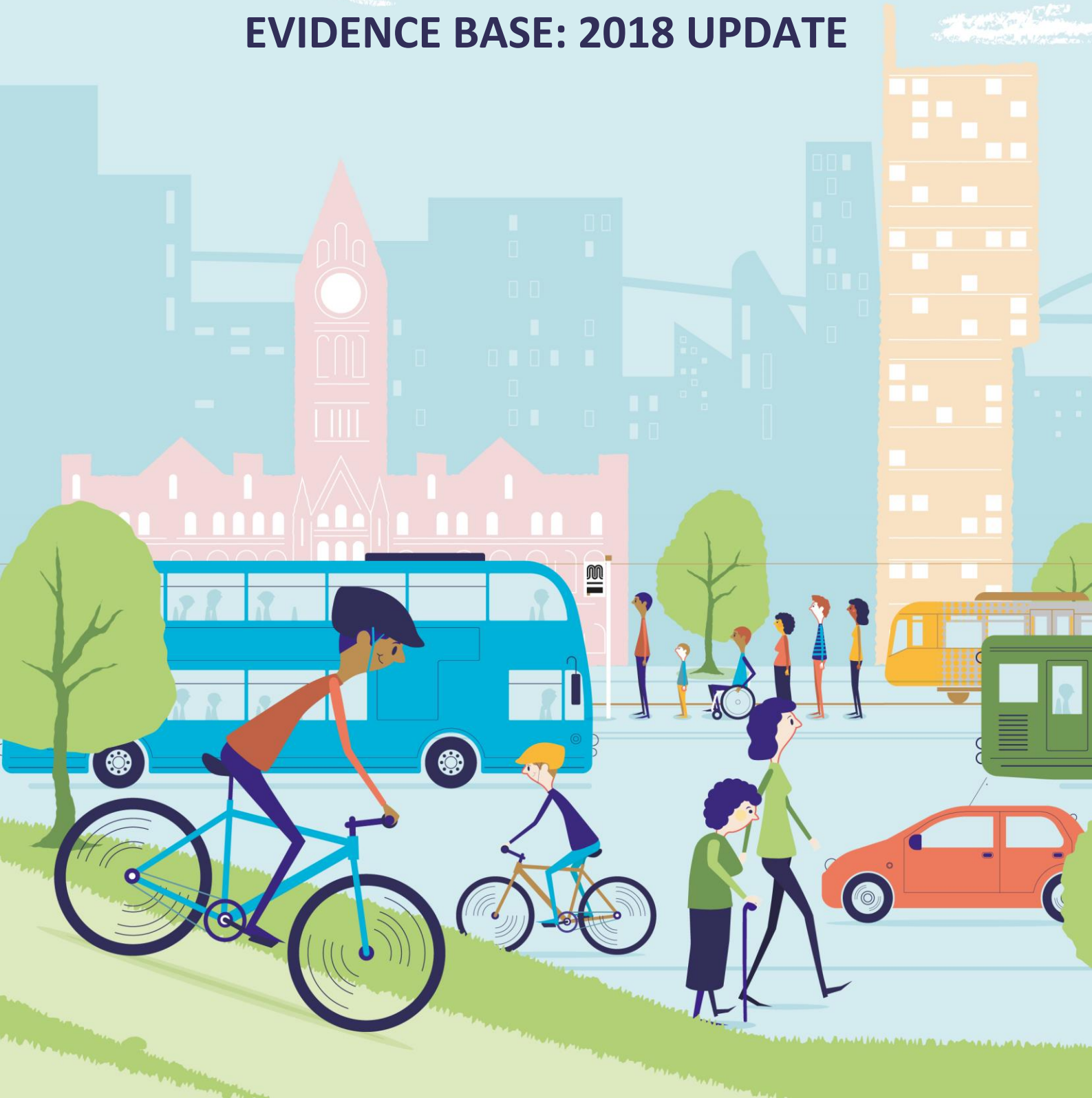
Transport for Greater Manchester

GMCA GREATER MANCHESTER COMBINED AUTHORITY

Greater Manchester Local Enterprise Partnership

GREATER MANCHESTER TRANSPORT STRATEGY 2040

EVIDENCE BASE: 2018 UPDATE



Overview of this document

1. This document provides the updated evidence base supporting the *Greater Manchester Transport Strategy 2040*, and the new *Greater Manchester Transport Strategy 2040: Delivery Plan (2020-2025)*.

2. The previous version of this Evidence Base was published in 2017, together with the *Greater Manchester Strategy 2040*. This Evidence Base document has now been updated to include the latest available data, and more specifically to support the publication of the new *Delivery Plan 2020-2025*.

3. The Evidence Base document begins by setting out recent trends in **Travel in Greater Manchester**. This chapter focuses on providing a picture of the current transport situation, with reference to recent travel trends in Greater Manchester.

4. This document then includes new evidence and analysis undertaken by TfGM to support **Our Vision for 2040** as set out in the new Delivery Plan 2020-2025 – namely, for 50% of all journeys in Greater Manchester to be made by public transport, walking and cycling by 2040; equivalent to a million more sustainable journeys every day.

5. The remainder of the Evidence Base document is then grouped into five thematic chapters. These chapters cover the key societal trends and issues which drive transport demand in Greater Manchester. These chapters are as follows:

    - **Economy and Employment.**
    - **Society and Community.**
    - **Urban Development.**
    - **Environment and Resources.**
    - **Technology and Innovation.**

6. Each of these chapters summarises the main implications that the identified trends are likely to have for the 2040 Transport Strategy and the Delivery Plan 2020-2025.

7. The previous version of the Evidence Base document also included a chapter on Policy and Governance. A comprehensive overview of the latest policy and governance trends in Greater Manchester and their implications for transport is now included within the *Greater Manchester Transport Strategy 2040: Delivery Plan (2020-2025).*

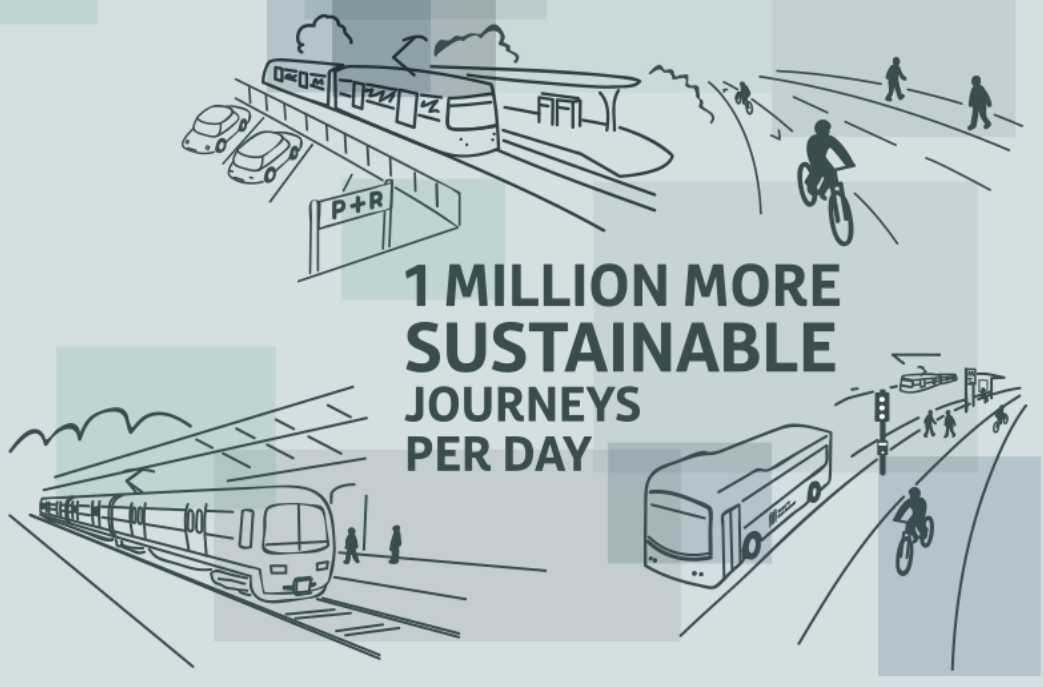
8. If you would like to provide feedback on the evidence provided in this document and if you have any data that you would like to share with us to help strengthen our evidence base, please email us at 2040@tfgm.com.

Travel in Greater Manchester

Travel in Greater Manchester – update coming soon

1. An updated version of the *Travel in Greater Manchester* chapter will be published soon.
2. In the meantime, for an overview of recent travel trends in Greater Manchester, please refer to the previous version of the Greater Manchester Transport Strategy 2040: Evidence Base (available from www.tfgm.com/2040, under 'Archive').

Our Vision for 2040



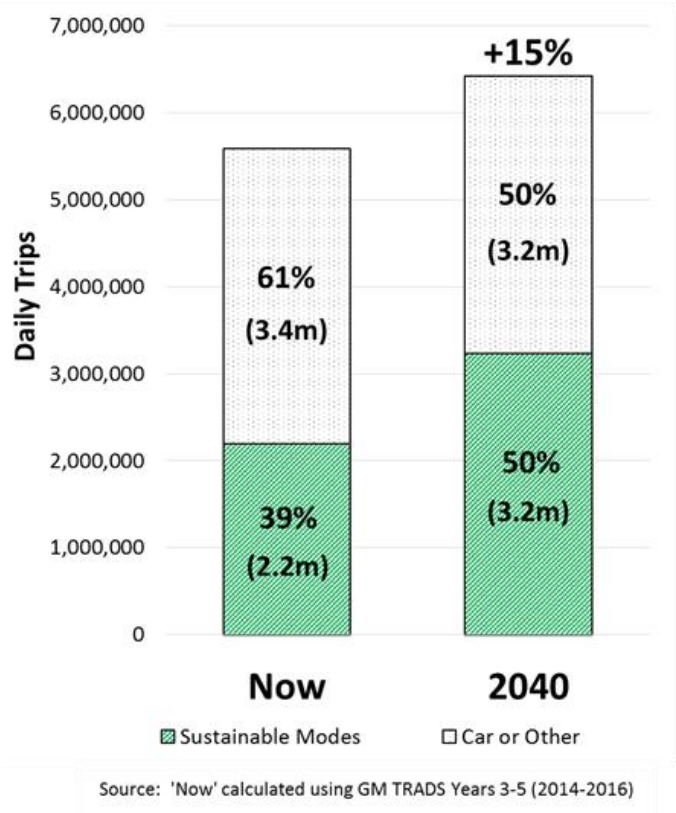
Our Vision for 2040: the "Right Mix"

Our mode share ambitions for 2040

1. Our vision – set out in the new Greater Manchester Transport Strategy 2040: Delivery Plan (2020-2025) – is to improve our transport system so that we can reduce car use to no more than 50% of daily trips, with the remaining 50% made by public transport, walking and cycling. This will mean a million more trips each day using sustainable transport modes in Greater Manchester by 2040 (Figure V1).

2. Our analysis suggests that achieving this vision will enable us to deliver our economic growth ambitions reflected in GMSF without increasing overall motor-vehicle traffic[1] in Greater Manchester. This vision – to be achieved by 2040 – entails 50% of trips by sustainable modes and no net increase in motor-vehicle traffic. It is termed the "Right Mix" of transport modes.

Figure V1: Our vision for 2040 – as set out in the Greater Manchester Transport Strategy 2040: Delivery Plan (2020-2025)



[1] The vision of no net increase in motor-vehicle traffic includes trips by Greater Manchester residents, as well as trips by non-residents and goods vehicle movements, which will also be influenced by our transport and land-use interventions - but less so. We expect no net increase in motor-vehicle traffic to be achieved by a net reduction in residents' traffic (the great majority of motor vehicle-km in Greater Manchester); an increase in light goods vehicle movements; and – potentially – some net increase in car-trips by non-residents.

3. The Delivery Plan 2020-2025 has now been published for consultation, alongside Greater Manchester's Plan for Homes, Jobs and the Environment – The Greater Manchester Spatial Framework (GMSF). Public consultation will begin on 21st January 2019 for 8 weeks.

4. If you would like to give us your views on the Delivery Plan 2020-2025 – including our vision for the "Right Mix" of transport modes by 2040 and the proposed pathway to reach that vision – please email us at 2040@tfgm.com.

A proposed pathway for achieving the "Right Mix"

5. In this section of the report, a proposed pathway is set out for achieving the Right Mix. The pathway is set out as a series of steps, which would in reality be made at the same time, but which are described as separate sequential steps to assist explanation. The development of the proposed pathway was led by TfGM with the benefit of feedback from officers of the ten Greater Manchester Local Authorities.

6. The steps in the pathway will be reviewed in the light of monitoring progress towards achieving the Right Mix. It is expected that the pathway proposed below will change in response to the results of monitoring. The changes could comprise changes in the interventions needed to achieve particular steps within the pathway, or changes to the steps themselves. To take one example of how this "adaptive planning" approach will work, there is presently little understanding of how "Future Mobility" – which can be broadly defined as the application of digital technology to provide new and improved transport services – will affect travel behaviour. As those effects become apparent, changes will be made to the proposed pathway to the Right Mix.

Spatial themes

7. The steps in the pathway to the Right Mix are defined using the framework of the spatial themes in the Greater Manchester Transport Strategy 2040. Trips by Greater Manchester residents have been categorised into the spatial themes.

8. The spatial themes have been represented within the Greater Manchester TRADS[2] Years 3-5 (2014-2016) person-trip dataset through the application of the following criteria (Table V1).

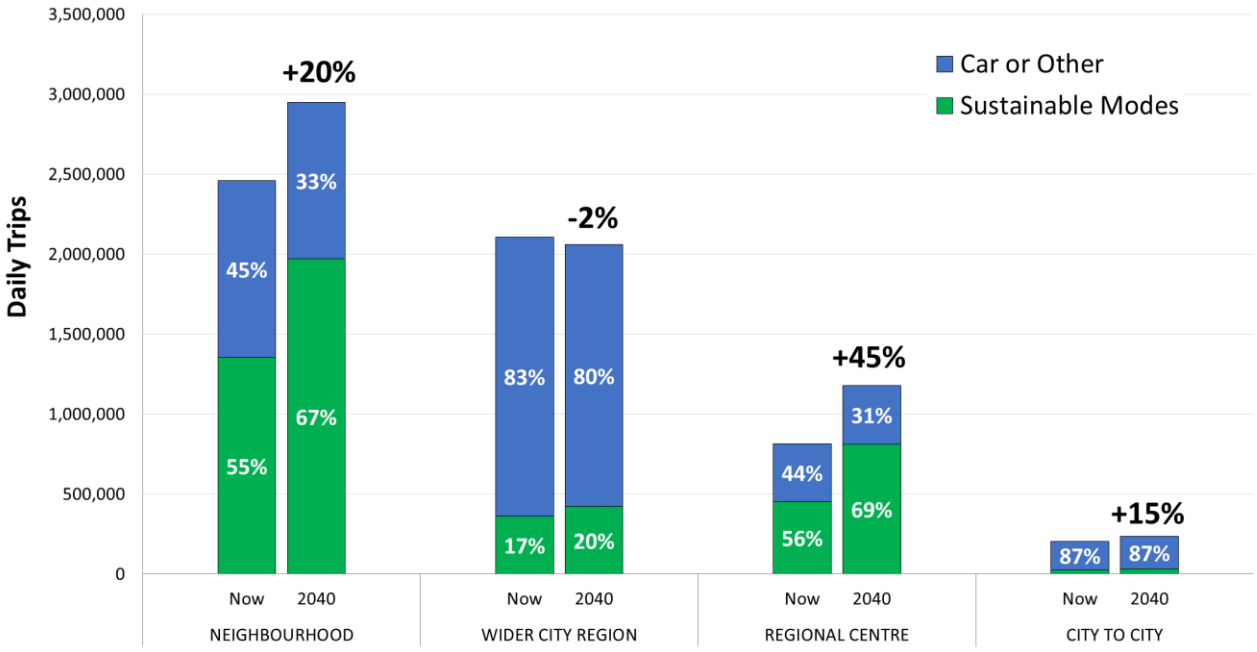
9. Figure V2 shows the change in volume of trips by mode for 'Now' and '2040' within each spatial theme in the Right Mix vision.

[2] Greater Manchester TRADS is Greater Manchester's household travel diary survey, in which a representative sample of Greater Manchester residents are interviewed about their recent trips. It is the Greater Manchester equivalent to the DfT's National Travel Survey, although there are some differences in survey methodology.

Table V1: Allocation of trips to the spatial themes defined in the 2040 Transport Strategy

Spatial Theme	Includes	Except
Neighbourhood	Trips less than 2km (straight line) with at least one end within Greater Manchester	• Trips with a non-work attraction end at Manchester Airport and surrounding developments[3] • Trips with an end within the Regional Centre
Wider City Region	Trips with at least one end in Greater Manchester, and both ends no more than 10km outside the Greater Manchester boundary	• Trips with a non-work attraction end at Manchester Airport and surrounding developments • Trips with an end within the Regional Centre • Trips under 2km
Regional Centre	Trips with an end in the Regional Centre	• Trips with a non-work attraction end at Manchester Airport and surrounding developments • Trips with an end more than 10km outside the Greater Manchester boundary
City to City	Trips with one end in Greater Manchester, and the other more than 10km outside the Greater Manchester boundary	• Trips with a non-work attraction end at Manchester Airport and surrounding developments

Figure V2: "Right Mix Vision" change in volume of trips by mode for 'Now' and '2040', by spatial theme



[3] The spatial theme, 'A Globally Connected City' (i.e. non-work trips to Manchester Airport) has been excluded from the analysis. TRADS surveys cannot accurately pick up these trips as residents making trips to Manchester Airport will likely be outside Greater Manchester at the time of the survey. The number of 'A Globally Connected City' trips is likely to be very small compared to the other spatial themes, so this is not considered to have a material impact on the results.

The steps to achieve the “Right Mix”

10. The steps in the pathway to achieve the Right Mix are as follows:

- **Step 1: 15% population growth leads to 15% growth in trips (and trip-kilometrage) by all modes.**
- **Step 2: Land-use and transport policies (plus changes in individual preferences) lead to a redistribution of 5% of trips from Wider City Region to Neighbourhood.**
- **Step 3: Land-use and transport policies (plus changes in individual preferences) lead to a redistribution of 10% of Wider City Region trips to Regional Centre.**
- **Step 4: Land use change and transport interventions lead to a higher mode share for walking for Regional Centre and Neighbourhood trips.**
- **Step 5: Transformational cycling policies lead to a switch to cycle from other modes – reaching a 10% mode share for Regional Centre and Neighbourhood trips and a 5% mode share for Wider City Region trips by 2040.**
- **Step 6: Improved metro and suburban rail services and complementary policies cause metro and rail to increase their mode-share, with metro taking 5% of Wider City Region trips.**
- **Step 7: Transport policies (including travel demand management) lead to a 5% reduction in trip-length of Wider City Region car-trips.**

11. Each of the steps in the pathway to the Right Mix is described below, together with the evidence behind them. The changes in travel behaviour that they represent comprise a set of adjustable targets which will be reviewed and modified within the adaptive planning approach outlined in paragraph 4 above.

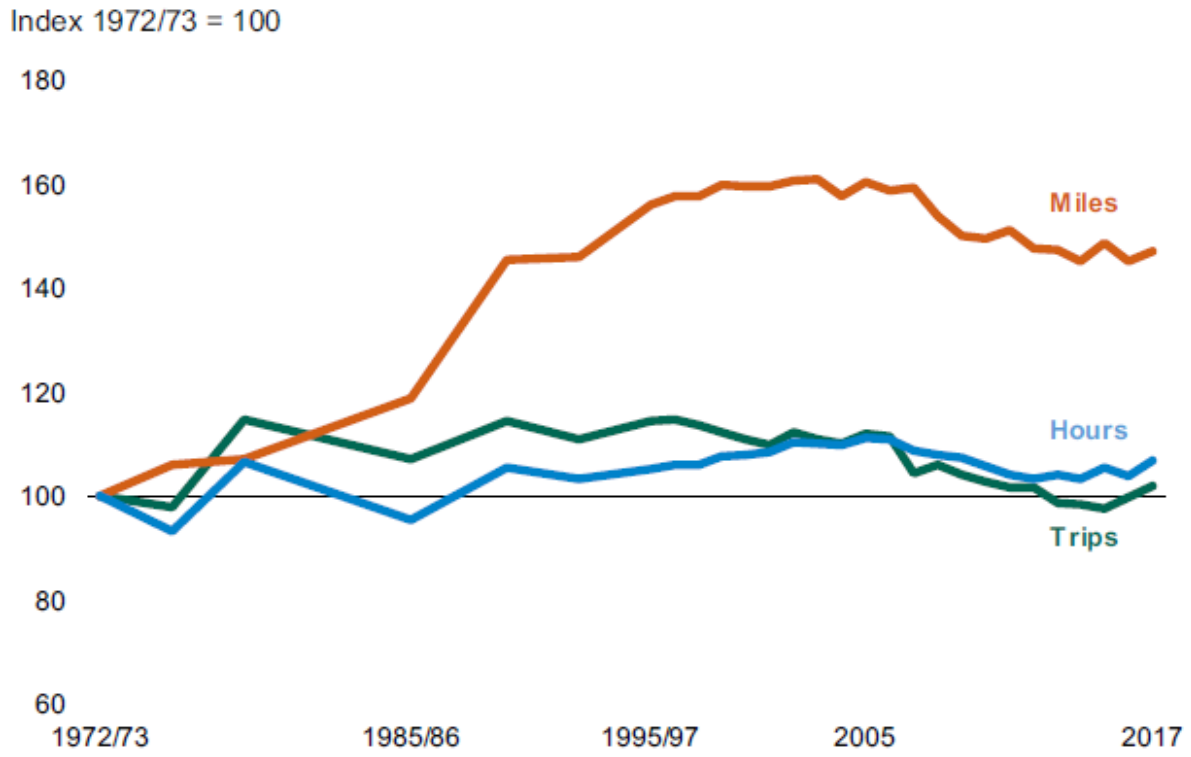
12. The seven steps above do not quantify any specific proposed increase in public transport mode share for city-to-city trips. This is considered to be a cautious assumption, which leaves potential to offset any shortfall in achieving any of the other steps in the pathway to the Right Mix. This is discussed in more detail in the final section.

Step 1: 15% population growth leads to 15% growth in trips (and trip-kilometrage) by all modes

13. Step 1 assumes that the expected 15% growth in Greater Manchester population by 2040[4] leads to a 15% increase in the number of trips – i.e. that trip-rate per person remains constant. In the early years of this century, trip-rates per person – both across England (see Figure V3) and in Greater Manchester (see Figure V4) - declined sharply, possibly as a result of the growth of the digital economy. There are some signs that the decline has levelled-off in recent years.

14. It is not expected that Greater Manchester's transport and land-use interventions will have much effect on trip-rates per person, and that factors outside Greater Manchester's influence will be the main driver of any changes in trip-rates.

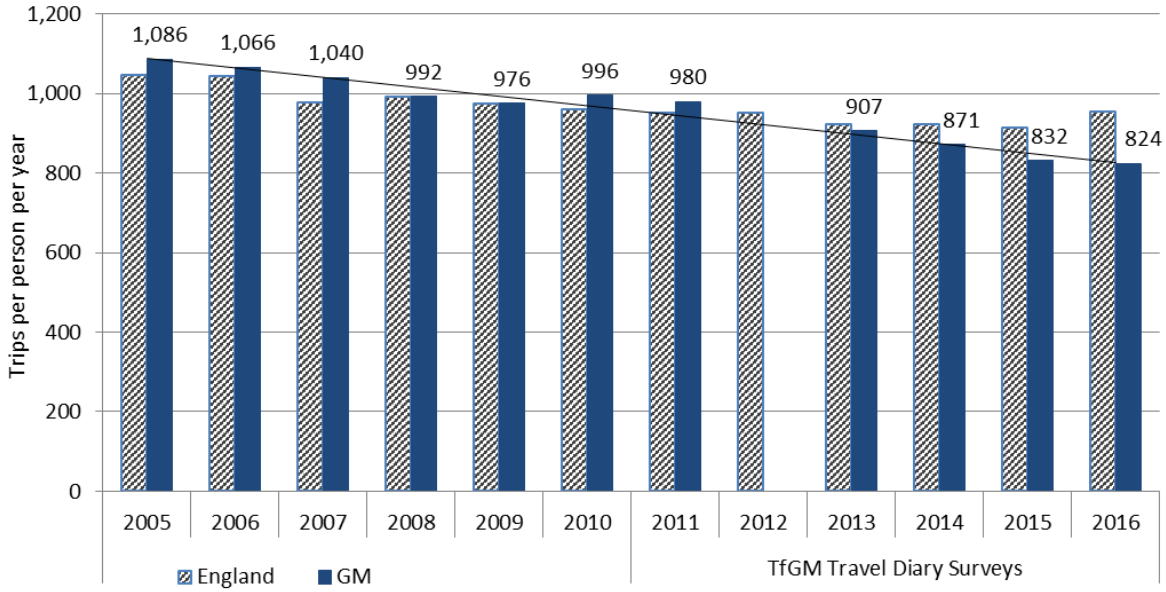
Figure V3: Trend in trip rates, miles travelled per person and hours per person spent travelling: England 1972/73-2017, National Travel Survey (NTS0101)[5]



[4] For estimating a pathway to the Right Mix, a 15% increase in population has been assumed by TfGM analysts based on a review of Census 2011, ONS population projections, and the Greater Manchester Forecasting Model – Accelerated Growth Scenario (GMFM-AGS). The expected population growth reflects Greater Manchester's ambition for economic growth, and will need to be supported by transport and land-use policies that achieve the growth in a sustainable manner. The population growth expectations in Step 1 will be kept under review in light of any new ONS forecasts and the final version of the GMSF.

[5] Source: Department for Transport (2017), National Travel Survey: 2017 report. Available from: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/729521/national-travel-survey-2017.pdf

Figure V4: Trips per person per year 2005 – 2016 Greater Manchester[6]



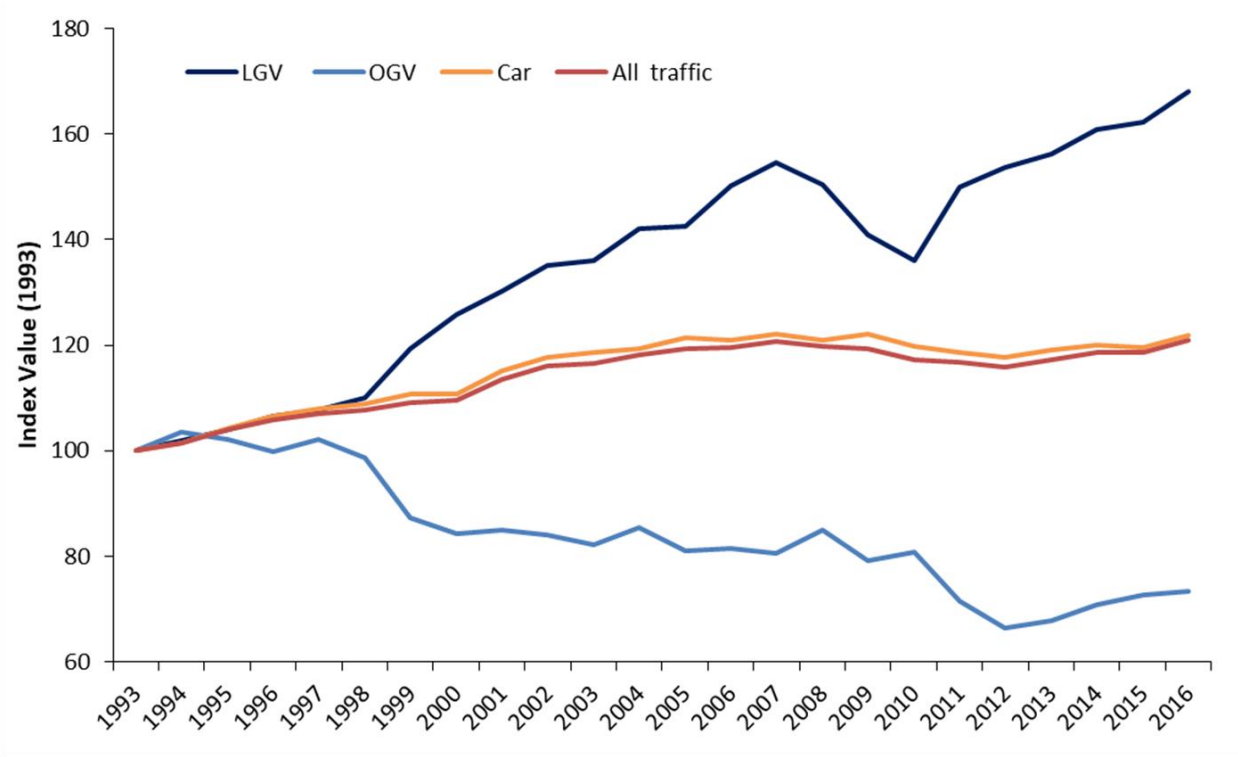
15. In recent years, the effect of falling trip-rates on motor-vehicle traffic has been at least partly offset by an increase in light-van movements, with an important cause being the growth of the digital economy leading to replacement of shopping-trips by movements of delivery vehicles. The growth of light-van movements has not been explicitly allowed for in this analysis, and the assumption that trip-rates will not continue their recent decline provides a balancing element of caution in estimating how externally-driven factors will affect volumes of motor-vehicle traffic in 2040.

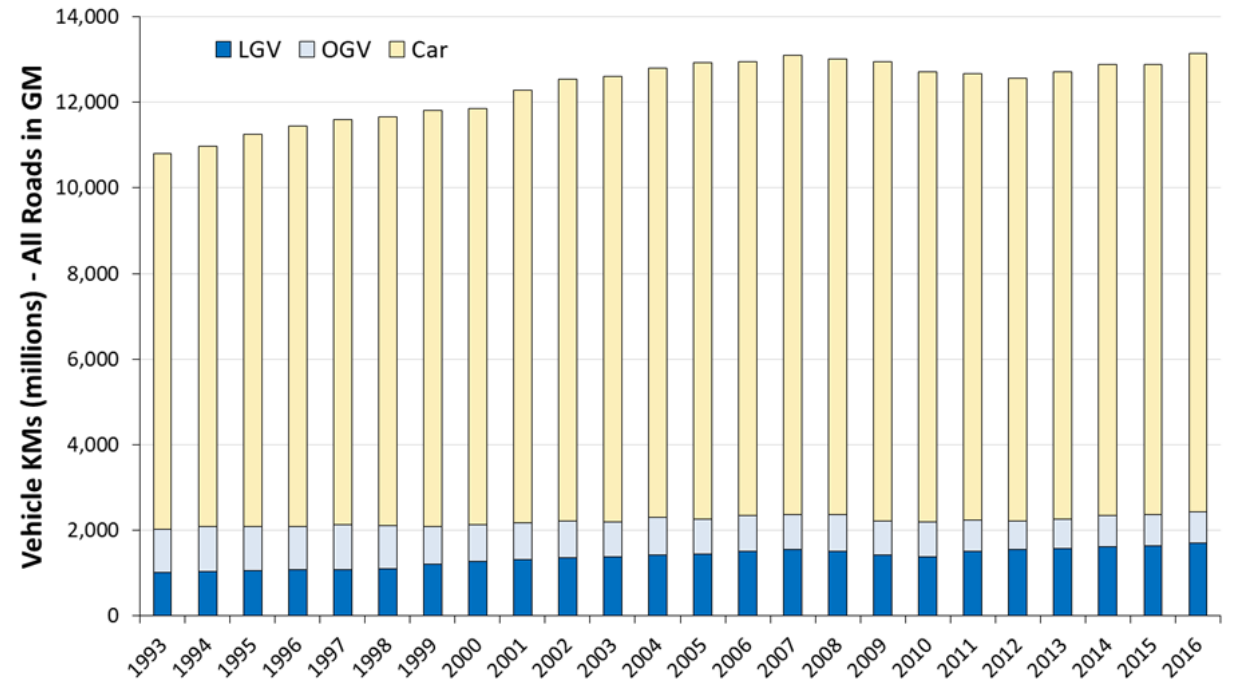
16. Figure V5 shows that between 1993 and 2016 traffic in Greater Manchester increased by around 21% whereas LGV kilometrage on Greater Manchester roads increased by around 68% in the same period. LGVs now account for c. 1.7 billion kilometres on Greater Manchester roads, representing 13% of all traffic (up from 9% in 1993).

17. It is important to note that the majority of this growth in LGV traffic has taken place on motorways, where the total distance travelled by LGVs has more than doubled between 1993 and 2016. In comparison, A roads have seen a 27% increase, and B roads a 21% increase over the same period. In 2016, motorways accounted for 56% of total Greater Manchester LGV kilometres travelled, up from 41% in 1993.

[6] Based on TfGM analysis of the Department for Transport National Travel Survey (2005 – 2016) and TfGM Travel Diary Surveys (2011 – 2016). N.B. DfT have recently changed the method for recording short walks – amended values for the trend for trips in England excluding short walks are reported in the Greater Manchester Transport Strategy 2040 Evidence Base - Travel in Greater Manchester section.

Figure V5: Growth in the number of Light Goods Vehicles on Greater Manchester roads[7]





[7] Source: TfGM Highways Forecasting and Analytical Services: Report 1912 Transport Statistics 2016 Road Traffic Section.

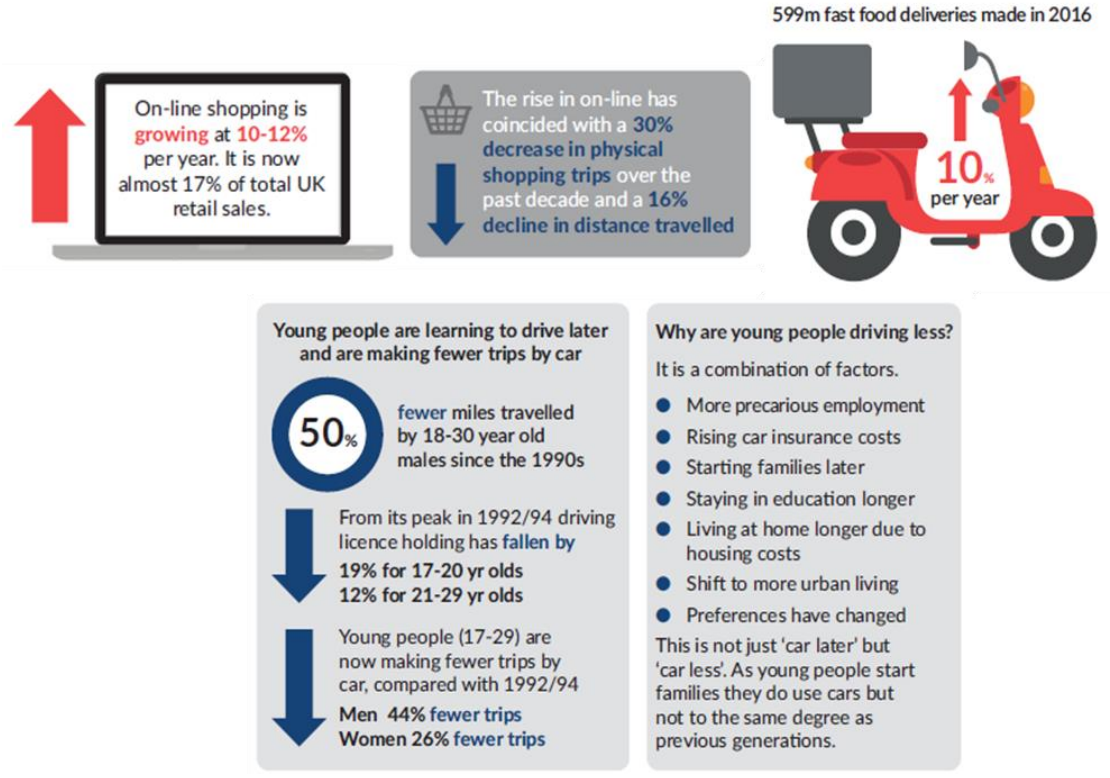
Step 2: Land-use and transport policies (plus changes in individual preferences) lead to a redistribution of 5% of trips from Wider City Region to Neighbourhood

18. There is a growing body of evidence that highly skilled young professionals want to live in attractive walkable urban environments. For example, in a recent survey of millennials aged 18-34 in ten major US cities, three in four said it is likely they will live in a place where they do not need a car to get around[8].

19. We anticipate that these preferences will translate into more Neighbourhood trips. Processes by which that might occur include (as reflected further by Figure V6):

- Trips to the supermarket being replaced by online delivery plus trips to the local convenience stores for top-up shopping.
- More walk-friendly neighbourhoods causing travel to local restaurants to replace travel to more distant eating venues.
- Reduced car-ownership among younger age-cohorts leading to a switch to neighbourhood trips that are more suitable for other modes of transport.

Figure V6: Evidence from 'All Change?' (Commission on Travel Demand)[9]



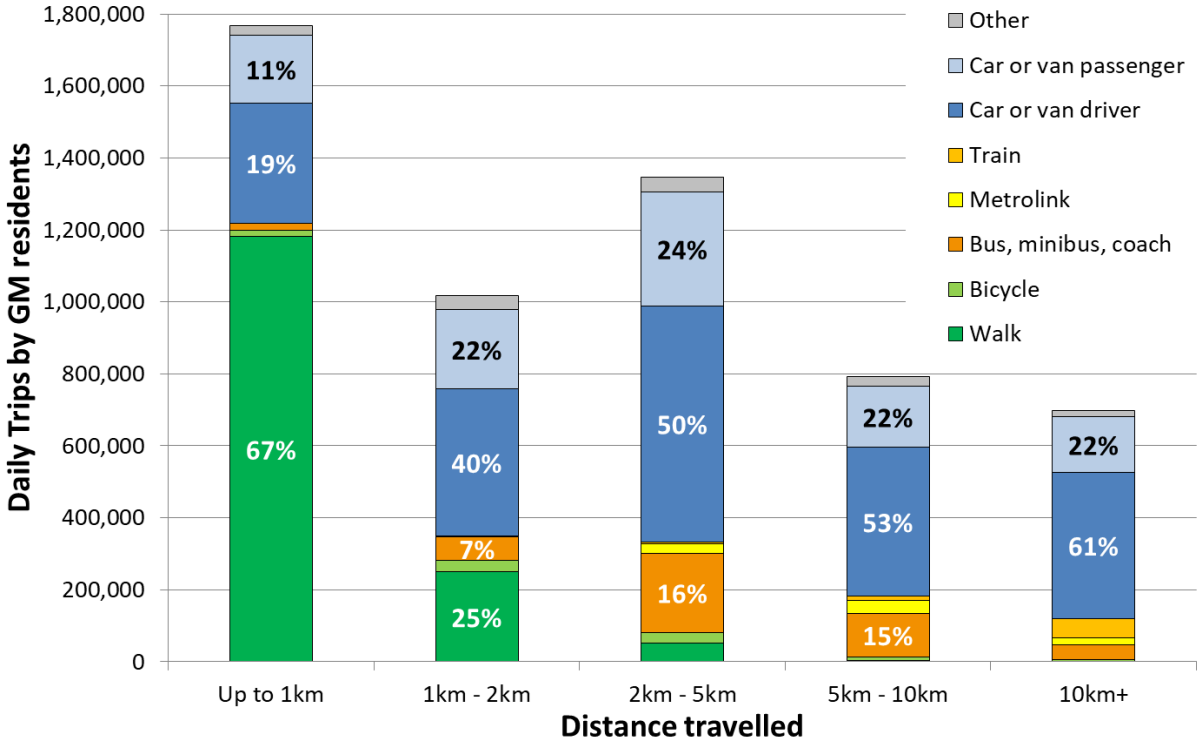
[8] Source: Transportation for America (2014), Survey: To recruit and keep millennials, give them walkable places with good transit and other options. Available from: http://t4america.org/2014/04/22/survey-to-recruit-and-keep-millennials-give-them-walkable-places-with-good-transit-and-other-options/

[9] Source: Commission on Travel Demand (2018), All Change? The future of travel demand and the implications for policy and planning. Available from: http://www.demand.ac.uk/commission-on-travel-demand/

20. The targeted regeneration of town centres (including - but not confined to - the eight largest town centres in Greater Manchester[10]) will reinforce this preference and increase the potential for Neighbourhood trips. More residents in town centres will lead to more demand for local services, which will result in more people being employed to provide those services.

21. Many of these local trips will be made by walking. Figure V7 shows that the vast majority of walking trips made by Greater Manchester residents are under 2km in length.

Figure V7: Main mode and distance travelled, Greater Manchester TRADS Years 3-5 (2014-2016)

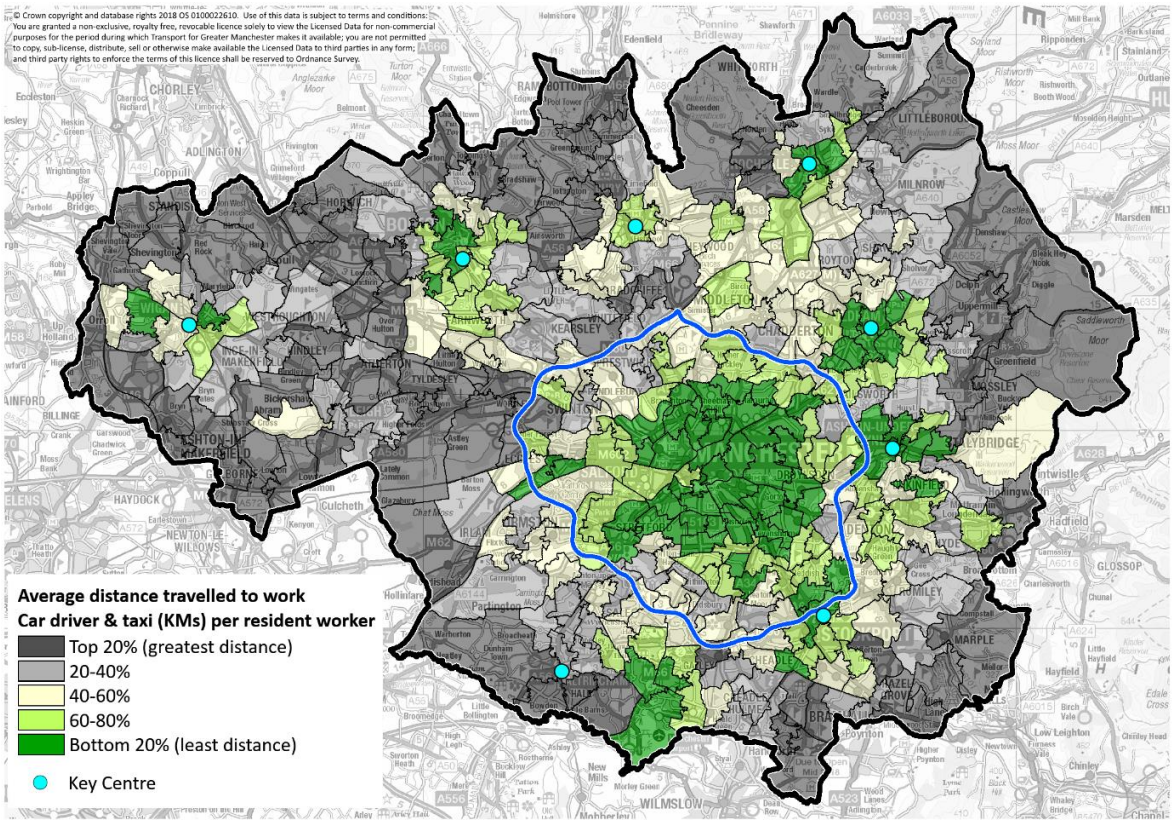


22. The Mayor's Town Centre Challenge will provide a new and concerted effort to support Greater Manchester's local authorities to realise the potential in town centres, with a particular emphasis on achieving sustainable communities featuring thriving housing markets. These sustainable communities will provide their residents with greater scope to adopt non-car lifestyles by increasing the likelihood of being able to access the majority of what they need (across the full spectrum of journey purposes) without needing to travel further than 2km.

23. Figure V8 highlights the existing potential of the eight largest town centres and the urban area within the M60 for delivering beneficial travel outcomes by showing that residents within these areas tend to travel less distance (measured by car-driver-km per head) to travel to work (when compared to areas on the periphery of Greater Manchester).

[10] Altrincham, Stockport, Ashton-under-Lyne, Oldham, Rochdale, Bury, Bolton and Wigan.

Figure V8: Average distance travelled to work (km) by car-driver per resident worker[11], Census 2011



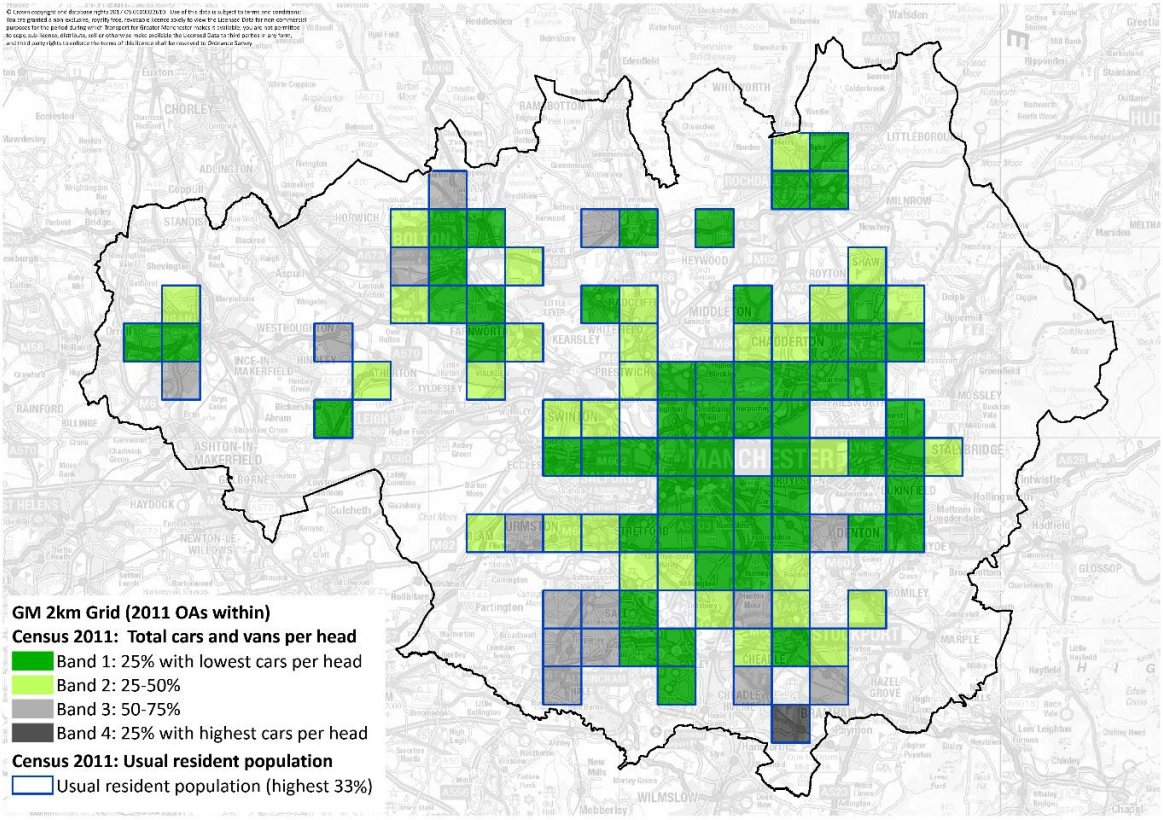
24. To support the 2040 Transport Strategy and the Delivery Plan 2020-2025, Greater Manchester is planning to implement "Streets for All". Streets for All is Greater Manchester's new way of thinking about the role of streets in creating sustainable, healthy and resilient places. It focuses on balancing the movement of people and goods alongside the creation of more people-friendly and less polluted streets and places. Specific Streets for All investments will depend on the specific needs of each locality, but they are likely to reflect a greater emphasis on "place" in densely-populated residential areas, thereby encouraging the development of walkable communities which generate Neighbourhood trips.

25. Figure V9 shows the tendency within Greater Manchester for densely-populated areas to hold above-average (in comparison to Greater Manchester as a whole) concentrations of no-car households. This is complemented by Figure V10 which shows how these densely-populated areas are also generally characterised as having above average (in comparison to Greater Manchester as a whole) levels of public transport accessibility.

[11] Note that this map shows average car-driver-km to work across all workers in each zone, including those who don't travel by car.

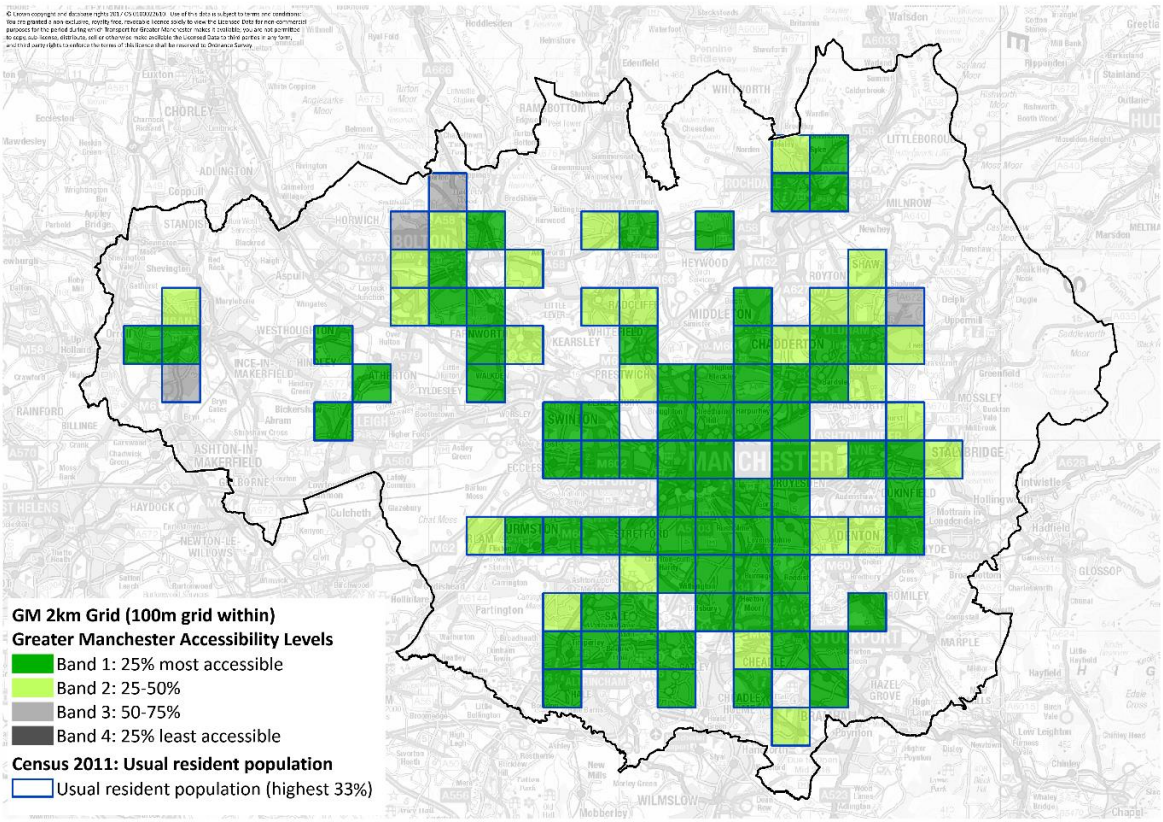
26. In Figure V10, public transport accessibility is measured by GMAL (Greater Manchester Accessibility Levels), which is a detailed and accurate measure of the accessibility of a point to both the conventional public transport network (i.e. bus, Metrolink and rail) and Greater Manchester's Local Link (flexible transport service), taking into account walk access time and service availability. GMAL gives particular emphasis to bus accessibility[12].

