

COVID-19 Cross-Group Benchmarking Review of Recent Activities: Public Report



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 Projects

Overview

The purpose of this document is to help operators optimise their response to the ongoing COVID-19 pandemic by sharing knowledge and experience from a wide range of organisations globally, including many of the largest operators in the world's major cities. The focus is on both short-term measures to deal with specific challenges arising from the pandemic in the present, as well as on longer-term impacts, such as the funding crisis or more permanent changes to travel patterns and behaviour, that operators are having to respond to and plan for.

This document summarises recent updates and key findings related to COVID-19, sourced from the benchmarking group members and activities within the groups: over 100 metro, rail, bus and light rail operators participate in the international benchmarking groups (see Appendix A for a list of benchmarking groups and members) managed through the Transport Strategy Centre (TSC) at Imperial College London.

All information provided is anonymised to respect confidentiality rules of the benchmarking groups (unless any information has been sourced publicly).

Full references of relevant literature on COVID-19 in the transport industry are provided at the end of this document, along with a short description for each piece of research.



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A change in the global picture for public transport: continued easing vs. the reintroduction of restrictions

The COVID-19 pandemic has presented the public transport sector with significant and unique challenges, and operators continue having to adjust to changing priorities as the crisis evolves. The COVID-19 Delta variant is potentially changing the course of the pandemic with some cities and countries now being hit much harder relative to previous outbreaks in this pandemic. A consequence is that we are starting to see a slight change in the global picture for the public transport sector. On the one hand we see the **reintroduction of restrictions and declining demand** in some cities, particularly in parts of Asia-Pacific where there are concerns around outbreaks of the Delta variant. In contrast, higher vaccine coverage in Europe and North America has led governments to **continue easing restrictions** (despite growing case rates) and **public transport demand is steadily growing** in these locations. Metro services were temporarily halted in Delhi, Sydney Trains demand has fallen with new lockdown measures, recovery in London appears to have been held back, yet June patronage on the Paris metro exceeded 70% of 2019 demand.

One aspect that has come under scrutiny following the UK government's decision to proceed with the final phase of its COVID-19 exit roadmap, is the wearing of face masks. In July, the UK government removed all legal restrictions imposed during the pandemic, including the requirement for passengers to wear face masks on public transport, and operators in England were instead asked to develop their own policies around masking requirements. Many organisations, including Transport for London and Newcastle Nexus, have responded by keeping their **masking requirement as a condition of carriage**. The obvious questions are whether compliance will continue, and whether the mixed messaging around face masks, and differences between national guidance and operator requirements, not only causes **confusion amongst passengers**, but also **heightens anxiety around public transport travel**. In particular, passengers who have mostly stayed away from public transport throughout the pandemic, or are vulnerable, may begin to **feel less safe using public transport** as masking requirements are removed. Similarly, there is a risk that staff may feel too exposed working in an unmasked environment, which could impact on staff availability. This newsletter reports on driver shortages and absenteeism which are already an issue in some locations and have been worsened by the pandemic situation. Both **staffing issues** and changes

in the **perception of safety** on public transport could be a significant challenge for operators and risk disrupting demand recovery. Nonetheless, passenger demand may grow amongst younger age groups with the reopening of entertainment venues. The UK approach is at odds with practice in almost all other countries; therefore its experience may inform other operators whose governments also relax their own COVID-19 stringency measures.

At an operational level, public transport supply has remained at generally high levels throughout the pandemic despite the continued uncertainty around demand recovery. In this newsletter, we show that, across modes, operators had reasonably **small service level cuts** and levels have typically been maintained at **twice the level of demand**. One of the reasons for maintaining high service levels, is the provision of sufficient capacity to allow for social distancing requirements to be met. Where capacity restrictions were implemented for this purpose, many are now beginning to lift in line with government recovery plans. As demand continues to recover from very low levels in Europe and the Americas in particular, passengers are likely to experience less opportunity for social distancing, **higher levels of crowding** and potentially **lower levels of reliability**. As such there is a risk that operators may see customer satisfaction drop from the high levels measured during the pandemic.

It will be interesting to monitor how the pandemic impacts on customers' changing priorities and what this means for the public transport sector in terms of responding to and managing customers' evolving needs.

New COVID-19 outbreaks and declining demand in Asia/Pacific (with metro levels now below European demand)

Recent Metro Demand Trends

Average metro ridership by region as a proportion of pre COVID-19 demand (indexed to January or February 2020) is shown in Figure 1. The graph is based on daily demand data that is collected in the COMET metro benchmarking group.

- In Europe, average metro demand has experienced significant growth, with demand recovery to just over 60% on average in June and thereby **exceeding average demand in Asia/Pacific for the first time during this pandemic**. Although infection rates remain high, and are growing rapidly in many cities where cases of the Delta variant are increasing, the easing of national restrictions across much of Europe is reflected in growing passenger demand and several metros are now seeing their highest levels of demand since the start of the crisis.
- In Asia/Pacific, consistently strong demand, averaging around 70-75% of pre-pandemic levels earlier this year, has been impacted by new COVID-19 waves in recent months. In particular, **COVID-19 outbreaks in Taipei, Bangkok, Singapore and India have had the most significant impacts on metro demand** in the past couple of months.
- Although demand trends show that North American metros continue to experience the slowest recovery overall, this **growth is steady and has increased to levels of around 30% of pre-pandemic demand** in June and July.
- In Latin America, average demand in recent months is progressing on a **slow and steady upward trend**, following a return to around 40% of pre-pandemic demand toward the end of April. This trend isn't accurately reflected in Figure 1 due to gaps in recent data, however on an individual level, metro demand in the region is stable.

Comparison of recent Multi-Modal Demand Trends

Multi-modal demand across bus, metro, suburban rail and mainline rail modes were shown by region in the previous edition of this newsletter. Due to limited multi-modal data availability covering all modes and regions for recent month ridership levels, the focus of this newsletter is on the North American region only, and now includes data for light rail.

Figure 2 shows average bus, light rail, suburban rail, and metro ridership (indexed to January or February 2020) for operators in North America.

