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Final report

Further development of public transport in and after the pandemic

German case study

by:

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(KCW GmbH, Berlin)

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Probst & Consorten Marketing-Beratung, Dresden

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Abstract: Development of public transport during and after the pandemic Further development of public transport in and after the pandemic

This report provides an overview of the effects of the coronavirus pandemic on the passenger transport market and in particular on short-distance public transport in Germany. Based on recent studies and market research, the changes in transport demand and modal split during the first two years of the pandemic are being reported and the consequences for the development of public transport presented.

At the beginning of the pandemic transport demand decreased considerably. In particular, middle- to long-distance trips no longer took place. Instead, the focus shifted to mobility within neighbourhoods and short-distance trips. Through the increase of working from home and online shopping, the pandemic led to a breakthrough of the digital transformation. Mass transport, on the other hand, lost importance during the pandemic, and multimodality also became less widespread. Public transport lost many regular customers during the pandemic and is considered by many to be poor in terms of cleanliness and hygiene standards - even though no increased risk of infection was identified in public transport.

To win back "lost" costumers and attract new ones, the report recommends improving public transport services, especially by increasing passenger transport services, developing a better understanding of what passengers need and providing an extension of the transport service network. It also makes recommendations on specific measures to increase protection against viruses or to respond to changing demand for different fares. The latter recommendations are made according to specialised market research.

This report is part of the ReFoPlan project "Clean Air and Climate Protection by Strengthening Public Transport: Expanding and Stabilizing the Financing Basis".

Kurzbeschreibung: Weiterentwicklung des ÖPNV in und nach der Pandemie

Das vorliegende Gutachten gibt einen Überblick über die Auswirkungen der Corona-Pandemie auf den Personenverkehrsmarkt und insbesondere auf den ÖPNV. Es wird anhand aktueller Studien und eigens angestellter Marktrecherchen ausgeführt, welche Veränderungen in Verkehrsnachfrage und Verkehrsmittelwahl über die ersten beiden Jahre der Pandemie beobachtet werden konnten und welche Konsequenzen für die Entwicklung des ÖPNV zu ziehen sind.

So ist die Verkehrsnachfrage zu Beginn der Pandemie zunächst erheblich zurückgegangen. Vor allem mittlere bis weite Wege fanden nicht mehr statt. Dafür rückten der Nahraum und mit ihm kurze Wege in den Fokus. In Form von Homeoffice und Online-Einkäufen verhalf die Pandemie der Digitalisierung zum Durchbruch. Kollektiv genutzte Verkehrsmittel erfuhren hingegen während der Pandemie einen Bedeutungsverlust, auch Multimodalität hat an Verbreitung eingebüßt. Der ÖPNV verlor im Verlaufe der Pandemie viel Stammkundschaft und wird von vielen hinsichtlich seiner Sauberkeit und Hygienestandards schlecht eingeschätzt – obwohl in öffentlichen Verkehrsmitteln kein erhöhtes Infektionsrisiko festgestellt werden konnte.

Zur Rückgewinnung „verloren gegangener“ Fahrgäste und Gewinnung neuer Fahrgäste empfiehlt das Gutachten eine Verbesserung des ÖPNV-Angebots vor allem durch Leistungsaufwuchs, Kundenorientierung und Erhöhung der Netzdichte. Außerdem gibt es Empfehlungen zu konkreten Maßnahmen, die einen erhöhten Schutz vor Viren bewirken oder tariflich auf veränderte Nachfragemuster reagieren. Letztgenannte Empfehlungen werden auf Grundlage eigens durchgeführter Marktrecherchen getroffen.

Der vorliegende Bericht ist Teil des ReFoPlan-Vorhabens „Luftreinhaltung und Klimaschutz durch Stärkung des ÖPNV: Finanzierungsgrundlagen erweitern und verstetigen“.

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BBSR	Bundesinstitut für Bau-, Stadt- und Raumforschung im Bundesamt für Bauwesen und Raumordnung (engl. Federal Institute for Research on Building, Urban Affairs and Spatial Development at the Federal Office for Building and Regional Planning)
CiBo	Check-in-Be-out-system with automatic trip recording and pricing
DLR	Deutsches Zentrum für Luft- und Raumfahrt (engl. German Aerospace Center)
DZFS	Deutsches Zentrum für Schienenverkehrsforschung (engl. German Centre for Rail Traffic Research at the Federal Railway Authority)
FFP-2	particle-filtering half mask ("filtering face piece") in the middle of three particle filter classes
GPS	Global Positioning System
GVH	Großraum-Verkehr Hannover GmbH (engl. Transport Association of Greater Hanover)
HEPA filter	high-efficient particulate air filter
IBP	Fraunhofer-Institut für Bauphysik (English: Fraunhofer Institute for Building Physics)
IRK	Kommission für Innenraumlufthygiene (engl. Commission for Indoor Air Hygiene)
KBA	Kraftfahrt-Bundesamt (engl. Federal Motor Transport Authority)
KCD	Competence Centre Digitalisation North-Rhine Westfalia (NRW)
MiD	“Mobilität in Deutschland” (engl. “Mobility in Germany") traffic survey
MIV	motorised private transport
MVV	Münchner Verkehrs- und Tarifverbund (engl. Munich Transport and Tariff Association)
NAH.SH	Nahverkehrsverbund Schleswig-Holstein (engl. Schleswig-Holstein Local Transport Association)
NVV	Nordhessischer Verkehrsverbund (engl. North Hessian Transport Association)
ReLUT	ResearchLab for Urban Transport
RKI	Robert Koch Institut (engl. Robert Koch Institute)
SBB	Schweizerische Bundesbahnen (engl. Swiss Federal Railways)
SWMS	Stadtwerke Münster (engl. municipal utilities Münster)
SSB	Stuttgarter Straßenbahnen AG (engl. Stuttgart transport company)
SVV	Salzburger Verkehrsverbund (engl. Salzburg transport association)
UITP	Union Internationale des Transports Publics
UV-C	ultraviolet radiation with a wavelength of 100 to 280 nanometers
VAG	Verkehrs-Aktiengesellschaft Nürnberg (engl. Nuremberg traffic stock corporation)
VBB	Verkehrsverbund Berlin-Brandenburg (engl. transport association Berlin-Brandenburg)
VDI	Verein Deutscher Ingenieure e. V. (engl. Association of German Engineers)

BBSR	Bundesinstitut für Bau-, Stadt- und Raumforschung im Bundesamt für Bauwesen und Raumordnung (engl. Federal Institute for Research on Building, Urban Affairs and Spatial Development at the Federal Office for Building and Regional Planning)
VDV	Verband Deutscher Verkehrsunternehmen e. V. (engl. Association of German Transport Companies)
VDV-KA	VDV core application (German industry standard for e-ticketing)
VDV-PKM	product control module as part of the VDV-KA standard
VRN	Verkehrsverbund Rhein-Neckar (engl. transport association Rhein-Neckar)
VRR	Verkehrsverbund Rhein-Ruhr AöR (transport association Rhein-Ruhr)
VVO	Verkehrsverbund Oberelbe (engl. transport association Upper Elbe)
VVS	Verkehrs- und Tarifverbund Stuttgart (engl. Stuttgart transport and tariff association)
VZBV	Verbraucherzentrale Bundesverband (engl. Federation of German Consumer Organisations)
WZB	Wissenschaftszentrum Berlin für Sozialforschung (engl. Social Science Research Center Berlin)

Summary

The coronavirus pandemic has led to a significant drop in public transport demand in Germany. In spring 2020, numbers of passengers in public transport almost halved during the first wave of the pandemic. Since then, these numbers have improved again, but they have not yet reached the levels which existed before the pandemic.

This report describes this development based on current studies and addresses the question as to what consequences should be drawn from this for public transport. With the help of market research, specific measures are evaluated in depth. On the one hand, the focus is on technical solutions that are available on the market and can help to improve hygiene and protection against viruses, especially in vehicles. On the other hand, the focus is on fare structures that can help to attract a broader customer base to public transport and increase passenger numbers, if possible, without reducing the level of financing.

The second chapter reviews the current understanding of the changes in travel demand triggered by the coronavirus pandemic. Particularly remarkable is the considerable decrease in travel frequency at the beginning of the pandemic. It was caused by contact restrictions and the closure of many facilities. With the withdrawal of these preventive measures, the frequency of trips has returned to the level before the pandemic. What has remained, however, is an increased proportion of short trips. At the same time, the use of digital exchange formats has increased dramatically. Home office, home schooling or online shopping made it possible to participate in social life in times of lockdown. It is not yet possible to say for sure which of these changes in transport demand will persist. However, it can be assumed that the mentioned digital areas of everyday life will continue to play an important role in the future. In addition, the increased local-orientated offers are an important milestone for transport policy and planning which are aimed at sustainability.

Concerns about infections were very high during the coronavirus pandemic. Public transport became the subject of public attention because it was difficult to comply with safety distance regulations in its vehicles. Public transport was seen as a possible driver of infection. Although studies were unable to provide any evidence, public transport continues to suffer from its deteriorated image. It is seen as the "loser of the pandemic".

The industry is trying to meet this challenge and raise hygiene standards by using technical solutions. This report identifies in detail the measures that can be taken to increase protection against viruses by improving air quality. Intensifying cleaning can also improve hygiene. In principle, the measures for capacity management, which have long been in testing and development, can also be used to enable passengers to avoid overcrowded transport services. However, they can only be effective if the system offers enough alternative options. Finally, the digitalisation of customer services can also avoid direct customer contact while keeping services running. The bottom line is that all these measures can help to increase protection against the coronavirus and other viruses as well. However, since the actual risk of infection in public transport is already low without these measures, the measures cannot by themselves contribute to a better perception of public transport. They need to be accompanied by an appropriate information and marketing policy to the effect that the subjective feeling of safety among passengers increases.

Finally, the public transport system is also losing its regular customers. This gives reason to take action for improving customer loyalty and retention - to attract new customers and to recover former ones. An innovative, more courageous fare design can be one of several keys to this. For this completely new, digital fare models as well as gentle reorientation of familiar commercial

approaches - focused on attractive flat-rates for as many target groups as possible - are suitable. It is important to send positive messages that show that the public transport industry is adapting to the new times and is stimulating its demand.

The pandemic has created serious risks for public transport. It is important to use the knowledge gained during this time as an opportunity to develop public transport services in a passenger-oriented way. Only in this way public transport will be able to make its in-dispensable contribution to achieving Germany's climate targets.

Zusammenfassung

Die Corona-Pandemie hat im ÖPNV zu einem erheblichen Nachfragerückgang geführt. Die Fahrgastzahlen brachen während der ersten Pandemie-Welle im Frühjahr 2020 um fast die Hälfte ein. Seither haben sich diese Zahlen wieder erholt, aber sie haben noch nicht das von vor der Pandemie bekannte Niveau erreicht.