Figure V9: Total Cars & Vans per head and Resident Population Density, Census 2011



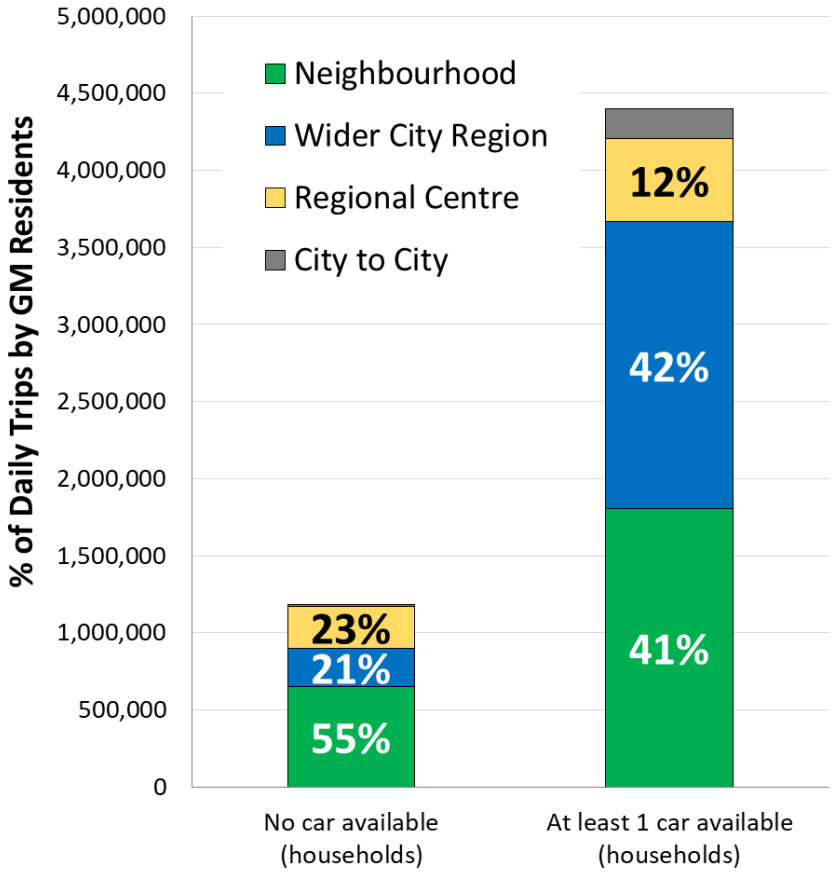
[12] GMAL scores are not affected by the higher speeds offered by National Rail or Metrolink services.

Figure V10: GMAL (October 2017) and Resident Population Density, Census 2011



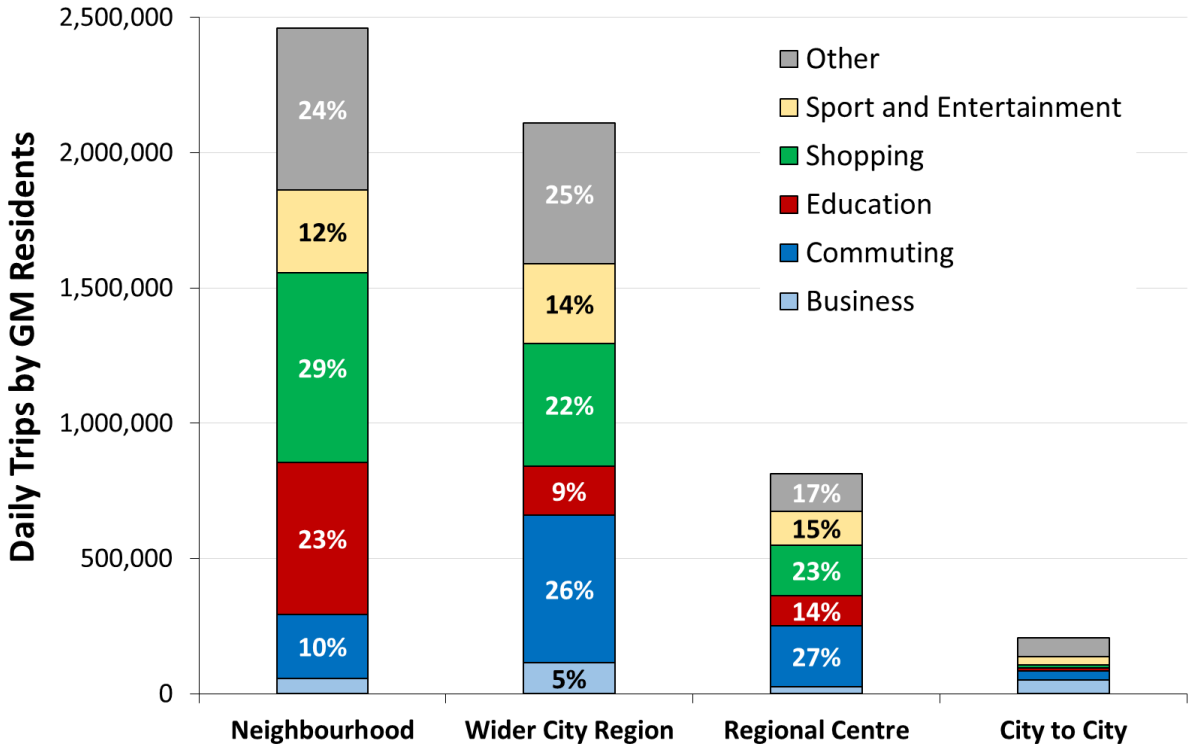
27. Together, Figure V9 and Figure V10 highlight the importance of attractive and frequent bus services in facilitating non-car-dependent lifestyles. Investment in bus priority will be important in facilitating those attractive and frequent bus services. Figure V11 shows that people who don't own cars are likely to make more Neighbourhood trips.

Figure V11: Daily Trips by Spatial Theme: No car households vs. Car available households, Greater Manchester TRADS Years 3-5 (2014-2016)



28. Figure V12 shows journey purpose by spatial theme. This analysis highlights the dominant role of education and shopping within the Neighbourhood spatial theme, when compared to the Wider City Region and Regional Centre spatial themes where there is a much greater emphasis on commuting.

Figure V12: Journey Purpose by Spatial Theme (Daily Trips by GM residents, GM TRADS 2014-16)



29.

30. There are some counteracting forces against a move to more Neighbourhood trips: for example, increased choice for both primary and secondary education and increased centralisation of healthcare facilities. There are also major employment growth areas in locations such as Manchester Airport and M62 North-East Corridor, which will attract most of their workers from outside the immediate neighbourhood. Interventions to minimise any growth in motor-vehicle traffic resulting from developments such as these are detailed in the draft Delivery Plan 2020-25.

31. In sum, with land-use and transport policies which reinforce strong changes in individual preferences, we consider a net redistribution of 5% of Wider City-Region trips to Neighbourhood trips by 2040 to be a realistic as an adjustable target.

Step 3: Land-use and transport policies (plus changes in individual preferences) lead to a redistribution of 10% of Wider City Region trips to Regional Centre

32. Step 2 represented how land-use and transport policies will combine to promote sustainable travel outcomes that will be focused upon the regeneration of existing urban areas outside of the Regional Centre. Step 3 accounts for the opportunities provided by the intensification of both the residential and employment markets within the Regional Centre.

33. From 2017 BRES data[13] it is estimated that c. 280,000 people work in the Regional Centre, whilst employment within Greater Manchester as a whole totals c. 1,300,000. This equates to approximately 21.5% of total Greater Manchester employment being located within the Regional Centre. It is expected that jobs in the Manchester, Salford, and Trafford core areas will comprise c.75% of net growth in the number of jobs in Greater Manchester between 2017 and 2040.

34. It is estimated that this will mean Regional Centre jobs increasing to c. 415,000 out of a Greater Manchester total of 1,500,000 in 2037. (Note that there is also expected to be growth in the total of travel-to-work trips to destinations elsewhere in Greater Manchester, but by less than Regional Centre trips).

35. That means that the proportion of travel-to-work trips in the Regional Centre will increase from 21.5% to 28% of the total of travel-to-work trips ending in Greater Manchester. Therefore 6.5 percentage-points out of 78.5% of travel-to-work trips ending elsewhere in Greater Manchester will be redistributed to the Regional Centre – i.e. approximately 8.3% of "elsewhere" trips – i.e. travel-to-work trips with an end in Greater Manchester outside the Regional Centre.

36. It needs to be emphasised that this "redistribution" from "elsewhere" to the Regional Centre in fact means that it is expected that in 2037 there will be more travel-to-work trips ending in both the Regional Centre and elsewhere in Greater Manchester, but that the proportional (and absolute) growth in travel-to-work trips in the Regional Centre will be greater than those to locations elsewhere in Greater Manchester.

37. It is expected that most of these redistributed "elsewhere" trips will in fact be taken from Wider City-Region trips. As shown in Figure V12, about two-thirds of "elsewhere" commuting trips are Wider City-Region trips, with most of the others being in the "Neighbourhood" category. Workers making "Neighbourhood" commuting trips are probably more likely to work in locally-focused businesses, such as convenience stores, and those workers are expected to be less likely to switch to Regional Centre workplaces. It is therefore expected that the actual percentage of Wider City-Region travel-to-work trips redistributed to the Regional Centre is likely to be somewhat higher than 8.3% due to the closer similarity between the jobs accessed by Regional Centre trips and those accessed by Wider City-Region trips than to that between the jobs accessed by Regional Centre trips and those accessed by Neighbourhood trips.

38. Therefore a redistribution of 10% of "Wider City-Region" travel-to-work trips to the Regional Centre represents a reasonable estimate.

[13] Analysis by TfGM based on Office for National Statistics (2017), Business Register and Employment Survey. Available from: https://www.nomisweb.co.uk/

39. Redistribution of Wider City-Region travel-to-work trips to the Regional Centre is expected to lead to a similar redistribution of Wider City-Region trips with other purposes towards the Regional Centre for reasons that include:

- Regional Centre workers will take trip-chaining[14] opportunities to visit Regional Centre shopping and leisure attractions.
- More jobs in the Regional Centre will cause an increase in population density in locations well-located for travel to the Regional Centre, which will have a relatively high propensity to travel to the Regional Centre for other purposes. This will be an additional effect to the increase in Regional Centre walk-trips resulting from more residents within the Regional Centre considered in Section 4 below.
- The developments that create the additional jobs in the Regional Centre will themselves attract trips for other purposes.

40. As noted above, the "redistribution" of non-work trips towards the Regional Centre means higher proportional growth in trips to the Regional Centre, with net growth expected in the number of non-work trips to locations within all of the spatial themes in the Greater Manchester Transport Strategy 2040.

41. The growth of Regional Centre trips is expected to take place without any net growth in car trips, reflecting the constraints on the highway network and an increased focus on "place" in allocating highway space. Annual counts of movements crossing the MSIRR inbound show that car volumes crossing the MSIRR cordon inbound have fallen substantially over the past fifteen years, both in the AM peak (see Figure V14) and inter-peak periods.

42. The growth of Regional Centre trips will place substantial demands on the public transport network. More details of public transport capacity requirements are given under Step 6 below.

Step 4: Land use change and transport interventions lead to a higher mode share for walking for Regional Centre and Neighbourhood trips

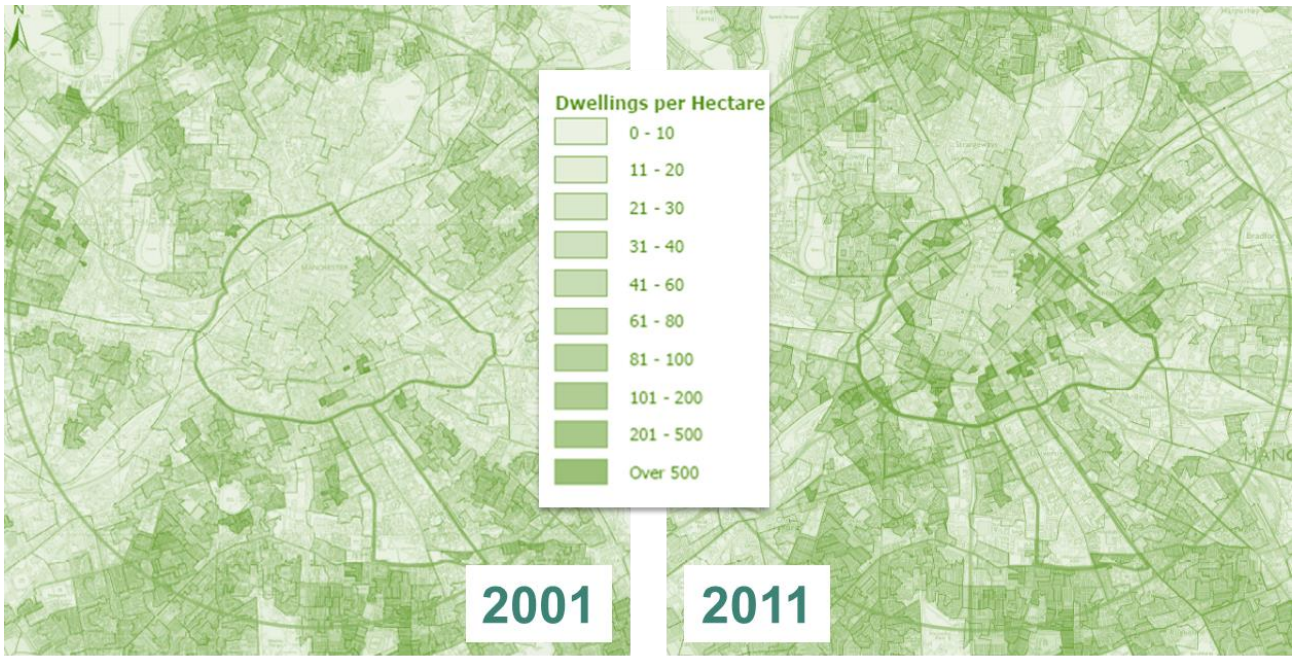
43. The population of the Regional Centre is expected to roughly double by 2040, which is expected to lead to an increase in the proportion of Regional Centre trips made by walking. A cautious allowance has been made for this by increasing the walk mode share of Regional Centre trips from 24% to 31% (an increase of 25%) and reducing the mode share of other Regional Centre trips by the same proportion.

[14] Combining several activities through linked trips – e.g. city-centre shopping on the way home from work.

44. Greater Manchester's Streets for All approach will reflect a greater emphasis on "place" at the local street level, thereby encouraging the development of walkable communities. This is estimated, at a high level, to support an increase in walk mode-share for Neighbourhood trips from 50% to 55% (the effect of interventions to improve cycling is allowed for under Step 5, "Transformational Cycling Policies" below). As noted under Step 2, attractive bus services – and hence investment in bus priority – will be important in increasing walk-trips.

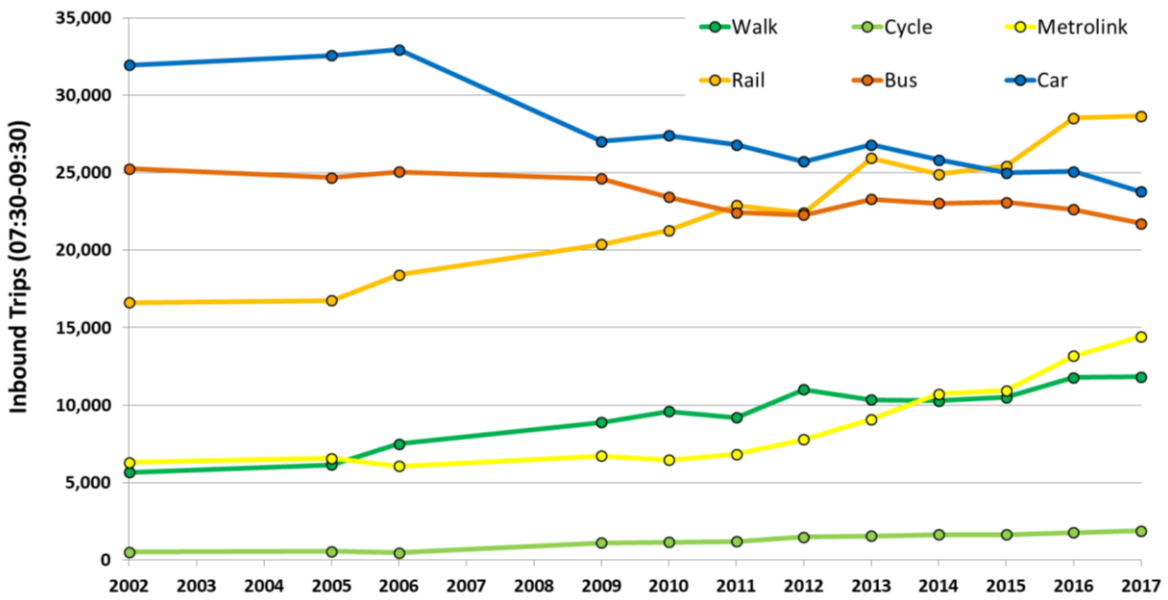
45. Figure V13 and Figure V14 indicate how the increase in dwelling density in the vicinity of the MSIRR (located in close proximity to the extensive range of facilities offered within the city centre) between 2001 and 2011, coincided with a rapid increase in the volume of inbound walk movements across the City Centre cordon during the AM Peak. In interpreting Figure V14, it is important to note that the walk movements across the MSIRR include walk-egress legs of car trips, by which motorists park outside the MSIRR and walk across it to their city-centre destinations. It is believed that the number of such walk-egress legs of car trips has reduced over time, and so the increase in walk trips across the MSIRR by local residents is probably greater than the overall observed increase in walk movements.

Figure V13: Residential dwelling density around the MSIRR[15]



[15] Source: TfGM analysis of Census 2001 and 2011 data

Figure V14: Inbound Trips by Mode across the City Centre cordon (AM Peak)[16]



Step 5: Transformational cycling policies lead to a switch to cycle from other modes – reaching a 10% mode share for Regional Centre and Neighbourhood trips and a 5% mode share for Wider City Region trips by 2040

46. The adjustable targets for cycle mode shares for Greater Manchester in 2040 are set out below.

- Neighbourhood: 10%
- Wider City Region: 5%
- Regional Centre: 10%.

47. These cycle mode shares targeted in Step 5 represent Greater Manchester's ambitious aims for growing levels of cycling, in line with current policies.

Greater Manchester's current ambitions for cycling

48. Greater Manchester's ambitious vision for cycling is set out in the 'Made to Move' report, by Greater Manchester Cycling and Walking Commissioner Chris Boardman. Among other actions, it calls for a ring-fenced, 10 year, £1.5 billion infrastructure fund, starting with a short-term Mayor's Challenge Fund to kick-start delivery for walking and cycling (now committed through the Transforming Cities Fund, totalling £160m). The goal of the Made to Move report is described as follows:

[16] Source: TfGM Highways Forecasting and Analytical Services

"To double and then double again cycling in Greater Manchester and make walking the natural choice for as many short trips as possible."

49. Assuming this goal is aligned with the suggested 10-year fund, this would mean a 300% increase in cycling levels by 2028. Based on the current Greater Manchester cycling mode share (from TRADS) of 1.7%, a 300% increase would equal a 6.8% mode share across all spatial themes. This suggests that the adjustable targets for mode shares above should be achievable by 2040, if current policies are fully delivered.

50. Interventions needed to achieve these adjustable targets for cycle mode share in Greater Manchester will include:

- Reallocation of road space towards cycling in appropriate locations as part of Greater Manchester's Streets for All approach.
- Implementation of the Cycling and Walking Commissioner's proposed cycle network.
- Increases in capacity of the cycle network, especially in and around the Regional Centre and areas of high cycle demand elsewhere in Greater Manchester.
- Provision of cycle parking.

Evidence from other city regions

51. Benchmark evidence from other city regions also suggests that rapid growth in cycling levels is possible. For example:

- The central aim of the Mayor of London's Transport Strategy is to achieve an 80% mode share for sustainable (non-car) modes by 2041. The current cycle mode share in London is approximately 2%. Current projections prepared by TfL to support the Strategy range from a 6% mode share for cycling in the 2041 'Core reference case', through to a 15% mode share by 2041 in the most aspirational scenario[17].
- In Seville, cycle mode shares were negligible in 2006 but rose to 5.6% by 2011 following the implementation of a cycle investment programme[18].
- In Dublin, less than 2.3% of people travelled into the city centre by bike, in 2006, but by 2015 this figure had more than doubled to 5.4%[19].

[17] Greater London Authority (2018), Mayor's Transport Strategy 2018. Available from: https://www.london.gov.uk/what-we-do/transport/our-vision-transport/mayors-transport-strategy-2018
[18] Marques, R., Hernandez-Herrador, V. and Calvo-Salazar, M. (2014). Seville: a successful experience of bicycle promotion in a Mediterranean context. *The Sustainable City*, Volume 1, pages 769-781. Available at: https://www.witpress.com/Secure/elibrary/papers/SC14/SC14065FU1.pdf?_sm_nck=1
[19] Dublin City Council. (2016). Dublin City Council Transport Study. Available at: https://consultation.dublincity.ie/traffic...transport/traffic.../Dublin%20City%20Centre

Abstraction of trips from other modes

52. DfT's meta-analysis of studies of abstraction, which has informed DfT's Active Mode Appraisal toolkit – see Table 1 below – has been used as the basis for estimating how cycle trips are abstracted from other modes. It has however been necessary to modify the source-mode shares reported in that analysis in order to allow for variations in baseline mode shares by spatial theme.

53. The abstraction from rail-based modes is very high in the DfT meta-analysis, which suggests that it may be based on metropolitan areas with higher shares for rail-based modes than Greater Manchester. Since (developed-world) cities with high rail-based mode shares typically have relatively low car mode-shares, there is reason to believe that the use of the values in Table 1 could well understate the reduction in car trips resulting from transformational cycling policies.

Table V2: Meta-analysis of studies of sources of abstraction from improved cycle facilities[20]

Recipient / source mode	Metropolitan
Bus	0.19
Car	0.11
Rail	0.14
Light Rail	0.12
Walk	0.20
Taxi	0.08
No Travel	0.17
N (number of studies)	33

54. The reallocation of trips from other modes to cycle will lead to a reduction in total person-kilometrage because cycle trips within most of the spatial themes (although not Neighbourhood) are shorter than average. This reflects the expectation that there will be an element of trip redistribution within each spatial theme from a mode shift towards cycling.

[20] Source: Department for Transport (2018), TAG data book table A.5.4.7. Available from: https://www.gov.uk/government/publications/tag-data-book

Step 6: Improved metro[21] and suburban rail services and complementary policies cause metro and rail to increase their mode-share, with metro taking 5% of Wider City Region trips

55. At present in Greater Manchester, approximately 60% of metro and suburban rail trips have an end in the Regional Centre. Although the Regional Centre will always be a very important trip attractor for rapid transit, Greater Manchester aims that metro and suburban rail (and especially metro) should in the future serve a wider range of trip-origins and destinations, thus greatly extending the benefits of these rapid transit modes. For example, there is a need to provide better rapid transit connections for residents of the north of Greater Manchester to reach job opportunities in the south, in locations that include Manchester Airport and Trafford Park. Traffic congestion on the highway network and slow public transport links mean that many of these trips are at present difficult, especially at peak times.

56. The present limited focus of metro and suburban rail on the Regional Centre reflects:

- Limited peak capacity has in the past prevented offering attractive metro fares to cross-city trips serving a wider range of trip-origins and destinations. These trips will be more fare-sensitive because alternative modes to metro are typically more attractive than for travel to Manchester City Centre – e.g. car-parking is much cheaper outside Manchester City Centre.
- Journey-times through the city centre are slow on the street-running section of Metrolink, and cross-city connections for suburban rail are often difficult.
- Fares for mixed-mode trips are high: many non-Regional-Centre trips require travel on more than one mode if made by public transport.

57. At present, Greater Manchester TRADS data shows that 1.25% of Wider City Region trips use metro, most of which will comprise short trips within metro corridors. For metro – or other rapid transit modes – to attract as many as 5% of Wider City Region trips, it would be necessary to attract demand from a much wider base than just intra-corridor trips served by metro lines. Instead it would need to attract the middle-distance trips – especially longer middle-distance trips – for which metro can compete with car. These are mostly trips that would route via the M60 if using car, and would route via the Regional Centre if using metro or other rapid transit.

[21] The term "metro" is used here to refer to turn-up-and-go rail-based rapid transit services which offer excellent access to the network hubs that they serve. Metro includes existing Metrolink services, potential "tram-train" extensions that would incorporate track-sharing with National Rail services, and potential future routes that could utilise a metro tunnel under Manchester City Centre.

58. Therefore Step 6, together with Step 3 above (redistribution of 10% of Wider City Region trips to Regional Centre without any increase in Regional Centre car trips) will have substantial implications for public transport capacity and service-levels on rapid transit services to and through Manchester City Centre. Several considerations indicate that only a major increase in metro capacity in the city centre would create a sufficient step-change to achieve these adjustable targets. It is due to these considerations – set out below - that Step 6 refers specifically to metro.

59. The National Rail network in Manchester City Centre is constrained by several key junctions. Increasing the capacity of these junctions would be very expensive and, in some cases, very difficult to fit in with the city-centre environment. Although some substantial increases in National Rail network capacity are needed in Manchester City Centre, even a very major programme is likely to create capacity for fewer than ten additional trains per hour in each direction. By contrast, a metro tunnel under the city centre, connecting into the existing Metrolink network and with underground stations in the city centre, would be expected to accommodate more than twenty additional trains per hour in each direction.

60. Metro services – as experience with past conversions of suburban rail lines to Metrolink shows – attract a more balanced range of trips than suburban rail services[22], on which trips are strongly focused on the travel-to-work peak. The ability of metro services to attract trips outside the travel-to-work peak is critical to their financial viability – and hence fundability – and is related to the combination of high frequency and excellent access to key trip-attractors provided by metro services. Therefore the emerging draft Greater Manchester Rapid Transit Strategy proposes the "metrofication" of those suburban rail lines that are focused on shorter middle-distance trips, which would require a major increase in metro capacity in the city centre.

61. A city-centre metro tunnel would also reduce the journey-times of cross-city trips by avoiding the city-centre street-running of the existing Metrolink system, whilst retaining its high service-frequencies. That will be very important in achieving the adjustable target of 5% of Wider City-Region trips using metro.

62. To achieve 5% Wider City-Region trips using metro, a high-capacity metro system would need to be supported by better access to stops and stations, since many Wider City-Region trips have at least one end located outside easy walking-distance to a rapid transit service. New Mobility (defined here to mean the use of digital technology to provide new and improved transport services) has great potential to improve access to the "first and last mile" of rapid transit journeys.

[22] Source: The current performance of rapid transit systems in Greater Manchester – TfGM Position Paper, 2018.

63. Finally, integrated fares between public transport modes will be important in increasing the use of rapid transit, and especially for Wider City-Region trips.

64. The greatest capacity requirements in achieving the adjustable targets in Step 3 and Step 6 will be placed on metro. Initial analysis by TfGM suggests that a city-centre tunnel accommodating 24 trains per hour in each direction using trains of 150m length would be sufficient to meet the adjustable targets in Step 3 and Step 6. That would mean using trains that are more than twice as long as a present Metrolink double unit (two vehicles coupled together).

65. Further study and development of a city-centre metro tunnel and conversion of suburban rail services to metro/tram-train is included in the Delivery Plan.

66. National Rail services would also need to accommodate substantial demand growth. There is considerable scope for increasing National Rail network capacity in Greater Manchester by running longer trains. Initial technical work carried out for TfGM has estimated that 8-car trains would be feasible on most of those lines where demand in 2040 would require it[23].

67. However, the same technical work indicated that – even with 8-car trains – it would not be possible to provide an acceptable level of reliability if sufficient trains were operated to accommodate 2040 demand, even with longer trains. That conclusion has been confirmed by the sharp reduction in reliability following introduction of a more ambitious timetable in May 2018.

68. However, metrofication of suburban rail lines – as proposed above – would reduce the demands on the National Rail network in Greater Manchester, releasing capacity to enable remaining suburban rail services to increase their service-frequencies to accommodate demand growth. That, in combination with 8-car trains on the National Rail network (and the substantial infrastructure investment needed to achieve that) is expected to accommodate the growth of the Regional Centre trips together with 5% of Wider City-Region trips on metro.

69. Further study and development of infrastructure to accommodate longer trains on the National Rail network is included in the Delivery Plan.

[23] Source: Manchester Rail Network Capacity Study Technical Note: 8-Car Train Extension Wrap-Around Summary – Interim Issue 5, 2018.

70. Buses are expected to make a substantial contribution to accommodating the growth of travel demand to the Regional Centre. However, the growth in the metro network – as discussed above – would abstract demand from bus. Integrated fares between bus and metro would also reduce bus travel into the city centre by increasing use of buses as feeders to metro, rather than as a mode for travelling all the way into the city centre.

71. Despite the above negative factors, a net increase in bus travel to the city centre is nonetheless likely to be necessary to achieve adjustable targets in the Right Mix.

72. Bus capacity constraints are more flexible than for rail-based transport, in that they can be overcome by allocating more roadspace to bus, and there is potential to introduce such measures in response to demand growth. Bus terminus capacity in Manchester City Centre is another constraint which will need to be resolved within the developing City Centre Transport Strategy.

73. Further study and development of the interventions recommended by the study of city centre bus routeing and termination is included in the Delivery Plan.

Step 7: Transport policies (including travel demand management) lead to a 5% reduction in trip-length of Wider City Region car-trips

74. Trip redistribution – leading to either longer or shorter trips – is the main driver of long-term change in travel behaviour. For example, the roughly ten-fold increase in car travel in the UK since 1950 is almost entirely due to trip redistribution, with short trips by walk and bus being replaced by much longer car trips. Trip redistribution also caused average car trip-length to increase during the second half of the twentieth century.

75. Trip redistribution effects are allowed for in Steps 2 to 5 above, represented by Wider City Region trips redistributing to Neighbourhood (Step 2) and Regional Centre (Step 3). Step 4 and 5 allow for a shortening of Neighbourhood and Regional Centre trips due to greater use of active modes.

76. Step 7 allows for a shortening of average car trip-length in the Wider City-Region category, due to roadspace reallocation to improve “place” and prioritisation of modes that make most efficient use of limited roadspace through Greater Manchester’s Streets for All approach.

Potential Step 8: Increased use of public transport for city-to-city trips (not quantified in the Right Mix analysis)

77. City-to-city trips (see Figure V2) show a very high car mode-share, which reflects the fact that most of these trips are not between city centres, for which the public transport mode share is much higher than the average for this spatial theme (see the definition of "City to City" under "Spatial Themes" at the start of this chapter).

78. This spatial theme has potential to contribute to the Right Mix adjustable targets by improvements to longer-distance public transport, which in the context of Greater Manchester mainly means rail transport. There are several important proposals for improved inter-urban rail transport, notably the Northern Powerhouse Rail network of fast and frequent rail services connecting city centres in the north of England.

79. It should also be noted that a relatively high proportion of city-to-city trips will be made by non-residents of Greater Manchester, who will be influenced by Greater Manchester's policies and transport interventions, but on average to a lesser extent than Greater Manchester residents.

80. By adopting the cautious approach of not quantifying any specific proposed increase in public transport mode share for city-to-city trips, there is potential to offset any shortfall in achieving any of the other steps in the pathway to the Right Mix.

Economy and Employment

Economy and Employment: Summary of Trends and Implications

Increasing travel demand associated with a growing economy

- The strong growth in employment expected for the conurbation is anticipated to lead to a significant increase in total travel demand in Greater Manchester. The precise nature and location of these jobs will determine the scope of transport interventions.

Increasing productivity while delivering positive travel outcomes

- A more productive workforce, in higher paid jobs, focusing on more specialised and skilled activities, has historically tended to lead to increased commuting distances and more complex trip patterns. The GMSF therefore needs to, and will, place a very strong emphasis on directing new development towards locations that will encourage people to use sustainable transport modes.

Greater labour market participation leading to more trips

- A greater proportion of people of traditional working age, 16-64, participating in employment or training will lead to more trips on the transport network.

Ageing population

- Employment in later life is increasing steadily, leading to a more diverse set of working patterns, additional travel demand, and a broadening set of traveller needs.

Accessing employment opportunities

- An increasingly centralised distribution of GM employment is expected, emphasising the need to continue to invest in improving accessibility to the regional centre and principal town centres by means other than car for residents across GM and beyond.
- There is some disparity between areas of employment deprivation and identified sites for employment growth. Transport has an important role to play in order to sustainably connect deprived communities with employment.
- For the majority of commuter movements the private car is the dominant mode, in part due to the dispersed nature of employment within and outside of GM. The city centre, where the majority of jobs are accessed by non-car modes, is a clear exception.

Transport network congestion and overcrowding

- If not managed effectively, severe road congestion and public transport overcrowding during peak periods could undermine GM's ability to improve economic productivity and deliver its growth aspirations.

A growing visitor economy

- An increase in the number of visitors to GM will lead to more trips on the transport network. It will be important to accommodate the needs of those who are unfamiliar with GM in a manner that promotes sustainable travel choices.

A Growing GM Economy

1. GM is the main driver of the Northern economy and generates nearly 40% of the North West's total GVA and 19% of the North of England's GVA[1]. With a total GVA output of £59.6bn[2], GM is the largest city-region economy outside London, contributing 3.5% of total national economic output[3]. Just over 1.3m people are employed within firms located in GM, making up around a fifth of jobs in the North of England[1].

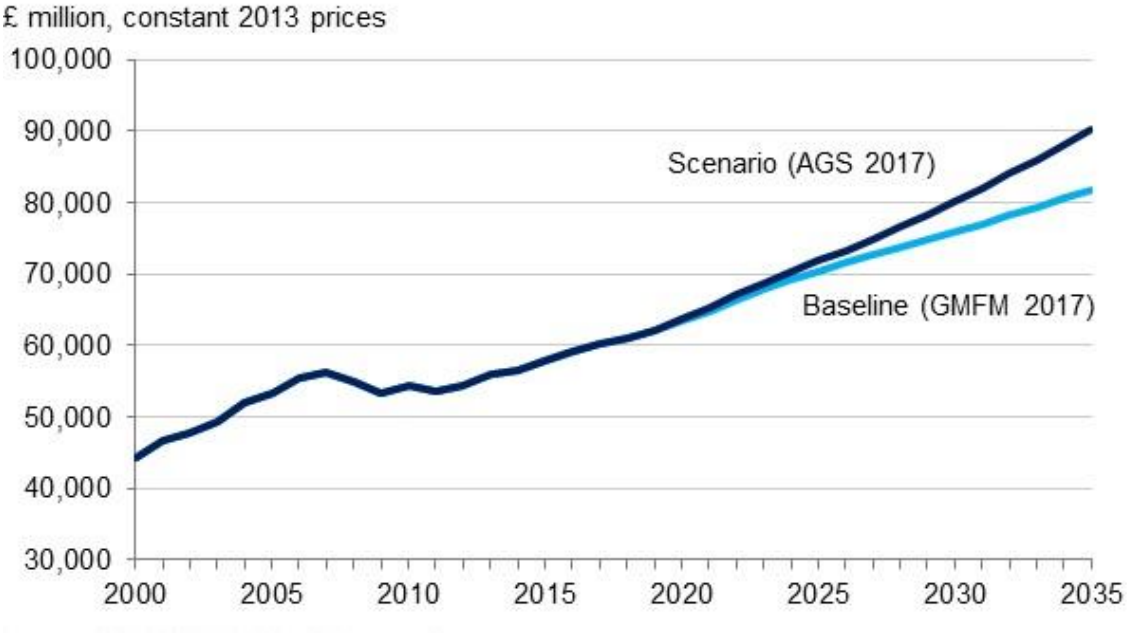
2. The Greater Manchester Forecasting Model 2017 (GMFM 2017) suggests that over the next 20 years, under baseline conditions, GVA could grow at 1.7% per annum up to 2035, broadly comparable to the UK average (1.8% per annum). This is equivalent to an additional £23.9 billion of economic activity in GM's economy in 2035 (measured in constant 2013 prices), with GVA rising to a total of £81.7 billion. Total employment is forecast to grow at 0.5% per annum in GM, slightly faster than the UK average (0.4%), equating to a net increase of 141,000 employees from 2015 to 2035[4].

3. The GMCA also commissioned forecasters to produce an Accelerated Growth Scenario (AGS-2017) for GM. This illustrates a future where improvements to the skills base, innovation and transport connectivity boost GVA, employment and productivity growth across the North. This scenario predicts the following level of growth for GM[4]:

    - GVA growth of 2.2% year on year, giving an uplift of £8.5 billion above baseline conditions by 2035;
    - Additional 190,000 jobs representing a 0.6% growth rate for GM, higher than that projected for the UK;
    - Strong population growth of 286,000, predominantly driven by natural increase (birth rates and people living longer).

[1] Greater Manchester Combined Authority and New Economy, (2016). 'Deep Dives: Phase 1 Summary Report', p.6. Note: The definition used covers the English regions of: North West, North East, and Yorkshire & Humberside
[2] Invest in Manchester, (2018). 'Manchester Economy' [online]. Available at: https://www.investinmanchester.com/why-manchester/economic-overview [accessed 16 Jan. 2018]
[3] ONS, Regional Gross Value Added (Income Approach)
[4] Greater Manchester Combined Authority, (2017). 'Economic Forecasts for Greater Manchester' [online]. Available at: https://www.greatermanchester-ca.gov.uk/info/20004/business_and_economy/73/greater_manchester_forecasting_model/1 [accessed 16 Jan. 2018]

Figure EC1: GMFM Baseline and Accelerated Growth Scenario forecasts of GVA in Greater Manchester, 2015 to 2035[4]



Implication for GMSF and 2040 Strategy

The strong growth in employment expected for the conurbation is anticipated to lead to a significant increase in total travel demand in Greater Manchester. The precise nature and location of these jobs will determine the scope of transport interventions.

Prospective Increases in Productivity

4. Despite Greater Manchester's economic assets and opportunities, productivity remains below what would be expected for a city region of its size. If GM's GVA per capita were the same as the UK average, the city region would generate an additional £10bn per annum, and its economy would be fully 20% larger[1]. Figure EC2 breaks down the productivity gap into its composite parts and shows[1]:

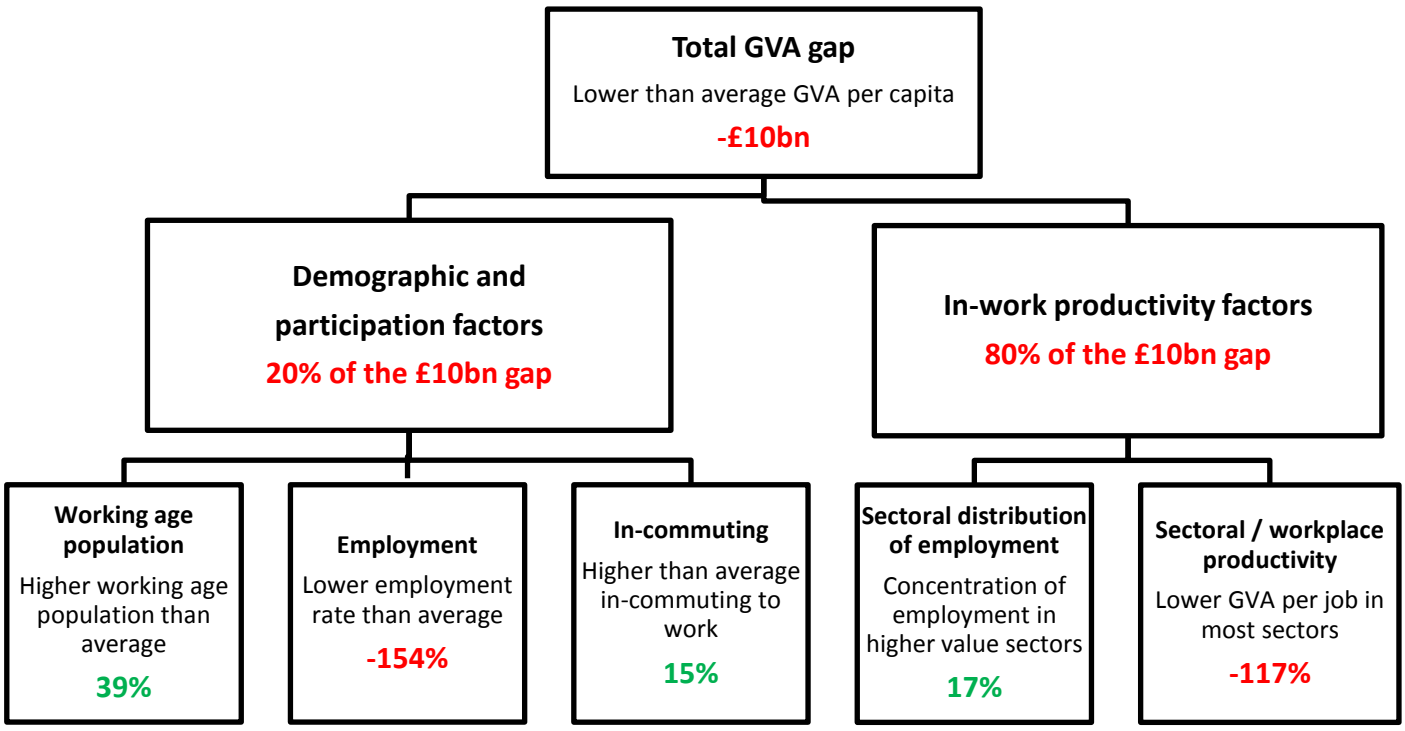
    - Productivity in GM is low due to a mix of both demographic and "in work" productivity factors.

    - Demographic factors account for around 20%-25% of the productivity gap between GM and the UK. While GM benefits from a large working age population and high levels of in-commuting compared to other areas, low employment rates and high levels of economic inactivity act as a significant drag on its economic potential.

    - "In work" productivity accounts for 75-80% of the productivity gap. GM's sector mix gives it a boost compared to other parts of the UK, as it has concentrations of high value industries. However, the GVA generated on average in jobs across the city region acts as a brake and is the single biggest factor in accounting for the difference in productivity.

5. It is important to note that the productivity gap is not as substantial if London is excluded from the UK average, falling to around £2.7bn. In part this reflects different regional prices as prices are typically lower in regions with lower incomes per capita, although analysis undertaken for the Northern Powerhouse Independent Economic Review (June 2016) suggests this only explains about 3-4% of the 20% performance gap. Eurostat data from 2012 shows the performance gap compared with comparator European cities – Lille, Leipzig, Turin, Barcelona, Rotterdam, Cologne, Dusseldorf, Helsinki, Frankfurt and Munich – is larger still (40-50%)[1].

Figure EC2: Drivers of productivity and the composition of GVA gap, 2014/15 (green numbers indicate a positive contribution to GM's productivity performance, red a negative)[1]



GM sector analysis

6. Aligning analysis of GM's sector strengths with work undertaken as part of the Northern Powerhouse Independent Economic Review (NPIER) has led to the identification of four leading sectors in GM by New Economy. The NPIER analysis shows that the North has four prime capabilities which are highly productive and can compete on the national and international stage (Advanced Manufacturing, Energy, Health Innovation, and Digital), alongside three enabling capabilities (Financial & Professional Services, Education, and Logistics) that support the prime capabilities and combine to create a complementary and distinctive offer[1].

7. GM has internationally significant opportunities in three of the four Northern Powerhouse prime capabilities (manufacturing, health innovation, and digital)[1]. In addition, Business, finance & professional services is a prime capability for GM, as it is central to both GVA and jobs growth; however at the level of the North it is only identified as an 'enabling' capability as it does not have a pan-regional footprint. GM also benefits from the strong interactions and linkages between the prime capabilities; digital is particularly important as a capability that runs across and interacts with most parts of GM's economy[1].

8. Figure EC3 shows productivity by sector (and sub-sector within these) in GM, compared to the GM whole economy average of £42,300 per worker in 2016[5].

9. A number of sectors are high productivity in GM and perform well against the national average for these sectors, such as: Food and Drink Manufacturing (£56,400 per employment in GM) and Textile Manufacturing (£58,600).

10. Some sectors have very high productivity compared with the GM average, but remain some way behind the average for the sector in the UK, for example Professional Services (£77,400), and Financial Services (£81,200). The national average is to a large extent skewed by high-productivity financial and professional services industries in London.

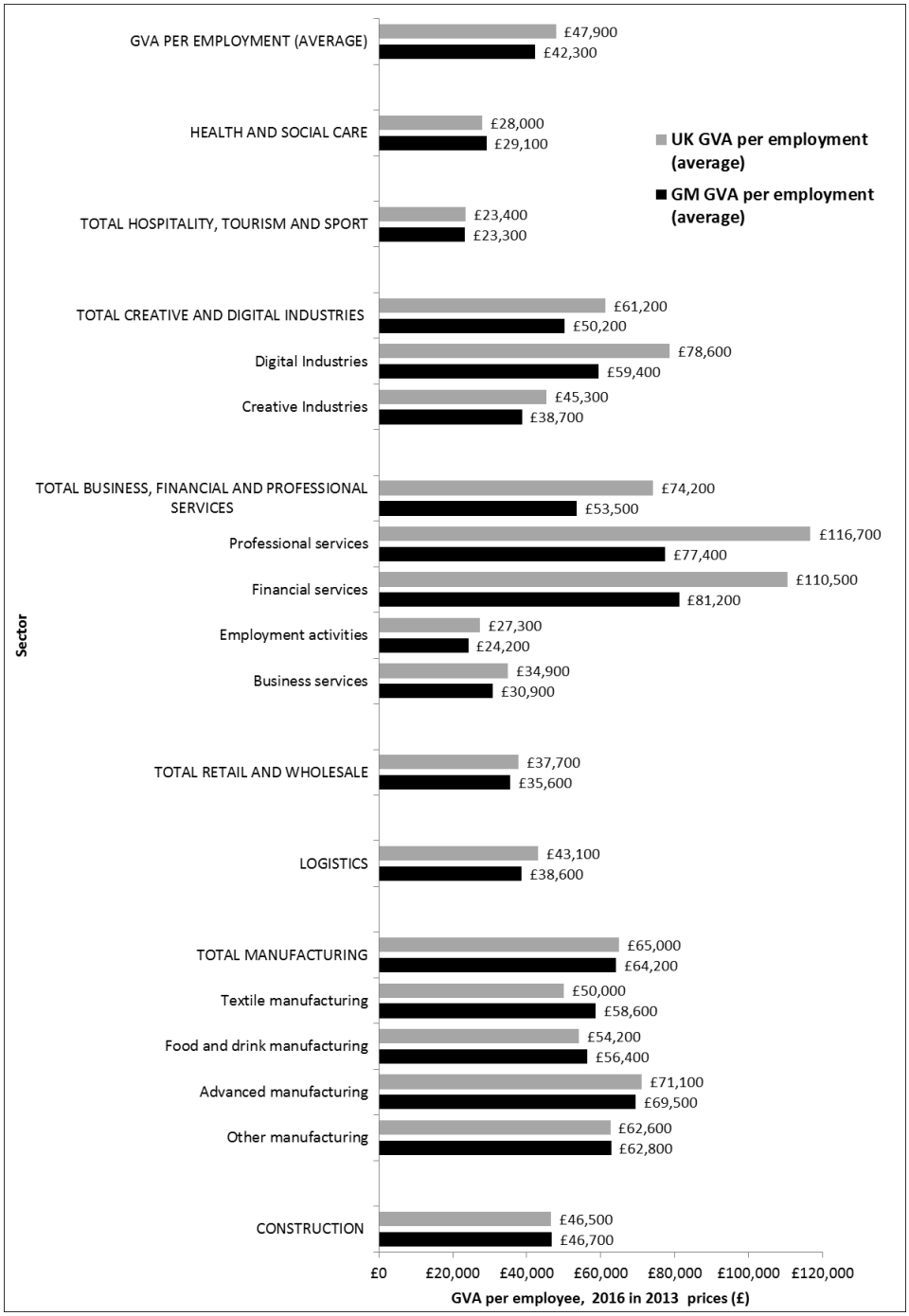
11. Some sectors in GM have generally lower levels of productivity (in an absolute sense cf. the GM average for all industries), but are close to their peers (and UK average) in terms of productivity within the respective sector. These include Health and Social Care (£29,100 in GM) and Hospitality, Tourism and Sport (£23,300).

12. The critical issue for policy makers will be how to address the workplace productivity gap within each sector of GM's economy and help close the gap between GM and the UK average. In some sectors this will require productivity to grow as fast, and even faster, than other better performing parts of the UK economy. In others, it may rely on growing the employment and business base.

13. Of those residents that are in employment, there is a high concentration within low pay occupations when compared with the national average and a reliance on tax credits to supplement low earnings.

[5] Greater Manchester Forecasting Model (2017): Productivity by New Economy Sectors. It should be noted that the GMFM-2017 uses constant price productivity estimates for forecasting purposes, with 2013 as the base year. For this reason, the 2016 estimates of productivity are expressed in 2013 prices; due to inflation and other factors, productivity per worker in 2016 is likely to be higher if expressed in 2016 prices.

Figure EC3: Productivity by New Economy Sectors - Gap between GM and UK average, 2016[6]



[6] Oxford Economics, (2017). 'Greater Manchester Forecasting Model Dataset' [online]. Available at: https://www.greatermanchester-ca.gov.uk/info/20004/business_and_economy/73/greater_manchester_forecasting_model/1 [accessed 20 January 2018]
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GM workforce upskilling and possible implications on distance travelled to work

14. Table EC1 uses Census 2011 data to demonstrate the tendency for GM residents in employment with Level 4+ qualifications (degree or equivalent as a minimum qualification) to travel longer distances to access employment. This suggests that skills and qualification levels play a major part in determining a resident's willingness to travel. In large part, this relates to the significantly higher earnings that higher level qualifications attract.

