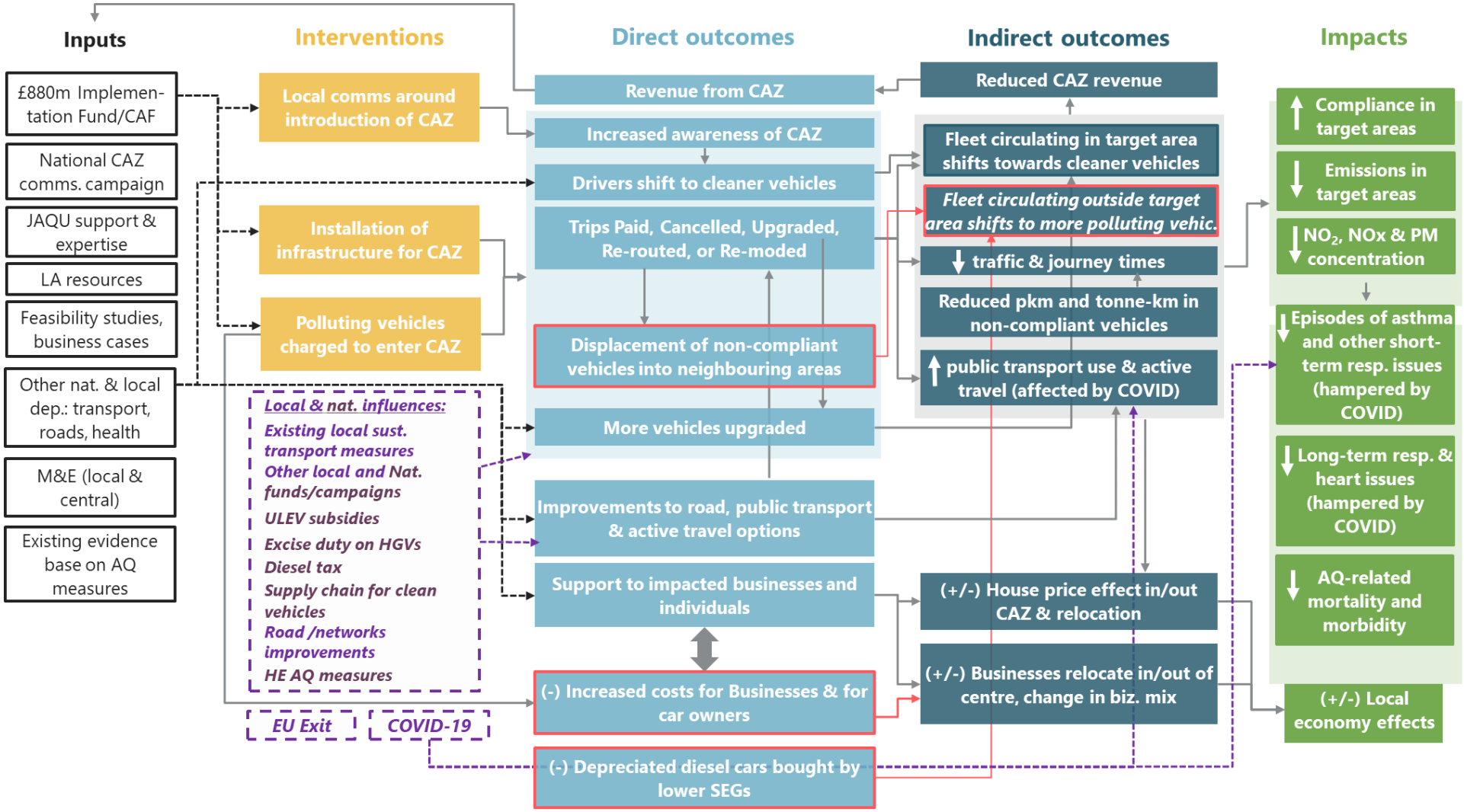
Indirect outcomes. The accelerated retrofit or purchase of cleaner vehicles, leads to a reduction in the number of polluting vehicles going into the CAZ area as a percentage of all vehicles entering the zone. Changes made to the mode and route of trips also contributes to a reduction in passenger miles driven in the zone, which in turn lead to reduced travel times within the zone. This may be associated with a rebound effect; any road space that is released tends to be consumed by the high level of suppressed traffic demand, which is attracted by lowered journey times initially enabled by the CAZ. Other indirect outcomes of the CAZ may include a shift in the destination of polluting vehicles, an increase in the onward purchase of polluting vehicles outside of the zone (particularly by those in lower socio-economic grades and related to changes in the relative price of compliant compared to non-compliant vehicles), an increase in parking in the roads adjacent to the charging boundary and implications for the property market and price of goods and services both within and outside the zone (with property purchase prices potentially increasing within the zone due to improved air quality but goods and services becoming more expensive to help compensate increased business delivery costs). Furthermore, where present, the CAF measures are effective in containing impacts from the CAZ, and hence, the effects on the business mix within and outside the target area are positive. That is, local businesses are preserved and thrive, and new businesses are attracted to the target area and to neighbouring areas. Where there are no measures to mitigate the possible adverse effects of the CAZ, the key indirect outcome that can be expected are the displacement of local individual tenants and businesses to outside the CAZ and the displacement of polluting fleet towards areas without exceedance.

Impacts. The cleaner fleet mix in the CAZ area will contribute to a reduction in transport-related emissions of NO_2, but also of particulate matter (PM) and may impact greenhouse gases emissions (GHG). All other variables constant, this should be reflected in a reduction in NO_2 concentrations (and of PM) at the CAZ area, and support an area to bring NO_2 concentrations within statutory levels. In the fairly immediate term, improved air quality is likely to contribute to reduced episodes of asthma and other respiratory diseases across the population. In the longer term, reduced exposure to NO_2 and other pollutants has been linked to reduced pulmonary and other heart diseases, reduced prevalence of

mental illness, reduced morbidity and mortality by those diseases. Following on from the range of economic outcomes the introduction of the CAZ may have on the local economy, through its effects on the property market, business mix and employment, there are likely to be a range of longer-term economic impacts, although how these may manifest is currently not clear.

External influences. There are also external influences that can contribute to the effectiveness of the charging CAZ. Existing local sustainable transport measures will contribute to the increased active travel and use of public transport; national incentives to ULEV will favour the shift towards cleaner vehicles, as will an existing supply chain for cleaner vehicles. Beyond these, the CAF also contributes to mitigating any unintended negative effects of the charging CAZ.

Figure 1.2: Theory of Change | Charging CAZ

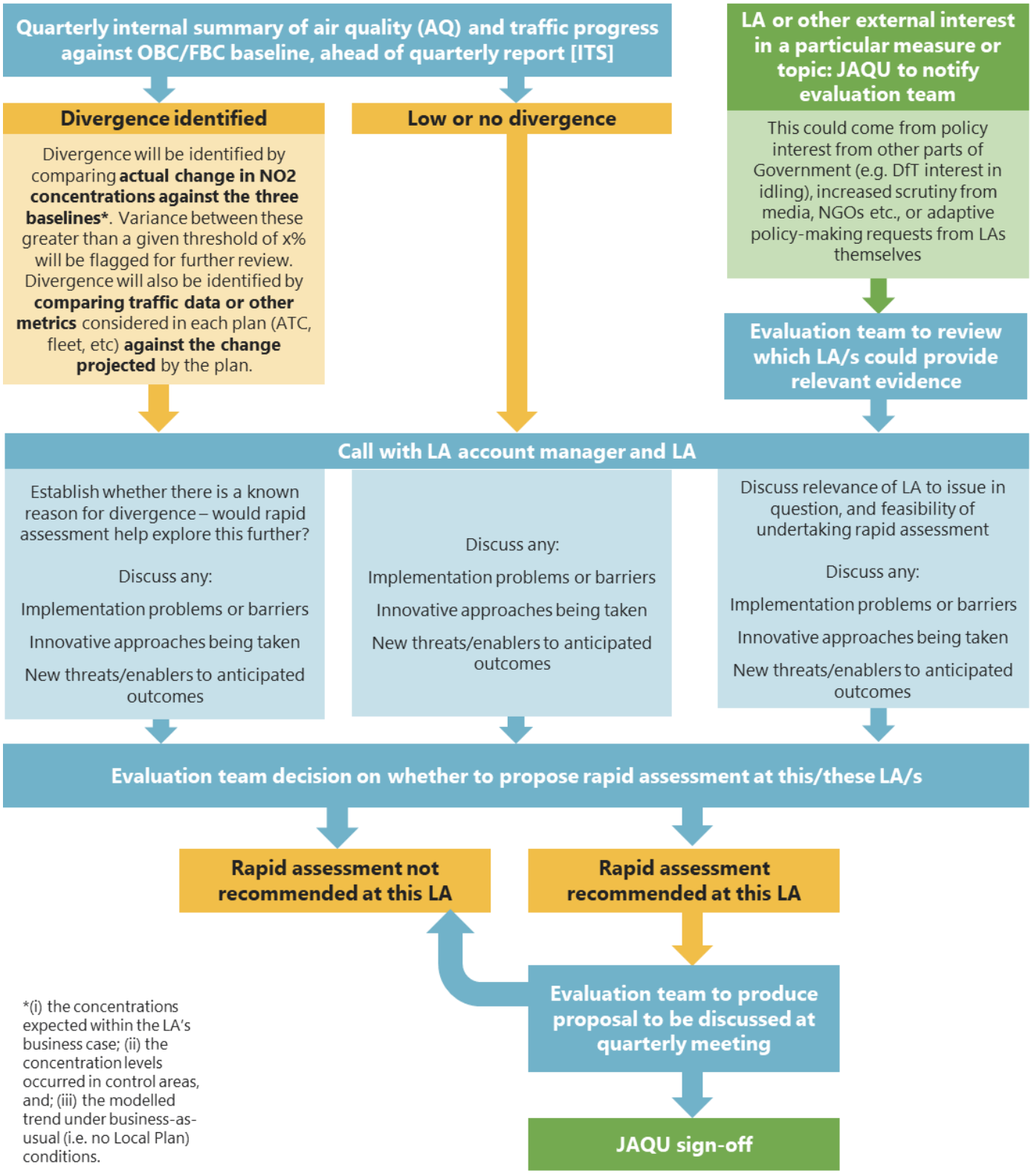


Source: Ipsos & ITS, based on inputs gathered during the Theory of Change Workshop, 25 March 2019.
Note: This Theory of Change does not depict all existing links between the various elements, but only the links between the interventions and their key direct outcomes. Red borders around boxes depict unintended consequences.

2 Process for selecting rapid assessments

Figure 2.1: outlines the process that was developed in order to select the rapid assessments that will be conducted as part of this evaluation.

Figure 2.1: Rapid assessment selection decision tree



3 Before and After Analysis

This section provides a detailed outline of some key elements of the before-and-after analysis method described in chapter 2 of the main report, namely: the approach for converting Automated Numberplate Recognition (ANPR) data intro Anonymised Fleet Data (AFD) (3.1), the architecture for the database storing traffic and air quality data for this project (3.2) and the process for selecting the sites for additional monitoring under this evaluation (3.3). In addition, section 3.4 provides additional technical detail from the data analysis conducted for B&NES to supplement the reporting set out in Chapter 3 of the Annual Report.

3.1 Processing ANPR data to generate Anonymised Fleet Data (AFD)

Local authorities are routinely collecting ANPR data from their networks of cameras. On a quarterly basis, they securely submit a representative 1 week sample (7-days, 24-hours) of ANPR records for a sample of camera sites to JAQU. LAs not implementing a CAZ are requested to submit a representative 1 week sample of ANPR data annually, unless otherwise agreed with JAQU. This data can be accessed by JAQU and DfT only, not the ITS evaluation team. From each submission, DfT generate Anonymized vehicle Fleet composition Data (AFD). This processed data is securely shared with the ITS Evaluation team.

DfT generate the Anonymized vehicle Fleet composition Data (AFD) by cross-referencing Vehicle Registration Marks (VRMS or number plates) from the ANPR cameras with other UK vehicle registration databases. The Vehicle Certification Agency produce a bespoke database that is used to assign a fuel/propulsion type and Euro standard for each vehicle. The data sources for this include the Society of Motor Manufacturers and Traders (SMMT) dataset purchased under licence[1]. This is supplemented for more recent light-duty vehicles by the Allgemeiner Deutscher Automobil-Club (ADAC) vehicle classification database[2] , which allows the specific Euro 6 designation of light-duty vehicles to be established that is, Euro 6a/b, Euro 6c, Euro 6dtemp and Euro 6d. For vehicles which do not appear in these databases, the Euro Standard defaults are derived from month of first registration and body type. Some vehicles are retrofitted with technologies which reduce the tailpipe pollution emissions. Retrofitted vehicles may for example be classed as meeting Euro 6/VI vehicle emission standards and therefore be CAZ-compliant. Data on vehicles' retrofit status if gathered from the Clean Vehicle Retrofit Accreditation Scheme (CVRAS)[3].

If implementing a CAZ, a local authority is required to submit information on registered taxis and private hire vehicles on a weekly basis (as a minimum). This database[4] is also cross-referenced to identify taxis and private hire vehicles and their emission standard/retrofit status. Anonymisation by DfT includes replacement of vehicle registration marks (VRMs – number plates) with a unique identifier. Unique identifiers are generated for each sample. A vehicle's unique identifier is consistent within a week sample, but changes between quarterly samples. The AFD is anonymised further by only reporting the hour and date of recording. The resulting AFD provided to ITS is a non-panel weeklong sample.