- Light rail and bus demand have followed a very **similar trend** throughout the pandemic, with bus demand growing slightly faster than light rail demand in recent months (between 10-20%), relative to pre-pandemic levels.
- Both bus and light rail demand have recovered to levels **more than double that of average metro and suburban rail demand** in the region, at around 45-50% of pre-pandemic

demand respectively.

- Suburban rail demand has been steadily recovering since February 2021 and this recovery trend has continued in recent months. Demand is **expected to recover further** throughout the summer months, particularly as the new school year starts, and people resume returning to workplaces.

Encouraging customers' first trip back is key and a renewed focus on quality is needed to restore demand

Crucial to recovery is gaining an understanding of customers (including both active customers and those not currently using public transport) to anticipate and influence travel behaviour.

A recent study within the metro benchmarking group identifies that around half of COMET metros have conducted **new COVID-19 customer surveys** to understand what customers expect in order to feel confident using the metro. Customers are reassured with the following:

- **COVID-19 safety procedures** are being followed and enforced.
- **Consistent use of face masks** is the highest priority.
- Assurance of **social distancing** and **visibility of cleaning**.

Regarding return to travel in the longer term, metros have deducted from the surveys that **8-15% of customers will not return beyond the pandemic**. However, the majority of customers have indicated that they expect to return when there is a low risk of infection, when vaccines have been made widely available or when they return to work.

Short Term Actions to Restore Confidence

In the short term, **encouraging customers to make their first trip back** is key: a North American metro has found that active customers generally feel much safer about metro travel as through regular travel they have become more aware and assured of the COVID-19 precautions in place.

- Transport for London's campaign titled '**We are ready when you are**'¹ centres its messaging around safety, hygiene and the independent viral testing on London's transport network, to reassure passengers and encourage travel.
- A North American railway's efforts to attract demand not only focuses on cleaning and disinfection but also **ensuring that trains look clean** to passengers.
- A European railway reports that cleaning currently takes place during the day, rather than at night: the reason for this is that **daytime cleaning is cheaper and more visible to customers**, hence increasing the perception of safety and hygiene.

Medium-Long Term Actions to Stimulate Demand

In the longer term, strategic and targeted communications are required by public transport providers to stimulate non-essential demand through marketing, fares promotions and stakeholder partnerships:

- Consider new ways to **reach inactive customers at home via social media**.
 - A North American operator has a new **podcast featuring interviews with celebrities while travelling on public transport**. The idea is to normalise the use of public transport and improve perceptions of safety.
- **Target particularly inactive customer segments** to respond to specific barriers and influence their travel behaviour.
- Work with local transport operators and national transport authorities to **deliver proactive marketing campaigns**.
- Communicate **the necessity and centrality of public transport travel** in everyday life.
- Consider new **fare promotions** or altering fare structures to new patterns of demand. Examples include:
 - Orange County Transportation Authority in California, USA, has developed two ridership campaigns for launch in September 2021:
 - » “Welcome Back” fare reduction campaign²: a six-month programme providing **discounted monthly and day passes by approximately 40%**.
 - » “Youth Ride Free Pass”³: a six-month promotion providing **free travel passes for children** aged 18 and under.
 - Foothill Transit in California, USA, is offering a **50% discount on all fare passes** from July 2021 as part of its Summer Sale campaign⁴ to support returning travel demand in the region.
 - Pinellas Suncoast Transit Authority in Florida, USA, is providing **free travel** from July 5th until 31st August as part of the launch of the new Flamingo Fares electronic payment card system for the Tampa Bay region.
 - The Danish Government has repeated a travel pass promotion⁵ offering **unlimited travel for 8 days** throughout Denmark for DKK 399. The promotion was available from 27th June to 9th August 2021 and designed to support domestic tourism in the country.
 - San Francisco BART has announced a 50% fare discount for all travel during September 2021.
- Consider **working with stakeholders in the tourism/leisure industry** to promote and stimulate non-essential travel.
- Consider how to **adapt facilities** and services to new ways of life and **new demand patterns** and accelerate the digital product offering.
 - Examples include incorporating click and collect delivery booths or parcel return centres, and improving Wi-Fi and 5G facilities.

Close to full service levels are typically maintained (despite substantial drops in demand)

Every service level decision involves inherent trade-offs, and there are both costs and benefits of reducing service. For example, a North American bus organisation reported approximate savings of 30,000 annual service hours in April 2021 as a result of reduced road congestion and ridership, improving commercial speed and reliability.

However, service cuts during the pandemic have also meant reduced fare income at a time when fixed operating costs have remained the same or even increased; and in some cases, service cuts have reduced capacity and removed the ability for passengers to socially distance at certain times of day, despite huge falls in demand.

Recent Service Level Trends

Average metro service levels by region as a proportion of pre COVID-19 service (indexed to January or February 2020) is shown in Figure 3. The graph is based on monthly service level data (revenue car km) that is collected in the COMET metro benchmarking group.

- Service returned to **almost 100% of pre-pandemic service in March 2021 for metros in all regions apart from Latin America**.
- Latin America is the only region where **average metro service levels are significantly below pre COVID-19 levels** at around 76%.
- Chinese metros continue to offer **service exceeding pre-pandemic levels** by up to around 24%, although this is largely driven by continued **network expansion** throughout the pandemic period.
- Metros in India have been significantly impacted by **long-term closures** throughout much of the pandemic in 2020. More recently, the impact of a further period of full closures for several weeks in May and June can be seen in Figure 3, when curbs were reintroduced in response to a surge in infection rates of the Delta variant.

Figure 4 shows average service levels by region by mode as a proportion of pre COVID-19 service (indexed to January or February 2020).