Das vorliegende Gutachten beschreibt diese Entwicklung anhand aktueller Studien und widmet sich der Frage, welche Konsequenzen für den ÖPNV zu ziehen sind. Unter Zuhilfenahme eigens angestellter Marktrecherchen werden konkrete Maßnahmen vertieft bewertet. Zum einen geht es um technische Lösungen, die am Markt verfügbar sind und helfen können, vor allem in den Fahrzeugen die Hygiene und den Schutz vor Viren zu verbessern. Zum anderen wird das Augenmerk auf Tarifkonzepte gerichtet, die dazu beitragen können, wieder eine breitere Kundschaft für den ÖPNV anzusprechen und die Fahrgastzahlen zu erhöhen, möglichst ohne die Finanzierungsbasis zu schmälern.

Im zweiten Kapitel wird der gegenwärtige Wissensstand über Veränderungen in der Verkehrsnachfrage, die durch die Corona-Pandemie ausgelöst worden sind, aufbereitet. Besonders auffällig ist der zu Beginn der Pandemie erhebliche Rückgang der Wegehäufigkeit. Er wurde durch Kontaktbeschränkungen und die Schließung vieler Einrichtungen befördert. Mit Rücknahme dieser präventiven Maßnahmen hat sich die Wegehäufigkeit inzwischen wieder normalisiert. Geblieben ist aber ein erhöhter Anteil kurzer Wege. Zugleich nahm die Inanspruchnahme von digitalen Austauschformaten sprunghaft zu. Homeoffice, Homeschooling oder Online-Einkäufe erlaubten es in Zeiten des Lockdowns, am gesellschaftlichen Leben teilzuhaben. Noch kann nicht sicher gesagt werden, welche dieser Veränderungen in der Verkehrsnachfrage Bestand haben werden. Aber es ist davon auszugehen, dass die angesprochenen digitalen Bereiche des Alltags auch künftig eine wichtige Rolle spielen werden. Und die gestiegene Nahraumorientierung bietet einen wichtigen Baustein für eine an Nachhaltigkeit ausgerichtete Verkehrspolitik und -planung.

Die Sorge vor Infektionen war während der Corona-Pandemie sehr hoch. Der ÖPNV geriet insofern in den Fokus der Öffentlichkeit, als in seinen Fahrzeugen Abstandsregeln kaum einzuhalten sind. Er geriet in den Verdacht, Infektionstreiber zu sein. Zwar konnten Studien für diese Befürchtungen keine Belege beibringen, aber nach wie vor leidet der ÖPNV unter dem verschlechtern Image. Er gilt als „Verlierer der Pandemie“.

Die Branche versucht, diese Herausforderung anzunehmen und mittels technischer Lösungen die Hygienestandards zu heben. In diesem Gutachten wird im Einzelnen herausgearbeitet, welche Maßnahmen zur Verbesserung der Luftqualität den Schutz vor Viren erhöhen. Eine Intensivierung der Reinigung kann daneben die Hygiene verbessern. Grundsätzlich bieten sich außerdem die längst in Erprobung und Entwicklung befindlichen Maßnahmen zur Auslastungssteuerung an, um Fahrgästen zu ermöglichen, überfüllte Verkehrsmittel zu meiden. Ihre Wirkung vermögen sie allerdings erst dann zu erfüllen, wenn das Angebot ausreichend Ausweichalternativen anbietet. Schließlich kann durch eine Digitalisierung von Kundenservices auch der direkte Kundenkontakt unter Beibehaltung der Dienstleistungen vermieden werden. Unter dem Strich können sämtliche dieser Maßnahmen helfen, den Schutz vor dem Corona-Virus und auch vor weiteren Viren zu erhöhen. Da allerdings auch ohne diese Maßnahmen das objektive Infektionsrisiko im ÖPNV gering ist, werden sich diese Maßnahmen erst dann in einer erhöhten Wertschätzung des ÖPNV und in steigenden Fahrgastzahlen niederschlagen, wenn sie durch passende Informations- und Kommunikationsmaßnahmen unterstützt werden und so auch das subjektive Sicherheitsgefühl der Fahrgäste erhöhen.

Letztlich verliert der ÖPNV besonders seine Stammkundschaft. Dies gibt Anlass, die Bindung vorhandener Fahrgäste zu verbessern sowie neue zu gewinnen und ehemalige zurückzugewinnen. Eine innovative, mutigere Tarifgestaltung kann dazu einer von mehreren Schlüsseln sein. Dazu eignen sich sowohl gänzlich neuartige, digitale Tarifmodelle als auch die sanfte Neuausrichtung altbekannter kommerzieller Ansätze – insbesondere mit dem Fokus auf attraktive Flatrates für möglichst viele Zielgruppen. Wichtig sind positive Botschaften, die zeigen, dass die ÖPNV-Branche sich den neuen Zeiten anpasst und Nutzungsimpulse setzt.

Die Pandemie hat für den ÖPNV eine ganze Reihe ernsthafter Risiken geschaffen. Wichtig für seine weitere Entwicklung ist, die in dieser Zeit gewonnenen Erkenntnisse als Anlass für eine fahrgastorientierte Weiterentwicklung des ÖPNV-Angebotes zu nutzen. Nur so wird der ÖPNV seinen unverzichtbaren Beitrag zur Erreichung der bundesdeutschen Klimaziele leisten können.

1 Introduction

Among the transport systems widely used in Germany, local public transport has a number of special characteristics. For example, it is accessible to the general public without discrimination. Because of its economies of scale, it has become particularly established where many different routes (used by people who have no personal connection to each other) can be bundled. Public transport is thus indispensable for so-called mass transport; without it, sustainable urban and regional development would not be possible. The same applies to urban-rural linkages to the extent known.

Precisely these characteristics have caused significant disadvantages to public transport since the beginning of the coronavirus pandemic. For example, since March 2020, the population has been called upon to keep their distance from other people with whom they do not have a personal connection. Everyday traffic to destinations such as offices or cinemas has been temporarily "relocated" to home - taking advantage of the possibilities of digital communication. Shopping is increasingly done digitally - instead of a person going to the store, the goods are delivered to the customer by courier. This has eliminated many trips for which public transport would have been an option. During a particularly critical phase of the pandemic, people were not allowed to leave their own city: Staying in the neighbourhood, which could be reached on foot, experienced a boom. And many people acquired a bicycle.

The actual vehicles of public transport also became the focus of attention of those concerned about health. This is because they are enclosed spaces in which strangers come comparatively close to each other and touch the same contact surfaces. Public confidence in public transport as a safe means of transport declined accordingly.

Examples like these illustrate that the coronavirus pandemic triggered a profound crisis for public transport. Customer loyalty waned and passenger numbers remained in decline. Public transport will certainly only be able to retake its previous growth tendency and make its contribution to achieving the climate targets if it is possible to accept the challenges posed by the pandemic and offer suitable solutions.

Against this backdrop, this report provides in chapter 2 an overview of the state of knowledge (Spring 2022) on both, the effects of the pandemic on travel demand and choice of travel mode and the challenges this poses for public transport.

Even during the pandemic, transport companies reacted and took various measures to make public transport safer. This primarily concerns technical measures to reduce the likelihood of contracting the disease when using public transport. Chapter 3 provides an overview of instruments in use or being tested. Practical experience is systematically compiled, and recommendations are set out.

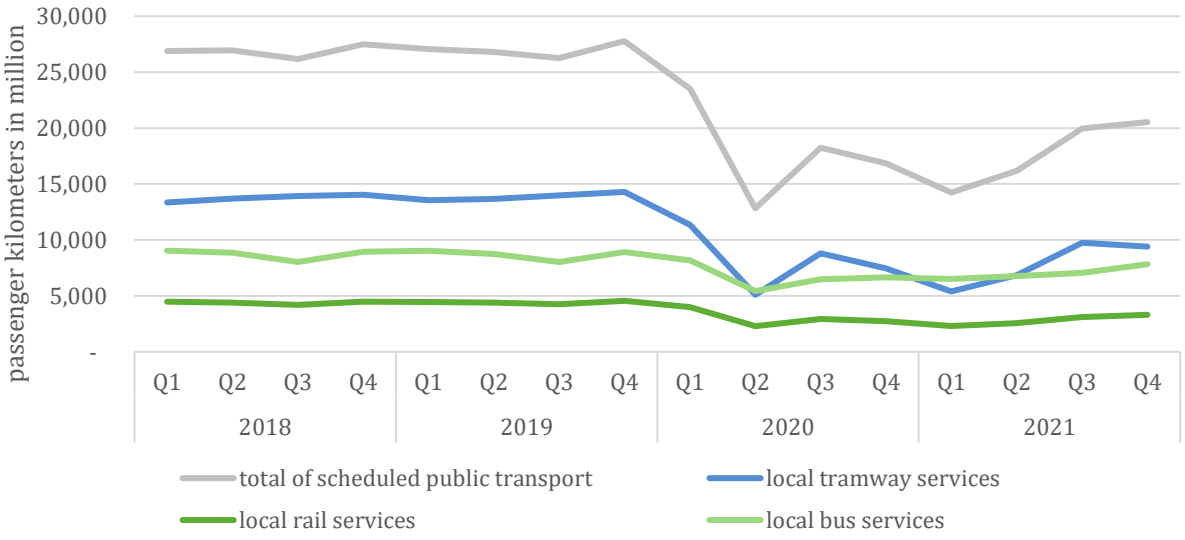
The pandemic also provides an opportunity to test or introduce a number of measures in relation to fares. Their genesis often goes back to the period before 2020 and is evidence that the pandemic highlights very pointedly the need for action on many aspects. Chapter 4 compares the strengths and weaknesses of these fare models and sets out recommendations.

2 Effect of the pandemic on public transport demand

Sars-CoV-2, commonly called coronavirus, is a respiratory disease. Transmission occurs mainly as droplet infection and via inhalation of aerosols containing the virus. Transmission as a smear infection is possible, but of secondary importance for the pandemic event (cf. RKI 2021). The closer one gets physically to an infected person, the greater is the risk of transmission of aerosols containing the virus and subsequent infection. A longer duration of contact with an infected person amplifies the risk of infection. Physical proximity of people, however, is constituent for all societies, especially for societies based on the division of labour and organized over long distances in everyday life. In this respect, the pandemic has fundamentally called into question the reasons for travel and the choice of transport modes.

This has profoundly changed mobility. This is particularly true for public transport, as the demand dropped considerably at the beginning of the pandemic. Since then, it has recovered somewhat, although the Federal Statistical Office reports that transport performance and passenger numbers for the last two quarters of 2021 are a quarter below comparable periods in 2019 (see Figure 1). Just to reach pre-pandemic levels significant efforts are still needed to improve public transport. In the meantime, a number of studies and market experiences provide indications of the lessons that can be learned from the developments triggered by the pandemic.