[1] More information available at www.smmt.co.uk/vehicle-data
[2] More information available at www.adac.de
[3] More information available at www.energysavingtrust.org.uk/service/clean-vehicle-retrofit-accreditation-scheme
[4] More information available under section 2.8 of the "Air Quality (Taxi and Private Hire Vehicles Database) (England and Wales) Regulation 2019: Statutory Guidance", accessible at www.gov.uk

3.2 Project Database Architecture

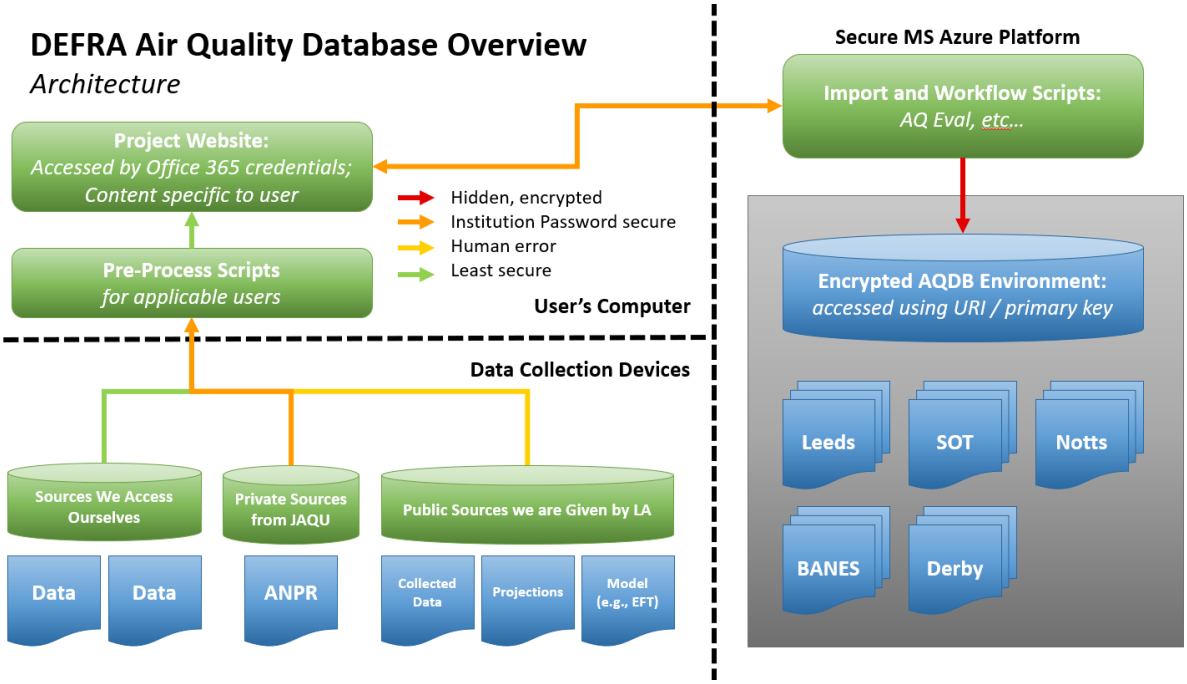
A secure, cloud-based flexible project database has been created for the project to store these multiple data streams. The chosen platform is Microsoft Azure[5] CosmosDB[6] database. Microsoft Azure is an enterprise level data platform with many features including database support and web app hosting. CosmosDB is a NoSQL / Document style database that allows for a high degree of flexibility in data upload and retrieval. The CosmosDB database is split into containers, with one being designated for each local authority providing data. The container structure allows for segregated storage which increases the security if this platform were to be made more widely available outside the immediate ITS and JAQU teams. The data provided by different local authorities is often in different formats which would cause problems for traditional SQL style databases. Web applications have been developed using the Python language[7], Streamlit[8] for web app development and a range of different data visualisation packages which provide a good degree of interactivity and visualisation potential. A set of web applications is being developed to support the analysis and includes:

- Data upload, including quality checks, for a variety of different data types (traffic flow, AFD, weather, air quality), with formats often varying between local authorities
- Data overview and retrieval for quick analysis and data download

Critically for the evaluation team, the Azure CosmosDB platform can be accessed remotely using the preferred www.r-project.org and R Markdown[9] analysis platform. This allows the AQEval software and tools to retrieve and analyse data in a similar way to how it was used to analyse local data sets earlier in the project.

[5] More information available at www.azure.microsoft.com
[6] More information available at www.azure.microsoft.com/databases/cosmos_db
[7] More information available at www.python.org
[8] More information available at www.streamlit.io
[9] More information available at www.rmarkdown.rstudio.com

Figure 3.1: Project data work-flow and architecture



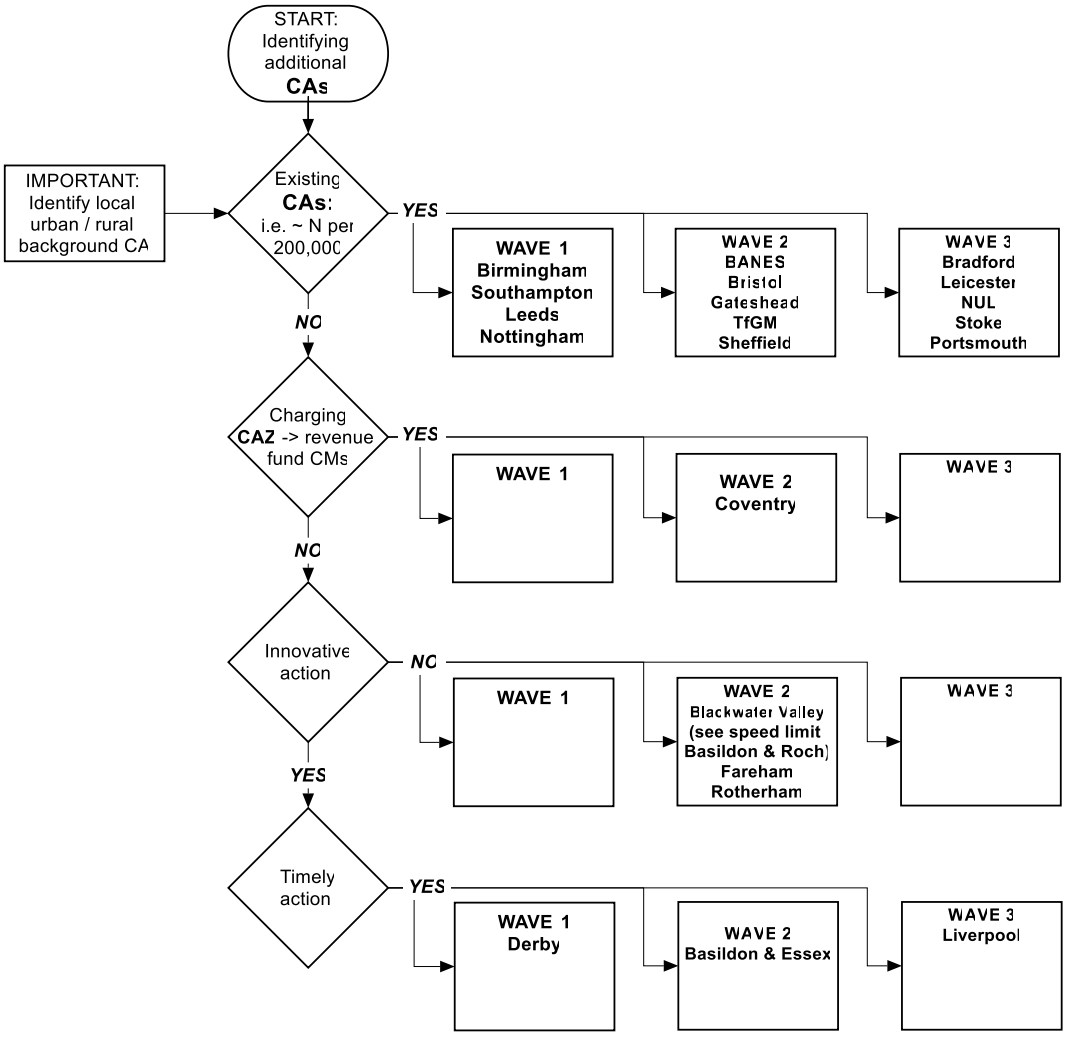
3.3 Additional monitoring for this evaluation

The site for the additional monitor in Derby is located at a mid-link location on Uttoxeter New Road (A516, coordinates 52°55'14.82"N, 1°29'18.52"W), 150 up-stream of the re-designed signalised roundabout that connects the A516 with Derby inner-ring. The site is a broken street canyon, with building set-back from the kerb edge on its North-side where the monitor is sited.

In Liverpool, which currently does not have any roadside CAs, the CA is proposed to be located on East-side of the major North-South Scotland Road (A59 coordinates 52°55'21.42"N, 1°29'4.67"W) arterial. The road is a 3-lane, two-way urban motorway link in an open setting. With the monitor located on the downwind side of the road in the prevailing westerly wind direction, it will detect a strong signal of changes in flow/emissions of the aggregate fleet inside the Local Plan area.

With Basildon & Essex being the first Local Plan area to implement a significant traffic management intervention, lowering the speed limit on sections of the major A127 dual carriageway from the national speed limit to 50 mph, it was deemed a priority to locate a CA within this plan area. The preferred site meets AAQD siting criteria and the exact location is to be confirmed with testing under-way to identify a suitable electrical connection (November 2021).

Figure 3.2: Decision-making tree to select the sites of the three new continuous NO2 analysers



3.4 Additional B&NES data analysis technical detail

The section supplements Chapter 3 of the Annual Report providing charts and tables that provide the technical detail for the commentary within the Chapter.

Table 3.1: AFD summary table for quarter one, two and three of 2021 by camera location. Note that car data is included under the separate CAZ D heading as is not directly affected by the CAZ C.

Vehicle type	Camera ID	Obs Q1 (count)	% CAZ C compliance	Obs Q2 (count)	Q2 % CAZ C compliance	Obs Q3 (count)	Q3 % CAZ C compliance
Bus & Coach	105	2,046	44	2004	87	2,124	86
	112	1,929	100	648	98	582	98
	114	3,575	68	1,688	97	2,264	98
	120	2,614	90	2,029	99	1,797	99
	122	3,088	73	3,687	94	3,514	97
	203	1,279	51	2,465	86	2,286	84
HGV	105	3,128	75	2,816	87	1,905	91
	112	516	67	199	86	170	86
	114	1,886	74	907	88	1,247	92
	120	2,998	79	2,711	89	1,855	92
	122	972	77	1,136	88	1,143	88
	203	130	71	469	91	695	94
LGV	105	21,747	47	19,843	66	15,220	70
	112	8,909	49	3,468	69	3,146	74
	114	15,780	46	7,885	67	10,380	71
	120	13,034	47	11,873	67	8,844	70
	122	10,173	45	9,983	67	9,938	71
	203	1,027	49	3,336	66	4,548	70
Taxi	105	3,179	64	6,894	85	7,092	87
	112	1,804	61	1,738	87	1,680	90
	114	3,937	66	2,146	88	2,989	90
	120	3,113	64	4,146	85	3,898	89
	122	2,515	61	5,768	85	5,492	88
	203	619	55	3,729	85	5,535	90
Vehicle type	**Camera ID**	**Obs Q1 (count)**	**% CAZ D compliance**	**Obs Q2 (count)**	**Q2 % CAZ D compliance**	**Obs Q3 (count)**	**Q3 % CAZ D compliance**
Car	105	77,590	64	141,567	69	111,861	70
	112	44,520	69	33,999	73	31,739	75
	114	69,773	66	56,257	69	81,788	70
	120	58,896	67	96,945	70	79,952	71
	122	38,616	65	73,413	69	72,976	70
	203	7,715	69	32,029	71	32,259	72

Table 3.2: B&NES continuous NO2 analyser sites local site characteristics and matched AURN control sites

Site name		Bath A4 Roadside	Worthing A27 Roadside	Windsor Bridge	Guildhall	Oxford Centre Roadside	Chelsea House	Reading London Road
Site type		AURN	AURN	LAQ	LAQ	AURN	LAQ	AURN
TRAFFIC	Road configuration	Two-way	Two-way	Two-way	One-way	One-way	Two-way	Two-way
	Lane configuration	Single-lane	Single-lane	Single-lane	Single-lane	Single-lane	Single-lane	Single-lane
	Junction Type	Signalised	Signalised	Signalised	Signalised	Signalised	Mixed	Mixed
	Speed Limit	30 mph	30 mph	30 mph	30 mph	20 mph	30 mph	30 mph
LOCAL ENVIRONMENT	Urban setting	Arterial	Arterial	Arterial	Central	Central	Arterial	Arterial
	Street setting	Two-sided canyon	Irregular	Irregular	Two-sided canyon	Two-sided canyon	Irregular	One-sided canyon
STREET CANYON	Aspect ratio	0.75	NA		1	1.2		0.6
	Width	20m	14m	20m	16m	14m	18m	14m
	Road alignment (deg N)	60 to 240	85 to 265	100 to 290	175 to 355	155 to 335	150 to 330	80 to 260
	Up/down-wind in Westerlies	Parallel (N)	Parallel (N)	Parallel (N)	Windward	Windward	Up-wind	Parallel (S)
AIR QUALITY	Annual mean NO_2 in 2018		36.5			39.0		29.7
	Annual mean NO_2 in 2019		33.1			42.0		26.7

Table 3.3: B&NES continuous NO2 analyser AQEval detected trends

Each row represents refers to a section of constant trend before a change-point (which may have been caused by the CAZ or other factors), as captured by a continuous analyser (identified in the 'site' column). Multiple rows for the same 'site' correspond to different periods when a constant trend was identified, with each of those periods having been attributed an identified mapped in the 'Index' column.
BCH = Bath Chelsea House; BGH = Bath Guildhall; BWB = Bath Windsor Bridge; BHA4 = Bath A4 Roadside (AURN)

Site	Pollutant	Index	Start date	End date	Concentration ($\mu g.m^{-3}$) at start	Concentration ($\mu g.m^{-3}$) at end	Concentration ($\mu g.m^{-3}$) difference	Duration (days)	Gradient (change per day)
BCH	NO2	1	01/10/2020	11/12/2020	21.50	23.00	1.50	71	0.02
BCH	NO2	2	11/12/2020	24/12/2020	23.00	16.00	-7.00	13	-0.54
BCH	NO2	3	24/12/2020	04/06/2021	16.00	19.00	3.00	162	0.02
BCH	NO2	4	04/06/2021	14/06/2021	19.00	14.50	-4.50	10	-0.45
BCH	NO2	5	14/06/2021	30/09/2021	14.50	17.50	3.00	108	0.03
BCH	NOx	1	01/10/2020	25/12/2020	47.50	49.50	2.00	85	0.02
BCH	NOx	2	25/12/2020	26/12/2020	49.50	26.00	-23.50	1	-23.50
BCH	NOx	3	26/12/2020	30/09/2021	26.00	25.50	-0.50	278	0.00
BGH	NO2	1	01/10/2020	23/12/2020	21.00	28.00	7.00	83	0.08
BGH	NO2	2	23/12/2020	28/12/2020	28.00	19.50	-8.50	5	-1.70
BGH	NO2	3	28/12/2020	01/05/2021	19.50	20.50	1.00	124	0.01
BGH	NO2	4	01/05/2021	06/05/2021	20.50	17.50	-3.00	5	-0.60
BGH	NO2	5	06/05/2021	13/08/2021	17.50	19.00	1.50	99	0.02
BGH	NO2	6	13/08/2021	03/09/2021	19.00	22.00	3.00	21	0.14
BGH	NO2	7	03/09/2021	30/09/2021	22.00	20.50	-1.50	27	-0.06
BGH	NOx	1	01/10/2020	23/12/2020	41.50	59.00	17.50	83	0.21
BGH	NOx	2	23/12/2020	27/12/2020	59.00	39.00	-20.00	4	-5.00
BGH	NOx	3	27/12/2020	28/03/2021	39.00	37.00	-2.00	91	-0.02
BGH	NOx	4	28/03/2021	30/05/2021	37.00	35.50	-1.50	63	-0.02
BGH	NOx	5	30/05/2021	13/06/2021	35.50	23.00	-12.50	14	-0.89
BGH	NOx	6	13/06/2021	15/06/2021	23.00	39.00	16.00	2	8.00
BGH	NOx	7	15/06/2021	30/09/2021	39.00	43.00	4.00	107	0.04
BWB	NO2	1	01/10/2020	09/11/2020	24.50	34.00	9.50	39	0.24
BWB	NO2	2	09/11/2020	15/11/2020	34.00	22.50	-11.50	6	-1.92
BWB	NO2	3	15/11/2020	01/05/2021	22.50	22.00	-0.50	167	0.00
BWB	NO2	4	01/05/2021	03/05/2021	22.00	18.50	-3.50	2	-1.75
BWB	NO2	5	03/05/2021	30/09/2021	18.50	21.50	3.00	150	0.02
BWB	NOx	1	01/10/2020	12/12/2020	63.00	90.00	27.00	72	0.38
BWB	NOx	2	12/12/2020	27/12/2020	90.00	41.00	-49.00	15	-3.27
BWB	NOx	3	27/12/2020	29/01/2021	41.00	62.00	21.00	33	0.64
BWB	NOx	4	29/01/2021	28/03/2021	62.00	49.00	-13.00	58	-0.22
BWB	NOx	5	28/03/2021	30/09/2021	49.00	50.00	1.00	186	0.01
BHA4	NO2	1	01/10/2020	11/12/2020	31.00	38.00	7.00	71	0.10
BHA4	NO2	2	11/12/2020	01/01/2021	38.00	25.50	-12.50	21	-0.60
BHA4	NO2	3	01/01/2021	27/03/2021	25.50	28.00	2.50	85	0.03
BHA4	NO2	4	27/03/2021	14/08/2021	28.00	22.50	-5.50	140	-0.04
BHA4	NO2	5	14/08/2021	30/09/2021	22.50	25.00	2.50	47	0.05
BHA4	NOx	1	01/10/2020	15/12/2020	79.00	99.00	20.00	75	0.27
BHA4	NOx	2	15/12/2020	27/12/2020	99.00	53.00	-46.00	12	-3.83
BHA4	NOx	3	27/12/2020	30/09/2021	53.00	50.00	-3.00	277	-0.01