Figure 1:

Average metro ridership by region as % of pre COVID-19 demand
 Source: TSC/COMET

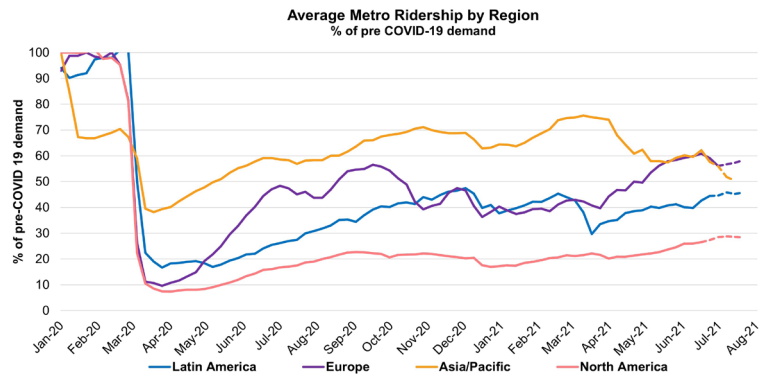


Figure 2:

Average North American ridership by mode as % of pre COVID-19 demand
 Source: TSC bus, light rail, suburban rail and metro benchmarking groups / National Transit Database (Federal Transit Administration)

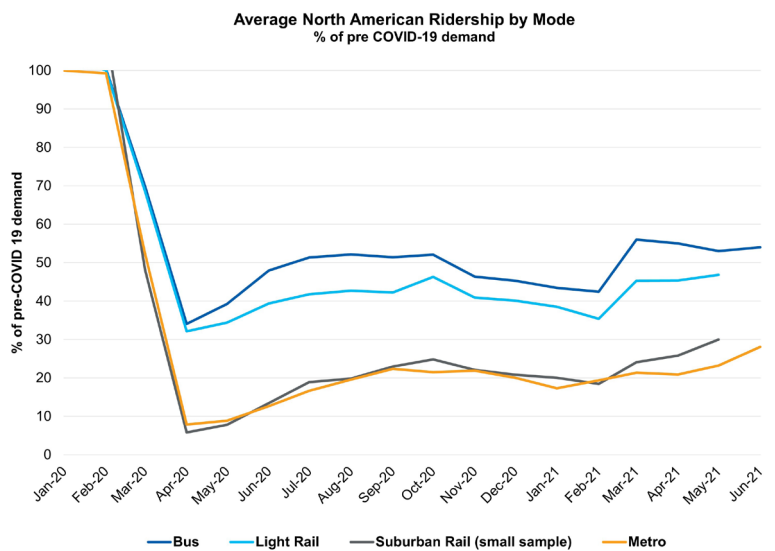
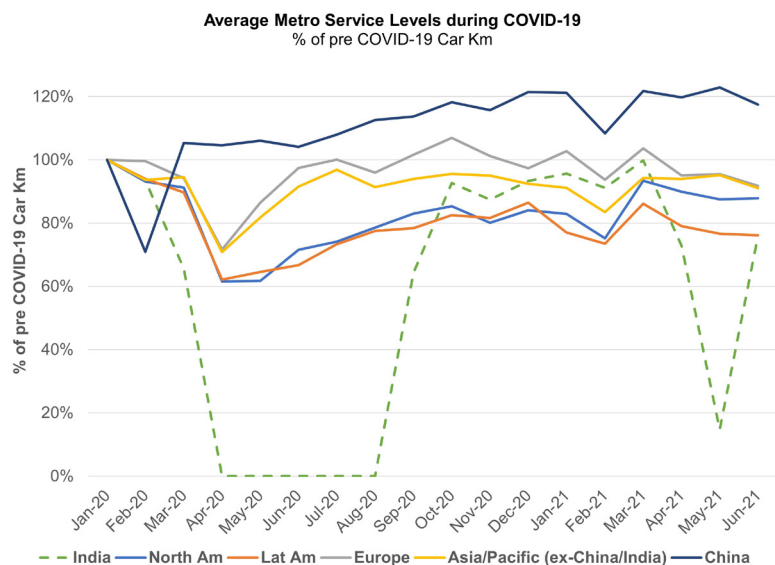


Figure 3:

Average metro service by region as % of pre COVID-19 service
 Source: TSC/COMET



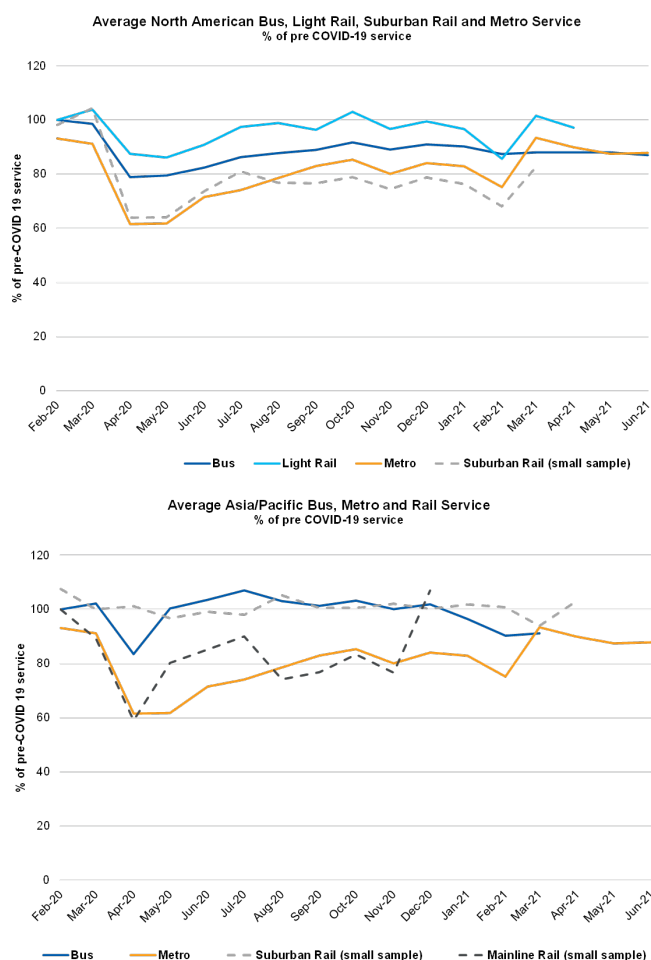
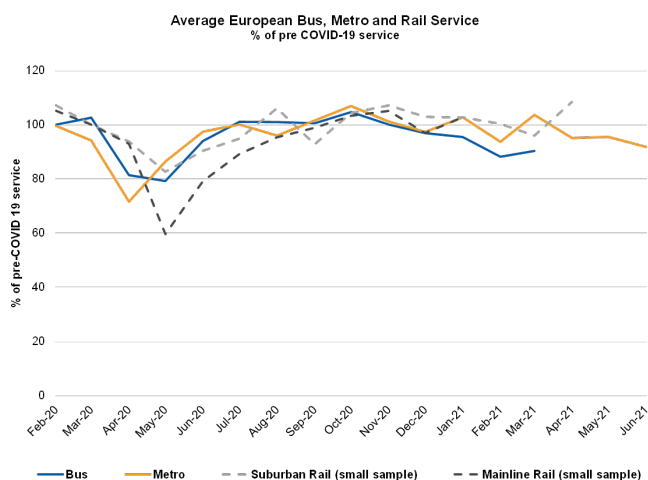