Table EC1: Distance travelled to work by qualification[1]

	Level 4+ qualifications		No qualifications	
	Number	%	Number	%
Less than 2km	50,847	12.7%	33,754	24.3%
2km to less than 5km	74,490	18.6%	34,228	24.6%
5km to less than 10km	91,081	22.8%	24,563	17.7%
10km to less than 20km	76,279	19.1%	13,114	9.4%
20km to less than 30km	22,390	5.6%	2,772	2.0%
30km to less than 40km	8,366	2.1%	1,118	0.8%
40km to less than 60km	8,477	2.1%	1,074	0.8%
60km and over	10,345	2.6%	2,213	1.6%
Work mainly at or from home	35,484	8.9%	12,586	9.1%
Other	22,548	5.6%	13,536	9.7%
Total	400,307	100.0%	138,958	100.0%

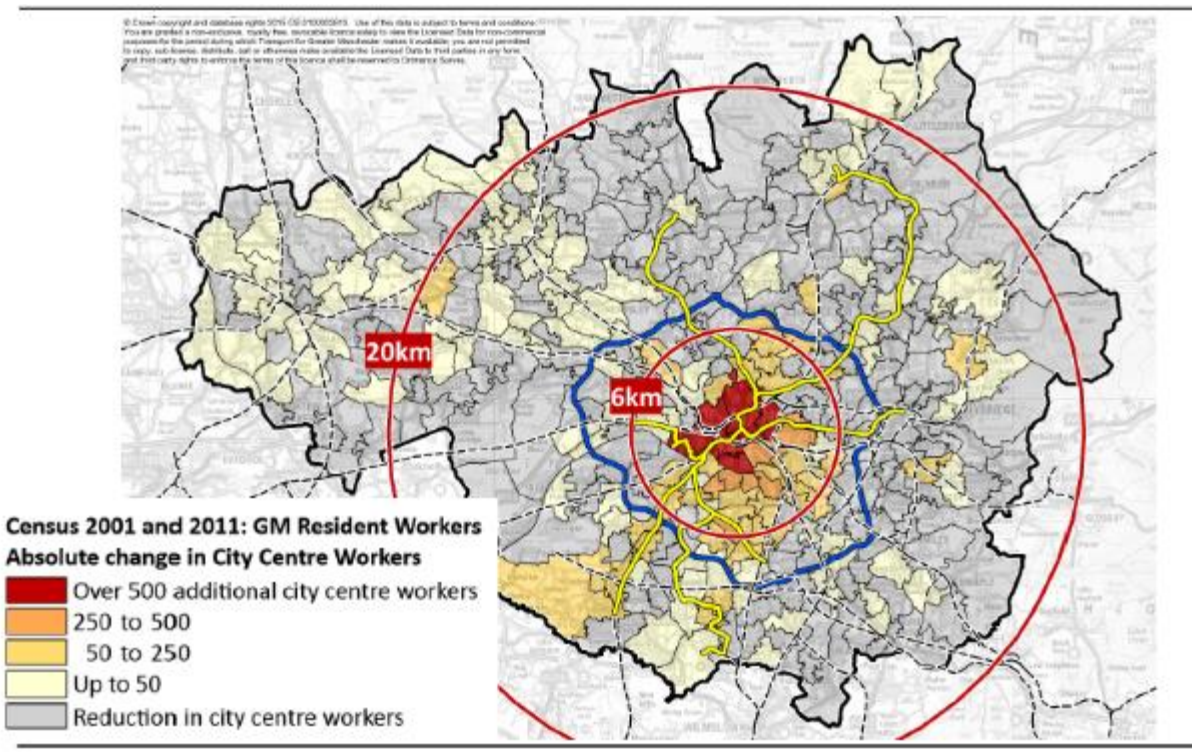
Implication for GMSF and 2040 Strategy

A more productive workforce, in higher paid jobs, focusing on more specialised and skilled activities, has historically tended to lead to increased commuting distances and more complex trip patterns. There will therefore be a strong need to direct new employment development towards locations that will encourage people to use sustainable transport modes.

Concentration of the city centre workforce

15. A trend that looks likely to moderate the potential for longer-distance trips to work is the increasing tendency for workers in the City Centre to live within the urban core. Figure EC4 compares the home locations of City Centre workers in the 2001 and 2011 Census. The changes in the home locations of City Centre workers need to be seen in the context of an increase between 2001 and 2011 of 14.3% in the number of city-centre jobs, compared with an increase of 11.5% in the number of jobs in Greater Manchester as a whole[7].

Figure EC4: Census 2001 and Census 2011 – Absolute change in the home-locations of City Centre workers[8]



Implication for GMSF and 2040 Strategy

More people living and working within the urban core will promote sustainable economic growth by strengthening the potential for reduced trip lengths and increasing the use of sustainable modes of travel.

[7] Based on TfGM analysis of Census 2001 *table UV075 - Age (workplace population)* and Census 2011 *table WP101EW Population (Workplace population).*

[8] Based on TfGM analysis of Census 2001 *UK travel flows* and Census *2011 table WF01BEW - Location of usual residence and place of work.*

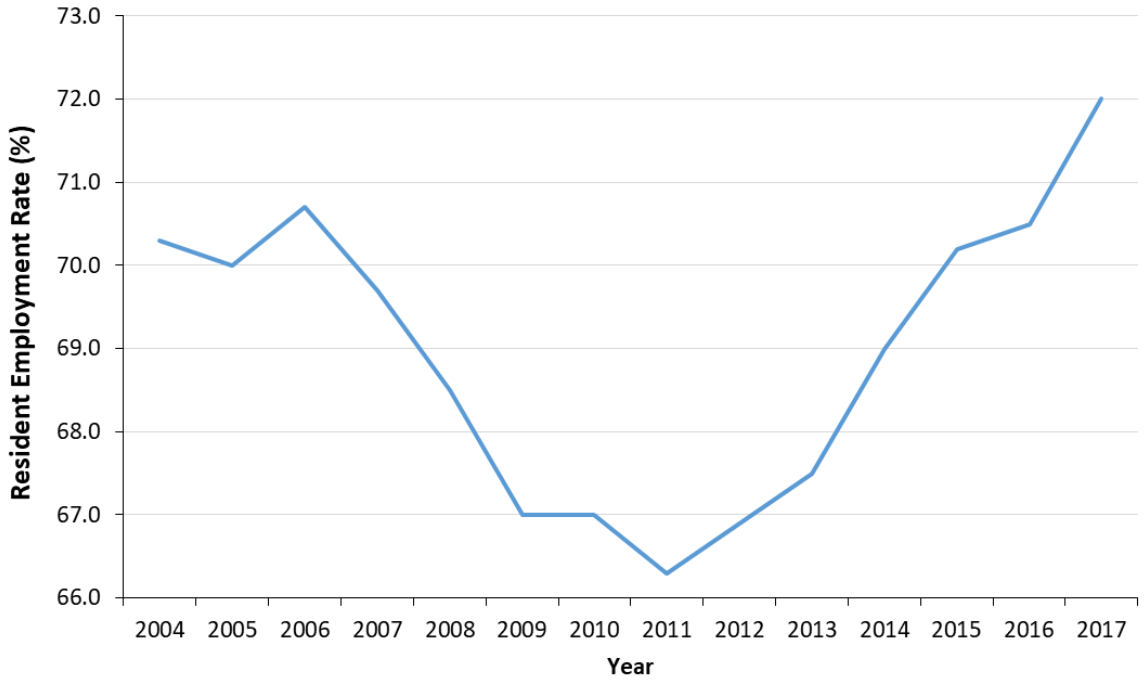
Greater Labour Market Participation

Resident Employment Rate (RER)

53. Greater Manchester's GVA per capita benefits from having a higher than average working age population and high levels of in-commuting to work. However, it is held back by higher than average levels of unemployment and economic inactivity in the city region[1].

54. Figure EC5 highlights that Greater Manchester's Resident Employment Rate (RER) has, however, increased in recent years. The RER is the proportion of the working age population who are employed, and provides a good measure of the health of the local labour market. The RER in GM has increased from 66.3% in 2011 to 72% in 2017, but it is still lagging behind the resident employment rate nationally (74.7% in 2017)[9].

Figure EC5: Changes in Greater Manchester's Resident Employment Rate (proportion of working age population employed), 2004-2017[9]



[9] Office for National Statistics, Annual Population Survey: Employment Rate – aged 16-64 (2004 – 2017).

Barriers to increasing the employment rate

55. Despite a picture of healthy recent growth, there are still significant challenges which exist within the labour market. These are substantial enough to play out at a city region scale as well as more deeply at a local level.

56. There are major barriers to employment for residents across the conurbation. One of these is poor skills levels, which act as a significant brake on GM's overall economic performance. Skills levels are also a key factor in explaining the disparity in economic outcomes seen between districts and neighbourhoods across GM. The correlation between employment rate and skills level is striking: just 38% of residents with no qualifications are in work compared to 66% of those with a Level 2 qualification (5+ A*-C grades at GCSE) and 84% of those with a degree[1].

57. There are equally strong correlations between skill levels and earnings, and between skill levels and distance travelled to work, as discussed earlier in this section. These findings are in line with the Northern Powerhouse Independent Economic Review, which highlighted the importance of skills, alongside other factors, in explaining the North's underperformance[10].

Implication for GMSF and 2040 Strategy

To meet the forecast ambition for additional jobs and to boost the employment rate, it is anticipated that a greater proportion of people of traditional working age, 16-64, will participate in employment or training, resulting in more trips on the transport network. It is crucial that GM ensures that all residents, particularly those that are in the most deprived neighbourhoods, have the skills and ability to access these new jobs.

[10] SQW, (2016). 'The Northern Powerhouse Independent Economic Review: Final Executive Summary' [online]. Available at: www.sqw.co.uk/insights-and.../northern-powerhouse-independent-economic-review [accessed 18 February 2018]

An Ageing Population, Remaining Economically Active for Longer

58. The ageing of the Greater Manchester population is discussed in detail in the *"Society and Community"* section of the 2040 Evidence Base document.

59. For a variety of reasons, older people are increasingly choosing to remain in the labour market. 8.5% of GM residents aged over 65 were in employment in 2017, equal to around 36,600 people[11]. The number of GM residents over the age of 65 in employment has more than doubled since 2005, when it stood at around 17,300[12]. Since 2010 (when there were 22,800 over 65s in employment) this number has increased by 61%[12]. Nationally, 1.19 million people of pensionable age are in employment, an increase of 48% since 2010[12].

60. In GM, male residents over 65 are more likely to be in employment than female residents (with an employment rate of 10.5% for men compared to 6.9% for women in 2017). However, the number of female workers over 65 has been growing slightly faster between 2010 and 2017 than for males (68% compared to 55%)[12].

Implications for GMSF and 2040 Strategy

The trend for the proportion of people working in later life to increase is expected to continue, with implications for additional travel demand and a more diverse set of traveller needs.

[11] Office for National Statistics, Annual Population Survey: Employment Rate by Age – aged 65, 2004-2017.
[12] NOMIS (2018), Annual Population Survey: Employment Raye by Age.

Accessing Employment Opportunities

Distribution of Employment

61. Figure EC6 uses Census 2011 data to show the distribution of employment across GM using the number of jobs per sq. km as a density measure. It is immediately noticeable that there is a significant concentration of employment opportunities within the Regional Centre.

62. As a result of GM's polycentric nature, there are also clusters of employment at each major town centre, as well as other strategic employment locations such as Salford Quays, Trafford Park, the Trafford Centre, and Manchester Airport.

63. However, it is noticeable that there are fewer jobs to the east of the city centre. It also demonstrates that there are a number of significant employment clusters located outside of GM but within commuting distance of GM districts e.g. Warrington, Birchwood, St Helens, Huddersfield and Halifax.

64. Overall, Figure EC6 shows the important role that the City Centre and core areas of the principal town centres play in accommodating large amounts of employment. The Regional Centre (which covers the City Centre as well as Salford Quays and the Etihad Campus) is the main concentration of employment in GM, accounting for 19% of all jobs[1]. It is the location in which the bulk of GM's most productive service activities, research assets, and nationally / internationally mobile jobs are clustered. Outside the Regional Centre, employment is more dispersed. Trafford Park accounts for 3% of employment, Manchester Airport 2% and collectively the 8 district town centres account for 10%. 65% of employment is therefore outside these large employment locations[1].

65. Figure EC7 shows the car driver mode share of the workplace population, which when compared with Figure EC6, shows the important role that the city centre and core areas of the principal town centres play in accommodating large amounts of employment by non-car modes.

Figure EC6: 2011 Employment Density[13]

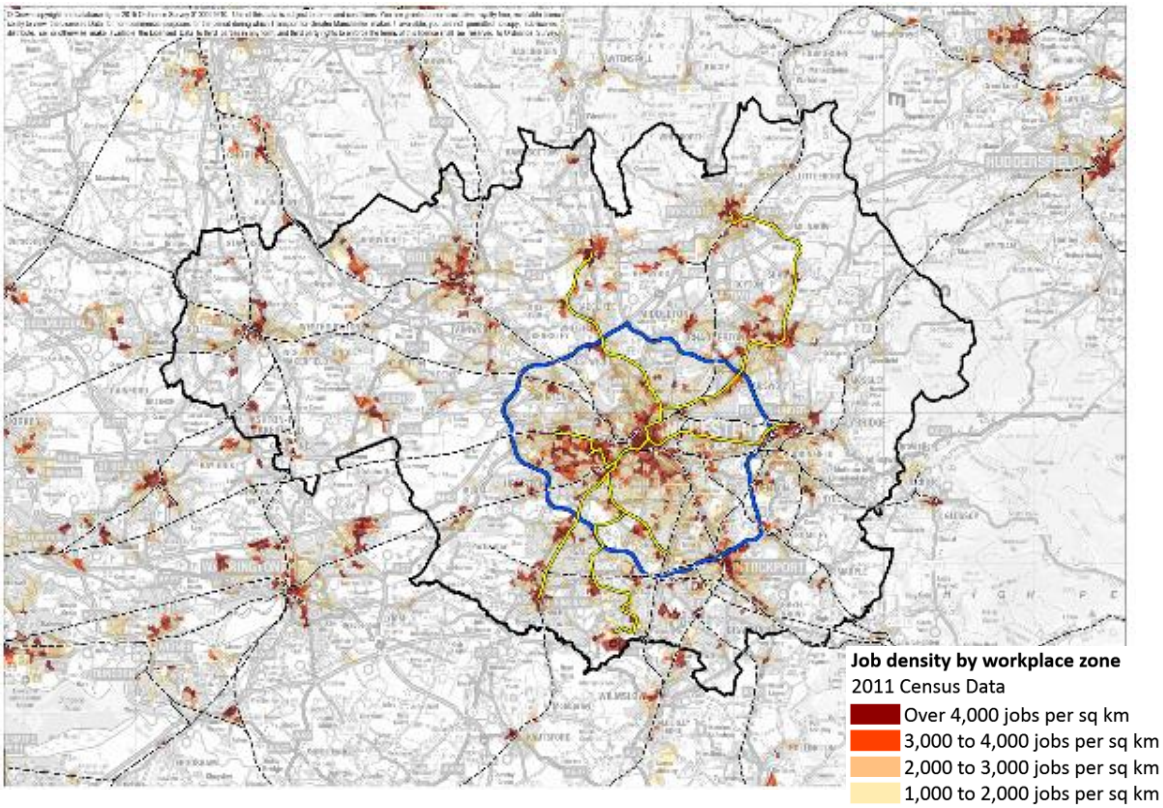
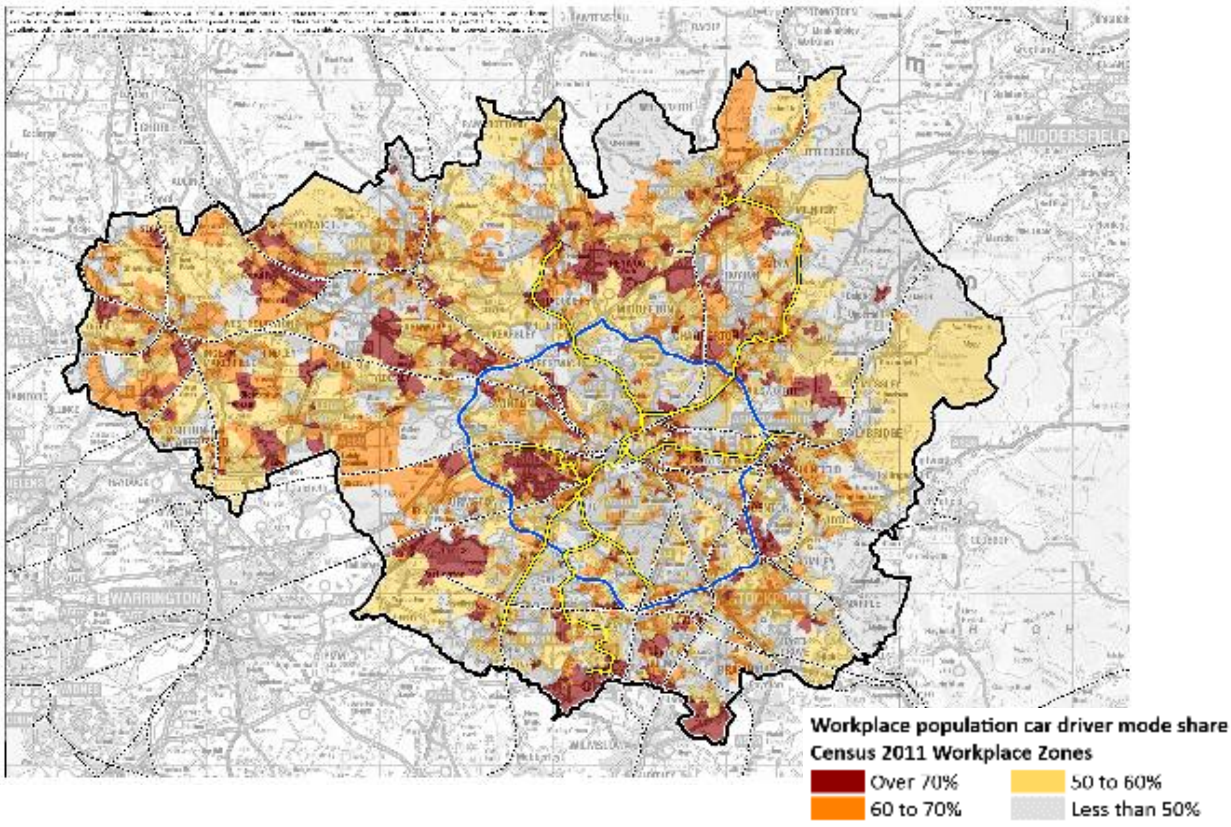


Figure EC7: 2011 Workplace Population Car Driver mode share[14]

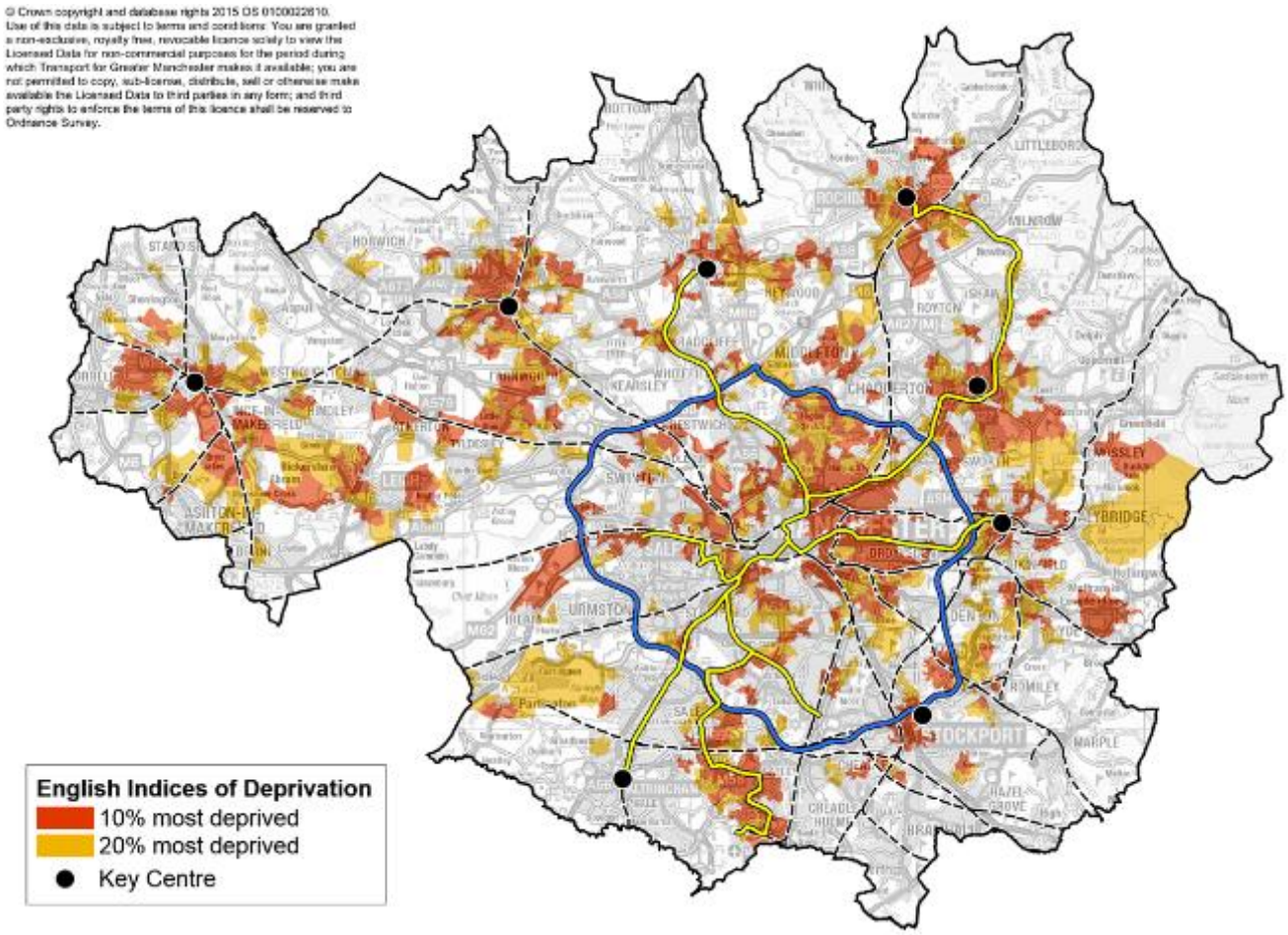


[13] Based on TfGM analysis of 2011 Census table WP703EW - Method of travel to work

[14] Based on TfGM analysis of 2011 Census table WP703EW - Method of travel to work

66. Figure EC8 shows analysis of the employment indicator of the 2015 English Indices of Deprivation which highlights the communities within GM that fall within the bottom 20% across the country. There are various areas of relative employment deprivation across GM; a notable example being to the east of the regional centre, an area which is subject to low job densities.

Figure EC8: Employment Domain: 2015 English Indices of Deprivation[15]

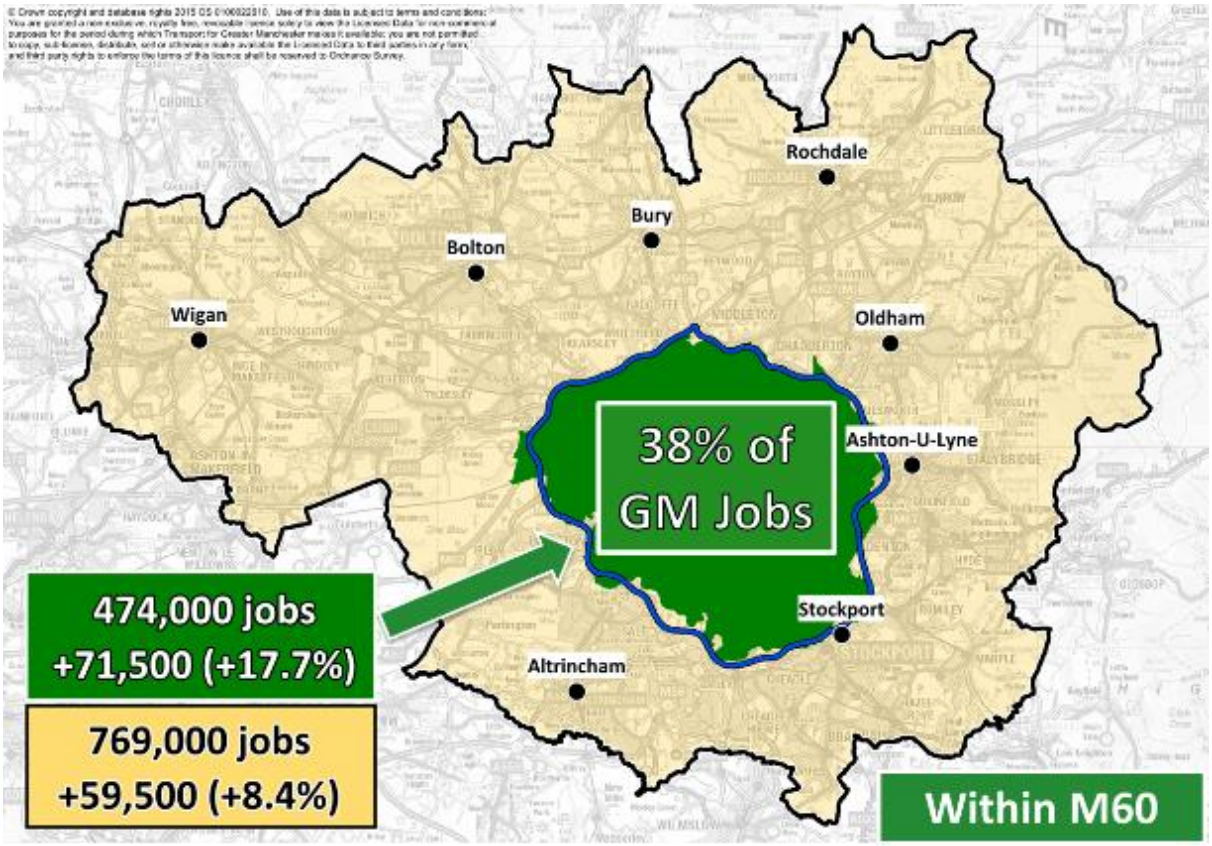


[15] English Indices of Deprivation (2015): *File 2 Domains Deprivation*, available at: https://www.gov.uk/government/statistics/english-indices-of-deprivation-2015

Distribution of recent employment growth

67. Figure EC9 illustrates how the central part of the conurbation acts as a focus of employment growth. Using data from the 2001 and 2011 Census, it shows that the area broadly within the M60 contained c.38% of GM employment (474,000 jobs), translating to c. 2,400 jobs per sq. km, whilst the area broadly outside the M60 contains c.62% of GM employment (769,000 jobs), at a density of c. 700 jobs per sq. km. A comparison against Census 2001 data demonstrates that the area within the M60 recorded a significantly higher level of job growth over this period.

Figure EC9: 2011 GM distribution of employment by M60 (and change since 2001)[16]



68. This pattern of employment growth has helped to support the growth in Metrolink and rail travel, as much of it is associated with areas where the workplace population displays relatively lower levels of dependency on the car for accessing employment.

69. Table EC2 shows that the highest absolute levels of employment growth between 2007 and 2017 are in the conurbation core. Manchester and Salford have accounted for a net increase of 67,300 people employed in this decade, whilst Bury, Rochdale and Stockport have seen net reductions.

[16] Based on TfGM analysis of Census 2001 *table UV075 - Age (workplace population)* and Census 2011 *table WP101EW Population (Workplace population).*

70. During this decade, Greater Manchester as a whole saw an increase of 91,900 people in employment, the equivalent of a 7.8% increase.

Table EC2: Number of people in employment by district in Greater Manchester, 2007-2017[17]

District	Overall employment growth 2007-2017	Overall percentage change in employment 2007-2017 (%)
Bolton	0	0
Bury	-1,400	-1.6
Manchester	48,900	23.6
Oldham	2,200	2.4
Rochdale	-300	-0.3
Salford	18,400	17.8
Stockport	-3,500	-2.5
Tameside	900	0.9
Trafford	10,400	9.9
Wigan	16,300	11.8
Greater Manchester	**91,900**	**7.8**

71. The table below shows the growth in annual GVA between 2005 and 2015 for the ten districts in Greater Manchester. Overall Greater Manchester saw a growth in annual GVA of approximately £13.8 billion between 2005 and 2015 which was the equivalent of a 23.2% increase.

[17] Office for National Statistics, Annual Population Survey: Employment rate – aged 16-64 (2007-2017).

Table EC3: Annual GVA (Income approach) by district in Greater Manchester (2005-2015)[18]

District	Overall Growth in GVA 2005-2015 (£millions)	Overall percentage change in GVA 2005-2015 (%)
Bolton	931	19.7
Bury	583	18.6
Manchester	5,320	31.2
Oldham	761	21.3
Rochdale	622	18.6
Salford	1,428	24.7
Stockport	796	12.9
Tameside	359	10.5
Trafford	2,013	26.4
Wigan	1,018	21.2
Greater Manchester	**13,831**	**23.2**

72. The districts of Manchester and Salford, which together cover the Regional Centre, showed the greatest overall increase in annual GVA of approximately £6.8 billion between 2005 and 2015. Other districts that showed notable increases in GVA during this time period include Trafford and Wigan.

Implication Greater Manchester

An increasingly centralised distribution of GM employment is expected based on historical trends, emphasising the need to continue to invest in improving accessibility to the regional centre and principal town centres by means other than car for residents across GM and beyond.

[18] Office for National Statistics, Regional GVA by local authority in the UK. [accessed 16/02/2018] https://www.ons.gov.uk/economy/grossvalueaddedgva/datasets/regionalgvaibylocalauthorityintheuk

Commuter flows across the GM boundary

73. Table EC4 indicates that GM supports employment across the wider region via a net gain of employees as a result of cross boundary commuting flows.

Table EC4: GM Cross Boundary Commuter Flow Totals[19]

Area	Total Workplace Population	In-Commuters	Out-Commuters	Net in-commuters
GM	1,223,865	155,350	127,664	27,686

Inbound and outbound commuter flows across the GM boundary

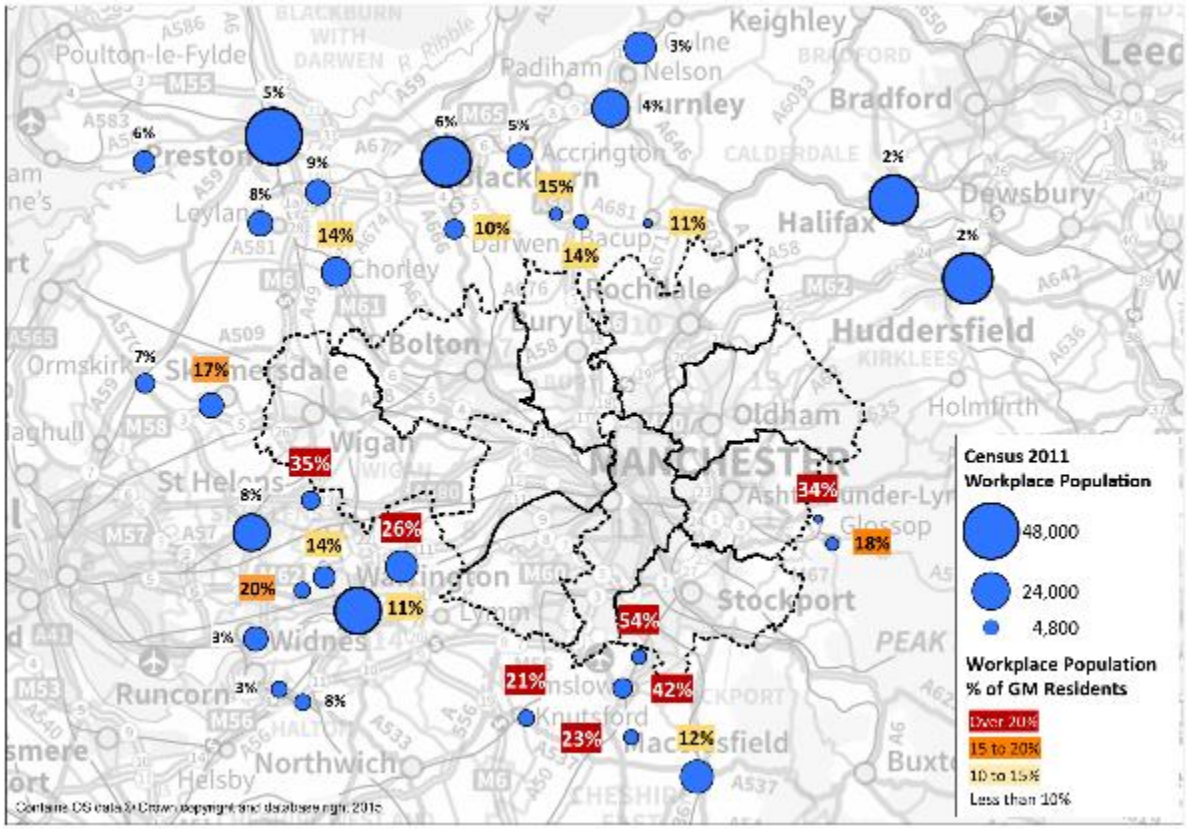
74. Cheshire East, Warrington and High Peak districts are the greatest contributors in respect of inbound GM cross boundary commuter movements. Together these district areas provide approximately 48,000 employees to GM, representing approximately a third of all inbound GM cross boundary commuter movements[20]. This highlights the dispersed nature of GM cross boundary inbound commuter movements.

75. Cheshire East, Warrington and St. Helens are also the most significant destinations for external commuting. Together these district areas provide approximately 43,000 GM residents with employment, representing approximately a third of all outbound GM cross boundary commuter movements[20].

76. In its entirety the overall outbound cross boundary commuting market is dispersed, but there are a number of employment clusters adjacent to GM in which significant concentrations of GM out-commuters travel. Figure EC10 shows the proportion of GM residents working outside of GM at selected employment clusters (each area is based on an aggregation of Workplace Zones, each with a minimum of 1,000 jobs per sq. km) that were identified by mapping employment density. The percentage values represent the share of GM resident workers against the workplace population total for each employment cluster.

[19] Based on TfGM analysis of Census 2011 table *WF02EW - Location of usual residence and place of work.*

Figure EC10: Census 2011 Non GM-Employment Sites and % of GM Residents within Total Workplace Population[20]



77. Figure EC11 highlights the comparatively higher proportion of GM residents within the total workforces of employment clusters to the south of the county in comparison to the north. The five employment clusters identified in Cheshire East (Handforth, Wilmslow, Nether Alderley, Macclesfield and Knutsford) account for approximately 50% of the 19,000 GM residents who work within the district. In the case of Warrington four employment clusters were analysed (Birchwood, Warrington centre, Lingley Mere and the Gemini area); taken together, the associated workplace clusters accounted for 65% of the 16,000 GM residents who work within the district of Warrington.

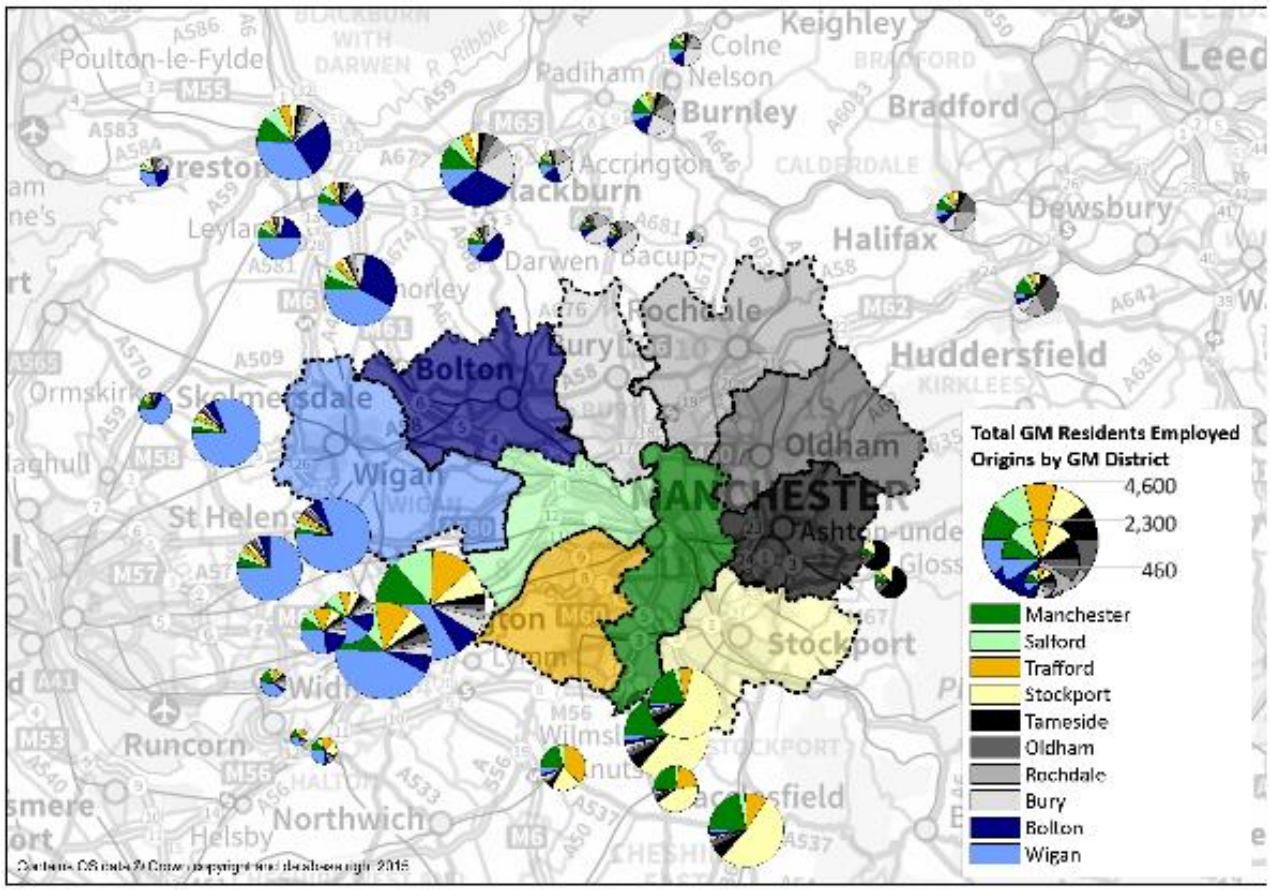
78. To the north of GM the most significant flows in terms of absolute numbers of GM resident workers are to Blackburn (2,400), Preston (2,300) and Chorley (2,100). The 500 GM resident workers who travel to the Warton Aerodrome (BAE systems) site in Fylde, points to the propensity to commute further in order to access skilled employment.

[20] Based on TfGM analysis of Census 2011 *table WF02EW - Location of usual residence and place of work.*

79. Figure EC11 provides an indication of the district origins of GM resident workers at each of the selected employment clusters while showing the overall volume of GM resident workers. It is noticeable that the largest concentrations of GM resident workers are in locations that are well served by the highway and rail networks. This relationship is particularly striking on the M62 corridor, which accounts for the two locations with the highest absolute flow of GM out-commuters (Birchwood and Warrington), as well as the M6 / M61 and A34 corridors.

80. There are a total of 43,000 GM out-commuters across all the employment clusters identified[21]. Wigan is the origin of the highest proportion at 30% (12,800), while Oldham and Rochdale are lowest at 4% each[21].

Figure EC11: Census 2011 District Origin of GM Residents within Non-GM Employment Site Workplace Population[21]



[21] Based on TfGM analysis of Census 2011 table *WF02EW - Location of usual residence and place of work.*

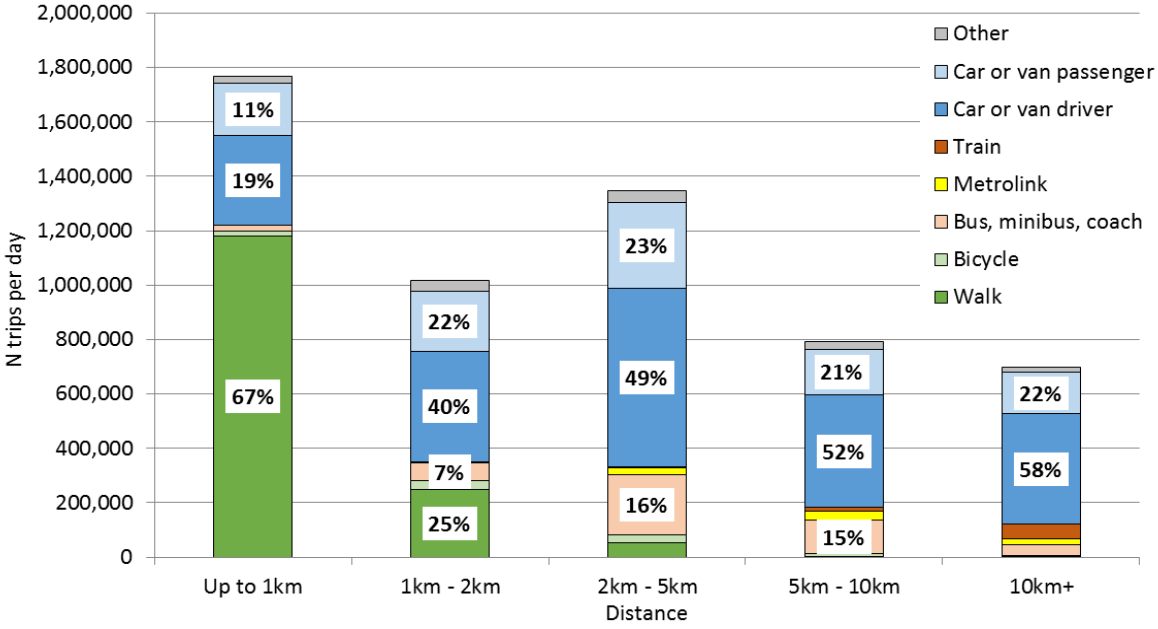
Implication for Greater Manchester

Greater Manchester is a significant economic centre that continues to draw in employees from areas surrounding Greater Manchester, leading to significant net in-commuting flows.

Reliance on the car for accessing employment within GM

81. GM Travel Diary Surveys (GM TRADS) for the 3 years to the end of 2016 indicate that that the mode choice of a commuting trip is sensitive to the total distance travelled. Figure EC12 shows that for commuting trips over 2km, the car is highly dominant with over 70% of trips being made in a car or van as either a driver or passenger. Even between 1km and 2km 62% of trips are made in a car. It is possible that some of these commuting trips are linked to other journeys; such as dropping children off at school.

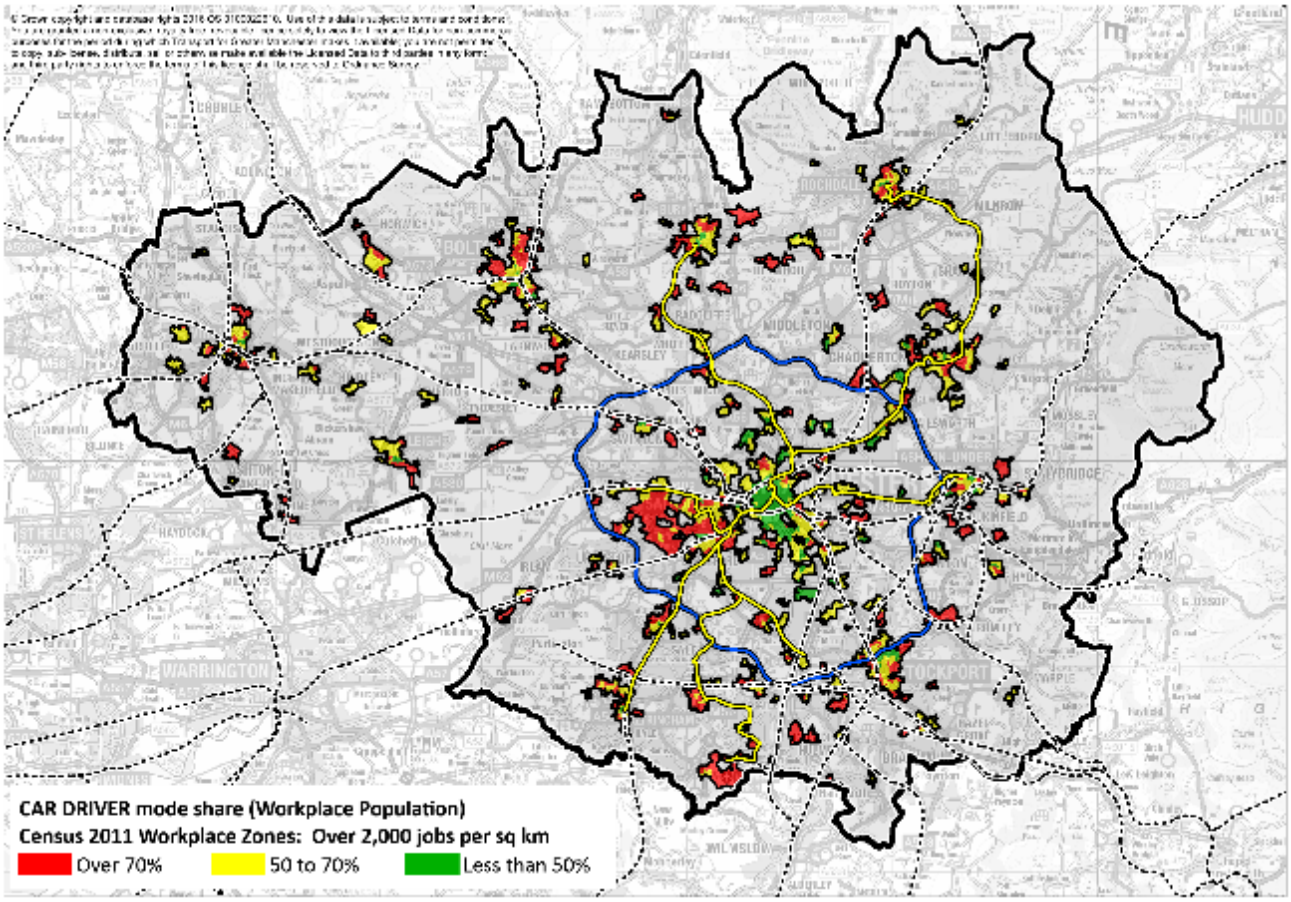
Figure EC12: Mode of Travel by Distance Band, Commuting Trips by GM Residents[22]



82. Figure EC13 shows the areas of GM that have at least 2,000 jobs per sq. km. These areas comprise less than 10% of the total area of GM, yet they accommodate over 55% of GM's jobs. Figure EC13 also shows the proportion of jobs within these areas that are accessed by workers driving a car. It is clear that with the obvious exceptions of the Regional Centre and selected areas around GM's town centres, car is the dominant mode of commute travel in most areas of GM.

[22] TfGM Travel Diary Surveys 2014 – 2016

Figure EC13: Census 2011 Car Driver mode share of Workplace Population[23]



83. The remainder of jobs across GM as identified by Census 2011 are highly dispersed. This represents a major challenge to ensuring that they are easily accessible without reliance on a car. The Census 2011 demonstrates this by showing that 67% of GM's 1,220,000 usual resident workers rely on a car to access a job[23].

84. Analysis of comparable Census 2001 and 2011 journey to work datasets has pointed to significant spatial variation across GM in respect of changes in commuter car driver mode share by age. One of the key trends evident from Figure EC14 is the overall decrease across GM in the number of people aged 25-34 driving a car to access employment between census years. This is in direct contrast to the trends shown in Figure EC15 which shows the population aged 50-64.

85. Figure EC14 also shows that the area within the M60 showed a decrease in terms of commuter car driver mode share for the 25-34 cohort; down from 54% in 2001, to 45% in 2011. This is in contrast to Figure EC15 which shows that for those aged 50-64, car driver mode shares to access employment have increased both within and outside the M60.

[23] Based on TfGM analysis of 2011 Census *table WP703EW - Method of travel to work*.

Figure EC14: Mode Share % Point Change: 2001 vs 2011 Journey to Work: Car Driver (25-34)[24]

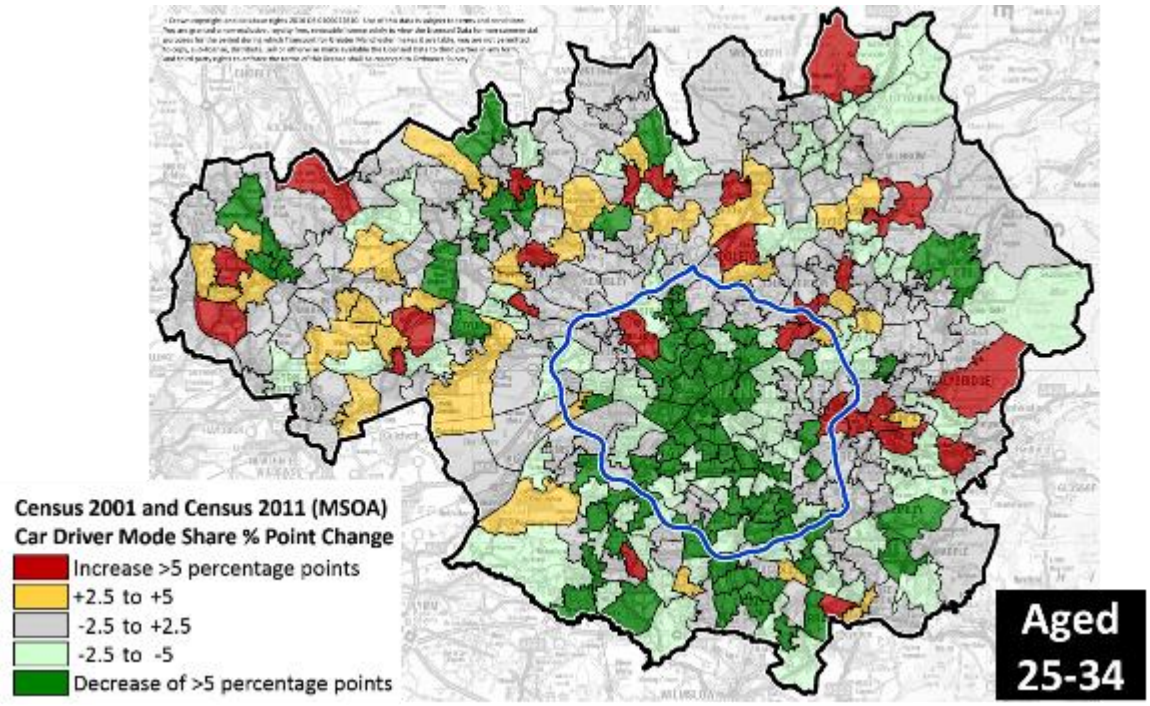
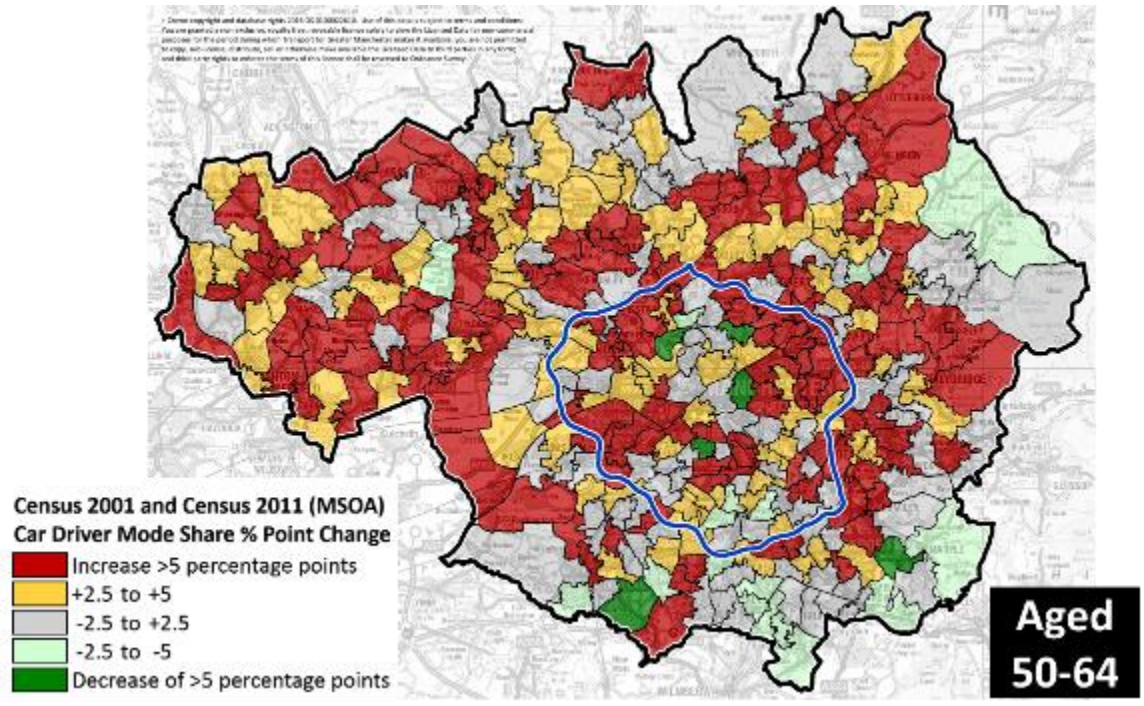


Figure EC15: Mode Share % Point Change: 2001 vs 2011 Journey to Work: Car Driver (50-64)[24]



[24] Based on TfGM analysis of Census 2001 *table ST119 - Sex and age by method of travel to work* and Census 2011 *table WP7101EW - Method of travel to work by age*.

