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Urban Transport Capacity and Demand Analysis: Demand Management Report

National Infrastructure Commission
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Introduction

Background and Purpose

1.1 Demand management describes a range of measures that seek to better manage the use of transport capacity, typically through reducing the demand for car trips and consequently:

- reducing traffic congestion, and the negative impacts of congestion on journey times and the local environment;
- releasing capacity (and roadspace) for more efficient modes such public transport and for cycling, including dedicated bus/tram priority or segregated infrastructure, and/or urban realm enhancements;
- contributing to other goals such as meeting net zero; and/or
- raising additional revenue to fund transport capital or operating expenditure.

1.2 However, as highlighted within the NICs' June 2022 *Getting Cities Moving* report[1], the success of such measures is not guaranteed, and is highly context-specific. Through a case study evidence review, and a high-level assessment of the capital and operating costs and revenues of potential demand management approaches, we have sought to:

- assess the potential role of demand management in increasing and/or better managing transport capacity to support city growth;
- assess the role of demand management in encouraging mode shift, and the consequent impacts on capacity requirements within cities;
- discuss the potential role of demand management within the 54 cities as a future policy tool, and the wider benefits versus costs of different demand management approaches;
- understand the potential capital costs, and ongoing revenue impacts, of these different approaches.

1.3 This section discusses the first three of these themes. Capital costs and revenues for different demand management approaches are set out in Chapter 7. It should be highlighted that the evidence that is available and directly transferable to support our assessment is limited, since:

- Within the UK, there is very limited evidence regarding the effects of charging-based approaches. In particular, outside London there is no observed evidence of the impacts of congestion charging, noting that the London Congestion Charge operates in a very different urban environment to other English cities. Even globally, there are very limited examples of where charging has been introduced in medium and smaller-sized cities;

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[1] National Infrastructure Commission (2022) '**Getting Cities Moving: Adaptive transport solutions for an uncertain future**'

- Much of the evidence only considers short-term, transport impacts of schemes – such as change in demand by mode – and does not consider wider implications such as local economic impacts or changes to patterns of land use.
- Schemes are highly context-specific, and outcomes from one scheme are may not be readily applicable elsewhere. When thinking about overseas examples, consideration also needs to be given to legal, cultural and societal differences as well as economic, land use and transport characteristics.

1.4 With these considerations in mind, we have sought to assess the role of demand management based on a case study evidence review, together with a wider consideration of the mechanisms through which demand management operates, and how the impacts of these could vary 'in practice' across the 54 cities.

Types of demand management

1.5 There are many types and variants of demand management. However, in an urban context these essentially fall into three broad categories. These are:

- **Urban Congestion Charging**: This involves vehicles having to pay a charge either to enter a specified area (cordon charge) or to travel within a specified area (area-based or zonal charge). The London Congestion Zone, introduced in 2003, is the only large-scale UK example.
- **Workplace Parking Levy**: A Workplace Parking Levy (WPL) imposes an annual charge on businesses based on the number of eligible workplace parking spaces at their premises. The only UK example is the Nottingham WPL scheme, which started in 2008, although several are at a mature stage of development by local authorities.
- **Physical Demand Management**: These involve the physical restriction of certain vehicles from crossing specified entry points. Examples include city centre 'bus gates', adopted in a number of UK cities. Oxford has recently approved trial 'traffic filters' which would restrict car users (without a permit) from passing through filters which is aimed at reducing traffic levels across much of the central and inner areas of the city.

1.6 The first two of these approaches represent '**charging-based'** approaches in that they seek to deter car trips by increasing the '**financial' cost of travel**. The latter represents a '**physical-based'** approach in that, by removing routes for private cars or reducing capacity, they typically deter car trips by lengthening journey times and increase the '**time' cost of travel**. We do not consider 'distance-based' charging approaches, which would likely require in-vehicle GPS technology, as such systems would likely be national in scope and are unlikely be delivered at the scale of individual cities (or city centres).

Social and distributional impacts

1.7 An important consideration for the development and implementation of such approaches is their **distributional** impacts, and in particular the extent to which impacts vary across different social groups. Public acceptability challenges relating to the perceived fairness of introducing demand management – and in particular charging those who are perceived to have no alternative choice to car travel for their journey – have historically been a key factor for why such approaches have not been taken forward.

1.8 Our assessment highlights the potential distributional impacts of different demand management approaches, drawing from a review of the groups each approach targets. However, it should be highlighted that the distributional impacts of any approach will be highly locally specific, and pertain to the availability of alternatives to the car for the user and trip in question, the local context, and the design of any 'discounts' or 'exceptions' for specific users (e.g. blue badge holders, residents within a charging zone, etc.)

Congestion charging

Summary of evidence

1.9 Within both a UK context and abroad, there is proven evidence that both cordon and area-based charging can relieve traffic congestion, support mode shift, and generate additional revenue to help fund improved transport infrastructure (both for capital investment and ongoing subsidy). It should be noted that these schemes were typically, but not always, delivered alongside improvements in public transport. This evidence includes:

- The London Congestion Charge, which reduced private car trips entering the zone by 36% by 2007 relative to 2002, the year pre-implementation (21% of all 4+ wheeled vehicles);
- Electronic Road Pricing in Singapore, which has reduced weekday traffic entering the restricted zone by 24%;
- The (initial) Stockholm Cordon Charge, delivered in 2006, which resulted in a 22% reduction in traffic entering/exiting the congestion charging zone.
- The Milan 'Area C' congestion charge, which reduced traffic in the charging zone by 15%.

1.10 Notably, each of these projects was delivered in large city centres, each within a wider metropolitan area of more than 2 million people, and with mature, comprehensive public transport networks. We are not aware of any comparable cordon or area-based schemes that have been delivered in small or medium-sized cities.[2]

1.11 Figures vary for the level of charge in different cities – higher in London (£5 in 2003, £15 in 2023), lower in Stockholm and Milan (circa £3.50 and £2.20 to £4.40 respectively in 2022), but still material relative to the wider cost of private car and public transport alternatives. The different scale of impact in terms of traffic volumes reflects both the level of charge, the scale of 'exceptions' or 'discounts' (e.g. to local residents) and the local context.

Implications for mode shift and demand suppression

1.12 The evidence suggests that, across the cities examined, the introduction of charging has also seen an increase in public transport patronage. Within London, for example, bus passengers crossing the city centre cordon increased by 37% after the first year of operation. However, the introduction of the charge occurred alongside wider improvements to public transport – indeed the number of bus and coaches crossing the city centre cordon increased by 23%.

1.13 From the data available it is not possible to directly determine the extent that those travelling by car change to travelling by another mode. Broadly speaking, after the introduction of charging for those who were previously driving to a city centre there are several potential outcomes:

- They continue to drive, to the same destination, and pay the charge;

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[2] Durham has a congestion charging 'zone', but this is not comparable as it is a lower, £2 charge to access a very small geographic area (the 'peninsula' in Durham City – only one circa 650 m long street is subject to the charge).

- They change modes, to public transport or active modes **('mode shift'**) – note where congestion charging occurs in a small geography, this may include park elsewhere outside the zone and walking the 'last mile' to their destination;
- They no longer drive to a city centre but instead change their destination and travel elsewhere, for example shopping elsewhere, or (especially in the longer-term) working in a job outside the charging zone and employment consequently occurring elsewhere ('**destination switching'**);
- They do not travel at all **('demand suppression')**
- They drive via a different route, avoiding the charge, if they were simply driving through the zone rather than to a city centre destination ('**route switching'**).
- They drive at a different non-charged time of day to do the same activity.

1.14 In the absence of empirical data or evidence, considering each of these outcomes is important to considering the likely economic implications for city centres specifically. This is summarised in the table below for the first five, which are most likely to occur in practice. Note this only considers the 'first-order' effects – revenue from charging can be used to fund wider transport enhancements, which have the potential to mitigate negative economic impacts.

Continue to drive	While charge payers experience a welfare disbenefit (a 'user charge'), there is no direct impact on city centre economic activity. Charging raises revenue but reduces long-term competitive advantage of city.
Mode shift	No direct impact on city centre economic activity, as individuals still travels to a city centre for work or leisure. People who change mode experience a welfare disbenefit. Potential benefit from reduced externalities of car travel, e.g. for urban realm, which may increase the attractiveness of city centre and hence deliver long-term economic benefits.
Destination switch	Lower city centre economic activity, as individuals now travel for work or leisure elsewhere. Implication that employment is adversely affected. People who change destination experience a welfare disbenefit.
Demand suppression	Lower city centre economic activity, as individuals now travel for work or leisure less frequently. Implication that employment is adversely impacted. Likely small in scale compared to destination switching. People who experience trip suppression have a welfare disbenefit.
Route switching	No net change in traffic but different routes taken change journey times and level of congestion in different areas with potential disbenefits. Significant for large cordons or charging zones (e.g. London); less relevant for small areas.

1.15 The likelihood of each of these outcomes will be different in different contexts, and there is very limited evidence regarding the relative share of each. However, it would be expected that the level of mode shift will be greatest in cities with the densest public transport networks, which provide a genuine, viable alternative to the private car on the basis of time, financial cost, quality and convenience. Typically, but not always, this is most likely to be the case in larger cities. For example:

- within London, with an unrivalled public transport network compared to other UK cities, even prior to the congestion charge the number of private car trips to/from the city centre for which private car was the fastest and/or cheapest mode relative to public transport (or park-and-ride) was very limited, if any. There was therefore scope for users to switch to other modes without any negative impact on their journey time or cost. Far more users will 'mode shift' as instead of 'destination switch' or not travel at all.

- within a 'large' city, such as Manchester or Birmingham, the public transport network offers a broadly good level of coverage and frequency, although for some journeys it will be less competitive (slower; more expensive; and/or less convenient) than private car. A greater proportion of car users 'priced off' by charging are likely to not find the alternatives suit their requirements, and hence either 'destination switch', or do not make the journey at all.
- Within 'small' cities, such as Burnley or Plymouth, the public transport network is typically less competitive than car for a significant number of trips. More users are likely to 'destination switch' as opposed to 'mode shift', with negative implications for city centre economies.

1.16 The London Congestion Charge model, an initial £5 charge (in 2003; now £15 with intermediate increases) applied to traffic within the charging zone is estimated to have reduced general traffic volumes by circa 21%, rising to 36% for cars, by 2007. The other international comparators (Singapore, Milan, Stockholm) of comparator schemes have delivered comparable changes in traffic volumes, typically around 20%, at a lower daily charge level.

1.17 The proposed all-day charge of £5 within Cambridge is projected to reduce traffic by 40 - 50%, but **only** if implemented alongside complementary investment in the public transport and active travel network, which is projected to increase bus trips by 30-50%, cycle trips by 15-30% and walking trips by almost 30%. Without this, the level of impact on traffic would be materially lower. However, this level of reduction in traffic and mode shift is forecasted, as opposed to observed and delivered in practice.

1.18 Assuming a £5 charge, based on the evidence available, we would expect a reduction in general traffic within the city centre cordons of 15 – 30% in the AM peak[3] dependent on the local context and the extent to which charging is paired with complementary investment, and:

- **The level of mode shift, versus destination switching, to be materially higher in larger city centres such as Birmingham, Leeds and Manchester** where the public transport networks are most comprehensive. Of the 15 – 30% reduction in highway trips, we would expect the majority of these to shift to other modes, with the majority of the remainder either 'destination switching' or 'route switching';
- This would **also be the case in smaller cities with strong city centre economies, and where significant complementary public transport investment is proposed**, such as Cambridge, which results in public transport and walking and cycling being strongly competitive for the majority of journeys;
- However, **in most (but not all) small- and medium-sized cities and/or those with poor public transport connectivity, we would expect the level of mode shift to be significantly less**, a higher proportion of former highway trips to 'destination switch' rather than 'route switch'. This is more likely to have a potentially negative impacts on economic activity in such city centres, deterring employment growth due to the poor perceived alternatives to

[3] The scale of reduction is likely to be greater in the off-peak, since off-peak trips are typically for more 'discretionary' trip purposes e.g. shopping, and where there is more choice regarding the ability to make the trip and to which destination.

driving. Less ability to mode shift means individuals feel either 'forced' to pay the charge or instead travel elsewhere, and such schemes are likely to face even greater public and stakeholder acceptability challenge.

Wider benefits and costs of congestion charging

1.19 Policy decisions to adopt congestion charging in any specific city, alongside any other demand management approach, would be based on a wider set of benefits and costs, beyond the direct impact on traffic reduction and/or mode shift. Reducing traffic volumes within cities is associated with a wider range of benefits, including:

- **Faster (and more reliable) journey times arising from reduced traffic congestion**. Even small reductions in traffic volumes will typically result in reductions in congestion and faster journey times. For example, a year post-implementation of the London Congestion Charge, congestion reduced by 30%, despite a smaller reduction in all traffic of 14%. This led to 14% faster car journey times, a 6% improvement in average bus speeds and a 30% reduction in bus excess waiting time.[4] These changes would have resulted in:
    i. Productivity benefits for business and freight users, such as an ability to make more deliveries within the working day for a courier. Particularly for those with very high values-of-time, and those using vehicles within the charging area for much of the day, these benefits can exceed the financial cost of the charge, and in such cases they experience an overall benefit despite having to pay;
    ii. Welfare benefits for commuting and leisure users, for both private car and bus users. They will experience faster journeys, for the former in exchange for an increased financial cost.
    iii. Reduced operating costs for bus services, which directly scale with average bus speeds, and potentially a reduced requirement for ongoing subsidy.
- **Social and environmental benefits from reduced traffic volumes**, including:
    i. Improvements in local air quality (NOx; PM10s) and reduced carbon emissions (both from reduced traffic volumes **and** more free-flowing traffic conditions);
    ii. Reduced negative impacts of traffic on local ambiance and amenity and the 'place' function of cities;
    iii. Potential safety benefits.
- **Greater opportunities for road space re-allocation**, as reduced traffic volumes provide increased scope to remove space from general traffic to walking, cycling and public transport which may not have been practically or politically feasible to otherwise implement. This includes:
    i. Bus priority infrastructure (e.g. bus lanes);
    ii. Better segregated cycling provision;
    iii. Better pedestrian facilities (e.g. greater 'green man' signal times) or urban realm improvements (e.g. part-pedestrianisation of major junctions);

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[4] Transport for London (2004) '**Congestion Charging Impacts Monitoring: Second Annual Report**'

Note that in London's case these benefits have been subsequently eroded over time, in part as road space has been re-allocated to other purposes since the introduction of the scheme in 2003, despite the reduction in traffic volumes being sustained over the longer-term.

   iv. Improved air quality and reduced severance/negative impacts of traffic on surroundings and better 'place' function for city centres.[5]
- **Greater revenue funding** enabling ability to fund wider transport improvements which would not otherwise be possible. Particularly in today's constrained funding climate, there are numerous transport improvements which local/combined authorities would like to deliver but are unable to do so because of a lack of either capital or revenue funding. Greater revenue funding can help provide both:
   i. **Ongoing subsidy** for local bus, rail and/or tram services, to increase service frequencies, improve network coverage and/or directly subsidise fares;
   ii. **Capital funding** for new bus, rail and/or tram infrastructure, through providing an income stream that can be borrowed against.

  Directly linking demand management to transport improvements can also help ensure that public transport network provides a viable alternative to the car for those who were otherwise driving to city centres, and hence:
   i. Reduce the potential for negative economic impacts for city centres from demand suppression and destination switching;
   ii. Help make demand management politically deliverable, and help demonstrate that the positive impact of public transport connectivity will outweigh the negative impact of charging general traffic.

1.20 All of the above will deliver second-order **economic benefits** to cities, making them a more attractive place for firms to locate, and supporting and facilitating city centre employment growth in the longer-term. However, they should be balanced against the costs of a congestion charging system, including:

- the **financial impact** of charging on highway users who continue to drive (in economic terms the charge is a 'user charge');
- **longer journey times** and/or **welfare disbenefits** for those users who continue to travel, but switch to an alternative mode less suited to their journey;
- potential for **negative economic impacts** should drivers travel by extended routes to avoid passing through a congestion charge zone. These negative impacts would be felt by those taking an extended route and by other traffic on those routes;
- potential for **negative economic impacts** whereby users who were previously driving instead travel elsewhere or not at all, with the implication that employment is adversely impacted.

1.21 While a business case process can help assess each of the above, the extent to whether congestion charging is an appropriate policy tool is subject to the relative weight decision-makers place on each of the above benefits versus costs. However, the overall core driver of the benefits of congestion charging is from reducing traffic volumes, and hence congestion, in cities, but via **mode shift** rather than **destination switching** or **demand suppression**, and hence avoiding negative economic consequences.

[5] Note that there are 'trade-offs' between these benefits – re-allocating significant road space away from general traffic may undermine the other benefits of the scheme in terms of reduced congestion. This has occurred, at least in part, in London, where levels of congestion have largely returned to pre-2003 traffic levels despite traffic volumes remaining below that before the introduction of the charge.

1.22 As discussed in Para 1.15, we would expect mode shift to be greatest within large cities and/or those with the most mature public transport networks. It therefore follows that congestion charging is likely to be best suited to such contexts, and where the car commuting mode share is already comparatively low.

1.23 Where car is the majority mode, and/or within most small and some medium-sized cities, it is unlikely even with significantly greater funding leading to improved public transport frequency and service coverage that the public transport network would be capable of matching the cost and convenience of travelling by car. Within these contexts, with lower levels of mode shift, the negative effects of charging are likely to be greater compared to the positives, and congestion charging is therefore unlikely to be an appropriate (or publicly acceptable) policy approach.

Potential social and distributional impacts

1.24 As considered in this study, congestion charging is applied to those users who **drive to, from or through city centres only**. On average, these users will be on higher incomes, since:

- Car ownership, distance travelled and trip frequency by car is strongly associated with increased income. People in highest income quintile drive travel circa 50% further by car each year than those in the lowest quintile[6]; 78% of households in the highest quintile have access to at least one car, compared to 62% in the lowest[7];
- Specifically for trips to city centres, within small and medium-sized cities car is unlikely to be the lowest cost mode of transport once parking costs are included[8]. For those who pay for parking, this means that few are driving to city centres on the basis of cost alone, and that users are driving because it is more expensive (in financial terms) in exchange for a faster or more convenient journey – which is more likely for those on higher incomes, who typically place a higher value on their time. Some drivers will have access to Private Non Residential (PNR) parking at no cost, but again on average it is expected that such people will be on higher incomes.

1.25 In practice, this will mean that the direct negative financial impacts of congestion charging on road users is more likely to be felt by those on higher incomes, especially in cities with already-high parking charges. Even so, there will be a proportion who incur the charge who will be on lower-than-average incomes and for these people the charge will have a greater negative impact than those in the higher income groups. Within the largest cities, city centre focussed congestion charges will be felt by a relatively small number of people, in relation to the total urban population; only a very small proportion of residents regularly drive (for any purpose) to large city centres.

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[6] DfT Statistics (2021) Table NTS0705: Travel by household income quintile and main mode / stage mode: England, from 2002.