Table 3.4: Control sites continuous NO2 analyser AQEval detected trends

Each row represents refers to a section of constant trend before a change-point (which may have been caused by the CAZ or other factors), as captured by a continuous analyser (identified in the 'site' column). Multiple rows for the same 'site' correspond to different periods when a constant trend was identified, with each of those periods having been attributed an identified mapped in the 'Index' column.
REA5 = Reading London Road; OX = Oxford Centre Roadside; WTHG = Worthing A27 Roadside

Site	Pollutant	Index	Start date	End date	Concentration ($\mu g.m^{-3}$) at start	Concentration ($\mu g.m^{-3}$) at end	Concentration ($\mu g.m^{-3}$) difference	Duration (days)	Gradient (change per day)
REA5	NO2	2	28/01/2021	29/03/2021	21.00	23.50	2.50	60	0.04
REA5	NO2	3	29/03/2021	01/04/2021	23.50	13.00	-10.50	3	-3.50
REA5	NO2	4	01/04/2021	13/04/2021	13.00	33.50	20.50	12	1.71
REA5	NO2	5	13/04/2021	15/04/2021	33.50	20.00	-13.50	2	-6.75
REA5	NO2	6	15/04/2021	19/06/2021	20.00	18.50	-1.50	65	-0.02
REA5	NO2	7	19/06/2021	30/09/2021	18.50	22.00	3.50	103	0.03
REA5	NOx	1	01/10/2020	30/09/2021	47.00	47.00	0.00	364	0.00
OX	NO2	1	01/10/2020	14/05/2021	38.00	33.00	-5.00	225	-0.02
OX	NO2	2	14/05/2021	26/07/2021	33.00	25.50	-7.50	73	-0.10
OX	NO2	3	26/07/2021	30/09/2021	25.50	32.00	6.50	66	0.10
OX	NOx	1	01/10/2020	02/12/2020	79.00	99.00	20.00	62	0.32
OX	NOx	2	02/12/2020	27/12/2020	99.00	73.50	-25.50	25	-1.02
OX	NOx	3	27/12/2020	30/09/2021	73.50	74.00	0.50	277	0.00
WTHG	NO2	1	01/10/2020	26/04/2021	29.00	29.50	0.50	207	0.00
WTHG	NO2	2	26/04/2021	03/07/2021	29.50	21.50	-8.00	68	-0.12
WTHG	NO2	3	03/07/2021	30/09/2021	21.50	23.00	1.50	89	0.02
WTHG	NOx	1	01/10/2020	29/04/2021	59.00	59.00	0.00	210	0.00
WTHG	NOx	2	29/04/2021	30/04/2021	59.00	51.00	-8.00	1	-8.00
WTHG	NOx	3	30/04/2021	30/09/2021	51.00	51.00	0.00	153	0.00

4 Progress on deep-dive case study strand

This section provides an overview of the Local Air Quality Plans being implemented by Local Authorities that are covered by the deep-dive case studies.

As explained in the main report, the Central Evaluation will complete eight deep-dive case studies. The areas selected are Leeds, B&NES, Birmingham, Basildon & Essex, Sheffield & Rotherham, Coventry, Bradford and Bristol. This annex provides a description of the measures in each, and summarises the rationale for selecting these areas.

4.1 Local Plan measures in each of the deep-dive areas, and rationale for selection

Table 4.1: below outlines the key characteristics of the confirmed deep-dive case studies and the information that each can contribute to the wider evaluation.

Table 4.1: Summary of Local Plans measures as part of deep-dive case studies

Local Plan Area	Description of the measure	Key potential learning from case study
Birmingham	Birmingham is operating a **Class D CAZ** on the central A4540 Middleway Ring Road. This affects all non-compliant vehicles that drive and operate within the Middleway Ring Road excluding those for whom exemptions have been made. The charging CAZ began operating from June 2021 on a 24/7 basis with non-compliant vehicles (excluding those for which exemptions will be made) charged for driving in the CAZ. The measure of compliance is Euro 6 for diesel vehicles and Euro 4 for petrol vehicles. In addition to implementing the CAZ, a further set of measures have been implemented as supplementary to the CAZ to improve air quality within the zone to the required level. These include parking restrictions to convert all currently free, council controlled parking within the CAZ to spaces which have a charge applied, closing junctions between Lister, Great Lister Street and Dartmouth Middleway to all traffic apart from buses, and banning northbound traffic on Suffolk Street Queensway that exits onto Paradise Circus and banning southbound traffic from Paradise Circus entering the A38 (that is, making this road a through route).	Monitoring how the Class D CAZ and supplementary measures affect behaviours, and whether this differs across population segments. Exploring whether the CAZ is economically sustainable (including the potential impact on businesses) and whether there are distributional impacts of its effects. Understanding the impact of the CAZ on key groups for which mitigation measures are in place, such as those who work within or regularly travel to the CAZ, taxi drivers, bus, HGV and coach fleets. We will also explore the effect of external, contextual factors on the outcomes of interest; and what has been learned about implementing this type of measure.
Leeds	Leeds was selected as it was due to implement a **Class B+ CAZ** in the central and northern part of the city, up to the Outer Ring Road boundary. This would have affected HGVs, buses, coaches, taxis and private hire vehicles (PHVs) that are not compliant with emissions standards. There were additional requirements (the "+") for taxi and PHVs that would require them to go beyond Euro 6 standard and upgrade to either a petrol hybrid or ultra-low	Following the decision to not proceed with the Class B+ CAZ in October 2020, this case study was re-scoped to provide learnings on what drove compliance earlier than originally modelled. In particular, the rescoped case study aimed to assess how businesses in Leeds acted in relation to upgrading and redistributing their fleets, the factors which drove change in behaviour, and whether this

Local Plan Area	Description of the measure	Key potential learning from case study
	emissions vehicle (ULEV). The implementation of the CAZ did not proceed, following findings that the distribution of Euro classes across the vehicle fleet in Leeds had reached the profile expected should the CAZ have been implemented. Reduced flows on the single exceedance link and fleet upgrades both contributed to this.	behaviour is likely to change following cancellation of the CAZ.
Basildon & Essex	Basildon & Essex have implemented a **speed limit reduction** on the A127. The speed limit has been reduced from 70 miles per hour to 50 in both directions on a five mile stretch of the road, from Fortune of War roundabout in the west, to Pound Lane in the east. The enforcement of the measure was kept on hold initially due to issues with camera connections caused by pandemic related delays, but was eventually implemented in August 2021. This reduction is expected to reduce NO_2 concentrations, as the reduced speed limit is expected to lead to a steadier driving cycle which, evidence shows, is linked to lower emissions. Furthermore, it is hoped that the speed limit reduction will raise awareness of air quality issues among the local population, and as such, will lead to other positive outcomes motivated by a desire for cleaner air. Additionally, Basildon will replace the existing crossing layout in East Mayne to reduce people's exposure to air pollution	To explore the impact of the speed limit reduction, as the evidence base for this type of measure is currently limited. The deep dive case study will explore how the speed limit reduction affects journey times, travelling behaviours, and its impacts on local businesses. Basildon & Essex are working closely with a contractor around implementation and the case study will also seek to identify lessons learned from this type of partnership.
Bath & North East Somerset	Bath & North East Somerset (B&NES) is operating a **Class C CAZ** in the centre of Bath, which launched in March 2021. This affects HGVs, buses, coaches, vans, taxis and private hire vehicles (PHVs) that are not compliant with emissions standards, excluding those for whom exceptions have been made. There was a soft enforcement running from the CAZ launch (15th March) until mid-June 2021. This meant that non-compliant vehicles going into the CAZ during that period without paying the charge were not fined; instead, they were only required to pay the charge. From the end of this period, vehicles that were not compliant and did not pay the charge were fined for entering the CAZ. Further measures have also been implemented alongside the CAZ. There is a traffic management scheme comprised of installation of traffic lights at junctions in the A367 Capel Row/Princes Street and at Queen Square Place to reduce the flow of traffic into Gay Street (a heavily polluted spot). This scheme began in Autumn 2020, and will also include improvements to footways, priority for cyclists and traffic lights crossings.	Monitoring of how the Class C CAZ affects behaviours, and whether the distributional impact of these effects differs across population segments. We will also explore the effect of external, contextual factors on the outcomes of interest. Another area of focus for the case study will be the approach taken for the implementation of the Plan, what has gone well and less well and what has been learned about implementing this type of measure. It is hoped learnings from this case study will provide useful insight for other local authorities with similar geographies, that is, urban towns with wide rural fringes (for example, Oxford, Cambridge).

Local Plan Area	Description of the measure	Key potential learning from case study
Bradford	Bradford is implementing a **Class C CAZ** in 2022 inside the Bradford outer ring road and along the Aire valley corridor. This will affect taxis, PHVs, vans, LGVs, buses, coaches and HGVs that do not meet the required emission standards, excluding those for whom exceptions have been made (such as emergency services vehicles). The Local Plan includes Clean Air Funding (CAF) funding to support local businesses, including offering financial assistance through grants to help people and businesses to upgrade vehicles. These included upgrade programmes for HGV, coach, minibus, LGV Hackney Carriage and PHV of up to £16,000; Bus Retrofit Programme, offering grants up to £16,000; and advice and support to residents and businesses looking to access this support.	This case study is expected to collect a range of high quality health outcomes data through its collaboration with the Born in Bradford study, a large-scale cohort study. In addition, the Bradford team (through Born in Bradford) is able to access longitudinal NHS data for the local population, beyond those in the Born in Bradford cohort. As the ultimate impact of Local Plans is to improve population health outcomes, and as health outcome data is typically so difficult to access, the involvement of Bradford as a case study area provides a valuable and unique opportunity for the evaluation team to explore the health outcomes associated with local plans. This case study will also assess the potential impact on businesses and whether there are distributional impact of these effects differs across population segments.
Bristol	Bristol is implementing a **Class D CAZ** covering the eastern side of Bridge Valley Road. The CAZ will charge non-compliant cars (including private vehicles), buses, coaches, taxis, HGVs and LGVs. Alongside the CAZ, Bristol City Council (BCC) is also implementing Fast Track measures of closing Cumberland Road to inbound general traffic, and using a Variable Message Sign (VMS) strategy, including the use of existing transport infrastructure to hold back traffic to the city centre. BCC is also offering a financial assistance scheme, with loans and grants for various businesses (including taxi, PHVs and LGV drivers) to upgrade. The maximum grant available to HGVs and coaches is £16,000, and the lowest maximum grant is extended to cars, at £2,000. A grant to bus companies to retrofit and replace their vehicles is also available. Other programmes and schemes with CAF funding include: Liveable Neighbourhoods Programme, expanding the Legible City Signage, and the Old Market Gap Cycle Scheme.	Explore how the Small Class D CAZ affects behaviour, particularly residents' behaviours, and what impact it has across different groups in the population in conjunction with "Fast Track" measures. Furthermore, the final area for the Bristol CAZ is relatively small, so this deep dive will help us to understand if this leads to greater journey displacement compared with other areas where avoiding the zone is not as straightforward. Finally, findings from this case study can be used to compare with the experience in Birmingham, which implemented a similar CAZ, and provide learnings for future other local authorities that will also operate similar CAZs.
Sheffield and Rotherham	Sheffield & Rotherham is implementing a **Class C CAZ** in Sheffield affecting a large population including people travelling through the area. High polluting taxis, PHVs, vans, HGVs, buses and coaches would pay a charge to drive in the zone within the city's inner ring road but private cars will not.. Rotherham will be implementing non-charging measures. These include reducing speed limit to 50mph on the Rotherham section of the Parkway, improving the Rotherham bus fleet, and traffic management measures, such as proposing to divert some buses from the A633 Rawmarsh Hill to Barbers Avenue, and restricting HGVs on the	Similar to Bath & North East Somerset in monitoring a CAZ C and in this case an area where the CAZ will affect a large population journeying through the city. The case study is an opportunity to understand how local authorities in close proximity can work together, and to explore how joint measures such as the active travel communications campaign work in different contexts (with and without a CAZ).

Local Plan Area	Description of the measure	Key potential learning from case study
	northbound carriageway of the A629 Wortley Road/Upper Wortley Road.	

5 Case Study Methodology

This annex provides details of the methodologies of the two strands of case studies utilised in the Central Evaluation: deep-dive case studies, and Rapid Assessments (RAs). For further details on how deep-dive case studies and RAs work within the Central Evaluation, see **Chapter 2** of the main report. The following provides details of the methodology used to date in each of the case studies covered in this report.

5.1 Deep Dive Case Studies

These are mini-evaluations of a specific Local Plan, employing a range of quantitative and qualitative research activities to collect evidence on how and why specific measures are affecting NO_2 concentrations. Eight deep-dive case studies have been selected based on different geographies, measures and demographics. Sample sizes used in each deep-dive were decided considering the largest sample that could be achieved considering the budget available for each strand of work.