Implication for Greater Manchester

For the majority of commuter movements the private car is the dominant mode, in part due to the dispersed nature of employment within and outside of GM. The regional centre, where the majority of jobs are accessed by non-car modes, is a clear exception.

Transport Network Congestion and Overcrowding

Transport investment and productivity

86. Closing both the productivity gap by getting more residents into work and improving in-work productivity remains an important aim for public, private and social sectors in GM. Broadly speaking there are two ways to bring about an increase in GVA output and productivity. One is to enhance productivity by making GM more attractive for people to live in, thus bringing the skills and talent needed by employers. The other is to reduce the costs of agglomeration, including reducing housing and commercial property constraints, transport and congestion costs; and supporting people into work.

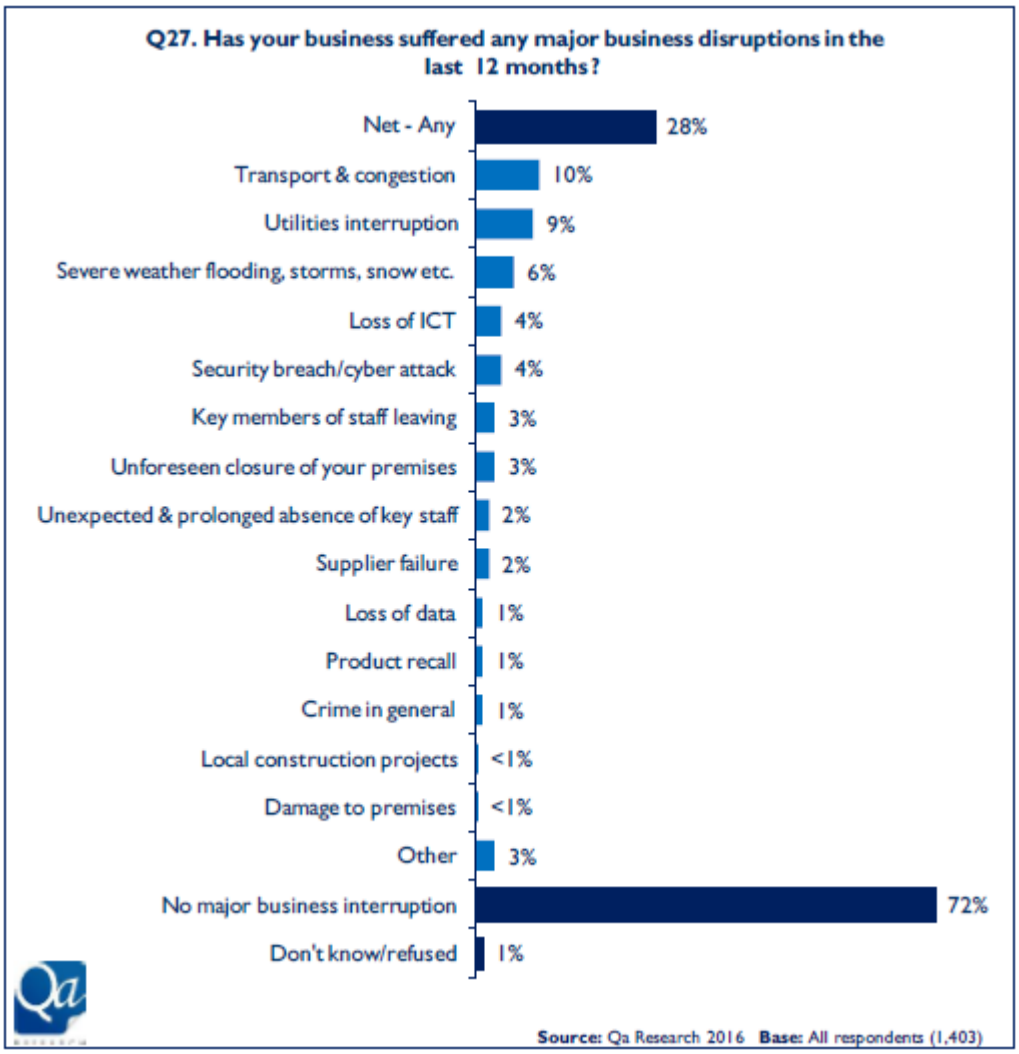
87. Transport enables cities to specialise, developing sector-specific advantages. Improved transport links will generally make a location more attractive to invest in where existing trends are supportive of business investment.

88. The 2016 Greater Manchester Business Survey supports this general principle of the importance of ensuring an efficient and effective transport network to attracting and maintaining the presence of businesses in an area as well as supporting economic growth. According to the 2016 Greater Manchester Business Survey, 72% of businesses are satisfied with their access to public transport, and 63% with their road transport access[25].

89. Nonetheless, transport and congestion was identified in the Business Survey as the leading cause of major business disruption in GM. Around a quarter of respondents (28%) cited at least one of the disruptions presented in the survey with the most likely being 'Transport & congestion' at 10% (Figure EC16).

[25] Qa Research and tbr. (2016), 'Greater Manchester Business Survey 2016 – Report' [online]. Available at: www.neweconomymanchester.com/.../greater-manchester-business-survey-2016 [accessed 5 March 2018]

Figure EC16: Has your business suffered any major business disruption in the last 12 month? - Results[25]



Congestion on the Greater Manchester road network

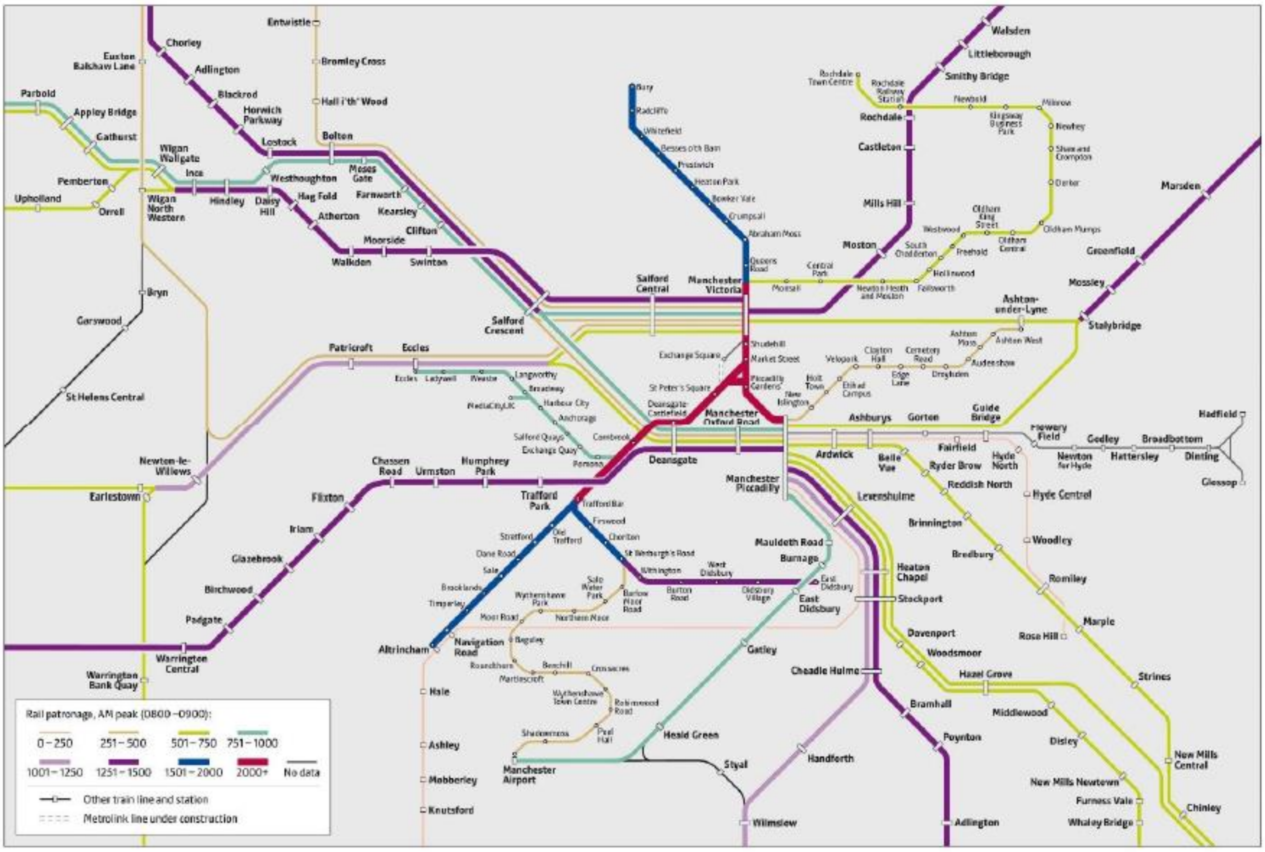
90. Data on road network journey times and congestion is presented in the 'Travel in Greater Manchester' section of this document. As shown there, during the weekday morning peak period (between the hours of 07:00 and 09:30) journey times on some parts of the Greater Manchester road network can be double the journey times of the rest of the day.

Overcrowding on public transport networks in Greater Manchester

91. This issue of congestion and overcrowding also impacts on the public transport networks servicing Greater Manchester.

92. The map below shows the AM Peak (08:00-09:00) patronage in 2015/16 for both heavy and light rail lines in Greater Manchester. This map highlights the heavy and light rail lines in Greater Manchester that are the busiest and therefore potentially more susceptible to constraints through congestion and over-capacity.

Figure EC17: AM High Peak (08:00 – 09:00) Patronage by Heavy and Light Rail Line (Train Operating Companies Automatic Passenger Count data and Metrolink passenger counts)[26]

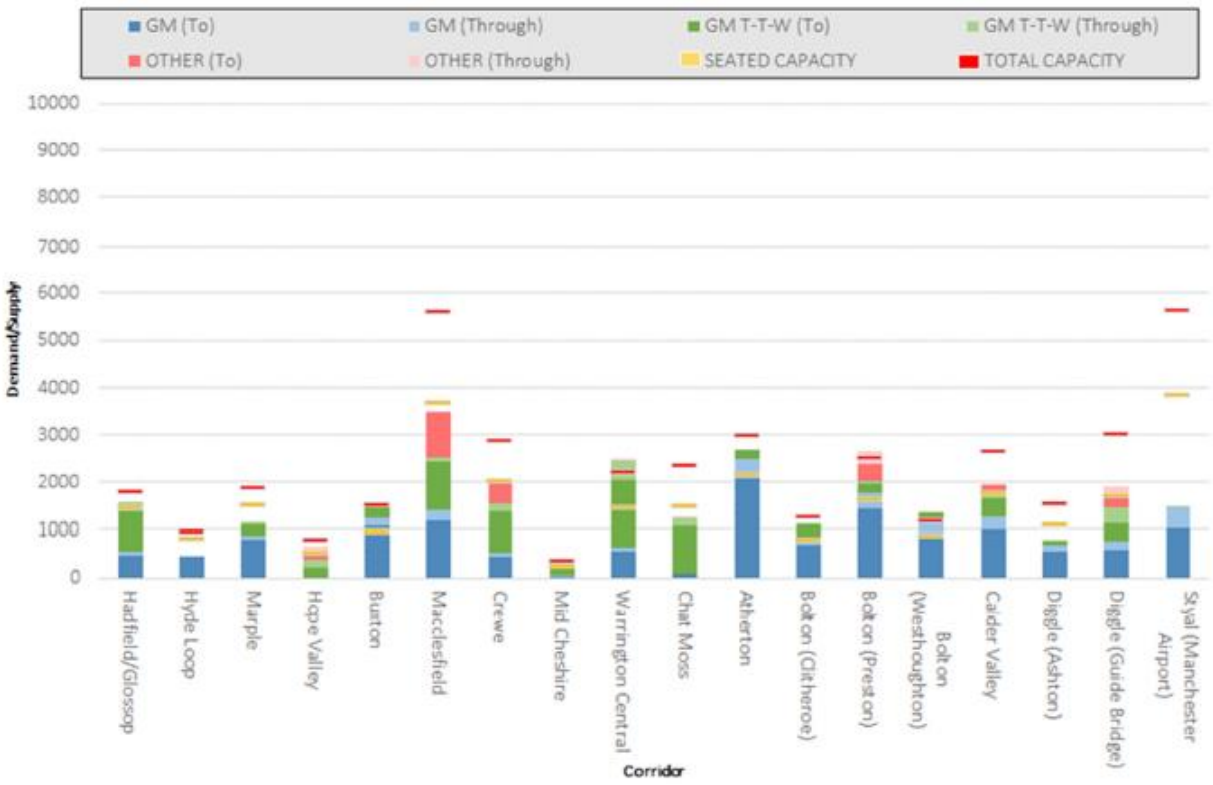


93. In the centre of the network, the section of the Metrolink network between Manchester Piccadilly, Manchester Victoria and Trafford Bar has the highest patronage during the AM Peak of any Metrolink or rail line with over 2,000 people using services on these sections. The Altrincham, Bury and part of the East Didsbury Metrolink lines also experience high patronage during the AM Peak with between 1,501 and 2,000 people using the Altrincham and Bury lines as well as between the East Didsbury line as far as St Werburgh's Road.

94. The rail lines that recorded the highest levels of patronage during the AM Peak (08:00-09:00) are the Macclesfield Line, CLC (Warrington Central) Line, Calder Valley Line, Huddersfield Line, Bolton Line and Atherton Line with between 1,251 and 1,500 people using these lines.

[26] Mott MacDonald (2017), Manchester Rail Network Capacity Study: Final Study Report.

Figure 18: AM Peak average weekday demand vs supply on rail corridors to Manchester City Centre for 2015/16[27]



95. Of the rail lines shown on the graph the following lines are shown to have been over total capacity (including standing capacity) on journeys to Manchester City centre:

- Warrington Central
- Bolton (Preston)
- Bolton (Westhoughton)

96. The following rail lines were shown to be over seating capacity only on journeys to Manchester city centre:

- Hadfield/Glossop
- Hope Valley
- Buxton
- Mid Cheshire
- Atherton
- Bolton (Clitheroe)

[27] TfGM Rail Passenger Surveys 2017

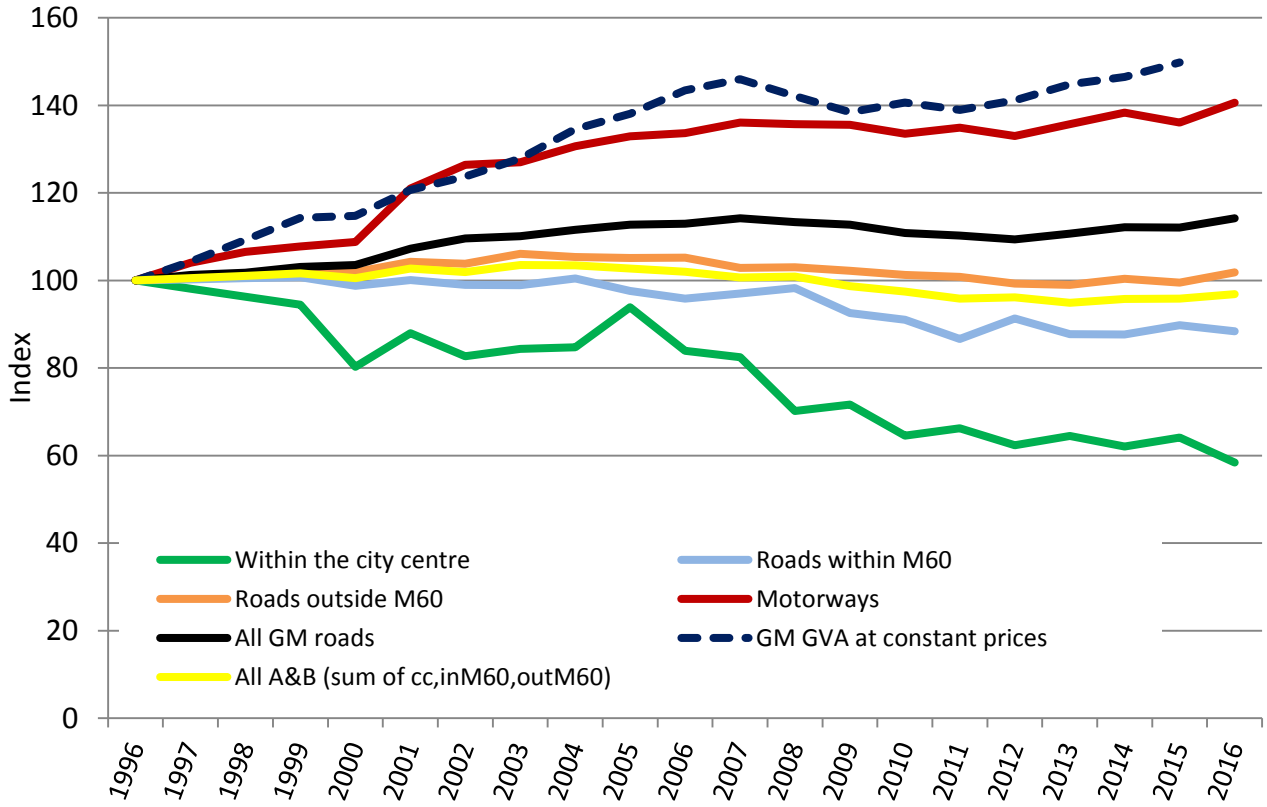
- Calder Valley
- Diggle (Guide Bridge)

The regional centre: an example of a change of relationship between economic growth and congestion

97. While GM has historically conformed to a pattern of traffic growth accompanying economic growth, there have been signs of a change in this traditional relationship between car use and economic growth in some locations. The greatest economic growth within GM has been achieved alongside a decline in car modal share and traffic flow, as exemplified by the City Centre.

98. Figure EC19 summarises how motor vehicle traffic volumes have changed in recent years.

Figure EC19: Changes in motor vehicle kilometres by area of Greater Manchester (1996 values set to 100)[28]



[28]TfGM Highways Forecasting and Analytical Services.
Note that: values for the all-purpose road network are totals for links on which traffic counts were carried out throughout the period. Values for motorway are estimated vehicle kilometrage for all motors: a check has confirmed that comparing link-flow over time for motorways yields similar results (but creates complications due to the opening of new sections of motorway, specifically M60 Denton – Middleton). Note that "within M60" means within M60 but outside MSIRR. Values interpolated between 1996 and 1999.

99. Conclusions that can be drawn from Figure EC19 include:

- There has been an overall increase in motor vehicle km across the total of all Greater Manchester roads between 1996 and 2016.
- Levels of motor vehicle km on roads outside of the M60 saw a slight increase between 1996 and 2002 before decreasing until 2014. Since 2014 another increase in the levels of motor vehicle km has been recorded that reaches above 1996 levels.
- For roads within the M60 there has been an overall decrease in the levels of motor vehicle km between 1996 and 2016.
- Overall road traffic has increased significantly less than proportionally with GVA.

100. This recent increase in road traffic experienced in Greater Manchester in 2016 is mirrored in London, with the latest Travel in London report showing that volumes of motorised traffic experienced growth of 1.6%[29] (all traffic). More specifically in central London traffic was down by 0.9% despite significant recent growth in the numbers of licensed private hire vehicles here; in inner London traffic was up by 0.9% and in outer London by 1.9%[29].

101. Figure EC20 demonstrates how inbound car movements across the City Centre cordon[30] have fallen between 2002 and 2017, whilst rail and Metrolink have seen significant growth over the same period. This trend is evident post-recession against the backdrop of a 20% increase in the employment base within the Regional Centre between 2009 and 2016, as shown in Figure EC21. Significant investment in the Regional Centre has helped to achieve the recent high level of economic growth alongside a backdrop of increasing non-car mode share.

[29] Transport for London, (2017). 'Travel in London Report 10' [online]. Available at: https://tfl.gov.uk/corporate/publications-and-reports/travel-in-london-reports [accessed 5 Mar. 2018]

[30] Note that the Manchester cordon is based on the alignment of the MSIRR, as opposed to the wider regional centre.

Figure EC20: AM Peak (07:30-09:30): Total inbound movements across the City Centre cordon (2002-2017)[31]

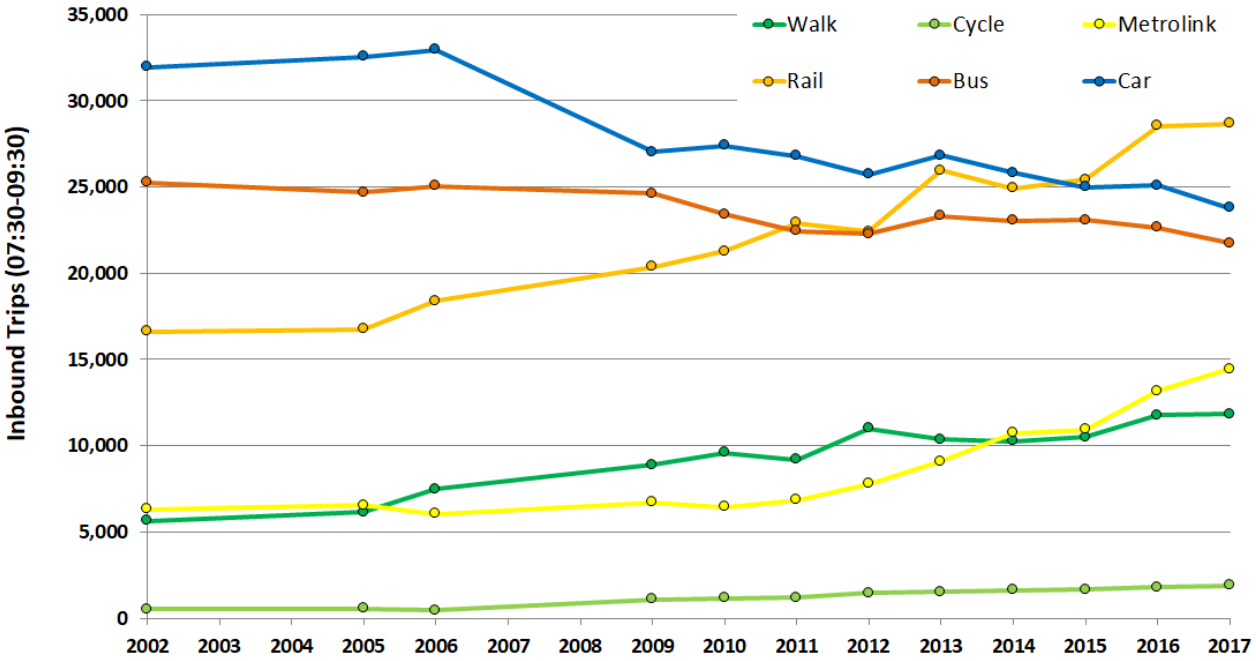
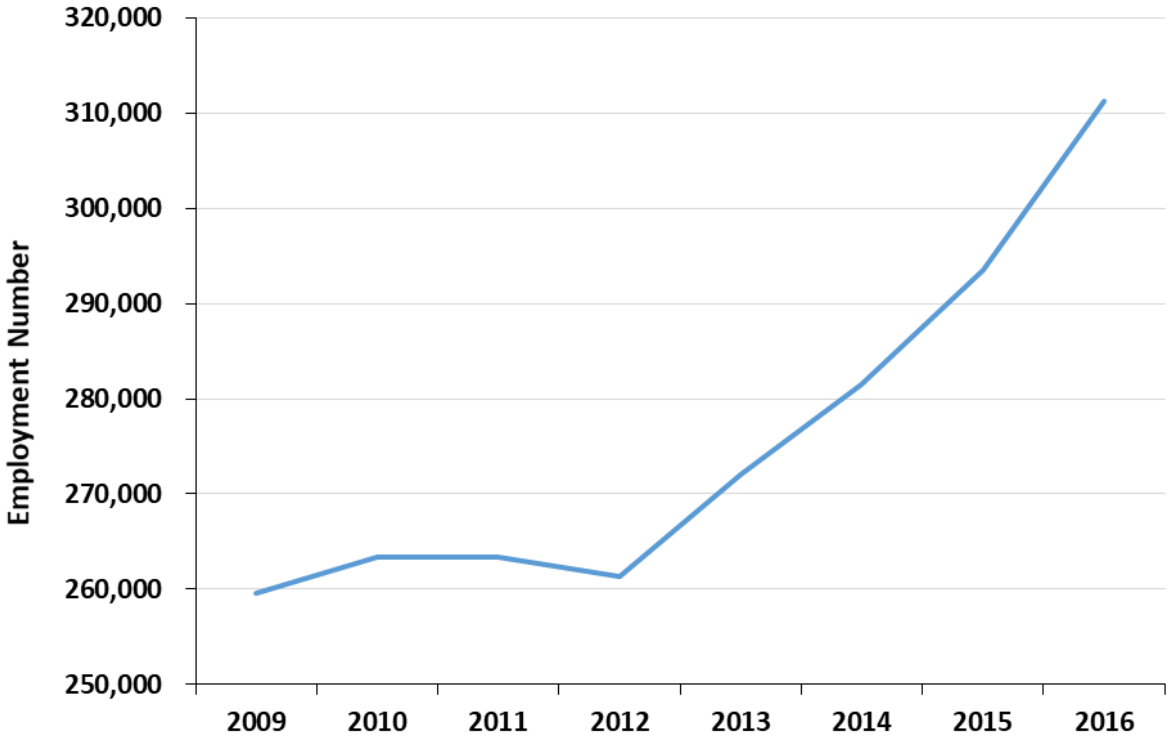


Figure EC21: Employment growth in the Regional Centre, 2009-2016[32]



[31] TfGM Highways Forecasting and Analytical Services: *DSD Report 1915 Transport Statistics Manchester 2016*
[32] Based on TfGM analysis of Business Register and Employment Survey data
Note: analysis uses data from LSOAs that intersect with a defined Regional Centre boundary.

Implication for Greater Manchester

If not managed effectively, severe road congestion and public transport overcrowding during peak periods could undermine GM's ability to improve economic productivity and deliver its growth aspirations.

A Growing Visitor Economy

102. The third iteration of the Greater Manchester Strategy (GMS) published in 2017 aims to create a thriving economy by harnessing the strengths and assets of Greater Manchester[33]. Amongst the strengths and assets of Greater Manchester are its transport networks that enable efficient domestic and international connectivity as well as numerous tourist attractions of significant historical and cultural importance.

103. In 2015 Marketing Manchester commissioned a detailed 'Tourism Economic Activity Monitor' to better understand the state of the tourism sector in Greater Manchester and provided the following key indicators to measure the productivity of the sector. The table below summarises these key tourism indicators for Greater Manchester in 2015 and compares them to the previous year.

Table EC5: Key tourism indicators for Greater Manchester[34]

Key indicator	2014 performance	2015 performance	Trend
Economic impact	£7.5bn	£7.9bn	5% increase
FTEs supported	91,963	93,928	2% increase
Number of day visits	104.5m	107.9m	3% increase
Number of staying visits	10.49m	10.53m	0.4% increase
Total visits	115.0m	118.5m	3% increase
Number of visitor days hosted (all visits)	126.9m	130.8m	3% increase

***Visitor days: This is the number of visits (both staying and day visits) multiplied by the average length of stay. This therefore provides an indication of how 'busy' the destination is with visitors.**

[33] Greater Manchester Combined Authority, (2017). 'Our People Our Place: The Greater Manchester Strategy' [online]. Available at: https://www.greatermanchester-ca.gov.uk/ourpeopleourplace [accessed 5 Mar. 2018]
[34] Marketing Manchester (2015). 'Greater Manchester's Tourism Economic Activity Monitor' [online]. Available at: www.marketingmanchester.com/what-we-do/leisure-tourism/research-and-data [accessed 5 March 2018]

104. In terms of international tourism, Manchester Airport is a key asset to Greater Manchester. As of 2017, Manchester Airport handled over 27.7 million passengers per year[35] and offers direct flights to over 200 destinations worldwide[36]. In 2016 Manchester was ranked as the third most visited city in the UK in regards to inbound staying visits to Britain, with over 1.1 million overseas visitors staying one night or more in the city. Only London and Edinburgh were ranked higher in the same year[37].

105. Significant destinations for tourism are spread throughout GM, though a number of destinations within the Regional Centre are among the most visited. Table EC6 highlights the top 10 attractions in GM based on annual visitor numbers.

Table EC6: Top 10 GM Attractions, 2016[38]

Attraction	District	2016 Visitors	Admittance
The Lowry	Salford	846,097	Free
HOME	Manchester	837,621	Free
Museum of Science & Industry	Manchester	651,473	Free
Manchester Art Gallery	Manchester	593,168	Free
National Football Museum	Manchester	481,541	Free
Manchester Museum	Manchester	406,997	Free
Bolton Museum, Aquarium & Archive	Bolton	354,653	Free
Runway Visitor Park	Manchester	338,450	Free
The Whitworth	Manchester	321,269	Free
Manchester United Museum & Tour Centre	Trafford	313,812	Paid entry

[35] CAA, (2017). 'Airport Statistics Summary' [online]. Available at: https://www.caa.co.uk/Data-and-analysis/UK-aviation-market/Airports/Datasets/UK-Airport-data/Airport-data-2017-12/ [accessed 1 Mar. 2018]

[36] Manchester Airport, (2018). 'Flying from Manchester Airport' [online]. Available at: http://www.manchesterairport.co.uk/destinations-and-guides/ [accessed 24 Jan. 2018]

[37] Visit Britain, 'Inbound town data' [online], Available at: https://www.visitbritain.org/town-data [accessed 13 Feb. 2018]

[38] Marketing Manchester, (2017). 'One Stop Intelligence Document – Greater Manchester's Tourism Sector' [online]. Available at https://cityco.com/report/manchester-tourism-factsheet/ [accessed 16 Jan. 2018]

GM visitor travel choices

106. According to a 2014 study, half of all visitors entered GM through private transport using the UK road network, with this rising to 57% for day visits and decreasing to 41% for staying visits[39]. The next most frequent method used was train (27%), showing consistent levels of usage for both day visitors (28%) and staying visitors (26%)[39]. The other most frequently used method varied between day and staying visitors. 19% of staying visitors reported travelling by air, with a further 8% using bus /coach[39]. This compares to 9% travelling by bus/coach, for a day visit, and just 1% by air[39].

107. When looking at visits to Manchester city centre alone, the proportions arriving by train and those arriving in private transport were both 37%[39]. There is also an increased proportion arriving by air of 11% compared to 8% for the full GM sample[39].

108. Although a significant proportion of visitors still arrive in GM by private transport (50%), this has decreased from 62% in 2010 mainly due to an increase in those arriving by train from 20% in 2010 to 27% in 2014, but also an increase in those using a bus or coach, from 6% in 2010 to 9% in 2014[39].

109. Around a quarter of visitors (26%) used public transport to get around GM during their visit. As would be expected, due to time availability, this increases for staying visitors at 41% compared to 16% of day visitors[39]. The most reported transport used was Metrolink (58%) followed by: bus (38%); train (15%) and Metroshuttle bus (4%)[39].

110. 54% of visitors who were visiting more than one district of GM used public transport to make these journeys[39]. For those just visiting one district the sample shows that over a quarter still used public transport during their visit[39]. For those visiting more than one district the modes used were: Metrolink tram (66%), bus (36%), train (23%) and Metroshuttle bus (2%). The use of the Metrolink tram was highest for those sampled in Salford, Trafford & Manchester city centre[39].

111. 42% of visitors reported that a smartcard would provide encouragement to use public transport to get around GM[39]. This rises for those with increased time with over half (52%) of staying visitors reporting they would be encouraged, compared to 35% of day visitors[39].

[39] Marketing Manchester and New Economy, (2014). 'Greater Manchester Leisure Visitor Survey' [online]. Available at: www.marketingmanchester.com/.../Greater-Manchester-Leisure-Visitor-Survey-2014 [accessed 1 March 2018]

GM visitor average spend

112. In 2014 the average spend for day visitors to GM is £35, with staying visitors spending £79 on average[39]. However, this rises to £97 for visitors staying in paid for accommodation. With over 2,400 hotel rooms planned for construction across GM the opportunity for further economic growth is clear[39].

Implications for Greater Manchester

An increase in the number of visitors to GM will lead to more trips on the transport network. It will be important to accommodate the needs of those who are unfamiliar with GM in a manner that promotes sustainable travel choices. In particular, this will require a simple, easy to use public transport network supported by targeted marketing materials and passenger information. A legible walking environment will also be critical.

Society and Community

Society and Community: Summary of Trends and Implications

A growing Greater Manchester resident population

- A rapidly growing Greater Manchester population will lead to an increase in the number of trips on the transport network. The spatial distribution of this growth will have significant implications for the type and scale of transport interventions required.
- Urban densification offers a major opportunity to reduce car dependence.

An ageing Greater Manchester resident population

- The ageing of the Greater Manchester population will have wide-ranging implications that will include the need to provide more accessible transport infrastructure and services.

Tackling inequality

- There is a need to tackle income and employment-related inequality through reducing barriers to accessing opportunities, including considering the affordability of transport and improving access to key facilities such as employment, health and education.
- Transport has a role to play in improving health across Greater Manchester by developing active travel infrastructure and supporting widespread take-up among a broader range of groups.

Behavioural change

- Travel attitudes and behaviours are changing in different ways across different social groups. Interventions will have to be tailored appropriately in recognition of this.

Safety and Security

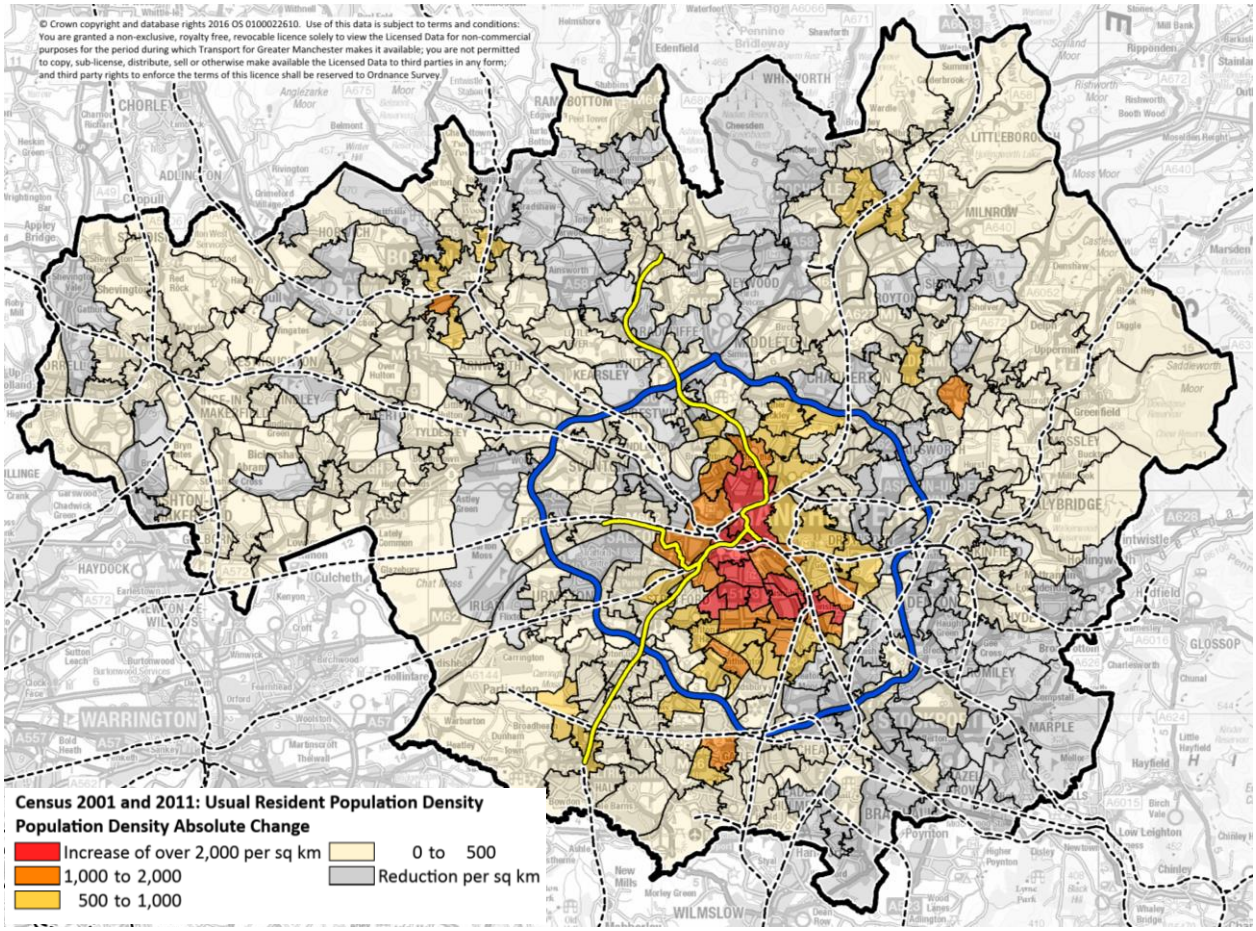
- There is a need to improve perceptions of personal safety and security when walking, cycling and using public transport to encourage greater uptake of those modes.
- Despite a trend of falling casualties in recent decades, there remains an ongoing issue in relation to vulnerable road users including children. There is a need for interventions to lower risk for vulnerable road users.

Greater Manchester's Growing Population

1. A growing population underpins many of the challenges and opportunities that will shape transport provision between now and 2040. Between 2006 and 2016, the population of Greater Manchester increased significantly by 7.7%[1].

2. Analysis of the 2001 and 2011 Census data indicates that the recent increase in population has not been evenly spread, and has been largely concentrated in the centre and south of Greater Manchester, within the M60 and around some town centres (Figure S1). There have also been population reductions in some outer areas of Greater Manchester.

Figure S1: Resident Population Density Change, 2001-2011[2]

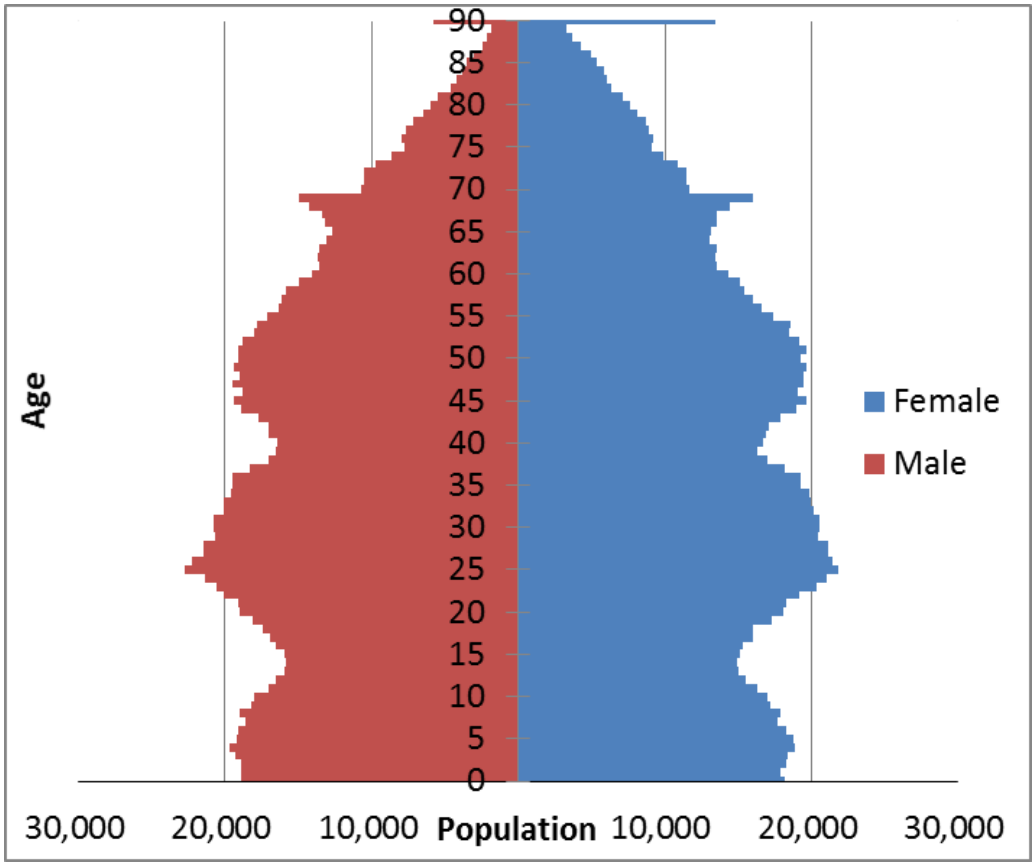


[1] ONS, (2017). 'Population Estimates for England and Wales Mid-2016. Population Estimates – Local Authority by Single Year of Age' [online]. Available at: https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationestimates/bulletins/annualmidyearpopulationestimates/mid2016 [accessed 1 Mar. 2018]

[2] NOMIS, (2018). 'Usual Resident Population, MSOA Based: Census 2001 - KS001, Census 2011 - KS101EW' [online]. Available at:

3. Population growth has been fuelled particularly by the in-migration of young people to the conurbation core. Greater Manchester has a younger age profile than nationally, particularly concentrated near the conurbation core: for example, while almost 40% of Greater Manchester's population was under 30 in 2016 compared to almost 37% nationally, this rises to 50% within Manchester[3]. Greater Manchester's Age/Gender profile is displayed below.

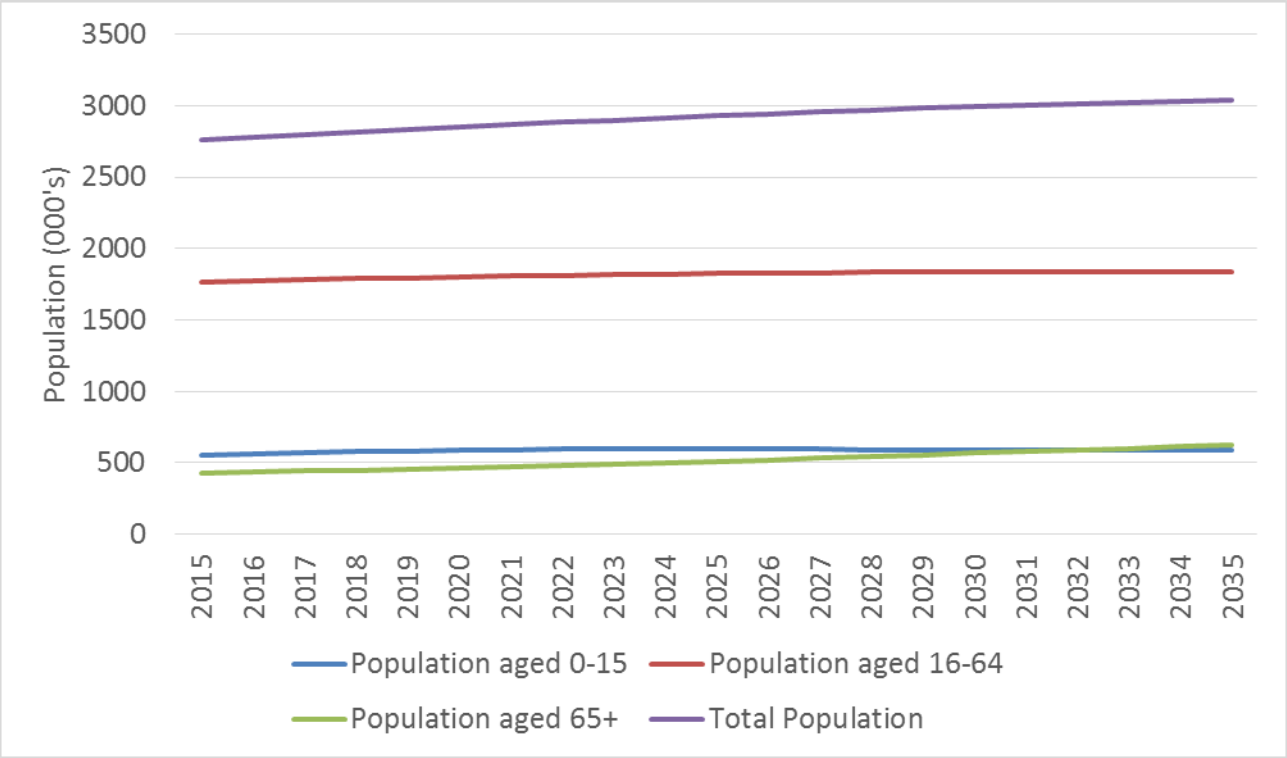
Figure S2: Greater Manchester Population, Age/Gender Distribution (note 90 includes age 90 and above)[3]



4. By 2035, the population of Greater Manchester is predicted to rise to 3,042,500, a further 286,100 people compared to 2015 (Figure S3).

[3] ONS, (2017). 'Population estimates for UK, England and Wales, Scotland and Northern Ireland: mid-2016' [online]. Available at: https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationestimates/bulletins/annualmidyearpopulationestimates/mid2016 [accessed 1 Mar. 2018]

Figure S3: Forecast Population Growth in Greater Manchester, 2015-2035[4]



Implications for Greater Manchester

A rapidly growing Greater Manchester population will lead to an increase in the number of trips on the transport network. The spatial distribution of this growth will have significant implications for the type and scale of transport interventions required.

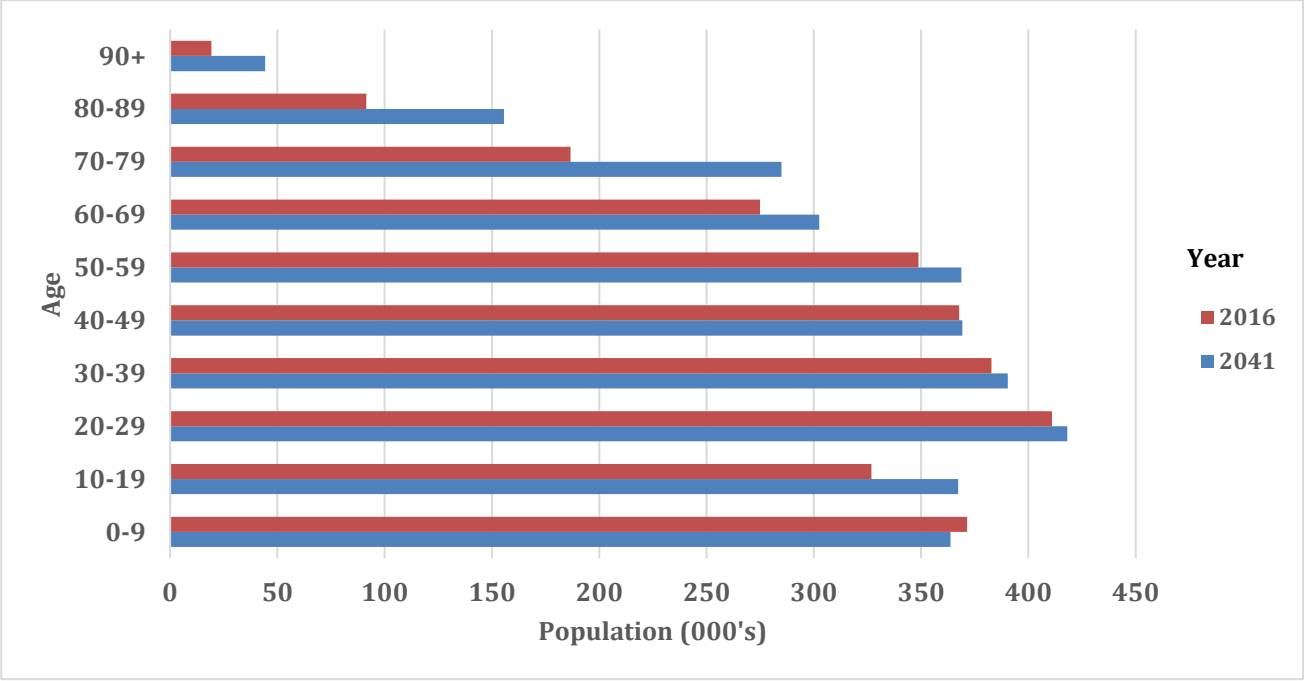
Urban densification generally leads to more demand for public transport and active travel. That is partly because short-distance trips to urban centres favour active modes and public transport. Car ownership is also less attractive in dense urban areas due to costs and difficulties of parking cars there. Urban densification therefore offers a major opportunity to reduce car dependence.