Figure 4:

Average bus, light rail, metro, suburban and mainline rail service by region as % of pre COVID-19 service
Source: TSC bus, light rail, metro and rail benchmarking groups / National Transit Database (Federal Transit Administration)



Across the regions, public transport service levels have remained high relative to much lower levels of demand:

- North American **light rail service has, on average, remained high throughout the pandemic** with service largely above 90% of pre-pandemic levels.
- Bus service levels in North America have recovered to an average of just below 90% of pre-pandemic service. Although 10% below the level of service offered by light rail in the region, **bus service has remained stable** throughout the crisis.
- North American **metro service dropped the lowest** of the four modes (followed closely by suburban rail service), however service recovered relatively quickly after the initial reduction in 2020. Service levels have been averaging above 90% of pre-pandemic service since March 2021.
 - San Francisco BART⁶, which has had the lowest service levels amongst COMET metros, has expanded service hours and implemented a significant increase to almost full service at the beginning of August 2021.
- In the Asia/Pacific region, average bus service returned to pre-pandemic levels faster than metro service following the initial drop at the start of the pandemic. Service has remained at **consistently high levels** throughout for both modes.

- Similarly, rail service has remained high in Asia/Pacific. Suburban rail service levels were kept close to pre-pandemic levels, whereas mainline rail service saw more of a drop to around 60-80% of pre-pandemic service levels, reflecting **changes in intercity travel**.
- Across the bus, metro and rail modes, **service levels in Europe have largely been kept high**. Mainline rail service saw the slowest return to pre-pandemic levels, reflecting the impact of strict travel restrictions in place across much of Europe during the pandemic.

As shown in the graphs, many public transport operators have maintained service at, or close to, pre-pandemic levels. In some cases this was a specific request from the government, to maximise capacity and accommodate social distancing despite below normal demand.

One benchmarking study found that on average between March 2020 and March 2021, **bus service levels were maintained at twice the level of demand**. Similar observations are made for metro service levels, with COMET metros seeing an average of 92% of pre-pandemic supply vs. 47% of pre-pandemic demand in June 2021. In addition to the social distancing rationale, providing a **static service supply irrespective of the changes in demand** is a factor in this decision.

Staff sickness, unavailability and driver shortages are contributing factors to lower service levels in the bus industry

In the bus industry, service levels largely returned to pre-pandemic levels by April 2021. As restrictions are increasingly lifting, more operators will be returning to pre-pandemic service levels.

However, staff sickness and unavailability can **limit the ability of operators to provide high levels of service** and may even result in the temporary reduction of service. North American bus organisations in particular, where driver shortages are a common issue and further fuelled by the pandemic, often face the challenge of having the necessary resources to operate a full service.

Service level flexibility –adapting service levels to rapidly changing scenarios amidst ongoing demand uncertainty

COVID-19 has showed that it is possible to flexibly adapt service levels in response to demand, but this requires a contingency planning effort. The pandemic has forced public transport organisations to repeatedly adapt service levels to rapidly changing scenarios –whether due to government policy, changing ridership patterns or staff availability.

As demand uncertainty continues, flexibility remains key: in the bus industry for example, being prepared for a range of scenarios can include developing several timetables in advance to help speed up the implementation of service changes and avoid multiple changes in a short-period of time; and having a catalogue of pre-existing service schedules will aid the **rapid implementation of service changes in response to different demand scenarios**: staff availability, social distancing requirements and future unexpected events.

Recovery plans: opportunities to improve service and better match resources to community needs

A North American bus operator is taking the opportunity to engage with its customers to **better match service and resources to current community needs**, rather than restoring service to 100% of pre-pandemic levels.

Washington WMATA⁷ has been evaluating **service and fare policy changes to support the region's recovery** from the pandemic. Approved changes include:

- Service improvements to provide more frequent all day metro service, including for weekday evening and weekend service (e.g. service running at a frequency of at least 12 minutes). These changes will be made in September for weekday service and late 2021 for weekend service.
- Extending metro service to midnight seven days a week (effective since July), and to 01:00 for Friday and Saturday service (from September).

Public transport capacity restrictions are beginning to lift in line with government recovery plans

Throughout the pandemic, there has been a mix of public transport operators **adopting capacity limits to keep occupancy below a threshold** to minimise virus spread, and those where capacity limits are not strictly adopted but instead social distancing is encouraged, if possible, with **customers asked to use their judgement** on whether or not to board a service. In some cases, low levels of demand have not necessitated any curbs to be adopted.

In recent months, as a result of government recovery plans and the associated easing of restrictions, many public transport operators have begun lifting any capacity restrictions on their systems, either fully or gradually as part of phased recovery periods.

Examples of public transport operators **lifting, or planning to lift, capacity limits** are described below.

- In London, bus capacity limits were doubled in May when the UK government lifted a first set of restrictions. This meant that all seats became available for use, excluding rear facing seats which continued to be blocked off from use. As the UK government announced the full easing of restrictions in July, bus capacity has returned to pre-pandemic levels, with all seats and standing available.
- Vancouver CMBC⁸ in Canada is beginning to lift capacity restrictions and is planning a return to pre-pandemic capacity later in the year. CMBC will continue to encourage passengers to create space where possible and plans to maintain some social distancing decals (e.g. at bus stops).
- Capital Metropolitan Transportation Authority⁹ in Austin, Texas, lifted all capacity restrictions in May 2021 in line with the easing of restrictions across the City of Austin.
- In Ireland, public transport capacity increased from 25% to 50% in April 2021. Capacity has since further increased to 75% in July 2021, in line with new measures announced by the government as part of their pandemic recovery plan (see announcements from Dublin Bus¹⁰ and Irish Rail¹¹).