5.1.1 Bath and North-East Somerset (B&NES)

B&NES deep-dive was developed to gather learnings and assess outcomes from the earliest local authority to implement a Class C CAZ. To date, both the baseline and midline waves of fieldwork have been completed.

Baseline

Baseline data sources included a resident survey, a business survey, and secondary data review.

Resident survey: Ipsos carried out a telephone survey of **302 B&NES residents**, 73 living near in or near the CAZ and 229 living within the North-East Somerset constituencies. Fieldwork took place between **3rd and 25th November 2020**. Quotas were set for various demographic metrics.

- **Sampling design:** quotas were set for various demographic metrics, including age, ethnicity, income and gender. Quotas were also set to ensure a sufficient number of respondents lived both within the CAZ, and in other areas of B&NES.
- **Weighting:** data was weighted to match the known age profile of the adult population of B&NES, based on the latest Office for National Statistics (ONS) population estimates. Additionally weighting by working status was explored, but this was ultimately not included in the final data as the risks outweighed the benefits. It was found that using weights could reduce the effective base size of the sample which would have limited the statistical power of the survey data. Additionally, the weighting suggested working status was not a key discriminating factor in survey responses.
- **Sample profile**: the weighted sample profile is approximately representative of the population of B&NES in terms of age and gender. There are slightly more working people in the weighted sample, and slightly fewer retired people, than the proportions in the B&NES population overall. It has not been possible to establish whether the sample is representative in terms of income as over 40% of respondents did not disclose this information. Respondents who lived within the CAZ made up 24% of the sample, where they make-up 10% of the city's population.

Business survey: Ipsos carried out a telephone survey of **300 businesses**, based in or near B&NES. Fieldwork took place between **5th November and 3rd December 2020**. 178 of these businesses (59%) were based in Bath centre (within 3km of the centre of the CAZ); 122 were more than 3km but less than 30km away from this point.

- **Sampling design**: quotas were set on the metrics of proximity to the city centre, defined as within 3km of the city centre, and those on the periphery (between 3km and 20km from the city centre).Sample was purchased from a commercial supplier.
- **Sample profile**: a small share (6%) of surveyed businesses were identified in the sample as fleet operators, but 63% of surveyed businesses owned at least one vehicle according to their survey responses – and most (86%) owned between one and 10 vehicles that travelled into Bath. 40% of respondents did not report their annual turnover. The sample over-represents taxis, PHVs, HGVs, LGVs and coach companies (making up 43% of the sample) – which was important for answering the evaluation questions related to behaviour changes in these groups.

Secondary data review: the baseline stage also drew on other publicly available sources of data, listed below:

- Bath public consultations at final business case (FBC) and outline business case (OBC) stages
- 2011 census
- Public Health England Mortality Profiles
- ONS Population Estimates
- National Travel Survey
- GP Patient Survey

Midline

At midline, qualitative interviews with businesses and the B&NES Council CAZ delivery team were carried out. Fieldwork took place **between July and August 2021**.

B&NES Council depth-interviews: three interviews took place with members of staff at B&NES Council responsible for the implementation of the Local Plan. These interviews lasted 60-90 minutes, and explored views on how the CAZ was implemented, lessons learned, and impacts of the CAF mitigation measures and progress in monitoring and managing the CAZ.

Businesses interviews: 12 interviews were conducted with a range of businesses operating vehicles in Bath City Centre. Interviews lasted 30-45 minutes. They followed a detailed topic guide, exploring businesses' perceptions on the CAZ, the extent to which it has impacted business, and how they responded to its introduction. Interviews also explored views and experiences of the mitigation measures offered.

- **Sample:** Businesses who were contacted had previously taken part in either the deep-dive baseline survey, or the midline or end-line comms survey. The sample was purposefully biased towards fleet owners who were aware of the CAF support measures; findings are therefore not representative of the overall population of businesses (which was intentional). Instead, the

interviews provide insight into the experiences and choice pathways of those that did take action in response to the CAZ.

Table 5.1: Breakdown of businesses interviewed at midline by type of vehicle operated in B&NES city centre

Type of vehicle operated in B&NES City Centre	Number of businesses interviewed
HGVs	2
LGVs	5
Coaches	1
Buses	1
Cars (company fleet/pool cars)	3

Secondary data review: midline stage also drew on secondary data from B&NES City Council, listed below:

- CAZ Quarterly Monitoring Report April to June 2021;
- CAZ revenue and compliance data from;
- Park and Ride Passengers data;
- Bus usage and fare data;
- Walking and cycling counts;
- Taxi fares and unmet demand data;
- Health data/hospital admissions data;
- Data on retail/business/office space vacancy figures;
- Tourism statistics;
- Monitoring data on uptake of mitigation measures;
- GP Patients Survey (NHS data, publicly available).

The deep dive will conclude with end-line research, taking place in December 2021-May 2022. This will involve an end-line survey of businesses, qualitative interviews with businesses, and interviews with B&NES' Local Plan Delivery Team.

5.1.2 Birmingham

Birmingham's deep-dive was developed to gather learnings and assess outcomes from the earliest local authority to implement a Class D CAZ. To date, the baseline fieldwork has been completed, and the midline fieldwork is currently ongoing.

Baseline

The findings in this baseline report are based on a survey of residents, a survey of businesses, and on a secondary data review.

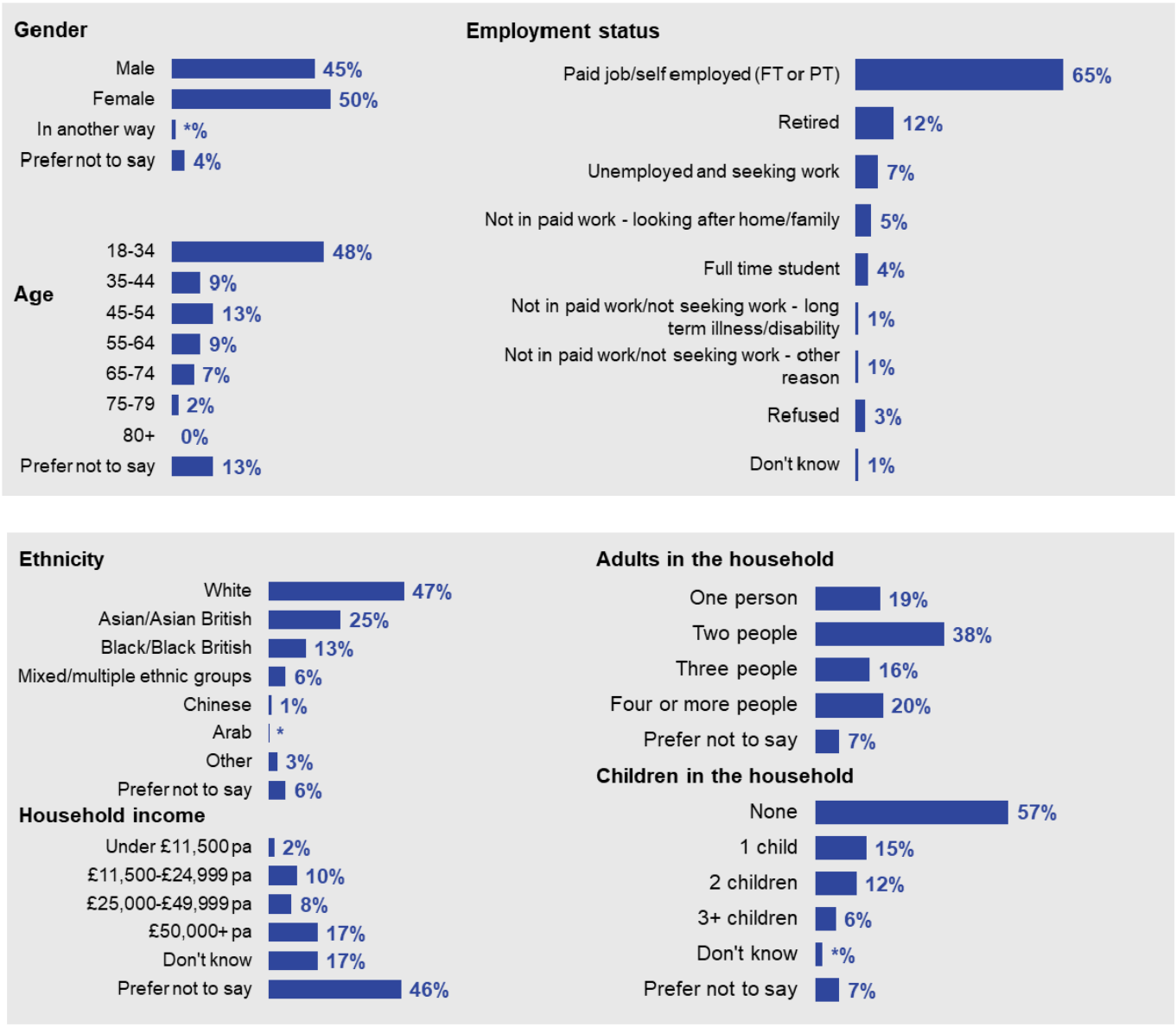
Resident survey: Ipsos carried out a telephone survey of **500 Birmingham residents**, half living in or near the CAZ and half living in the wider city. Fieldwork took place between **21st February and 29th April 2020**.

- **Sampling design:** quotas were set for various demographic metrics, including age, ethnicity, income and gender. Quotas were also set to ensure a sufficient number of respondents lived both within the CAZ, and in other areas of Birmingham.

- **Weighting:** quotas based on respondents' age were relaxed during the fieldwork period, as it proved challenging to meet the age quota within the restricted geographical areas that the survey targeted. Age appeared to be a significant discriminator of responses on a number of important measures and outcome variables; therefore, the evaluation team agreed to apply non-response weights to correct the age bias in the achieved sample. Weighting on variables other than age was agreed to be unnecessary, either because the profile of the achieved sample was in line with population figures (based on the latest ONS population estimates), and/or because those variables were not significant discriminators of responses.

- **Sample profile**: as shown in **0** the weighted sample profile is approximately representative of the population of Birmingham in terms of ethnicity. There were slightly more employed people in the weighted sample; slightly fewer students and retired people than overall Birmingham population. A larger proportion of respondents described themselves as female (50%) than male (45%). Nearly half of respondents did not disclose income information.

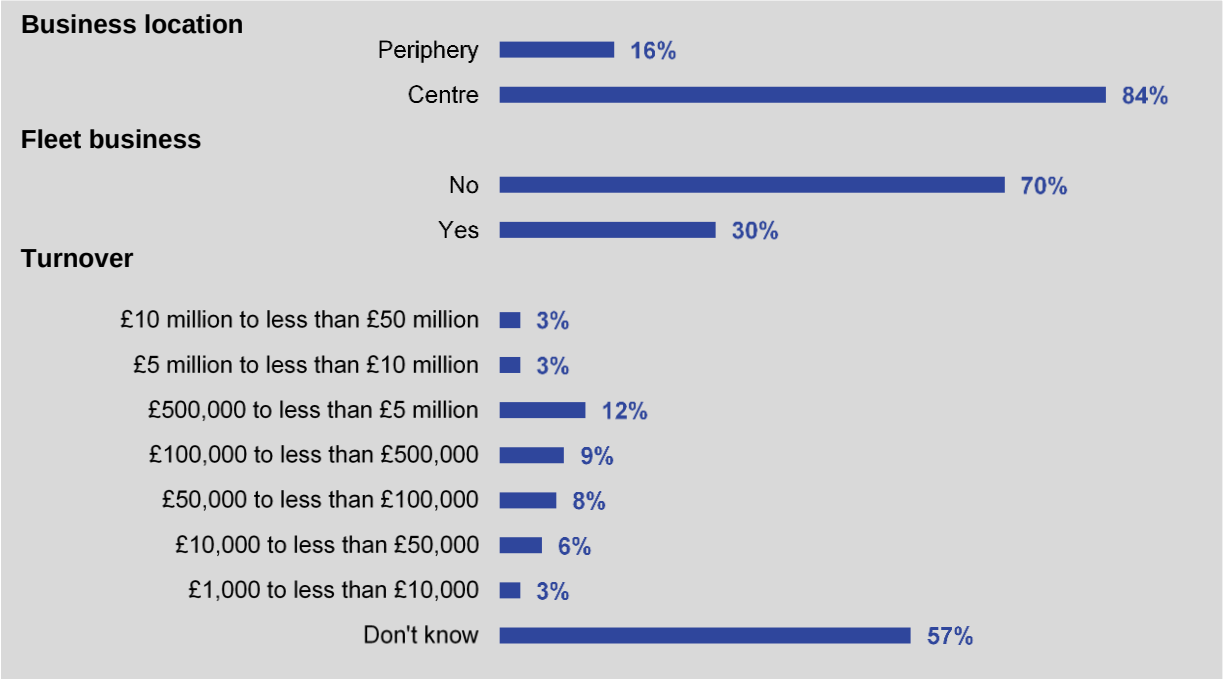
Figure 5.1: Weighted baseline resident survey profile Birmingham



Business survey: Ipsos carried out a telephone survey of **283 businesses**, based in or near Birmingham City Centre. Fieldwork took place between **22nd September to 29th October**. 239 of these businesses (84%) were based in Birmingham centre (within 3km of the centre of the CAZ); 44 were more than 3km but less than 10km away from this point.

- **Sampling design**: quotas were set on the metrics of proximity to the city centre, defined as within 3km of the city centre, and those on the periphery (between 3km and 20km from the city centre). Sample was purchased from a commercial supplier.
- **Sample profile**: three in five (61%) of the sample were businesses that operated at least one type of vehicle within the proposed CAZ area according to their survey responses. 30% of surveyed businesses were identified as fleet operators in the sample; these are likely to be bigger fleet operators with more vehicles. A larger proportion of businesses in the sample were located in the centre of Birmingham than the periphery (between 3km and 10km from the centre of the CAZ), as these are the business of greatest interest to the evaluation.

Figure 5.2: Baseline business survey profile Birmingham



Midline

Midline fieldwork is, at the time of this report, ongoing. Ipsos are currently undertaking 12 depth interviews with residents, 12 with businesses, and three interviews with staff at the Local Authority who are responsible for implementation of the CAZ.

Sample for the business and resident interviews has been drawn from those who previously participated in the communications evaluation business and resident surveys, and a smaller proportion has been drawn from surveys conducted in Birmingham baseline surveys.

5.1.3 Bradford

The Bradford deep-dive case study has been developed to gather a range of high-quality health outcomes data, in line with the Born in Bradford (BiB) study and access to NHS data for the local population. To date, the baseline fieldwork has been completed.

Baseline

Data sources for this stage included: qualitative depth-interviews and a business survey.