[7] DfT Statistics (2021) Table NTS0703: Household car availability by household income quintile: England, from 2002

[8] The cost of city centre car parking, even before other car costs are included, will typically be greater than travel by bus to a city centre destination. For longer journeys, parking outside the city centre and using park-and-ride is also typically cheaper. Typically, but not exclusively, parking charges are highest in the largest cities where land values are greatest, and in these city centres driving will be most associated with those in higher income brackets.

1.26 Consideration also needs to be given to people travelling by car for non-work purposes, for instance to go shopping or access leisure activities found in city centres. Some of these impacts can be mitigated through how the charging scheme is specified, but generally such people be expected to be from across the income spectrum and would incur a disbenefit.

1.27 Many of the benefits of congestion charging are likely to disproportionately benefit those on lower incomes, who are more likely to use public transport, and especially bus services. Outside London, people in lowest income quintile, for example, make 76% more local bus trips than those in the highest[9]. Those on lower incomes are hence more likely to:

- Benefit from faster journey times and improved reliability of bus services from the reduction in traffic congestion created by congestion charging;
- Benefit from of greater revenue funding being invested in the public transport network, especially if funding is directed into the bus network (or light rail)[10].

Implications for capacity requirements, investment approaches and capital costs

1.28 Introducing congestion charging, and delivering a circa 20% reduction in highway traffic, would in practical terms increase the scale of capacity requirement for public transport and active modes. Drawing from the earlier demand and capacity analysis, we have assessed:

- The scale of this increased requirement;
- The extent to which it cannot be accommodated by the existing transport network, and hence results in an increased capacity requirement for each city.

1.29 We have assessed this impact based on three assumptions for the level of traffic reduction and mode shift. As discussed above, we would expect the 'high' assumptions to be more likely to occur within the largest cities with the most comprehensive public transport networks. These assumptions are:

- '**low'** – 15% reduction in traffic, 50% mode shift assumption, remainder do not travel, travel elsewhere or via a different route;
- '**medium'** – 20% reduction in traffic, 60% mode shift assumption;
- '**high'** – 25% reduction in traffic, 70% mode shift assumption.

1.30 Considering the 'City Centre Renaissance' scenario, prior to introducing the demand management assumptions eight cities had a requirement for additional urban transport capacity by 2055. Applying the above assumptions:

- The scale of capacity requirement (for public transport and active modes) increases in each of the eight previously constrained cities, as a proportion of highway demand shifts to public transport. Under the 'high' assumptions, the increase in capacity requirement (for non-car modes) is circa 15%;
- For two cities, there is now an urban capacity requirement – with the additional mode shift from demand management, the transport network can no longer accommodate the

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[9] DfT Statistics (2021) Table NTS0705: Travel by household income quintile and main mode / stage mode: England, from 2002

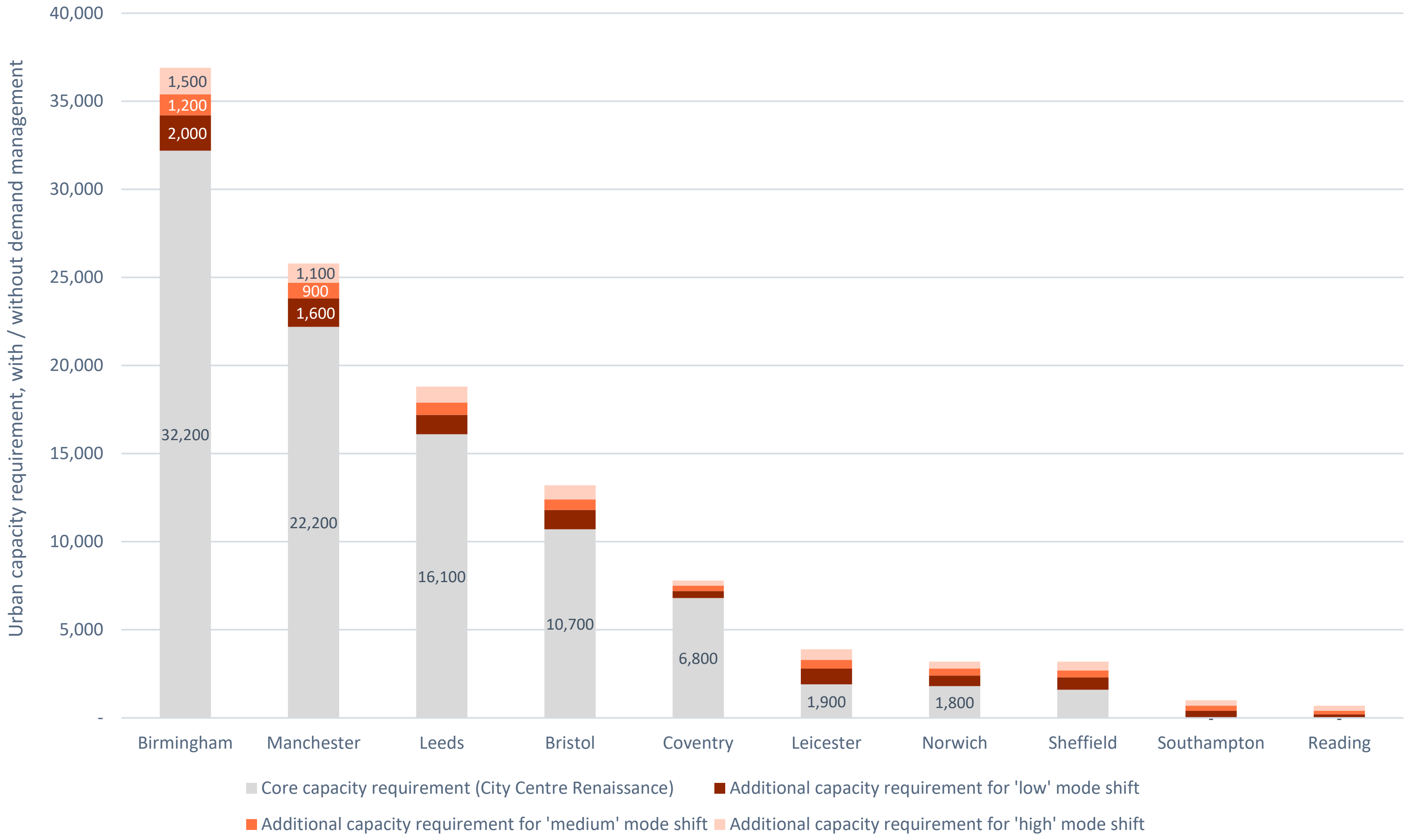
[10] Investment in longer-distance connectivity, especially rail, is more likely to benefit those on higher incomes, as these groups are significantly more likely to travel and commute longer distances to city centres that those on lower incomes.

increased demand to non-car modes arising from mode shift resulting from demand management;

- For the other ten cities, the level of mode shift away from private car can be accommodated within the existing transport network, and there continues to be no additional requirement for increased urban capacity.

1.31 Figure 1.1 summarises the scale of this potential increase capacity requirement for each city, again for the City Centre Renaissance scenario. The **grey** element of the bar represents the core urban capacity requirement, directly corresponding to the capacity requirements set out in **blue** bars in Figure 4.4 of the Main Report. The **dark red** represents additional requirement from mode shift under the 'low' charging assumptions; and each additional element of the bar moving from 'low' to 'medium', and 'medium' to 'high', levels of mode shift as a result of introducing charging.

Figure 1.1: Potential effect of introducing cordon-based congestion charging on urban capacity requirements



1.32 We have not included these additional requirements within the capital costings for new infrastructure in Chapter 7, as the scale of increased capacity requirement across different modes is highly uncertain and would be context-specific.

1.33 The reduction in highway demand would be expected to result in a greater ability to increase public transport and active travel capacity and potentially at lower cost – for example, less traffic making it easier to introduce bus priority measures and segregated active mode facilities, as well as reducing bus operating costs by reducing the negative impact of congestion. Revenue from charging would also help fund enhanced infrastructure and services which would otherwise not be available to cities.

Potential revenue and operating costs

1.34 We have assessed the high-level revenue, capital and operating costs of introducing a cordon charging system within the eight 'large' cities where charging is considered feasible.

1.35 This is based on an assumed £5 a day charge per vehicle, with exceptions similar to that in London, and the 'medium' assumptions for the reduction in traffic and mode shift as set out in Paragraph 1.29. The geography assumed for the cordon charging is generally tightly defined around an inner-city ring road and matches the city centres employment cordons. It should be highlighted that the revenues would be materially greater if implemented across a wider geography, such as the proposed Cambridge scheme, and those proposed in Manchester and Edinburgh in the late 2000s.

1.36 Figure 1.2 illustrates the potential annual gross revenue and operating costs of a cordon-based congestion charging scheme within 'large' cities, with the scale of the range accounting for potential downside effects of homeworking and business centralisation trends on commuting intensity, and/or a higher level of reduction in traffic crossing the cordon.

Figure 1.2: Estimated gross revenue and operating costs, eight 'large' case study cities

1.37 This indicates the potential for net revenues (including gross charge revenue and operating costs) of circa £50 - 60m per annum for Birmingham, £40m for Manchester and £30m for cities like Leeds, Bristol or Liverpool, all in 2022 prices. By way of contract, the revenue of the London Congestion Charge (and ULEZ) in 2019/20 was £247m.[11] Its operating costs were £85m, leaving a net position of £162m.[12]

1.38 The costs of development and implementation largely scale to the geographic size of the scheme and have been estimated based on the London Congestion Charge. Implementation costs are estimated at circa £60-70m for Sheffield or Newcastle and £140-150m for Birmingham[13].

Workplace Parking Levy (and other parking controls)

Background and summary of evidence

1.39 Parking charges can have an important role in deterring car usage, and the cost (and availability) of parking plays an important role in the decision of a user to drive to their destination, or where to travel for discretionary trips. Parking can be provided either in private car parks (charging the 'market rate' based on the scarcity, value of the land and the customers' willingness to pay, or discounted or free in the case of leisure or shopping destinations), public car parks or on-street (charges set by the local authority), or by private workplaces (often for free or heavily discounted).

1.40 Within this context, except for where a very large proportion of parking is provided by the local authority, there is limited scope for the public sector to directly use parking as a policy lever to manage demand. The exception is through a Workplace Parking Levy, of which Nottingham forms the sole delivered UK example.

1.41 The Nottingham scheme applies a charge per private workplace parking space, In 2022/23 this is £458, equating to circa £2 a day for a worker driving to work 5 days a week. However, this is **only** charged for commuting trips for where the parking space is provided by the employer (and for Nottingham if the employer has more than 10 spaces). This is only a narrow sub-set of car commuting journeys – in Nottingham we estimate circa 37% of car commuters – and an even smaller subset of all highway trips to city centres are affected by the WPL. Also, a significant proportion of employers do not pass on the charge to their employees (equivalent to around half the licensed spaces).

1.42 Compared to a cordon charge, where a £5+ daily charge is applied to the vast majority of city centre private car trips, the number of 'in scope' movements for charging is far smaller, and the daily charge they are in effect paying (circa £2 in the case of Nottingham) also smaller. It is therefore expected that the impacts on highway demand and mode shift are also significantly smaller than for a 'congestion charge' type approach.

1.43 Within Nottingham, ex-post evaluation evidence suggests:

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[11] Other than the last few weeks of 2019/20, this year was unaffected by the pandemic. In 2019/20, the charge was £11.50; it increased to £15 in June 2020.

[12] Transport for London (2020) '**Annual Report and Statement of Accounts 2019/20**', page 123

[13] Note this does not include any potential efficiencies where cities already have existing ANPR infrastructure for other charging systems (e.g. Birmingham's Clean Air Zone)

- Of those commuting by non-car modes, 4.4% responded that they switched from the car in part due to either an increase in the cost of parking at work, or the removal of parking at work. This increases to 8.6% if they reported switching from the car due to PT and cycling improvements funded by the WPL itself (which would not otherwise have been delivered);
- Since non-car modes account for circa 47% of all commuting trips (2011 Census data), this 4.4% and 8.6% equates to a circa 3.5% increase in the use of non-car modes for journeys to work linked to the WPL itself, or 7% if the complementary transport investment it helped fund are also included;
- Accounting for other general traffic for non-commuting trip purposes would reduce the aggregate level of mode shift further, likely to circa 1-2% and 3-5% respectively for WPL alone and WPL plus funded measures;
- The ex-post evaluation suggested that, additionally, a quarter of car commuters surveyed had switched to the car since 2010 – in part due to the release of highway capacity caused by the above effects. This reduces the net level of mode shift, with the study concluding there is "*evidence of significant suppressed demand for travel by car and this may be obscuring the beneficial impact on individual mode shift of the WPL package*".

Implications for mode shift and demand suppression

1.44 The implication of the above is that the WPL can play a role in supporting modest levels of mode shift from private car to more sustainable levels of travel. It also highlights that the 'carrot' of improved PT capacity (funded by the WPL) was of comparable importance as the 'stick' of the charge itself in driving travel behaviour.

1.45 However, the size of the levy, and its applicability to only a small proportion of all AM peak hour traffic, is likely to mean that the level of reduction of highway demand and mode shift to public transport and active travel is likely to be relatively modest in absolute terms – perhaps 1-2% - when compared to the total demand crossing the city centre cordons.

1.46 Hence, WPL can play a role in supporting mode shift and raising revenue to help fund local transport enhancements (in the case of Nottingham, a major expansion of their tram network). These enhancements will, in turn, increase the overall capacity of the transport network – and for a city or local authority with large funding pressures not be affordable without it. However, the direct impact of WPL **itself** on user behaviour on demand crossing city centre cordons by mode – the focus of our study – is likely to be small in practice and we have not assessed it further.

1.47 Were higher WPL charging levels to be introduced, we would expect the impact on highway demand and mode shift to be materially greater. However, it should be noted that:

- for city centres where a high proportion of parking is provided at private car parks not at workplaces (e.g. contract parking in commercial car parks), there are no current powers available to local authorities for this to be subject to charging, and this will limit the ability of a higher level of WPL to be implemented in practice (as individuals simply use a cheaper, private car park instead);
- for small city centres, where there is significant free on-street parking outside the cordon but within walking distance of the city centre, this would also constrain the effectiveness of WPL, particularly with higher charging levels – as individuals can simply park on-street and walk to the workplace.

1.48 Reducing or limiting parking provision within city centres would be expected, in isolation, to increase the cost of parking and hence deter car journeys, especially for commuting trips where spaces are typically occupied 'all-day'. The nature and type of impact would be expected to be similar to for congestion charging by reducing city centre traffic, but the scale will be dependent on the extent to which parking is reduced, and the price increased.

1.49 Since the ability of local authorities to manage or reduce **existing** commercial parking is limited, it is unlikely that this can make a material contribution to reducing city centre traffic volumes, outside of a small number of cities where the local authority is the major provider of public parking.

Wider benefits and costs of a workplace parking levy

1.50 The discussion and evidence above highlight the **net** impact on mode shift and traffic volumes of a WPL similar to Nottingham is likely to be very modest in practice. Hence, the effects of a WPL on journey times and decongestion; local air quality; carbon emissions; local environment; and opportunities for road space reallocation are also likely to be small, even if some individuals do adapt their behaviour in response to the WPL. The nature of the benefits will be comparable to congestion charging (as set out in Para 1.19), but far smaller in magnitude.

1.51 The core benefit of the WPL is instead the ability to raise significant revenue to fund transport enhancements. This is demonstrated in Nottingham, where the revenue raised by the scheme helped fund a major £570m, 18 km expansion of the tram network, redevelopment of Nottingham station and ongoing financial support to the bus network. Each of these delivers a wider set of social and economic benefits, which can at least in part be attributed to the WPL.

Potential social and distributional impacts

1.52 A WPL is applied as a charge for those who drive to workplace-provided parking. Since commuting by car is also associated with higher incomes, overall the net effect is greatest on those on higher incomes. However, unlike city centre congestion charging, it should be highlighted that:

- a WPL is typically applied across an entire local authority geography. Within this, there will be many workplaces and car commute journeys which are poorly suited to any other mode, and where public transport will be significantly longer and/or more expensive. Some of these journeys will be made by those on lower incomes, who will perceive they have no alternative to drive;
- compared to commuting to a city centre, one would expect less variation in car commute mode share by income. Compared to congestion charging, proportionally more revenue would be expected to be raised from those on lower incomes. The personal impact of the charge (at circa £450 per year) will be greater for an individual on a lower than higher income, as it accounts for a greater share of their total income;
- since a WPL is applied across a wider geography, the total number of people affected is likely to be substantially greater than a city centre congestion charge;
- in contrast to a congestion charge, only commuters are affected. People travelling by car for other purposes would incur no extra charge.

1.53 Similar to congestion charging, the overall distributional impact will also depend on how revenue raised from the charge is spent. In the case of Nottingham, the greatest benefits from improvements to bus services and expansion of the tram network are likely to have been felt by those on lower incomes and/or more disadvantaged groups. Specific discounts from the WPL can help alleviate negative distributional impacts – for example excepting blue badge holders or NHS staff – and since the charge is levied on the business itself, it is the businesses decision whether to pass some or all of the charge onto its employees.