In some cities, public transport **capacity restrictions continue to be enforced**. Examples include:

- Delhi DMRC is currently severely limiting train capacity in line with government regulations, with alternate seating only and no standing permitted.
- In Australia, affected states have brought restrictions back in in light of recent COVID-19 outbreaks. In New South Wales, for example, public transport capacity was increased to around 75% in April 2021, however the recent surge in cases has resulted in the operation of essential service or reduced timetables (e.g. Sydney Trains capacity is limited to 20% during the current lockdown).
- Metro Rio's train capacity is set to 60% by a state decree.

Some public transport operators are easing masking requirements for fully vaccinated staff; passenger masking remains mandatory

In the US, there is a split between operators following recommendations issued by the Centers for Disease Control and Prevention (CDC) and **removing the need for fully vaccinated staff to wear face masks in outdoor areas** (in some cases only in non-public outdoor areas), versus operators maintaining masking requirements for all employees. Where masking requirements are being relaxed for employees, **proof of vaccination is required**. The wearing of face masks **continues to be mandatory for passengers** per the country's federal mask mandate.

Passengers, in general, **continue to be required to wear face masks on public transport** across the majority of cities. This requirement typically aligns with a government mandate on masking.

In England, the recent relaxation of almost all restrictions relating to COVID-19 means that the wearing of face masks is no longer considered mandatory in any setting according to government law. Instead, businesses (including transport operators) are asked to make their own rules in relation to masking. Nonetheless, many public transport operators have chosen to maintain their masking rules, including Transport for London¹².

“The Mayor of London, Sadiq Khan, has asked TfL to keep the requirement to wear face coverings on public transport as a condition of travel on all TfL services after 19 July when the existing national legal requirement finishes. This would provide an extra layer of protection and additional reassurance to Londoners and visitors to the capital by going further than the Government’s updated messaging that it is “expected” and “recommended” that people wear face coverings on public transport, and support our city’s economic recovery.”¹³

Other operators are adopting more of a hybrid approach: in the case of DSB S-Tog in Copenhagen¹⁴, for example, face masks are no longer mandatory on public transport (seated on-board, on the platform or in stations) in line with Government policy effective from June, however, both staff and passengers are advised to continue masking when boarding, alighting, and moving on the train.

In Australia, where large-scale COVID-19 outbreaks had been contained until more recently, policy has changed and **face masks have only now become mandatory** on public transport.

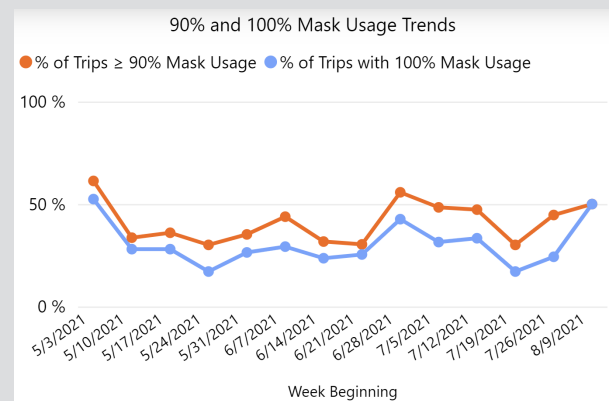
Interestingly, passengers on Moscow’s public transport network were, until recently, **required to wear both a mask and gloves**, with gloves now no longer mandatory.



Source: Moscow Metro

Measuring and Reporting Mask Compliance: Examples from New York MTA and Seattle KCM

- The MTA has been **measuring mask compliance** (based on observations) and **statistics¹⁵ are publicly available**.
- Seattle KCM is using **CCTV surveys** to measure mask use:
 - A **public dashboard¹⁶ on KCM’s website** includes a KPI on mask use by month.



Source: Seattle KCM

Practical examples to manage COVID-19 operational challenges

This section summarises recent information on practical examples or decisions around practices being considered by transport operators to manage operational challenges arising from the COVID-19 pandemic.

New York City has launched an extensive campaign to support a strong public transport recovery

- The MTA’s **#TakeTheTrain #TakeTheBus** campaign¹⁷ encourages ridership growth and a return to a cleaner and more reliable public transport network as the city recovers from the pandemic. The campaign takes four communication approaches:
 - **“New York is Open”**: targeting use of the Long Island Rail Road and Metro-North Railroad to travel to attractions in the wider metropolitan area.
 - **“Comeback”**: focus on New York’s continued recovery from the pandemic.
 - **“Public Transit is Better”**: emphasis on the improvements to public transport service (i.e. unprecedented cleanliness and reliability)
 - **“Signs of Affection”**: play on the subway design characteristics to encourage travel
 - **“Merchandise”**: campaign merchandise is sold via the New York Transit Museum’s online store.



Source: MTA New York

Reduced demand for season tickets and monthly passes is resulting in changing ticket types

A common observation across operators is the change in ticket types purchased as a result of the pandemic: people travel less frequently and no longer need season tickets and monthly passes (as well as reduced peak travel).

- A North American railway is planning to introduce a **new 20-trip ticket** to align with customers’ changing needs.
- The UK government has introduced **new flexible season tickets** to reflect changing working patterns:
 - The new tickets¹⁸ were launched in June 2021 across all major commuter routes, giving passengers access to a discounted ticket allowing for **travel on any eight days during a 28-day period**. There will be no need to select travel days in advance and traditional season tickets will continue to be available to passengers.

WMATA is pursuing opportunities for fare policy changes

Washington WMATA has approved plans to **simplify fares and support new travel patterns** in the region. Fare changes¹⁹ planned for September include:

- Free rail-bus transfers;
- USD \$2 flat fares on weekends and improved passes.

Transport for London and the UK Government have reached a third extraordinary funding agreement of GBP £1.09 billion (May to December 2021)

The UK Government and Transport for London (TfL) have settled on a **third extraordinary funding agreement**²⁰, which supports TfL operations from 29th May until 11th December 2021 amidst ongoing financial challenges due to the pandemic.