Depth-interviews: A total of **four interviews** were conducted with staff at Bradford Council with responsibility for delivering the Local Plan, and members of the Born in Bradford team. Interviews lasted 60 minutes. They explored views on how the CAZ was designed and has been managed, communication activities planned, financial support measures being offered, and anticipated impacts of the CAZ and other air quality measures on Bradford. These were conducted over the phone or virtually.

Business survey: Ipsos carried out a telephone survey of **150 businesses**. Fieldwork took place **31st August and 14th September 2021**.

- **Sampling design**: quotas were set whether the business is a fleet operator (according to the sample) and on location (in Bradford/on periphery). Sample was purchased from a commercial supplier.

- **Sample profile**: 34% of businesses who participated were in fleet-operating sectors, according to the sample; 86 businesses (57%) were within 3km of the centre of the CAZ; 64 (43%) were based in the periphery of the CAZ (approximately 3km to 20km from the CAZ).

Secondary data: the baseline wave of research has also utilised data from publicly available sources, including outputs from Bradford City Council and Born in Bradford, with whom the team are working collaboratively. These sources included:

- Consultation (May 2020) with taxi drivers and businesses with and without fleet from Bradford Council;
- CAZ monitoring information on telephone and web enquiries
- Health data from Bradford Council, Public Health England and Born in Bradford (Bradford District Respiratory Disease Mortality 2018; Bradford Public Health Joint Strategic Needs Assessment 2019; 2021 GP Patient Survey)

The next steps for this deep dive will involve midline and end-line research, expected to take place in 2022 – roughly three and six months after the implementation of the CAZ. This will likely incorporate qualitative research with business and further qualitative interviews with the Bradford Council team.

5.1.4 Leeds

The Leeds deep-dive has drawn on data from several sources. Following the cancellation of the Leeds CAZ in October 2020, this deep-dive was re-scoped, combining the midline and end-line reporting. A new set of research questions were agreed. To date, both the baseline and mid/end-line fieldwork has been completed. The following details the methodology used at each stage.

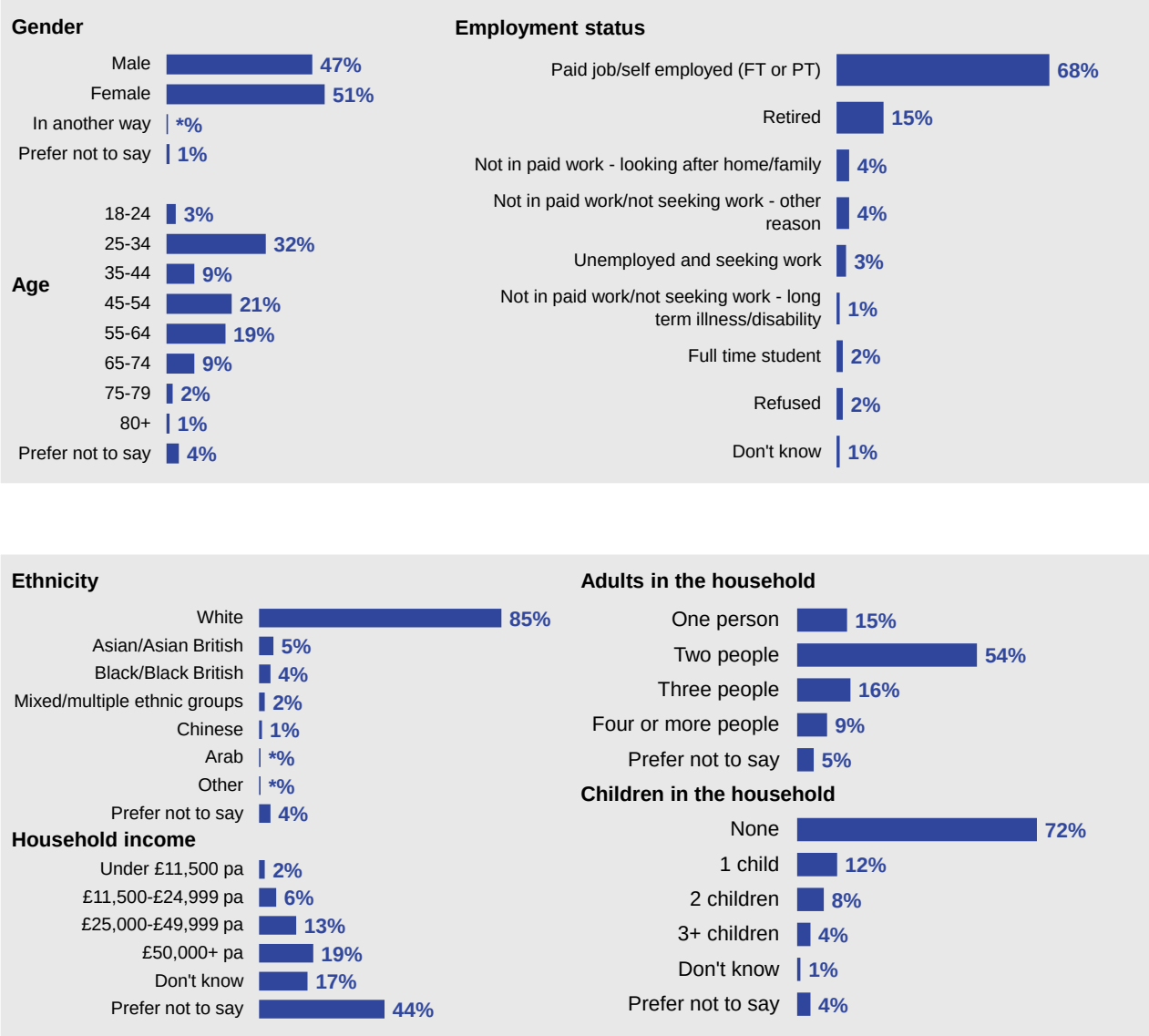
Baseline

The findings in this report are based on a survey of residents.

Resident survey: Ipsos carried out a telephone survey of **500 Leeds residents**. Fieldwork took place between **21st February and 29th April 2020**.

- **Sampling design:** quotas were set for various demographic metrics, including age, ethnicity and gender. Quotas were also set on the basis of residents living in the CAZ, and people living on the periphery (between 3-30km from the city centre).
- **Weighting:** the data was weighted to match the known age profile of the adult population of Leeds, based on the latest ONS population estimates. 21 survey participants did not provide their age; they were assigned a weight of 1. Additional weighting by working status was explored, but was ultimately not carried out as it would have limited the statistical power of the survey data through reducing the effective base size of the sample, but with limited benefits as working status was not found to be a key discriminating factor in survey responses.
- **Sample profile:** the following charts (Figure 5.3:) show the profile of the weighted sample.

Figure 5.3: Leeds baseline residents survey weighted sample profile



Midline/End-line

Following re-scoping, Ipsos and the Local Authority agreed this final stage of research would include a business survey and qualitative interviews with staff at Leeds City Council with responsibility for implementing the Local Plan, and a further 10 interviews with businesses which had replaced, retrofitted or redistributed vehicles at some point in the past three years. This also included accessing secondary data.

Business survey: Ipsos surveyed **125 businesses** located in Leeds and operating vehicles in the city. Fieldwork took place between **10th March and 2nd April 2021**.

- **Sampling design**: a purposive sampling approach was used, with minimum quotas set by vehicle type (see **Table 5.2:**). Taxi drivers were anticipated to be hardest to reach, so a proactive approach was taken wherein a bulletin publicising the survey was sent to taxi drivers by Leeds City Council. Licensed taxi drivers were invited to call a Freephone number to take part in the survey. Bus and coach operators were not included in this quantitative research, as there are relatively small numbers of such businesses, meaning the sub-sample would be too small to analyse.

- **Sample profile**: the sample over-represented businesses operating fleets in Leeds, with 80 (87%) of businesses surveyed operating in the centre of Leeds; the remaining 12 (13%) operated on the periphery. **0** shows the break-down of businesses surveyed by the vehicles they operate. It should be noted that there was crossover in vehicle types, with 70% of HGV operators also operating vans. 82 of the 125 businesses surveyed were SMEs, and one business was categorised as a large firm.

Table 5.2: Break-down of businesses in Leeds surveyed by vehicle operated at midline/end-line

Type of vehicle operated in Leeds	Businesses surveyed (number)
HGVs	26
LGVs	66
PHV/Hackney Cab	34
Cars	44
Businesses surveyed	**125***

Depth-Interviews: two sets of qualitative interviews were carried out at midline/end-line in Leeds.

- **Leeds City Council staff**: interviews with **five members of staff** at LCC who were responsible for implementing the Local Plan. Interviews lasted 60 minutes. These interviews helped inform the design for the business survey (see above), and contributed to the findings of the Leeds deep dive report. The interviews focused on the staff member's experience setting up the Local Plan.

- **Interviews with businesses**: **10 businesses** who had replaced, retrofitted or redistributed vehicles at some point the past three years from the sample. Interviews lasted 30 minutes, following a detailed topic guide exploring awareness of the CAZ, factors driving decisions to change vehicles or behaviours, and further changes planned in the future. The sample was purchased from an external sample provider and included interviews with bus and coach companies, who were not represented in the business survey.

Table 5.3: Break-down of businesses interviewed by type of vehicle operated at midline/end-line

Type of vehicle operated in Leeds	Number of businesses interviewed
HGVs	2
LGVs	3
Taxi	3
Buses and coaches	2

Secondary data: Ipsos has also utilised data from secondary sources:

- Leeds Clean Air Modelling Report, Leeds City Council, February 2021 (available at www.datamillnorth.org/publisher/leedscitycouncil by searching "Leeds Clean Air Zone – Compliance Modelling 2021")
- CAZ Statutory Consultation (Phase 2) Jul-Aug 2018, 3,532 responses to an online survey (m.e.l Research)
- ITS modelling data
- Leeds Analysis: Initial Findings, JAQU

5.1.5 National Communications Campaign

Aiming to assess the impact of communications campaigns around the launch of the CAZs in B&NES and Birmingham, baseline, midline and end-line surveys have been completed for residents and businesses in both local authorities. The results from these surveys have fed into the deep dive studies in these areas. Due to changes in methodology over the course of the evaluation, resident data is not available for B&NES at midline. See **Table 5.4**: for an overview of survey dates, and the number of both residents and businesses surveyed.

Table 5.4: Overview of methodology and sample sizes achieved across all waves in B&NES

Wave	Number of businesses surveyed	Fieldwork dates	Number of residents surveyed	Fieldwork dates
Baseline	300	5th Nov to 3rd Dec 2020	144	3rd to 29th Nov 2020
Midline	100	22nd Feb to 2nd March 2021	n/a	n/a
Endline	100	31st March to 7th May 2021	140	31st March to 14th May 2021

Table 5.5: Overview of methodology and sample sizes achieved across all waves in Birmingham

Wave	Number of businesses surveyed	Fieldwork dates	Number of residents surveyed	Fieldwork dates
Baseline	283	22nd Sep to 29th Oct	299	3rd to 29th Nov 2020
Midline	100	10th May to 2nd June 2021	150	10th to 21st May 2021
Endline	100	12th to 26th July 2021	150	5th to 25th July 2021

Birmingham

As part of this communications campaign evaluation, two waves of research were undertaken in Birmingham at midline and end-line; the baseline findings used the Birmingham deep dive serve as a baseline. To reflect this, this section will only discuss the methods used at midline and end-line.

Business survey: Ipsos carried out a telephone survey of **100 businesses at midline,** and **100 businesses at endline**. Midline fieldwork took place between **10th May and 2nd June 2021**; end-line fieldwork took place between **12th and 26th July 2021**.

- **Sampling design**: At both waves quotas were set on the basis of businesses in the CAZ or on the periphery (<3km and 3-20km from the centre) and on fleet versus non-fleet operators, according to the sample. Sample was purchased from a commercial supplier.
- Sample profile:
    - Midline: just below a fifth (17%) of businesses were identified as fleet operators in the sample, but 82% said they operated at least one type of vehicle in the city centre in their survey answers.
    - End-line: a similar proportion (14%) of businesses were identified as fleet operators in the sample. 87% operated at least one type of vehicle in the city centre in the city centre.

Resident survey: Ipsos carried out a telephone survey of **150 residents at midline** and **150 at end-line**. Midline fieldwork took place between **10th and 21st May 2021**, and end-line fieldwork took place between **5th and 25th July 2021**.

- **Sampling design:** At both waves, quotas were set for various demographic metrics, including age, ethnicity, income and gender. Quotas were also set to ensure a sufficient number of respondents lived both within the CAZ, and in other areas of Birmingham.).
- **Weighting:** At both waves, the data was weighted to match the known age profile of the adult population of Birmingham, based on the latest ONS population estimates.
- Sample profile:
    - Midline: the resulting sample profile saw men slightly over-represented, with 55% of the sample identifying as male, and 44% as women. Older age groups were also over-

represented, with 41% reporting to be 55+, and those under-35 were under-represented, with 23% reporting they were this age.

- End-line: the resulting sample profile once again had a similar proportion of men being slightly over-represented, with 55% answering they identified as male. The sample profile of age groups was more representative than the sample at midline, with 33% reporting to be under-35, and 30% being over 55.

B&NES

As part of this communications campaign evaluation , two waves of research were undertaken in B&NES at midline and end-line; the baseline findings used the B&NES deep dive serve as a baseline. To reflect this, this section will only discuss the methods used at midline and end-line. Due to changes in methodology over the course of the evaluation, resident data is not available for B&NES at midline.

Business survey: Ipsos carried out a telephone survey of **100 businesses at midline** and **100 at end-line**. Fieldwork dates for midline were between **22nd February and 2nd March 2021**, and at end-line between **31st March to 7th May 2021**.

- **Sampling design**: At both waves, quotas were set on the basis of businesses in the CAZ or on the periphery (<3km and 3-20km from the centre) and on fleet versus non-fleet operators, according to the sample. The sample is based on residents that drove through the proposed CAZ areas.
- Sample profile:
  - Midline: a small share (4%) of businesses were identified as operating a fleet at midline. However, half (50%) said they operated at least one vehicle in the city centre. 78% were identified as being based in the city centre.
  - End-line: a slightly higher proportion (9%) of businesses were identified as operating a fleet in the sample, and two-thirds (61%) operated at least one vehicle in the Bath city centre. 84% of businesses were identified as being based in the city centre.

Resident survey: Ipsos carried out a telephone survey of **144 residents at end-line**, with fieldwork taking place between **31st March to 14th May 2021.** Initially, baseline and midline surveys were carried out on Ipsos iOmnibus, but data revealed few respondents who were residents of B&NES (As the sample targeted those who drove through), hence limiting ability to assess locally targeted communications. The end-line survey was therefore redesigned as a telephone survey for comparison with the telephone residents' survey that fed into the B&NES deep dive evaluation, allowing Ipsos to target areas reached by communications. As a result, resident data is not available for B&NES at midline.