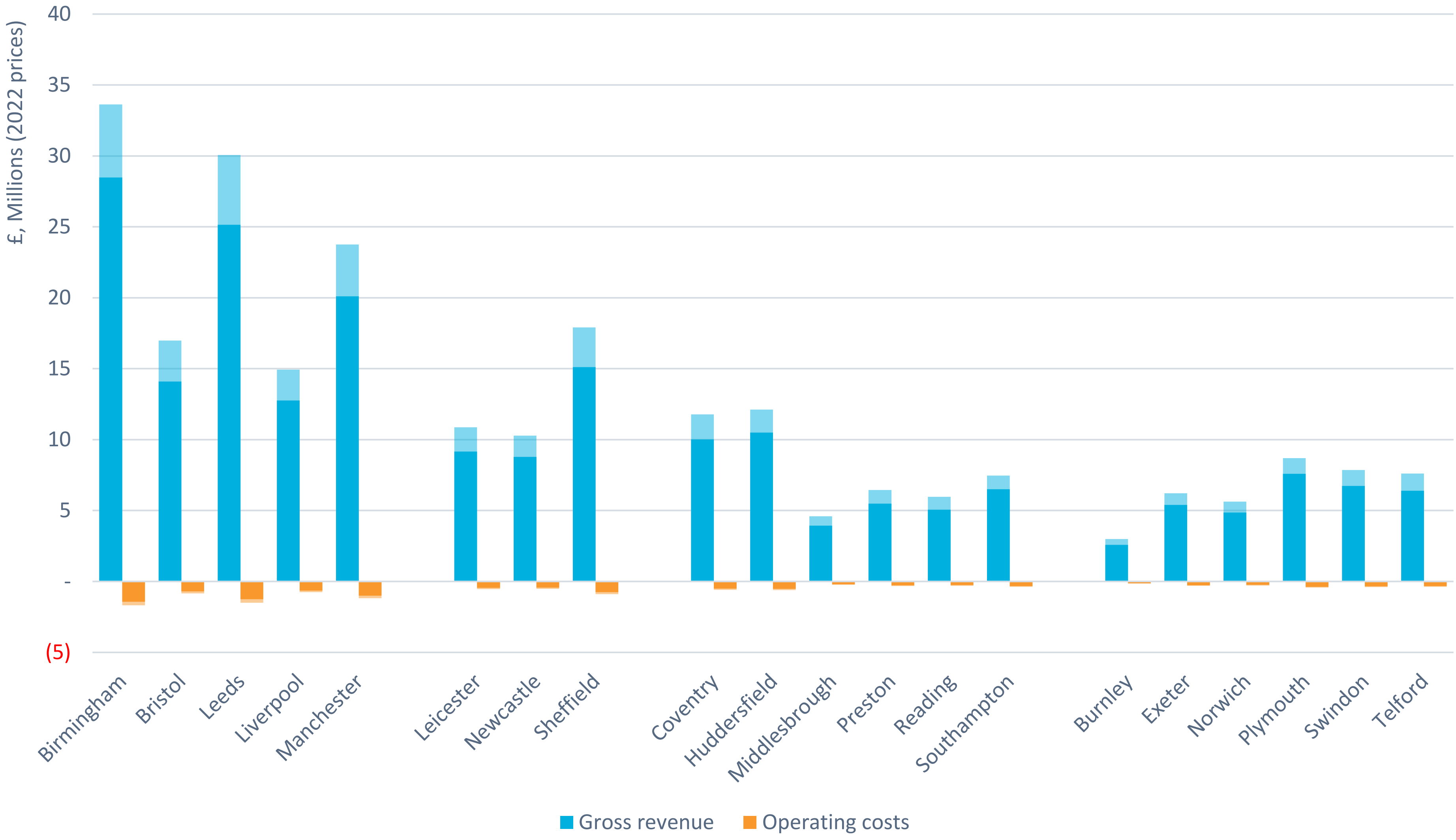
Revenue and operating costs

1.54 We have assessed the high-level revenue, capital and operating costs of introducing a Workplace Parking Levy across the 20 case study cities. This assumes a levy similar to that delivered in Nottingham and under development elsewhere. The levy is applied within the local authority boundary to workplace parking only. This is a significantly broader geography compared to the city centre-based cordon charging described above.

1.55 Figure 1.3 shows the indicative potential annual gross revenue and operating costs of a workplace parking levy scheme on the case study cities, with ranges accounting for the potential effects of homeworking and business centralisation trends on commuting intensity.

1.56 It illustrates the potential for net revenues (including gross charge revenue and operating costs) of circa £25-30m per annum for Birmingham or Leeds and £15-20m for other large cities such as Bristol and Manchester, all in 2022 prices. A 'medium' sized city like Coventry could potentially have annual net WPL revenues of around £10m, while a 'small' city like Norwich would be around the £5m mark.

Figure 1.3: Estimated workplace parking levy gross revenue and operating costs, 20 case study cities



1.57 It should be highlighted that the workplace parking levy assessment has been undertaken at an LAD level, which may not always reflect a practical or ideal geography for such a charge to be introduced. This is particularly the case within Huddersfield, where the LAD geography (Kirklees) also includes a wider rural area and several free-standing towns such as Dewsbury.

1.58 The costs of development and implementation of the WPL would be directly related to the size of the scheme and have been calculated using available data from Nottingham. They are expected to range from £1-2m for smaller cities like Norwich to £8-10m for Birmingham, the largest city and LAD.

Physical demand management

Summary of evidence

1.59 There is a broad range of evidence of different types of physical demand management, all with the common aim of restricting access to general traffic and hence deterring use at different scales. These range from:

- local measures such as 'bus gates' on specific streets;
- traffic filters introduced to limit or constrain access specifically to city centres (such as within Cambridge and Groningen); and
- wider, 'area-based' measures which restrict traffic movements between distinct zones across a wider city geography, such as proposed in Oxford and often referred to in a UK context as 'Low Traffic Neighbourhoods'.

1.60 The wide scale over which these measures are implemented can make it challenging to assess and compare their impacts, particularly at a 'network level' as opposed to specific streets as traffic re-routes on the network.

1.61 Within Ghent, after the delivery of the New Circulation Plan, focused on movements across and within the city centre, overall peak hour car traffic is reported to have fallen by 12%, increasing to 29% on specific routes within the ring road and 58% on local, residential streets, with a 25% increase in cycle traffic and 6% in public transport, indicating the potential for a high level of mode shift. Similar findings have been reported from early research for Low Traffic Neighbourhoods within London.

Benefits and implications for mode shift and demand suppression

1.62 The primary means by which such schemes are successful in reducing traffic is by making traffic to take longer routes – for example, rather than driving through a city centre or residential area, a driver would be required to make a longer journey via a boundary or ring road to make their journey. This lengthens journey times, increasing the 'time' cost of travelling, and encourages travel via an alternative mode (or destination, route or not at all).

1.63 This also delivers a significant benefit to the street or corridor which has been filtered (indeed, this is the primary objective), which will experience a large-scale (50%+, dependent on if some vehicles are exempt) reduction in traffic, which dependent on local context can:

- release significant capacity for public transport in the managed area by removing general traffic (e.g. 'bus gates' delivered in Cambridge city centre, Manchester and elsewhere – all of which by removing general traffic have released capacity for local bus services and typically led to faster journey times and reduced bus operating costs, and will support local mode shift);
- enable urban realm improvements, and road space reallocation to walking and cycling;

- improve the local ambiance by virtue of removing traffic, reducing noise, severance and improving air quality; and
- result in second-order health benefits from increased active travel.

1.64 Unlike charging-based approaches, physical demand management does not directly raise revenue, and schemes are primary justified on the basis of the social and environmental benefits above. These benefits must be balanced against longer journey times for those who continue to drive and must take a longer route, and potentially greater traffic volumes and/or congestion on 'boundary' roads to which traffic is displaced.[14]

1.65 It should be highlighted that such schemes will generally be most effective at deterring short-distance car journeys. This reflects how the level of 'inconvenience' will generally be lower for longer-distance car trips – both in terms of total time (likely only one 'end' of the trip affected by traffic filters) and proportional impact (a longer journey by 5 mins will be perceived as more inconvenient on a 10 min drive compared to a 60 min one). This partly explains how:

- Mode shift is especially greater towards active modes, which are used over shorter distances, compared to bus and (especially) rail;
- For the proposed traffic filtering scheme in Oxford, car trips *wholly within* the city are expected to reduce by 20%, but the reduction for all trips *to and from* the city is less, at 9%.

Potential social and distributional impacts

1.66 The nature of the social and distributional impacts of physical demand management will depend strongly on the nature of the scheme and the geography over which it is implemented.

1.67 The distributional impacts of physical demand management in **city centres** would be expected to broadly similar to that of congestion charging. Disbenefits for those who drive to and within city centres (from longer journey times from a more inconvenient route) are largely focused on higher income groups, and benefits from improved public transport to those on lower incomes. Benefits from improved urban realm and traffic reduction are likely to accrue to those living and working in the immediate surroundings of the access restrictions. Any disbenefits to areas where traffic may re-route to will depend on the characteristics of the areas concerned.

1.68 Specific exceptions can be applied for blue badge holders, and/or local residents, where ANPR infrastructure is used. The proposed Oxford traffic filtering scheme is innovative in proposing to allow Oxford residents a 100-day pass per year to drive through the filters (and Oxford**shire** residents a 25-day pass)[15] which focuses the negative impacts on those who drive very regularly within the city, but at the expense of reducing the overall benefits of the scheme on traffic reduction.

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[14] The level of traffic displacement, and any negative impacts on boundary roads, will be context-specific and dependent on the level of mode shift and demand suppression versus displacement to other routes.

[15] BBC News, **'Oxford's £6.5m traffic filter trial set to be approved'**, 22 November 2022

Implications for capacity requirements

1.69 The implication of this for urban capacity requirements is complex. Physical demand management can, in effect, provide a means of delivering increased net capacity but at the expense of that for general traffic. It is unlikely to broadly change the overall net capacity requirement for cities, but it should be noted:

- When considering urban capacity requirements, particularly over shorter distances within city centres and their immediate surroundings, physical demand management can help enable and support mode shift to walking, cycling and public transport. At a local level, it will make a city centre more attractive to access by walking, cycling or public transport, and less so by car. This evidence suggests this typically, but not always, leads to local economic benefits to city centres and other neighbourhoods;
- Targeted physical demand management can support and enable road space reallocation along specific corridors, enabling significant increases in public transport capacity (and frequency, speed and reliability) that would not otherwise be possible, and supporting mode shift to these modes. Both the Eastside and Westside Extensions of the West Midlands Metro, for example, runs along previously major highway corridors into Birmingham City Centre along which general traffic is now prohibited;
- However, physical demand management is of **reduced importance** when considering **longer-distance demand to city centres**, and in many cases will only result in a small increase in the perceived cost for such trips.

1.70 The exact impact of physical demand management on the capacity of different modes will also be highly scheme and context-specific. For example, a scheme may significantly reduce highway capacity by removing access to general traffic for a core highway corridor entering a city centre, reducing net highway capacity. However, if this space is re-allocated to public transport or active travel infrastructure, there is the potential for the overall net transport capacity and demand along the corridor to increase. However, this will be dependent on the extent to which the new public transport and active mode capacity is 'taken up', itself based on exact pattern of former highway trips and their potential to shift mode.

Revenue and operating costs

1.71 A physical approach to demand management would not include raising revenue as a direct objective (although an ANPR-led approach would be likely to yield some revenue from non-compliance).

1.72 The cost of physical demand management would vary significantly based on the scale of the scheme, the number and type of filters (e.g. physical bollards versus ANPR cameras) and any complementary measures to physically re-allocate road space or reconfigure streets (e.g. new cycling infrastructure or urban realm improvements. The proposed trial scheme in Oxford, with six traffic filters enforced by ANPR, is reported to cost:[16]

- circa £6.5m to introduce (including ANPR cameras, associated infrastructure, legal consents and consultation);
- annual maintenance, enforcement, signs and road markings costs of £150,000;
- annual back-office and communications costs of £300,000;
- potential penalty revenue from driver non-compliance of £1.1m annually.

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[16] BBC News, **"Oxford's £6.5m traffic filter trial set to be approved"**, 22 November 2022

Summary of Demand Management scheme impacts

1.73 Table 1.1 summarises each of the case studies considered within our review, and their impacts. Each is described in further detail in the following chapters, together with a review of their costs and revenues, transport outcomes, economic impacts and public acceptability.

Table 1.1: Summary of Demand Management Schemes and Impacts

Scheme Description							Transport Outcomes		
Scheme Name/Location	Type	Implementation date	Implementation cost	Area covered	Current charge (if applicable)	Associated interventions (if applicable)	Annual revenue generated	Traffic reduction in area	Increase/ change in other mode demand
WPL, Nottingham	Workplace Parking Levy	2011/2012	£2.5 million (2008 prices)	Administrative area of Nottingham	£458 per parking space and per annum	WPL Package including extra tram lines	£9-10 million	Liable parking numbers reduced by 25%.	8.6% commuters switched from car to sustainable modes between 2010 and 2016.
London Congestion Charge	Area-based road user charge	2003	£160 million	37 km^2 including Greater London and WEZ	£15 during 07:00-18:00 Mon-Fri, 12:00-18:00 Sat-Sun and bank holidays	Increase in bus service frequency	£137 million (2007/2008)	In 2006, London CC reduced traffic by 15%.	By 2007, 31% increase in buses and coaches and 66% increases in pedal cycles.
Singapore Electronic Road Pricing	Variable Pricing	1998	S $200 million (US $110 million – 1998 prices)	Over 50 gantries linking to Singapore's central area	Averaging S $4 with charges varying on vehicle size and entry time	Investment in active travel zones	S $150 million/year (US $100 million)	Weekday traffic entering the zone reduced by 24% per day.	Increase of bus and train ridership of 15%.

Cambridge road user charge (proposed)	Area-based Sustainable Travel Zone	Expected to be introduced by 2025	£23 million (predicted)	Outskirts of the town, linking between park and ride sites	£5 for cars, £10 for LGVs and £50 for coaches/HGVs per day	Increased bus/cycle routes and support for access to specialist and disabled cycles	N/A	50% reduction in traffic (predicted).	40% increase in public transport usage within and outside the zone (predicted).
Stockholm	Cordon Charge	2007	£1,900 million SEK	20 control points	High peak charge of 45 SEK = £3.55 per direction	New buses and 16 new bus routes as well as 2,800 new park and ride facilities	€147 million (2016)	Traffic reduced by 20% after introducing the charge in 2006.	Public transport patronage increased during the trial period by 6%.
Milan Area C	Congestion Charge	2012	€7 million	8.2 km^2 covering 4.5% of the municipality of Milan	€5 non-residents, €2 residents and €3 commercial	Financing increase in public transport and installing bike-sharing stations	€20.3 million (2013)	14.5% decline in traffic, with 27,000 fewer cars.	28% decrease in road congestion.
Gent	Traffic Circulation Plan	2017	N/A	Gent city divided into six sections	N/A	Safer crossings and additional cycling streets	N/A	Average decrease if 13% during rush hour.	Cyclists in the city centre increased by 50% and public transport increased by 6% on a daily basis.

Rome	Limited Traffic Zones (ZTL)	2001	N/A	Fascia Verde, Anello Ferroviario, Centro Storico, Centro, Trastevere, Tridente, San Lorenzo and Testaccio	€15-55 for 5 years for different vehicle types	Electronic gate implementation	£90 million (2007)	Traffic decreased by 20%.	Public transport increased by 1%.
Manchester City Centre	Bus Gates	2022	Part of a £1 billion city centre travel investment plan	Portland Street, Oxford Road, King Street, Bridge Street	N/A	Investment in alternative commuter options e.g., wider footpaths	N/A	N/A	Rail and Metrolink patronage increase (predicted)
Oxford (proposed)	Traffic Filters	Proposed. Experimental Traffic Filters approved November 2022. Planned implementation early 2024.	N/A	Six traffic filters operating 7 days a week from 7am - 7pm	N/A	Permits for residents, and for some private cars	N/A	35-40% traffic reduction across city centre/ inner parts of the city (predicted).	Bus, walking and cycling demand expected to increase by 10%.

2 Workplace Parking Levy – Nottingham (UK)

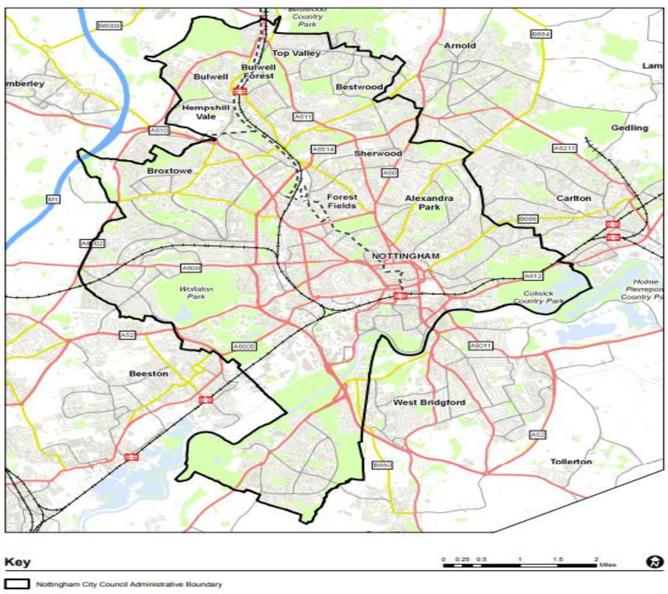
2.1 Nottingham City Council introduced a Workplace Parking Levy (WPL) in 2011/12 which applies to the entirety of the administrative area of the city, with a current charge of £458 (2022/23) per parking space and per annum.[17]

2.2 Nottingham is the only UK example of an implemented WPL. Several authorities have recently considered introducing a WPL including Oxfordshire, Leicester and Hounslow. However, proposals in Hounslow were paused at the outset of the Covid pandemic while those in Leicester were abandoned in late 2022, with the cost of living cited as the ostensible reason. Oxfordshire County Council is currently progressing with its WPL proposals.

Scheme Description

2.3 Nottingham introduced the WPL to tackle problems associated with traffic congestion, with the objective of incentivising employers to reduce their workplace parking provision to encourage mode change while, at the same time, generating funding to deliver improvements to the local tram and bus networks. As revenues from WPL must, by law, be used to fund local transport improvements, the impacts of WPL in the Nottingham area are considered together with the improvements that WPL has helped to fund.

Figure 2.1: Map of Nottingham City Council Administrative Boundary



Source: Nottingham City Council[7]

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[17] Nottingham City Council (2022), 'Workplace Parking Levy'

2.4 Focusing on a smaller number of larger employers also helps to minimise the amount of effort required to "enforce" the scheme. Nottingham has achieved a 100% compliance among liable employers since the first year of the scheme and, as of February 2021, has only had to write off £10,000 of the £83 m collected by 2022 (representing a debt collection rate of 99.9%). High levels of compliance are partly achieved through a close relationship with employers including a Workplace Travel Service (similar to the TfGM Travel Choices Travel Planning for business support) which offers journey planning, car park management advice and grants for workplace facilities. The Nottingham Workplace Travel Service is funded using 5% of WPL revenues[18].

2.5 WPL schemes can be revenue neutral for an employer as they can pass the cost on to the vehicle user – staff members.

2.6 The WPL was one element of a package of measures which are collectively referred to as the WPL Package. This comprises the WPL itself and:

1. Net Phase 2 - the provision of two additional tram lines linking the suburbs of Clifton and Beeston/Chilwell to the City Centre including additional Park and Ride facilities;
2. The refurbishment of Nottingham railway station's passenger facilities (concourse and platform areas);
3. Quality enhancements to the LinkBus services which are supported by the City Council to link major employment sites, hospitals and Universities to the wider transport network;
4. Additional support for businesses in the form of workplace travel planning services, parking management advice and cycling infrastructure grants[19]

2.7 These measures were designed to complement each other so that the overall impact is greater than the sum of the individual parts.

Scheme Costs and Revenues

Costs

2.8 The reported capital cost of the Nottingham WPL is around £2.5 m (2008 prices), split between scheme development costs of £1,085,000 and scheme Implementation costs of £1,315,000.