[4] Oxford Economics (2017) Greater Manchester Forecasting Model: Accelerated Growth Scenario 2017

Greater Manchester's Ageing Population

5. While the total population of Greater Manchester is increasing, there is a great deal of variation in projections among age groups. 2016-based ONS population projections suggest we are likely to see a broad population increase, with significant increase in those aged 60 or over. A breakdown of absolute growth between age groups from 2016-2041 is displayed in Figure S4.

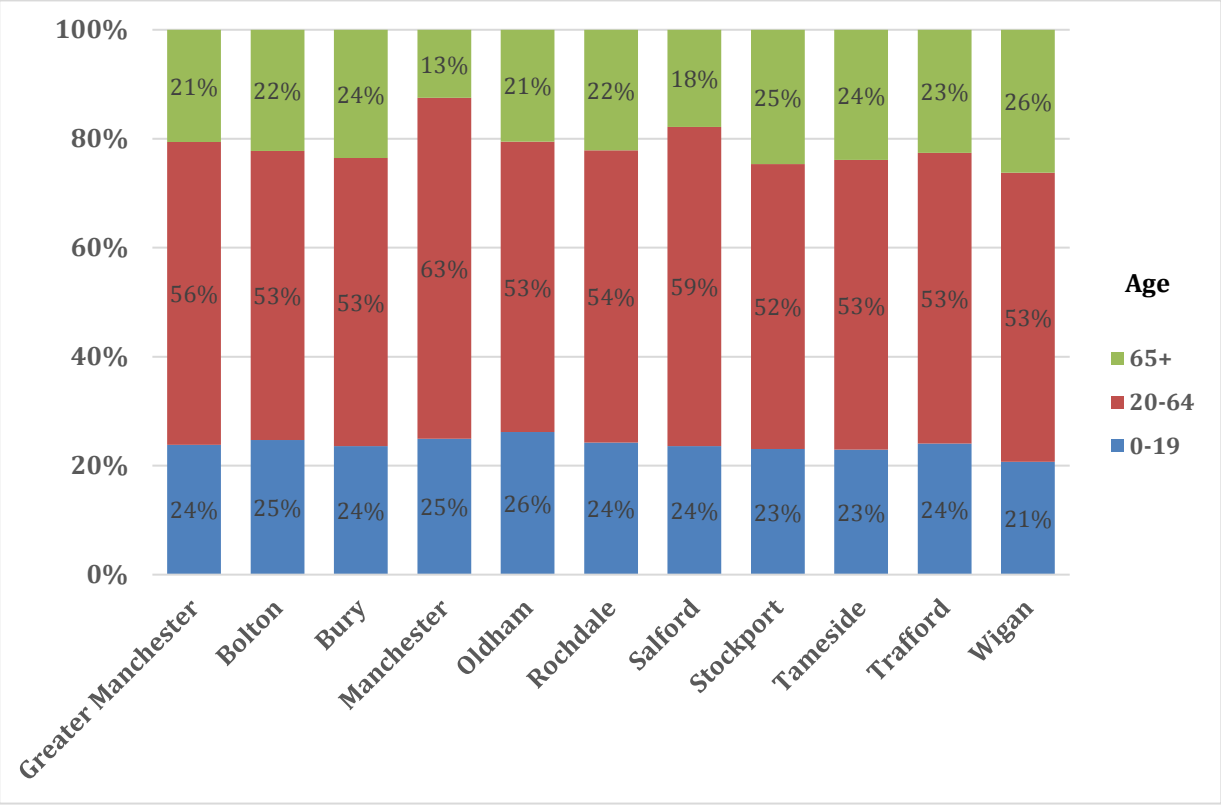
Figure S4: Age Distribution of Projected Population in Greater Manchester[5]



6. A key factor will be people living longer, with the age cohorts over the age of 70 expected to grow significantly. This growth in the elderly population is most notable in Wigan and Stockport, where the 65+ age group is forecast to make up approximately a quarter of their resident populations by 2041 (Figure S5).

[5] ONS (2018), 2016-based Subnational Population Projections for Local Authorities and Higher Administrative Areas in England

Figure S5: Age Distribution of 2041 Projected Population within Greater Manchester Local Authorities[6]



7. The ratio of elderly men to women is expected to become more balanced, compared to today, potentially leading to more households with two elderly occupants. This will impact to some extent on housing needs and prices as well as on health facilities and transport demand[6].

8. It is well understood that ageing impacts upon an individual's ability for fully independent mobility, particularly the ability to use a car. Research conducted into older people's changing travel capabilities found giving up car use can lead to a reduction in independent mobility, and is associated with significant lifestyle change. This can result in physical and mental health problems, though research found that those who plan and give up driving gradually suffer far fewer negative effects than those who are told to give up driving immediately[7].

[6] ONS, (2018). '2016-based Subnational Population Projections for Local Authorities and Higher Administrative Areas in England'

[7] Musselwhite, C & Haddad, H. (2010). *Mobility, accessibility and quality of later life. Quality in Ageing and Older Adults*, 11(1), pp. 25-37.

9. There is a marked increase in difficulty of accessing key services (e.g. hospitals, banks, supermarkets) reported by those aged over 80, and while individuals live longer, access to health services for older age groups has been recognised as a priority[8].

Implications for Greater Manchester

The ageing of the Greater Manchester population will have wide-ranging implications that will include the need to provide more accessible transport infrastructure and services.

[8] Age UK and International Centre for Longevity UK, (2015). *The Future of Transport in an Ageing Society*. London.

Inequality in Greater Manchester

135. The 2017 Greater Manchester Strategy aims to create a more inclusive and productive city-region where everyone can succeed. This includes outcomes such as reduced inequality across Greater Manchester places and population groups[9].

Levels of Income and Employment Related Inequality in Greater Manchester

136. Within Greater Manchester, the proportion of the population aged 16-64 that are economically active[10] has increased between 2007 and 2017. However, this varies considerably across authorities. While Manchester and Stockport have seen the highest growth in the proportion economically active between 2008 and 2017, increasing 4%, Bury and Rochdale have experienced a decline over time (Table S1).

Table S1: Greater Manchester's Economically Active Population (of those aged 16-64)[11]

	Number Economically Active		Proportion Economically Active		
Location	**Oct 2007-Sep 2008**	**Oct 2016-Sep 2017**	**Oct 2007-Sep 2008**	**Oct 2016-Sep 2017**	**Change**
Bolton	129,200	132,800	74.6%	75.4%	0.8%
Bury	89,300	87,100	76.3%	75.0%	-1.4%
Manchester	225,000	271,400	67.7%	71.7%	4.0%
Oldham	101,100	103,700	72.4%	73.4%	1.0%
Rochdale	98,800	94,600	74.2%	71.7%	-2.5%
Salford	111,400	128,000	75.4%	78.9%	3.5%
Stockport	139,500	142,500	77.5%	81.6%	4.0%
Tameside	106,400	104,200	75.2%	75.3%	0.0%
Trafford	114,500	118,800	80.9%	80.8%	0.0%
Wigan	155,700	157,500	76.5%	77.5%	1.0%
Greater Manchester	**1,270,900**	**1,340,600**	**74.3%**	**75.8%**	**1.4%**

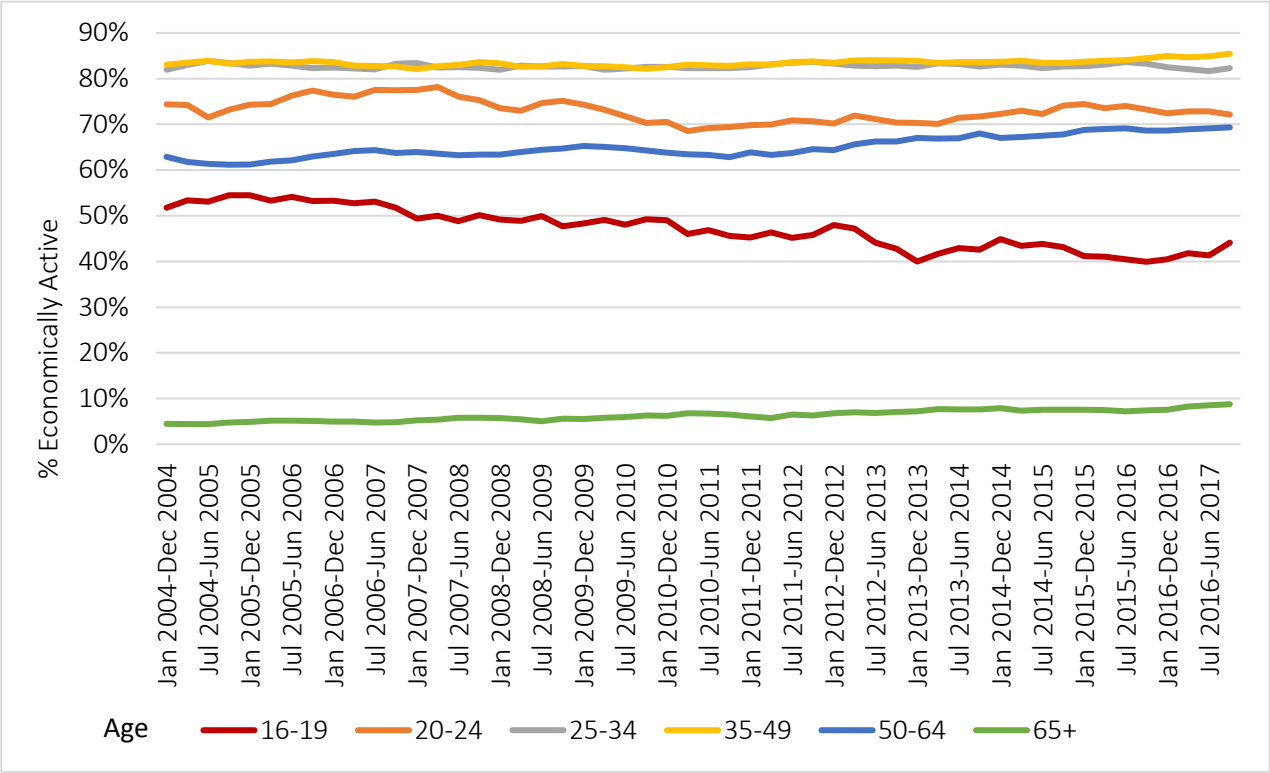
[9] Greater Manchester Combined Authority, (2017). 'Greater Manchester Strategy' [online]. Available at: http://www.greatermanchester-ca.gov.uk/download/downloads/id/405/greater_manchester_summary_-_full_version.pdf [accessed 18 Feb. 2018]

[10] People aged 16 and over who are either in employment or unemployed, as defined by the Office for National Statistics.

[11] ONS (2016) Annual Population Survey: Economic Activity Rate, Aged 16-64. April 2004-March 2005, April 2015-March 2016.

137. Within Greater Manchester, levels of economic activity amongst people aged 16-19 have declined, while levels of economic activity amongst people aged 50-64, and above 65, have risen (Figure S6).

Figure S6: Greater Manchester Economic Activity, by Age Band[12]

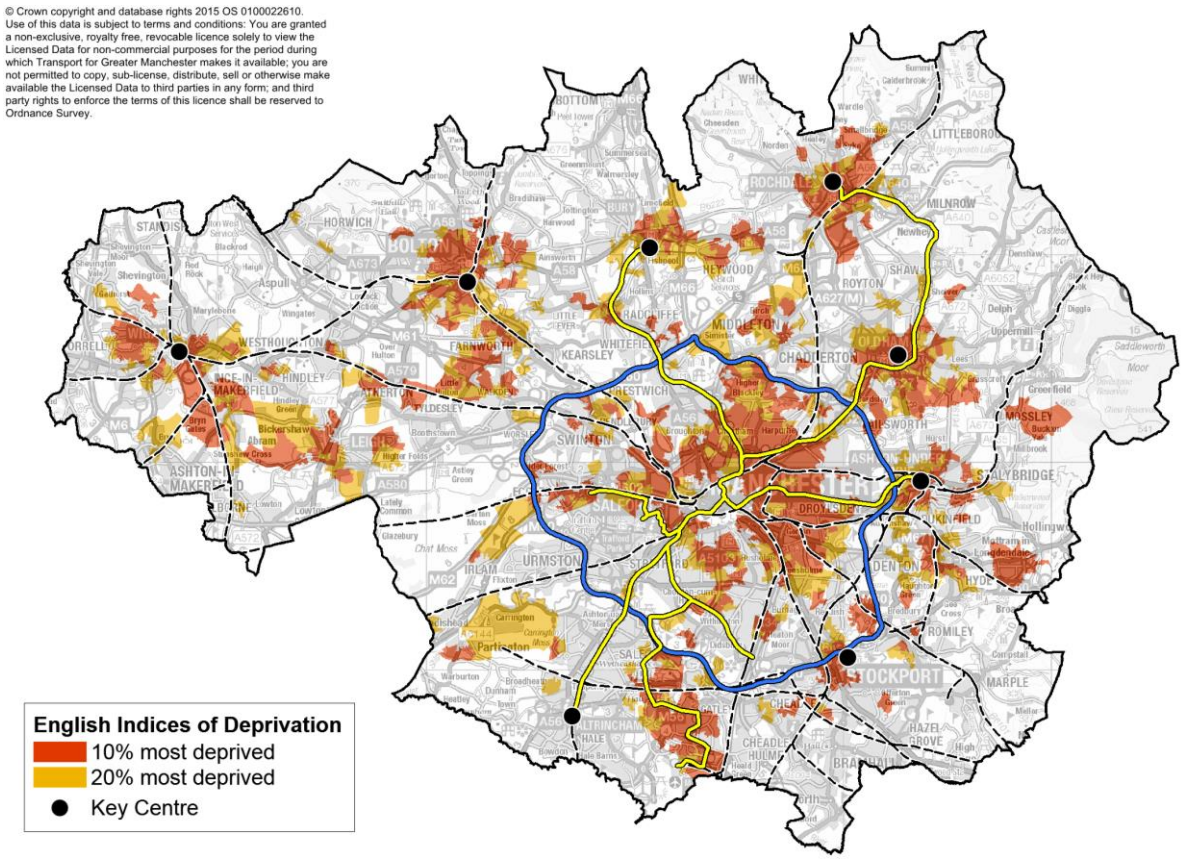


138. Within Greater Manchester, areas to the east of the regional centre within the M60, and surrounding many of our major town centres fall within the 10-20% of most deprived areas nationally. Figure S7 highlights the areas of greatest deprivation[13].

[12] ONS (2018) Annual Population Survey: Economic activity rate by age

[13] Index of Multiple Deprivation is compiled (and weighted) by a range of factors including: Income Deprivation (22.5%), Employment Deprivation (22.5%), Education, Skills and Training Deprivation (13.5%), Health Deprivation and Disability (13.5%), Crime (9.3%), Barriers to Housing and Services (9.3%), Living Environment Deprivation (9.3%)

Figure S7: Index of Multiple Deprivation 2015[14]



139. The index is related to a range of factors such as the employment opportunities available to local residents. Transport has a role in improving access to employment from deprived areas by strengthening existing centres of employment, but also linking areas of deprivation with areas of new job creation.

140. Evidence gathered as part of Greater Manchester's Local Sustainable Transport Fund programme revealed 35% of job seekers found transport a barrier in getting to work. When asked which barriers were considered when deciding what type of transport to use, cost was most considered, by 72% of respondents[15].

141. Transport accessibility varies widely across Greater Manchester. Some of the most accessible areas include the Regional Centre and town centres. Higher population densities in these locations support higher density housing and more frequent public transport services, compared to those living in more rural, sparsely populated areas.

[14] ONS, (2015). 'Index of Multiple Deprivation. Mapped to Lower Super-Output Areas' [online]. Available at: https://www.gov.uk/government/statistics/english-indices-of-deprivation-2015 [accessed 20 Feb. 2018]
[15] TfGM (2015) Local Sustainable Transport Fund, analysis of interviews with jobseekers

142. The availability of cars among households across Greater Manchester varies considerably, with a strong correlation between household income and car ownership. Car ownership is discussed in more detail in the 'Travel in Greater Manchester' chapter earlier in this document.

143. Nationally, access to the internet and online services is increasing across the population, including among older age groups. While Ofcom research indicated the proportion of those aged 65+ using the internet rose from 58% in 2016, to 65% in 2017, this remains lower than the wider national average (89%). Furthermore, this research indicates lower internet use among lower socio-economic groups[16]. Lack of access to internet services can reinforce inequalities across Greater Manchester, particularly as transport information services are increasingly delivered through internet channels.

144. Furthermore, the potential for new technologies to influence travel decisions among Greater Manchester residents is likely to be mixed. While 73% of those aged 16-34 would use public transport more if they could access real-time information via their smartphone/tablet app (compared to 54% overall), conversely, 48% of people aged 65 and above disagree that such innovation would increase their use of public transport[17].

Implications for Greater Manchester

There is a need to tackle income and employment-related inequality through reducing barriers to accessing opportunities, including considering the affordability of transport and improving access to employment, health and education.

[16] Ofcom, (2017). 'Internet use and attitudes: 2017 Metrics Bulletin' [online]. Available at: https://www.ofcom.org.uk/__data/assets/pdf_file/0018/105507/internet-use-attitudes-bulletin-2017.pdf [accessed 20 Feb 2018]

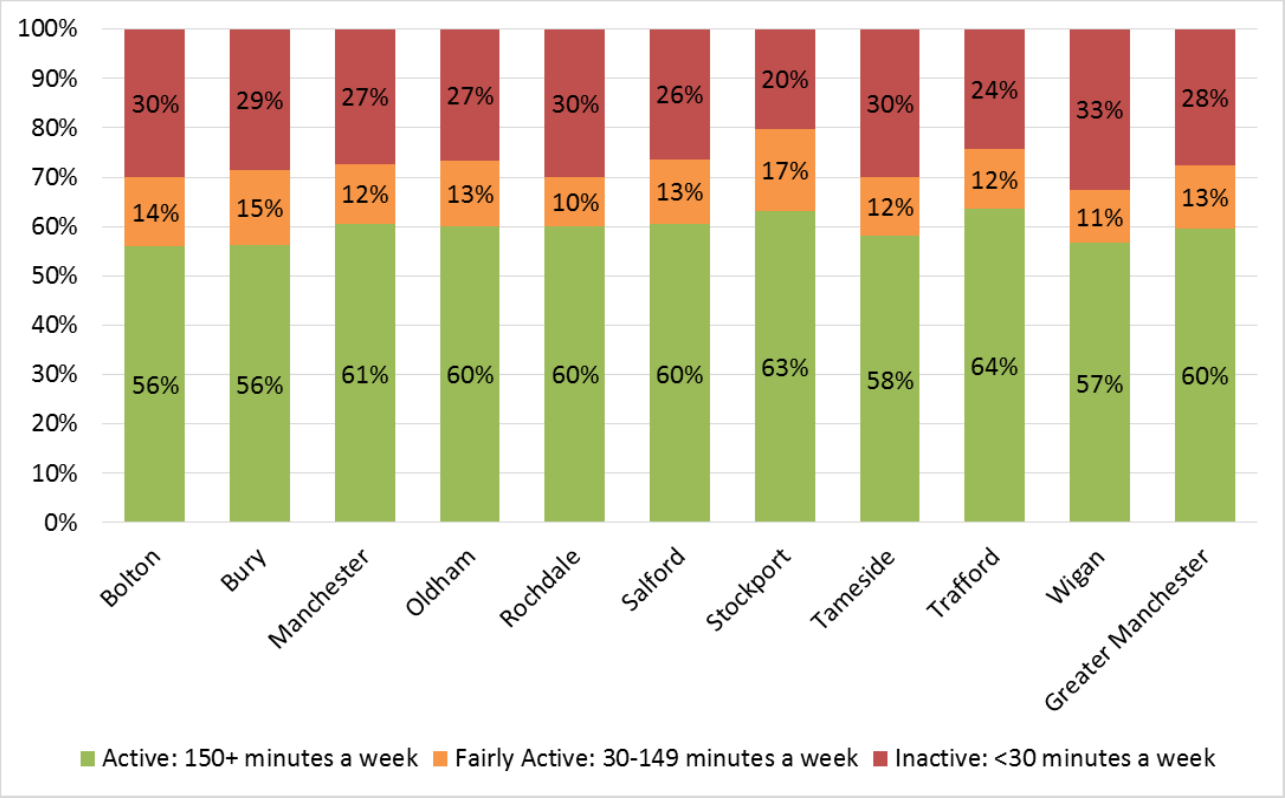
[17] TfGM Segmentation Survey (2017)

Health Issues, Health Inequality and Walking and Cycling in Greater Manchester

145. 110,700 people in Greater Manchester aged 16-64 were economically inactive due to long-term sickness through 2016-17, higher than the national average[18]. This not only impacts on those individuals' life chances, but also reduces Greater Manchester's productivity and increases the public cost of out-of-work benefits.

146. National government advice recommends adults achieve at least 150 minutes of moderate intensity physical activity per week[19]. Within Greater Manchester, approximately 60% of residents aged over 16 achieve this (Figure S8). Increasing levels of walking and cycling in Greater Manchester could therefore improve health outcomes for Greater Manchester residents.

Figure S8: Frequency of Physical Activity, Greater Manchester Residents, 2017[20]



[18] ONS, (2017). 'Labour Market Profile: Greater Manchester' [online]. Available: https://www.nomisweb.co.uk/reports/lmp/lep/1925185547/printable.aspx [accessed 28 Feb. 2018]

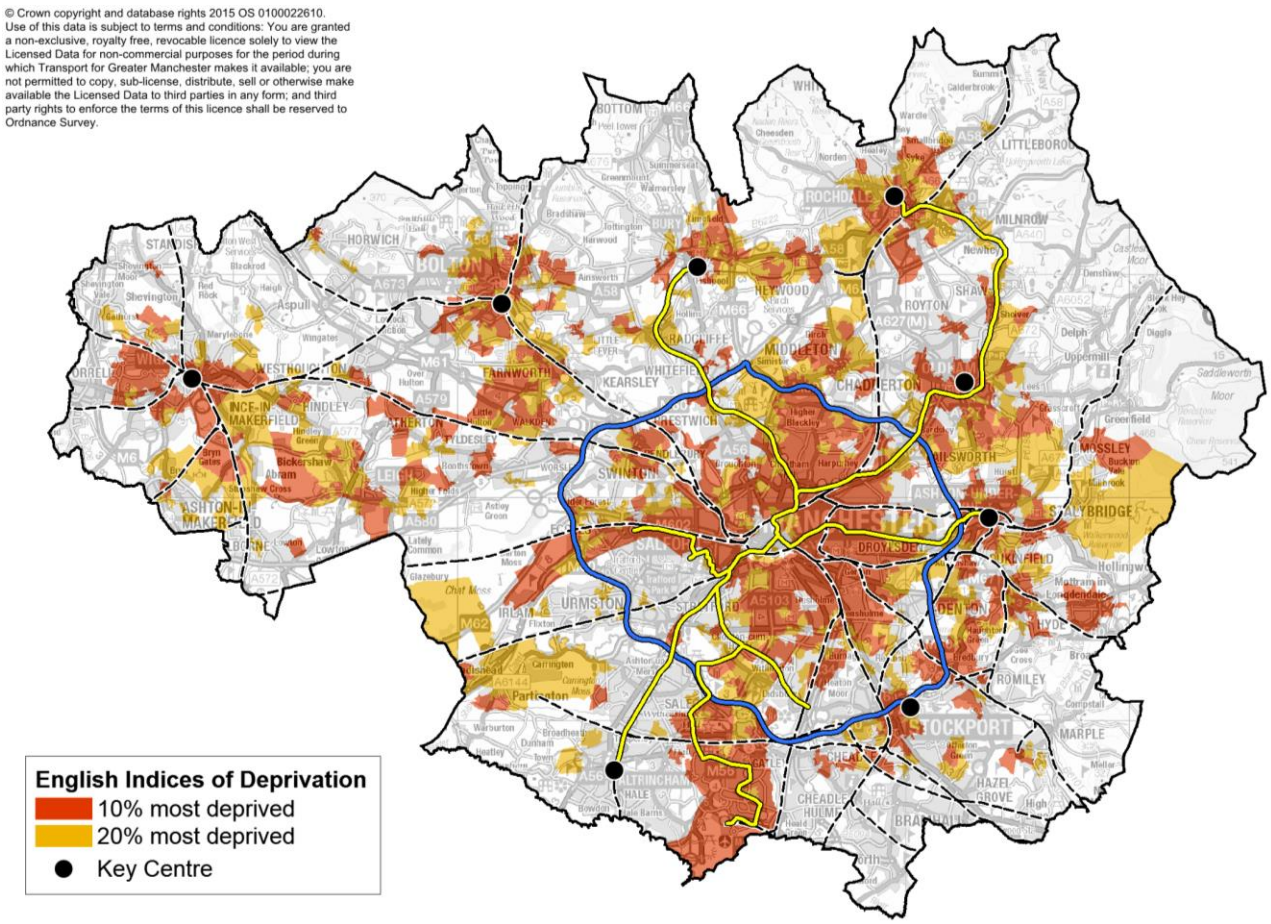
[19] Department of Health and Social Care, (2011). 'UK Physical Activity Guidelines. Factsheet 4: Physical activity guidelines for adults' [online]. Available at: https://www.gov.uk/government/publications/uk-physical-activity-guidelines [accessed 28 Feb. 2018]

[20] Sport England, (2017). 'Active Lives Survey. Sport and Physical Activity Amongst Adults Aged 16+' [online]. Available at: http://www.sportengland.org/media/12451/tables-1-4_levels-of-activity.xlsx [accessed 28 Feb. 2018]

147. The Index of Multiple Deprivation gives an overall improve of the level of deprivation experienced by an area. The Health Domain combines the indicators: Years of Potential Life Lost, Comparative Illness and Disability Ratio, Measures of Acute Morbidity, and The Proportion of Adults under 60 suffering from mood or anxiety disorders.

148. Levels of health deprivation vary significantly across Greater Manchester. While there are some areas of Trafford, such as Altrincham, and of Stockport that perform relatively well, large areas of Greater Manchester lie within the bottom 10% nationally. The Index of Health Deprivation for 2015 is shown in Figure S9.

Figure S9: Health Domain: 2015 English Indices of Deprivation[21]



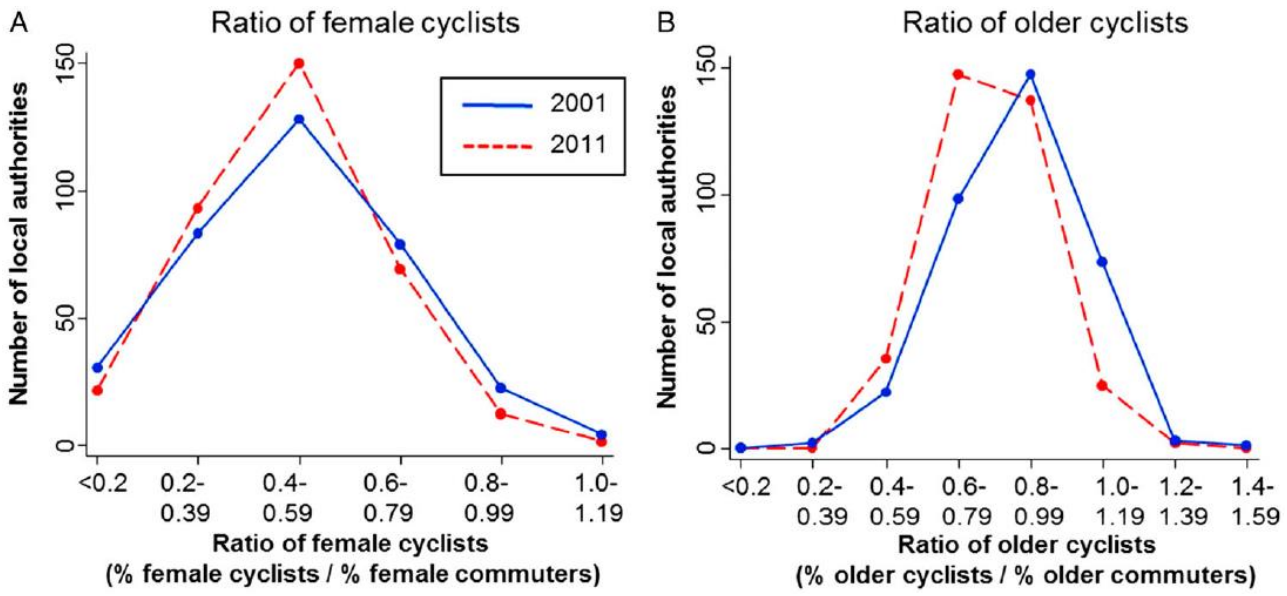
[21] ONS, (2015). 'Index of Multiple Deprivation. Mapped to Lower Super-Output Areas' [online]. Available at: https://www.gov.uk/government/statistics/english-indices-of-deprivation-2015 [accessed 28 Feb. 2018]

149. There is a well-established link between reduced personal car use, increased active travel, and improved physical and mental health[22] even when incorporating public transport use[23].

150. Greater Manchester Travel Diary Surveys (TRADS)[24] indicate private cars remain the dominant mode for travel. Of trips up to 1km, 30% are made by car; of trips between 1 and 2km, 62% are made by car (see 'Travel in Greater Manchester' chapter for details). There therefore is great potential for walking and cycling to replace short car trips.

151. In low-cycling countries, cycling is not evenly distributed across genders and age groups. In the UK, commuter cycling in the UK is concentrated among specific demographic groups, with regular commuters more likely to be male, white, and young. The ratio of female cyclists relative to male cyclists is just under half across England (Figure S10).

Figure S10: Distribution of ratios of (A) female cyclists and (B) older adult cyclists across 346 local authorities in England and Wales in 2001 and 2011[25]



152. By contrast, in high-cycling countries, where gender differences exist, women tend to cycle more than men. Recent data from the Netherlands show that women's cycling mode share is higher than men's for commute and shopping trips; and similar for leisure and educational trips[25].

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[22] Gatersleben, B., Uzzle, D. (2007). Affective Appraisals of the Daily Commute. Comparing Perceptions of Drivers, Cyclists, Walkers and Users of Public Transport. *Environment and Behaviour*, 39(3), pp. 416-431.
[23] Martin, A., Panter, J., Suhrcke, M., Ogilvie, D. (2015). Impact of changes in mode of travel to work on changes in body mass index: evidence from the British Household Panel Survey, *Journal of Epidemiology and Community Health*, 0, pp. 1-9.
[24] TfGM Travel Diary Surveys 2014-2016.
[25] Aldred, R., J. Woodcock & A. Goodman. (2016). Does More Cycling Mean More Diversity in Cycling? *Transport Reviews*, 36:1, pp. 28-44.

Implication for Greater Manchester

Transport has a role to play in improving health across Greater Manchester by developing active travel infrastructure and supporting widespread take-up among a broader range of groups.

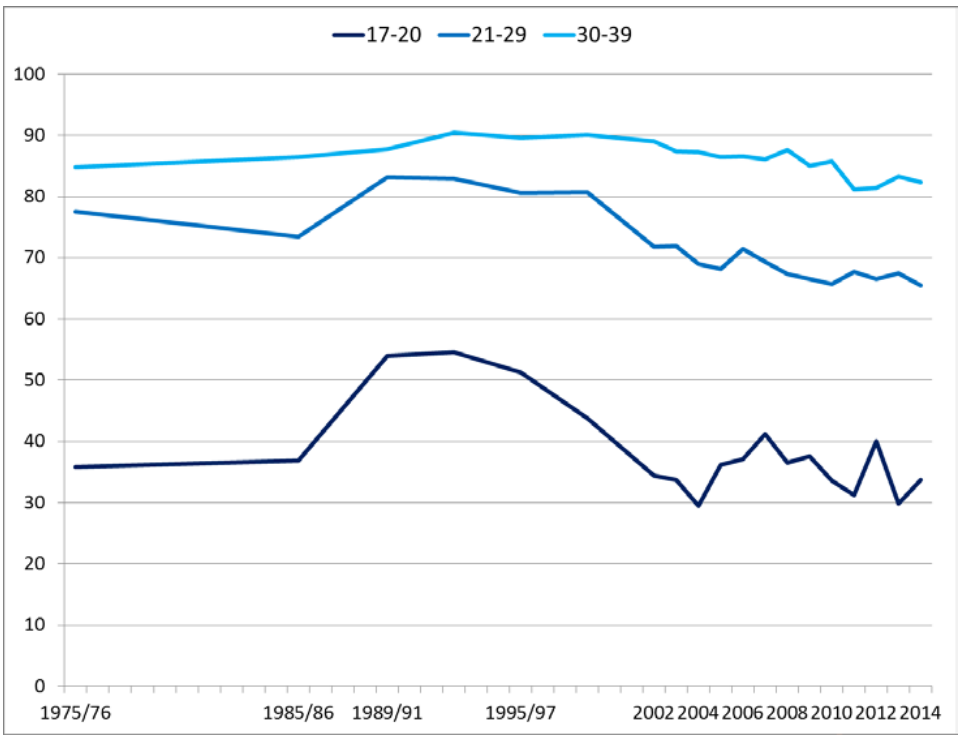
Changing Attitudes and Travel Behaviour

153. National research indicates a change over time of licence holding and car driving mileage between age cohorts and genders.

154. Research from the University of the West of England and Oxford University commissioned by the Department for Transport shows the changes over time in terms of licence holding by both males and females (Figure S11 and Figure S12).

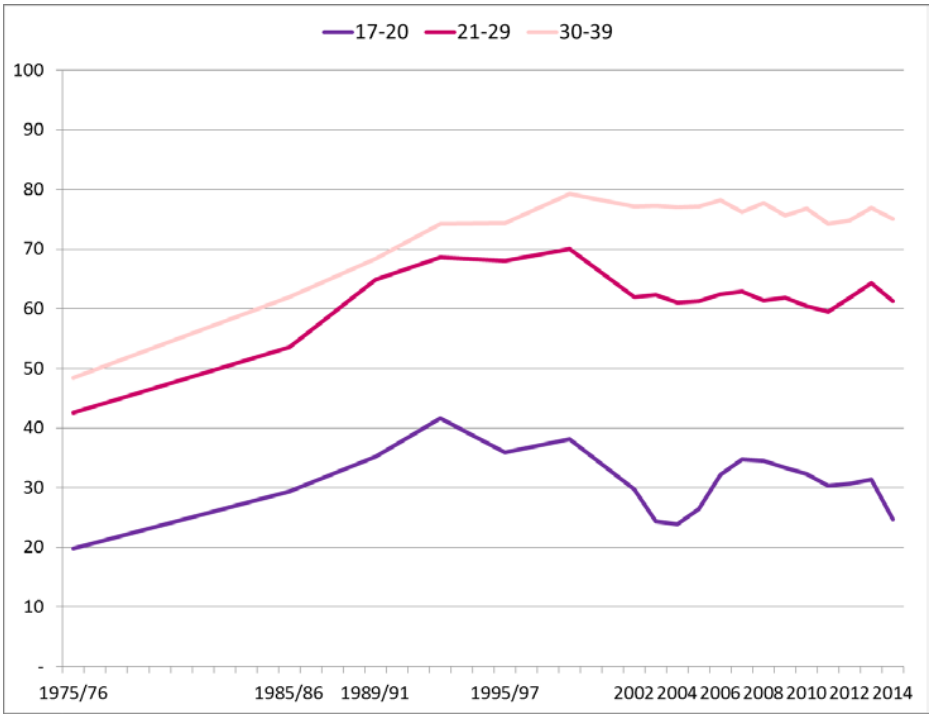
155. Driver licensing among young people is the lowest of the three age cohorts measured and peaked in 1992/94 with 55% of males and 41% of females between 17 to 20 year olds holding driver licences. The age cohort between 30 to 39 year olds have consistently recorded the highest levels of driver licencing over time with males peaking at 90% in 1992/93 and females peaking at 80% in 1988/99. In the last few years there is also evidence of a gradual decline in the number of people holding driver licences overall.

Figure S11: Percentage of Men with Driving Licence by Age Group in England 1975/76 to 2014[26]



[26] DfT, (2018). 'Young People's Travel – What's Changed and Why?' [online]. Available at: https://www.gov.uk/government/publications/young-peoples-travel-whats-changed-and-why [accessed 3 August 2018]

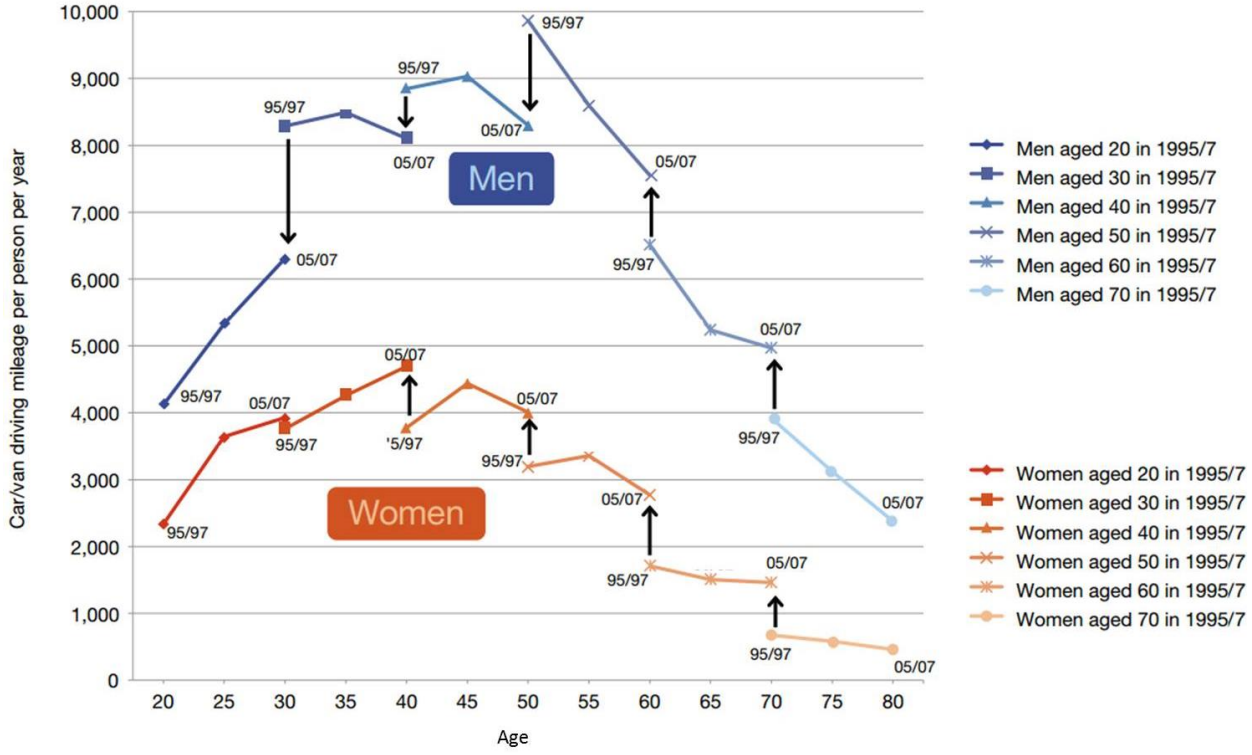
Figure S12: Percentage of Women with Driving Licence by Age Group in England 1975/76 to 2014[26]



156. Figure S13 indicates where driving levels increased or decreased within an age cohort by means of a vertical arrow in the direction of the trend. The evidence in the graph shows significant reductions of private vehicle mileage among younger male groups, but an increase in private vehicle mileage among females. There was a reduction in vehicle mileage among males aged 30, of almost 2000 miles annually. While women aged 30 saw a small increase, this represents a marked contrast to other female cohorts, that all saw much larger increases in private vehicle mileage, though from a much lower base.

157. Meanwhile, both men and women aged 60+ saw a significant increase in mileage per capita. In light of projected ageing population trends and an increase in economic activity among more elderly people, this presents a significant challenge. The decline in vehicle mileage has been partly attributed to national taxation changes in the late 1990s, reversing a system incentivising car travel for those with access to company cars.

Figure S13: Great Britain Car Driving Mileage, by Age Cohort Groups Over Time[27]

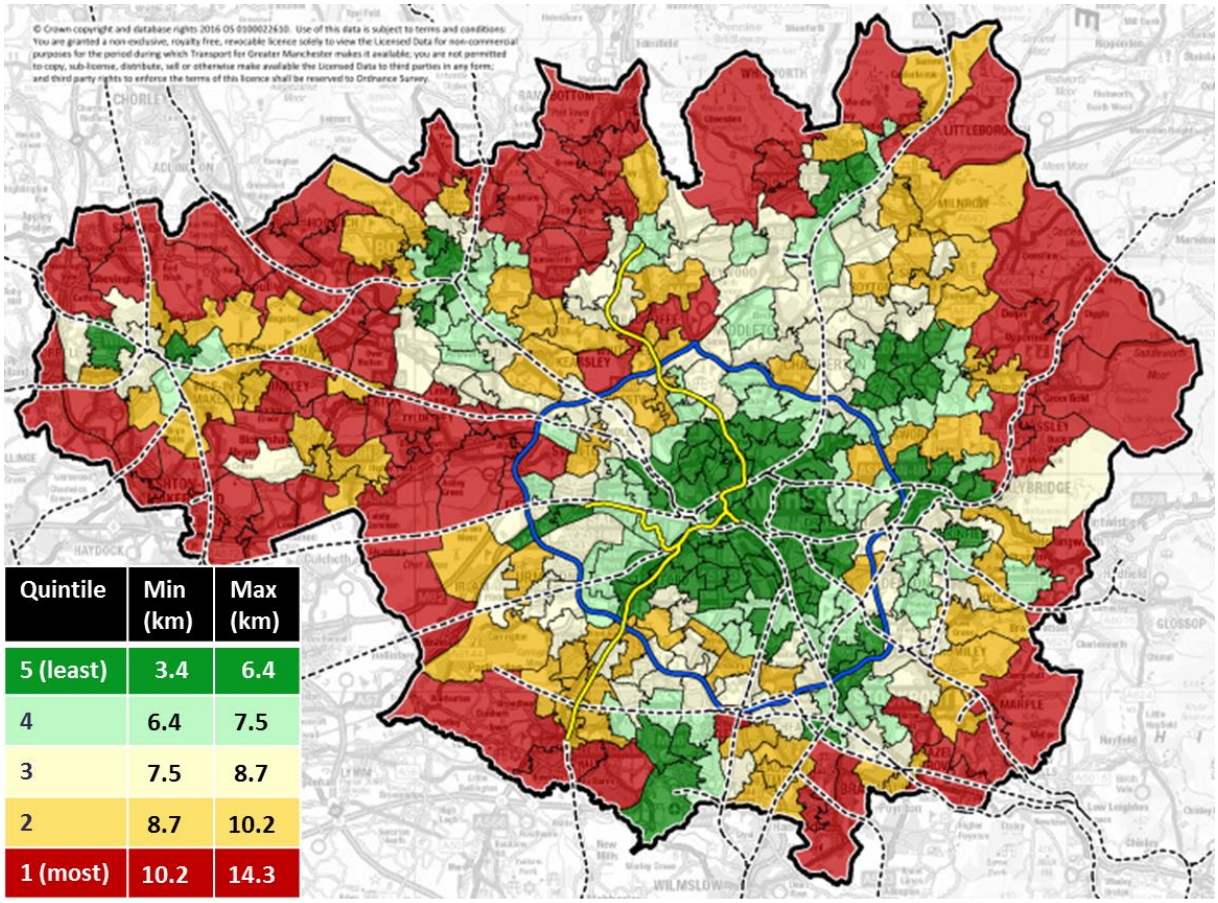


158. These general trends of national decreasing numbers of licence holders in young people and car driving mileage can be attributed to a number of factors including re-urbanisation of younger age groups, less disposable incomes combined with rising car costs as well as the later starting of families.

159. Within Greater Manchester, average distances travelled to work by car, per resident worker, are lower within the conurbation core within the M60, and within key town centres (Figure S14).

[27] Le Vine, S. & Jones, P. (2012). 'Making sense of car and train travel trends in Britain. RAC Foundation. "Car Driving Mileage, by Age Cohort Groups Over Time"' [online] Available at: https://www.racfoundation.org/wp-content/uploads/2017/11/on_the_move-le_vine__jones-dec2012.pdf [accessed 5 Mar. 2018]

Figure S14: Average Distance Travelled to Work (km) per Resident Worker, 2011[28]

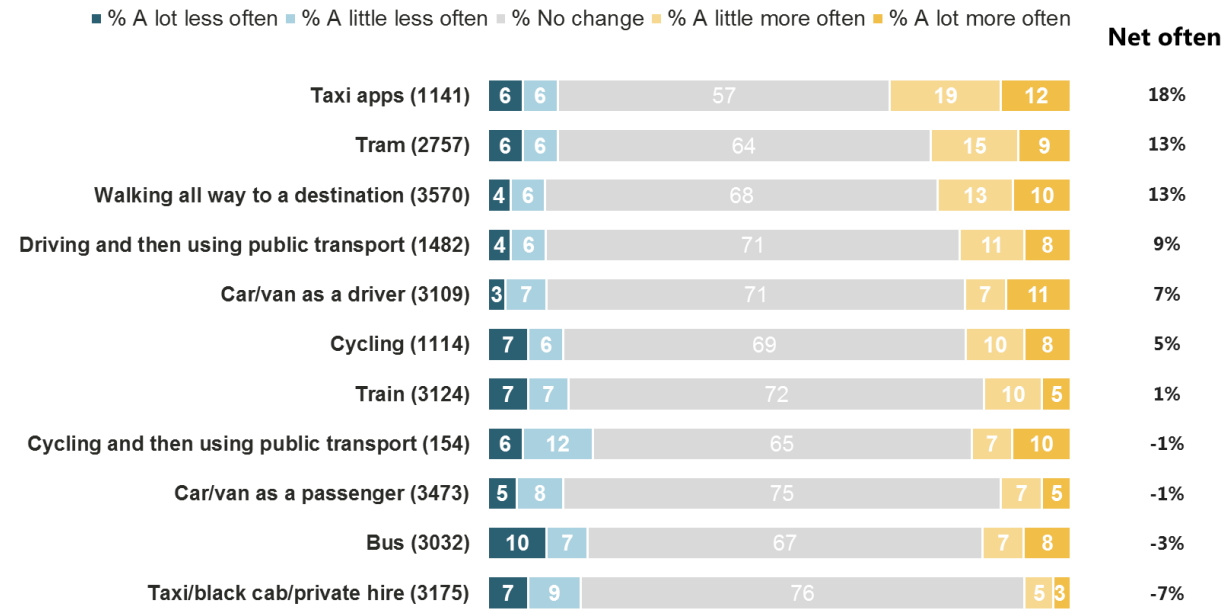


Quintile	Min (km)	Max (km)
5 (least)	3.4	6.4
4	6.4	7.5
3	7.5	8.7
2	8.7	10.2
1 (most)	10.2	14.3

160. Research into changing travel behaviours of Greater Manchester residents between 2016 and 2017, has found an increase in those using private hire taxi apps, while residents use of black cab taxis and other private hire vehicles has decreased (Figure S15).

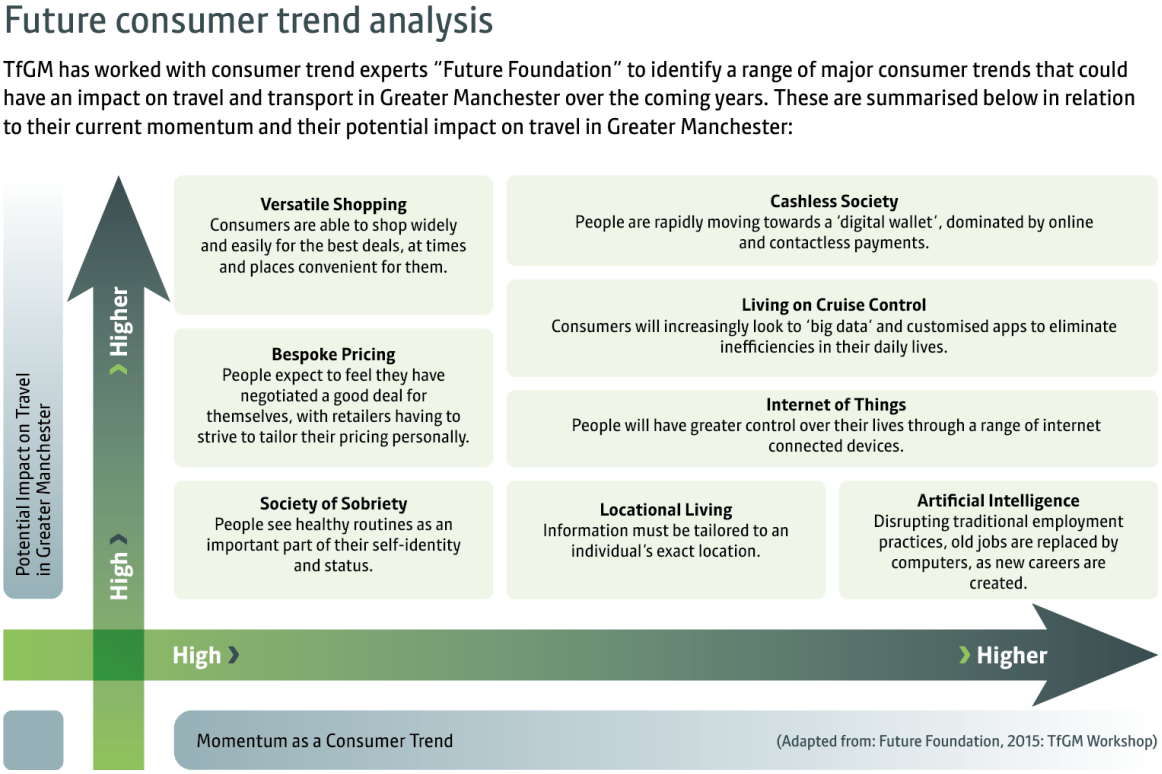
[28] NOMIS (2018) WU03EW - Location of usual residence and place of work by method of travel to work (MSOA level)

Figure S15: Respondent Reported Change in Frequency of Modal Use Within Greater Manchester (2016-2017), by Greater Manchester Residents[29]



161. Workshops held with Future Foundation helped summarise several key societal trends that could have a particular impact on transport in Greater Manchester's future (Figure S16).

Figure S16: Future Foundation Consumer Trend Analysis[30]



[29] TfGM Segmentation Survey (2017)

[30] Adapted from: Future Foundation, 2015: Future consumer trend map for Transport for Greater Manchester.

162. Within Greater Manchester, attitudes to travel show significant scope for increased uptake of cycling. Recent evidence indicates that 35 million trips were made by bike in Greater Manchester during 2016. 76% of residents in Greater Manchester would like to see more investment in cycling, and 73% agree that things would be better if people cycled more[31].

163. Recent research conducted by TfGM indicates that while 63% of people consider the opportunity to exercise an important factor when making travel decisions, this is of lowest priority when compared to other factors such as safety, reliability, flexibility and cost[32].