Figure 1: Development of passenger kilometres in public transport



Source: own presentation based on passenger traffic data from the GENESIS-Online database, data table 46181-0015.[1]

This chapter summarises the knowledge available in the industry about the most important developments. The chapter concludes with a concise, practice-oriented description of the challenges facing public transport.

[1] https://www-genesis.destatis.de/genesis//online?operation=table&code=46181-0015&bypass=true&levelindex=0&levelid=1652773781825#abreadcrumb

2.1 Changes in transport demand

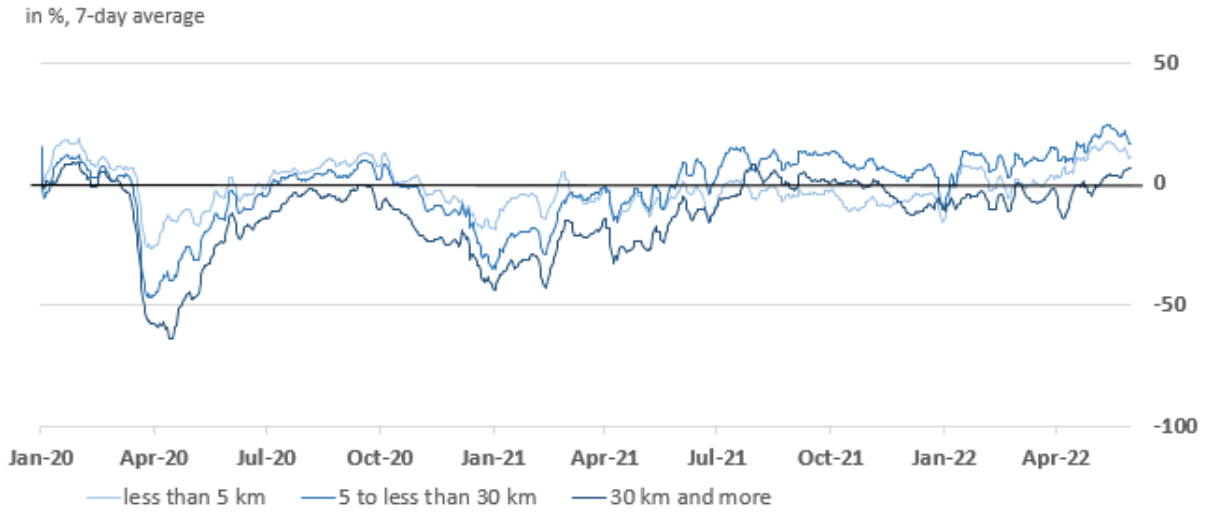
The changes in transport demand in Germany resulted in a temporary decline in the number of trips made outside the home. This is also related to the fact that virtual alternatives (home office, home shopping) were used instead of individual trips. These developments are briefly described below and examined in terms of their significance for public transport.

2.1.1 Fluctuation in number of trips

Traffic demand has been subject to unprecedented fluctuations over the past two years. This is illustrated by an analysis of mobile phone data (see Figure 2): In spring 2020, the number of trips fell by about half. The decline was even above average for long trips with a distance of over 30 kilometres. This reflects the cancellation of many business and vacation trips. After transport demands appeared to have recovered to a large extent over the summer months, there were sharp declines again over the winter and spring of 2021.[2] This development is repeated in the summer of 2021 and the following winter, albeit with considerably smaller fluctuations.

Characteristic of the period of the pandemic are differences by distance class shown in figure 2: The number of trips of short, walkable distances declined at a below-average rate compared to longer trips. Over a large period of time, it deviated significantly less from the previous normal than longer distances did. This reflects the attachment to one's place of residence typical of the pandemic and the temporary renaissance of the neighbourhood. Pedestrian and bicycle traffic gained in importance and the proportion of such modes in traffic accordingly. This needs not be disadvantageous for public transport, because on short distances it is often inferior to cycling and walking. Its strength lies in middle to long distances, which were covered less during the pandemic though.

Figure 2: Change in the number of trips compared to 2019 by trip distance



Note: For the 7-day average, only the existing data within the 7-day window is considered. Data gaps usually occur due to technical problems at the mobile network provider. Source: https://www.destatis.de/DE/Service/EXDAT/Datensaetze/mobilitaetsindikatoren-mobilfunkdaten.html#Reisedis-tanzen, accessed 7.4.2022

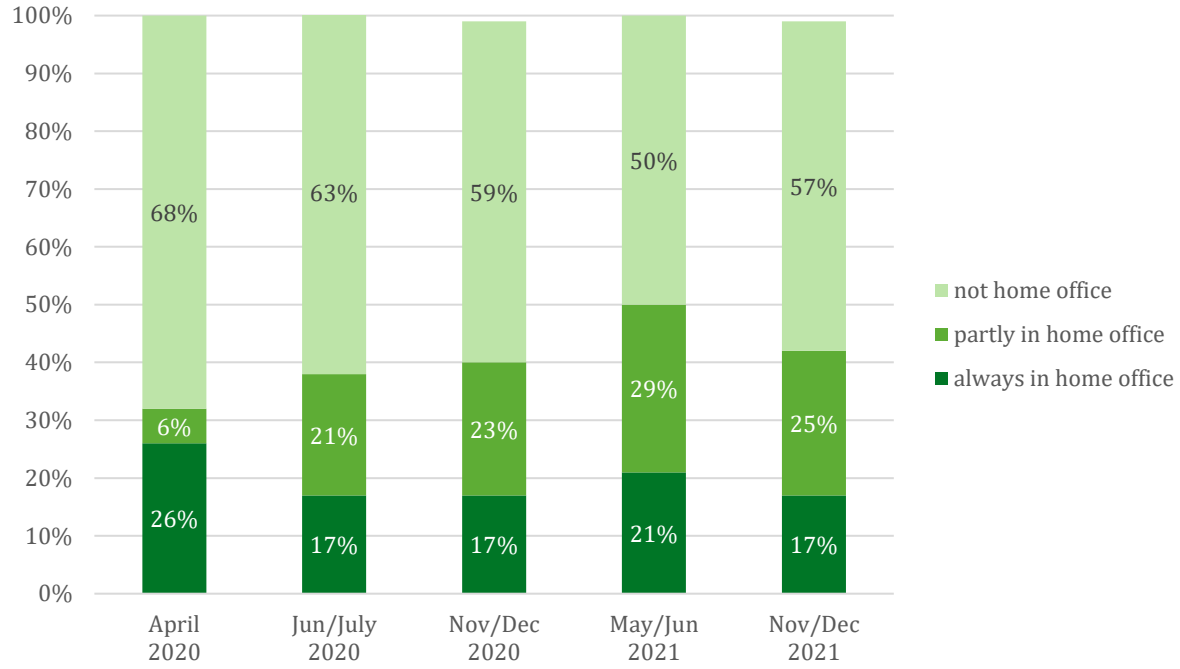
[2] These findings are supported by the MOBICOR study, which documented considerable declines for the first pandemic year, particularly for the trip purposes leisure (-16 percent), work (-12 percent), business trip (-22 percent). There was an even more significant decline in the number of educational trips (-67 percent) and trips to accompany others (-38 percent) due to the widespread school closures in spring 2021 (WZB, Motiontag, Infas (2021): 27).

In the spring of 2022, most of the restrictions and requirements for the population were lifted. In Figure 2 it can be seen that the number of trips at this time has largely reached the level of the time before the pandemic. This is especially true for local trips. Long-distance trips on the other hand remain - slightly - below average, while trips at an average distance of five to less than 30 kilometres are above average.

2.1.2 Widespread use of working at home (home office)

An expression of this commitment to stay at home is the skyrocketing prevalence of home office. The 2017 German transport survey "Mobility in Germany" (MiD) found that at the time 13 percent of employed people worked at home at least occasionally (Nobis / Kuhnimhof 2018: 111). At the start of the pandemic, the figure was 32 percent at once, and as high as 50 percent in mid-2020 (see Figure 3). Since then, this figure has fallen again to a certain extent. However, at the end of 2021 it is still more than three times as high as before the pandemic.

Figure 3: Regular professional activity in home office according to pandemic phases



Source: own representation according to DLR (2021b: 11).

In the meantime, digital communication formats (video conferencing, document storage in clouds) have become established in many areas of the working world. Accordingly, it is generally expected that the home office will continue to be part of everyday working life for many employees in the period after the pandemic. Uncertainty about the extent of its use, however, exists because not all activities can be performed by working from home. The Federal Institute for Research on Building, Urban Affairs and Spatial Development (BBSR) estimates that the proportion of home-office-affiliated industries nationwide is 45 percent (Pütz 2020: 85).[3] What is relevant for spatial planning and development and thus indirectly for transport is that, based on these BBSR analyses, home office primarily is an option for professionals whose workplace is located in major cities. This suggests a strengthening of the trend toward suburbanisation, which has already been observed since 2015 after a decade of re-urbanisation (Bundesinstitut

[3] However, only employees subject to social insurance contributions are taken as the basic population for the statistics used here.

für Bevölkerungsforschung 2021: 53): According to the results of an online survey conducted by the Zeit-Stiftung in the summer of 2020, the desire to move from a city to the countryside already existed before the pandemic for almost three quarters amongst those who wanted such a move, while for only 6 percent it did arise as a result of the pandemic (Siedentop / Stroms 2021: 33).

A typical feature of suburbanisation is a distance-intensive lifestyle in which the place of residence in the surrounding area of a large city goes hand in hand with an unchanged workplace in the large city itself. Among the environmentally friendly transport modes, it is especially public transport that can provide suitable services for the resulting transport demand. However, it can only do this if the urban development relies on the public transport axes with the highest demand. Only then a bundling of traffic flows is possible.

During the pandemic, working from home was associated with a significantly increased number of trips made on foot or by bicycle (WZB / Motiontag / Infas 2021: 29): Their combined share of all trips was considerably lower among employees who worked in presence (27 percent) than among those who worked exclusively at home (43 percent). The share of private motorised transport (MIV) reacted exactly diametrical (67 to 52 percent), and there were only minor differences at a low level for public transport (6 and 4 percent, respectively). Uncertainty exists as to how the transport behaviour of those employees will develop, who will continue to work in a "new normal" home office after the pandemic. As soon as travel restrictions are no longer in place and concerns about the risk of infection have receded, a rebound effect is quite conceivable. It is possible that the travel not taking place because of home office is taking place for other purposes (such as leisure travel).[4] One indication for this hypothesis is that the travel time budget, which has remained largely constant over decades, was not exhausted during the pandemic (WZB / Motiontag / Infas 2021: 7), which is probably due to a pandemic-related lack of opportunities.