2.9 Ongoing operating costs represent around 5% of revenues.

Revenues and Investment

2.10 The levy, with a charge that updates on a yearly basis with inflation, is currently generating approximately £9-10 million a year and costs around £500,000 a year to run. All money raised by the Council from the WPL must be invested into improving local transport services. It has helped fund the extension of the local tram network (NET Phase Two), which has doubled in size and now carries more than double the number of passengers it did when the WPL was introduced, as well as the redevelopment of Nottingham Station. Specific revenue and investments details include:

[18] Hallam (2021), 'The Workplace Parking Levy: Nottingham pioneers the way ahead'

[19] Frost et al (2019), 'The impact of the Nottingham Workplace Parking Levy on travel to work mode share'

- £83 million of revenue had been raised directly from levy by 2022.
- A further £600 million of spending on public transport infrastructure obtained from outside sources. This £600 million has funded a major extension of Nottingham's tram network, a £60 million renovation of its train station, the expansion of the city's electric bus fleet, and £500,000 in grants to help employers make sustainable transport options available for employees[23].
- The guaranteed revenue stream that WPL provides has enabled Nottingham City Council to match-fund and take advantage of prudential borrowing. According to NCC, WPL has unlocked £600m of inward investment, including £200m a new electric bus fleet.[20]
- Nottingham has achieved 100% compliance among liable employees since the first year of the scheme[21].
- Money raised from the WPL has helped to fund NET Phase Two extensions to the existing tram system, which now carries more than 19 million passengers a year, as well as the redevelopment of Nottingham Station. It also supports the city's popular Link bus network.[21]
- Unlike other road user charging schemes, WPL generates a guaranteed revenue stream. Even in the middle of a very severe lockdown, significant revenues were being collected through the levy.

Transport Outcomes

Public Transport

2.11 Public transport patronage has increased after the implementation of the levy, with public transport now accounting for more than 40% of journeys within the city. Travel demand and mode choice have been affected by the WPL. Liable parking numbers reduced by 25% after the introduction of the scheme and more than half of the spaces are provided by employers that pass the charge on to employees, which has simultaneously reduced capacity and increased travel cost for those employees that were commuting by car.

2.12 The tram network, whose extension the WPL scheme helped fund, now serves 1,270 workplaces and more than 55,000 employees use it to travel to work, which are greater figures than those of workplaces and car parking spaces that are liable for the charge.

Mode shift

2.13 Research undertaken by Loughborough University indicates 8.6% of commuters currently travelling by sustainable modes switched from the car between 2010 and 2016, at least in part due to the implementation of the WPL and/or the associated transport improvements. Almost 50% of those individuals cited the WPL as being an important factor in their decision to shift away from the car, either owing to an increase in the cost of parking at work or because their employer had removed workplace parking spaces.[24]

2.14 There is also evidence of some commuters switching to the car, a fact which appears to indicate suppressed demand for travel by car which may offset some of the desired impacts of the WPL package (a quarter of all current car users surveyed have switched to this mode in the

[20] Dale et al (2017), 'An evaluation of the economic and business investment impact of an integrated package of public transport improvements funded by a Workplace Parking Levy'

[21] Halam(2021), 'The Workplace Parking Levy: Nottingham pioneers the way ahead'

study period – i.e. reduced road congestion released as a result of the WPL is generating additional trips indicating suppressed demand).[24]

2.15 The mode share of public transport rose over the study period from 2010 to 2017 and a more detailed examination of this data reveals an increase in PT mode share prior to the introduction of the WPL and then a further rise in 2015/16 associated with the opening of NET Phase 2, the two additional tram lines. The initial rise can only partly be attributable to the WPL as the bulk of the increase occurred between 2009 and 2010, prior to any pre-emptive actions taken by major employers in response to the WPL. However, the further increase in PT mode share following the opening of NET Phase 2 - the most significant of the public transport improvements part funded by the WPL in 2015 - appears to be directly linked to that intervention.

2.16 This impact is supported by public transport patronage data which shows that, following the opening of these two new tram lines, there was a rise in public transport patronage due to more people arriving by rail and patronage on the two new tram lines. Cycling has also shown a steady growth in the number of trips throughout the evaluation period although no specific causality is evident.

2.17 Three million private car miles have been eliminated because of public transport infrastructure improvements.[23]

Air quality

2.18 Nottingham did not include carbon reduction or air quality improvement in the list of key success factors – however, it is normally concluded that if congestion can be reduced then these associated factors will also be reduced. NCC states that it is on course to become carbon neutral by 2028 and has demonstrated that the whole transport package including WPL has enabled cleaner air. This meant that Nottingham did not need to designate a Clean Air Zone, as it was released from the list of cities mandated by the Secretary of State to develop a plan to meet national air quality standards in the shortest possible time[22].

2.19 It is estimated that by September 2021, 7,840 tonnes of CO2 emissions have been saved since the levy's introduction. The levy has contributed to a 33% fall in carbon emissions in Nottingham since 2005. An estimated 350 tonnes of CO2 was saved by electrification of 15 buses, paid for by the levy.[23]

Economic Impact

Employment/Jobs

2.20 The number of jobs based in Nottingham has seen strong and sustained growth and suggests that Nottingham has fared better than average when compared to other comparator cities. Despite ambiguous performance on economic output and net business registrations, it is concluded that there is no observable negative effect on overall macro-economic performance associated with the introduction of the WPL.[24]

[22] Leicester City Council (2021), 'Leicester Workplace Parking Levy – Business Case'

[23] Friends of the Earth (2022), 'How Nottingham used a parking levy to cut congestion and raise millions'

[24] Dale et al (2017), 'An evaluation of the economic and business investment impact of an integrated package of public transport improvements funded by a Workplace Parking Levy'

2.21 Tram and train station redevelopments led to the employment of 1,200 people. Public transport infrastructure has encouraged businesses to relocate to Nottingham.[23]

Investment impact

2.22 The investment examples collated so far suggest that the WPL is a relatively minor consideration when businesses make investment decisions, while the availability of good connectivity to public transport has been a strong attractor to at least three major inward investments in this period[24].

2.23 There is strong evidence that the WPL is having no significant negative impact on inward investment. This is supported by case study evidence that suggests that the WPL plays a very small role in business location decisions[24].

2.24 The strong growth in employment combined with a positive movement in the inward investment specific indicators suggests that Nottingham is relatively attractive to potential investors. There is positive evidence from case studies of five major inward investments that the public transport improvement components of the WPL package are playing a role in this.[24]

Acceptability

2.25 Despite initial objections from some employers and the Chamber of Commerce, there is currently no evidence of significant negative economic impact of the implementation of the WPL in Nottingham. As an example, high profile employer Boots (which is headquartered in Nottingham) expressed concern prior to the launch of the WPL, stating an intention to relocate its employee car parking outside of the city[25] [26]. Boots subsequently decided to pass the WPL charge on to its employees[27] with charges levied on a sliding scale in line with staff salaries (equating to between 30 to 70p per day in 2012) and have remained a key employer within the city.

Evolution of Nottingham WPL scheme

WPL charge

2.26 The WPL charge started at £288 per annum per liable space in 2011/12 and was increased each year by inflation. It was also subject to a three-year accelerator. The charge per liable space in 2022/23 is £458 and is adjusted in line the with RPI (Retail Price Index). The charge has increased by an average of 6% per year since its introduction.

Number of spaces licensed

2.27 The number of chargeable workplace parking spaces reduced in the first year of the WPL. This is likely due to employers rationalising their parking provision to minimise their WPL liability. The table below (Table 2-1) shows that the number of spaces has remained broadly constant since the initial post-scheme reduction.

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[25] Parliament (2003), 'Urban Charging Schemes'

[26] Peacock (2009), 'Boots 'outraged' by workplace parking levy'

[27] BBC (2012), 'Boots passes on Nottingham Workplace Parking Levy to staff'

Table 2-1: Number of chargeable Workplace Parking Places in Nottingham 2012-2020

Year	Number of chargeable WPPs	Change (+/-%)
2012/13	26,916	
2013/14	25,308	-6%
2014/15	25,107	-0.7%
2015/16	24,896	--0.8%
2016/17	24,960	-0.1%
2017/18	25,033	-0.6%
2018/19	25,154	-0.4%
2019/20	25,840	2.5%

Source: Leicester City Council WPL business case[28]

2.28 There has been some reduction in chargeable spaces following the Covid-19 pandemic, potentially as a result of increased working from home leading to employers reducing parking provision. The number of employers eligible for the WPL in Nottingham has reduced from 473 before the pandemic to 370 following the pandemic. As a result, revenues generated from the levy reduced by 21% from 2019/20 to 2020/21.[29]

[28] Leicester City Council (2021), 'Leicester Workplace Parking Levy – Business Case'

[29] Jarram (2022), 'Workplace Parking Levy up by 7% to £458 per space in April will stretch margins for businesses'

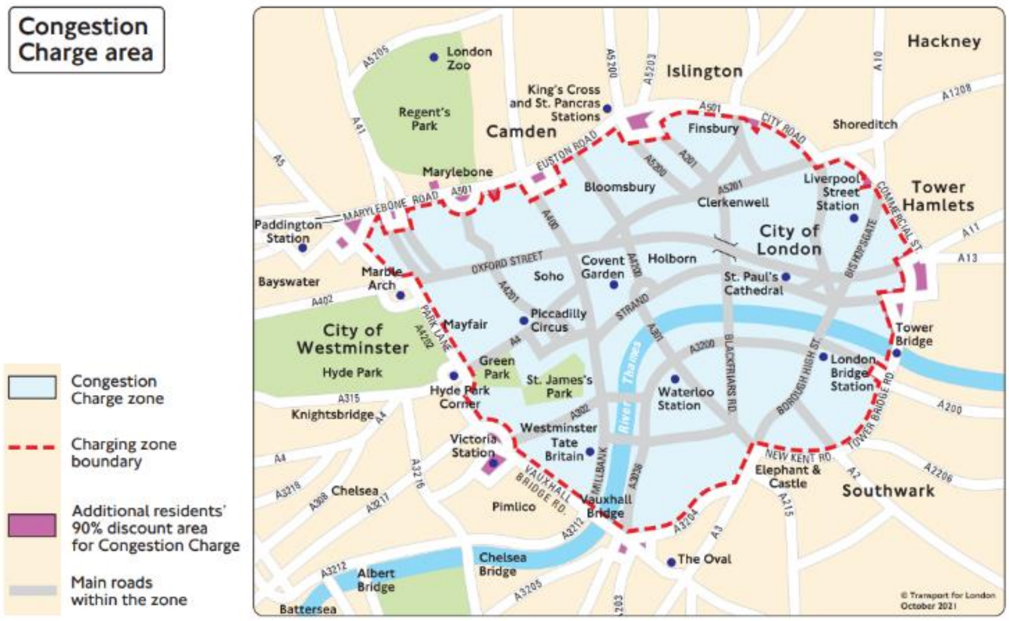
3 London Congestion Charge Zone (area-based)

Scheme Description

3.1 London Congestion Charge (LCC) was introduced in 2003, aiming to reduce traffic and stimulate public transport usage. The scheme originally required road users to pay a daily charge of £5 for driving within a bounded area of Central London. Currently, the daily charge for driving within the Congestion Charge Zone during charging times (07:00-18:00 Mon-Fri, 12:00-18:00 Sat-Sun and bank holidays) stands at £15 (December 2022). There is no charge between Christmas Day and New Year's Day bank holiday (inclusive).[30]

3.2 The original LCC zone was 21 km^2, representing 1.3% of the total 1579 km^2 of Greater London.[31] The zone was extended westwards (Western Extension Zone – WEZ) on 19 February 2007 to a total of 37 km^2.

Figure 3.1: Map of London Congestion Charging Zone



Source: Transport for London[32]

[30] Transport for London (2022), 'Congestion Charge (Official)'

[31] Transport for London (2022), 'Congestion Charging Low Emission Zone Online Fact Sheet '

[32] Transport for London (2022), 'Congestion Charge zone '

Scheme Costs and Revenues

Costs

3.3 The reported implementation cost for the London congestion charge was £160 m, with an annual operating cost of around £90 m.[33]

Revenues and Investment

3.4 In 2007/2008, £137 million was generated in net revenues which were reinvested back into Transport for London.[34]

3.5 In the 14 years (2003 to 2017), £1.7 bn net revenue[35] has been generated and re-invested in the Capital's transport infrastructure. Some £1.3 bn of has been spent on improvements to the bus network, £196 m on roads and bridges, £80 m on road safety, £90 m on local transport/borough plans and £64 m on sustainable transport and the environment.

Transport Outcomes

Public Transport and Traffic

3.6 The overall change in traffic levels following the introduction of the London CCZ is summarised in Table 3.1.

Table 3-1: Traffic Entering Central London Charging Zone

Transport	2003 vs 2002	2007 vs 2002
All vehicles	-14%	-16%
Four or more wheels	-18%	-21%
Cars	-33%	-36%
Vans	-11%	-13%
Lorries	-10%	-5%
Licensed Taxis	17%	7%
Buses & Coaches	23%	31%
Powered two wheelers	13%	-3%
Pedal Cycles	20 %	66%

Source: TfL 2008[24]

3.7 Initial monitoring and evaluation by TfL demonstrated a positive impact both in terms of reducing traffic and public transport uptake. For example, in 2006, Transport for London (TfL) reported that the charge reduced traffic by 15% and congestion – that is, the extra time a trip would take because of traffic – by 30%. Similarly, by 2006, the congestion charging zone had reduced congestion in central London by 26 percent from its 2002 levels. While the reduction in all vehicles was around 15%, the reduction in car trips was significantly higher as over 30%.

Congestion and air quality

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33 Croci (2016), 'Urban Road Pricing: a comparative study on the experiences of London, Stockholm and Milan'

34 Transport for London (2008), 'Executive Summary Western Extension Consultation Report'

35 Transport for London (2017), 'Freedom of Information Request Detail'

3.8 In terms of air quality, research suggests that the charging scheme resulted in significant reductions across a range of pollutants compared to comparison cities (between 2003 and 2018) and that the reductions were significantly larger than would be expected from a reduction in traffic flows alone.

3.9 Beyond the impact on public transport patronage, a 30% reduction in congestion in 2003 and 2004 (averages compared with 2002) was attributed to the introduction of the CCZ; this was towards the top end of TfL's range of expectation (20 to 30%).[36] By 2006, it was estimated that congestion charging had reduced congestion in central London by 26% from the 2002 baseline.[37] Unsurprisingly, this decongestion benefit resulted in improvements to pollution levels; it has been reported that greenhouse gas emissions reduced by 16% within the first year.[38]

Mode shift

3.10 The implementation of the CCZ was accompanied by a significant increase in bus service frequency (+23% in overall bus and coach vehicles) and in the first year of the CCZ being in operation, there was a 37% increase in the number of passengers entering the congestion charging zone by bus within charging hours.[39]

3.11 There was also a significant increase in cycling (+20% in 2003 and +66% by 2007, vs 2002), and this reflects both the 'push' factor of disincentivising car via charging and the 'pull' of significant investment in cycle infrastructure – such as the Cycle Superhighways programme – over the period.

3.12 Since, the reported impacts of the CCZ on public transport use have varied but generally demonstrate positive outcomes. Transport for London's Sixth Annual Monitoring Report of the Congestion Charging stated that whilst the patronage of the London Underground and National Rail had largely reflected wider economic conditions, with no disproportionate impacts from the CCZ noted, the introduction of charging had contributed to a wider trend of significant increases in both bus network capacity and patronage.[40]

Economic Impact

3.13 The impacts of the LCC scheme were observed by TfL within the framework of a five-year monitoring program, and as such, six annual reports have been produced - the latest being in July 2008.

3.14 TfL's initial conclusion on the economic and business impacts was the scheme had a broadly neutral impact on London's economy. This was reiterated by an independent study conducted by EY.

3.15 The final evaluation report (2008) demonstrated for the central core charging zone, that in terms of business performance (sales and profitability) and business start-up (VAT

[36] Transport for London (2008), 'Central London Congestion Charging Impacts Monitoring, Sixth Annual Report'

[37] Centre for Public Impact (2016), 'London's congestion charge'

[38] UNESCAP (2012),'London United Kingdom's congestion charge '

[39] Centre for Public Impact (2016), 'London's congestion charge'

[40] Transport for London (2008), 'Central London Congestion Charging Impacts Monitoring, Sixth Annual Report'

registrations) – both in absolute and relative terms – there was positive growth in the original central London CCZ, following the introduction of the charge. In the run up to charging in 2006 for the western extension zone, in terms of rising business turnover and profitability, there were large increases in tourist visitors and strengthening property markets.

3.16 Most revenue is raised from individuals in the richest quintile, who are more likely to travel by car. The overall impact of the congestion charge is deemed disproportionately progressive due to the subsidisation of public transport, primarily for the usage of those in the lowest-earning quintiles[41]. In 2007/2008, £137 million was generated in net revenues which were reinvested back into Transport for London.[42]

Acceptability

3.17 In the present day, the central charging zone has received significant public transport investment with a significant improvement in public realm and cycling infrastructure (Healthy Streets, Santander Cycle Hire Scheme, Cycle Superhighways, etc).

3.18 Public support was low before the introduction of CCZ but increased upon implementation of the scheme. Opposition reduced from 72% to 36% five years after the scheme's introduction[43].

3.19 The congestion charge is not a tax; therefore, diplomats are not excused from paying it. While most London embassies do pay the charge, a minority refuse to do so, and the current diplomatic debt stands at £142 million. Transport for London continues to pursue all unpaid congestion charge fees and are advocating for the International Court of Justice to engage in the matter.[44]

[41] Blow et al (2003), 'London's congestion charge'

[42] Transport for London (2008), 'Executive Summary Western Extension Consultation Report'

[43] Clayton et al (2017), 'Funding and Financing for Inclusive Growth'

[44] Transport for London (2022), 'Congestion Charging Low Emission Zone Online Fact Sheet'

4 Singapore Electronic Road Pricing – Variable Pricing

Scheme Description

4.1 To manage road congestion in Singapore, Electronic Road Pricing (ERP) is used where drivers incur charges when passing through ERP gantries during hours of operation. To prevent charges being incurred, road users are encouraged to find alternative routes outside ERP gantries, travel outside operational hours or use public transport instead. The charge paid is dependent upon the vehicle size and time of entry (peak or non-peak hours) as opposed to per day in the previous Singapore ALS scheme. ERP rates are set in half-hour intervals up to but excluding the end of the half-hour period, and no charges are enforced on Sundays/public holidays.[45]

4.2 Singapore registered vehicles must have an In-Vehicle Unit (IU) installed to pass through ERP operating gantries, with a penalty charge of S $70 incurred for no installation. Stored value cards can be inserted into the IU for payment purposes, or alternatively a backend payment service (credit/debit card) can be used. Overhead gantries detect the vehicle type, the route congestion levels and deduct the variable fee from the smart card.[46]

4.3 The ERP Scheme initially started with 28 gantries, but since there has been over 50 additions throughout the inner city,[47] as illustrated in figure 4-1.

Original ALS Scheme

4.4 The 1998 ERP scheme replaced an existing Area Licensing Scheme (ALS) initially implemented in 1975. In 1975, Singapore introduced an Area Licensing Scheme to reduce congestion in the city centre. Drivers had to purchase licences for a day or a month to allow them to enter the bounded area between 07:30 and 10:15.

4.5 Initially, the charge was S $3 but was raised to S $4 in 1976. Vehicles with four or more occupants were exempt. Police at the 22 entry points observed vehicles and recorded those without licences to incur fines. Subsequent modifications involved extensions to the evening peak, the working day and Saturdays, to a set of charging points on expressways, and to all cars however many occupants they had. Different charges were levied for different types of vehicle. A major study was conducted in 1975 (Holland and Watson, 1978); the evidence below comes from this.