Implication for Greater Manchester

Travel attitudes and behaviours are changing in different ways across different social groups. Interventions on the transport network will need to be tailored appropriately in recognition of this.

[31] TfGM & Sustrans. (2017). 'Bike Life: Greater Manchester 2017' [online]. Available at: https://assets.contentful.com/nv7y93idf4jq/7v2reNiRWwSomuSAUuI4WE/34ce2682eb5af3532d8a3702279c9dfa/BikeLife17_GManchester_digital.compressed.pdf [accessed 6 Mar. 2018]

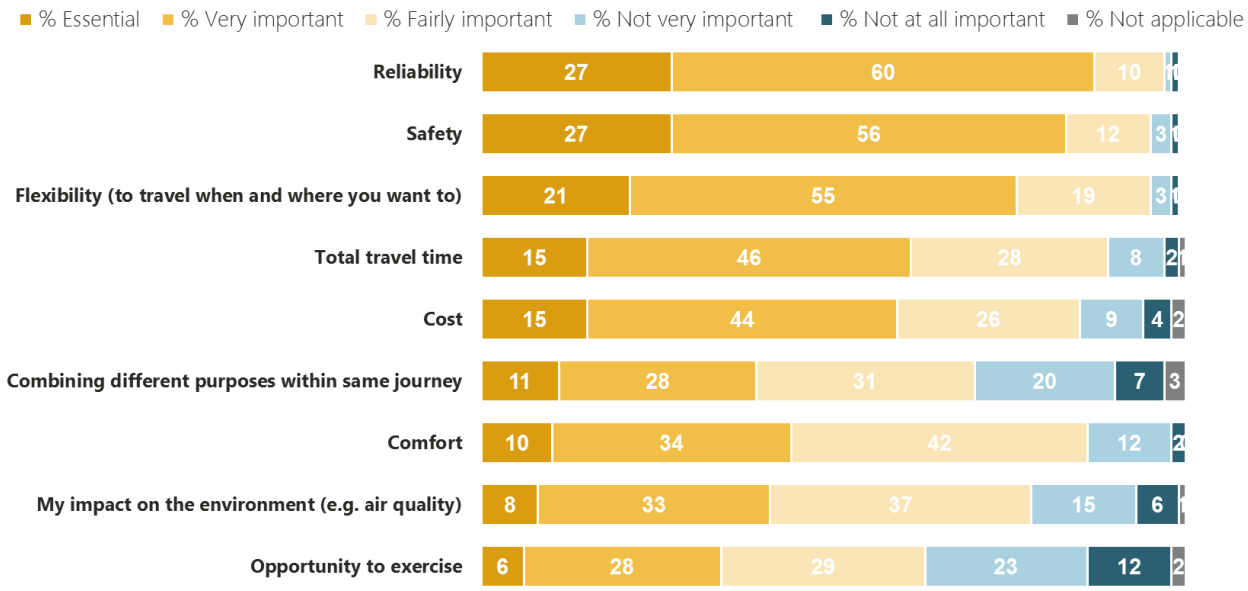
[32] TfGM Segmentation Survey (2017)

Safety and Security

164. Safety and security is a fundamental issue for transport. It is reflected in everything from crime and anti-social behaviour, to road safety issues limiting cycling uptake. Perceptions of safety and security can be just as important as actual safety and security in influencing people's travel behaviour.

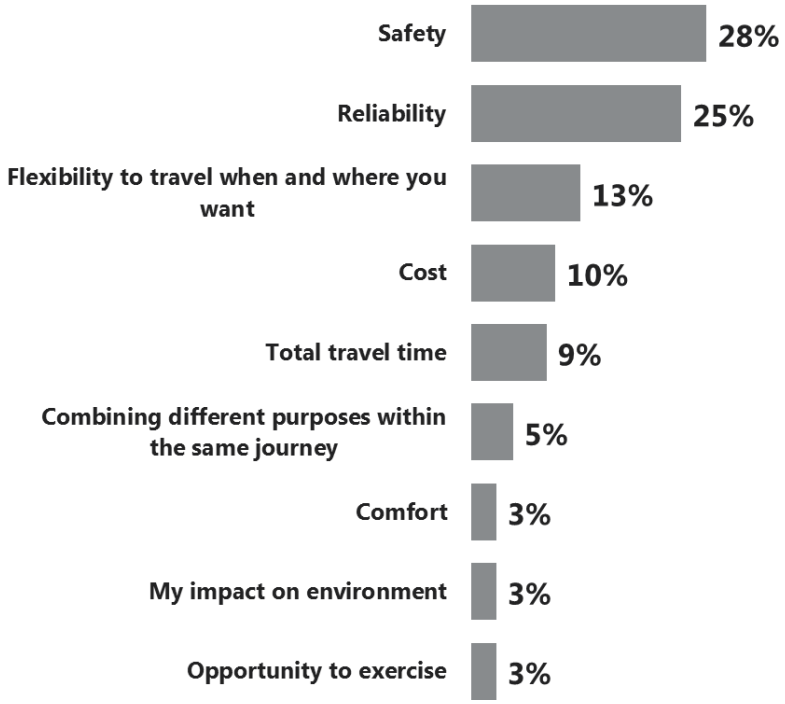
165. Recent research of Greater Manchester residents indicates reliability, safety and flexibility are by far the most important factors when making transport decisions. When respondents were asked to prioritise their list of factors considered essential, safety and reliability were the overwhelming drivers of transport decisions (below). This does however vary between groups. While young people are relatively less concerned about safety (8% of students felt it is unimportant), 30% of those with children/young people in the household see it as essential[33].

Figure S17: How important, if at all, are each of the following factors when you are making a decision about which means of transport to use for a journey?[33]



[33] TfGM Segmentation Survey (2017)

Figure S18: Respondent Reported "Essential" Considerations When Deciding How to Travel, Ranked by Importance. Greater Manchester Residents[33]



166. Reported transport crime and anti-social behaviour incidents are summarised below (Table S2). With the recent strengthening of the dedicated Travel Safe Unit, which has a remit including tackling crimes on the transport network that have previously gone unreported and unrecorded, there is an anticipation that recorded crimes may increase in the near future.

Table S2: Total Incidents of Reported Transport Crime and Anti-Social Behaviour in Greater Manchester[34]

2012	2013	2014	2015	2016	2017
6,139	6,920	6,033	6,909	6,907	7,148

[34] TfGM (2018) Incidents of crime and antisocial behaviour reported to TfGM by Operators, Bus station staff and British Transport Police.

167. Perceptions of security can be critical in determining travel habits. Studies conducted on the bus network in 2009-11 as part of the "Knife Enabled Crime Gateway Programme" revealed approximately a third of users avoided travelling at night due to concerns over crime and anti-social behaviour[35].

168. Research conducted in 2010 found that bus, rail and Metrolink users tended to perceive them as safer than non-users did, while perception of safety also significantly varies between hours of daylight or darkness. The proportion of residents who felt fairly safe, or very safe, for several public transport modes in daylight and darkness hours is shown in Table S3.

Table S3: Perceptions of Safety on Public Transport[36]

Proportions of residents (including users and non-users) who would feel fairly/very safe travelling on public transport		
Mode	**Daylight Hours**	**When It Is Dark**
Bus	94%	50%
Train	90%	49%
Metrolink	91%	47%

169. Customer satisfaction surveys conducted by Transport Focus have found that while the proportion who are satisfied with personal safety and security has had no significant change from 2015 to 2016, there has been an increase in satisfaction with personal security, on board bus services in 2016, recovering from a reduction in 2015 (Table S4).

Table S4: Customer Satisfaction with Safety and Security, 2016[37]

2016 Transport Focus satisfaction	Bus	Rail	Metrolink
Stop / station measures			
Personal safety at stop/security at station	77%	72%	85%
On-board measures			
Personal security	83%	75%	79%

[35] TfGM (2011) KEC Gateway Passenger Check Programme Evaluation
[36] MRUK for TfGM (2010) Multi-modal track survey. Greater Manchester Residents Survey: Overall Safety
[37] Transport Focus (2017) Comparisons between 2016: Tram Passenger Survey, Bus Passenger Survey, National Rail Passenger Survey.

170. It often remains difficult to disentangle perceptions of safety from actual levels. For example, despite positive attitudes to cycling, safety remains a concern for many. Whilst just under half (43%) of people think Greater Manchester is a good place to ride a bike overall, only 27% of Greater Manchester residents think cycling safety in Greater Manchester is good, and only 19% of people believe that safety for children riding a bike is good[38].

171. Research indicates that non-injury incidents, or "near misses", that traditionally go unreported, happen on a daily basis across the UK. These may have a substantial impact on cycling experience and uptake, and within the current recording system, are not given the same weight as collisions involving injuries. It has been recommended that more attention should be paid to under-recording of non-injury incidents, and communicating with risk-averse individuals in future[39].

Implication for Greater Manchester

There is a need to improve perceptions of personal safety and security when walking, cycling and using public transport to encourage greater uptake of those.

[38] TfGM & Sustrans. (2017). 'Bike Life: Greater Manchester 2017' [online]. Available at: https://assets.contentful.com/nv7y93idf4jq/7v2reNiRWwSomuSAUuI4WE/34ce2682eb5af3532d8a3702279c9dfa/BikeLife17_GManchester_digital.compressed.pdf [accessed 6 Mar. 2018]

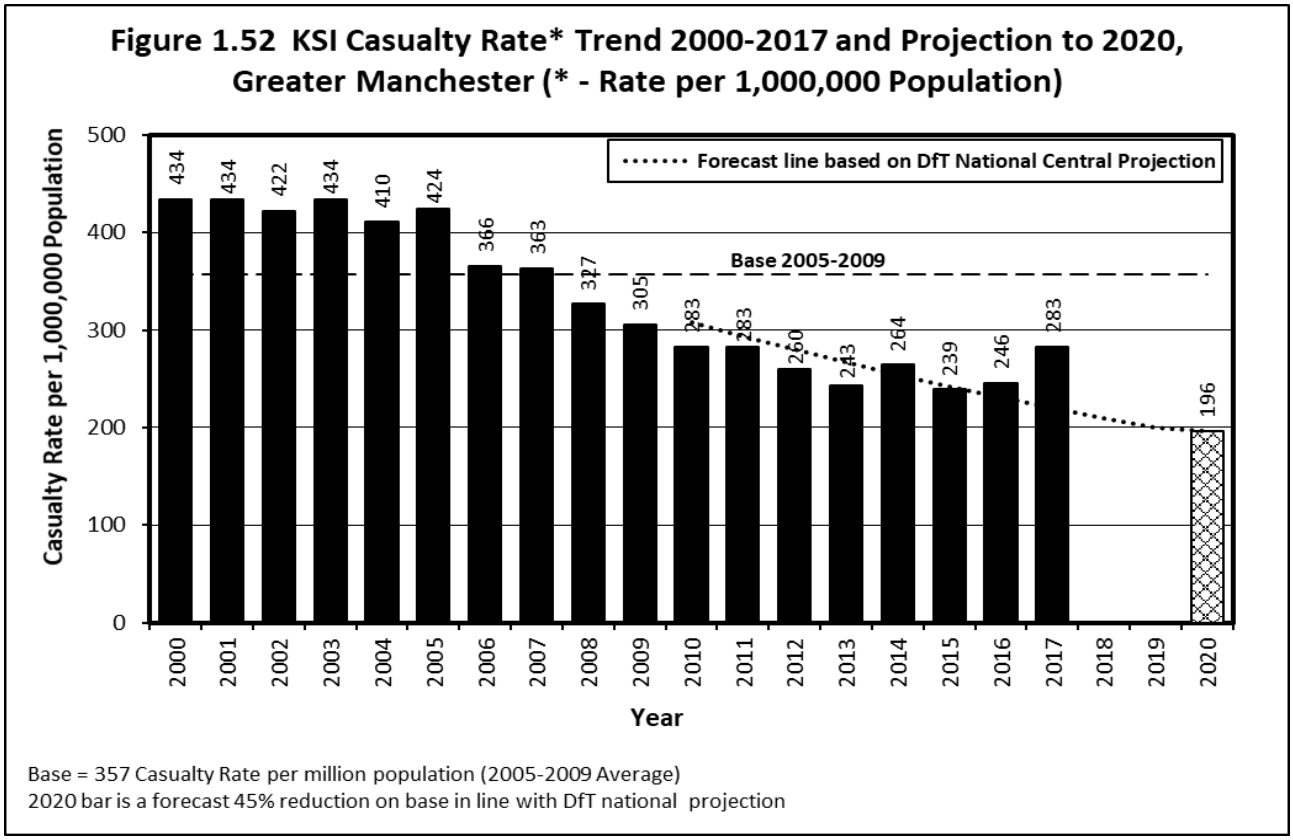
[39] Aldred, R. & Crosweller, S. (2015). Investigating the rates and impacts of near misses and related incidents among UK cyclists. *Journal of Transport and Health*, 2, pp. 379-393.

Road Casualties

172. During 2017, there were 4,066 reported injury collisions on the road network, resulting in 4,649 casualties. Both figures were significantly higher than the 2016 figures, at 39.9% and 41.9% respectively.

173. Greater Manchester has seen a significant reduction of people killed or seriously injured (KSI) on the transport network from 2000, as part of a long term effort to improve road safety (Figure S19). However, there has been an increase in the KSI casualty rate since 2015. Annual variations within this wider downward trend are attributed to some extent by a wider range of external factors, including seasonal weather, economic growth, and fuel prices. These are reflected by wider patterns nationally.

Figure S19: Casualty Trends in Greater Manchester[40]



[40] Transport for Greater Manchester, Highways Forecasting and Analytical Services (2018). Greater Manchester Reported Road Casualty Statistics 2017 District tabulations and comparisons data. Available from: http://www.gmtu.gov.uk/reports/default.htm [accessed 21 Jan. 2019]

174. Rates of KSI casualties vary considerably between districts. In 2017 there was an annual average of 28 KSI casualties per 100,000 head of population in Greater Manchester. Within Greater Manchester, Manchester had the highest KSI rate per head of population with 35, while Stockport had the lowest rate with 20[40].

175. Pedestrians, cyclists, motorcyclists, and young drivers make up a minority of overall road users, but represent a disproportionately high number of all KSI casualties. In 2017, pedestrians, cyclists and motorcyclists accounted for 17.8%, 11.2%, and 6.9% of all casualties respectively; but for KSI casualties, these numbers rise to 33.0%, 18.4% and 20.4% respectively. The proportion of KSI collisions involving drivers aged 29 or under has fallen gradually since the 1990s, to 27.4% in 2017[40].

Implication for Greater Manchester

Despite a trend of falling casualties in recent decades, there remains an ongoing issue in relation to vulnerable road users including children. There is therefore a continuing need to lower risk for vulnerable road users.

Urban Development

Urban Development: Summary of Trends and Implications

Increasing travel demand associated with GM growth and growth in neighbouring areas

- As reflected in Economy and Employment and Society and Community sections, the prospective high levels of economic growth and population growth within Greater Manchester and neighbouring areas will equate to a large increase in the overall demand for travel in Greater Manchester.
- The scale of growth will inevitably increase demand on existing transport infrastructure, although the location, density and design of new development will significantly affect the levels of impact. A significant mode shift will be needed to reduce highway congestion, requiring further investment in public transport and active travel, supported by travel demand management.

Regeneration

- There is a need to support the regeneration of GM's Key Centres. This will involve improving access by all modes, improving the environment for workers and visitors by reducing the dominance of the car and improving linkages across the centres for pedestrians and cyclists, including public realm enhancements and establishing clear, evidence-based local parking policies that support regeneration aspirations.

Urban Development

1. The ways in which new developments are delivered has a significant influence on travel behaviour and transport infrastructure requirements. Greater Manchester is anticipating high levels of economic growth by 2040 (see the section on Economy and Employment), along with continued population growth (see the section on Society and Community). This will inevitably increase demands on the transport network in terms of both managing increased volumes of trips and providing links to new locations.

2. The location and density of development and the quality of local facilities can greatly influence demands on the network. For example, locations which offer a range of attractive facilities can reduce the need to travel or to use the car for day to day journeys, while higher density developments are more walkable, can sustain a wider range of local facilities and services and can increase the likelihood of providing viable public transport.

3. This section describes:

    - How future growth in Greater Manchester will be planned for;
    - The levels of growth expected in the surrounding areas;
    - The role and future development of Greater Manchester's main town centres; and
    - The impact of new development on travel.

How future growth in Greater Manchester will be planned for

4. GMCA and the ten Greater Manchester local authorities have prepared a new Draft of the Greater Manchester Spatial Framework (GMSF). The GMSF is a joint plan for Greater Manchester that will provide the land for jobs and new homes across the city region. The framework, which has been produced by GMCA and all 10 councils working together in partnership, will ensure that the right land will be available in the right places to deliver the homes and jobs needed up to 2037. It will also identify the new infrastructure such as transport, schools, health centres and utility networks required to achieve this.

5. The Office for National Statistics (ONS) population figures and household projections created new assumptions for housing growth in October 2018 and a new formula was applied to these figures to produce estimates of housing need. However following a period of uncertainty, Government has now directed local authorities to continue to use the 2014 household projection figures whilst they develop and consult on, a new methodology for determining local housing needs.

6. More detail on the proposed levels of future growth in Greater Manchester is provided in the draft GMSF published for consultation in January 2019.

Neighbouring Authorities

7. Significant development is also being planned in neighbouring authorities. The following table summarises the key growth aspirations of neighbouring authorities and the implications for Greater Manchester.

Table U1: Key growth aspirations in neighbouring authorities[1]

Neigh-bouring authority	Key policy documents	Key findings
High Peak	High Peak Local Plan 2031	• Over the duration of the Local Plan period in 2031 it is estimated that 7,000 dwellings are required between 2011 and 2031 and a gross employment land requirement of 45.216ha. • Within the Glossopdale area High Peak Borough Council is expecting to account for between 958 and 1,242 new houses out of the total required during the Local Plan period. • Evidence from the High Peak Local Plan Transport Study indicates that future development within High Peak will further increase traffic on the A6, A57 and A628. • It is the intention of High Peak Borough Council to continue improving rail services to Manchester.
Cheshire East	Cheshire East Local Plan: Local Plan Strategy 2010-2030 Local Transport Plan: Final Strategy 2011-2026	• 36,000 homes will need to be built and a minimum of 380 hectares of land will need to be made available between 2010 and 2030. • The principal town of Macclesfield expected to accommodate 20 hectares of employment land and 4,250 homes. Other key service centres are also expected to accommodate development during the lifespan of the Local Plan period including: – Handforth – 22 hectares of employment land and 2,200 new homes. – Poynton – 10 hectares of employment land and 650 new homes. – Wilmslow – 10 hectares of employment land and 900 new homes. • A number of major highway schemes have been put forward, including the A6 to Manchester Airport Relief

[1] For sources see 'Key policy documents' column

Neigh-bouring authority	Key policy documents	Key findings
		Road and improvements to the A34 and A555 corridors in Handforth.
Warrington	Local Plan Core Strategy 2027	• Between 2006 and 2027 it is estimated that Warrington Borough requires 277 hectares of employment land to be developed. • The housing policies in Warrington's Local Plan have been challenged in the High Court, and this has resulted in the removal of elements of the housing policies, including the housing target of 10,500 new homes (equating to 500 per year) between 2006 and 2027. The council are working ensure the housing elements of the Plan are revised in line with the ruling. • Proposed improvements include the reduction of private car use in the borough, improving integration of existing public transport infrastructure as well as more specific improvements such as a new/replacement high-level crossing of the Manchester Ship Canal.
St Helens	Local Plan Core Strategy 2027	• The Local Plan has chosen to focus the majority of development on St Helens itself as well as the Newton-le-Willows and Earlestown area. In St Helens 20,000sqm of retail floorspace is planned to be developed and there are plans for a Strategic Rail Freight Interchange at Parkside near Newton-le-Willows. • The attractiveness of St Helens Borough to businesses and residential developers is closely linked with its transport connections to major urban centres like Manchester, Liverpool and Warrington via national and regional roads (M6, M62 and A580), rail (West Coast Mainline) and airports (Manchester and Liverpool). Improving the accessibility of St Helens Borough via these and other transport links is therefore considered essential to meeting objectives of the Local Plan.
Rossendale	From East to West Making Rossendale the Best: Core Strategy Development Plan 2026	• Over the duration of the Local Plan period in 2026 it is estimated that 3,700 dwellings are required, equating to 247 dwellings per year, and a gross employment land requirement of 45.216ha. • It is the intention of Rossendale Borough Council to focus residential development within urban boundaries of the main settlements across the borough whilst economic development will be distributed amongst the largest urban centres of the borough including Rawtenstall and Haslingden.

Neigh-bouring authority	Key policy documents	Key findings
		• To continue to improve the strategic transport links between Rossendale Borough, wider Lancashire and Greater Manchester ideas have been put forward for improvements to be made to the key A56/M66 road links, as well as a Rawtenstall-Manchester Railway link.
Lancashire	Lancashire LEP Strategic Economic Plan: A Growth Deal for the *Arc of Prosperity*	• In the Strategic Economic Plan produced by the Lancashire LEP several targets have been set in terms of development including the creation of 50,000 new jobs, 40,000 new homes and £3 billion additional economic activity. • The Strategic Economic Plan does outline several areas that will be a focus for future development, some of which are located close to Greater Manchester. It is estimated that East Lancashire has the potential to generate almost 10,000 jobs and over £500m in GVA. Skelmersdale is another area that is identified as a spatial priority with over 2,000 new homes built as well as 52ha of employment land to be developed. • Key transport issues include congestion during peak periods on the A56/M66 route and the M60/M62 in East Lancashire impacting commuters travelling to and from Greater Manchester, as well as the inadequate provision of rail services to Greater Manchester.
West Yorkshire	Leeds City Region Strategic Economic Plan 2016-2036 West Yorkshire Transport Strategy 2040	• The West Yorkshire Strategic Economic Plan sets out overall delivery targets of upwards of 35,000 additional jobs and an additional £3.7 billion annual economic output by 2036. A target was also set for residential development with a headline initiative to build between 10,000 and 13,000 new homes per year between 2016 and 2036. • The major cities of Halifax, Huddersfield, Bradford and Leeds are considered key urban growth centres whilst the North Kirklees Growth Zone has been identified as a key housing growth area. The focus of future economic growth will be centred mainly on the major road corridors passing through the region such as the M62 Corridor that has the Clifton Business Park (Calderdale), Lindley Moor East, Lindley Moor West and Moor Park Mirfield (Kirklees) located along its length. • Efficient motorways, High Speed Rail, fast East-West rail connections through Northern Powerhouse Rail across the north of England as well as better access to international

Neigh-bouring authority	Key policy documents	Key findings
		gateways are all part of the new West Yorkshire Transport Strategy 2040. • For the Calderdale and Kirklees districts bordering Greater Manchester improving transport links between these two regions is essential to supporting future growth in these areas. In Calderdale improvements are required to rectify congestion hotspots such as Junction 25 on the M62 as well as the electrification of the Calder Valley Line is also a key strategic transport priority whilst in Kirklees congestion alleviation is also a major issue on key routes such as the A616, A636 and A637.

Implications for Greater Manchester

As reflected in Economy and Employment and Society and Community sections, the prospective high levels of economic growth and new housing delivery within Greater Manchester and neighbouring areas will equate to a large increase in the overall volume of trips on the transport network. Furthermore, the location, density and design of that development will significantly affect the levels of traffic impact.

Town Centres

8. Greater Manchester's eight main town centres (Altrincham, Ashton-under-Lyne, Bolton, Bury, Oldham, Rochdale, Stockport and Wigan) are significant employment centres, providing 10% of GM jobs[2]. They provide a critical mass of facilities and services and are the hubs of local public transport networks, making them highly sustainable development locations from a transport perspective. Significant investment has been made, or is planned, in improved public transport infrastructure and services.

9. The significant effort to regenerate and revitalise Greater Manchester's town centres follows a 2010 study by the Business Leadership Council, which concluded that they were making a diminishing contribution to the Greater Manchester economy due to a number of factors, such as[3]:

   - Competition from out-of-town, office/retail/leisure;
   - The increasing prominence of the Regional Centre;
   - A decline in the quality of the retail offer;
   - A decline in the attraction of town centres for office/commercial employment and for leisure activity;
   - Increasing dependence on the public sector for investment; and
   - Reduced ability to compete for mobile investment.

10. A further study of the eight town centres, based on private sector expertise in retail analysis showed that they are very different in terms of the scale of their offer and recent trends. Table U2 illustrates some of these differences in terms of:

   - Catchment area: the primary catchment area is the area from which a town centre draws very high market shares (i.e. 50% of its fashion/clothing spend);
   - Retained market share: the proportion of spending from the catchment area retained by a centre (based on fashion/clothing spend);
   - Retail offer and scale: the *venuescore* figure rates towns and shopping centres in terms of the presence of leading multiple retailers; and
   - National rank: town and shopping centres are also ranked nationally (and within the region) in terms of their retail offer, showing how they change in relation to each other over time.

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[2] Greater Manchester Combined Authority and New Economy, (2016). 'Deep Dives: Phase 1 Summary Report' [online]. Available at: http://www.neweconomymanchester.com/publications/deep-dive-research [accessed 20 Mar. 2018]

[3] Business Leadership Council, (2010). 'Town Centre Study 2010' [online]. Available at: *https://www.greatermanchester-ca.gov.uk/.../greater_manchester_town_centre_review* [accessed 20 Mar. 2018]

Table U2: Traditional town centre indicators for retail (2010)[4]

Source: Javelin Group	Altrincham	Ashton	Bolton	Bury	Oldham	Rochdale	Stockport	Wigan
Primary catchment size	109,000	136,000	175,000	176,000	179,000	90,000	280,000	120,000
Retained market share	28%	20%	46%	36%	26%	27%	29%	59%
Venuescore (presence of multiples)	110	129	212	174	149	124	166	176
UK / NW Rank* (1 = highest)	227 / 24	183 / 20	66 / 5	108 / 11	147 / 17	203 / 23	118 / 18	104 / 10

*red moved down; green moved up, amber stable (average over last 10 years)

11. Bolton, Bury and Wigan had the largest town centre based retail offer within GM. They had also remained largely dominant within their primary catchment areas in previous years, maintaining a status as the main shopping destination for households who live close by. Bolton and Bury (along with Oldham) had also improved their position on the national retail ranking, whereas Wigan had remained stable in its position as the 104th retail centre in the country.

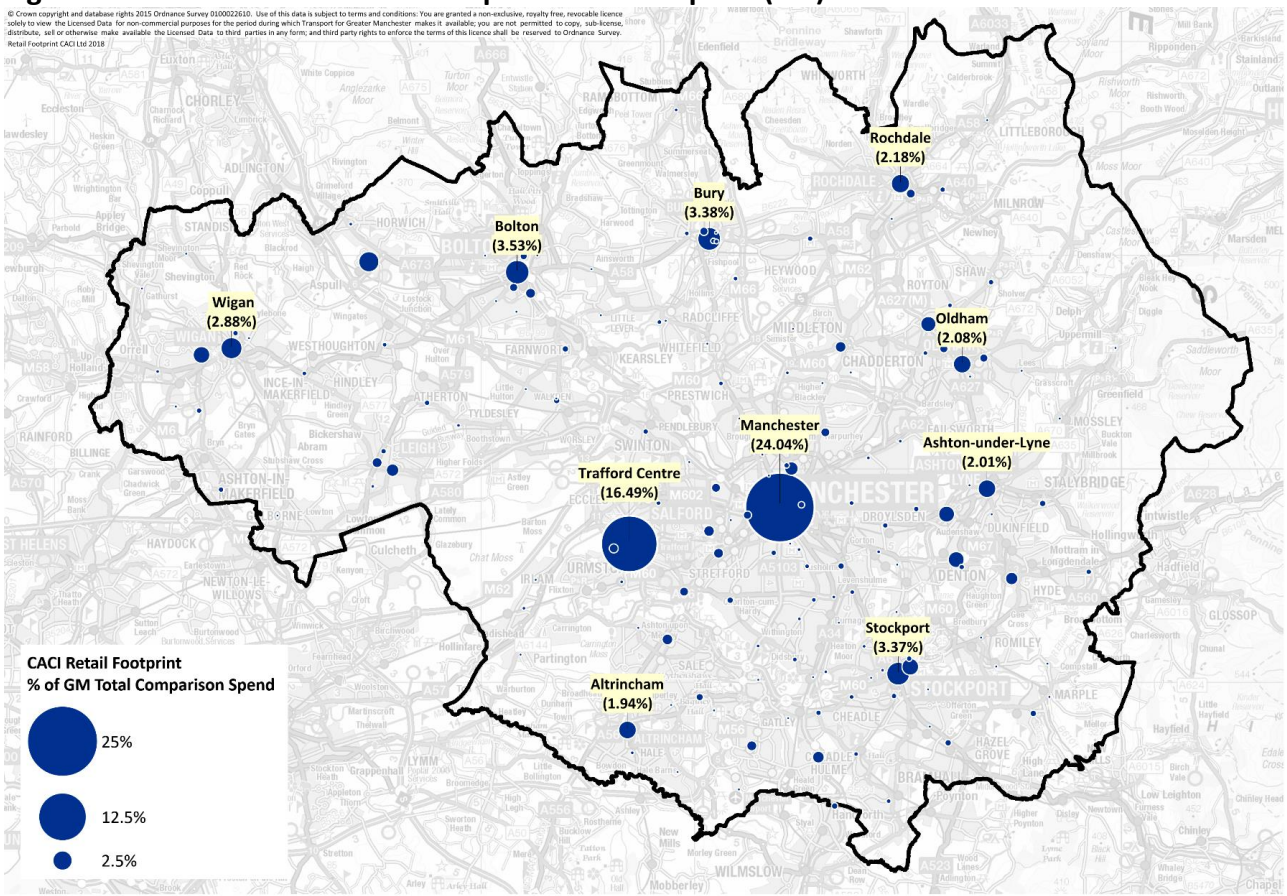
12. The smaller retail centres of Altrincham, Ashton and Rochdale were less dominant within their immediate catchment area and, although Ashton had remained stable on the national rank of retail centres, Altrincham and Rochdale (along with Stockport) had moved down the retail hierarchy in the previous ten years. For all eight GM town centres, it is the Trafford Centre and regional centre which account for most of the spend leaking from their primary catchment area. This is a well identified trend, as more affluent residents are likely to be drawn to these locations and presents a particular challenges for smaller centres with a more limited retail offer.

13. The study found that town centres were facing a fundamental challenge due to changes in retail sector (particularly the growth of e-commerce, which accounted for nearly half of all retail sales between 2003 and 2010). Nationally the expectation is that there will be 30% fewer chain stores by 2020 and 20% less retail floorspace on the high street[3].

[4]Greater Manchester Combined Authority, (2013). 'Greater Manchester Town Centres Review' [online]. Available at: https://www.greatermanchester-ca.gov.uk/downloads/file/16/gm_town_centre_review [accessed 20 Mar. 2018]

14. Figure U1 shows the distribution of total comparison retail spend across Greater Manchester. This clearly demonstrates the importance of the City Centre and Key Centres as retail destinations. It also shows the high proportion of comparison retail spend that is associated with out of town retail parks, and in particular the Trafford Centre.

Figure U1: Distribution of Total Comparison Retail Spend (£m) across Greater Manchester[5]



15. Recommendations from the GM Town Centres Review (2013) are currently being implemented. Recommendations for transport improvements varied between centres, but common themes were[4]:

- a need to improve the quality of waiting facilities, including the desire to relocate or redevelop interchanges to free up development sites or to better integrate the transport offer;
- a need to improve internal connectivity - improving movement in and around centres (including from public transport stations and stops) for pedestrians and cyclists; and
- a need for reliable evidence on the impact and importance of free parking/reduced fees and any benefits to town centre businesses.

16. High quality and attractive environments were identified as playing a fundamental role in increasing dwell time and raising footfall, helping to grow turnover for neighbouring

[5] Retail Footprint 2017, CACI

businesses and therefore raising property values, which leads to new business investment. The report concluded that public realm is increasingly important as a form of infrastructure, connecting businesses to their customers and town centres to their wider hinterlands, improving business confidence and turnover as well as stimulating further investment. Examples of where this approach will be important were identified as follows:

- Oldham and Rochdale, where investment in public realm will help to connect passengers using the new Metrolink service to town centre shops, restaurants, cafes, etc.;
- Wigan, where public realm improvements across a busy road will be an important part of measures to attract students and young people in the Innovation Zone to town centre shopping areas;
- Ashton and Bury, where public realm investment around successful markets is required to encourage new customers and increase flows between the markets and the rest of the centre; and
- Altrincham, where a public space and movement strategy is predicated on the need to increase access to the core of the town centre.

17. Many of these improvements are now being implemented.

18. A further report examined the role of car parking policy within the centres[6]. In Greater Manchester, local authorities are currently responsible for both setting their own parking policy and collecting car parking revenue. The report concluded that the link between town centre prosperity and car parking is weak, due to lack of clear evidence. However a practical and efficient approach to car parking can help generate more footfall. Town centre car parking can be influenced in four broad areas by the local authorities: setting the correct tariff (for local authority owned car parks), offering limited free parking, having fair parking enforcement and improving the overall car parking experience, for example through the use of technology.

19. The approach to car parking in the principal GM town centres is broadly similar with the differences in pricing reflecting the needs and demands of individual town centres. The majority of the eight town centres have parking offers and limited free parking but the use of new technology such as the ability to pay for a space via a mobile app is not widespread[6].

20. A lack of evaluation of existing parking policy and possible free parking trials means that it is difficult to show what works best. Few examples exist but in Swindon, a reduced tariff was assessed to have increased the length of time people stayed in the town centre and in Middlesbrough a free car parking element led to a doubling of use of the parking spaces.

[6] New Economy, (2014). 'Car Parking in Town Centres'. [online]. Available at: http://www.neweconomymanchester.com/media/1023/town_centre_car_parking_2014.pdf [accessed 20 Mar. 2018]

More locally, Bolton and Oldham's free parking offers have produced positive feedback from retailers in their evaluation of the schemes that have taken place[6].

21. Overall, a clear and evidence based car parking strategy designed around the needs of local business and with an understanding of the existing car parking occupancy can attract visitors back to town centres and boost the overall town centre vitality.

22. The Mayor's Town Centre Challenge[7] will provide a mechanism for promoting regeneration and investment in town centres and will develop specific recommendations for each of the nominated centres. In November 2017, Stockport became the first to submit a nomination. The plans, setting out how the council proposes to build on the £1 billion transformation that is already helping the town to fulfil its potential, include a new multi-million pound transport hub, redevelopment of the town's retail heart and innovative new town centre living. Since then, Bolton, Wigan, Bury, Tameside, Trafford and Salford councils have submitted their proposed locations for the Challenge: Farnworth, Leigh, Prestwich, Stalybridge, Stretford and Swinton respectively[8].

Implications for Greater Manchester

There is a need to support the regeneration of GM's Key Centres. This will involve improving access by all modes, improving the environment for workers and visitors by reducing the dominance of the car and improving linkages across the centres for pedestrians and cyclists, including public realm enhancements and supporting clear, evidence-based approaches to parking that support regeneration aspirations.

[7] GMCA, (2017). 'A new initiative to regenerate town centres across Greater Manchester has been launched' [online]. Available at https://www.greatermanchester-ca.gov.uk/news/article/227/new_drive_to_regenerate_town_centres_across_greater_manchester [accessed 20 March 2018]

[8] GMCA, (2017). 'Bold plans to regenerate out town centres across Greater Manchester have taken a major step forward' [online]. Available at https://www.greatermanchester-ca.gov.uk/news/article/265/mayor_s_town_centre_challenge_marks_major_milestone_as_new_locations_revealed [accessed 20 March 2018]

Impact of New Development on Travel

24. The impact that new development will have on the transport network will depend on the number and length of additional trips being generated and extent to which these are being made by car, or by sustainable modes. A greater proportion of trips made by public transport, walking or cycling will reduce the demand placed on the highway network.

25. There is evidence that travel distances and mode share can be affected through strategic planning. This is summarised in research for the Commission for Integrated Transport[9]. This concluded that density has an influence on travel behaviour, even when other urban structure variables, socio-economic and attitudes are accounted for. The main association appears to be with travel distance - at lower densities, travel distances tend to be longer. Car mode share also tends to be higher, but there is often less significance to the relationship. Trip rates remain similar across density ranges.

26. Analysis of National Travel Survey data showed that[9]:

- areas with higher densities tend to have shorter annual travel distances, particularly by car, and lower car mode shares than average;
- there is a broadly inverse relationship between settlement size and average distance travelled – metropolitan areas, large urban areas and settlements larger than 25,000 population tend to have shorter annual average travel distances; and
- there is broadly an inverse relationship between distances travelled by car driver and accessibility of key services.

27. Urban form affects the ability to provide a public transport alternative to the car and the extent to which people will use it. Minimum densities for viable public transport depend on the type of public transport, the local urban and cultural context, and the availability of alternative modes. Everything else being equal, higher densities support higher frequency and specification in services and help to justify dedicated rights-of-way.

28. A report by the Urban Task Force suggests that the lower the density of development, the more people are beyond walking distance of facilities[10]. This promotes car use and makes it hard to justify a bus route. In a new settlement of 7,500 houses, a bus route only begins to

[9] Halcrow Group Ltd et al for CfIT (2009). 'Land Use and Transport: Settlement Patterns and the Demand for Travel' [online]. Available at: http://scholar.google.co.uk/scholar_url?url=http%3A%2F%2Fciteseerx.ist.psu.edu%2Fviewdoc%2Fdownload%3Fdoi%3D10.1.1.890.5596%26rep%3Drep1%26type%3Dpdf&hl=en&sa=T&oi=ggp&ct=res&cd=0&d=6171704095280630110&ei=Rz-_W_-DN9OzmAG_263IAw&scisig=AAGBfm1OCVePV6CvRXav9P-mj1TjUjzTfg&nossl=1&ws=1366x673 [accessed 20 Mar. 2018]

[10] Rogers, R. (1999). *The Urban Task Force*. London: E&FN Spon.

become viable at densities of 40-60 dw/ha. Fixed track public transport, like Metrolink or Guided Bus, require far higher population catchments.

Implications for Greater Manchester

The design of new development will affect the likelihood of viable public transport links being provided and will determine the type of public transport that can be supported.

Environment and Resources

Environment and Resources: Summary of Trends and Implications

Climate Change

- Future levels of growth in Greater Manchester are likely to result in an increased demand for travel. The 2040 Transport Strategy needs to contribute to climate change reduction by cutting carbon emissions from transport: mode shift and measures to encourage the faster uptake of low emission vehicles will be required.
- There is a need to embed flood resilience measures where feasible to minimise flood risk and damage from soil shrinkage.

Air Quality

- NO_2 and PM_{10} emissions from vehicles must be reduced because of the health impacts.
- To improve air quality, measures will be most effective if targeted at problem areas e.g. the largest urban centres and towards the vehicles that contribute most to the problem.

Vehicle Technology

- Developments in vehicle technology will contribute towards the reduction of transport related pollution in Greater Manchester.

Noise

- There is a need to ensure that opportunities are taken to reduce traffic noise where feasible, e.g. through choice of surfacing materials and encouraging take-up of quieter Ultra-Low Emission Vehicles (ULEVs).

Biodiversity

- Individual schemes need to be designed to minimise any negative impacts and, where possible, enhance any positive impacts on biodiversity.

Water Quality

- To improve water quality in line with the EU water framework directive, measures should be introduced, where possible, to reduce or diffuse pollution from transport.

Environment and Resources

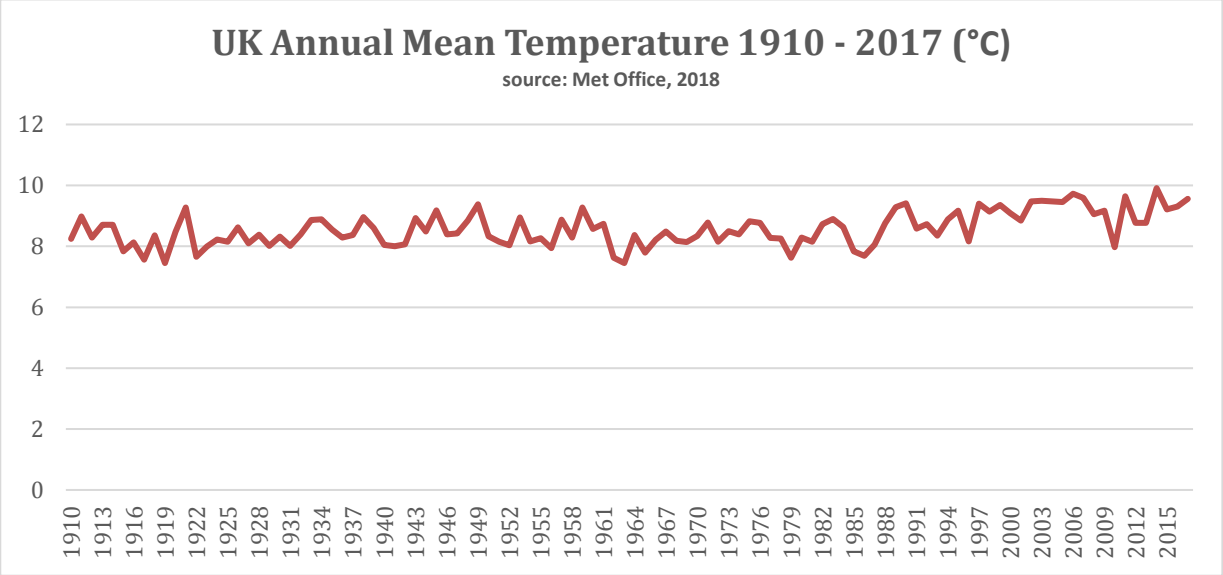
1. Transport has a significant impact on the environment, either through the physical presence of its infrastructure, or through the emissions from vehicles. Significant economic and population growth in Greater Manchester (described in the Economy and Employment and Society and Community sections) is likely to result in a greater demand for travel and therefore potentially more severe environmental impacts. This section covers:

    - Climate Change;
    - Air Quality;
    - Vehicle Technology;
    - Noise;
    - Biodiversity; and
    - Water Quality.

Climate Change

3. The predicted impact of climate change is well understood: north-west England can expect to experience warmer, drier summers impacting on water supply and soil shrinkage/subsidence, and warmer, wetter winters with increased flood risk from rivers and surface runoff[1]. Historical data collated by the Met Office has shown a visible increasing trend of average temperature in the UK, with the warmest year since 1910 being 2014 with a mean temperature of 9.91˚C[2].

Figure EN1: UK Annual Mean Temperature 1910-2017 (˚C)[2]



4. More extreme weather patterns are likely, with more intense rainstorms, heatwaves and droughts. In addition climate change will impact on the behaviour and distribution of species.

5. The UK Climate Change Risk Assessment 2017: Evidence Base highlighted flooding as a key risk, with specific reference made to the consequences for transport infrastructure;

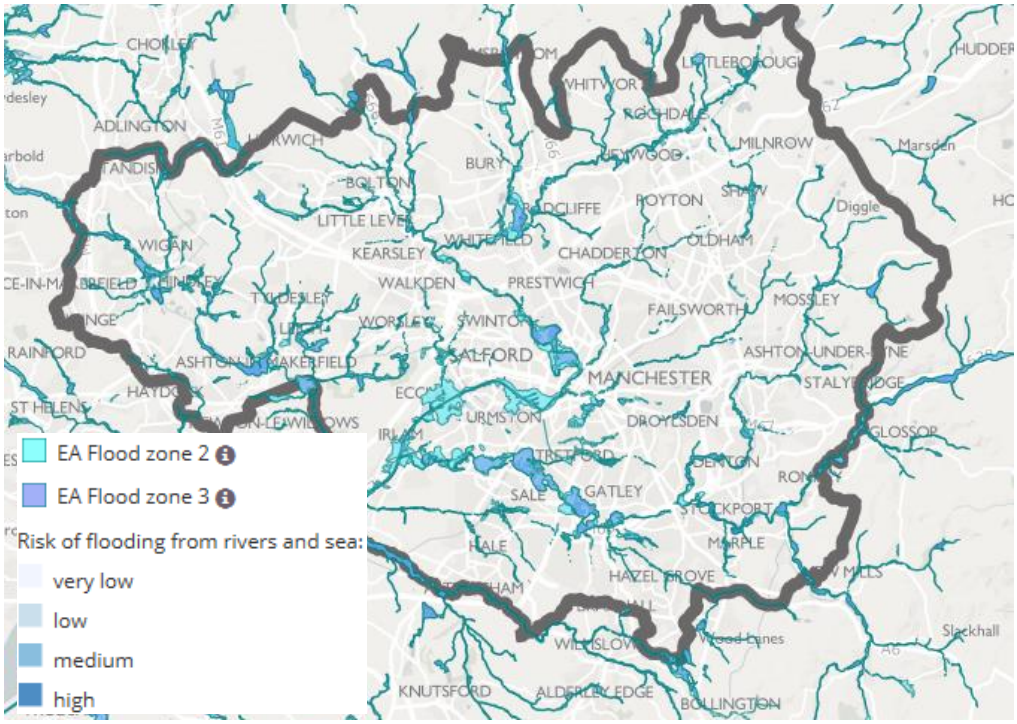
[1] Cavan, G., (2011). 'Climate change projections for Greater Manchester' [online]. Available at: http://www.adaptingmanchester.co.uk/documents/climate-change-projections-greater-manchester-version-2 [accessed 16 Feb. 2018]
[2] Met Office, (2018). 'UK Mean Temperature' [online]. Available at: https://www.metoffice.gov.uk/pub/data/weather/uk/climate/datasets/Tmean/date/UK.txt [accessed 7 Feb. 2018]

"Increased frequency of flooding from all sources is the most significant climate change risk to UK infrastructure, including energy, transport, water, waste and digital communications. Assets and networks across all infrastructure sectors are already exposed to multiple sources of flooding, and the number of assets exposed could double under expected changes in climate by the 2080s."[3]

6. With the risk of flooding increasing with climate change, compounded by factors including growing transport demand and development pressure, key elements of Greater Manchester's transport network will be placed at greater threat of malfunction or damage[3].

7. Figure EN2 provides a map of the risk of flooding from rivers in Greater Manchester.

Figure EN2: Risk of Flooding from Rivers[4]



8. Flood risk can be reduced not only through the introduction of adaptation measures, but also through proactive risk mitigation through transport infrastructure design and improved management of blue-green infrastructure (the interface between water management infrastructure and green infrastructure).

[3] The Committee on Climate Change, (2017). 'UK Climate Change Risk Assessment 2017: Evidence Report' [online]. Available at https://www.theccc.org.uk/tackling-climate-change/preparing-for-climate-change/uk-climate-change-risk-assessment-2017/ccra-chapters/infrastructure/ [accessed at 7 Feb. 2018]

[4] GMCA (2018), 'Mapping GM' [online]. Available at: https://mappinggm.org.uk/gmodin/?lyrs=ea_floodzone2,ea_floodzone3,ea_rofrs_gm#os_maps_light/10/53.5069/-2.3201 [accessed 9 Feb. 2018]

9. Tackling climate change makes economic as well as environmental sense. The OECD estimate that climate change can reduce global annual GDP by between 1.0% and 3.3% by 2060 in the absence of further intervention[5]. In the UK, the North of England's economy is more carbon intensive than the UK average. Decarbonisation therefore has the potential to negatively impact the North of England more significantly than the rest of the country[6]. This would mean Greater Manchester falling short of its economic and regeneration goals.

10. In 2012, the Low Carbon Environmental Good and Services (LCEGS) sector in Greater Manchester was the third largest in the UK. LCEGS is an umbrella term for capturing disparate low carbon, environmental and renewable energy activities spread across many existing sectors such as transport, construction and energy. The LCEGS sector in 2012 employed over 37,000 people across Greater Manchester with £5.4 billion of sales and 4% year on year growth across the environmental, renewable energy and low carbon sectors[7].

11. In line with international frameworks and targets including the UNFCC Kyoto Protocol, the EU (together with Iceland) has committed to reduce carbon emissions by 20% (relative to 1990) by 2020. The EU is currently on track to achieve these targets[8]. At the national level, the UK's Climate Change Act 2008 includes the obligation to reduce national greenhouse gas emissions by 80% relative to 1990 by 2050[9]. The protocol agreements will run until 2020 and discussions on a new agreement were held in 2015. This resulted in the Paris agreement that became ratified and legally binding on the 4th November 2016.

[5] OECD, (2015). 'The Economic Consequences of Climate Change' [online]. Available at: http://dx.doi.org/10.1787/9789264235410-en [accessed 9 Feb. 2018]
[6] Institute for Public Policy Research North, (2017). 'Net-Zero North: Delivering the decarbonisation mission in the North of England' [online]. Available at: https://www.ippr.org/files/2017-12/net-zero-north-report-1712.pdf [accessed 9 Feb. 2018]
[7] Environmental Sustainability Technical Assistance, (2012). 'The economic potential of the low carbon and environmental goods and services (LCEGS) sector – Greater Manchester' [online]. Available at: http://enworks.com/ESTA-project-outcomes [accessed 9 Feb. 2018]
[8] European Commission. 'Kyoto 2nd commitment period (2013-2020)' [online]. Available at: https://ec.europa.eu/clima/policies/strategies/progress/kyoto_2_en [accessed 15 Jan. 2018]
[9] UK Government, (2018), 'Climate Change Act 2008' [online]. Available at: https://www.legislation.gov.uk/ukpga/2008/27/section/1 [accessed 15 Jan. 2018]

12. The Paris agreement seeks to strengthen the global response to the threat of climate change by keeping a global temperature rise this century well below 2 degrees Celsius and to pursue efforts to limit the temperature increase even further to 1.5 degrees Celsius. Additionally, the agreement aims to strengthen the ability of countries to deal with the impacts of climate change. To reach these ambitious goals, appropriate financial flows, a new technology framework and an enhanced capacity building framework will be put in place, thus supporting action by developing countries and the most vulnerable countries, in line with their own national objectives. The Agreement also provides for enhanced transparency of action and support through a more robust transparency framework[10]. Responding to this, Greater Manchester has an ambitious target to reduce carbon emissions by 48% by 2020 compared to 1990[11].

13. To meet these targets outlined by the Paris Agreement, the government has set five-yearly carbon budgets which currently run until 2032. They restrict the amount of greenhouse gas the UK can legally emit in a five year period. The UK has transitioned into the third carbon budget period (2018 – 2022), which aims to save 2,544 $MtCO_2e$[12] over the period reducing annual emissions to 37% below 1990 levels. UK emissions were 42% below 1990 levels in 2016. The first carbon budget (2008 to 2012) was met and the UK is currently on track to outperform on the second (2013 to 2017) and third (2018 to 2022). To meet future carbon budgets and the 80% target for 2050, the UK will need to reduce emissions by at least 3% a year, from now on. This will require the government to apply more challenging measures[13].