Conditions of the agreement include:

- Providing GBP £300 million in savings in 2021/22 and identifying a path to financial sustainability by April 2023;
- Conducting a joint options review of potential new funding streams generating between GBP £500 million to £1 billion from April 2023 (e.g. commercial development options such as providing housing on TfL land);
- Freezing pay in line with the public sector pay pause and reviewing TfL’s pension fund;
- Developing an implementation plan to accelerate TfL’s modernisation programme, and investigating driverless trains to deliver operational efficiencies;
- Conducting a service level review for all public transport modes: a review for London Underground and rail is planned to take place at the end of September, and a review for buses is taking place in July and September.

Lane Transit District in Eugene (Oregon) is incentivising vaccination in the community with a free 1-month bus pass

In the US, Lane Transit District is offering a “Vax Pass”²¹ for the month of August to vaccinated individuals. An application for the **free bus pass** can be made via a simple form on the operator’s website.

Pop-up vaccine clinic at the RTS Transit Center in Rochester (New York State) vaccinates 115 individuals

The **central location** of the clinic held on 26th May 2021 made the vaccine **accessible** to people who either didn’t have time or didn’t have easy access to a vaccination clinic. Following the success of the clinic and the positive response from the public, the Transit Center is hosting additional clinics throughout the summer months. All individuals receiving the vaccine are also given a free bus pass.

Jacksonville Transportation Authority has expanded its comprehensive set of transport services to vaccination locations

Jacksonville JTA (Florida, USA) has added further transport options to its comprehensive set of services²² providing access to vaccination clinics. The latest additions include a new **partnership with Uber** providing a door-to-door service to and from clinics.

Port Authority offering employees incentives to get vaccinated against COVID-19

Port Authority in Pittsburgh (Pennsylvania, USA) is paying USD \$200 to employees providing proof of a COVID-19 vaccination. In addition to the **incentive payment**, employees are entitled to two additional sick days for each vaccination dose in case of any side effects.

ZOONO cleaning chemical is effective but may not be sustainable in the long term given its high cost

The application of ZOONO on surfaces (including soft surfaces) provides an additional layer of protection lasting up to 30 days. The cleaning product is, however, **expensive and a high cost is associated with its application**: a medium sized European metro reports using a team of five persons in stations every day and needing three weeks to cover the full network.

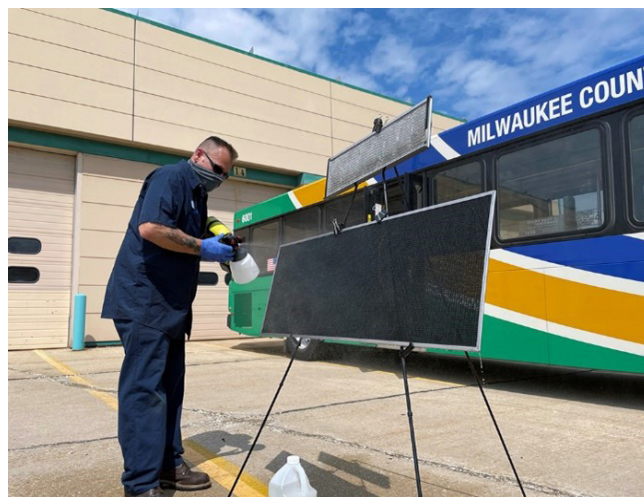
Bus air filtration devices to reduce the spread of airborne viruses

Examples of **new air purification methods** currently being used or installed on buses are provided by Capital Metropolitan Transportation Authority²³ in Austin, Texas, and Milwaukee County Transit System²⁴ in Wisconsin.

- Capital Metropolitan Transportation Authority’s device, Active Air Purification, is manufactured by United Safety and Survivability Corporation and is reported to **eliminate over 99% of microorganisms in the air and on surfaces**. The

maintenance requirements of the air purification device are minimal and involve the replacement of the UV bulb approximately yearly.

- Milwaukee County Transit System’s buses are in the process of being installed with the Aeris Guard Bioactive Filter Treatment manufactured by Aeris Environmental. The treatment is a spray which coats bus HVAC filters with a special polymer system that is reported to **control microorganisms for up to three months** after a single application.



Source: Milwaukee County Transit System

Endnotes

- 1 <https://tfl-newsroom.prgloo.com/news/tfl-press-release-travel-information-for-customers-as-government-restrictions-are-eased-furtherfrom-monday-12-april>
- 2 <https://www.octa.net/News/Bus/OCTA-Plans-to-Use-State-Funds-to-Welcome-Back-Bus-Riders/>
- 3 <https://www.octa.net/News/Bus/OCTA-Moves-Toward-Offering-Free-Rides-for-all-OC-Youth/>
- 4 <http://foothilltransit.org/summersale/>
- 5 <https://www.thelocal.dk/20210604/denmark-offers-cheap-train-and-ferries-to-boost-domestic-tourism/>
- 6 <https://www.bart.gov/news/articles/2021/news20210726-0>
- 7 <https://www.wmata.com/about/board/meetings/board-pdfs/upload/3A-Service-and-Fare-Opportunities.pdf>
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- 9 <https://www.capmetro.org/news/details/2021/05/18/capital-metro-to-open-vehicle-capacity-as-community-reaches-stage-2-milestone>
- 10 <https://dublinbus.ie/News-Centre/General-News/Public-transport-capacity-will-increase-to-75-on-Monday-19th-July-2021/>
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Relevant COVID-19 Literature

Barbieri DM, Lou B, Passavanti M, Hui C, Hoff I, et al. (2021) Impact of COVID-19 pandemic on mobility in ten countries and associated perceived risk for all transport modes. PLoS ONE 16(2): e0245886.

Description: A cross-country study researching the individual mobility patterns for all transport modes before and during restrictions. The study findings suggest that air and bus travel are perceived by the public to be the riskiest transport modes for COVID-19 transmission, and avoidance of public transport for commuting and non-commuting trips is found across all 10 countries included in the research.

Dai J, Liu Z, Li R (2021) Improving the subway attraction for the post-COVID-19 era: The role of fare-free public transport policy. Transport Policy.