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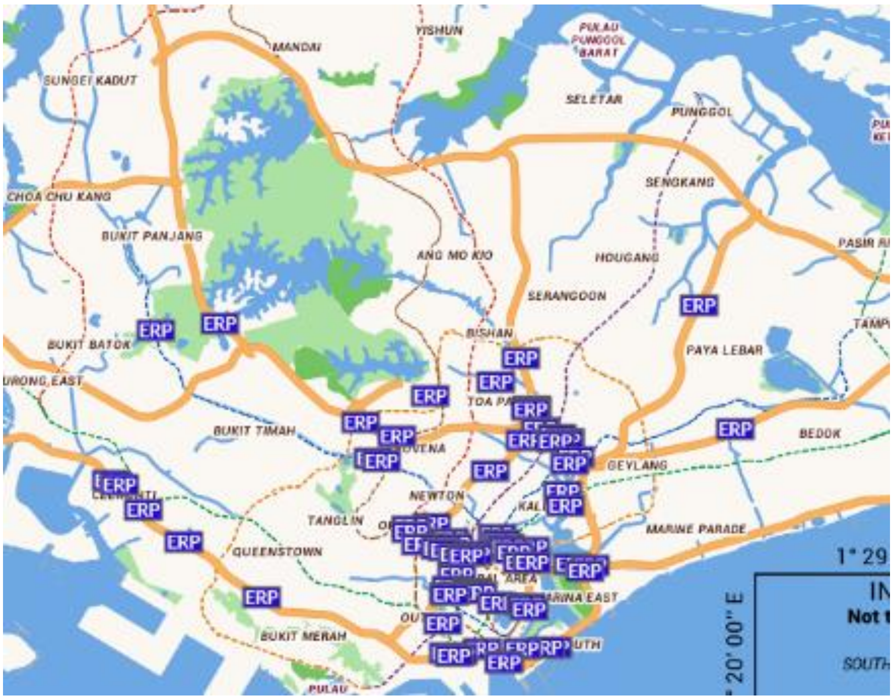
[45] Government of Singapore (2023), 'Electronic Road Pricing (ERP)'

[46] Provonsha et al (2018), 'Road Pricing in London, Stockholm and Singapore '

[47] Menon and Guttikunda (2010), 'Electronic Road Pricing: Experience and Lessons from Singapore'

Figure 4.1: ERP Gantries in Singapore



Source: LTA[35]

Scheme Costs and Revenues

Costs

4.6 Capital costs of the ERP System have been estimated to be S $200 million (US $110 million at the time of implementation in 1998), half of which was for the purchase and installation of about 1.1 million IU units. The annual operating cost is estimated to be around S $25 million (US $18.5 million).

Revenues

4.7 The annual net revenue is S $150 million/year (US $100 million).

Transport Outcomes

Original Area Licensing Scheme

4.8 Most drivers affected by the ALS continued travel to the city centre, with no major reductions in car trips. However, 19% of drivers travelling to the city centre switched to bus, while 17% switched to car sharing to take advantage of the exemption for cars with four or more people. The quality of service on the roads improved for these vehicles.

4.9 Among vehicle owning households with employment in the city centre, non-SOV share of trips declined from 48 to 27%. HOV 4+ share went up from 8 to 19% and bus share increased from

33 to 46%. Congestion inside the restricted zone was essentially eliminated. Speeds inside the restricted zone in the morning peak increased by 20% or more (including for buses).[48]

4.10 In terms of patterns of behaviour, 22% of drivers travelling through the restricted area switched to travelling before or after the charged period, resulting in some increases in congestion at these times. Further to this, some drivers diverted their route to the ring road which created congestion around that area. No further changes were noted during evening peak travel patterns, despite changes during the morning peak.[49]

Electronic Road Pricing Scheme (ERP)

Public Transport and Traffic

4.11 Weekday traffic entering the restricted zone has reduced by 24% from 271,000 vehicles to 206,000 vehicles per day. This decline has resulted in average speeds within the restricted zone increasing from 30-35 kph to 40-45 kph.[50] Traffic levels are also 15% lower than what was achieved by the previous ALS scheme.[51]

4.12 Bus operators increased their revenues due to the significant increase in patronage. According to many analysts, increased ridership and faster speeds have almost certainly resulted in increased productivity of operations.[52]

Mode shift

4.13 Combinations of congestion pricing and investment in active travel have led to an increase of bus and train ridership by 15%. In terms of park and ride schemes, 15,000 park and ride spaces were established outside the restricted zone.[53]

Air quality

4.14 The Land Transport Authority that due to less congestion, levels of CO_2 and other greenhouse gas emissions have been reduced by 10-15%.[54]

Economic Impact

4.15 Most of the economic research considered the economic productivity and business impacts following the implementation of the initial scheme in 1975. Key findings were that: [55]

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[48] US Department of Transportation Federal Highway Administration (2021), 'Lessons Learned From International Experience in Congestion Pricing'

[49] Holland and Watson (1977), 'Measuring the Impacts of Singapore's Area License Scheme '

[50] US Department of Transportation Federal Highway Administration (2021), 'Lessons Learned From International Experience in Congestion Pricing'

[51] Menon (2000), 'ERP in Singapore - A perspective one year on'

[52] US Department of Transportation Federal Highway Administration (2021), 'Lessons Learned From International Experience in Congestion Pricing'

[53] Provonsha et al (2018), 'Road Pricing in London, Stockholm and Singapore'

[54] Palliyani and Lee (2017), 'Sustainable transport policy—An evaluation of Singapore's past, present and future'

[55] US Department of Transportation Federal Highway Administration ((2021), 'Lessons Learned From International Experience in Congestion Pricing'

- Productivity: Benefit-cost analysis by World Bank economists in 1978 suggested that the ALS pricing produced net benefits.
- Other economic assessments of the ALS program from 1975 through 1988 suggested that pricing not only reduced congestion dramatically, but also kept the RZ mostly free of congestion over the entire period even as the income, employment and business activities were growing dramatically. Thus, the ALS pricing has allowed Singapore to defer or cancel major investments for roads. The savings have been estimated to be on the order of S$1.50 billion (more than US$1.0 billion at current exchange rates).
- In the public transportation sector, bus operators increased their revenues due to the significant increase in patronage. According to many analysts, increased ridership and faster speeds have almost certainly resulted in increased productivity of operations.

4.16 There was no evidence that the scheme had any adverse impacts on office, retail or labour markets. Over several years, when employment in the entire state of Singapore increased by 32%, employment in the central area increased by 34%.

4.17 Overall, it appears that the ALS did not, by itself, initiate changes in business conditions or location patterns. Overall, the business community responded positively to the ALS, probably believing that the combined package of actions by the government was necessary and beneficial in the long run.

Acceptability

4.18 Given the governmental structure in Singapore, authorities could have implemented congestion pricing with little or no public involvement. Instead, authorities carried out a year-long intense assessment and education program. They responded to public reaction by making adjustments to the pricing program before implementation. The Government has continued to modify and expand the pricing program incrementally ever since its beginning in 1975.

4.19 The government also packaged the pricing program to enhance acceptability. Leaders introduced broad improvements that both preceded and accompanied the introduction of pricing. Among other things, congestion pricing reforms have been packaged with major expansion in public transportation modes and services and reductions in certain vehicle purchase and ownership taxes.

4.20 Generally, people in Singapore were in favour of the pricing and accompanying package of improvements. Early scepticism was addressed effectively via information and on-ground experience. The public has come to accept and respect bold policy initiatives like pricing and have largely trusted the authorities as providers of effective public services.[56]

[56] US Department of Transportation Federal Highway Administration ((2021), 'Lessons Learned From International Experience in Congestion Pricing'

5 Cambridge RUC Area-Based Proposal

Scheme Description

5.1 A Sustainable Travel Zone has been proposed in Cambridge, where vehicles would be charged for entering during certain times. The money raised from the charge would be reinvested into transport schemes such as improving the bus network. Consideration for the Sustainable Travel Zone has been given due to the need to support public transport provision. Other options such as higher parking charges and pollution charges were also assessed with feedback from public engagement.

5.2 This proposal is part of wider package of enhancements under the 'Making Connections' project, with complementary investment part funded by charge revenues. The zone is expected to be fully operational by 2027/28 with a steady introduction in 2025, once bus service improvements take place.[57]

5.3 On weekdays, vehicles will be charged for travel anywhere within the zone from 7am to 7pm. The price breakdown is shown in Table 5-1:

Table 5-1: Cambridge Proposed Charge Levels

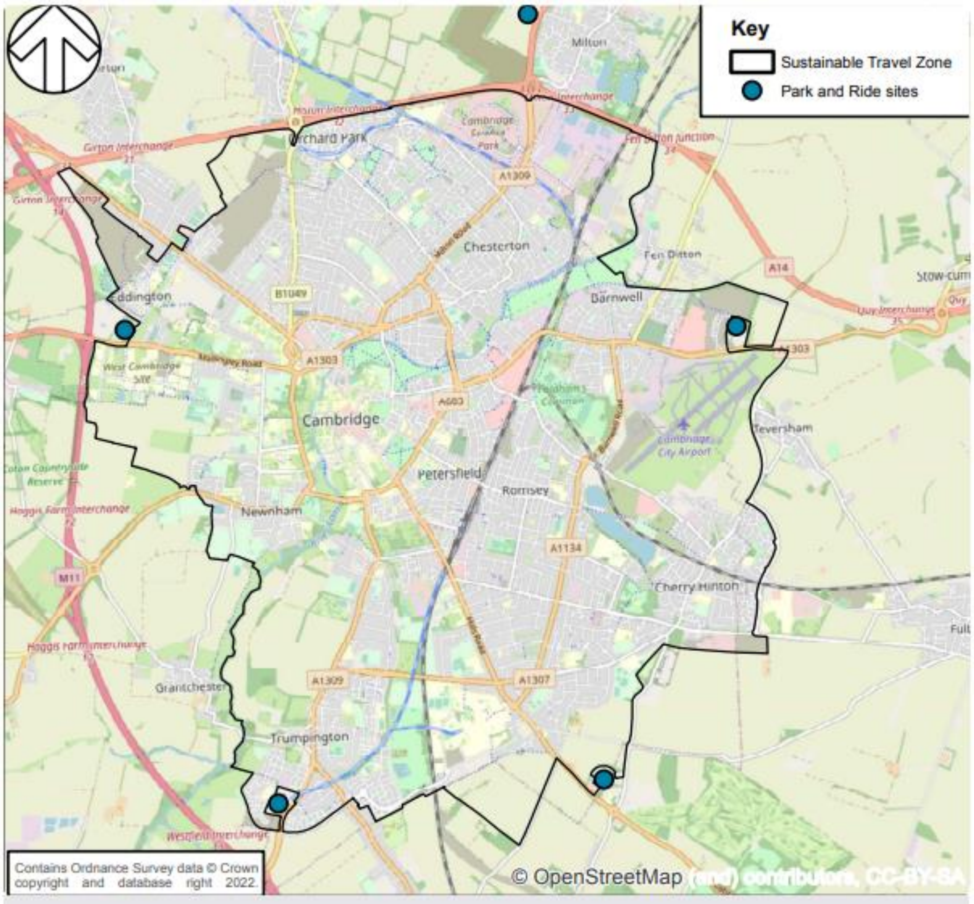
<table>
<tr><th>Vehicle Type</th><th colspan="2">Proposed Charge Levels</th></tr>
<tr><td>Cars</td><td colspan="2">£5 per day</td></tr>
<tr><td>Powered two-wheeler (motorbikes and mopeds)</td><td colspan="2">£5 per day</td></tr>
<tr><td>LGVs</td><td>£10 per day</td><td rowspan="4">Potential to explore a 50% discount for zero emissions vehicles</td></tr>
<tr><td>Vehicles with over 9 seats (e.g. school minibuses etc.)
- Except coaches and buses</td><td>£10 per day</td></tr>
<tr><td>Coaches</td><td>£50 per day</td></tr>
<tr><td>HGVs</td><td>£50 per day</td></tr>
<tr><td>Registered bus services</td><td colspan="2">100% discount, potential to link to 2030 zero emission bus target</td></tr>
<tr><td>Hackney Carriage (Taxis) and private hire vehicles</td><td colspan="2">100% discount if follow Cambridge City Licensing condition, i.e. if zero emissions (from 2028), and wheelchair accessible.
£5 for those not meeting this</td></tr>
</table>

[57] Greater Cambridgeshire Partnership (2022), 'Making Connections Public Consultation Brochure'

Source: GCP Public Consultation brochure[58]

5.4 The Sustainable Travel Zone shown below is representative of the responses received during public consultation. The results of the consultation showed a majority favouring a lower charge covering a wider area. Signage would be in place informing drivers they are entering the zone, with alternative route options provided.

Figure 5.1: Proposed Sustainable Travel Zone in Cambridge



Source: GCP Public Consultation brochure[59]

Scheme Costs and Revenues

5.5 The operating cost of this scheme lies between £17m-£19m per annum, depending on the volume of traffic using the scheme.[60] The proposed costs for charging scheme interventions are shown in Table 5-2.

[58] Greater Cambridgeshire Partnership (2022), 'Making Connections Public Consultation Brochure'

[59] Greater Cambridgeshire Partnership (2022), 'Making Connections Public Consultation Brochure'

[60] Greater Cambridgeshire Partnership (2022), 'Making Connections Strategic Outline Business Case'

Table 5-2: Costs for the proposed Cambridge charging scheme interventions

Scheme element	2022 Base Prices, Factor costs
Road Side Equipment	£11m
Back Office Software, development & licences	£3m
Back Office & Fixed Operating costs (Fit outs etc)	£1.5m
Signs and lines	£50,000
Subtotal	**£15m**
Optimism Bias (46%)	£7m
Total including OB	**£23m**

Source: Making Connections SOBC[61]

Transport Outcomes (predicted)

Public Transport

5.6 Significant impacts are expected as a result of the scheme. Through transforming bus services, the RUC scheme aims to reduce transport-related marginalisation by increasing access opportunities and consequently lowering disproportionate effects on socially excluded groups. Car dependency is expected to decrease, as both young people and old people have greater access to public transport to facilitate their needs.

5.7 An expected £50 million will be invested in transport per year in order to create a stable network. In doing so, Cambridge expect less reliance on government funding for sustenance and the area is able to be 'back in control' of future travel.[62]

Air quality

5.8 The introduction of the Sustainable Zone will result in a 50% reduction in traffic as well as cleaner air. Carbon reduction targets for the UK are expected to be met in order to tackle larger issues such as climate change.

Mode shift

5.9 Active travel is expected to increase with 60,000 additional walking and cycling trips and a 40% increase in public transport usage both within and outside the Zone.[63]

Economic Impact (predicted)

5.10 The scheme is at the planning stage, so not impact assessment has been undertaken. However, the need to address congestion and provide the sustainable capacity to support future economic growth provides the economic rationale for the scheme.

"The Challenge: Congestion is clogging up our roads, making journeys slow and unreliable, and contributing to poor air quality and high carbon emissions. But for many journeys there is still no viable alternative to car travel, meaning people miss out on opportunities. With

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[61] Greater Cambridgeshire Partnership (2022), 'Making Connections Strategic Outline Business Case'

[62] Greater Cambridgeshire Partnership (2022), 'Making Connections Public Consultation Brochure'

[63] Greater Cambridgeshire Partnership (2022), 'Making Connections Public Consultation Brochure'

employment and population growth increasing, pressures on our transport system will keep building. We need to introduce new sustainable travel measures to transform how we travel and keep Cambridge moving" (Making Connections Public Consultation, Autumn 2022).[64]

Acceptability

5.11 There was major acceptance of the scheme during public consultations. A small majority of respondents to the 2021 consultation were in favour of a charge for peak period journeys alone. However, in practice this would result in increased congestion during other periods during the day. To compromise, the scheme proposes starting with morning peak time charging before changing to 7am-7pm charging.[65]

[64] Greater Cambridgeshire Partnership (2022), 'Making Connections Public Consultation Brochure'

[65] Greater Cambridgeshire Partnership (2022), 'Making Connections Public Consultation Brochure'

6 Stockholm Cordon Charge Scheme

Scheme Description

6.1 Stockholm implemented a Cordon charge following a trial scheme which took place for 7 months in 2006, followed by a referendum. Following acceptance from the citizens of Stockholm City, the congestion tax was permanently installed in August 2007. The main objectives of the cordon charge include a reduction in congestion, an increase in accessibility and improvement to the environment. The congestion tax is levied when entering or leaving the inner-city zone on weekdays between 6:30 am and 6:29 pm. Charges vary depending on the time of day. By 2016, the peak charge increased by 75% and the system was extended to include all car traffic between the north and south part of Stockholm along the Essinge bypass (E4/E20). A similar Swedish cordon charging system was also implemented in Gothenburg.[66]

6.2 The current charging schedule is shown in Table 6-1.

Table 6-1 Stockholm city centre charges (from 1 January 2020)

Hours	Off-peak season tax amount in SEK	Peak season tax amount in SEK
6:00–6:29	15	15
6:30–6:59	25	30
7:00–8:29	35	45
8:30–8:59	25	30
9:00–9:29	15	20
9:30–14:59	11	11
15:00–15:29	15	20
15:30–15:59	25	30
16:00–17:29	35	45
17:30–17:59	25	30
18:00–18:29	15	20

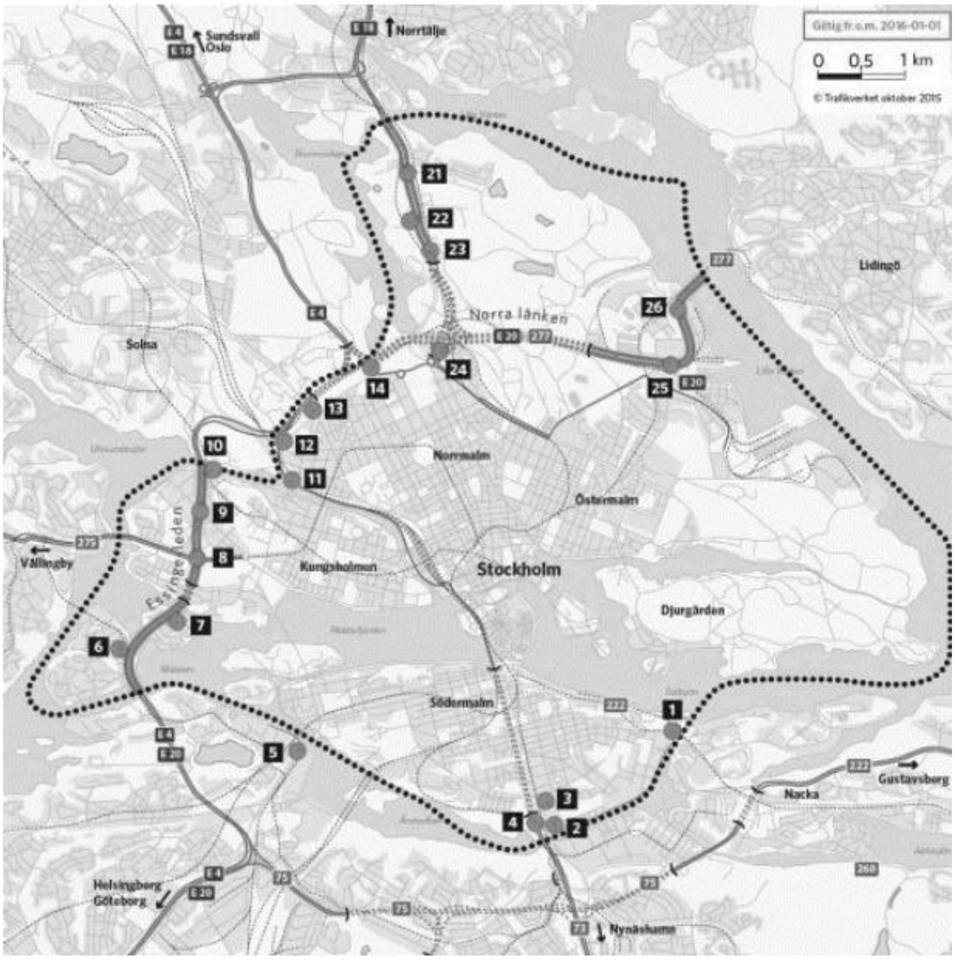
Source: Transport Styrelsen[67] Notes: Charges current as of Dec 2022. Exchange rate Dec 2022 1 SEK = 0.079 GBP, so 'high-peak' charge of 45 SEK = £3.55 per direction.