- **Sampling design:** quotas were set for various demographic metrics, including age, ethnicity, income and gender. Quotas were also set to ensure a sufficient number of respondents lived both within the CAZ, and in other areas of B&NES. The sample is based on residents that drove through the proposed CAZ areas.
- **Weighting**: At both waves, the data was weighted to match the known age profile of the adult population of B&NES, based on the latest ONS population estimates.

- **Sample profile**: There were significant challenges securing participants under 35 years old at end-line. The baseline survey showed differences with respect to age on key survey metrics, meaning differences between the survey waves could be influenced by different age profiles. To ensure the findings are comparable, under 35s have been excluded from baseline survey findings, and there are no under-35s in the sample profile for the end-line survey.

5.2 Rapid Assessments

Rapid assessments (RAs) are shorter-term case studies which focus on a particular area, measure, or relevant theme. Three RAs have, at the time of this report, either been completed or are currently in progress. The following provides details on the methodologies behind each of these.

5.2.1 Impacts of COVID-19

This RA examined how the COVID-19 pandemic has and will continue to impact businesses' ability to respond to the introduction of a CAZ. Wave 1 of fieldwork consisted of **401 business interviews** and was carried **29th October to 19th November 2020**, in Local Plan areas that will be implementing a CAZ: B&NES, Birmingham, Bristol, Greater Manchester, Sheffield and Rotherham, Gateshead/Newcastle (Tyneside).

- **Sample design**: a purposive sample approach was used to target businesses most likely to be affected by the CAZ due to be implemented in each of the six local areas. Broad quotas were set by area, geography, and whether businesses were flagged as operating a fleet by the sample provider. The sample was not designed to provide individual area analysis; rather, it aimed to provide an overview of business practices and views across these areas.
    - Geography refers to whether a business operates within the city centre (within 3km of the centre of the proposed CAZ) or on the 'periphery' (>3km and up to 10km from CAZ centre). In Manchester, what has been defined as Periphery is still affected by the CAZ due to its size.
- **Sample profile**: **401 businesses** were surveyed, 196 of whom had at least one site located in the CAZ area, including 43 who were classified as periphery because they *also* had a site on the periphery of the city centre. 150 interviews were conducted in areas due to introduce a Class D CAZ; 251 in areas due to introduce a Class C CAZ.

Table 5.6: Number of interviews conducted in each Local Area, by geography and whether businesses were fleet operators (Wave 1)

	Birmingham (Class D CAZ)	Bristol (Class D CAZ)	Bath (Class C CAZ)	Manchester (Class C CAZ)	Sheffield (Class C CAZ)	Tyneside (Class C CAZ)
Fleet operator, centre	21	28	3	13	30	21
Other business, centre	24	26	10	32	22	17
Fleet operator, periphery	15	18	15	15	19	19
Other business, periphery	10	8	12	9	6	8

A second wave of this research has been completed, examining the same local areas to understand how businesses' practices and plans have changed over time and their expectations for the future. Sample design for the second wave was the same as the first wave.

- **Sample profile**: **400 businesses** were surveyed, 250 (62%) of whom had at least one premise in a CAZ area. 165 interviews were conducted in areas due to introduce a Class D CAZ; the remaining 235 were conducted in Class C CAZ areas.

Table 5.7: Number of interviews conducted in each Local Area, by geography and whether businesses were fleet operators (Wave 2)

Classification	Total	CAZ Centre	CAZ Periphery	Birmingham (Class D CAZ)	Bristol (Class D CAZ)	Bath (Class C CAZ)	Manchester (Class C CAZ)	Sheffield (Class C CAZ)
Fleet operator, centre	200	137	63	33	41	41	37	48
Other business, centre	199	192	7	51	33	49	36	30

5.2.2 National Fleet Operators

This RA focused on national fleet operators, meaning fleet operators managing large fleets across England. The RA consisted of **four interviews with trade bodies** and a further **10 depth-interviews with national businesses from different industries.** Interviews were conducted virtually via Microsoft Teams. This approach was taken to achieve in-depth insights on how national fleet operators were responding to the introduction of CAZs. An incentive of £70 was offered to fleet managers completing interviews. Depth-interviews were 30-45 minutes long, following a detailed topic guide.

- **Sampling approach**: details of businesses who were surveyed were largely sourced through leads from the trade bodies who had been previously interviewed, and through JAQU. Quotas were set for different industries. These were: logistics/courier and express organisations; food

retailers; organisations producing aggregate; construction companies; utilities companies; transport companies.

- **Sample profile**: five of the businesses interviewed were logistics/courier and express organisations, referring to businesses responsible for transporting goods around the country, both in supply chains, from business-to-business and business to consumer. **Table 5.8:** shows a break-down of the resultant sample by industry, the role participants played in their organisation, and the size, type and ownership structure of fleets. Throughout the interviews, participants in different roles within their organisation often had a different base of knowledge, such as those in Public Affairs or Communications roles were more aware of the policy context, whereas those operating directly with Fleets or Operations tended to have more knowledge of how CAZs had impacted day-to-day operations.

In order to establish the context surrounding national fleet operators, a **rapid evidence review** was carried out. This systematic review was conducted via desk-based research, and examined government documents, 'clean air' plans from some of the UK's biggest fleets, and the wider industry approach to combatting air pollution.

Table 5.8: Number of businesses interviewed by industry and by the participants' role within their business

Type of business	Number
Logistics/courier and express organisations	5
Food retailer (Note: 1 of the logistics organisations was also involved in food service logistics)	1
Organisation producing aggregates	1
Construction company	1
Utilities company	1
Transport company	1
Public Affairs, Communications or Corporate Social Responsibility Roles	5
Fleet, Logistics or Operations management	5

No further research is planned as part of this rapid assessment.

5.2.3 Taxi Drivers Research

This RA was comprised of **15 telephone depth-interviews** conducted by Ipsos with taxi drivers who are registered in or near Birmingham (**9 interviews**) and B&NES (**6 interviews**). Fieldwork took place in **October 2021**.

- **Sampling approach**: aside from the geographies targeted, recruitment aimed to reach taxi drivers in terms of their employment type (with a split between those working for agencies, and those who were self-employed), and all with a minimum two years of experience.

- **Sample profile**: the taxi drivers interviewed represented a mix of self-employed taxi/PHV drivers, agency-affiliated drivers, and drivers who work for gig economy providers (for example, Bolt, Uber

or Ola). One participant worked as both a PHV driver and the manager of a taxi agency. Years of experience ranged from three years to 43 years. All drivers worked full-time.

Table 5.9: PHV/Taxi Drivers interviewed in each Local Area by Current Occupation

Current Occupation	Number
Birmingham	**Total interviews: 9**
Self-employed driver in an app (“gig economy” drivers)	1
PHV driver/taxi driver: self-employed	4
PHV driver/taxi driver: in an agency/company	4
B&NES	**Total interviews: 6**
Self-employed driver in an app (“gig economy” drivers)	0
PHV driver/taxi driver: self-employed	6
PHV driver/taxi driver: in an agency/company	0

Research in two further local areas, covering 15 interviews is planned for 2022.

6 The effects of COVID-19 and other external factors

6.1 Introduction

How have external factors impacted the effectiveness of local plans?

This annex aims to assess the extent to which external factors might have contributed to or hindered the impact of Local Plans in businesses and the general population. It relies both on secondary data available from the UK Government and sector associations, as well as on the findings from the two RAs conducted this year. These RAs explored how far external factors, predominantly the COVID-19 pandemic and EU Exit, may have affected businesses' ability to prepare for, and respond to the introduction of CAZs. The COVID-19 RA primarily targeted small businesses located in and around Local Plan areas, while the national fleets RA, targeted businesses operating large fleets across the country – and provided insights on both COVID-19 and EU Exit effects on these businesses.

Figure 6.1: Timeline of lockdown measures (2020)

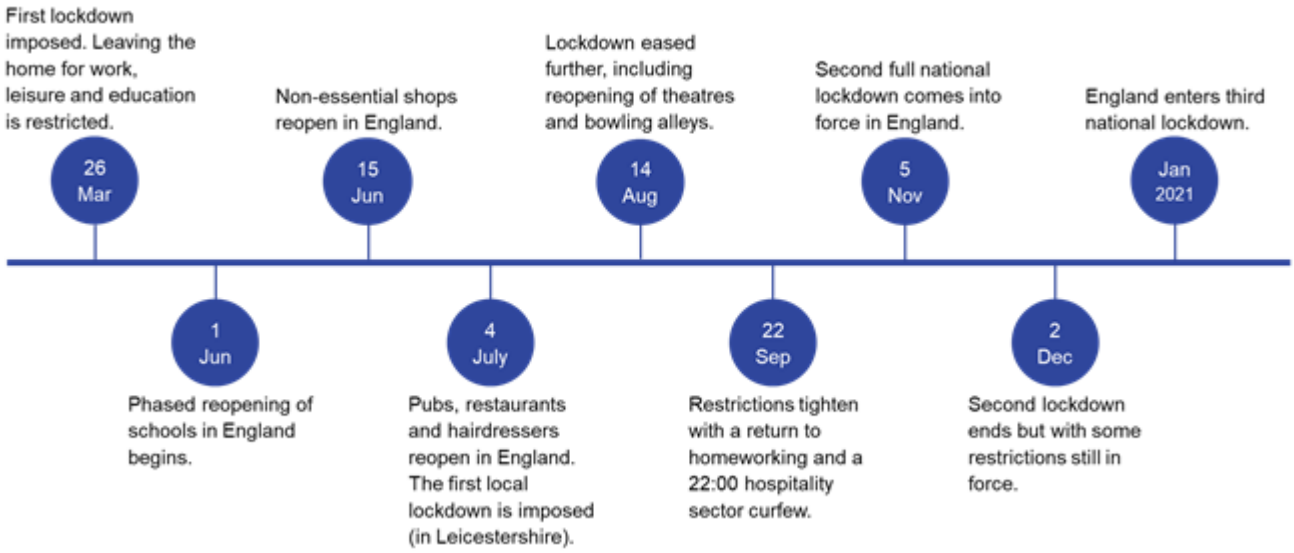


Figure 6.2: Timeline of the 'Roadmap out of lockdown'

6.2 COVID-19 effect on travel across UK

While most planned CAZs or those which have been implemented do not directly affect private vehicle owners, assessing the behaviours of private vehicle owners – as well as commercial ones – is relevant to understanding the extent to which changes observed can be attributed to the CAZs or otherwise. The COVID-19 pandemic and the associated lockdown measures were naturally key factors affecting the population's travel choices, with both private and public vehicle use decreasing overall initially, and discomfort surrounding the use of public transport remaining prevalent. Lockdown measures have meant a drastic decrease in travel by personal vehicle, due to the closing of non-essential commerce, office-based employees shifting to working from home, and the UK Government's stay-at-home order. Simultaneously, health concerns may have led more people to avoid public transport. The following section summarises the evidence available so far on how personal travel has changed as a result of pandemic, in terms of transport modal shifts or vehicle upgrades.

6.2.1 Modal shifts

The pandemic has led to ongoing concerns across the general population about using public transport, coupled with increased use of private vehicles – a trend that, if sustained, would potentially hamper the intended effects of the Local NO_2 Plans.

From the outbreak of the COVID-19 pandemic in March 2020, the use of public transport declined. Between February 2020 and March 2021, according to Department for Transport's (DfT's) "All Change" Study, the proportion of the public travelling by bus fluctuated between 18-31%, while train usage fluctuated between 7-25%[10]. Public transport usage was highest during Summer 2020, although still below pre-COVID-19 levels[11]. In the period of the first nationwide lockdown (March-May 2020), net-15% said they were using the bus less than previously, and net-12% said they were using the train less than before the pandemic[12]. The "All Change" study highlighted health concerns being a driving factor behind the general public avoiding public transport use, even after the strictest restrictions had been lifted. Less than a third reported feeling comfortable travelling by public transport between February 2020 and March 2021. Similarly, a survey by the Centre for Climate Change and Social Transformations (CAST) found that about half the general public (52%) were planning to reduce their public transport use in May 2020, which declined slightly to two-fifths (42%)[13] in October/November 2020, when some restrictions had been lifted.

The reduced use of public transport has been accompanied by a comparative increased usage of private vehicles. DfT's "All Change" Study has also shown an increase in private vehicles usage frequency between November/December 2020 and February/March 2021 (25% had increased frequency of travel with private vehicles, while 11% had decreased). Although the study does not provide a pre-pandemic baseline, DfT's National Travel Attitude Survey (NTAS), found that adults in England who owned at least one car tended to have travelled outside their home more during the pandemic than those without a vehicle.

It is unclear the extent to which these trends are likely to persist in the long term. DfT's NTAS found that, in August/September 2020, two-thirds (65%) of the public were likely to avoid using public transport when it is crowded, even after restrictions were removed.[14] Similarly, the NTAS study found that car use

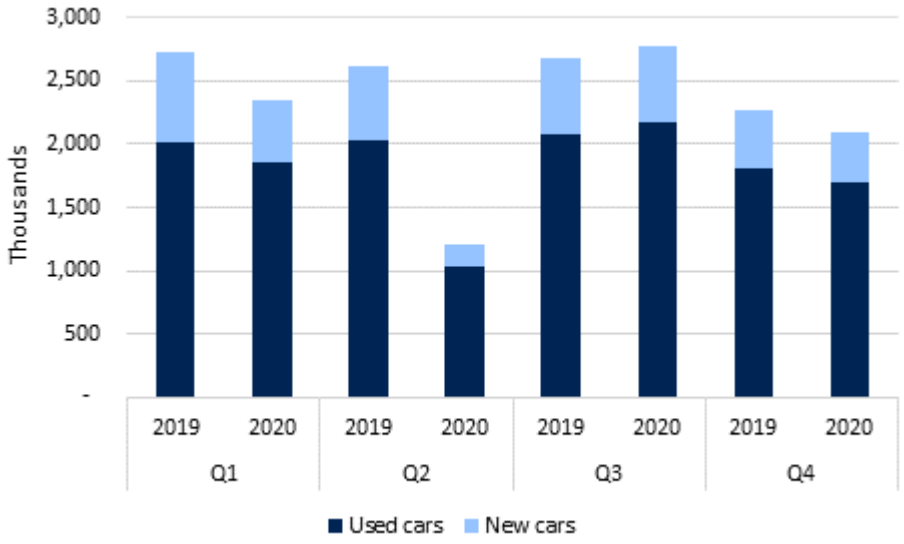
[10] See the wave one report, available at www.gov.uk/government/publications/covid-19-travel-behaviour-during-the-lockdown
[11] See the wave one report, available at www.gov.uk/government/publications/covid-19-travel-behaviour-during-the-lockdown
[12] See the wave one report, available at www.gov.uk/government/publications/covid-19-travel-behaviour-during-the-lockdown
[13] Full report available at www.cast.ac.uk
[14] National Travel Attitudes Study: Wave 4 (Final). Available at www.gov.uk/government/statistics/national-travel-attitudes-study-wave-4-final

had risen even as restrictions loosened, while another survey found that a higher share of people expect to use their car more after the pandemic than otherwise (23% against 9%).[15] However, in the "All change" study, conducted after the start of the vaccination programme, two thirds said they would feel comfortable using public transport once they (61%) and members of their household (60%) had taken the vaccine, suggesting a shift of these trends as the country moves out of lockdown restrictions.