It also remains to be seen to what extent employees will continue to work in home office after the pandemic. From Figure 3 it can be seen that hybrid forms of office presence and working from home already increased again during the pandemic. It is conceivable that employees will stay at home on single weekdays[5] and try to avoid traffic peaks by postponing the start and end of work by one or two hours. For public transport, the first consequence of this might be that among the working days Fridays will take on a special role in transport demand as the peak for demand caused by the working population will flatten out and demand on Fridays would become more similar to Saturday. From Monday to Thursday, rush hours will continue to exist unless it is possible to flatten their peaks to a more widespread demand through appropriate fares, service expansion, and passenger communication (capacity management). It must also be expected that employees with longer commutes, in particular, will work from home and, in the future, will accept longer commutes when choosing where to work and live (Nobis / Kuhnimhof 2018: 112).

2.1.3 Increase in online shopping

During the pandemic, many people turned to virtual means for shopping and to accomplish other tasks. The survey conducted by the German Aerospace Center (DLR) on "Mobility in times

[4] Home office has also increased the need for private rooms to work in. In this respect, it cannot be ruled out that in the coming years apartment seekers will see an increased need for an additional room and thus the living space per person will increase, which would ultimately lead to an increase in settlement area and thus also longer trips.

[5] According to the MOBICOR study, a majority would like to work from home at least one day per week (WZB / Motiontag / Infas 2021: 27).

of crisis" shows that at the end of 2021, 86 percent of all respondents had made at least one online purchase in the past four weeks. Compared to 2017, when 42 percent did so, this is roughly double the figure (DLR 2021b: 13ff). This primarily affects goods for aperiodic needs.[6] The stores that stock such goods are located particularly in city centres and other central locations. Here, too, the pandemic is reinforcing a previously known trend, namely that of online shopping and the structural change triggered by it. This leads to declining visitor frequencies, which are also making themselves felt in public transport.

It is to be expected that this purchasing behaviour will be maintained at least in part, and that the structural change in shopping areas will thus continue. The development of city centres and other central locations consequently depends on how they (can) respond to this development conceptually and strategically. Cities that can functionally develop their centres into lively places that are also suitable for leisure activities have an advantage (cf. Polívka 2021). This can apply to the centres of large cities as well as to smaller centres in rural areas. Specifically, traffic flows will be rearranged. Furthermore, it will be possible that shopping traffic will be carried out by using mainly public transport services.

2.2 Changes in the choice of transport modes

Changes in travel demand affect the choice of transport mode during the pandemic. Among the different modes public transport is commonly considered the "loser of the pandemic". This can be seen in the general decline in the use of collective transport modes, declining multimodality, specific passenger groups no longer using public transport, and finally a deteriorated image. These effects may well outlast the pandemic and thus become trends that the public transport industry must address.

Collective modes of transport are becoming less important.

People currently feel less comfortable in collectively used modes of transport than before the pandemic (DLR 2021b: 6). At the beginning of the pandemic, this was the case for about 60 percent of passengers in public transport by both bus and train or airplanes - compared to 4 percent for cars or 14 percent for bicycles. Car sharing, in which users take a particular vehicle subsequently, also suffered and continues to suffer from the current imperative to keep a distance (39 percent felt more uncomfortable than before). The aversion to collectively used modes of transport has since decreased slightly, but remains as a result very high.

Hitching rides is also becoming less common. However, this only applies among the affluent. Among people of low or medium economic status, giving others rides in one's own car has not decreased during the pandemic (WZB / Motiontag / Infas 2021: 15). In this respect, driving alone appears to be a privilege that one must be able to afford.

Monomodality is on the rise again.

The decline in the use of shared transport goes hand in hand with an increase in car use. Whereas before the pandemic one in two people used cars exclusively, this proportion shot up to 66 percent in the first wave. It has since declined again, but according to the DLR survey it has settled at a share slightly below 60 percent (DLR 2021b: 10). A noticeable increase can be seen particularly on trips to work that take place at times when rules on social distancing can hardly be observed in public transport (Sunder / Hagen / Lerch 2021: 12).

However, the increased use is not reflected in the number of cars. This continues to increase slightly (KBA 2021a; KBA 2022a). Car registrations fluctuated greatly during the pandemic:

[6] For the change in errands for daily needs, see Sunder / Hagen / Lerch (2021: 21f).

They declined considerably in the first months of the pandemic - at a time when car dealerships were also in lockdown (KBA 2021b). Conversely, the fleet age increased (KBA 2022b). It cannot be ruled out that people are postponing purchase decisions in order to better assess the development of new drive technologies.

The bicycle industry, on the other hand, experienced a real boom. Sale figures for bicycles went up considerably, especially during the lockdown phases (Sunder / Hagen / Lerch 2021: 30). For the period after the pandemic, too, the resulting increase in the number of bicycles represents considerable potential for strategies of mobility transformation.

Evaluation of public transport changes for the worse.

People feel less comfortable in public transport than before the pandemic. Although this finding decreases somewhat as the pandemic progresses and "normality" returns, it remains conspicuous and critical for the development opportunities of public transport (DLR 2021b: 6). Critical are reservations about the state of hygiene and excessively high occupancy rates in vehicles (DLR 2021b: 9).

A detailed analysis of the risk of infection in public transport is difficult. In its analysis of outbreaks[7] in Germany since the beginning of the pandemic, the Robert Koch Institute (RKI) has been able to attribute 0.02 percent of outbreaks to public transport (as of 10.02.2022) (cf. RKI 2022). However, due to the anonymity of public transport following up contacts and assignment of outbreaks to public transport is possible only to a limited extent, so that an unreported figure must be assumed here (IBP 2021: 21). According to a study by the German Centre for Rail Transport Research (DZSF) the most effective protective measures for staff and passengers are to wear FFP-2 masks continuously and correctly and not to speak – or at least speak quietly. In addition, air and wipe samples in vehicles and train stations were used to examine the virus load in the air or on surfaces. No coronaviruses were found. According to the team of experts, this already shows the existing effectiveness of the measures (wearing masks, personal hygiene, regular disinfection) (IBP 2021: 13f.).

Despite the scientific findings in relation to a risk of infection in public transport, the 4th mobility survey conducted by the German Aerospace Center (DLR) in April/May 2021 stated that only 14 percent of respondents considered the risk of infection in public transport to be low. It also presents that most of the respondents are worried that other passengers will not wear their masks correctly. As many as 40 percent are afraid of infection through contact with poles and handles. Only 31 percent consider the hygiene measures to be sufficient (DLR 2021a: 9). In DLR's 5th survey of November/December 2021 concerns about hygiene in vehicles topped the list of reasons for less frequent public transport use - tied with too many people riding public transport (DLR 2021b: 9).

Numerous surveys on the existing weaknesses of public transport also mention deficiencies that existed before the pandemic and that will apparently remain unchanged among the challenges facing the public transport industry.[8] The Forsa Institute, which was commissioned by the consumer association, found hardly any difference in statements about the qualities of public transport before and after the pandemic (VZBV 2021: 15).

The public transport system is losing its regular customers.

27 percent of regular season ticket holders have discontinued their season ticket and for 42 percent of them the pandemic was the main factor in their decision (DLR 2021b: 7). The number

[7] Consideration is given to all outbreaks with two or more cases.

[8] For example, poor connections and frequency of service (WZB / Motiontag / Infas 2021: 21).

of costumers is declining, especially among people with a high economic status, while people with a low economic status are more likely to remain loyal to the public transport system (WZB / Motiontag / Infas 2021: 18f.).

At the same time, a growing number of respondents in the DLR survey consider that they will use public transport more often in the future than before the pandemic (DLR 2021b: 8). It is not known in detail what motivation people have in doing so. However, it cannot be ruled out that the pandemic has fundamentally led to an increased awareness of the vulnerability of our society and that public transport is seen as an indispensable element of a resilience strategy.

People who do not use public transport at all mainly criticise the lack of simplicity of access (comprehensibility of different fares and the distance to stops) and the low speed of travel (probably in comparison to cars) (VZBV 2021: 14). It is critical for public transport that the number of people has increased during the pandemic, who do not use public transport at all (WZB / Motiontag / Infas 2021: 18).

2.3 Challenges for public transport

The coronavirus pandemic triggered fundamental changes in transport demand in Germany. It cannot yet be said with certainty how long the changes will last. For example, there was initially a significant decline in the frequency of trips, i.e. trips made away from home. The almost universal contact restrictions and temporary closures of stores, cultural venues, educational institutions, businesses, etc. meant that, especially at the beginning of the pandemic, people moved mainly within the neighbourhood and often did so non-motorised. The importance and also the vulnerabilities of digitalisation became clear during the pandemic in particular. Digital applications enabled home offices, home schooling or online shopping and thus participation in social life without having to move among people and expose oneself to a risk of infection. As a result, digital applications and services were greatly enhanced in many places.

The coronavirus pandemic also raised concerns about infections. Public transport became the focus of public attention insofar as rules of social distancing are hardly observed in its vehicles and many people touch the same contact surfaces of various kinds in quick succession. Although studies have not shown an increased risk of infection for public transport, the decrease of passengers using public transport can be attributed to people feeling more uncomfortable in public transport than before the pandemic. Although this finding diminishes somewhat as the pandemic progresses and "normality" returns, it remains striking and critical for the development prospects of public transport.

Indirectly, these changes also affected the choice of transport mode. Among the various modes, public transport is generally regarded as the "loser of the pandemic". The decline in passengers was particularly sharp in the so-called "first wave" in the spring of 2020. Since then, numbers have risen again, but remain about a quarter below pre-pandemic levels. The decrease in demand can also be seen in other collectively used modes of transport, i. e. carpooling or carsharing. This development was also accompanied by declining multimodality.

To win back "lost" passengers and attract new ones, the following strategies can generally be recommended:

- improve public transport services, especially by increasing service levels, customer orientation and network density,
- improving hygiene in vehicles (see chapter 3),
- further development of common fare and sales concepts (see chapter 4).

3 Technical concepts for improved hygiene, innovative protection against viruses, and real-time capacity management

Various measures have proven effective in reducing the risk of infection. In particular, keeping a distance, wearing protective masks and cleaning contact surfaces have been widely recommended for their effectiveness (RKI 2021; RKI 2020b; see table 1). Regardless of the objectively low risk of infection in public transport, public transport passengers feel comparatively poorly protected (see chapter 2.2).