[66] Börjesson (2018), 'Long-Term Effects of the Swedish Congestion Charges'

[67] Transport Styrelsen (2022), Hours and amounts in Stockholm

6.3 There are 20 control points with automatic number plate recognition (ANPR), with 25% of users signing up for direct debit payment methods and 75% paying a monthly invoice.

Figure 6.1: Tolling Boundary for Stockholm Cordon Charge



Source: OECD[68]

Scheme Costs and Revenues

Costs

6.4 The reported implementation cost for scheme was £1,900m SEK (c. £150m at current exchanges rates), with an annual operating cost of around £220m SEK (c. £17.5m at current exchanges rates).[69]

Revenue and Investment

6.5 Initially during the trial, revenue was suggested to be invested into public transport, however post-trial, the revenue has been used to finance new road infrastructure investments.

[68] Börjesson (2018), 'Long-Term Effects of the Swedish Congestion Charges'

[69] Croci (2016), 'Urban Road Pricing: a comparative study on the experiences of London, Stockholm and Milan'

Investment cost for the system was roughly €200 million in 2006. By 2016, the operation cost was €10.3 million – accounting for only 7% of the total revenue made that year.[70]

Transport Outcomes

Public Transport and Traffic

6.6 During the trial period, 197 new buses and 16 new bus routes were introduced as well as 2,800 new park and ride facilities to provide commuters with options for travelling through the restricted zone. [71]

6.7 Upon introduction of the charge in 2006, traffic reduced by 20%. Travel time reductions took place across the network, due to intersections being blocked upstream of the bottleneck area before charges were implemented.[72]

6.8 Public transport patronage increased by 6% during the trial period, and during the implementation public transport routes were extended. Park and ride sites were introduced, however the potential for them was not fully observable as they were under-utilised.

6.9 Prior to the extension including Essinge bypass, there was a 22% reduction in traffic entering/exiting the congestion charging zone across the 18 control points during the trial period. Traffic passing through both major and minor streets was reduced by 10%.[73]. Traffic already flowing within the congestion zone are not required to pay the toll, therefore reductions in traffic entering the zone are greater.[74]

6.10 Delays (defined as excess travel time during peak times) decreased by 33% on arterials leading into the city. As observed during the trial period, fewer delays occurred due to the introduction of congestion charging. During the trial period, travel times increased along the Essinge bypass due to commuters redirecting routes.[75]

6.11 The Stockholm trial results showed that time-of-day effects were much smaller than expected. While the authorities expected to see peak spreading on a much larger scale due to the differentiated charges, the available data did not substantiate this hypothesis. Instead, the data showed that there were no time periods during which traffic over the cordon increased to avoid other time periods when charges were higher.

Air quality

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[70] Börjesson (2018), 'Long-Term Effects of the Swedish Congestion Charges'

[71] Provonsha et al (2018), 'Road Charging in London, Stockholm and Singapore'

[72] Börjesson and Kristoffersson (2017), 'The Swedish Congestion Charges: Ten Years On'

[73] University of Leeds (n.d.), 'Road user charging evidence on performance'

[74] Eliasson et al (2009), 'The Stockholm congestion charging trial 2006: Overview of effects'

[75] University of Leeds (n.d.), 'Road user charging evidence on performance'

6.12 Vehicular emissions were reduced within Stockholm between 8-14%.[76] The congestion tax in Stockholm reduced air pollution by 5-15%, which was also linked to the significant decrease in the rate of acute asthma attacks amongst young children.[77]

Economic Impact

6.13 Surveys of business leaders suggested that charges are likely to be a minor factor in influencing these dimensions. Also, no identifiable impacts on retail business or household purchasing power were identified.

6.14 The distributional effects (benefits and costs) vary among groups. Effects for disadvantaged groups were generally smaller than effects for middle- and high-income groups. There was difficulty in determining whether inhabitants experienced an improved city environment as this was considered subjective.

Acceptability

6.15 The 2002 congestion pricing initiative resulted from changing alliances, stemming from the 2002 national elections. The Social Democrats won and formed a government, partially by attracting the support of the Environmentalist Party. In exchange for this support, the Social Democrats agreed to an experiment in congestion charging.

6.16 Opinion polls taken before the election showed the share of individuals in Stockholm supporting the congestion charge experiment to have fallen significantly. The results from the last opinion poll undertaken during the trial showed that the share supporting the experiment increased to 54% - a good indicator of the referendum outcome.

6.17 Overall, acceptability changed from a negative majority before the introduction to a positive majority. When the referendum was held even those who had to pay the charge (i.e. those living within the cordon) (since the charge was for both entering and exiting the cordon) were in favour of keeping the pricing system. 52% of the city's voters were in favour of the scheme.[78]

[76] University of Leeds (n.d.), 'Road user charging evidence on performance'

[77] Simeonova (2018), 'Congestion Pricing, Air Pollution and Children's Health'

[78] Harsman and Quigley (2011), 'Political and Public Acceptability of Congestion Pricing: Ideology and Self-Interest in Sweden'

7 Milan - Area C Congestion Charge

Scheme Description

7.1 Major concern for pollution levels led to the introduction of the "Ecopass" scheme in 2008. In 2012, the scheme was upgraded to a congestion charge following the results of a referendum where 79% of voters demanded an extension of the Ecopass area to all vehicle types (Area C Road Pricing). [79]

7.2 Area C is a Limited Traffic Zone (LTZ) spanning 8.2 km^2 –covering approximately 4.5% of the Municipality of Milan. The area has restricted access Monday to Wednesday and on Friday between 07:30 and 19:30, and also from 07:30 to 18:00 on Thursday.

7.3 Cars entering the area are detected by the 43 electronic gates, equipped with automatic number plate recognition (ANPR).

7.4 The daily entrance ticket covers all accesses made by the same vehicle during the same day. Mopeds, motorcycles, electric cars, vehicles for disabled people, public utility and public transport service vehicles, taxis, hybrid/methane-powered/LPG/ biofuel cars are exempt from the charge.[80] The current charging schedule is show in Table 7-1.

Table 7-1: Milan city centre charges (from 24 February 2021)

Engine Class	Gasoline		Diesel		Hybrid/ biofuel	Electric/ Scooters
Euro Levels	Euro levels 1-6	Level 0	Euro levels 1-6	Level 0		
Non-Residents	€5	Banned	€5	Banned	Free	Free
Residents	€2		€2		Free	Free
Commercial	€3		€3		Free	Free

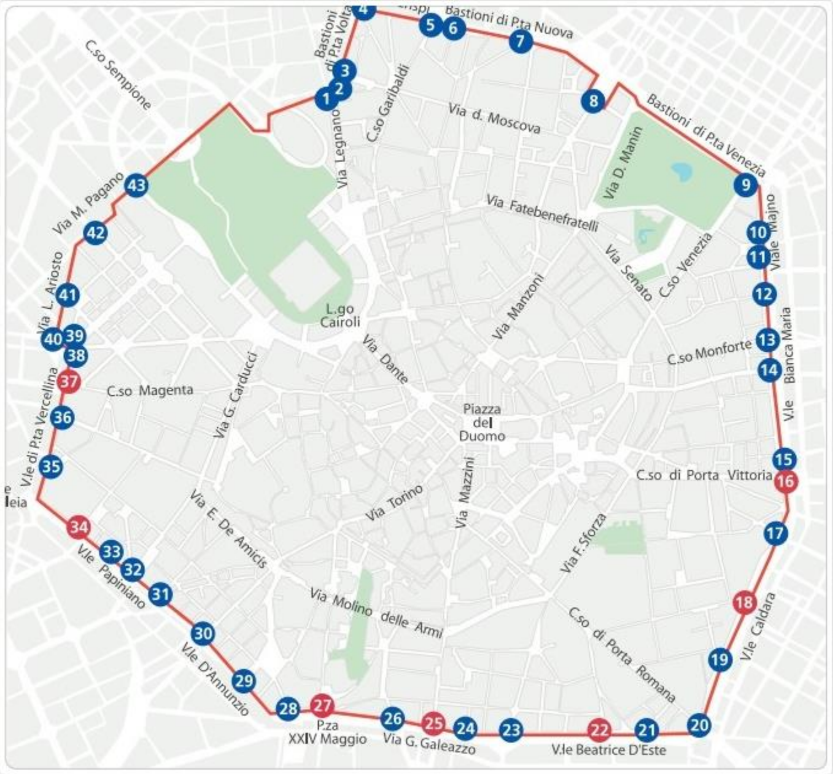
[79] Mattioli et al (2012), 'Milan's pollution charge: sustainable transport and the politics of evidence'

[80] C40 Cities (2015), 'Milan's Area C reduces traffic pollution and transforms the city centre'

Public Service	Free	Banned with exceptions	Free	Banned with exceptions	Free

Source: Wikipedia[81]

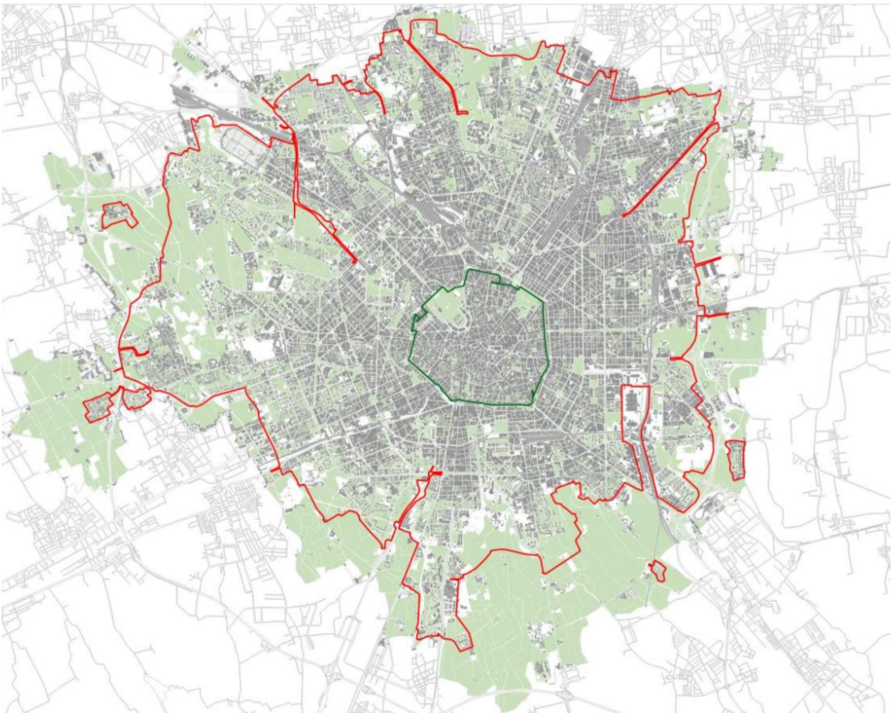
Figure 7.1 Area C - Detail[82]



[81] Wikipedia (2021), 'Milan Area C'

[82] Area C Milano (n.d.), 'Area C Milano'

Figure 7.2 Area C (Green Area) Wider Context[83]



Scheme Costs & Revenues

Costs

7.5 The reported implementation cost for the scheme was €7m (though this was noted as excluding sunk costs), with an annual operating cost of around €14m[84]. In comparison to other cities, the running costs of the system were relatively low equipment such as control cameras had previously been financed during the Ecopass scheme.[85]

7.6 During 2012-2013, 59% of total admittances to Area C were made up of paying vehicles – the majority of which were passenger cars. Overall, regular users did not change their behaviour during the first year of charge.

Revenues and Investment

7.7 The former Ecopass scheme received criticism over how collected revenues were to be used, and as a result the Area C scheme was more transparent with how money was reinvested. Table 7-2 below shows revenues.

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[83] Comune di Milano (2022), 'Area b'

[84] Croci (2016), 'Urban Road Pricing: a comparative study on the experiences of London, Stockholm and Milan'

[85] Beria (2016), 'Effectiveness and monetary impact of Milan's road charge, one year after implementation'

Table 7-2: Area C Revenues 2012 and Reinvestment

Operation	Cost/Revenue	Reinvestment
Running Costs	€ 7,100,000	
PT Increase	~ € 10,000,000	+ 3370 km/day tram and bus, +4900 km/day metro
New bike-sharing stations	~ €3,000,000	+46 stations

Source: Effectiveness of Milan's road charge[86]

7.8 Reinvestment was concentrated highly on public transport and sustainable mobility policies. For 2012, €10 m was used to finance an increase in public transport provision and €3 m was used to install bike-sharing stations.

7.9 Overall, one year after the introduction, total revenues were €20.3 m/year, and total reinvestment amounted to approximately €13 m/year.[87]

Transport Outcomes

Public Transport and Traffic

7.10 Area C has achieved important results in terms of mobility and the environment. Area C has had a 28% decrease in road congestion. In addition, a 24% reduction of all road casualties has been observed between 2011 and 2012, compared with an 11% reduction city-wide during the same period.

7.11 The pricing scheme has resulted in 27,000 fewer cars entering Area C which represented a 14.5% decline in traffic including cars exempted from the charge; the decline in those subject to it is even greater, at 19%.[88]

Air quality

7.12 In terms of the environment, polluting vehicles are circulating less in the area, having decreased by 49% (-2,400 vehicles daily) and the share of cleaner vehicles has gone from 9.6 to 16.6% of the total traffic. There has also been a significant reduction in black carbon concentration inside Area C compared to outside areas. Area C has also contributed to a reduction in ammonia, nitrogen oxides and carbon dioxide.

Mode shift

7.13 Fewer cars circulating in the city centre has enabled public space to be reclaimed by pedestrians. Moreover. the city's whole transport system has benefitted - according to a statement of AICAI (Courier Aircraft Association), Area C has facilitated a 10% increase in productivity of freight deliveries in the city centre.

[86] Beria (2016), 'Effectiveness and monetary impact of Milan's road charge, one year after implementation'

[87] Beria (2016), 'Effectiveness and monetary impact of Milan's road charge, one year after implementation'

[88] C40 Cities (2015), 'Milan's Area C reduces traffic pollution and transforms the city centre'

7.14 Transit commuter routes adjacent to public transportation saw smaller traffic changes than those without similar access. In other words, many of the people who took public transit to work continued to do so.[89]

Economic Impact

7.15 We have not been able to identify any research findings on the economic impacts of the Milan scheme.

Acceptability

7.16 The metropolitan area of Milan is one of the most car-dependent, with a car ownership rate of 0.6 cars per inhabitants. Milan has one of the highest concentrations of car in the world. Following the city administration's choice to organise a referendum, 79% of voters accepted the proposed scheme.[90]

7.17 Possible reasons for the high acceptance rate include the wording on the ballot papers, other local environmental referenda inducing a response-set effect, and the political stability of the country. A further possible reason for the high acceptance of the pricing measure is the small area covered by the scheme and the major concerns for pollution levels (rather than congestion).[91]

[89] Jaffe (2015), 'Milan Abruptly Suspended Its Area C Congestion Pricing Zone and Traffic Soared'

[90] Beria (2016), 'Effectiveness and monetary impact of Milan's road charge, one year after implementation '

[91] C40 Cities (2015), 'Milan's Area C reduces traffic pollution and transforms the city centre'

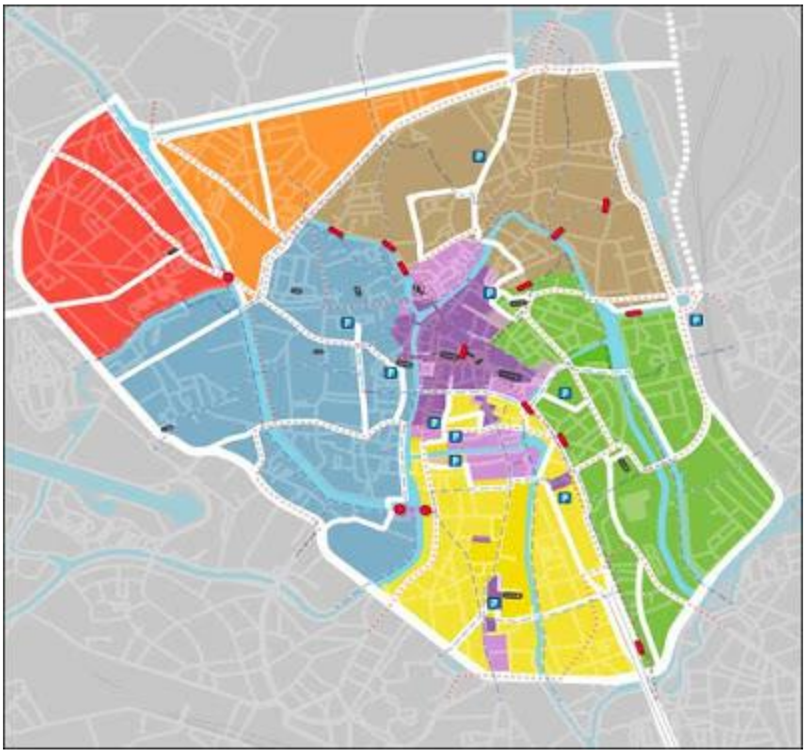
8 Gent Traffic Circulation Plan

Scheme Description

In April 2017, Gent introduced a Circulation Plan which sought to relieve the city centre of motorised through-traffic. Traffic in and out of the city began to flow differently. The aim of the scheme was to improve the city experience for its citizens and visitors and to ensure accessibility for cyclists, buses, and trams for accessing the city centre (and cars if that was their destination e.g. residents or businesses). The scheme formed part of the larger mobility plan which was devised in 2012.[92]

The city is divided in six sections surrounding the restricted traffic area (Figure 8-1). The circulation plan aimed to allow movement from one section to the other by using the inner-city ring road.