6.2.2 New vehicle purchase and use

Such predilection for private vehicle travel did not see an immediate reflection in vehicle sales figures. Rather, new vehicle registrations dropped by 27% against 2019 levels, following lockdown measures implemented from March 2020, and as a result of dealerships being required to close,[16] and potentially as a reflection of the economic downturn that followed from the pandemic. Similarly, 2020 saw a 15% decrease in used car transactions in the UK relative to 2019. During Q2 2021, **since lockdown restrictions started to ease in the UK, monthly registrations of new vehicles have sharply increased year on year compared with the same quarter in 2020;[17]** new vehicle registrations in Great Britain in Q2 2021 increased by 163% compared to Q2 2020, yet numbers remain below pre-pandemic levels (down by 12.5% compared to Q2 2019). By contrast, UK used car transactions market grew by 109% in Q2 2021 relative to Q2 2020, up by 6.6% on 2019 pre-pandemic levels.[18] The global shortage of computer chips[19] affecting the industry as well as the stock shortages in the new car market[20] may have played a role in the increase in second-hand car transactions and might negatively affect car sales in Q3 and Q4 2021. Although data suggests vehicle ownership is increasing given population's preference for private vehicles, it is unclear the extent to which people are replacing old vehicles with new ones or, by contrast, obtaining new ones while keeping old models.

Figure 6.3: Used car sales and new car registrations in the UK



Source: DfT and SMMT used car sales and new car registrations data.

[15] YouGov poll, 2020, reported by Guardian. "People plan to drive more post-Covid, climate poll shows", The Guardian. Available at: www.theguardian.com/environment/2020/nov/10

[16] Department for Transport. Vehicle Licensing Statistics. Annual 2020. Available at www.gov.uk/government/statistics/vehicle-licensing-statistics-2020

[17] Department for Transport. Vehicle Licensing Statistics 2021 Q2. Available at www.gov.uk/government/statistics/vehicle-licensing-statistics-april-to-june-2021

[18] SSMT. Used Car Sales Data. Available at: www.smmt.co.uk/category/vehicle-data/used-car-sales-data

[19] "Global Shortage in Computer Chips reaches Crisis Point", The Guardian. Available at: www.theguardian.com/business/2021/mar/21

[20] "Computer Chip Shortage Stalls UK Car Industry Production", The Guardian. Available at: www.theguardian.com/business/2021/sep/30

There is also evidence of a growing interest in ULEVs among the general public, regardless of COVID-19 effects. In 2020 zero emissions vehicles made up 10% of new car sales in the UK.[21] This trend has continued into 2021, with the Department for Transport reporting a sharp increase in monthly registrations of new ULEVs, accounting for 11.9% of all new vehicles registered in the second quarter of 2021, a 3-percentage point increase (7.8% in 2020 Q2) against the same period in 2021.[22]

6.2.3 Active Travel

The COVID-19 pandemic has also had an effect on active travel, with social distancing measures leading to a rise in walking and cycling. It is possible that some of the observed increase may be connected to the Cycle infrastructure design (LTN 1/20)[23] introduced in July 2020, and which may have stimulated cycling infrastructure being deployed in local areas across the country.

As shown by DfT's statistics,[24] during 2020, cycling stages[25] across leisure, sport and utility per person increased by 23% compared to 2019, while miles cycled per person increased by 62% (54 and 88 miles per person respectively).[26] While cycling stages for *utility*[27] decreased by 20% in 2020, this was offset by cycling stages for leisure increasing by 75%.[28] An unpublished study being conducted by ITS outside of the Central Evaluation also suggests an increase in cycling over and above historic trends (see **Figure 6.4:**): in 2020, the mean number of cyclists passing DfT traffic count points was three times higher than in previous years, according to cycle counters by the DfT, General Additive Model (GAM) and National Transport Survey (NTS). All regions (including Scotland and Wales) saw an increase in cycle flows, with London and North-East regions seeing a higher mean cycle Annual Average Daily Flow.

However, these trends have shown signs of shifting as lockdown restrictions are lifted across the country: while Sport England's latest Active Lives survey found that people saying they are cycling for leisure or sport increased throughout the pandemic by 2.6% in May 2020-2021 compared to the previous 12 months (May 2019-2020),[29] cycling for leisure and sport had begun to revert back to pre-pandemic levels. In mid-March to mid-May 2021, 0.4 million fewer people were cycling for leisure or sport than in the same period in 2020, although this is still higher than the number of people surveyed who were doing so regularly in 2019.[30]

Further statistics will be required to track the extent to which the higher cycling routines during lock down will be translated (if at all) into higher rates of cycling for utility.

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[21] European Alternative Fuels Observatory (EAFO). Alternative Fuel Market Share New Registrations M1 (2020). Available at www.eafo.eu/vehicles-and-fleet/m1

[22] Department for Transport. Vehicle Licensing Statistics 2021 Q2. Available at www.gov.uk/government/statistics/vehicle-licensing-statistics-april-to-june-2021

[23] More information available at www.gov.uk/government/publications/cycle-infrastructure-design-ltn-120

[24] DfT. The impact of the coronavirus pandemic on walking and cycling statistics, England: 2020. Available at www.gov.uk by searching "The impact of the coronavirus pandemic on walking and cycling statistics, England: 2020"

[25] In the DfT's statistics, cycling and walking stages refers to when an individual cycles or walks as part of an overall trip – for example, cycling to the station on the way to work would be classified as a cycling stage.

[26] Available at www.gov.uk/government/collections/walking-and-cycling-statistics

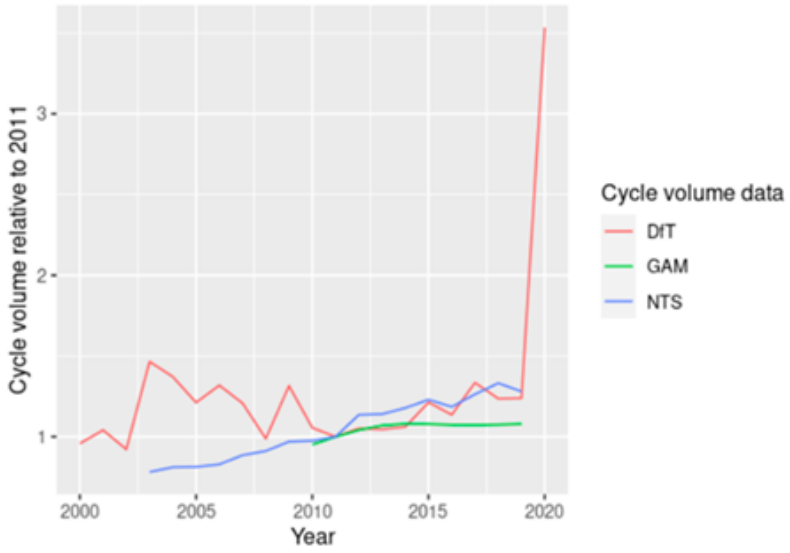
[27] According to the DfT, utility travel includes travelling for commuting and business, education and escorting as well as personal business. Travel for leisure includes shopping and other leisure (visiting family and friends, sport, day trips, and just walking/cycling).

[28] Available at www.gov.uk/government/collections/walking-and-cycling-statistics

[29] This refers to the proportion of survey participants doing this at least twice in the previous 28 days.

[30] It should be noted that this survey did not ask individuals about their active travel in relation to commuting, so this finding is not sufficient to say that more people are replacing motorised journeys with walking or cycling.
Active Lives Adult Survey May 2020/21 Report, available at www.sportengland.org/know-your-audience/data/active-lives

Figure 6.4: Cycle volume relative to 2011 and Mean Average Annual Daily Flow per DfT counter per region



Similar patterns were noticeable in people regularly walking. In the APSE survey, over half (55%) of participants said they were more likely to walk than they were than before the pandemic.[31] Reflecting this, the DfT's latest walking and cycling statistics found that the proportion of walking trips in relation to other transport modes increased in 2020, with people making 32% of their trips by walking in comparison to 26% in 2019.[32] Despite this, both walking trips and walking stages for utility decreased in 2020, while walking for leisure increased by 9%.[33]

The fall in active travel for utility should be seen in the context of the pandemic, in which people were generally told to work from home, and many individuals were put on furlough programmes or lost their jobs.

The impact of the COVID-19 pandemic on employment

According to ONS' overview of workers furloughed in the UK, one in four (26%) people who have been employed during the pandemic were furloughed at some point between March 2020 and June 2021.[34] Of these, just under a quarter (24%) were furloughed for 6 months or more; most (35%) were furloughed for between one and three months in total.[35]

Employment saw a precipitous decline between March and May 2020, with the number of pay-rolled employees falling by 660,000; by November 2020, 972,000 fewer people were pay-rolled employees than in February 2020.[36] The unemployment rate (meaning the proportion of economically active people aged 16+ who are unemployed) rose from 4% to 4.5% between January-March 2020 to June-August 2021.[37]

[31] More information in the article "The public trust councils more than Government in Covid Response" available at www.apse.org.uk/apse
[32] Available at www.gov.uk/government/collections/walking-and-cycling-statistics
[33] Available at www.gov.uk/government/collections/walking-and-cycling-statistics
[34] Full statistics in "An overview of workers who were furloughed in the UK: October 2021" available at www.ons.gov.uk
[35] Full statistics in "An overview of workers who were furloughed in the UK: October 2021" available at www.ons.gov.uk
[36] Full report "Coronavirus: Impact on the labour market" available at www.commonslibrary.parliament.uk/research-briefings/cbp-8898
[37] Full report "Coronavirus: Impact on the labour market" available at www.commonslibrary.parliament.uk/research-briefings/cbp-8898

6.3 COVID-19 effect on planned responses from businesses

COVID-19 effects on small businesses

COVID-19 pandemic has posed a significant strain on small businesses, and also on larger businesses operating across areas with planned or live CAZs. The travel restrictions and social distancing measures imposed to mitigate the spread of COVID-19 had significant impact on all businesses, with the UK's GDP shrinking by a fifth in the second quarter of 2020 (during the first nationwide lockdown).[38] Small businesses, according to the Bank of England in December 2020, were more severely impacted than large businesses (those with over 250 employees), with public health interventions coinciding with a 30-percentage point reduction in turnover growth for the average SME.[39]

In seeking to explore how these restrictions impacted on small businesses' ability to respond to the CAZs, the COVID-19 rapid assessment found that a third (33%) of small businesses surveyed had paused trading because of COVID-19 restrictions – and over a third (36%) of these paused for more than 12 weeks. COVID-19 related restrictions also caused businesses to reduce the frequency of travel within the CAZ areas, with business vehicle travel[40] dropping in half (49%) of cases, and employee commuting dropping in 70% of businesses that did not operate vehicles. This drop is likely due to changes in working patterns due to the pandemic; according to the Annual Population Survey (APS), an average of 37% of the workforce worked from home at some point in 2020, in comparison with 27% in 2019.[41] Notably, increases in homeworking and working flexibility since COVID-19 may continue even after the pandemic, in businesses for whom this is possible. In the Work After Lockdown survey from January 2021, three-quarters (73%) of office-based employees said they hoped for hybrid working arrangements in the future, and a third (36%) said they would like to work from home all the time.[42]

The COVID-19 pandemic and its impacts may also have affected business likelihood to replace or upgrade vehicles they thought may be non-compliant with the relevant CAZs. In the COVID-19 RA, a quarter (24%) of businesses surveyed had made plans to purchase or upgrade their vehicles to prepare for the implementation of their local CAZ, prior to the first UK-wide lockdown.

However, while two in five (40%) of those planning upgrades or purchase said their plans had been unaffected by COVID-19, a significant minority had cancelled (17%) or postponed (25%) the purchase of a new vehicle. While the reasons behind this were not explored, the fact that two-thirds (61%) of businesses surveyed had reported that turnover was lower than anticipated pre-pandemic suggests that this may have had significant impacts on their ability to invest in upgrades or amendments to their fleet. Notably, among the small businesses which had plans to upgrade or purchase new vehicle(s), 24% said they were planning on switching some or all of their fleets to either hybrid or electric vehicles. This reiterates a broader trend, with the market share of zero emissions vehicles making up 12% of new car sales in the UK in Q2 2021 (see below for more discussion on the general population's up-take of ULEVs).[43]

[38] Full report "The impact of the coronavirus so far: the industries that struggled or recovered" available at www.ons.gov.uk

[39] Full report "Staff Working Paper No. 924. Impacts of the Covid-19 crisis: evidence from 2 million UK SMEs"" available at www.bankofengland.co.uk

[40] Referring to trips for job purposes such as meeting clients or customers, but not commuting between home and work.

[41] Full report "Business and individual attitudes towards the future of homeworking, UK: April to May 2021" available at www.ons.gov.uk

[42] Full report "Working from Home under Covid-19 Lockdown" available at www.employment-studies.co.uk/resource

[43] Department for Transport. Vehicle Licensing Statistics 2021 Q2. Available at www.gov.uk/government/statistics/vehicle-licensing-statistics-april-to-june-2021

COVID-19 effects on large businesses operating fleets

In contrast, the qualitative research with businesses operating large fleets across the country found that, while those working in sectors such as construction saw a pause or decline in business operations initially, most participants generally felt that the pandemic had a positive impact on their business. This was particularly true for courier and logistics organisations or food retailers, who experienced a surge in demand due to the lockdown measures (including closing of non-essential businesses and the recommendation to stay at home) which resulted in an increase in online shopping.

"[Usually we] would have a peak season around Christmas, but since the beginning of the pandemic, we have been running in 'peak' and achieving double digit growth." (Fleet Manager)

As a result, the pandemic has had limited impact on these businesses' capacity to respond to the introduction of CAZs. As previously noted, all national fleet operators had long-term ambitions to "green" their fleets. These overarching business plans, upgrade schedules, and the more reactionary, shorter-term measures such as fleet redistribution in response to CAZs were largely noted to have remained on track during COVID-19.

'We're committed to full electric by 2025. [It's been] made more challenging by the pandemic, but we're still on track.' (Fleet manager)

However, in the short- to mid-term, some national fleet operators reported that vehicle upgrades had become more challenging – this is further explored below as it is also seen as connected to EU Exit. The temporary closure of auction houses due to government restrictions is also thought to have restricted the market for selling on older vehicles, further hampering fleet upgrades.