Description: This paper reviews the impact of fare-free policies in three Chinese cities to attract passenger demand. The study identifies that the role of the fare-free policies in helping recover demand is limited and recommends the use of multi-pronged approaches in combination with fare-free policies.

Di Carlo P, Chiacchiarretta P, Sinjari B, Aruffo E, Stuppia L, De Laurenzi V, et al. (2020) Air and surface measurements of SARS-CoV-2 inside a bus during normal operation. PLoS ONE 15(11): e0235943

Description: Air and surfaces of buses in an Italian town were tested during regular operations with average passenger loads of 123 passengers per run. All air and surface samples tested negative for the presence of the Sars-Cov-2 virus, indicating the effectiveness of cleaning, ventilation, and social behaviour policies (i.e. social distancing and wearing of masks). It should be noted that the infection status of passengers at the time of testing was unknown.

Hörcher, D., Singh, R., Graham, DJ., (2021) Social distancing in public transport: Mobilising new technologies for demand management under the Covid-19 crisis. Transportation.

Description: This paper reviews the literature of five demand management methods to enforce social distancing on public transport and the practical applicability of each method: 1. inflow control with queueing, 2. time and space dependent pricing, 3. capacity reservation with advance booking, 4. slot auctioning, and 5. tradeable travel permit schemes.

Hunt, M. (2020) Covid-19 Transmission Rates on Rail, Technical report, RSSB.

Description: A recent report by the UK Rail Safety and Standards Board (RSSB) estimated the infection risk on UK rail as a function of the inter-personal contact risk, the number of contacts per journey, and any mitigating factors. The risk of infection was estimated to be 1 in 11,000 journeys or 0.009% per journey. The report was published in August 2020, and so

infection parameters were based on disease dynamics at that time. Since then, infection dynamics have altered with the introduction of new variants, and the RSSB acknowledges that the quoted infection risk is likely to increase.

Moreno, T. et al (2021) Tracing surface and airborne SARS-CoV-2 RNA inside public buses and subway trains. Environment International 147 (106326) 1-11.

Description: Air and surfaces of buses and subway trains in Barcelona were tested - 30 out of 82 air and surface samples showed evidence of target RNA genes of the Sars-Cov-2 virus, with surface swabs showing more positive results than air samples. After bus cleaning, there was a reduction in positive surface swab samples, however 4 from 30 samples still yielded positive results. Further testing on the efficacy of cleaning is recommended.

Mutambudzi, M. et al. (2020) Occupation and risk of severe COVID-19: prospective cohort study of 120 075 UK Biobank participants. Occupational and Environmental Medicine.

Description: Research identifies that essential workers have a higher risk of severe illness from COVID-19. Risk to public transport workers is found to be double that of non-essential workers.

Tardivo A, Zanuy AC, and Martin CS (2021) COVID-19 Impact on Transport: A Paper from the Railways' Systems Research Perspective. Transportation Research Record.

Description: Analysis of the impact of the COVID-19 pandemic on the rail sector identifies resilience, return, reimagination, reform, and research, as the necessary steps to provide service and enhance rail competitiveness and resilience in the event of future crises.

Yabe, T., Tsubouchi, K., Fujiwara, N. et al. (2020) Non-compulsory measures sufficiently reduced human mobility in Tokyo during the COVID-19 epidemic. Scientific Reports 10, 18053.

Description: A study of mobility patterns in Japan showed that reductions in mobility (attributed to soft lockdown policies) were associated with reductions in the case reproduction number.

Zachreson C, Mitchell L, Lydeamore MJ, Rebuli N, Tomko M, Geard N. (2021) Risk mapping for COVID-19 outbreaks in Australia using mobility data. Journal of the Royal Society Interface 18: 20200657.

Description: COVID-19 outbreaks in Australia were found to be well predicted by mobility data - especially at locations associated with habitual travel patterns e.g. workplaces.

Contact us



The TSC at Imperial College London

The Transport Strategy Centre (TSC), previously known as The Railway and Transport Strategy Centre, was established in 1992 as a centre of excellence serving the railway industry on strategic, economic and technology issues. Today, the TSC is a globally recognised team specialising in performance benchmarking, research and policy for industry and government.

The Applied Research Team within the TSC works directly with industry to improve performance in public transport worldwide, based on a systematic process managed and facilitated by the TSC through multi-year international benchmarking projects.

Imperial College London is a global university with a world-class reputation in science, engineering, business and medicine. Well known for its excellence in teaching and research, Imperial College London is consistently rated in the top 10 universities worldwide.

Thank you for reading this report.

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Appendix A

List of Benchmarking Groups and Members



American Metros

- Metrovías (Buenos Aires – Argentina)
- Washington Metropolitan Area Transit Authority (WMATA – United States)
- Sistema de Transporte Colectivo (STC – Mexico City)
- Société de transport de Montréal (STM – Canada)
- MTA New York City Transit (NYCT – United States)
- Ottawa-Carleton Transportation Commission (OC Transpo – Canada)
- Rio de Janeiro (Metrô Rio – Brazil)
- Metro de Santiago (Santiago – Chile)
- Bay Area Rapid Transit (BART – United States)
- Companhia do Metropolitano de São Paulo – Metrô (MSP – Brazil)
- Toronto Transit Commission (TTC – Canada)
- SkyTrain (BCRTC – Canada)

European Metros

- Transports Metropolitans de Barcelona (TMB – Spain)
- Berliner Verkehrsbetriebe (BVG – Germany)
- Société des Transports Intercommunaux de Bruxelles (STIB – Belgium)
- Docklands Light Railway (DLR – United Kingdom)
- Metro Istanbul San. Ve Tic. A.S. (Metro Istanbul – Turkey)
- Metropolitano de Lisboa (ML – Portugal)
- London Underground Limited (LUL – United Kingdom)
- Metro de Madrid (Spain)
- Moscow Metro (Russia)
- Tyne and Wear Metro, (Nexus – United Kingdom)
- Oslo Sporveien (Norway)
- Régie Autonome des Transports Parisiens Métro (RATP Métro – France)
- Régie Autonome des Transports Parisiens RER (RATP RER – France)