14. Data from BEIS (Department for Business, Energy & Industrial Strategy) shows that transport accounted for 34% of the total carbon emissions across Greater Manchester in 2015, as shown in Figure EN3 below. Of this proportion of transport related carbon emissions, almost the entire total is caused by road transport including A roads, motorways and minor roads. This overall proportion of carbon emissions caused by transport was greater than the proportion attributed to Industry and Commercial activities and equal to the amount caused by Domestic activities.

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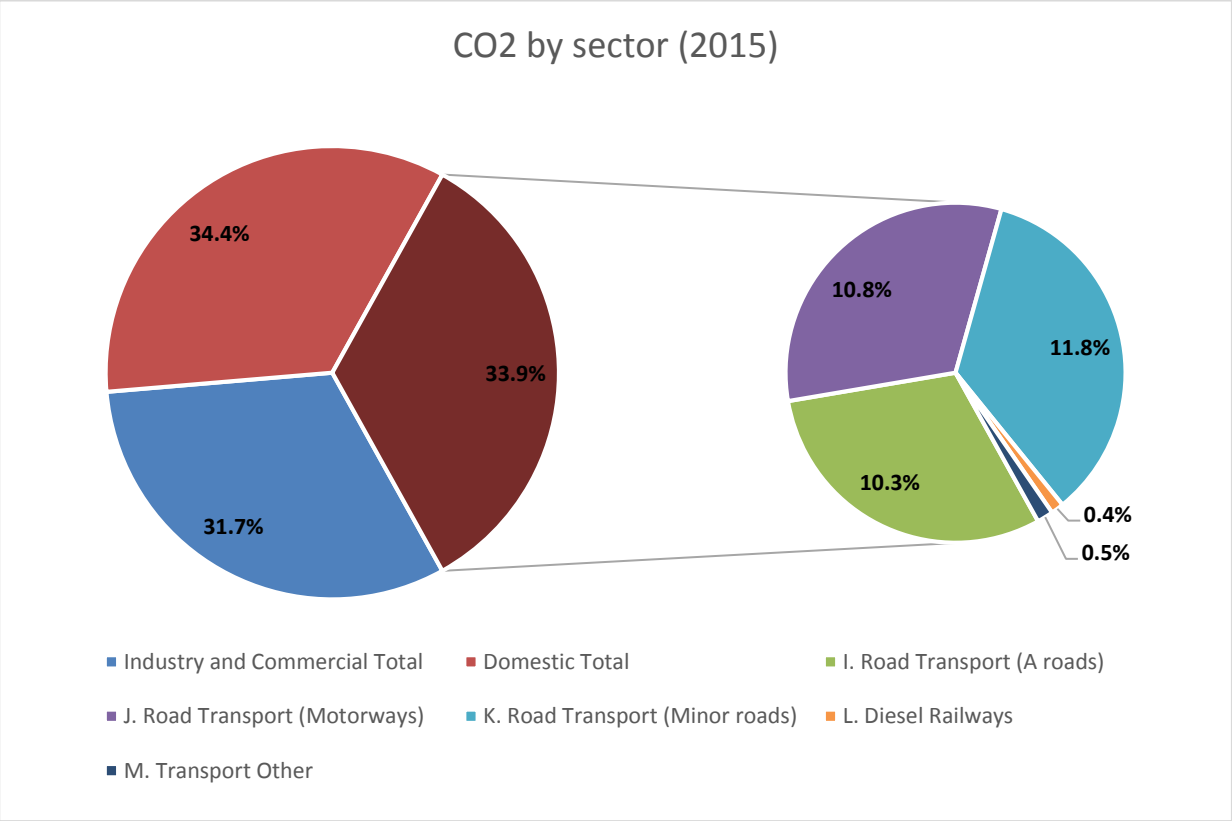
[10] United Nations, (2016). 'The Paris Agreement' [online]. Available at: http://unfccc.int/paris_agreement/items/9485.php [accessed 15 Jan. 2018]

[11] Greater Manchester Combined Authority, (2016). 'Greater Manchester Climate Change and Low Emission Strategies: Joint Implementation Plan 2016-2020' [online]. Available at: http://gmlch.ontheplatform.org.uk/content/greater-manchester-climate-change-and-low-emission-strategies [accessed 15 Jan. 2018]

[12] A metric measure used to compare the emissions from different greenhouse gases based upon their global warming potential (GWP). The carbon dioxide equivalent for a gas is derived by multiplying the tons of the gas by its associated GWP.

[13] Committee on Climate Chang. 'Carbon budgets: how we monitor emissions targets' [online]. Available at: https://www.theccc.org.uk/tackling-climate-change/reducing-carbon-emissions/carbon-budgets-and-targets/ [accessed 9 Feb. 2018]

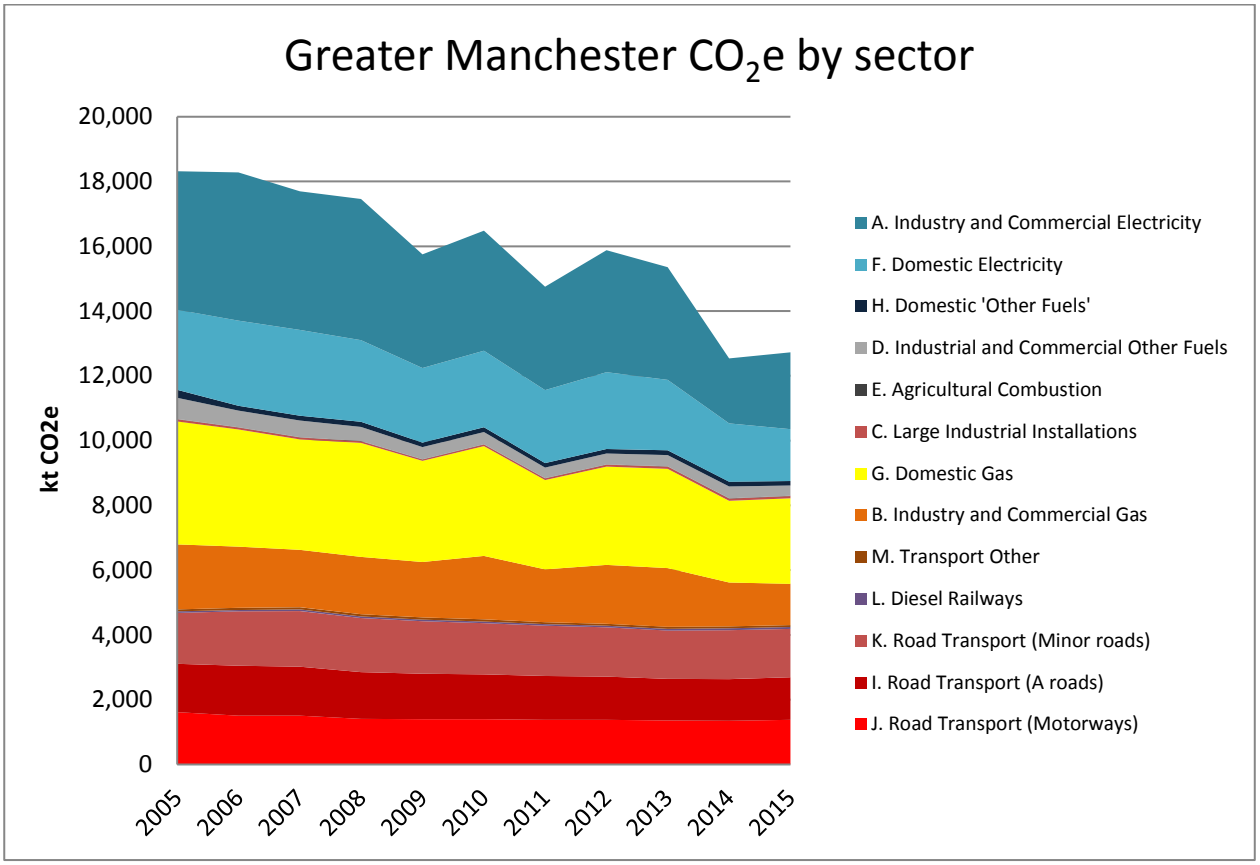
Figure EN3: CO_2 Emissions by sector in Greater Manchester (2015)[14]



15. The BEIS (Department for Business, Energy & Industrial Strategy) dataset also shows that Greater Manchester has reduced greenhouse gas emissions in line with the 48% target. However significant reductions have notably been achieved through electricity grid decarbonisation. Transport emissions only reduced by 10% from 2005 as shown in Figure EN4 below.

[14] Department for Business, Energy & Industrial Strategy, (2017). 'UK local authority and regional carbon dioxide emissions national statistics, BEIS' [online]. Available at: https://www.gov.uk/government/statistics/uk-local-authority-and-regional-carbon-dioxide-emissions-national-statistics-2005-2015 [accessed 9 Feb. 2018]

Figure EN4: Greater Manchester CO_2e[15] by sector[14]



16. It should be noted that updated data sets for emissions in Greater Manchester along with sectoral carbon budgets will become available in 2019 after the publication of this current edition of this document.

17. Measures for reducing carbon emissions are set out in the Greater Manchester Climate Change and Low Emission Strategies: Joint Implementation Plan 2016-2020[16]. These include: infrastructure improvements involving Cross City Bus, Leigh Salford Manchester Busway (now complete) and cycling infrastructure expansion, encouraging home working through improved broadband use, introducing an integrated fares system across all transport modes, supporting new rail or canal-served distribution centres, as well as making the case for funding to stimulate deployment of electric vehicles[16].

[15] CO2e, or carbon dioxide equivalent, is a standard unit for measuring carbon footprints.
[16] Greater Manchester Combined Authority, (2016). 'Greater Manchester Climate Change and Low Emission Strategies: Joint Implementation Plan 2016-2020' [online]. Available at: http://gmlch.ontheplatform.org.uk/content/greater-manchester-climate-change-and-low-emission-strategies [accessed 15 Jan. 2018]

18. The Global Covenant of Mayors for Climate and Energy requires Greater Manchester to set targets aligned with or exceeding an 80% emissions reduction by 2050, and to achieve a 40% reduction between 2005 and 2030[17].

Implications for Greater Manchester

Future levels of growth in Greater Manchester will need to take into account the latest targets set for reductions in carbon emissions. This will include reductions in transport based carbon emissions through mode shift and measures to encourage faster uptake of low emission vehicles.

[17]Covenant of Mayors for Climate & Energy, (2016). 'The Covenant of Mayors for Climate and Energy Reporting Guidelines' [online]. Available at: https://www.globalcovenantofmayors.org/participate/requirements/ [accessed 15 Jan. 2018]

Air Quality

19. With more and more of us living in cities, emissions are having a greater effect on people's health, especially in urban areas. This has implications for air quality; harmful emissions and climate change resilience.

20. It is likely that air pollution contributes a small amount to the deaths of a large number of people, rather than being the sole cause of the death of individuals. This health burden is estimated as an effect on annual mortality in the UK equivalent to around 40,000 deaths (2016 figures)[18].

21. The European Ambient Air Quality Directive 2008 (2008/50/EC) sets legally binding limits for key pollutants in the air we breathe outdoors, based on World Health Organisation recommendations[19]. Countries that are part of the EU must meet these limit values by a given date and the UK Government has therefore set national standards which local authorities must work to achieve. Local authorities therefore have a statutory duty, under the provisions of the Environment Act 1995, the National Air Quality Strategy 2000 and Air Quality Regulations, to review and assess air quality against these standards.

22. The main pollutants of concern in the UK are oxides of nitrogen, principally nitrogen dioxide (NO_2), and particulates (PM). Poor air quality has a real and significant effect on people's lives, contributing to bronchitis, asthma and other respiratory illness, as well as cardio-vascular problems and cancer. Long-term exposure to air pollution is understood to be a contributory factor in deaths from respiratory and cardio-vascular disease.

23. In 2010 the World Health Organisation (WHO) conducted an assessment into the economic cost of deaths from air pollution (both indoor and outdoor) for countries within Europe including the UK[20]. It was estimated that in 2010 the cost of deaths related to air pollution in the UK was approximately US$83bn, which at the time was the equivalent of 3.7% of the UK's Gross Domestic Product (GDP)[21] (at purchasing power parity)[22]. More recently in 2015

[18] Royal College of Physicians, (2016). 'Every breath we take: The lifelong impact of air pollution' [online]. Available at: https://www.rcplondon.ac.uk/projects/outputs/every-breath-we-take-lifelong-impact-air-pollution [accessed 15 Jan. 2018]

[19] European Commission. 'Air Quality – Existing Legislation' [online]. Available at: http://ec.europa.eu/environment/air/quality/existing_leg.htm [accessed 15 Jan. 2018]

[20] This excludes Andorra, Monaco and San Marino.

[21] The Gross Domestic Product measures the value of economic activity within a country. Strictly defined, GDP is the sum of the market values, or prices, of all final goods and services produced in an economy during a period of time.

[22] World Health Organisation, (2010). 'Annex: Economic cost of deaths from air pollution (outdoor and indoor) per country, as a percentage of GDP WHO European Region' [online]. Available at: http://www.euro.who.int/__data/assets/pdf_file/0008/276956/PR_Economics-Annex_en.pdf?ua=1 [accessed 15 Jan. 2018]

it was estimated that the negative health implications of exposure to particulate matter alone cost over £16bn per annum to the UK[23].

24. The Committee on the Medical Effects of Air Pollutants (COMEAP) conducted studies linking long-term exposure to ambient air pollution and chronic obstructive pulmonary disease (COPD) and calculating the likely number of people affected in the UK. Based on research into the estimated burden and impact of anthropogenic PM10[24] in 2010 it is estimated that in total for the UK and the North West there are 722,660 and 57,347 people suffering from Chronic phlegm attributable to anthropogenic PM10. Of these totals for the UK and the North West it is estimated by COMEAP that if there was a reduction of 1 µg/m3 in anthropogenic PM10 there would be 5,550 and 65,609 fewer people in the North West and UK respectively impacted[25]. In 2016 it was estimated that 1,300 deaths of people over 25 years old in Greater Manchester are attributable to anthropogenic particulate air pollution[26].

25. The graph below in Figure EN5 details the breakdown of deaths in the population aged 25 and over in the ten districts of Greater Manchester that were attributable to anthropogenic particulate air pollution.

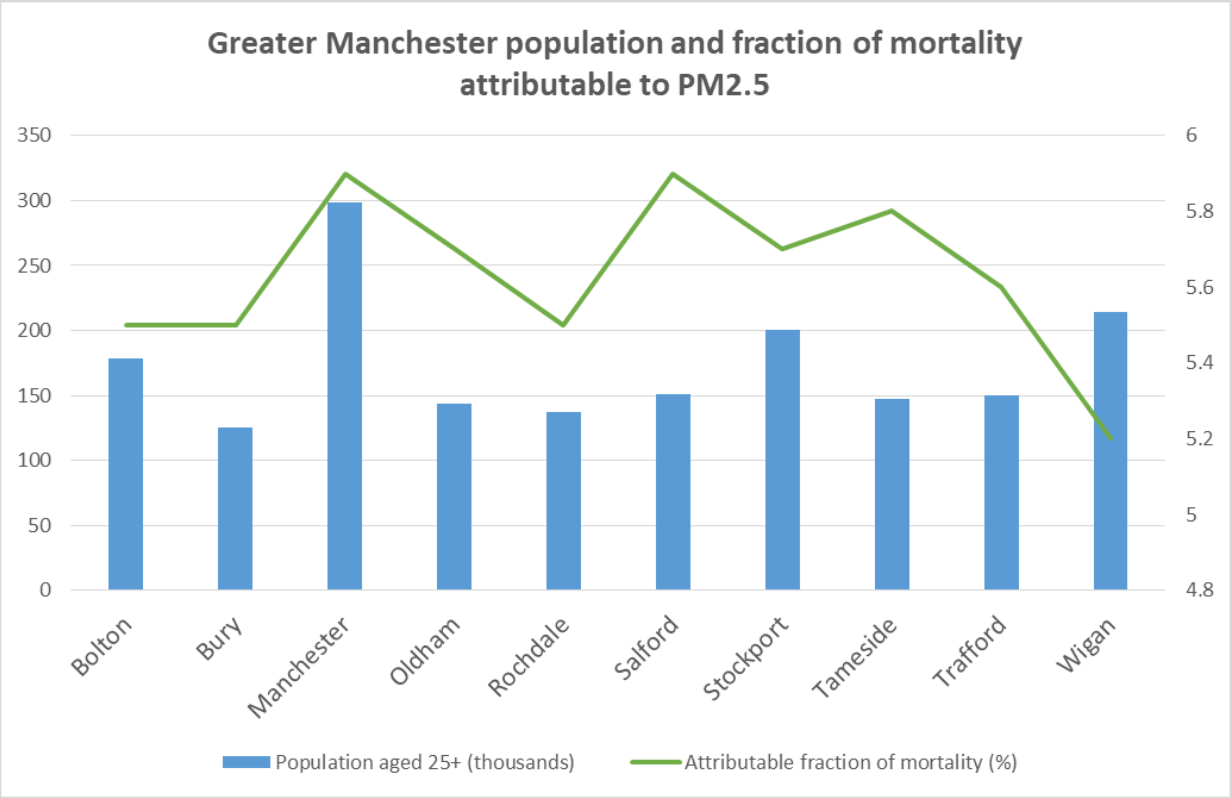
[23] Department for Environment Food & Rural Affairs, (2015). 'Valuing impact on air quality: Updates in valuing changes in emissions of Oxides of Nitrogen (NOx) and concentrations of Nitrogen Dioxide (NO_2)' [online]. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/460401/air-quality-econanalysis-nitrogen-interim-guidance.pdf [accessed 17 Jan. 2018]

[24] Anthropogenic PM10 is particulate matter 10 micrometers or less in diameter resulting from the influence of human beings on nature.

[25] COMEAP, (2016). 'Long-term Exposure to Air Pollution and Chronic Bronchitis' [online]. Available at: https://www.gov.uk/.../COMEAP_chronic_bronchitis_report_2016__rev_07-16_.pdf [accessed 17 Jan. 2018]

[26] Public Health England, (2014). 'Estimating Local Mortality Burdens associated with Particulate Air Pollution' [online]. Available at: https://www.gov.uk/government/publications/estimating-local-mortality-burdens-associated-with-particulate-air-pollution [accessed 17 Jan. 2018]

Figure EN5: Greater Manchester Population and fraction of mortality attributable[27] to PM (2014)[26]



26. Of the ten Greater Manchester districts it is the heavily urbanised inner city districts of Manchester and Salford that have recorded the highest fraction of mortality attributable to PM.

27. Short-term exposure to poor air quality can also have health effects. Some groups are at greater risk of symptoms, particularly adults and children with heart or lung problems, and public health advice is now included with the national Daily Air Quality Index[28].

[27] The number of deaths attributable to population exposure to a particular factor (i.e. the number of deaths fewer that would have been expected had the population been unexposed to that factor).
[28] Department for Environment Food & Air Pollution. 'Pollution forecast provided by the Met Office' [online]. Available at: https://uk-air.defra.gov.uk/air-pollution/daqi [accessed 15 Jan. 2018].

28. Commuting is considered as one of the high-exposure periods among various daily activities, especially in high vehicle-density metropolitan areas. Studies have shown that car commuters' exposure depends on traffic intensity and emissions by nearby vehicles. Research from the University of Surrey (2015) found that although commuting drivers spend just 2% of their journey time passing through junctions with traffic lights, it contributed to about 25% of their total exposure to PM. This is caused by decelerating, stopping and then accelerating to move away. Peak PM concentration at traffic signals proved to be 29 times higher than it is in free-flowing traffic conditions[29].

29. However, although cyclists usually ride in close proximity to motor traffic in urban areas, assessments of the overall health impacts of cycling have consistently concluded that the benefits outweigh the disbenefits. In 2016 an academic paper examined the risk versus benefits of cycling at the same time as being exposed to polluted air. This paper concluded that the benefits "outweighed the harm caused by air pollution in all but the most extreme air pollution concentrations"[30].

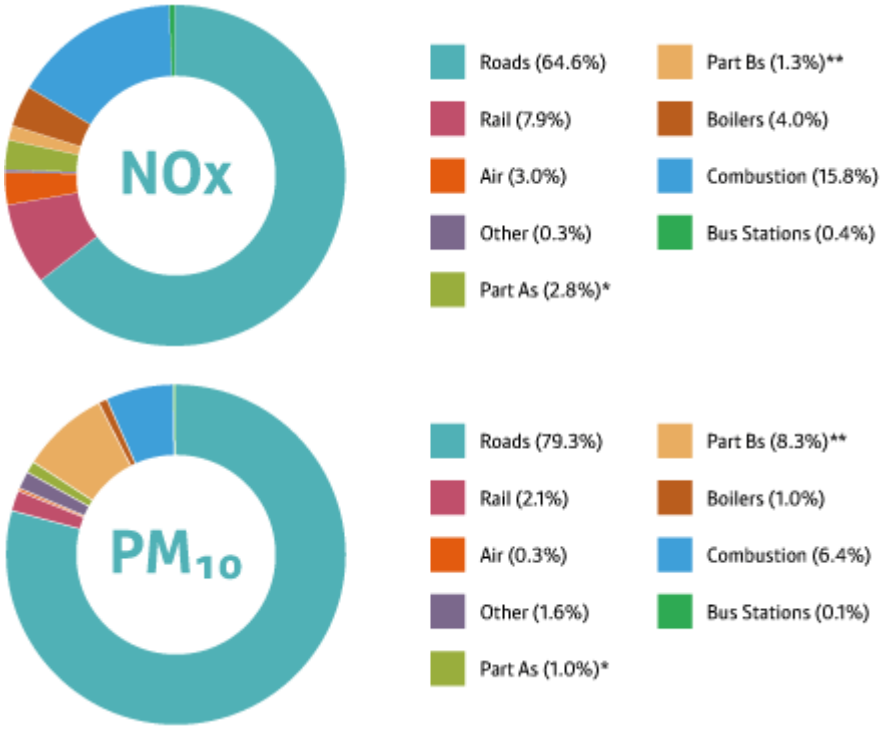
30. As well as the human cost of emissions, there is an indirect impact on the economy as a whole: health problems affect the ability to work and contribute to low productivity. Pollution levels in 2012 had an estimated total cost of £2.7bn in the UK through its impact on productivity and an impact in 2012 equivalent to a reduction in GDP of 0.11%[31]. Air pollution also has wide-ranging environmental impacts, including loss of biodiversity and reduced crop yields.

NO2 and PM10 Emissions

31. In Greater Manchester, road transport contributes to over 65% of emissions of nitrogen oxides and 79% of particulates, as shown in Figure EN6.

[29] Goel, Anju (2015), *Characterisation of nanoparticle emissions and exposure at traffic intersections through fast–response mobile and sequential measurements. Published in Atmospheric Environment*, Volume 107, pp. 374–390.
[30] Tainio M, et al (2016), Can air pollution negate the health benefits of cycling and walking? Preventive Medicine, 87, pp. 233-236.
[31] Department for Environment, Food and Rural Affairs, (2014). 'Valuing the Impacts of Air Quality on Productivity: Final Report' [online]. Available at: https://uk-air.defra.gov.uk/library/reports?report_id=832 [accessed 7 Feb. 2018]

Figure EN6: Emissions Inventory for Greater Manchester (EMIGMA), 2014[32]



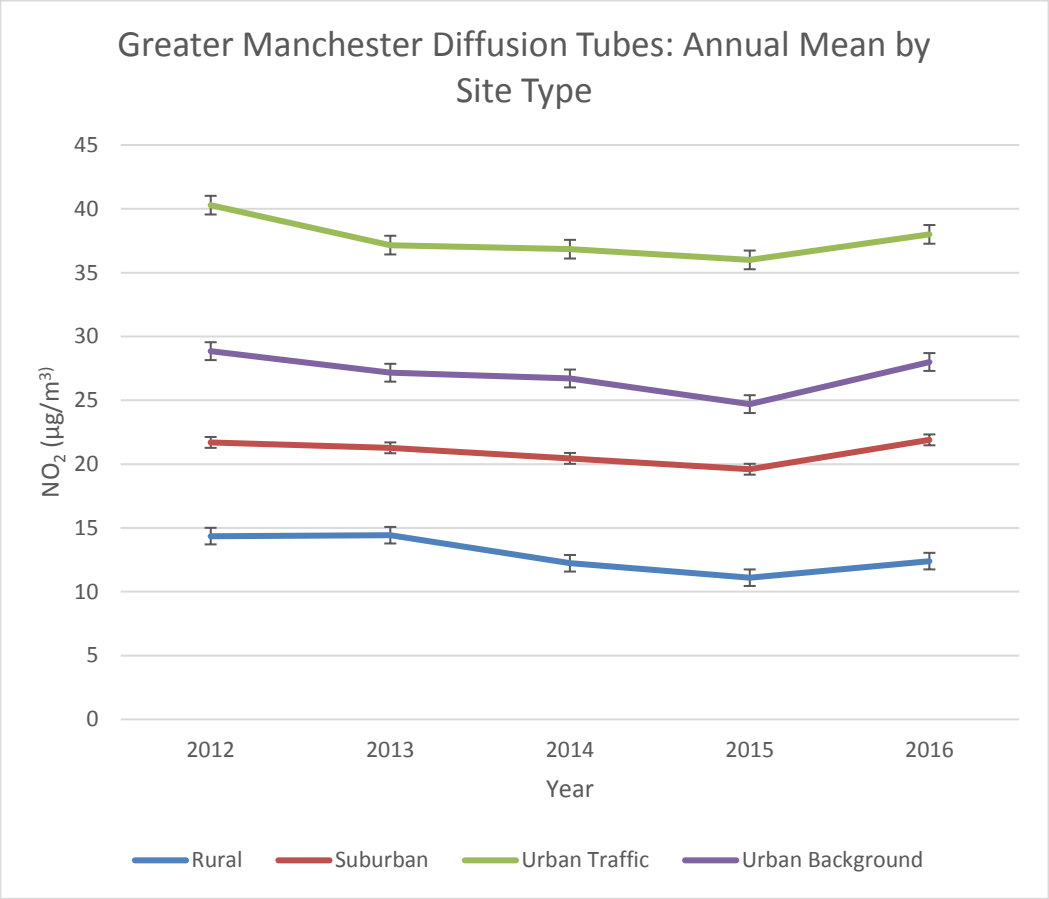
Notes: * Part As - Installations regulated by Environment Agency (large and more complex activities, generally those with a greater potential for pollution);
** Part Bs - Installations regulated by local authorities (smaller activities, generally with lower potential for pollution).

32. It should be noted that updated data sets for emissions in Greater Manchester will become available in 2019 after the publication of this current edition of this document.

33. The distribution of NO_2 emissions is captured in Figure EN7 below showing annual means by monitoring site type, emphasising the contribution of traffic to the areas air pollution.

[32] Emissions Inventory for Greater Manchester (EMIGMA), 2014.

Figure EN7: Greater Manchester Diffusion Tubes: Annual mean by site type[33]



34. The downward trend in emissions was curtailed by sustained construction activity in many parts of Greater Manchester throughout the 2016 monitoring period, most notably in the Oxford Road area where the regional high NO_2 annual mean concentration level was recorded at 66µg/m³. This site also recorded 90 exceedances of the 1-hour mean objective (200µg/m³), where 18 exceedances is the legal limit.

35. Greater Manchester is one of a number of major UK conurbations where NO_2 limits are exceeded. Where air quality objectives are not likely to be achieved, local authorities must designate Air Quality Management Areas (AQMAs).

[33] Greater Manchester Combined Authority, (2017). '2016 Air Quality Annual Status Report (ASR) for Greater Manchester' [online]. Available at: http://www.trafford.gov.uk/residents/environment/pollution/air-quality/docs/GMASR-2016.pdf [accessed 7 Feb. 2018].

36. Local modelling undertaken to inform the evidence base for Greater Manchester's forthcoming Clean Air Plan has identified 152 stretches of road where concentrations of NO_2 are forecast to exceed the legal Limit Value (40µg/m³) beyond 2020. 112 of these road links are on the national Pollution Climate Mapping (PCM) model, which have the highest car use and heavy freight flows. The distribution of these road links are shown in the table below.

Table EN1: Summary of numbers of areas across GM forecast to exceed the EU Limit Value beyond 2020[34]

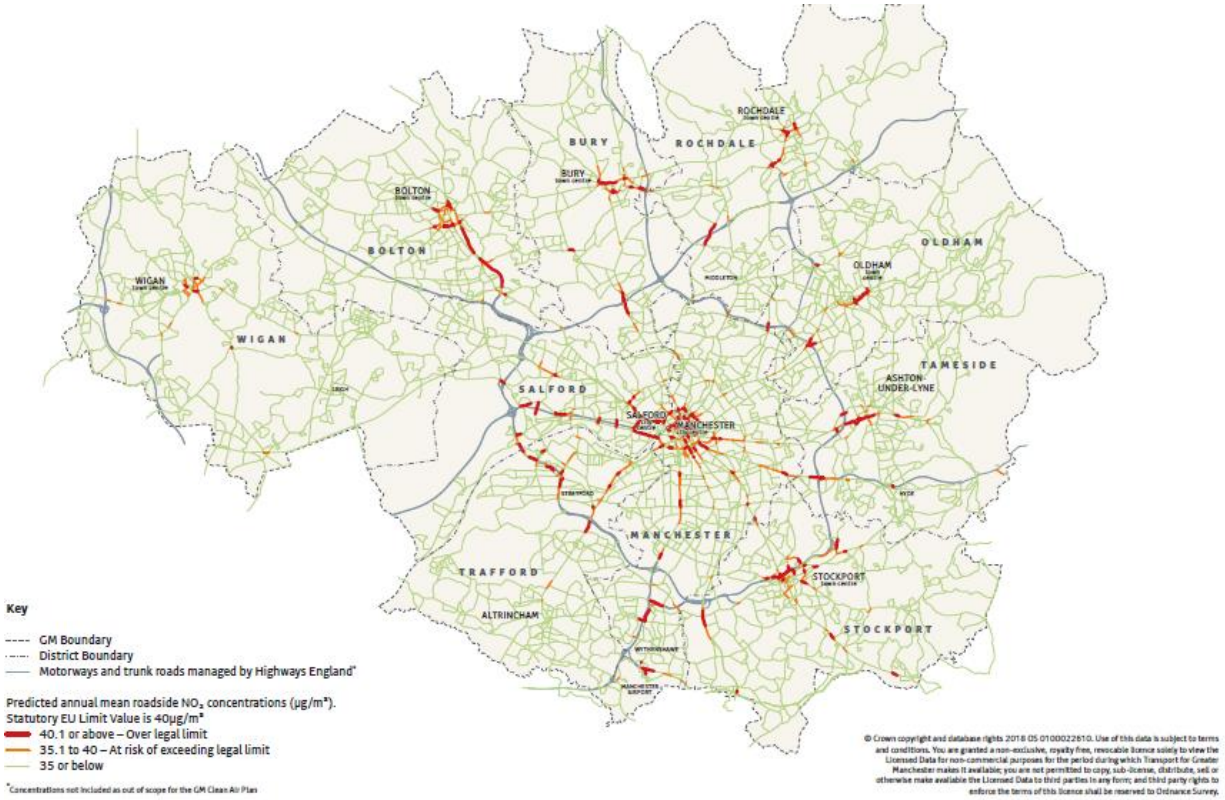
Local Authority	National (PCM) Model Exceedances Links	Local Model Exceedances on PCM Links	Additional Local Model Exceedances on Minor (non-PCM) Links[35]
Bolton	1	12	2
Bury	1	8	7
Manchester	4	35	16
Oldham	0	4	2
Rochdale	0	7	0
Salford	1	15	3
Stockport	2	13	6
Tameside	1	11	2
Trafford	1	4	1
Wigan	0	3	1
Total	**11**	**112**	**40**

[34] GMCA, (2018) 'Greater Manchester Clean Air Plan: Update on Local Air Quality Modelling' [online]. Available at: https://www.greatermanchester-ca.gov.uk/download/meetings/id/3811/10_clean_air_plan [accessed 26 Oct. 2018]
[35] These are roads links that are not included in the national PCM model but have been modelled locally.

37. In addition, higher concentrations of NO_2 were identified in Manchester City Centre and other town centres in Greater Manchester due to the volume of demand on these roads and also because of the 'canyon effect'. The canyon effect refers to the reduced air flow and circulation caused by tall buildings or in densely built up areas that act to reduce the diffusion and dissipation of air pollutants that occur in more open or low-risk locations.

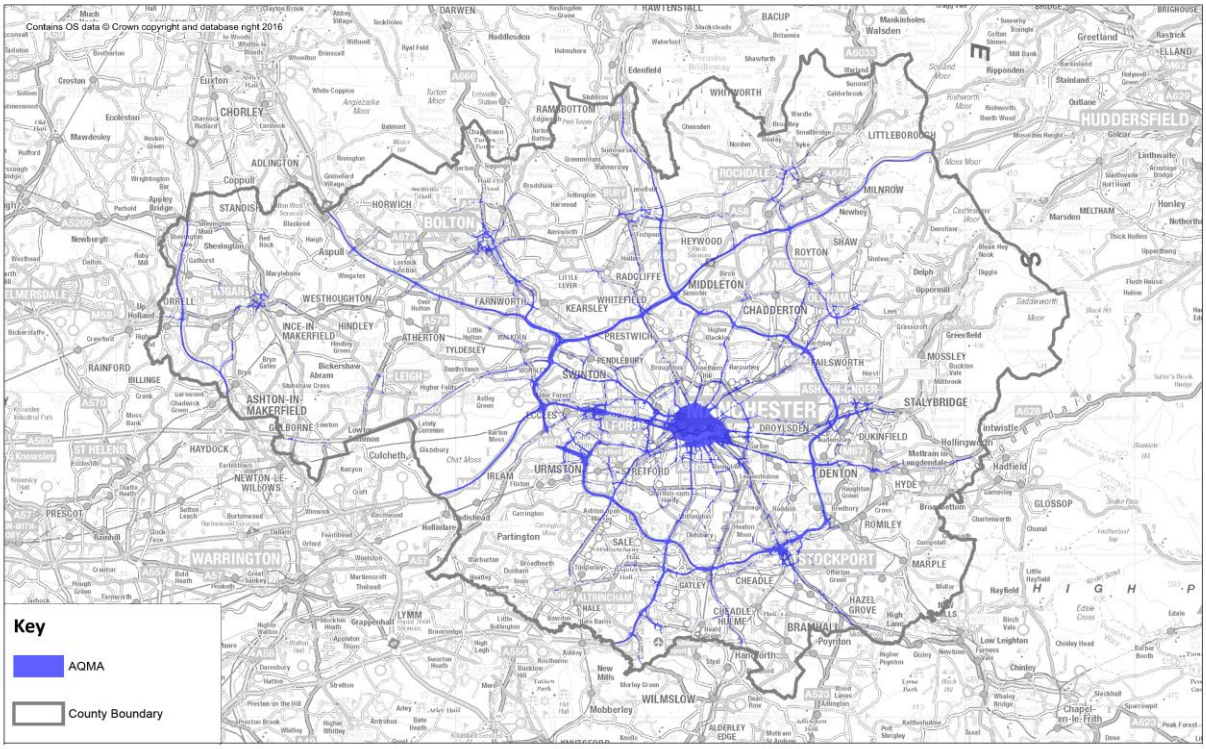
38. The map below demonstrates these road links in Greater Manchester showing high concentrations of NO_2 through the local modelling that has taken place.

Figure EN8: Predicted annual mean nitrogen dioxide (NO_2) concentrations for the Greater Manchester local road network in 2021



39. There are clear similarities between the local modelling of road links expected to show high concentrations of NO_2 and the AQMA. Figure EN9 shows the area in Greater Manchester covered by an AQMA (declared in May 2016).

Figure EN9: Greater Manchester Air Quality Management Area[36]



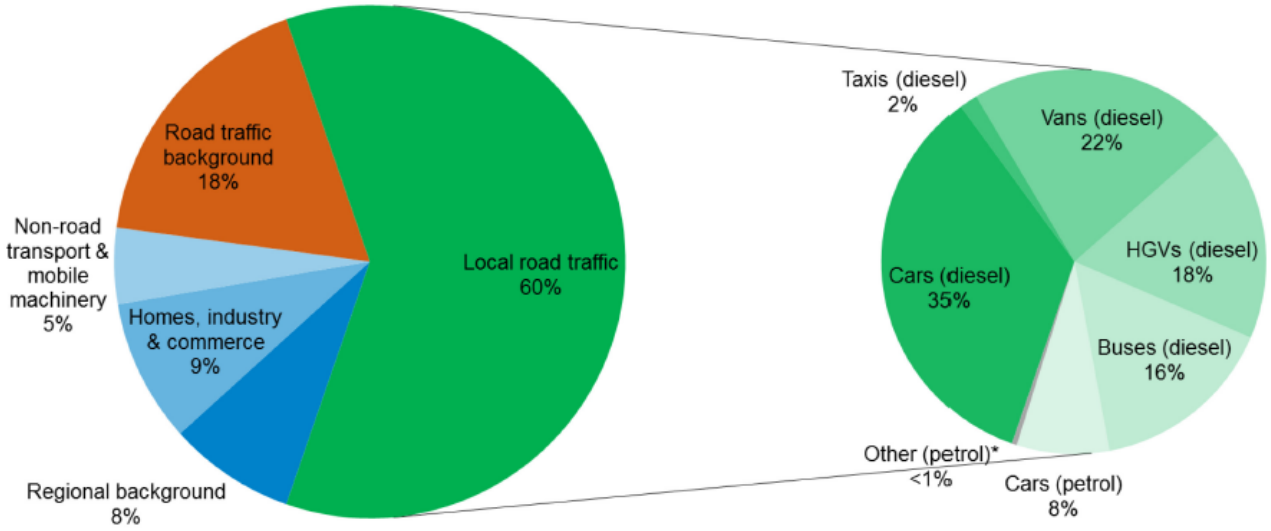
40. Given the contribution of transport to emissions, it is not surprising that the AQMA reflects the location of the confluence of the routes into central Manchester. In terms of the effect on people, this is greatest where high density residential areas coincide with major highways.

42. To improve the health of the population, the EU has also set a target of a 20% reduction in urban background concentrations of $PM_{2.5}$ between 2010 and 2020[37]. It should be noted that the direct emission of particulates from vehicle exhausts is not the only source. Significant contributions are also made by tyre and brake wear, road surface wear and the re-suspension of particles. These sources will not be improved by Euro engine standards.

43. Different vehicle types contribute differently to emissions. Figure EN10 below shows that local road traffic accounted for 60% of the UK national average NOx roadside concentration of NOx emissions in 2015 with diesel cars accounting for 35% of this overall proportion.

[36] Department for Environment, Food & Rural Affairs, (2016). 'Manchester AQMA' [online]. Available at: https://uk-air.defra.gov.uk/aqma/details?aqma_ref=36 [accessed 15 Jan. 2018]
[37] European Commission. 'New Air Quality Directive' [online]. Available at: http://ec.europa.eu/environment/air/quality/directive.htm [accessed 15 Jan 2018]

Figure EN10: UK national average NOx roadside concentration apportioned by source of NOx emissions, 2015[38]



Implications for Greater Manchester

NO_2 and PM_{10} emissions from vehicles must be reduced because of the health impacts. To improve air quality, measures will be most effective if targeted at problem areas e.g. the largest urban centres and towards the vehicles that contribute most to the problem.

[38] Department of Environment Food & Rural Affairs, (2017). 'UK Plan for tackling roadside nitrogen dioxide concentrations: Detailed Plan' [online]. Available at: https://www.gov.uk/government/publications/air-quality-plan-for-nitrogen-dioxide-no2-in-uk-2017 [accessed 15 Jan 2018]

Vehicle Technology

44. Significant advances in technology have been made since the introduction of EU regulations that have mandated incremental improvements for air quality pollutants through EURO standards and fleet average limits for CO_2 emissions[39]. These advances include the fitting of abatement technology, light weighting, aerodynamics, engine efficiency and the continued development of electric vehicles.

45. Figures published by the Society of Motor Manufacturers and Traders (SMMT) each month show that electric car sales in the UK have risen significantly over the past few years.

Figure EN11: Electric car registrations (UK) 2016-2018[40]

46. By the end of 2018, more than 60,000 plug-in cars had been registered over the course of the year - a new record. This significantly improved upon the previous record, set in 2017, increasing it by more than 13,000 units. By the end of the year, plug-in cars as a proportion of total UK registrations reached 3.8%, and averaged over 2018 electric cars represented 2.7 per cent of the total new car market in the UK[40].

[39] European Commission. 'Reducing CO2 emissions from passenger cars' [online]. Available at: http://ec.europa.eu/clima/policies/transport/vehicles/cars/index_en.htm [accessed 15 Jan. 2018]
[40] Next Greencar. 'Electric car market statistics' [online]. Available at: http://www.nextgreencar.com/electric-cars/statistics/ [accessed 21 Jan. 2019]

47. The cumulative figure also shows sustained and significant growth of the EV car and van market. According to the Office for Low Emission Vehicles (OLEV) and SMMT, around 180,000 claims have been made through the Plug-in Car Grant scheme. Taken together with the fact that a significant number of electric cars and vans which are not eligible for the grant schemes have also been registered, the total number of light-duty electric vehicles in the UK is more than 210,000 electric vehicles[40].

48. The cost of implementing electric vehicle charging infrastructure is not insignificant. Building a network requires capital expenditure to upgrade the grid, purchase and install urban charging infrastructure, and revenue funding to operate and maintain the system. In terms of supporting infrastructure, Greater Manchester has already installed 324 public charging sockets comprised of 160 dual headed 15kKW posts (7KWper unit) with 4 rapid chargers across the region. By mid-2018, over 180,000 Individual charging sessions had been registered with an average 42,430 KW/h drawn from the GMEV network each month[41].

49. The potential for ultra-low emission vehicles (ULEV) to contribute to lower emissions is considerable. The UK has set a target, via the Office of Low Emission Vehicles, that every new car will be a ULEV by 2050[42]. Some countries such as the Netherlands have set targets that require all cars must be emission-free by 2030[43]. Based on data for Q3 of 2018, there were 3,353 registered ULEV vehicles in Greater Manchester[44]. Faster charging infrastructure improves the attraction of the electric vehicle network, and therefore the use of electric vehicles.

50. The provision of power is a key source of emissions. Greater Manchester has 72 MW[45] of renewable energy installed across the region, producing around 70 GW of electricity per year[46]. This saves around 30,000 tonnes of CO_2 each year.

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[41] Greater Manchester Low Carbon Hub Board (2018), Electric Vehicle Update in GM [online]. Available at: https://www.gmcameetings.co.uk/meetings/meeting/553/low_carbon_hub_board [accessed 21 Jan. 2019]

[42] Office for Low Emission Vehicles, (2013). 'Driving the Future Today – a strategy for ultra-low emission vehicles in the UK' [online]. Available at: https://www.gov.uk/government/publications/driving-the-future-today-a-strategy-for-ultra-low-emission-vehicles-in-the-uk [accessed 15 Jan. 2018]

[43] Electrek. 'The Dutch government confirms plan to ban new petrol and diesel cars by 2030' [online]. Available at: https://electrek.co/2017/10/10/netherlands-dutch-ban-petrol-diesel-cars-2030-electric-cars/ [accessed 15 Jan. 2018].

[44] Department for Transport. 'Table VEH0132' [online]. Available at: https://www.gov.uk/government/statistical-data-sets/all-vehicles-veh01 [accessed 21 Jan. 2019]

[45] 1 gigawatt (GW) = 1,000 megawatts.

[46] Greater Manchester Combined Authority, (2016). 'Greater Manchester Climate Change and Low Emission Strategies: Joint Implementation Plan 2016-2020' [online]. Available at: http://gmlch.ontheplatform.org.uk/content/greater-manchester-climate-change-and-low-emission-strategies [accessed 15 Jan. 2018]

Implications for Greater Manchester

Developments in vehicle technology will contribute towards the reduction of transport related pollution in Greater Manchester.

Noise

51. According to the World Health Organization (WHO) noise is the second largest environmental cause of health problems, just after the impact of air quality (particulate matter). The World Health Organization's Night Noise Guidelines for Europe presents evidence of the health damage of night-time noise exposure and recommends threshold values above which adverse effects on human health are observed. According to this study an annual average night exposure not exceeding 40 decibel (dB) has been recommended in the Guidelines. Sleepers that are exposed to night noise levels above 40dB on average throughout the year can suffer health effects like sleep disturbance and awakenings. Above 55dB long-term average exposure, noise can trigger elevated blood pressure and lead to heart disease[47].

52. A study commissioned by Directorate General for the Environment of the European Commission, entitled *Health implication of road, railway and aircraft noise in the European Union*, found that exposure to noise in Europe contributes to[48]:

    - Approximately 910 thousand additional prevalent cases of hypertension;
    - 43 thousand hospital admissions per year; and
    - At least 10 thousand premature deaths per year related to coronary heart disease and stroke.

53. Since this study was based on partial data on noise exposure, the overall health effects in the entire EU are likely to be even higher than currently estimated. The WHO is currently working on revised noise guidelines for Europe based upon the latest evidence of the health impacts of noise pollution including updated recommendations on acceptable exposure levels.

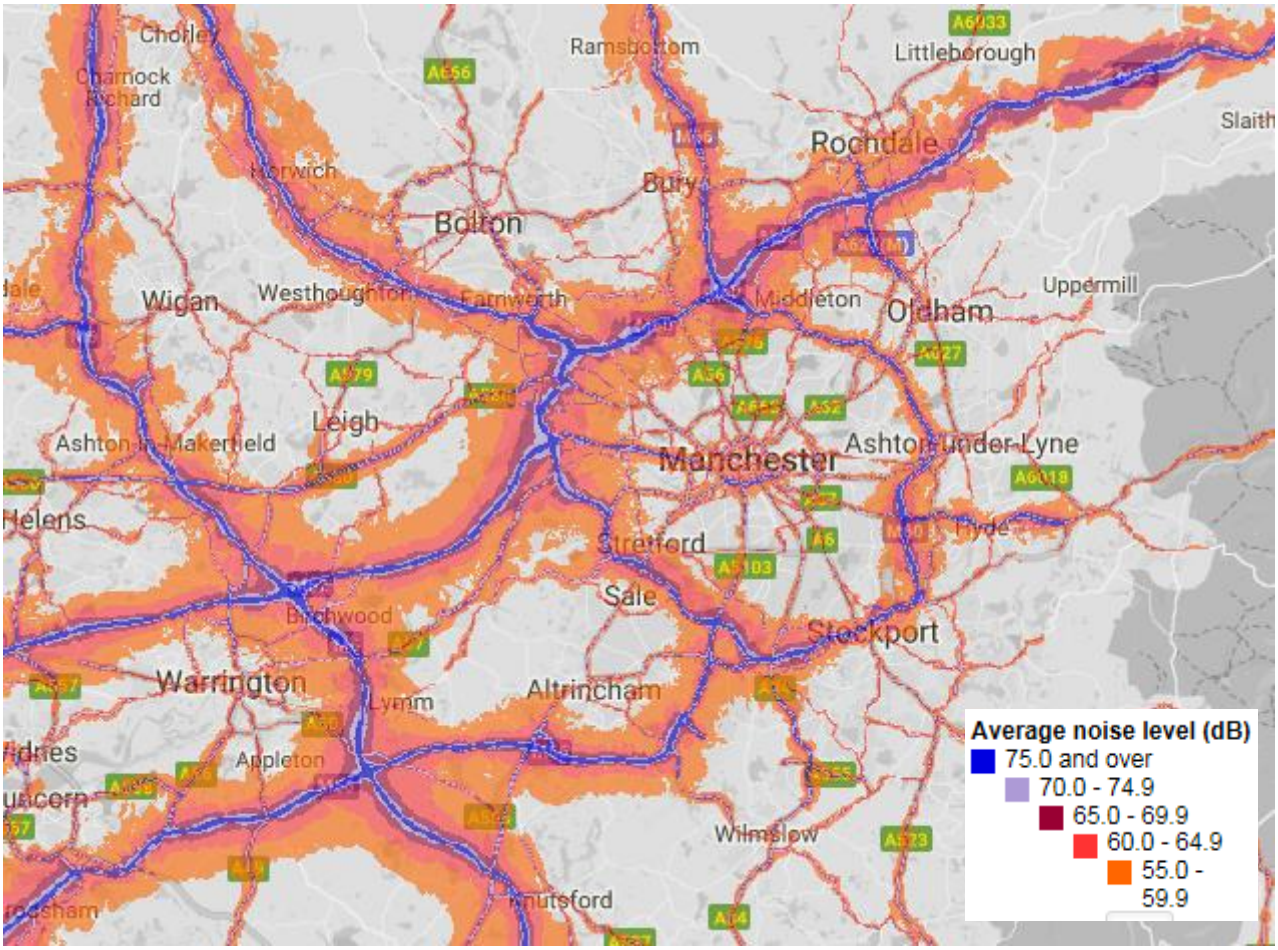
[47] World Health Organization, (2009). 'Night Noise Guidelines for Europe' [online]. Available at: http://www.euro.who.int/en/health-topics/environment-and-health/noise/publications/2009/night-noise-guidelines-for-europe [accessed 14 Feb. 2018]

[48] National Institute for Public Health and the Environment, (2014). 'Health implication of road, railway and aircraft noise in the European Union' [online]. Available at: http://www.rivm.nl/en/Documents_and_publications/Scientific/Reports/2014/december/Health_implication_of_road_railway_and_aircraft_noise_in_the_European_Union_Provisional_results_based_on_the_2nd_round_of_noise_mapping [accessed 14 Feb. 2018]

54. The Environmental Noise Directive requires European Member States to establish through the process of noise mapping the number of people exposed to noise levels above 55 dB(A) in the daytime and 50 dB(A) at night from major roads, major railways, major airports and in agglomerations (large urban areas)[49]. In these urban areas, noise from all other roads, railways, aircraft movements and significant industrial premises has been mapped, in addition to the major sources[50].

55. Noise mapping has been carried out in England by DEFRA and the map below has been created using the data gathered during this process in 2012. The map shown in Figure EN12 shows a 24 hour annual average noise level in decibels with weightings applied for the evening and night periods.

Figure EN12: Noise mapping from road transport in central Manchester[51]



[49] European Commission. 'Environmental Noise Directive' [online]. Available at: http://ec.europa.eu/environment/noise/directive_en.htm [accessed 15 Jan 2018]

[50] Major roads are considered to have over 6 million vehicles annually. Major railways are considered to have more than 60,000 trains annually. Major airports are considered to have over 50,000 aircraft movements annually.

[51] Extrium. 'England Noise Map Viewer' [online]. Available at: http://www.extrium.co.uk/noiseviewer.html [accessed 6 Feb. 2018]

56. Motorways have the highest levels of noise, including the M60 and the M62, although these are less likely to be in the direct vicinity of residential areas, unlike A and B roads. With regard to air travel, the area directly surrounding the airport, and take-off and landing approaches are the worst affected areas.