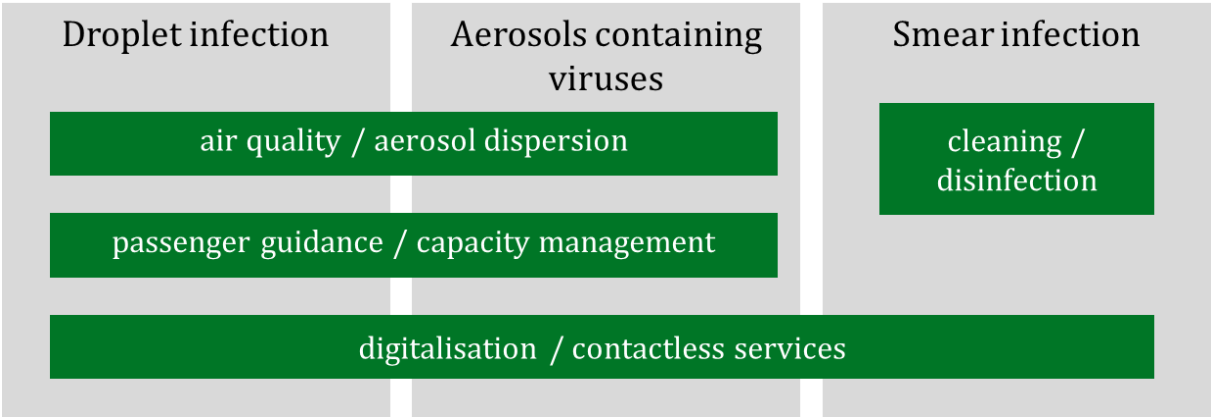
Table 1: Measures to reduce the risk of infection

Objective	General Recommendation	Effect for public transport
protection against droplet infection or aerosols	keeping a distance of 1.5 metres from the nearest person	keeping a distance (especially during rush hour) usually not possible.
protection against droplet infection or aerosols	wearing protective masks, especially an FFP-2 mask	mandatory wearing of masks in public transport (in the meantime also mandatory wearing of FFP-2 masks)
protection against smear infection	surface cleaning	intensification of the cleaning cycles of the transport companies to increase hygiene in general

Source: own representation, KCW

Since the beginning of the pandemic, many transport companies in Germany have introduced various measures to objectively reduce the risk of infection and to address the subjective fears of passengers. Based on comprehensive market research, these were identified and divided into four fields of action (see figure 4).

Figure 4: Infection paths and associated fields of action



Source: own representation, KCW

In the following chapters, advantages and disadvantages of the measures are being compared using the following criteria. They are each presented in a template:

- **Effectiveness**: What effect is achieved by the measure?

- **Implementation speed**: How long is the implementation time until the technology is usable?
- **Costs**: How much does it cost to introduce or operate the technology?
- **Visibility / communication**: How visible is the measure from the customers' perspective?
- **Sustainability**: Does the measure have a benefit for public transport even after the end of the pandemic?

Based on this summary we develop recommendations for future use of measures in public transport.

3.1 Air quality and aerosol dispersion

As already said, the coronavirus is mainly transmitted via droplets or aerosols in the air. Therefore, air quality plays a special role. In order to minimise the spread of viruses via the air from the outset, the correct wearing of an FFP-2 mask and refraining from (loud) speaking are the most effective means (IBP 2021: 28). Unfortunately, in many cases the mask is not worn correctly and in some cases not worn at all. In such cases, only supplementary technical measures for improved air exchange or - where necessary - also for effective air purification via filtering processes or UV-C systems on the ceiling can help. With both cleaning technologies, however, some aspects of protection against health risks and effectiveness against viruses must be taken into account in practice (VDI 2021).

To improve air quality or prevent aerosol dispersion, three measures have emerged since the start of the pandemic in 2020:

- opening the vehicle doors (see chapter 3.1.1)
- technologies for air purification (see chapter 3.1.2)
- separation screens in vehicles and customer centres (see chapter 3.1.3)

3.1.1 Opening the vehicle doors

According to the statement of the Kommission für Innenraumlufthygiene (IRK, Commission on Indoor Air Hygiene in Germany), the highest possible supply of fresh air is one of the most effective methods of removing potentially virus-containing aerosols from indoor spaces (IRK 2020a: 3). Therefore, regular air exchange - e.g. by regularly opening vehicle doors - is of particular importance. Since the beginning of the pandemic, nearly all transport companies have introduced central door opening by the drivers at every stop. On the one hand, this promotes air exchange and on the other, it reduces contact surfaces if the request to stop does not have to be expressed at the stop button.

A study conducted together by the Technical University of Berlin, the Berliner Verkehrsbetriebe (Berlin transport company) and the Charité hospital has shown that opening windows and doors can reduce aerosol concentrations by up to 80 percent in the short term (cf. TU Berlin 2021). Further research is still needed to determine the minimum time and interval at which doors must be opened to guarantee sufficient air exchange. The Deutsche Zentrum für Schienenverkehrsforschung (DZFS, German Centre for Rail Traffic Research) has already determined that in vehicles of similar design in commuter and regional rail traffic, the emission load in commuter trains could be reduced by opening doors more frequently. Therefore, technical measures for air pollution control were less common there (IBP 2021: 154).

Table 2: Automatic door opening

Automatic door opening	
Objective	exchange of air in enclosed spaces by opening the vehicle doors at every stop and especially at end stops ("ventilation").
Alternatives	opening of all doors at every stop by the driver
Effectiveness	► highest possible fresh air supply is one of the most effective methods to prevent aerosol dispersion ► further investigation of the extent to which short-term door opening leads to sufficient air exchange in the entire passenger compartment is necessary. ► first studies suggest effective reduction of aerosol concentration (especially urban traffic)
Implementation speed	immediate implementation
Costs	no additional costs, possibly increased heating or cooling costs
Visibility	measure is visible/experienced by passengers, is used automatically; no signs necessary, but useful for increasing potential sense of safety
Good Practice-Examples	► S-Bahn Berlin ► Oslo metro

Source: own representation based on market research, KCW

A disadvantage of central door opening, especially when no passenger is boarding or disembarking, is the associated reduction in heating or cooling capacity, which can lead to increased energy consumption and associated increased costs and greenhouse gas emissions.

In the future, central door opening could tend to accelerate passenger changes, especially in railbound traffic. The stopping time at the stops or stations could be reduced, thus allowing a higher frequency of services. In future, this measure could help to increase the efficiency of the system, especially in urban centres, as demand rises again.

The Union Internationale des Transports Publics (UITP), a global association for public transport stakeholders, conducted a survey of its member organisations in 2021. The aim was to get an overview of which pandemic-related measures had been implemented and which were most effective in winning back passengers. In the survey member organisations indicated that increased air exchange was the most cost-efficient and effective measure for recovery of passenger numbers. Just over half of the companies indicated that they would like to continue to provide additional ventilation beyond the pandemic (UITP 2021: 5f.).

3.1.2 Technologies for air pollution control

In addition to conventional ventilation through regularly opened vehicle doors various technologies are available to promote air exchange. Filter technologies and UV-C technologies can be considered for usage. In the case of inactivating processes, the formation of secondary reactions that are harmful to health (including the formation of ozone) must be avoided in all cases. When UV is used no residual radiation must be measurable in the passenger area (cf. UBA 2021a).

When using filter technologies the use of filters with filter class H 13 or a combination of filter classes F 7 and F 9 is recommended to ensure the efficient filtering of viruses from the air. H 14

filters, such as those used in ventilation systems in hospitals, are too cost-intensive and in any event are not necessary for comprehensive virus protection. Depending on the intensity of use, the filters must be replaced after about half a year or a year. This can usually be done by trained specialists in the workshops. However, certain hygiene regulations must be observed when replacing the filters as they are contaminated by pathogens (IRK 2020b: 3; market research by KCW).

Table 3: Technologies for air purification

Technologies for air purification	
Objective	exchange and cleaning or disinfection of the air in closed rooms
Alternatives	▶ Air conditioning/air purification systems with *HEPA filters*: Class H 13 filters or a combination of F 7 and F 9 (EU standard DIN EN 1822) filter aerosols and pollutants from the air through tightly woven layers of fleece. ▶ Air conditioning/air purification systems with *UV-C modules*: UV-C light makes viruses and bacteria biologically inactive. It is an ozone and chemical free solution. No virus collection filters are needed and no UV rays are emitted due to the closed installation. The noise level is usually lower than with conventional filters. The residual radiation must not be measurable in the passenger areas.
Effectiveness	validation without specific analysis of the product not possible
Implementation speed	can be delivered and installed within 3 months, depending on availability from the manufacturer
Costs	investment: 800 to 1,500 Euro per bus maintenance: HEPA filter replacement approx. 300 Euro; UV-C lamp replacement of minor importance during the year (replacement after approx. 10,000 operating hours)
Visibility	measure is hardly visible / experienced: passengers benefit from it unconsciously; direct (repeated) signs needed to potentially increase sense of security
Good Practice-Examples	▶ UV-C modules: Hanau city bus fleet ▶ filter: Verkehrs- und Tarifverbund Stuttgart (VVS), Hamburger Hochbahn

Source: own representation based on market research, KCW

UV-C radiation is an established measure for disinfection, especially in water treatment. To ensure effectiveness in air purification it is necessary to ensure that sufficiently large volumes of air can be disinfected with a certain radiation intensity and duration and that they are subsequently well distributed in the room. Since UV-C rays are harmful to the health of the eyes and skin, it is necessary to install them firmly and enclosed, e.g. in an air-conditioning or air purification system. For this reason, the IRK recommends obtaining proof of effectiveness and equipment safety from manufacturers. Since this technology does not use a filter that would have to be replaced after a certain period of use, the maintenance intensity is reduced; however, regular replacement of the lighting source by a specialist company is necessary (IRK 2020b: 3f.).

An assessment of the effectiveness of both technologies is only possible based on effectiveness tests under operating conditions. Manufacturers usually state the reduction of the virus load in the device and do not take into account the effect of the air distribution in the room. That means that the manufacturer's figures of reduction by 99 percent are sometimes significantly reduced. The VDI guideline 4300-14 requires a reduction of particles (for filtration processes) or viruses (for inactivating processes) by 90 percent within thirty minutes of operation (VDI 2021). It is

therefore always necessary to examine the technology under operating conditions (IRK 2020b: 2ff.; Sembach 2021: 7f.).

The use of these technologies in air-conditioning systems offers the advantage that fresh air can be drawn in and distributed in the room (IRK 2020b: 6). However, the air-conditioning systems currently used in public transport are usually not suitable for the installation of HEPA filters[9] , as they do not have the capacity to compensate for the pressure loss (IBP 2021: 20). Air purification systems that are independent of the air conditioning system (regardless of their technical implementation) purify the existing air in the room only to a limited extent. However, they do not ensure air exchange and consequently do not contribute to ventilation success. Therefore, a sufficient supply of fresh air - e.g. via the vehicle doors - is still necessary when using them(IRK 2020b: 6).