Figure 8.1: Circulation Plan



Source: Cadence Mag

The following formed part of this initiative:

- Travel directions were changed in about 80 streets;

[92] Stad Gent (n.d.), 'The Circulation Plan'

- More than 2500 traffic road signs were removed or newly placed;
- The restricted traffic area was extended by 150%;
- Motorised through-traffic has been made impossible at 14 locations;
- Only pedestrians, cyclists, public transport, taxi's and a limited number of other vehicles with a permit (for example emergency services and health care suppliers) can pass through.[93]

This has allowed space to be reclaimed for pedestrians, whilst simultaneously allowing a more comfortable and faster public transport service along with more space and safer infrastructure for cyclists. There was no Zero-Emission Zone introduced as part of this initiative. However, a Low Emission Zone was introduced in 2020.[94] Safer crossings and additional cycling streets were introduced (increase from 8 to 16 cycling streets in 2018). Gent City undertook an evaluation survey in 2017 and then a 'Mobility Survey' in 2018 to assess the impact of the Circulation plan to help understand the scheme's impacts.

Transport Outcomes

8.1 The transport outcomes for the Gent Traffic Circulation plan are summarised below[93]:

Public Transport and Traffic

8.2 There was a strong decrease of inbound and outbound motorised traffic. An average decrease of 13% during rush hours and an average decrease of 22% of freight traffic. An average decrease of motorised traffic of 39% on the most popular roads for cyclists in the inner city.

8.3 There was a decrease of reported road accidents by 35% to 40% since 2015. The number of accidents in the city centre of Ghent decreased by 25% in 2018 compared to the year before the introduction of the Circulation Plan. The number of casualties in an accident has fallen even more, namely by 33%.

Air quality

8.4 In terms of $N0_2$, there was an average decrease of 7,4 $\mu g/m^3$ or 18%, average decrease in Flanders: -3,7 $\mu g/m^3$.

Mode shift

8.5 Cyclists crossing the inner ring road increased by 37% compared to 2014 and 20% compared to 2016. An average increase of 35% on the most popular roads for cyclists in one year. An average increase of 25% of cyclists in the inner city in one year.

8.6 The number of users of sustainable transport modes has clearly increased: cyclists in the city centre by 50% and to and from the city centre by 60%, public transport users by 6% on a daily basis, with a stronger increase in the evening rush of 25%. These numbers continue the rising trends of 2017. The number of cars entering and leaving the city centre, on the other hand, has fallen sharply, by an average of 17%. This is also a confirmation of the decrease in 2017. Car use is falling, especially for non-work-related trips, and the use of sustainable transport modes is increasing.

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[93] Mobiliteitsbedrijf City of Ghent (n.d.), 'Ghent: A circulation plan as a step to the cycling heaven?'

[94] The Square.Gent (2021), 'Low Emission Zone in Ghent'

Economic Impact

Footfall

8.7 Although some local shopkeepers were worried about decreased revenue, the number of pedestrians in the city-centre did not decline following the adoption of the Circulation Plan. On the contrary, counters revealed a slight increase of between 2% and 10% from August to October 2017 compared with 2016.[95]

8.8 The passer-by counts indicate that there is a shift from the main shopping axes to other surrounding streets in the pedestrian shopping area.

Commercial activity

8.9 In the Mobility Survey, 5% of Gent residents indicate that they go shopping more often in the city centre since the introduction of the Circulation Plan. However, 30% indicate that they go shopping less often.[96]

Business Turnover

8.10 We note that the number of companies in Gent is increasing, more than the Flemish average. Specifically in the more central area (postal code 9000), there has been a clear increase in the number of catering and retail businesses over the period 2017-2018. The Circulation Plan therefore does not slow down the growth of companies for Gent and the effect of the growth of trade and catering is even stronger for the central area.[96]

Acceptability

8.11 The Mobility Survey (2018) highlighted that 50% of Gent residents thought of the Circulation Plan as a good thing for the area, while 30% did not agree with it. For the 2017 evaluation, these percentages were still 55% and 35% respectively indicating the polarisation between proponents and opponents of the scheme to have decreased. Age is an important differentiating factor in this respect, with half of the over-80s disagreeing with the Circulation Plan, whilst the 25–34-year-olds were more positive. There were no significant differences across the different sectors in the inner city.[96]

Successful Traffic Circulation Plan: Groningen

Groningen, Traffic Circulation Plan (*Verkeerscirculatieplan*, (VCP))
Groningen is perhaps the earliest example of a successful traffic circulation plan when it was introduced in 1977. The Groningen traffic circulation plan involved the centre of Groningen being divided into four sections. For motorists, it became impossible to go from one section to the other as cars had to make use of the ring road around the inner city. By contrast, cyclists could move about freely on new cycle paths constructed to accommodate them. It reduced car traffic in the inner city by 50% and concurrently improved the environment and revitalised the city centre.[97] At the time of launch in 1977, the scheme received a lot of pushback from local businesses and there was some initial analysis which suggested sales decreased for smaller businesses. However, the validity of this research was questionable and there were in fact other investigations which showed

[95] Cadence Team (2017), 'Ghent – Changing the Whole Circulation Plan Overnight: a Strong Political Decision'

[96] Stad Gent (2019), 'Evaluatierapport Circulatieplan Gent'

[97] Tsubohara (2018), 'Democracy in the traffic circulation plan for the central area of The Hague, the Netherlands'

the number of visitors increased. A nationwide survey revealed 19% of businesses increased their profit in the Province of Groningen from 1977 to 1978 and 24% for businesses in the inner city of Groningen.[98] Overall, it is difficult to say with certainty how the inner-city economy was impacted by the traffic circulation plan. Research suggests there is no negative relation between the economic development of businesses concerned and the introduction of traffic measures as part of the Traffic Circulation Plan.[98]

Today Groningen now boasts the cleanest air of all big Dutch cities (Groningen population of over 200,000) and cycling is thriving (inhabitants of Groningen possess an average of 1.4 bikes per person. The average number of bikes per household is 3.1.).[99]

[98] Tsubohara (2007), 'The effect and modification of the Traffic Circulation Plan (VCP) - traffic plannign in Groningen'

[99] Van der Zee (2015), 'How Groningen invented a cycling template for cities all over the world'

9 Limited Traffic Zones, Rome, Italy

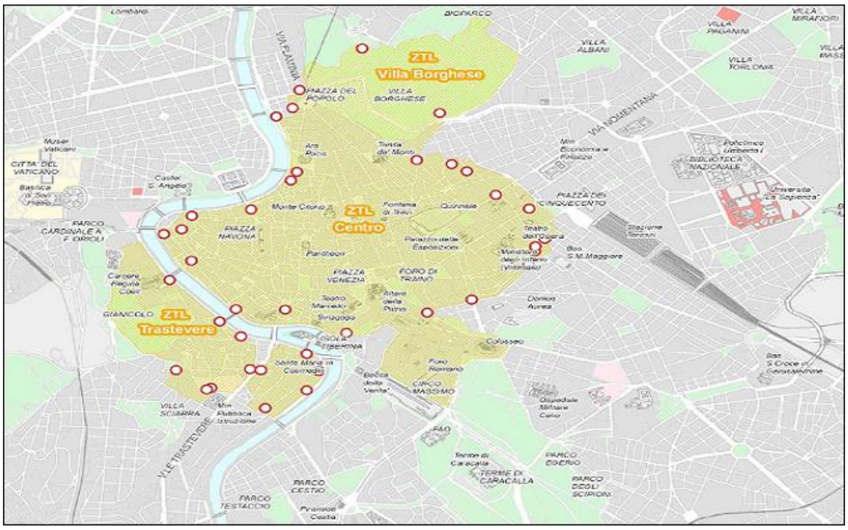
Scheme Description

9.1 Over the last 35 years, the metropolitan area of Rome has seen an increase in the number of vehicle km travelled and the overall number of vehicles (650%). During the same period, public transport has only seen a 90% increase in terms of vehicle km travelled.

9.2 There are 2.8 million inhabitants, with 1.96 million cars and more than 550,000 motorcycles and motor scooters passing around the city. More than half of Rome's population prefer using private vehicles (excluding motorcycles and scooters). This has raised concerns for the stability of the area in terms of pollution, congestion, and environmental degradation.

9.3 Rome's General Traffic Master Plan includes a strategy to restrict or limit private car use in the city centre in order to combat arising issues. As part of this, Rome has implemented an access control system called the "Zone a Traffico Limitato" (ZTL). The ZTL comprises of 8 areas in the City of Rome and Historic Centre: Fascia Verde, Anello Ferroviario, Centro Storico, Centro, Trastevere, Tridente, San Lorenzo and Testaccio.[100] The scheme mainly runs Monday to Friday 6am-6:30pm, with varying timings on Saturdays.[101]

Figure 9.1: Daily ZTL Zone in Rome



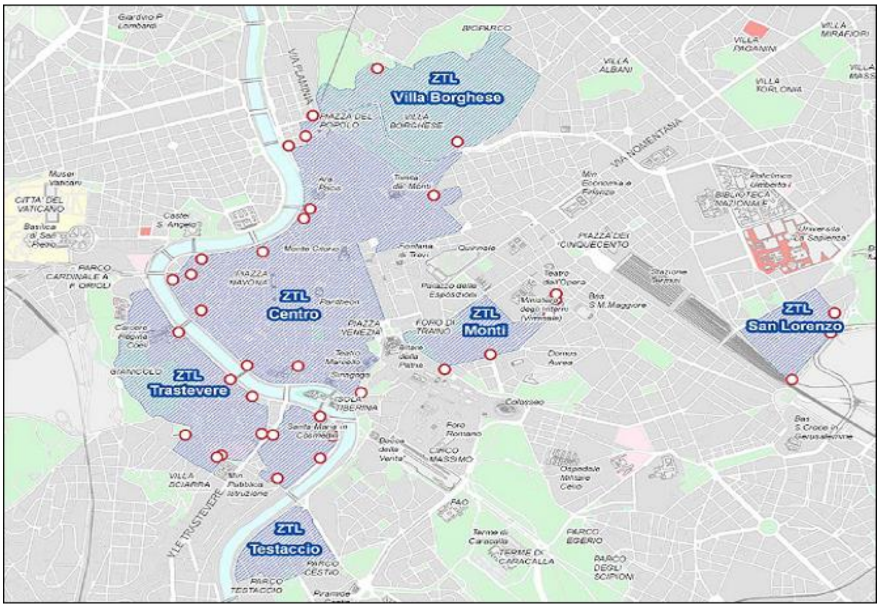
Source: CURACAO (2009b)[102]

[100] Parkimeter (2020), 'Rome's Limited Traffic Zone (LTZ)'

[101] University of Leeds (n.d.), 'Road user charging evidence on performance'

[102] CURACAO (2009b), 'Deliverable D3: Case Study Results'

Figure 9.2: Night Time ZTL Zone in Rome



Source: CURACAO (2009b)[103]

9.4 The first implementation, supported by electronic gates, was on 1st October 2001, in order to safeguard the central area of the city. Once the automatic system had been tested and modified, other potential areas and times were identified, and the scheme was extended. The charging schedule is shown in Table 9-1, with exemptions for two-powered wheelers.[104]

Table 9-1: Rome ZTL Charging Schedule

Category	Charge
Disabled	€15 for 5 years
Freight Distribution	€55 for 5 years
Private Taxi	€55 for 5 years
Residents	€55 for 5 years €300 (2nd registered vehicle per annum) €550 (3rd registered vehicle per annum)
Non-Residents (private)	€550 (per annum)
Public Utilities	€550 (per annum)
Coaches	Daily Charge
Daily Permits	€20/day (max €560/year)

Source: University of Leeds[97]

[103] CURACAO (2009b), 'Deliverable D3: Case Study Results'

[104] University of Leeds (n.d.), 'Road user charging evidence on performance'

Scheme Costs and Revenues

Revenues

9.5 Total revenue from the scheme amounted to £90 million in 2007.

Transport outcomes

Public Transport and Traffic

9.6 Across all ZTL areas and times, traffic flows have decreased by 20%. The morning peak traffic decreased by 15%.

9.7 Illegal accessing is still a prominent issue in the Rome area. The start of the scheme in 2001 saw 18% of total traffic flows as illegal, which reduced to less than 10% in 2007.

9.8 Average speed increased by 4% indicating less congestion and greater efficiency, which is further supported by a 5% increase in public transport speeds.

Air quality

9.9 Carbon monoxide pollution levels decreased by 21%, however this is also likely to be because of improved engine technology.

Mode shift

9.10 The ZTL has resulted in a 5% reduction in private car usage, with most usage being transferred to pedestrian flows. Exemptions for two-wheelers from the charge has also resulted in a modal shift to this. On the whole, the modal share of public transport modal has increased by 1%.[105]

Economic Impact

9.11 We have not been able to identify any research findings on the economic impacts of the Rome scheme.

Acceptability

9.12 Overall, residents favoured the scheme as the quality of life in the affected areas improved.[106]

[105] University of Leeds (n.d.), 'Road user charging evidence on performance'

[106] University of Leeds (n.d.), 'Road user charging evidence on performance'

10 Manchester City Centre

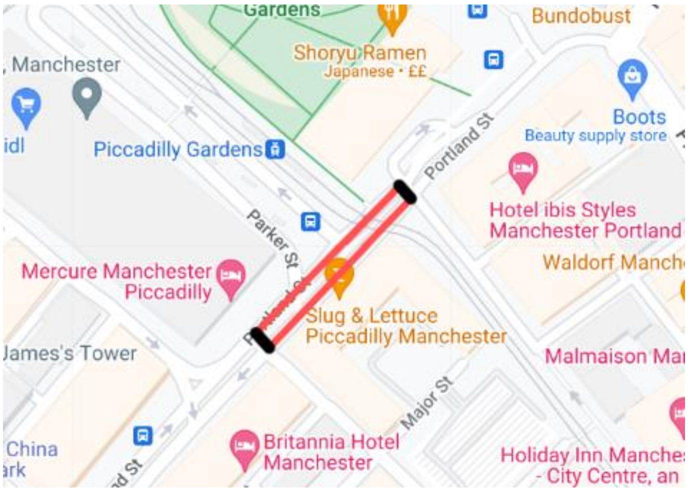
Scheme Description

10.1 Outside of London, Manchester City Centre serves as a large employment hub. Since 2009, employment within the city centre has grown by 30% from 135,000 to 175,000. Over this same period, car trips across the city centre decreased and rail/Metrolink patronage increased. This occurred to such an extent that by 2019, public transport accounted for around two-thirds of all inbound morning peak trips crossing the cordon.

10.2 Along Portland Street, Oxford Road, King Street and Bridge Street, bus gates have been introduced meaning that part of the road is only open to buses, black cabs and pedal cycles at all times. Penalty Charge Notices (PCN) of £60 are enforced for usage of a bus lane or bus gate. The major aim is to reduce private cars in the city centre and tackle congestion, such that there is no interference with public transport.

10.3 The Portland Street bus gate runs from Minshull Street to Aytoun Street, marked by a 'no motor vehicles' sign.[107]

Figure 10.1: Portland Steet Bus Gate



Source: Manchester City Council[79]

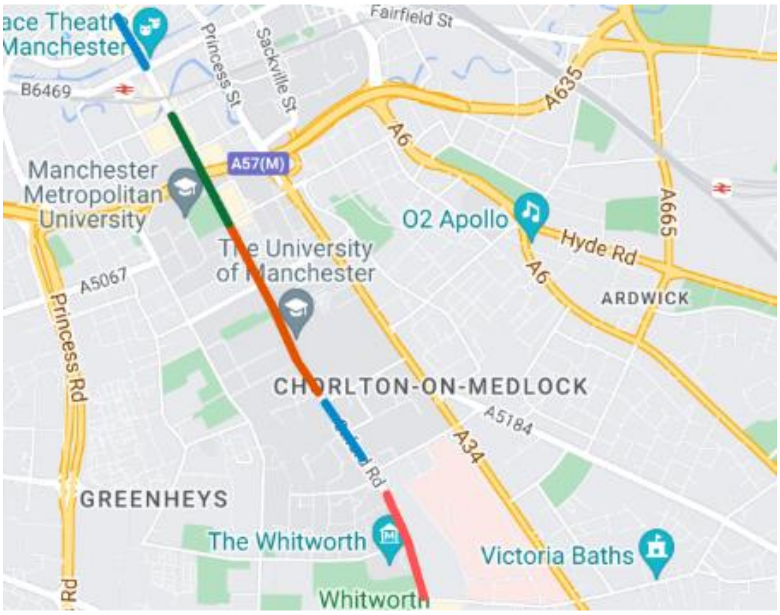
10.4 The Oxford Road bus gates that are only enforced in one direction include Whitworth Street-Portland Street (traffic heading North), Cavendish Street-Hulme Street (traffic heading South) and Devas Street-Dover Street (traffic heading North). The bus gates are divided into sections:

- One way southbound (blue)

[107] Manchester City Council (2023), 'The Portland Street bus gate'

- One way northbound (green)
- Restrictions from 6am-9pm (red/pink)

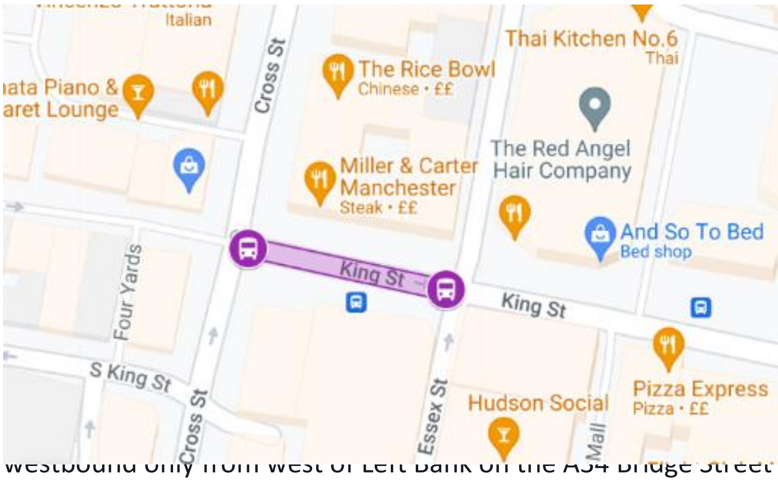
Figure 10.2: Oxford Road Bus Gate



Source: Manchester City Council[108]

10.5 The bus gate on King Street runs westbound only from Essex Street to Cross Street, marked by a blue sign with images of bus/cycle and word taxi on it.