57. DEFRA suggest that policymakers should identify complementary, cost-effective measures that reduce noise at source[52]. These may include technology improvements to vehicle components, such as engines and tyres, improvements to infrastructure, such as low-noise road surfaces, traffic management to limit vehicles to speeds where noise is lessened or restricting access to sensitive areas for the noisiest vehicles.

Implications for Greater Manchester

There is a need to ensure that opportunities are taken to reduce traffic noise where feasible.

[52] Department for Environment, Food & Rural Affairs, (2010). 'Noise policy statement for England' [online]. Available at: https://www.gov.uk/government/publications/noise-policy-statement-for-england [accessed 6 Feb. 2018]

Biodiversity

58. Biodiversity is vital to all urban areas, as the availability of nature is restricted in the development of urban areas. Greater Manchester's natural assets store and sequester approximately 21 million tonnes of carbon a year, reduce the risk of floods and also aid cooling[53].

59. In terms of environmental protection and management, TfGM has standard procedures set out in the TfGM Biodiversity Management Procedure. This document aims to improve the quality of life for transport users and non-transport users alike as well as promoting the natural environment[54]. TfGM has a duty under Section 40 in the Natural Environment and Rural Communities (NERC) Act 2006 "to have regard to the purpose of conserving biodiversity in the exercise of its functions"[54].

60. TfGM will manage its biodiversity responsibilities in all new transport schemes through[54]:

- Ensuring that developments are carried out in accordance with commitments to environmental responsibility;
- Ensuring all necessary ecological surveys for protected species are carried out and actions implemented;
- Developments take opportunities to protect and enhance biodiversity;
- Management should be put in place for new habitats to ensure they remain safe; and
- Aim that there is no net loss in biodiversity and plans for replacement habitat or enhancement proposals be implemented on a case by case basis.

[53] Greater Manchester Combined Authority, (2016). 'Greater Manchester Climate Change and Low Emission Strategies: Joint Implementation Plan 2016-2020' [online]. Available at: http://gmlch.ontheplatform.org.uk/content/greater-manchester-climate-change-and-low-emission-strategies [accessed 15 Jan. 2018]

[54] Transport for Greater Manchester, (2017). 'Biodiversity Management Procedure' [online]. Available at: https://edrms.tfgm.com:85/departmental/healthandsafety/Documents/366 EMS Biodiversity Management Procedure.pdf [accessed 6 Feb. 2018]

61. Traffic, particularly heavy goods vehicles, can also have a significant impact in biodiversity, through air pollution, noise and climate change. This is of particular concern in relation to the Peak District National Park, where heavy trans-Pennine traffic passes through a vulnerable ecosystem. Greater Manchester and its surrounding areas also contain a number of statutory nature conservation sites of European level Importance. These include Special Areas of Conservation, Special Protection Areas and Ramsar Sites[55], known collectively as European Sites. These sites are protected under the European Habitats Directive. Where schemes could have an adverse effect on the integrity of a European Site, schemes are subject to a Habitats Regulations Assessment at the project level which is in accordance with national and European law.

Implications for Greater Manchester

Individual schemes need to be designed to minimise any negative impacts and, where possible, to enhance any positive impacts on biodiversity.

[55] A Ramsar Site is a wetland site designated to be of international importance under the Ramsar Convention. The Convention on Wetlands, known as the Ramsar Convention, is an intergovernmental environmental treaty established in 1971 by UNESCO, and came into force in 1975.

Water Quality

62. The quality of the water in our rivers, lakes and estuaries is of crucial importance as an indicator of how well we look after our environment. Good quality waters also have great amenity and recreational value, enhance biodiversity and help reduce the costs and environmental impacts, such as from energy use, of treating water to make it fit to drink. The more polluted the water is, the more it costs to treat, and the greater the carbon footprint of the treatment.

63. Under the EU water framework directive all water bodies are required to reach 'good' status by 2027. Regulation 17 of the Water Environment Regulations places a duty on all public bodies to have regard to their local River Basin Management plan[56].

64. Transport networks often bisect important green-blue corridors. New and existing transport infrastructure projects should seek to actively enhance the natural environment through the adoption of green infrastructure solutions, such as sustainable urban drainage schemes, that will reduce the diffuse pollution caused by transport modes.

Implications for Greater Manchester

To improve water quality in line with the EU water framework directive, measures should be introduced, where possible, to reduce or diffuse pollution from transport.

[56] European Commission. 'The EU Water Framework Directive – integrated river basin management for Europe' [online]. Available at: http://ec.europa.eu/environment/water/water-framework/index_en.html [accessed 15 Jan. 2018].

Technology and Innovation

Technology and Innovation: Summary of Trends and Implications

Potential for technology and innovation opportunities to impact upon strategy implementation

- Technological innovations in the transport sector could have major implications for the implementation of the 2040 Transport Strategy and the Greater Manchester Spatial Framework.
- The 2040 Strategy identifies the areas where transport innovation and technology may be most relevant to delivering our desired transport outcomes, such as by improving the customer experience, reducing the need to travel, and reducing transport's impact on the environment.

Improving the customer experience

- Innovations in technology such as Mobility as a Service (MaaS) and autonomous vehicles have the potential to improve the public transport offer and the customer experience for Greater Manchester's travelling public. There is a need to continue to monitor and shape the development of these innovations over the coming years.

Improving performance and resilience through technology and innovation development

- Greater Manchester continues to be a test bed for transport innovations through the development and evaluation of pilot projects such as Mobility as a Service (MaaS) and autonomous vehicles.

Reducing transport impacts on the environment and enabling a reduction in the need to travel and transport goods

- New transport technologies have the potential to reduce the impact of transport on the environment, for example through the uptake of electric vehicles causing reductions in carbon emissions or reducing the need to travel.

Improved access to better data

- Data is becoming increasingly valuable, and a cause for concern by some members of the public. How Greater Manchester addresses security issues, maintains the trust of the public and uses new processes in data storage and utilisation will be a key issue in the future.

Technology and Innovation

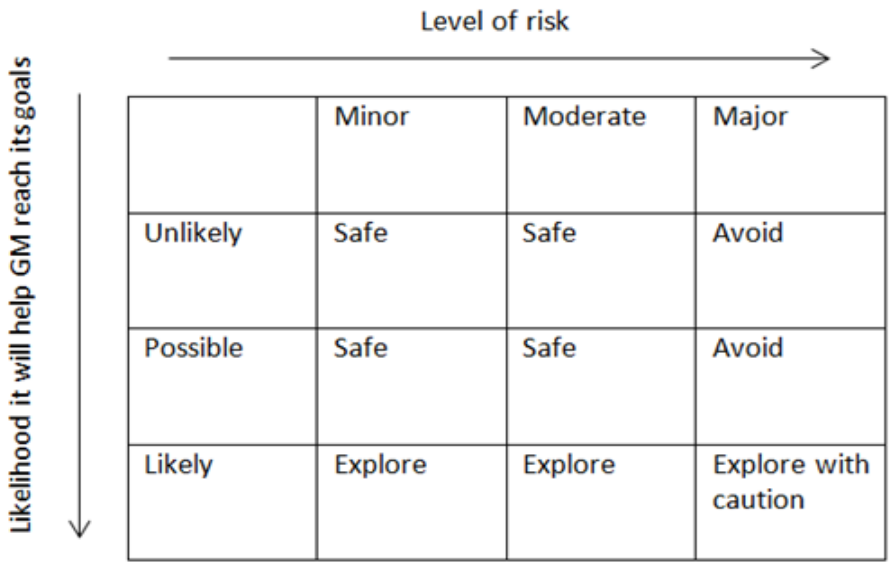
1. The speed of technological change is fast and often difficult to predict, with successes based on a range of factors. How Greater Manchester chooses to use new transport technologies that emerge over the next twenty years will have a significant impact on the transport network. The 2040 Transport Strategy identifies 5 key areas where transport innovation and technology may be most relevant to delivering our desired transport outcomes. These are[1]:

    - Improving customer experience;
    - Improving performance and resilience;
    - Improved access to better data;
    - Reducing the need to travel and transport goods; and
    - Reducing transport's impact on the environment.

2. This chapter provides an analysis of some of the current areas of opportunity and risk relating to technology, innovation and transport.

3. The matrix shown in Figure T1 has been applied throughout this section to determine the level of risk different technologies present, along with the likelihood each innovation has for helping Greater Manchester achieve its strategic goals.

Figure T1: Approach to Technological Developments



	Minor	Moderate	Major
Unlikely	Safe	Safe	Avoid
Possible	Safe	Safe	Avoid
Likely	Explore	Explore	Explore with caution

[1] GMCA and Greater Manchester Local Enterprise Partnership, 'Greater Manchester Transport Strategy 2040' [online]. Available at: https://www.tfgm.com/2040 [accessed 16 Feb. 2018]

Improving the customer experience

4. Some of the concepts that are emerging through technology and innovation will have a significant impact on improving the customer experience, the economy and the environment. This part of the evidence base sets out a range of initiatives that are already improving the customer experience, or could improve the customer experience in the future.

Focus on: Smart Payment Solutions

5. How people access and pay for services and products is changing. Traditionally in many UK towns and cities consumers have used paper based ticketing. However, many cities and countries have since largely moved to account based ticketing, including smart cards and mobile ticketing.

6. Initially, smart card systems were adopted by transport authorities to offer a more convenient mechanism for accessing transport. Notable early smart card systems include London's Oyster Card. Greater Manchester has recently rolled out its own smart card system - the Get Me There scheme.

7. The Get Me There scheme is the city region's first step towards smart payment technology and offers the public the ability to plan journeys and buy tickets across multiple modes of transport through the use of both a smart card payment system and a mobile app. This scheme is managed by TfGM in partnership with other transport operators[2].

8. In other city regions, contactless payments (via credit and debit cards), smartphone payments and wearable technology payments (watches etc.) have now emerged as mainstream payment mechanisms for accessing services and products. In the UK, the rise in contactless payments has been swift. As of April 2017, over 108.4m contactless cards were in circulation in the UK[3]. Some transport authorities have taken advantage of the contactless payment rise by incorporating the mechanism into transport ticketing. In the UK, Transport for London lead on contactless payment systems for public transport access. In 2017/18, over 535 million journeys were made using contactless payment methods[4].

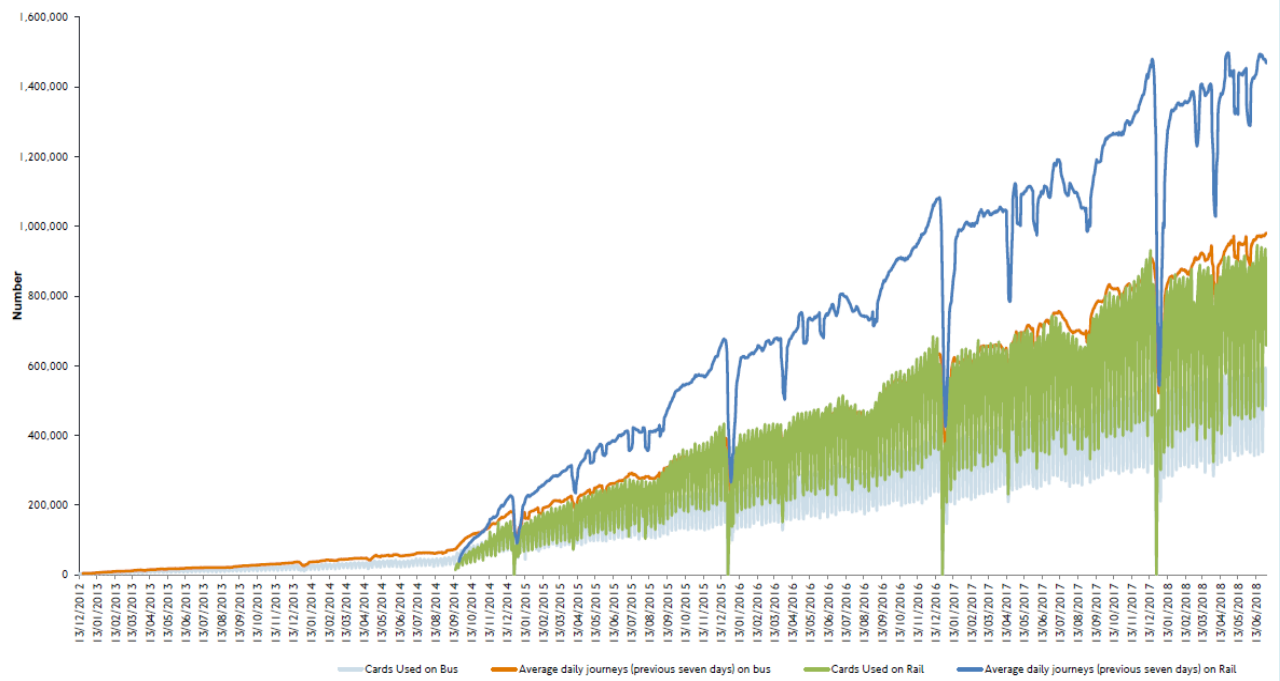
[2] Get Me There. 'The smarter way to get around' [online]. Available at: http://www.getmethere.com/about-getmethere.php [accessed 16 Feb. 2018]
[3] UK Card Association, (2017). 'Contactless Statistics' [online]. Available at: http://www.theukcardsassociation.org.uk/contactless_contactless_statistics/index.asp [accessed 16 Feb. 2018]
[4] Transport for London, (2017). 'Contactless Payment: analysis of contactless pay as you go journeys' [online]. Available at: https://tfl.gov.uk/corporate/publications-and-reports/contactless-payment [accessed 16 Feb. 2018]

Case Study: Contactless Payment, London

Contactless payment opportunities are the natural successor of smart cards, and Transport for London has set the global standard specification for contactless technology, working with the international banking industry. The rise of contactless payments has been significant since its launch in 2014. With very few marketing campaigns to promote contactless payments, consumers have adopted the new technology quickly, recognising the efficiency it represents when trying to access different transport modes. Contactless payments also reduce the overall cost of administering the smart payment system (when compared to the Oyster Card) for Transport for London[5].

Figure T2 below shows the average journeys per day and the number of unique contactless payment cards used on buses since December 2012 and on rail since September 2014. There is an evident positive correlation in both the average daily journeys made by both rail and bus in London and the numbers of these journeys paid for via contactless payments.

Figure T2: Use of contactless payments on Bus and Rail in London[6]



In June 2018 an average of 1,468,125 daily journeys were made in London via rail with 658,029 of these journeys paid for by contactless cards, which equates to 44.8%. In the same month an average of 980,816 daily journeys are made in London via bus with 484,489 of these journeys paid for by contactless cards, which equates to 49.4%.

[5] Hudson, M. (2015). Contactless Payments in Public Transport. Presented on 19/11/2015 at the POLIS conference, Brussels

[6] Transport for London, (2018). 'Contactless Payment' [online]. Available at: https://tfl.gov.uk/corporate/publications-and-reports/contactless-payment [accessed 22 Oct. 2018]

9. Transport for the North (TfN) also plans to implement an Integrated and Smart Travel Programme which aims to transform passenger experience in the North. The Integrated and Smart Travel Programme will be delivered in three key phases[7]:

- Phase 1: Focuses on building on existing schemes and commitments to deliver smart cards for rail travel across the North. Specific aspects of Phase 1 includes the replacement of traditional paper based tickets with smart rail season tickets, making smart tickets available via cards, online or mobile apps as well as introducing a range of platform validators and vending machines in stations to support introduction of smartcards.
- Phase 2: Focuses on making the same information currently available to rail passengers also available to bus and light rail passengers. Specific aims of Phase 2 includes the provision of fares data, sharing of disruption messaging across various formats, using an open data hub as well as supporting operators and transport authorities trial and develop technology to enhance later phases.
- Phase 3: Focuses on providing a London-style experience to the North with capped daily or weekly pricing on multi-modal journeys, and the ability to make contactless payments. Specific aims of Phase 3 includes the introduction of contactless payment, the promise that passengers will never pay more for a pay-as-you-go journey than a best value saver ticket and continue to build on aspirations of Phase 2 though the establishment of an account-based online presence and contact centre for customers.

Focus on: Mobility as a Service

10. "Mobility as a Service" (MaaS) is a concept that is becoming increasingly relevant for transport operators, planners and policy makers. MaaS integrates various forms of transport services (e.g. taxi, public transport and cycle hire) into a single customer experience, which is accessible on demand and uses a single payment application.

11. A MaaS system could enable customers to access all transport services required to facilitate their lifestyle choices, via a single, integrated portal. The services may be provided by a range of operators, but the customer accesses them in a seamless and simple way. The concept encourages an "eco-system" approach to service provision, identifying a transport network as a single inter-linked operation, and transport within that network as a flexible and convenient service. MaaS could also enable travel demand to be managed more effectively, improving overall network management[8].

[7] Transport for the North (2018). 'Integrated and Smart Travel' [online]. Available at: https://transportforthenorth.com/ist/ [accessed 22 Oct. 2018]
[8] Transport Systems Catapult (2016). 'Mobility as a Service: Exploring the Opportunity for Mobility as a Service in the UK' [online]. Available at: https://ts.catapult.org.uk/intelligent-mobility/im-resources/maasreport/ [accessed 22 Oct. 2018

Case study: MaaS4EU, Manchester

This project brings together seventeen partners from all sectors (academia, industry, users, transport authorities and ministries) to provide viable solutions for the MaaS realisation. The unique mix of experienced transport engineers, planners, modellers, economists, computer and data scientists, software developers, sociologists, legal advisors and policy makers within the consortium ensures a comprehensive approach to the MaaS concept and challenges is undertaken.

The main goal of MaaS4EU is to provide quantifiable evidence, frameworks and tools to remove the barriers and enable a co-operative and interconnected EU single transport market for the MaaS concept by addressing challenges at four levels: Business, End-Users, Technology, and Policy.

To undertake the project a living lab has been established in Greater Manchester and individuals have be recruited to use the services in real life conditions, while their travel patterns are evaluated during their use of the services. The result will be the definition of user models which can inform personalised mobility packages for MaaS service planners. Around 400 individuals are being recruited in Greater Manchester, to use the services for four months to enable an in-depth data gathering exercise, allowing partners to thoroughly evaluate and understand travel behaviour and customer experience.

Case Study: Whim, West Midlands (MaaS)[9]

Elsewhere in the UK, the West Midlands became the first region to pilot MaaS to its residents. Backed by Transport for West Midlands (TfWM) and the West Midlands Combined Authority (WMCA) the pioneering service, 'Whim', was launched by the MaaS operator MaaS Global in the West Midlands metropolitan area in early 2017. From the mobile app, users are able to access all modes of transport including National Express bus and metro tickets, routes and timetables, Gett taxi services as well as bicycles through Whim's partnership with nextbike. These smarter travel solutions are designed to cost less than the average monthly cost of running a car.

At present, Whim offers the following monthly subscription plans:

- *Pay as you Go:* Pay as you Go for public transport, taxi and car (£0).
- *Whim Everyday:* Unlimited public transport; Pay as you Go for taxi and car (£99).
- *Whim Unlimited:* Unlimited public transport, taxi and car (£349).

[9] Whim (2018). 'Travel Smarter' [online]. Available at: https://whimapp.com/uk/ [accessed 22 Oct. 2018]

12. For MaaS to be successful in Greater Manchester, TfGM could have an important role to play in informing customers about the availability of such services, ensuring the services are easily accessible and encouraging the development of 'one-stop-shop' platforms/gateways that simplify and integrate multiple service options.

Focus on: Applications and Social Media

13. Travel time has traditionally been considered unproductive, wasted time. As technology has advanced, transport users have been able to take advantage of mobile devices to improve their journeys. A Norwegian study highlighted that around 65% of commuters and 47% of business travellers felt their journeys are more productively spent if they are connected to the internet via an electronic device[10].

14. Improvements in consumer satisfaction, through the implementation of effective technological developments, could lead to an increased attraction of "choice-users": public transport users who have access to a car, but choose public transport instead as it represents an easier and more efficient method of travel.

15. Customer satisfaction can also increase or decrease due to the customers' ability to provide feedback that will be acknowledged and considered. TfGM currently operate across multiple social media platforms, but with limited timings and ability to respond to customers in real-time.

Case Study: Social Media at KLM Airways

In response to the volcanic eruption in Iceland in 2010, KLM introduced a social media team to respond to customers who use their services. Originally it started with volunteers providing the service in a time of crisis. It has since expanded to a full-time team of 250 staff, the world's largest dedicated social media team, that operate across Facebook, Twitter and WeChat, responding to customers' questions and complaints.

As of 2017, KLM has over 25 million followers across numerous social media platforms. Information regarding response times are displayed and updated throughout the day, and the service operates twenty four hours a day. KLM's customer satisfaction has increased through the implementation of this dedicated service, which allows customers to speak to KLM staff in real-time, and across channels that are convenient for them. In 2017, KLM also expanded their social media information provision to include world booking confirmation, check-in notification and boarding pass access for customers who book tickets or check-in via KLM.com[11].

[10] Gripsrud, M., & Hjorthol, R. (2012). Working on the train: from 'dead time' to productive and vital time. *Transportation*, 39, pp. 941-956.

[11] KLM, (2017). 'KLM takes next strategic social media step with flight info on Twitter and WeChat?' [online]. Available at: https://news.klm.com/klm-takes-next-strategic-social-media-step-with-flight-info-on-twitter-and-wechat-en/ [accessed 16 Feb. 2018]

KLM is also taking the next step in using artificial intelligence (AI) within its social media service. KLM worked with AI frontrunner, DigitalGenius, to add automated answers to general repetitive questions from customers without the intervention of a human service agent. This gives KLM agents more time to focus on questions in conversations with customers that require a human approach. KLM is the first airline to offer a combination of human agents and artificial intelligence in a single conversation on Twitter, Messenger and WhatsApp[12].

16. Table T1 below provides a summary of the measures related to customer experience and the potential implications for delivering the 2040 Transport Strategy.

Table T1: Measures to Improve Customer Experience

Concept	Potential implications for 2040 Strategy	Risk associated with innovation
Smart payment methods: transport payments made via contactless bank card or smart device as well as smart ticketing	Positive for economy, environment and quality of life. This innovation removes the need for paper tickets, saving time and resources at the point of use. It also removes the need for transport operators to handle cash, reducing the boarding time for some transport modes. However, additional consideration will be needed to ensure data collected is stored securely.	Technology is well-established elsewhere; work with other transport operators to implement as a priority, building on initial Get Me There roll-out
Mobility as a Service (MaaS): an integrated mobility concept which enables equal accessibility, affordability and reliability for users. It also lessens the need to own a private vehicle through sharing systems	Positive for economy, environment and quality of life, if organised effectively in partnership with GM authorities and TfGM. Mobility as a Service requires high levels of collaboration and projects that support each other.	Explore with caution – there is a possibility that this could lead to more private car trips at the expense of public transport (depending on the form MaaS takes in Greater Manchester)

[12] KLM, (2017). 'KLM's next step using artificial intelligence on social media' [online]. Available at: https://news.klm.com/klms-next-step-using-artificial-intelligence-on-social-media/ [accessed 22 Oct. 2018]

Implications for Greater Manchester

Greater Manchester will need to remain proactive in research and development to ensure opportunities that improve the customer experience are exploited and any potential remove pain points is maximised to the full. New technologies and innovations could offer new methods in access, information provision and Travel Demand Management, but only if used effectively across an integrated transport network.

Improving Performance and Resilience

17. In busy urban environments, there are often limited opportunities to increase the capacity of the transport network without significant negative impacts. However, increasingly technology can be used to improve the performance and efficiency of existing infrastructure. Some key opportunities for new technologies to improve network performance are highlighted below.

Focus on: Connected and Autonomous Vehicles

18. Connected and Autonomous Vehicles (CAVs) are emerging as a disruptive innovation, and are being developed with urgency by multiple car and technology manufacturers, such as Google and Tesla. The estimated market value for connected and autonomous road vehicles in the UK is estimated to be over £28 billion in 2035, which represents around 3% of the potential global market (£907 billion)[13].

19. CAVs could reduce congestion in urban areas, by exploiting the ability to safely drive closer together and therefore take up less road space. They could also free up significant areas of land in busy urban areas currently taken up by car parking if shared mobility is pursued (see "Mobility as a Service" above). New developments which have designated shared autonomous zones could offer between 15% and 20% additional developable area compared with a typical urban development[14].

20. The development of CAV technology could affect Greater Manchester in a variety of ways. Autonomous cars are being developed by major car manufacturers, and Greater Manchester will have to play a role in influencing the regulatory and infrastructure framework, and in determining how infrastructure may need to be adapted to accommodate such vehicles.

21. Security will also play a large role in the development of CAVs. The protection of data will be essential, along with security systems that prevent autonomous vehicles being hacked[15]. Similarly, the ownership and use of data used by and generated by autonomous vehicles will a critical issue for local authorities.

[13] Transport Systems Catapult (2017). Market Forecast: For Connected and Autonomous Vehicles. London: Transport Systems Catapult

[14] WSP (2016). Making Places Better: Autonomous Vehicles and future opportunities. London: WSP

[15] Bandyopadhyay, D., & Sen, J. (2011). Internet of Things: Applications and Challenges in Technology and Standardization. *Wireless Personal Communications*, 58, pp. 49-69.

22. Autonomous trains and buses are less talked about transport modes, when compared to autonomous cars. However, there are multiple examples of autonomous trains operating successfully around the world, including in China (Autonomous Rail Rapid Transit)[16], Australia[17], London (Docklands Light Rail) and Copenhagen[18].

23. In recognition of the potential benefits of autonomous vehicle technology, the government have set aside funding for the Centre for Connected and Autonomous Vehicles (CCAV), who have been charged with offering targeted investment, through competition funding, to enable innovative projects to be piloted in real-world scenarios. TfGM have played a key role, through discussions, consultations and applying for funding through CCAV, to ensure new opportunities which support the city region's wider goals are explored.

Case study – Trial project: Autonomous vehicles from Stockport Station to Manchester Airport[19]
The project involves deploying platoons of 3 electric powered, autonomous GTM sports cars to travel 10km, from Stockport train station to Terminal 2 of Manchester Airport (and vice versa), via a newly developed section of the A6 to Manchester Airport Relief Road. The trial also includes 3 autonomous pods to ferry passengers from a car park to the passenger terminals of Manchester Airport over a distance of 2km.

The project will focus on the operation and control of autonomous vehicles in a platoon formation, to reduce traffic congestion and carbon emissions; cyber security of data and virtual infrastructure; an interactive Artificial Intelligence concierge to improve the passenger experience; and the policy implications of autonomous vehicles in Greater Manchester.

Trials for the autonomous pods and platoons are scheduled to take place in 2019, with the project due to be completed by 2020.

[16] Dezeen (2017). 'Trackless, driverless "rail bus" takes to the roads in China' [online]. Available at: https://www.dezeen.com/2017/11/06/worlds-first-driverless-trackless-train-launches-china-zhuzhou-transport-design/ [accessed 16 Feb. 2018]
[17] Railway Gazette (2017). 'Rio Tinto operates first fully-autonomous test train' [online]. Available at: http://www.railwaygazette.com/news/single-view/view/rio-tinto-operates-first-fully-autonomous-test-train.html [accessed 16 Feb. 2018]
[18] Railway Technology. 'Copenhagen Metro, Light Rail and Metro Project, Denmark' [online]. Available at: https://www.railway-technology.com/projects/copenhagen/ [accessed 16 Feb. 2018]
[19] Synergy-cav.com, (2017). *Synergy CAV.* [online] Available at: http://synergy-cav.com/ [accessed 16 Feb. 2018]

Focus on: Car Sharing and Car Clubs

24. Climate change, congestion, transport costs and an increase in connectivity, are just a few of the many reasons for the current rise of the sharing economy in transport[20]. An increase in the use of shared vehicles could alter demand and patterns of transport usage across Greater Manchester. By preparing for shared-use mobility, Greater Manchester and its partners could also capitalise on the increasing popularity of low-emission vehicles[21].

25. The World of Collaborative Mobility argues: "[The Sharing Economy] is economically sustainable because it makes better use of existing capacities and requires no additional investments in infrastructures. It is ecologically sustainable because, by making better use of existing capacities, it spares finite resources; then again, it is socially sustainable because it promotes new forms of communal mobility organisation"[22].

26. Car clubs are currently being used in a variety of countries to support lower-car lifestyles and to tackle peak-hour congestion. Evidence shows that for each car club vehicle, four cars can be removed from the road due to members selling their car[23], equivalent to around 2,700 vehicles removed from the roads in England and Wales. This number varies depending on area, with Bremen (Germany) seeing between eight and eleven cars removed from the roads per shared vehicle[24].

27. Car clubs can also help increase wider transport provision in off-peak times, when public transport availability may be more limited. Currently, the majority of car sharing users are under 34 (50%), while a smaller percentage are over 50 (14%)[25]. In addition, 69% of car club members in the UK are male, compared to 54% of licence holders[26].

28. The technology associated with the consumer experience, operator management, fleet monitoring and digital mapping is developing rapidly. This should lead to a more convenient, flexible, on-demand service but also greatly improve the opportunity to integrate transport solutions within one system for the convenience of the customer.

29. Alongside improvements to the customer experience, shared mobility could also enable space to be used more effectively in dense urban spaces, particularly by reducing the need to provide car parking, offering new opportunities in place making.

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[20] CIVITAS (2015). Car sharing: New forms of vehicle use and ownership.
[21] Office for Low Emission Vehicles (2014*). Investing in ultra-low emission vehicles in the UK, 2015 to 2020*. London: Office for Low Emission Vehicles
[22] Beckmann, J. 'Collaborative mobility: Peer-to-Peer expands into the world of transport' [online]. Available at: https://www.wocomoco.org/assets/docs/Publikationen/CollaborativeMobility_E.pdf [accessed 16 Feb. 2018]
[23] Carplus (2014/15) Carplus annual survey of car clubs. Leeds: Carplus
[24] CIVITAS (2015). Car sharing: new forms of vehicle use and ownership. Brussels: European Union
[25] Kamargianni, M., Matyas, M., Li, W., & Schafer, A. (2015). *Feasibility study for "Mobility as a Service" concept in London*. London: UCL Energy Institute
[26] Carplus (2014/15) Carplus annual survey of car clubs. Leeds: Carplus

Case Study – Greater Manchester Car Club[27]

Greater Manchester Car Club has introduced to promote accessibility through the sharing of transport including cars. This concept has been introduced with the aim to save money, reduce carbon emissions and to improve sustainable travel choices for local authority staff and members of the general public.

A car club in Salford was established in 2015 with initial plans for 10 vehicles yet early demand led to an increase in the first three months to 21 vehicles including 4 electric vehicles. This increase in vehicle numbers has continued over time with 64 vehicles available across Greater Manchester including 4 electric vehicles in Salford. The number of members increased from 1,703 in December 2014 to 1,941 in December 2015, an increase of 238 members. It is planned that 1,200 members of Salford Council will be able to use the club for business travel in the future.

30. Car clubs members are three times more likely to be regular cyclists compared to the average person in England or Wales, twice as likely to be regular train users, and a third more likely to use the bus[28]. Changes to regulations, the reduction or removal of fuel costs, maintenance, insurance and purchasing could encourage more Greater Manchester residents to explore car sharing as a travel choice. This would contribute towards reducing congestion and lowering emissions across Greater Manchester.

Focus on: Drones

31. Online shopping has become increasingly popular in recent years, reshaping how we view the high-street. Airports may become a hub for delivery drones and logistics, past the traditional parameters and restrictions of air travel. Innovations in new materials and the understanding of aerodynamics mean that drones and other small-scale, air based transportation may become an economically feasible technology.

32. The Department for Transport has estimated that the social and economic benefits of drones in the UK by 2030 could be as much as £16bn in net cost savings, adding £42bn to GDP, with over 600,000 drone sector jobs[29].

33. However, drones can also be misused, risking safety, security and privacy. In the future the Government is focused on ensuring the potential of drones is harnessed for the UK, whilst appropriately addressing the risks[29]. In May 2018 the Government laid new legislation in the Houses of Parliament, amending the Air Navigation Order 2016, to introduce[29]:

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[27] Comouk (2016). Greater Manchester Car Club. [online]. Available at: https://como.org.uk/project/greater-manchester-car-club/ [accessed 22 Oct. 2018]

[28] Carplus (2014/15) Carplus annual survey of car clubs. Leeds: Carplus

[29] Department for Transport (2018). 'Taking Flight: The Future of Drones in the UK – Moving Britain Ahead' [online]. Available at: https://www.gov.uk/government/consultations/drone-legislation-use-restrictions-and-enforcement [accessed 1 August 2018]

- A height restriction of 400ft for all small drones;
- A 1km restriction on all small drone flights around protected aerodromes;
- A registration scheme for operators of small drones of a mass between 250g and 20kg inclusive; and
- Competence requirements for remote pilots of small drones of a mass between 250g and 20kg inclusive.

34. Exemptions can be made for innovative, commercial use of drones above 400ft or within 1km of a protected aerodrome boundary if the Civil Aviation Authority deems it appropriate and safe to do so[29].

35. These new measures, alongside an upcoming draft Drones Bill, are the first step in setting the UK on a path to be a global leader in the drones market, tackling misuse to build public confidence in drone technology and encourage positive, innovative drone use in the UK. These planned measures have recently become more urgent following the significant disruption to passenger flights at Gatwick Airport caused by a drone incident.

Focus on: ITS and freight and logistics

36. Freight and logistics generates 7% of the Greater Manchester economy and employs over 60,400 people[30]. With increases in online shopping and changes to delivery patterns, the freight and logistics sector, in collaboration with local authorities, will consider new advancements in technology and innovation to mitigate the impact of negative externalities of the sector on Greater Manchester residents.

37. Intelligent Transport Systems (ITS) are a combination of information and telecommunications technologies, enabling information gathering and sharing. ITS can be applied to road transport to improve efficiency and safety, to traffic control centres to improve monitoring and enforcement of regulations, and to city planning, using ITS solutions to reduce air pollution, noise pollution and reduce congestion in cities[31].

38. ITS is vital for "eFreight": technology enhanced freight and logistics operations, where "en-route" information on the location and condition of transport good is made available online[32]. This would enable transport authorities to monitor freight movements and ensure the transport network can work as effectively as possible.

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[30] Transport for Greater Manchester and Greater Manchester Combined Authority, (2017). 'Greater Manchester Freight and Logistics Transport Strategy' [online]. Available at: https://www.greatermanchester-ca.gov.uk/download/meetings/.../download_the_report [accessed 26 Feb. 2018]
[31] Intelligent Transport Systems UK, (2016). 'What is ITS?' [online]. Available at: http://its-uk.org.uk/about-its-uk/ [accessed 23 Feb. 2018]
[32] European Commission, (2016). 'Intelligent transport systems: Freight and Logistics' [online]. Available at: http://ec.europa.eu/transport/themes/its/road/application_areas/freight_and_logistics_en [accessed 26 Feb. 2018]

39. Alongside this, ITS can be incorporated into new consolidation of goods and items as well as modern procurement practices and can be used to better use alternative delivery means such as cargo bicycles. Harmonised information, collected through ITS, would also support services across modes, such rail and maritime freight and logistics operations.

40. Table T2 summarises the opportunities around using new technologies for improving performance.

Table T2: Measures to Improve Performance and Resilience

Concept	Potential implications for 2040 Strategy	Risk associated with innovation
Autonomous Vehicles: Cars with high levels of autonomy or do not require input from a human driver in the decision making process	Potentially positive overall for buses and trains, but fully autonomous cars may raise a number of potential concerns with congestion, safety, liability, health impact of increased car use, infrastructure requirements, and data privacy and ownership.	Explore with caution
Car sharing and car clubs to enable lower levels of car ownership and use	Positive overall for travellers, as it offers accessible, flexible transport without the need to own a private vehicle.	Safe
Intelligent Transport Systems improving freight and logistics practices	Positive to improve freight and logistics and network monitoring.	Safe
Application of drones for network management, deliveries and emergency response	Positive overall for transport and city region authorities as it would improve efficiencies and reduce costs.	Explore with caution – no certainty of application of drones, concerns over drone safety especially over shared airspace with commercial aircraft

Implications for Greater Manchester

Greater Manchester is currently a test bed for a number of initiatives to improve the performance and resilience of the transport network through technological innovations. It will be important to ensure this engagement in research, development and deployment continues, as it will support wider aims to achieve improved performance and secure increased resilience across the transport network in future.

Improved access to better data

41. Data is becoming increasingly valuable, and a cause for concern by some members of the public. How data is stored and used requires multiple guidelines, protocols and security systems. How Greater Manchester addresses these issues, along with gaining and maintaining the trust of those whose data are held, will affect how, and how much, data are stored by transport services.

42. Increased connectivity, more access to consumer data, and more flexible patterns of movement will change how consumers travel and the quality of service they demand. One way of improving customer satisfaction, through dedicated information provision, is providing real-time information to customers' mobile devices.

Focus on: Using Internet of Things and 'big data'

43. The "Internet of Things" (IoT) refers to the interconnection via the Internet of computing devices embedded in everyday objects, enabling them to send and receive data.

44. The (IoT) concept has a range of potential applications for transport. For example, it could be used to improve the customer experience on public transport through providing information and understanding customer needs in new and innovative ways[33].

45. Applications for the IoT range from transport, health, education, employment, and in the home. Estimates for the number of connected objects differ greatly, with some organisations anticipating 20.4 billion objects will be connected by 2020[34], which equates to almost 3 objects per human being on Earth.

46. In the coming years, educational, interesting, and entertaining technologies could be piloted on our transport networks, such as: games apps that promote healthy travel behaviour; smart, interactive surfaces that educate users of different ages; travel promotions; and applications that support a more seamless, pleasant journey experience.

[33] Arup, (2014). 'Future of Rail: 2050' [online]. Available at: https://www.arup.com/publications/research/section/future-of-rail-2050 [accessed 16 Feb. 2018]
[34] Gartner, (2017). 'Gartner Says 8.4 Billion Connected "Things" Will Be in Use in 2017, Up 31 Percent From 2016' [online]. Available at: https://www.gartner.com/newsroom/id/3598917 [accessed 16 Feb. 2018]

Case study – ProRail, the Netherlands[35]

ProRail (the Dutch equivalent of Network Rail) is having to deal with rising passenger numbers that are putting pressure on the rail network in the Netherlands. Together ProRail and NS Dutch Railways are developing a new transfer process for platforms to improve passenger experience. This process involves the installation of a trial 180m 'Intelligent Platform Bar', showing real-time boarding information including seat availability and where wheelchairs and bicycles can board incoming trains. This increase in information available to passengers is essential to ensure efficient use of platforms to reduce delays.

47. Supportive regulations, security measures and campaigns to ensure public confidence in operations which utilise citizens' data will be important here. The EU General Data Protection Regulation that was enforced in May 2018 has been designed to solve these issues surrounding data by harmonizing data privacy laws across Europe, protecting and empowering all EU citizens data privacy as well as reshaping the way organizations across the region approach data privacy[36].

48. A summary of currently relevant concepts is shown in Table T3.

[35] ProRail (2018), Straks makkelijker instappen op station Schiphol Airport. Available at: https://www.prorail.nl/nieuws/straks-makkelijker-instappen-op-station-schiphol-airport [accessed 24 Oct 2018]
[36] European Union, (2018). '2018 reform of EU data protection rules' [online]. Available at: https://ec.europa.eu/commission/priorities/justice-and-fundamental-rights/data-protection/2018-reform-eu-data-protection-rules_en [accessed 22 Oct. 2018)

Table T3: Measures to Improve Access to Data

Concept	Potential implications for 2040 Strategy	Risk associated with innovation
Analysis of IoT 'big data' (e.g. mobile phone and telematics) to inform service provision	Positive for the economy and quality of life. It may have positive environmental impacts in the long term.	Explore
IoT embedded in homes and physical objects: Sensors which enable physical objects to be connected to the internet, and by extension users who are not in close proximity to the object	Positive overall, although it may have a disruptive effect on the economy in the short term as shopping and other leisure activities can be undertaken at home instead of in urban areas. Security will play an important role to protect personal information stored through devices in the home.	Explore with caution

Implications for Greater Manchester

The ability to gather data and use it to improve service delivery and investment would have a significant impact on how the transport network in Greater Manchester runs daily, during events and also major disruptions. New opportunities are emerging in data collection, storage and utilisation, and TfGM will need to continue to be proactive in this area.

Reducing the need to travel

49. Technology embedded into homes, along with improvements in web based services, will affect services and provision requirements across the transport network.

Focus on: Changes to work patterns altering traditional ideas of "peak time" travel

50. Greater Manchester's "Get Digital" campaign, which aims for Manchester to become a Digital City by 2020 through the implementation of fibre optic broadband across the city region, will encourage more businesses to consider flexible working patterns for their employees[37].

51. If more employees choose to work from home, and use their travel time for leisure purposes, we may see a change in peak-time travel, with travel becoming more spread out through the day, and increasingly into the evening as they take advantage of the night-time economy.

52. However, whilst flexible working opportunities have existed for some time, a 2016 CBI report found that only one in ten job listings offered flexible working[38].

Focus on: 5G Communications

53. Many current and emerging technologies rely on robust communications systems. To date, 3G and 4G have limited the spread and uptake of technologies for a number of reasons. However, work is currently ongoing to develop the next generation of mobile network.

54. 5G (5th Generation Mobile Network) is expected to handle more data, significantly reduce latency, reduce battery usage and be demonstrably more reliable for users. 5G research has been underway for some time, but is not expected to be rolled out until 2020 at the earliest. The UK's largest network operator, EE, launched a live 5G trial in Tech City – roughly the area between Old Street and Shoreditch in London – in November 2018. Five small businesses and five homes will have the chance to get connected to trial the new technology, using prototype 5G broadband devices[39].

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[37] Greater Manchester Combined Authority (2017). 'Get Digital' [online]. Available at: https://www.greatermanchester-ca.gov.uk/news/article/238/ [accessed 23 Feb. 2018]
[38] CBI (2016). 'People and Partnership: CBI/PERTEMPS Network Group Employment Trends Survey'. Available at: www.cbi.org.uk/cbi-prod/assets/File/pdf/ETS_report_proof_X.pdf [accessed 16 Jan. 2019]
[39] EE (2018). 'EE switches on 5G trial sites in East London' [online]. Available at: https://newsroom.ee.co.uk/ee-switches-on-5g-trial-sites-in-east-london/ [accessed 19 Jan. 2019]

55. Whilst there will be benefits for mobile device users, some of the real benefits will be seen by new technological developments, such as autonomous vehicles, the Internet of Things and advancements in the health sector in relation to wide-area sensing (objection or situation detection) outside of hospital boundaries or remote, real-time surgery[40].

56. Travel to health and education facilities could change in the future, with more services being offered through connected devices in the home. Web based educational courses are becoming increasingly popular, and web based NHS diagnosis services have also recently been implemented. Both of these, along with other variables, will affect how users choose where, and when, to access transport services.

57. A summary of relevant trends and measures that may reduce the need to travel is shown in the table below.

Table T4: Measures that may reduce the Need to Travel

Concept	Potential implications for 2040 Strategy	Risk associated with innovation
Creative spaces in urban areas to facilitate business opportunities outside of traditional offices	Positive overall for city region residents and visitors as it enables more flexible working arrangements, with the potential to offer a better work-life balance.	Safe
Changes in work/leisure patterns: travel times becoming more dispersed and changing traditional notions of "peak travel" due to more home working and shopping	Positive overall, but may affect public transport operations if the spread of travelling is no longer largely over peak hours. Smaller on demand services may become more effective.	Explore
5G communications improving connectivity for consumers, operators and authorities	Positive overall for connectivity, data speeds, lowering latency and offering users a wider range of services that can be accessed with mobile devices such as smart phones and tablets.	Safe

[40] Tech4i2, Realise Wireless, CONNECT, InterDigital (2016). Identification and quantification of key socio-economic data to support strategic planning for the introduction of 5G in Europe. Brussels: European Commission

Implications for Greater Manchester

Reducing the need to travel could have positive effects on congestion, journey times and safety, during both peak and off-peak hours. Many of the potential solutions will be market led and Greater Manchester could help support businesses and organisations who wish to adopt a more flexible approach to working and employee engagement, and also new technologies which utilise autonomous systems. There could be a need to develop new policies and regulations to ensure strict guidelines are set to protect residents' data and safety.

Reducing transport's impact on the environment

58. Finite resources, limited capacity for infrastructure expansion in the Regional Centre, and a growing population will put pressures on multiple aspects of the transport network in the next twenty five years. Alternatives in fuel, and how consumers choose to travel, represent possible ways to alleviate pressures on the transport system.

59. Encouraging consumers to choose more sustainable transport options, which have positive benefits on their finances, health and productive use of time will increasingly become a focus as the population increases in size and the number of elderly resident's increases.

60. Metroshuttle already takes advantage of a hybrid fuel system on numerous routes in the city centre, Bolton and Stockport (with some electric vehicles in the city centre), reducing emissions considerably. Greater Manchester has also successfully bid for £3 million funding to reduce emissions from the region's bus fleet. This funding will be used to retrofit vehicles with technology to reduce tailpipe emissions of nitrogen dioxide and contribute to better air quality[41]. There could be potential for further implementation of clean fuel technologies on the bus fleet as part of potential reform of the bus market or a future Clean Air Plan for Greater Manchester.

Focus on: Electric vehicles

61. The UK government has reaffirmed its commitment to a future zero emission vehicle fleet with the announcement this year of plans to ban the sale of new petrol and diesel cars in Britain by 2040. One of the key means of achieving this is to encourage an increase in the uptake the electric vehicles and investing in the supporting infrastructure.

62. The Office of Low Emission Vehicles (OLEV) was established to kick-start growth in the electric vehicle market. Current UK objectives are set as[42]:

- every new car an Ultra-Low Emission Vehicle (ULEV) from 2040 and an effectively decarbonised fleet by 2050 to meet our Carbon Plan targets;
- a network of supporting infrastructure that ensures ULEVs are an attractive customer proposition;
- world class skills and facilities for the development and manufacture of ULEV technologies, exporting vehicles globally;

[41] TfGM (2018). 'Greater Manchester Mayor welcomes clean bus funding' [online]. Available at https://www.tfgm.com/press-release/clean-bus-funding [accessed 22 Oct. 2018]
[42] Greater Manchester Low Carbon Hub Board (2018), Electric Vehicle Update in GM [online]. Available at: https://www.gmcameetings.co.uk/meetings/meeting/553/low_carbon_hub_board [accessed 21 Jan. 2019]

- a smarter electricity grid that maximises the benefits to vehicle owners and the electricity system from the shift to ULEVs; and
- All of the above combining to make the UK the best place in Europe.

63. During 2018, more than 60,000 plug-in electric cars were registered in the United Kingdom. The UK's total number of ULEVs (including both electric and plug in electric) now stands at over 200,000, more than double the number of ULEVs registered in 2016[43].

64. Greater Manchester is determined to follow this national policy to increase the uptake of electric vehicles and provide the infrastructure required. The Greater Manchester Electric Vehicles (GMEV) scheme was therefore introduced to help the population access support and advice when making the switch to electric vehicles. The impact of this scheme can be seen by the increase in the number of drivers registering from 48 in 2013 to 1,808 in January of 2018[44].

65. In terms of supporting infrastructure Greater Manchester has so far installed 324 public charging sockets comprised of 160 dual headed 15kKW posts (7KWper unit) with 4 rapid chargers across the region. By mid-2018, over 180,000 Individual charging sessions had been registered with an average 42,430 KW/h drawn from the GMEV network each month[44].

66. Based on data for Q3 of 2018, there were 3,353 registered ULEV vehicles in Greater Manchester[45]. The UK Climate Change Commission has set a target for all car sales to be ULEVs by 2040. Within Greater Manchester, this would mean sales of 6,300 vehicles in 2020, increasing to 25,600 sales in 2025[44].

67. The uptake of electric bicycles would also provide transport for commuters living between 5km and 20km away from their work destination. With the ability to travel at speeds of up to 20kph, journey time differences between electric bikes and car are reduced[46].

68. Data from the 2011 Census shows that 20.8% of car journeys commuting from Greater Manchester into the city centre are between 10km and 20km; 32.3% are between 5km and 10km; and 12.9% are less than 5km[47]. These journeys represent a potential market for electric bicycles across Greater Manchester.

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[43] Next Greencar. 'Electric car market statistics' [online]. Available at: http://www.nextgreencar.com/electric-cars/statistics/ [accessed 21 Jan. 2019]
[44] Barlow. N. (2018) Greater Manchester powers ahead with electric vehicle charging network [online]. Available at http://aboutmanchester.co.uk/greater-manchester-powers-ahead-with-electric-vehicle-charging-network/
[45] Department for Transport. 'Table VEH0132' [online]. Available at: https://www.gov.uk/government/statistical-data-sets/all-vehicles-veh01 [accessed 21 Jan. 2019]
[46] Umwelt Bundesamt (2014) *Electric bikes: get things rolling*. Dessau-Rosslau: German Federal Environment Agency.
[47] TfGM analysis of Office of National Statistics (2011) Census data

Focus on: Bicycle sharing schemes

69. Bicycle sharing schemes have become significantly more popular in urban areas over the last decade, and Smart bicycle sharing schemes are the latest evolution of this trend. Smart bicycle schemes depend on information technology-based systems to offer better services in electronic payment systems, GPS tracking as well as better managed docking systems[48].

70. Public-private partnerships are a popular means of funding bicycle sharing schemes, with this model being utilised in London, Germany, Canada and the Netherlands. Smart bicycle sharing schemes allow for the gathering of data from users, to help plan and efficiently control traffic management.

71. Dedicated cycle lanes, with cycle highways outside of dense urban areas, would allow for an increase in bicycle usage across Greater Manchester. The expansion of cycle hubs near interchange points would also facilitate an increase in bicycle use.

72. Following the recent departure of Mobike, TfGM and the local authorities are now actively pursuing opportunities for a new bike sharing scheme to be implemented in Greater Manchester.

73. Relevant concepts and opportunities that may impact the economy, environment and residents' quality of life have been listed in Table T5.

Table T5: Measures with Environmental Implications

Concept	Potential implications for 2040 Strategy	Risk associated with innovation
Electric vehicles	Positive overall if it enables the city region to exploit all available assets.	Explore
Bike sharing	Positive for environment, health and quality of life. Allows more residents and visitors access to bicycles when they need them and the ability to leave the bicycle somewhere when they do not. However, Greater Manchester will need to ensure schemes are adequately managed to prevent issues such as street cluttering.	Explore with caution

[48] Cichosz, M. (2013). IT solutions in logistics of smart bike-sharing systems in urban transport. *Management,* 17, pp. 272-283.

Implications for Greater Manchester

A key ambition in Greater Manchester is to improve the air quality for residents and visitors. To ensure goals and aims are met, Greater Manchester will need to continue to work towards creating an environment that supports and positively promotes the use of low emission vehicles, electric vehicles and active travel.