Before installing air purification systems, the current air exchange rate of any existing air conditioning system in the vehicle should be checked. In long-distance trains, in particular, this is often sufficient and no further measures are required. In such cases, the system should draw mainly fresh air and not just circulate the existing air. Otherwise, additional filters or UV-C technologies would also be necessary here to clean the air during a pandemic (IBP 2021: 20ff.).

Retrofitting vehicles with air purification systems is proving difficult in part due to a lack of space (IBP 2021: 281).

3.1.3 Separation screens in vehicles and customer centres

In order to protect drivers and service staff in particular from infection, protective screens are increasingly used in vehicles and also in customer centres. At the beginning of the pandemic in 2020 screens were mostly made of plastic films. Now they are mostly replaced by long-term and stable solutions made of polycarbonate or safety glass. Protective screens have the advantage that they not only limit the spread of aerosols, but also protect the driving or service staff from physical attacks. For that reason protective screens were installed between the driver's seat and the passenger compartment in some cities even before the pandemic.

The effectiveness of separation screens was investigated in a study by the Technical University of Berlin, Berliner Verkehrsbetriebe and Charité hospital. The results show that they effectively reduce the spread of aerosols from the passenger compartment to the driver and adequately shield the staff (cf. TU Berlin 2021).

When installing separation screens in the vehicles, certain aspects of product law must be taken into account, especially in the case of solutions made of polycarbonate. In most cases test reports from independent approval organisations must be prepared for installation in vehicle types of the same design so that the vehicles do not lose their approval to operate. Safety glass screens usually already have approvals of their type (VDV 2020: 40f.).

The use of separation screens has proven successful for many transport companies. For example, in the UITP survey cited above, 68 percent of the surveyed member organisations indicated that they would like to retain the screens beyond the pandemic (UITP 2021: 8).

[9] HEPA filter stands for “high efficient particulate air filter”.

Table 4: Separation screens in vehicles (and customer centres)

Separation screens in vehicles (and customer centres)	
Objective	► prevention of air exchange between driver / service staff and passengers ► increasing the safety of staff regardless of the pandemic
Alternatives	► *polycarbonate* screens: inexpensive, durable, flexibly adjustable, low-vibration, scratch-resistant (anti-reflective coating recommended) ► *safety glass* screens: high durability and scratch resistance, even with frequent cleaning (anti-reflective coating is recommended)
Effectiveness	Separation screens prevent the spread of aerosols from the passenger compartment to the driver.
Implementation speed	can be delivered and installed within 3 months, depending on availability from the manufacturer; possible effects on vehicle approval must be taken into account
Costs	polycarbonate: ► depending on the city bus model: 900 to 1,200 Euro per screen for self-installation (250-450 Euro additional for installation) ► minibus: approx. 600 Euro per screen for self-installation (150 Euro additional for installation) safety glass: depending on bus model: 2,000 to 10,000 Euro
Visibility	measure can be seen/experienced by passengers, implementation does not require signs
Good practice examples	► Koblenzer Verkehrsbetriebe (polycarbonate) ► Kasseler Verkehrsgesellschaft (safety glass)

Source: own representation based on market research, KCW

3.1.4 Summary

Overall, regular air exchange is of overriding importance, especially in order to reduce the risk of an coronavirus infection. Therefore, central door opening in vehicles (in urban traffic) by the driver is a suitable measure that can be implemented in the short term without additional expenditure. In particular, it seems reasonable to ventilate vehicles at terminal stops over a longer period of time. Opening doors at stops during operation is directly visible for passengers and it can be assumed having a positive influence on the perception of safety. In order to reduce heating and air conditioning costs, the need to open the doors at each stop should be evaluated depending on the infection situation.

Insofar as the air exchange via the opening of the vehicle doors as well as the conventional air conditioning in the vehicles (fresh air supply) is not sufficient, the possible virus load in the room can be further limited by the use of air pollution control technologies. Signs e.g. in the form of pictograms increase the visibility of this measure. UV-C offers the advantage over conventional filter technologies that there is no need to replace the (contaminated) filters during the year. In addition, the noise level is lower. However, with UV-C, special safety aspects must be taken into account to protect against residual radiation in the room. In addition, for better staff protection from potential infection separation screens can be used.

3.2 Cleaning and disinfection

Even before the pandemic the cleanliness of vehicles and of stops and stations was a decisive quality criterion for passengers, as it significantly influences their first impression and sense of well-being when using public transport. Intensified cleaning can therefore also contribute to an improved perception of public transport.

At the same time, an improved perception of surface hygiene by passengers can be instrumental in enabling them to hold on again without fear of infection from handrails in vehicles. In the DLR survey, 40 percent of respondents had stated that they were afraid of catching an infection when touching the handrails and handles (DLR 2021a: 9).

The cleaning and disinfection of surfaces helps to prevent smear infections. However, these are of secondary importance for the coronavirus pandemic compared with transmission via droplets or aerosols (cf. RKI 2021).

Because of the way coronaviruses are transmitted, the RKI advises:

„Eine routinemäßige Flächendesinfektion in häuslichen und öffentlichen Bereichen, auch der häufigen Kontaktflächen, wird auch in der jetzigen COVID-Pandemie nicht empfohlen. Hier ist die angemessene Reinigung das Verfahren der Wahl." (RKI 2020b)[10]

Consequently, conventional cleaning remains of primary importance and can be intensified if necessary. Various options are available to support this:

- hygienic coatings on surfaces in vehicles and at stations (see chapter 3.2.1),
- novel cleaning agents (UV irradiation, etc.) (see chapter 3.2.2),
- disinfection by the passenger (see chapter 3.2.3).

When selecting and using cleaning agents and disinfectants, section 15a (2) No. 1 of the Ordinance on Hazardous Substances Regulation (German: Gefahrstoffverordnung) must be taken into account. This states that biocidal products may only be used to the minimum extent necessary and that the benefits and risks must be weighed up. Alternatives such as those offered by conventional cleaning must be taken into account.

3.2.1 Hygienic coatings on surfaces in vehicles and at stations

Hygienic coatings of surfaces in vehicles and at stations serve to increase the surface hygiene of frequently used contact surfaces and thus close the gaps between conventional cleaning cycles. According to the RKI, even surfaces with antimicrobial properties still require mechanical cleaning of surfaces to remove secretions and soiling (cf. RKI 2020b).

Three hygienic coatings are examined in more detail below:

- photodynamic hygienic coating,
- antimicrobial copper coatings (representative of coatings based on silver, zinc, etc.),
- hygienic coating made of titanium dioxide.

[10] Translation: "Routine surface disinfection in domestic and public areas including frequent contact surfaces is not recommended even in the current coronavirus pandemic. Instead adequate cleaning is the procedure of choice."

In addition to the effectiveness of the respective coating, the dermatological compatibility of the substances due to skin contact is of particular importance (cf. Fage / Faurschou / Thyssen 2014).

The effect of a photodynamic coating was explicitly investigated in a study for the use in bus transport (cf. Eicker and Salomon 2021). In this study, it was found that the surfaces are significantly less contaminated than expected during pandemic periods. When comparing coated and uncoated surfaces no significant difference could be found. Hence, no specific preventive advantage in public transport could be attributed to the coating for improving hygiene in public transport. The reasons for this may be complex:

- Passengers have been using handrails less since the start of the pandemic, or only with aids (e.g. clothing as a barrier). In addition, the use of private disinfectants to increase personal hand hygiene has increased, which may also have contributed to increased surface hygiene.
- The light irradiation in the vehicles is not sufficient to activate the surface coating (cf. Eicker and Salomon 2021).

Table 5: Hygiene coatings of surfaces

Hygienic coatings of surfaces	
Objective	improve hygiene of contact surfaces (especially door openers, handlebars, validators) to close gaps between cleaning cycles
Alternatives	▶ *Photodynamic* hygiene coating: Surfaces can be treated with a photodynamic hygiene coating. This is a coating that can be applied without biocides because it energetically activates oxygen through the incidence of light. This damages the cell envelope of germs. ▶ Antimicrobial *copper coatings* (copper surface layers, copper alloys and copper stickers): The effectiveness is based on the damaging effect of positively electrically charged ions on living cells (oligodynamics). However, copper can also trigger allergic reactions. ▶ Hygiene coating made of *titanium dioxide*: The effectiveness is based on the cationic effect of titanium dioxide, which results in the death of pathogens.
Effectiveness	effectiveness of germ reduction up to 99.9 percent according to manufacturer's data; tests under public transport operating conditions necessary to validate effectiveness
Implementation speed	can be delivered and installed within 3 months, depending on availability from the manufacturer
Costs	approx. 300 to 800 Euro per bus (depending on manufacturer and surface coating) The cycle for renewal of the hygienic coating depends on the intensity of use and on the product: usually after a half or full year, sometimes longer.
Visibility	measure is barely visible/experiential; direct (repeated) signs needed to increase potential sense of security
Good practice examples	▶ Regensburg, Ruhrbahn GmbH: photodynamic coating ▶ Busverkehr Rheinland GmbH (BVR), Busverkehr Ostwestfalen GmbH (BVO): Coating with titanium dioxide ▶ Bremer Straßenbahn AG: Copper stickers (pilot project)

Source: own representation based on market research, KCW

In most cases, the coatings are applied to the surfaces by electrospray or as stickers or integrated into the cleaning process (see the following comments on novel cleaning agents). Subject to availability of the products, application is usually possible at short notice. Coating can be carried out by the specialised staff in the workshops or as a service.

3.2.2 Novel cleaning agents

In addition to conventional cleaning agents, new types of cleaning agents (some with a long-term effect) are increasingly coming onto the market for public transport.

In general as already mentioned cleaning is preferred to disinfection in public areas. However, if disinfection becomes useful - e.g. after transporting a person with a proven infectious disease and visible surface contamination caused by this person - wipe disinfection is preferable to spray disinfection. This is more effective due to the mechanical application. The agents used for spray disinfection can also enter the respiratory and/or digestive tracts, which can lead to adverse health effects (cf. RKI 2020b).