Figure 10.3: King Street Bus Gate

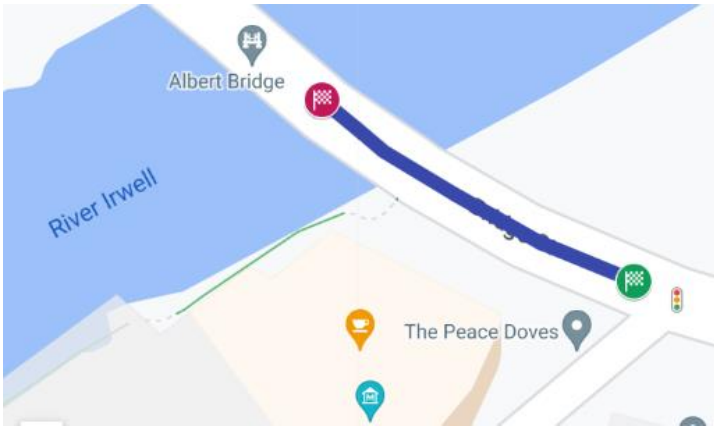


10.6 … r 2022 and will run westbound only from west of Left Bank on the A34 Bridge Street to the Albert Bridge.

[108] Manchester City Council (2023), 'The Oxford Road bus gate'

[109] Manchester City Council (2023), 'The King Street bus gate'

Figure 10.4: Bridge Street Bus Gate



Source: Manchester City Council[110]

Scheme Costs and Revenues

Costs

10.7 The scheme comes as part of a £1 bn city centre travel investment[111] to meet the goals of the city centre transport strategy – one of which is to get 90% of all peak morning journeys to be made on foot, by cycle or public transport by 2040.[112]

Transport Outcomes

Mode shift

10.8 Investment in alternative options for commuters to use will reduce private car usage. Additionally, motorists are encouraged to choose alternative routes to get across the city, which may increase journey times however this is expected to decrease as non-essential car use declines[113].

10.9 Highway trips have been sustained at levels below 10 years ago, whilst use of rail, Metrolink, cycling and walking has increased. To discourage car use, car parking facilities within the city centre will be removed and on-street parking reduced to repurpose street space for wider footways. The area is also expected to become a 20mph zone to limit through traffic.[114]

Economic Impacts

Metrolink and Employment Growth: Manchester

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[110] Manchester City Council (2023), 'The Bridge Street bus gate'

[111] Cox (2016), 'More than 150 drivers everyday are fined for driving into the new Portland Street bus lane'

[112] Manchester City Council (2023), 'Why we need bus gates?'

[113] Manchester City Council (2023), 'Why we need bus gates?'

[114] Transport for Greater Manchester (2021), 'City Centre Transport Strategy'

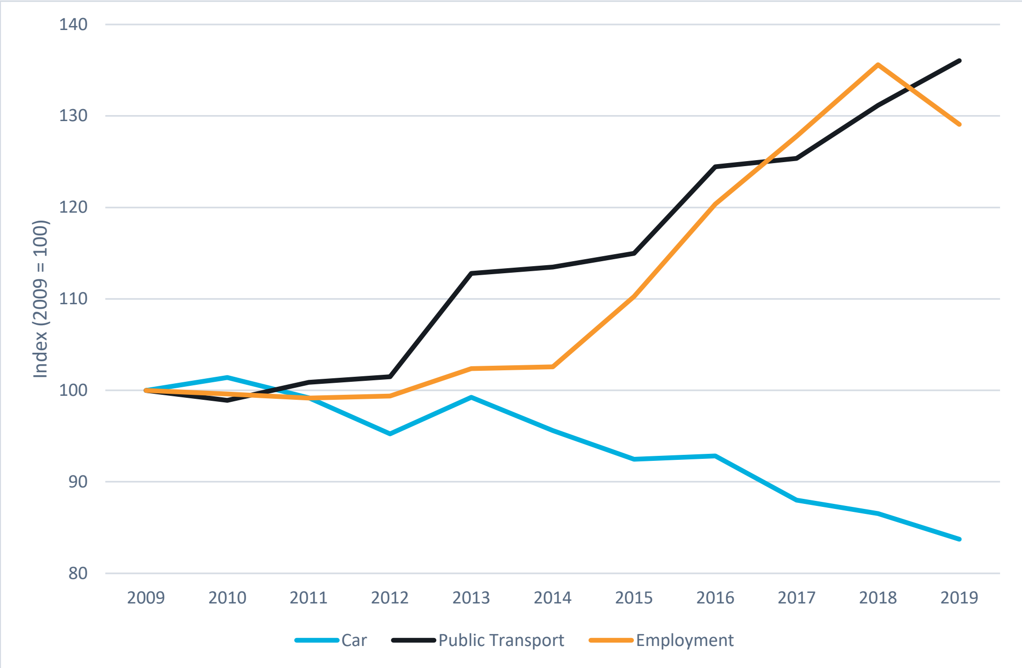
10.10 The role of Manchester Metrolink and its link to supporting city centre employment growth was set out as part of the Urban Transport Group's 2021 Report into the role of light rail.[115] The case study from the report is presented below.

Metrolink and Job Growth in City Centre Manchester

Manchester City Centre is one of the largest centres of employment outside London, much of it in highly productive office-based knowledge-intensive sectors.

As shown in Figure 10.5, there is a strong correlation between the rate of growth of Manchester City Centre jobs and the rate of growth in the use of public transport. As can be seen from Figure 10.6, Metrolink has been integral to this growth. Rail trips have grown in number, but rail's mode share has not increased. In contrast, Metrolink demand has grown nearly threefold. The only conclusion is that the expansion of the Metrolink network and the attractive public transport connectivity to the City Centre that it offers, has supported and facilitated the level of job growth. Without Metrolink, this could have only happened with increased traffic and the congestion and pollution this brings.

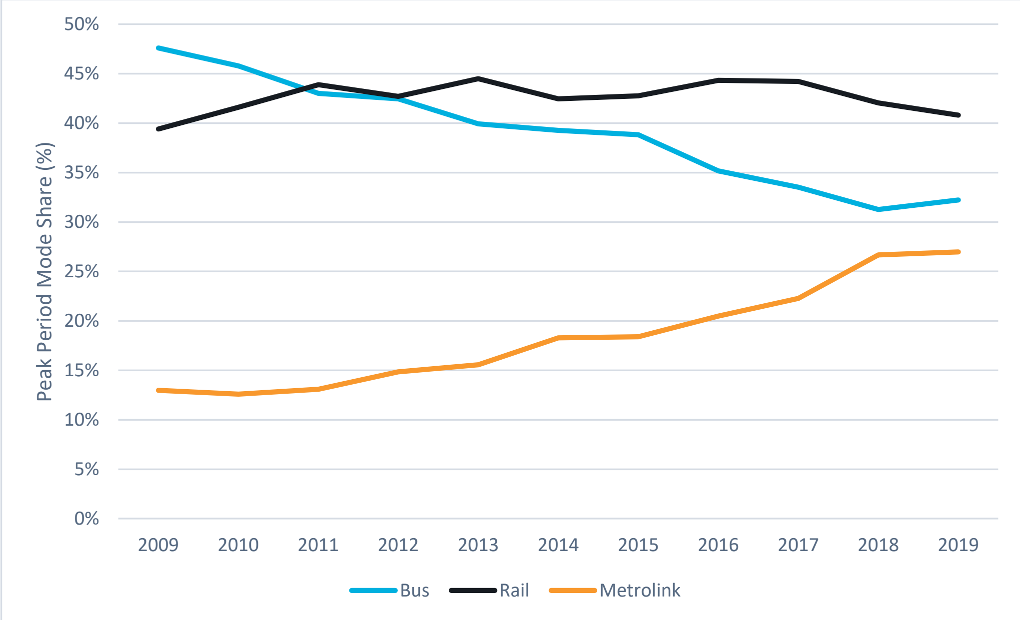
Figure 10.5 Peak Period Trips Crossing Manchester City Centre Cordon and City Centre Employment (2009 = 100)



Data Source: SRAD Report 2040 *Transport Statistics Manchester 2019-2020* Key Centre Section (Feb & March 2020) and TfGM analysis of Business Register and Employment Survey

115 Urban Transport Group (2021), 'Leading Light: What Light Rail can do for City Regions'

Figure 10.6: Peak Period Mode Share Crossing Manchester City Centre Cordon



Data Source: SRAD Report 2040 *Transport Statistics Manchester 2019-2020* Key Centre Section (Feb & March 2020)

10.11 The NIC in its '*Getting Cities Moving'* report[116] highlighted this Manchester example above, and elaborated the role of mass transit in providing the overall capacity to support the growth of cities. Most 'on-street' mass transit schemes involve an increase in public transport capacity and a decrease in highway capacity – both directly from the prioritisation given to mass transit and the wider strategy typically seeking to reduce levels of car traffic to and within city centres.

10.12 The NIC report stated that:

"In the most congested cities, it is likely that only high-capacity mass transit will allow more people to access the employment and leisure opportunities that will help levelling up".

"Mass transit systems are effective at moving large numbers of people quickly across urban areas. This need to move many people in a limited space is only necessary in large, densely populated built up areas".

10.13 The same underlying drivers of mass transit solutions – higher density centres and / or those where congestion is prevalent – as also those where demand management is an appropriate and complementary strategy.

Acceptability

10.14 A small minority have been unhappy with the lack of signage indicating alternative routes to access Portland Street. Additionally, there has been concern for visitors and tourists who would struggle to navigate the area whilst restrictions are in place.[117]

116 National Infrastructure Commission (2022), 'Getting Cities Moving - adaptive transport solutions for an uncertain future'

117 Cox (2016), 'More than 150 drivers everyday are fined for driving into the new Portland Street bus lane'

10.15 48% of respondents to the transport strategy indicated that cars, mopeds and motorcycles had too much space in the city centre. There is also major concern for the safety of cyclists with other vehicles on the roads.[118]

[118] Transport for Greater Manchester (2021), 'City Centre Transport Strategy'

11 Oxford Traffic Filters (proposed), UK

Scheme Description

11.1 Traffic filters are designed to reduce traffic, make bus journeys faster, and make walking and cycling more convenient and safer. When they are operating, private cars will not be allowed through certain sections of roads without a permit. All other vehicles including buses, taxis, motorbikes, vans, mopeds and HGVs will be allowed at all times. Traffic signs identify the location of each traffic filter, including operational hours and vehicles that are exempt to travel through.

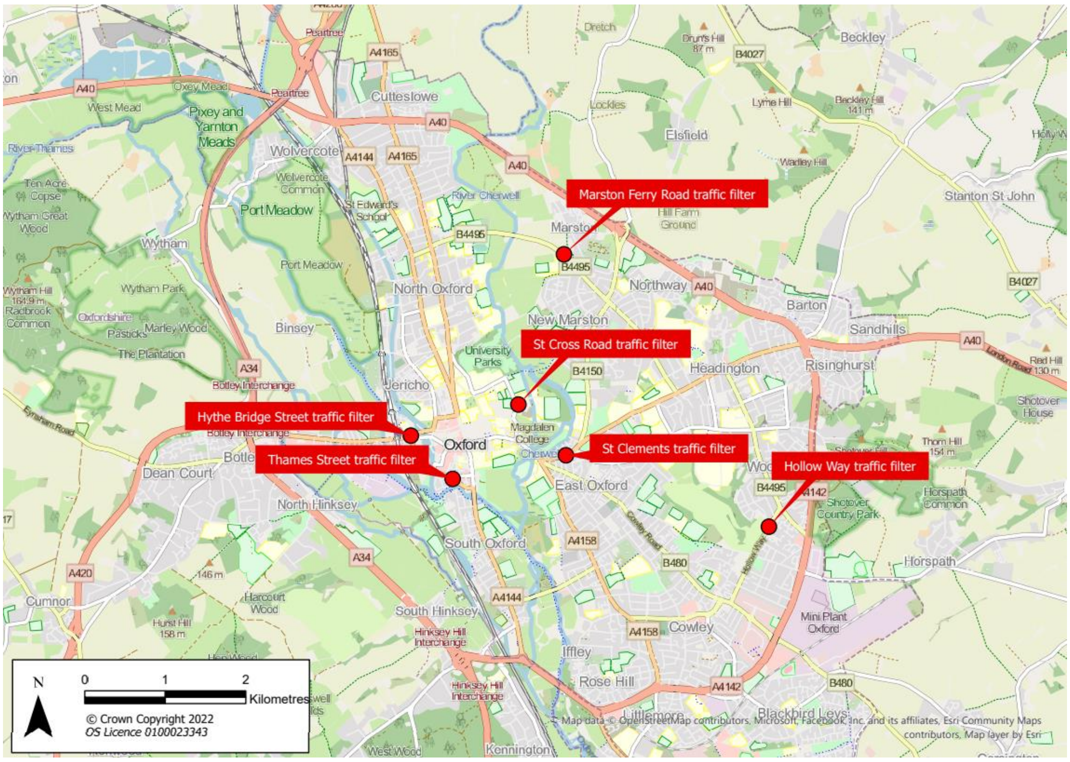
11.2 Automatic number plate recognition (ANPR) cameras will be installed to monitor vehicles going through the traffic filters. Any driver of a vehicle that goes through the traffic filter and is not exempt or using a permit, will be charged a penalty (currently £70).

11.3 The proposals include six traffic filters which will operate 7 days a week from 7am to 7pm, apart from traffic filters on Marston Ferry Road and Hollow Way which will not operate on Sundays.

11.4 The proposed filter locations[119] are shown in Figure 11.1.

[119] Oxfordshire County Council (n.d.), 'Final Scheme Definition'

Figure 11.1: Proposed traffic filter locations



Source: Oxfordshire County Council[113]

Exemptions

For the trial, it is currently proposed the following vehicles will be exempt from the traffic filters. This means they can travel freely, at all times and without applying for a permit.

- Buses
- Coaches
- Taxis
- Private hire vehicles
- Mopeds
- Motorbikes
- Vans (excluding people carriers)
- Heavy goods vehicles (HGVs)
- Special vehicles such as emergency services

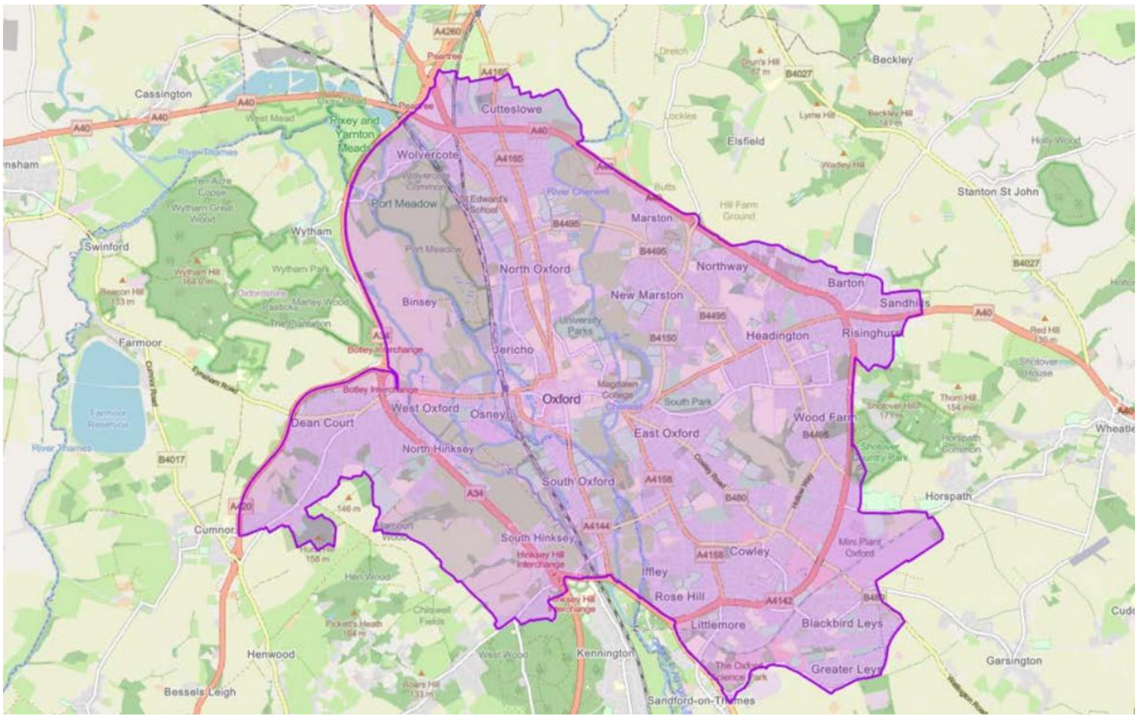
Permits

11.5 Permits for private cars will be available for the following groups.

- Blue badge holders
- Professional health or care workers
- Non-professional carers (for operational journeys, not commuting)
- Cars used as goods vehicles by businesses based in the permit area

11.6 Residents living in the permit area which includes Oxford City Council's administrative area, North Hinksey Parish, South Hinksey Parish, Cumnor Parish east of the A420, including Botley, Dean Court, Cumnor Hill, Chawley and parts of Cumnor. Residents in these areas will be able to apply for a permit to drive through the traffic filters for up to 100 days per year, with a maximum of three permits per household and one permit per person. The proposed permit area[120] is shown in Figure 11.2.

Figure 11.2: Proposed permit area



Source: Oxfordshire County Council[113]

Transport Outcomes (predicted)

11.7 Oxfordshire published a summary of the predicted and forecasts impacts of the scheme,[121] from which the figures below are drawn.

Traffic

11.8 Total traffic flows are forecast to reduce by 35% to 40% across the city centre in inner parts of the city.

11.9 As a result of the traffic filters, a total reduction in road casualties of 9% is estimated, almost entirely driven by reductions in levels of traffic within the ring road. Cycling casualties, which are more spatially concentrated in areas where traffic is forecast to reduce, are estimated to decrease by around 13%.

Mode shift

11.10 As a result of the scheme car person trips *wholly within the city* are forecast to reduce by 20% overall, equivalent to 24,800 fewer trips across the average 12-hour weekday (07:00 to 19:00). The reduction in total car trips, including trips to or from the city, is around 26,300. This represents a reduction of 9% in total car trips to, from and within the city.

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[120] Oxfordshire County Council (n.d.), 'Final Scheme Definition'

[121] Oxfordshire County Council (n.d.), 'Traffic filters'

11.11 Bus demand and walking and cycling demand are each forecast to increase by around 10%.

11.12 Bus journey time reduction within the inner sections of the city, where traffic flows reduce significantly, is expected to be around 15% in the AM and PM peak periods.

Air quality

11.13 The proposals are forecast to significantly improve air quality in Oxford City, which is a designated Air Quality Management Area (AQMA). NO2 concentrations are predicted to decrease on 76% of the assessed road links, and at 91% of existing monitoring locations as a result of the filters.

Economic Impact (predicted)

11.14 The scheme has not been implemented so there is no out-turn evidence on the economic impact of the proposals.

11.15 The objective of the proposals is to enhance overall growth and productivity by reducing traffic which improves bus journey times and enables reallocation of road space to other modes. It supports overall vision to deliver economic success in a way that is low-carbon, inclusive and sustainable.

Acceptability

11.16 The proposals are planned to be implemented as an Experimental Traffic Regulation Order (ETRO) in early 2024, following which there a public consultation exercise to inform whether the scheme should be made permanent.

Control Information

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