6.4 EU Exit effect on planned responses from businesses

The supply shortage of compliant vehicles was seen as the main indirect effect of both EU Exit and restrictions, which have been limiting businesses' ability to upgrade their fleets at the rate they would like to. For example, some say that difficulties in the supply chain have impacted the availability and wait times for electric vehicles or other compliant vehicles. This has been caused by a global shortage in semiconductors, which are central components in vehicles, and which has led to some vehicle production lines to be temporarily halted.[44] The Association of Fleet Professionals said in September 2021 that lead times on some vehicles could be six to twelve months, and the European Central Bank stated that this shortage is likely to persist until at least early 2022.[45]

'If anything at the moment, one of the challenges we do have is because of a shortage of parts when we've gone to place new orders for new vehicles, the lead times have been extended quite considerably. (...) I think it's a lead time of about two years, which will have any impact on how quickly we can react.' (Fleet manager).

A similar challenge raised by almost all national fleet businesses was the HGV drivers' shortage.[46] One construction retailer reported that the company's reliance on EU labour meant they had been '*hit hard*' by new restrictions on EU drivers coming into the country. The shortage of drivers had led to the business having vehicles standing idle. The participant was, however, confident that the business would quickly find the right balance. A trade organisation also reported this was a significant issue across the varied sectors it represents.

'One of the challenges is that we have a real skills shortage [of] HGV drivers. Not sure whether or not it's EU Exit or COVID-19, but we're not on the shortage occupation list and we don't qualify to be able to get non-UK workers to be HGV drivers, so we've got this real challenge of how we're going to fill the skills gap.' (Trade Association)[47]

Besides these points affecting business' ability to react to the CAZ, EU Exit has also affected day-to-day operations of logistics and carrier operators, due to the added hurdles in customs-checking. A construction business noted that shortages in a specific material from Spain and higher transport costs (accounting for between 20-30% of the value of goods) were challenges related to EU Exit. A logistics organisation said that a central issue was that communications from the UK Government seemed last minute, leaving limited time for businesses to prepare.

'The biggest challenge is about their communications and everything seems to go down to the wire. Businesses need time to prepare (...). They need to show us what to do and we'll do it, but at the moment we don't know.' (Fleet manager).

[44] August vehicle manufacturing update from the Society of Motor Manufacturers and Traders (SMMT), noting the continued impacts of global semiconductor (or "chip") shortage on UK and global car manufacturing. Available by searching for "August car production falls as global chip shortage continues to bite" at www.smmt.co.uk

[45] For more information see "Fleets should think carefully before buying safety decontented cars" available at www.theafp.co.uk; See also "The semiconductor shortage and its implication for euro area trade, production and prices" available at www.ecb.europa.eu/home/html/index.en.html

[46] More information available at www.gov.uk/government/topical-events/hgv-driver-shortage-uk-government-response/about

[47] This interview was conducted in July 2021, before the UK Government announced a package of measures in late-September 2021 to combat the HGV drivers' shortage. These policies included expanding the visa scheme until Christmas 2021 to allow an additional 5,000 HGV drivers to ease supply chain pressures.

6.5 Large fleet operators' vehicle upgrade practices

One of the key intended effects of CAZs is to accelerate vehicle upgrading towards compliant vehicles. However, vehicle upgrading practices in some groups tend to be more advanced than in others, and hence less likely to be affected by the CAZ. This evaluation sought to assess the extent to which this was the case for larger businesses whose core activity depends on transporting goods and people across the country – and whose fleet was hypothesised to make up a significant share of LGVs and HGVs circulating within existing and planned CAZ areas.

All of the businesses interviewed had strategies in place for upgrading and replacing vehicles in their fleet that they owned or leased regularly, based on mileage and wear and tear. However, for businesses with large fleets of self-employed drivers, most of whom owned their vehicles and were responsible for last mile deliveries, strategies for fleet upgrades were less regimented, focusing on offering leasing arrangements for cleaner vehicles, or ensuring drivers were aware of grants for which they could apply. Old vehicles that the businesses owned would be sold on the second-hand market and replaced with Euro 6 or alternative fuel ones (where they are available), or would be returned to the leasing business. Nearly all businesses interviewed had plans for upgrading their fleet to electric vehicles (EVs) or other alternative fuel vehicles, or were exploring their options to do so, with some working in partnership with manufacturers to supply vehicles that met their needs where they were not currently available. A review of strategy publications of similar businesses has shown a similar trend, with businesses primarily focussing on switching from petrol or diesel vehicles to electric or alternatively fuelled ones.[48]

Upgrade strategies included annual vehicle replacement programmes of part of the fleet, primarily based on age and functionality. Replacement age varied across sector and vehicle type, typically ranging from four to ten years.

"[The] age of vehicle [...] is the key aspect of replacement. There will also be some reliability of a vehicle: if you've got a 7-year-old vehicle that isn't working properly, that will probably get pushed down [meaning replaced]." (Fleet manager)

As highlighted in section **Error! Reference source not found.**, where non-compliant vehicles remained operational, fleet managers generally monitored vehicles operating around CAZs in an effort to prevent non-compliant vehicles entering the zones without the businesses' knowledge. Redistributing non-compliant vehicles away from CAZs and compliant vehicles into CAZs is also a recurring tactic. Ultimately, most businesses accept that fines may happen, but aim to reduce their frequency.

"We are committed to be fully electric by 2025 (...) but we can't get rid of Euro 5 vehicles as quickly as would like to. We will have to pay fines where we can't swap vehicles quick enough even though we've got them on order." (Fleet manager)

[48] For example: The Climate Group's Electric Fleet Coalition, bringing together over 30 leading national businesses including BP, DPD, Ikea and E.On. By joining the coalition, businesses are making a public commitment to transition vehicles to EVs and/or installing charging infrastructure on their premises. See www.theclimategroup.org/join-ev100.
Another example can be seen in members of the British Vehicles Rental & Leasing Association (BVRLA) pledging to increase their uptake of EVs, see www.bvrla.co.uk/industry-campaigns/decarbonisation/road-to-zero.html
Other businesses have their own plans, such as The Co-Op's ten point plan to reach net zero by 2040 in operations and productions, available at www.coop.co.uk/climate

Most national fleet operators with plans to upgrade fleets focused heavily on electric vehicles, where the technology was commercially viable across their fleets.[49] The replacement of conventional internal combustion engines (ICE) vehicles with hybrid or electric vehicles is key to the UK Government's net zero ambitions, and as part of this the Government has offered, in some form since 2011, a subsidy for those purchasing Ultra Low Emissions Vehicles (ULEVs).

Plug-In Vehicle Grants: changes in allowances

Introduced in 2011, the Plug-In Car and Van Grants reduce the up-front cost of eligible cars, providing a 25% grant towards the cost of new plug-in vehicles. For cars, it was capped at £5,000; van buyers could receive up to 20%, with a cap of £8,000.

Since then, the UK Government has responded to the shifting market for plug-in vehicles in the following ways:

In March 2020, it was announced that the electric car grant would be cut to £3,000; the following year in March 2021, the grant was further decreased to £2,500 for electric vehicles on cars priced under £35,000 focusing instead on 'more affordable models'.[50]

In the same budget it was announced that plug-in van customers would now receive a grant of 35% of the price for small vans to a maximum of £3,000, and 20% of the purchase price for a large van to a maximum of £6,000.[51]

However, for some national fleet operators the large-scale transition to electric vehicles is challenging. Generally, these tend to be those with a large proportion of HGVs or specialist vehicles in their fleets. A tracking survey by trade association Logistics UK in June 2021 found that 70% of businesses asked were dissatisfied with the availability of electric HGVs.[52] According to the IEA's 2021 report on global electric vehicle outlooks, while the market for electric HGVs is expanding, there remains a limited number of affordable models available, and a lack of necessary charging infrastructure (for example, "megachargers").[53]

While with large national business the impetus is clearly behind shifting the viable fleet towards ULEVs, a few national fleet operators suggested that UK Government cuts to the Plug-In Car and Van Grants were too abrupt, and negatively impacted the ability of these businesses to plan longer term business cases. The cost of ULEVs and other plug-in vehicles was also noted by one participant, who suggested that manufacturers would factor the subsidies into their prices – making such support redundant.

[49] Electric vehicles such as small vans and cars are widely available for national fleet operators – for example, Anglian Water has plans to replace 90% of their small vehicles with electric equivalents, but note the difficulty in switching to HGVs, opting instead to switch 55% of their HGV fleet to alternative fuels. There was a widespread understanding amongst participants with larger vans and HGVs that, at present, electrifying those vehicles is not possible, and these businesses are aiming instead to investigate the use of alternative fuels such as natural gas, biomethane or hydrogen.

[50] See the articles, "Plug-in vehicle grants update following today's budget" and "Plug-in car, van and truck grant to be targeted at more affordable models to allow more people to make the switch", available at www.gov.uk

[51] See "Electric car grant cut to £2,500 and eligibility changed", available at www.fleetnews.co.uk

[52] More information available at www.logistics.org.uk/coronavirus/logistics-performance-tracker

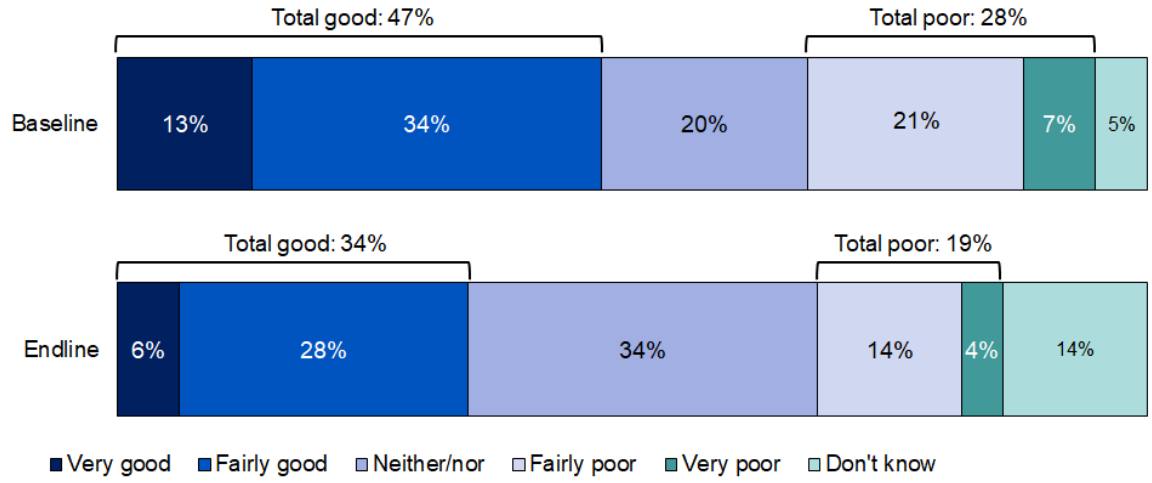
[53] Available at www.iea.org/reports/global-ev-outlook-2021. For more information, see "Why Regional and Long-Haul Trucks are Primed for Electrification Now" by ETA, available at www.eta-publications.lbl.gov, and "How Zero-Emission Heavy-Duty Trucks Can Be Part of the Climate Solution" by Global Drive to Zero, available at www.globaldrivetozero.org

7 Changes in perceptions of air quality

Despite air quality having improved over the analysed period, this is not reflected in perceptions of air quality across the general population. A third of the surveyed population said the air quality in Bath was good or very good when asked in April 2021, as opposed to 45% who said so in November 2020. On the other hand, perceptions of air quality have become slightly less negative as well: in April 2020, 19% of the surveyed population felt that air quality was poor or very poor in Bath, compared to 28% who said so in November 2020.

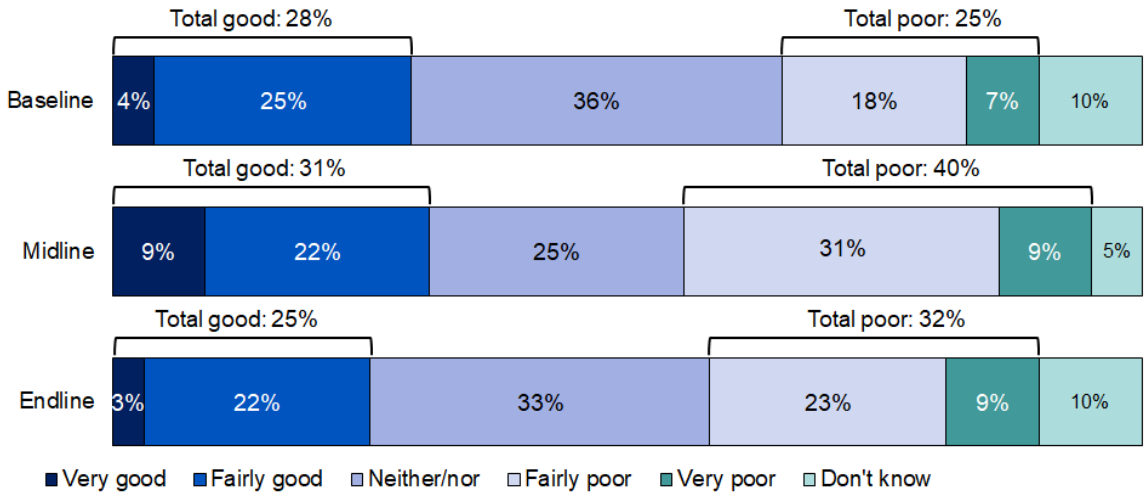
In Birmingham perceptions of air quality among residents have remained relatively stable overtime; approximately three in ten (29%) residents thought that air quality in the city was very or fairly good at baseline, a similar proportion (25%) than at endline. However, at midline, a larger proportion of residents thought air quality was poor (40%) compared to baseline (25%) and endline (32%) results. At endline, 45% of those who thought air quality was poor, supported to the CAZ while 23% thinking the same about the city's air quality supported its implementation.

Figure 7.1: Perceptions of air quality in Bath



Base: All adults in B&NES aged 18+. Communication Campaign survey – Baseline 3rd to 25th November 2020 (194); Endline 31st March to 14th May 2021 (140).

Figure 7.2: Perceptions of air quality in Birmingham



Base: All adults in Birmingham aged 18+. Communication Campaign survey – Baseline 21st February to 29th April 2020 (299); Midline 10th to 21st May 2021 (150); Endline 10th to 21st May 2021 (151).

Businesses surveyed in Bradford (n=150) had mixed views about the city's air quality; around one in three (35%) thought the air quality was very or fairly good, and one in four (25%) thought it was fairly or very poor, the same proportion of businesses mentioning it was neither good nor poor. One in seven (15%) did not provide an answer. There were some differences in the responses provided by those businesses located in the CAZ and those in the periphery; 34% of businesses located in the CAZ thought air quality was poor, compared to 13% of those located in the periphery. However, a similar proportion of businesses located in the CAZ (35%) and in the periphery (36%) thought air quality was good.

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