Table 6: Novel cleaning agents

Innovative cleaning agents	
Objective	thorough and / or long-lasting cleaning or disinfection of hard-to-reach areas
Alternative	► Cleaning by means of *UV-C*: Usage e.g. on escalator handrails (in operation) or as part of conventional cleaning, e.g. via steam suction systems (steam suction systems clean surfaces and at the same time suck room air into the device, where pathogens are irradiated with UV-C light and thus inactivated. Cleaning is done with water only and thus without detergents). ► Cleaning agents with *long-term effect*: Cleaning agents (biocidal product, e.g. based on water and silver) with long-term effect of approx. 14 days can be incorporated into the cleaning cycle of the vehicles and thus close the gap between the cleaning processes (see also hygiene coatings of surfaces).
Effectiveness	effectiveness of germ reduction up to 99.9 percent according to manufacturer; tests under public transport operating conditions necessary to validate effectiveness
Implementation speed	can be delivered and installed within 3 months, depending on availability from the manufacturer
Costs	► equipping escalators with UV-C: approx. 6,000 Euro per escalator ► cleaning agent: approx. 10 Euro per vehicle and month
Visibility	measure is barely visible/experienced; direct (repeated) signs needed to increase potential sense of safety.
Good practice examples	► escalators with UV-C: test trials by the Münchner Verkehrsgesellschaft (MVG) and the Deutsche Bahn (DB) ► cleaning agents with long-term effect based on silver: Verkehrs-Aktiengesellschaft Nürnberg (VAG), Rheinbahn AG (as part of cleaning)

Source: own representation based on market research, KCW

Fogging rooms with both hydrogen peroxide and sodium hypochlorite solutions has - depending on the concentration - an irritating effect on skin and mucous membranes. The IRK therefore advises against them. This also applies to fogging with other disinfectants unless special

protective measures and hazard analyses are available (IRK 2020b: 4). In this respect, these disinfection options are not discussed in further detail here. However, there are several products on the market in these categories for which the purpose of the measures for public transport could not yet be assessed.[11]

For public transport UV-C technology (which is also used for air purification) is a novel but not yet sufficiently tested possibility for disinfection. There are various possible applications here, e.g. the cleaning of handrails on escalators or the use of cleaning devices with integrated UV-C technology, e.g. for the disinfection of frequent contact surfaces such as stop buttons. [12]

In the field of UV-C technology, it is not yet possible to present an overview of suitable products for public transport (IBP 2021: 57). In the future, more standardised solutions are expected on the market, e.g. for cleaning control and touch panels as well as handles via compact UV-C modules (IBP 2021: 87).

UV-C has the following advantages over conventional chemical cleaning agents, among others:

- proven application in health care and water treatment
- time saving during cleaning
- gentler treatment of materials (IBP 2021: 56)

However, UV-C light can attack plastics during regular use (cf. Fraunhofer-Institut für Betriebsfestigkeit und Systemzuverlässigkeit 2020).

Cleaning agents with a long-term effect are also used. These usually have a similar effect to antimicrobial surface coatings, but with a shorter duration of action of 14 to 30 days (cf. Nöth / Steinrücke / Konradt 2022). They can be integrated into the conventional cleaning process. These cleaning agents usually contain or consist of biocide products. Their long-term effect is based on the antimicrobial properties of the ingredients, such as silver. The daily cleaning of high-touch surfaces introduced during the pandemic is then no longer necessary. This leads to more personnel capacities.

3.2.3 Disinfection by the passenger

According to the current situation, the RKI does not recommend routine surface disinfection in public areas but considers thorough cleaning as the best solution for reducing the pathogen load. Hand hygiene is of particular importance here to prevent the transmission of pathogens via surfaces (cf. RKI 2020b). Disinfection of hands is particularly advisable in the medical sector or in nursing. In other areas, thorough hand washing offers an equivalent alternative (cf. RKI 2020a).

However, unlike in regional railway services, there are no washbasins in public road passenger transport (buses, subways, trams). Passengers' subjective sense of safety can presumably be increased if it is possible for them to disinfect their hands or private items. For this purpose, (touch-free) disinfectant dispensers can be installed at bus stops and in vehicles.

In the UITP study disinfectant dispensers were assessed by member organisations as a cleaning measure with a positive cost-benefit balance. In particular, they increase passengers' subjective sense of safety and are requested by many passengers even beyond the pandemic. Nearly

[11] E. g. 3-D disinfection by ultrasound: A biocide used in medicine for wound disinfection is distributed as a mist in the room by ultrasound (3-D disinfection). This results in thorough disinfection of hard-to-reach areas in the room. In addition, a temporary protective layer is created.

[12] For advantages and disadvantages of UV-C technology, see chapter 3.1.

50 percent of the surveyed member organisations stated that they intend to continue providing disinfectant dispensers beyond the pandemic (UITP 2021: 5ff.).

Table 7: Disinfection by the passenger

Disinfection by the passenger	
Objective	preventing smear infections by disinfecting the passenger's hands and other private items
Alternative	(Touchless) disinfection dispensers for passengers: (Sensor-based) disinfection dispensers can act as hygiene locks at entrances and exits of stations but also in vehicles.
Effectiveness	possibility to wash hands in public areas mostly not given; disinfection dispensers offer remedy
Implementation speed	can be delivered and installed within 3 months, depending on availability from the manufacturer (approval may be required for installation in vehicles)
Costs	from 100 Euro per dispenser (quantity discount possible)
Visibility	measure is visible/experiential when actively used by passengers; signs may be useful to clarify added value and increase usage.
Good practice examples	▶ disinfection stations at Deutsche Bahn stations ▶ hygiene stations of the Münchener Verkehrsgesellschaft (MVG) ▶ Transport for London (UK): 1,000 disinfection dispensers were installed across the network, including all underground stops and stations. ▶ Nantes urban transport (France): dispensers and information boards in all tramways and buses ▶ Lahr (Südwestdeutsche Landesverkehrs-GmbH, SWEG): 25 city and intercity buses with touchless disinfection dispensers

Source: own representation based on market research, KCW

3.2.4 Summary

Novel cleaning options in public transport are mostly used to bridge the intervals between cleaning cycles, e.g. via the use of products with a long-term effect or disinfection during operation. One possibility is the use of UV-C irradiation on escalators.

According to the RKI appropriate cleaning is also preferable to general disinfection in public areas. The use of further cleaning and disinfection agents based on biocidal products must be weighed up in the light of section 15a (2) No. 1 of the Ordinance on Hazardous Substances Regulation (German: Gefahrenstoffverordnung). The focus therefore remains on conventional cleaning of vehicles and stations, which can be intensified if necessary.

Especially in vehicles - but also on escalators - it is important that passengers can hold on without fear of infection for safety reasons. Since there is usually no opportunity to wash hands in public spaces, disinfection dispensers offer passengers the opportunity to disinfect their hands during the trip. Disinfection dispensers in particular can be "experienced" directly by the passenger and can thus contribute to an increase in the subjective feeling of safety. The other measures listed must be included directly in the communication, since they themselves are not visible. However, disinfectants are biocidal products and should therefore only be used if the need for disinfection exists.

Intensifying cleaning can make a significant contribution to improving the public image of public transport and to increase the sense of well-being among passengers (quality criterion of cleanliness). Cleanliness should be pursued regardless of the coronavirus pandemic.

3.3 Passenger guidance and capacity management

Steering passengers and capacity management have been discussed to minimise occupancy peaks even before the pandemic. Passenger guidance should be practiced in peak hours at stations and in vehicles to accelerate operation, whereas capacity management is meant to distribute demand throughout the day. With the onset of the pandemic, these measures have taken on a new significance. In DLR's 5th mobility survey, 41 percent of respondents stated that there were too many people on public transport (DLR 2021b: 9). In this respect, passenger guidance now also serves to distribute the number of passengers at stops or in vehicles as far as possible so that distances between people do not decrease too much and a feeling of crowding is avoided.

Various options have been developed to provide passengers with the most up to date information on occupancy rate. This enables them to make their own informed decision as to whether they want to use a selected public transport connection at a particular time or change to less busy connections. This can address existing concerns about high occupancy rates in vehicles, which have become more pronounced as a result of the pandemic, provided that the density of service allows passengers to flexibly shape their travel route or time. The solutions in use can be differentiated according to their stage of development:

- First stage: Information, e.g. as a tabular presentation or as an integration into the timetable information (forecast for occupancy rates based on historical data),
- Second stage: Using the information in the trip planner to optimise the route by suggesting alternative connections to the passenger (based on historical data),
- Third stage: Use of historical and real-time data in timetable information for route optimisation as well as, for example, real-time information on vehicle occupancy at platforms or in occupancy maps.

The basis of all systems is a (partly adaptive) algorithm that generates a forecast of the occupancy rate from various data sources. The following, for example, can be considered as input data:

- Number of requests in the trip planner,
- Number of passengers in the vehicles (passenger counts, automatic passenger counting systems; in perspective via activated Bluetooth and/or WLAN interfaces),
- Number of (mobile phone) tickets sold.

In addition to the measurable input data mentioned above, further specifying indicators can be used by the algorithm, e. g.

- information from the partners working on site (bus companies, etc.),
- current construction sites, diversions, etc.
- weather data,
- major events.

Table 8: Capacity management

Capacity management	
Objective	offering passengers a basis of information so that they can make a decision on a start time and/or route choice
Alternative	▶ information in the *"occupancy rate indicator"/timetable information*: based on the last comparable days of operation (data from the counting devices of the vehicles, among others) ▶ *map display*: All vehicles equipped with automatic passenger counting systems are displayed on a map with position and occupancy rate information in real time. ▶ occupancy rate information via *entries by* staff and number of passengers checked in: App in which driving staff, train attendants and inspectors can enter the occupancy rate of vehicles and stations. (In addition, mobile tickets can also be processed via the app.) In addition: App users confirm check-in when boarding the vehicle as part of the use of digital distribution options on the smartphone. ▶ integration into the trip planner with *suggestion of alternative routes*: Forecast based on various data sources (e.g. query data from the trip planner, booked mobile phone tickets, automatic passenger counting systems or data from classic passenger counts), daily recalculation for the following days. Based on the forecast, route planning can be optimised in real time by suggesting alternative connections with low occupancy.
Effectiveness	In the trial phase: load control is only possible for passengers who are "free to choose" in terms of time and do not have to use public transport at a specific time. Further research is needed on usage behaviour[13] to investigate the extent to which capacity forecasting in general and alternative routing in particular lead to a change in behaviour (choice of a different connection). Capacity forecasts can have an effect if temporal (frequency) and spatial (stop infrastructure, multiple lines) alternatives are available. Accompanying measures (e.g. fare incentives) can increase effectiveness.
Implementation speed	Depending on the implementation alternative and initial situation: In addition to the development of an algorithm, its learning phase is also crucial. As the data input grows (in terms of time, breadth of data), the forecast becomes more precise.
Costs	Costs cannot be clearly delineated. Counting infrastructure and effort should not be taken into account, since they are usually installed or carried out independently of the load forecast. Relevant here are the development costs for the algorithm required to calculate the forecast.
Visibility	The measure is visible / experienced when actively used by passengers. Signs can be useful to clarify the added value and increase usage. In perspective, an occupancy rate of arriving vehicles displayed on the platform will achieve higher visibility.
Good practice examples	▶ integration of the capacity forecast into the timetable information/optimised route finding: Rhein-Main-Verkehrsverbund (RMV) ▶ real-time map display: Skanetrafiken (Sweden) ▶ tabular and map display in real time: bus traffic in Giessen (Stadtwerke Giessen AG and local transport subsidiary MIT.BUS GmbH)

Source: own representation based on market research, KCW and Probst & Consorten Marketing-Beratung

Currently, the systems for occupancy rates are under development and in some cases do not yet provide valid information. This is due to various reasons: On the one hand, there is sometimes

too little input data available to "feed" the algorithm, and on the other hand, the algorithm itself is not yet mature.