Asian Metros

- Bangalore Metro Rail Corporation Limited (BMRC – India)
- Bangkok Expressway and Metro Public Company (BEM – Thailand)
- Beijing Mass Transit Railway Operation Corp. (BMTROC – China)
- Delhi Metro Rail Corporation Ltd (DMRC – India)
- Roads and Transport Authority (RTA – United Arab Emirates)
- Guangzhou Metro Corporation (GMC – China)
- MTR Corporation Limited (MTR – Hong Kong)
- Nanjing Metro Operation Corp. (China)
- Seoul Metro (South Korea)
- Shenzhen Metro Operation Corp. Ltd (China)
- Singapore Mass Rapid Transit Corporation Ltd (SMRT – Singapore)

- Shanghai Shentong Metro Group (SSMG – China)
- Syarikat Prasarana Negara Berhad (RapidKL – Malaysia)
- Taipei Rapid Transit Corporation (TRTC – Taiwan)
- Tokyo Metro Co., Ltd. (Japan)
- Sydney Metro (Australia)
- Sydney Trains (Australia)

ISBERG

International Suburban Rail Benchmarking Group

- Ferrocarrils de la Generalitat de Catalunya (FGC – Spain)
- Queensland Rail (Australia)
- S-Tog, Danish State Railways (DSB – Denmark)
- PRASA – Metrorail (South Africa)
- MTR Hong Kong (East Rail, West Rail, Tuen Ma & Tung Chung Lines – Hong Kong)
- MTA Long Island Rail Road (LIRR – United States)
- London Overground – London Rail (United Kingdom)
- Metro Trains Melbourne (Australia)
- MTA Metro-North Railroad (United States)
- S-Bahn Munich, Deutsche Bahn (DB) Regio (Germany)
- Commuter Rail, Vygruppen (Vy – Norway)
- Bay Area Rapid Transit (BART – United States)
- Sydney Trains (Australia)
- East Japan Railway Company (JR East - Japan)

IMRBG

International Mainline Rail Benchmarking Group

- Danish State Railways (DSB - Denmark)
- Irish Rail (Ireland)
- Nederlandse Spoorwegen (NS – Netherlands)
- Société nationale des chemins de fer belges (SNCB – Belgium)
- New South Wales TrainLink (New South Wales, Australia)
- Via Rail Canada (Canada)
- V/Line (Victoria, Australia)

GOAL

Benchmarking Group of North American Light Rail Systems

- Niagara Frontier Transportation Authority (NFTA – Buffalo, NY)
- Maryland Transit Administration (MTA Maryland – Baltimore, MD)
- Calgary Transit (C Train – Calgary, AB)
- Charlotte Area Transit System (CATS – Charlotte, NC)
- Dallas Area Rapid Transit (DART – Dallas, TX)
- Edmonton Transit System (ETS – Edmonton, AB)
- Hampton Roads Transit (HRT – Norfolk, VA)
- Ottawa-Carleton Transportation Commission (OCTranspo – Ottawa, ON)
- Pittsburgh PAAC (The T – Pittsburgh, PA)
- Tri-County Metropolitan Transportation District (TriMet – Portland, OR)
- San Diego Metropolitan Transit System (MTS – San Diego, CA)
- Sound Transit (ST– Seattle, WA)
- Toronto Transit Commission (TTC – Toronto, ON)
- Utah Transit Authority (UTA – Salt Lake City, UT)



**International Bus
Benchmarking Group**

- Transport Metropolitans de Barcelona (TMB, Barcelona)
- Société des Transports Intercommunaux de Bruxelles (STIB, Brussels)
- Dublin Bus (Dublin)
- IETT İşletmeleri Genel Müdürlüğü (IETT, Istanbul)
- Rapid Bus Sdn Bhd (Rapid Bus, Kuala Lumpur)
- Companhia Carris de Ferro de Lisboa (Carris, Lisbon)
- London Buses (LBSL, London)
- Societe de Transport de Montréal (STM, Montréal)
- Mosgortrans (Moscow)
- MTA – New York City Transit (NYCT) & MTA Bus (New York)
- Régie Autonome des Transports Parisiens (RATP, Paris)
- King County Metro Transit (KCM, Seattle)
- SMRT Buses (Singapore)
- Transport for New South Wales (TfNSW, Sydney)
- Coast Mountain Bus Company (CMBC, Vancouver)



**American Bus
Benchmarking Group**

- Capital Metropolitan Transportation Authority (Cap Metro – Austin, TX)
- Niagara Frontier Transportation Authority (NFTA – Buffalo, NY)
- Charlotte Area Transit Systems (CATS – Charlotte, NC)
- Dallas Area Rapid Transit (DART – Dallas, TX)
- Des Moines Area Regional Transit Authority (DART – Des Moines, IA)
- Greater Dayton Regional Transit Authority (GDRTA – Dayton, OH)
- Lane Transit District (LTD – Eugene, OR)
- Mass Transportation Authority (MTA – Flint, Michigan)
- Foothill Transit (San Gabriel Valley, LA County, CA)
- Hampton Roads Transit (HRT – Hampton, VA)
- Jacksonville Transportation Authority (JTA – Jacksonville, FL)
- Milwaukee County Transit System (MCTS – Milwaukee, WI)
- Orange County Transportation Authority (OCTA)
- Pittsburgh PAAC (Port Authority – Pittsburgh, PA)
- Regional Transit Service (RTS – Rochester, NY)
- Rhode Island Public Transit Authority (RIPTA – Providence, RI)
- Omnitrans (San Bernardino, CA)
- San Joaquin Regional Transit District (RTD – Stockton, CA)
- Pinellas Suncoast Transit Authority (PSTA – St. Petersburg, FL)
- Spokane Transit Authority (STA – Spokane, WA)
- Utah Transit Authority (UTA – Salt Lake City, UT)
- Clark County Public Transportation Benefit Area (C-TRAN – Vancouver, WA)



RIAMBIG

**Railway Infrastructure Asset Management
Benchmarking Group**

- Queensland Rail (Brisbane, Australia)
 - KiwiRail (New Zealand)
 - Public Transport Authority Perth (Perth, Australia)
 - Sydney Trains (Sydney, Australia)
 - V/Line (State of Victoria, Australia)
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