In addition to the expected effect on pandemic spread noted above, capacity management may also have potential value in other aspects:

- The equalisation of peak periods can lead to an even distribution of demand throughout the day and thus, among other things, to a reduction in costs (less "hot" air during off-peak hours).
- The acceleration of operational processes through faster passenger changes (especially when passengers are distributed across the platform)[14] can lead, among other things, to an increase in punctuality and thus customer satisfaction.
- Information can be derived on short-term operational optimisation and long-term local transport planning (preparation and updating of local transport plans) (Vogel et al. 2021: 33ff.).

Summary

The purpose of public transport is organising traffic efficiently by bundling several people in one vehicle. Therefore, it can be expected that occupancy rates will continue to be high in the future, especially in metropolitan areas during rush hours. The current pandemic-driven trend toward increased use of working from home can support management of occupancy rates. Working from home increases the freedom to choose when to start; for example, it is conceivable to work from home in the morning and travel to the workplace during the day. However, this also presupposes that the public transport service allows this and that the higher service density during peak-times extends over a longer period. This would be supported by fare measures that provide an incentive for the use of later trips ("9 a. m. ticket"). In rural areas, peak times are determined by services of school busses. The times often last no longer than one to two hours. By staggering school times with foresight demand can be better distributed through the day, which also makes use of vehicles and their drivers more efficient.

Consequently, a forecast of occupancy rates can only be effective if there are alternatives for a passenger who is likely to be more flexible in terms of time and is willing to change to an alternative connection. Accompanying measures (e.g. fare incentives) would seem to be justified and can enhance the effectiveness of forecasts of occupancy rates.

3.4 Support for various measures through digitalisation

Advancing digitalisation is one of the drivers of current developments in almost all industries. Public transport also benefits from an increasingly digitised world, e.g. if access barriers with regard to fares and sales can be removed. In this context, digitalisation provides the framework for the development of various measures and can contribute to the release of synergies (e.g. decentralisation of customer communication, capacity utilisation management). With regard to hygiene safety, the following dominate

- contactless services (e.g. digital sales and cashless payment) (see chapter 3.4.1) and

[13] Note: Since October 2021, DLR, VBB, HaCon and BLIC have been working together on the three-year SAFIRA research project (= **S**icherheit und **A**bstand durch **F**ahrgastlenkung basierend auf **I**nfo**r**mationen und **A**uslastungsdaten, engl. safety and distance through passenger guidance based on information and utilisation data). Part of the work concerns studies on usage behavior.

[14] See also the section on automatic door opening, chapter 3.1.1.

- artificial intelligence (see chapter 3.4.2).

3.4.1 Contactless services

Digitalisation offers the opportunity to reduce access barriers to public transport, especially in terms of fares and sales. On the one hand, digital ticket purchasing can reduce contacts if tickets no longer have to be purchased from driving staff or at the ticket machine or customer centres. On the other hand, it offers the opportunity to simplify the fare system: By means of check-in/check-out, passengers can check in at the start of their trip and check out again at the end of their trip. In the future, it may even be possible to implement a be-in/be-out system in which passengers no longer have to check themselves in and out of the vehicles. In this way, distance-based paying is also possible. As a result, the passenger no longer has to worry about which fare to choose. Digitalisation also supports the implementation of flexible fare models (see chapter 4).

Passenger care can also be provided virtually via video terminals integrated in vending machines. On the one hand this reduces contacts and lowers the risk of infection. On the other hand, it gives staff the opportunity to provide direct assistance at stations or stops that are less in demand. Virtual communication also offers staff the opportunity to work from home. In this way it is possible to prevent the service from being completely shut down, as happened in some cases at the start of the coronavirus pandemic.

Measures to digitise fares and sales usually require a long lead in time in order to define the strategic framework, award contracts and then implement them.

Table 9: Digitalisation of fare and sales

Digitalisation of fare and sales	
Objecitve	reduce contacts through the digitalisation of processes
Alternative	► virtual customer support/sales: (if desired) 24/7 consulting through virtual customer centres; online subscription management ► digital ticketing: Digitalisation of ticket purchases through mobile phone paying, app-based ticketing, or e-ticketing using check-in/check-out or check-in/be-out or be-in/be-out systems.
Effectiveness	high (reduction of contacts)
Implementation speed	longer than 12 months
Costs	after implementation similar to conventional customer service; with increasing digitalisation savings in personnel and material costs possible
Visibility	The measure is visible/experiential when actively used by passengers. Signs can be useful to clarify the added value and increase usage.
Good practice examples	► digital ticketing: mobile phone ticket Verkehrsverbund Berlin-Brandenburg GmbH (VBB), ticketing app of Berliner Verkehrsbetriebe (BVG) ► virtual customer service: video vending machines at the Verkehrsverbund Rhein-Ruhr (VRR)

Source: own representation based on market research, KCW and Probst & Consorten Marketing-Beratung

In order to reduce contact areas in the vehicles, various options for contactless actuation of the stop request have been developed. A holographic stop button has been available since 2022. The

virtual button is located in a small box and is activated by holding a finger over it (cf. Conduent Transportation 2021). Apps offer another option: the timetable app of the Ruhrbahn (ZÄPP) has been further developed into a trip assistant in cooperation with Verkehrsverbund Rhein-Ruhr. It enables the communication of the stop request via Bluetooth and radar recognition. The function is primarily intended to increase accessibility but can be used by all passengers for contactless stop request notification (Ruhrbahn GmbH 2021: 72ff). Many of these measures are currently being tested, so the benefits for reducing contact areas cannot yet be fully assessed.

3.4.2 Artificial intelligence

For public transport, artificial intelligence offers considerable potential, especially in the context of image processing (see table 10). For example, it can provide support in the verification if masks are worn by the passengers. Pilot projects are currently being implemented for the most part in this area of application, while the technology is still being developed. It can also collect information on occupancy rates for vehicles, which can be used for forecasting respectively control of occupancy rates. In addition, artificial intelligence identifies emergency situations such as when a person is lying motionless on the ground and calls for assistance automatically. This supports the driving and service staff during the trip. Cleaning staff can also be assisted in identifying dirty areas and leading them to these places. There are fears that data protection could deteriorate from increased use of artificial intelligence. However, it should not collect personal data as the sensors identify people only as objects (triangulation of people). Triangulation takes place in the sensor without an Internet connection so that the sensors are considered secure against hacking attacks (Friedrichsen 2020: 34ff.).

Table 10: Artificial intelligence

Artificial intelligence	
Objective	support various processes (e.g. for real-time capacity management) with artificial intelligence (image processing)
Alternative	image processing through the use of artificial intelligence and sensors in the passenger area to obtain statements on the following aspects: Occupancy, minimum distance, mask requirement, soiling, vandalism, emergency situations
Effectiveness	The mask requirement and minimum distance can be controlled more effectively. Passenger flows can be equalised by image-processing (providing information on occupancy to passengers). It also provides greater safety for rail staff.
Implementation speed	in development
Costs	not specified
Visibility	The measure is hardly visible / perceptible without further ado: passengers benefit from it unconsciously. In order to make the technologies visible / perceptible and thus potentially increase the feeling of safety, direct (repeated) indications are required.
Good Practice-Examples	video-based passenger counting system (pilot project): 22 modernised trains of the Euregiobahn in the area of the Aachen transport association (DB Regio)

Source: own representation based on market research, KCW

3.4.3 Summary

Digitalisation strategies are generally seen as the most effective measure for passenger recovery and beyond (UITP 2021: 15). Within the framework of technical concepts for improving hygiene and infection control there is the opportunity to offer and carry out services without contact on the one hand and to facilitate control processes through the use of image-processing systems on the other. For example, compliance with an obligation to wear a mask, the reporting of damage caused by vandalism, the identification of contamination or capacity management can be improved.

3.5 Summary and recommendations

An increased risk of infection in public transport has not yet been proven. Nevertheless, many passengers report discomfort in shared transport. Cleanliness and hygiene in particular have become more important - against the backdrop of the pandemic. The rules on protection against infection in Germany still prescribe the wearing of an FFP-2 mask in public transport. In this way, passengers can effectively protect themselves. However, if this rule is sooner or later dropped, measures will be required for transport companies to meet increased cleanliness and hygiene requirements and to prevent infections in general. Against the background of the market research conducted, the following five recommendations can be made.

In principle, however, these recommendations are subject to the proviso that valid scientific findings on the use of the techniques in public transport are lacking for almost all the measures presented.[15] In some cases, the framework conditions differ considerably from their use in the healthcare sector, where most experience has been gained with hygiene measures. Therefore, the results of effectiveness analyses carried out there cannot be transferred a 100 percent to the considered use in public transport. Corresponding studies should also be carried out for public transport in the future.

First, communicate technical hygiene measures to reduce anxiety.

Even if objectively the risk of infection in public transport is not demonstrably increased, passengers' perception of risk may be different. The objective protection against infection is usually underestimated by passengers. In order to reduce fears of possible infection with the coronavirus or other infectious diseases in public transport, it is important to communicate measures to passengers correctly and directly.

A concise and pro-active communication of the (new and already existing) standards relevant for passengers is recommended. The technical quality in public transport is generally high due to strict testing routines - it is worth communicating this together with the extensive safety precautions. This can also be addressed by "staging" the cleaning of vehicles and infrastructure in public or providing information about the current state of research (e.g. masks protect; smear infections unlikely). This can strengthen the perception of objective safety in public transport.

Communication can take place through signs in and on the vehicles in the form of pictograms, through announcements or information in the online presence of the transport company. Depending on the safety precaution more or fewer signs are necessary so that these and their effect are "visible" to the passenger. However, care should be taken to keep the updating effort of the information as low as possible, e.g. to avoid costly "re-stickering" of pictograms.

[15] Note: The University of Kassel is currently working with several partners on the EMILIA research project, which will run until the beginning of 2024, to develop various recommendations for action to make public transport pandemic-resistant. Among other things, the effectiveness of various technical measures is being investigated. (Duration: 02/2021-01/2024)

Some of these communication approaches may also be useful beyond the pandemic situation, as it can be assumed that the topic of cleanliness and hygiene will play a more important role "afterwards" as well. Messages about more intensive or more frequent cleaning routines on the part of the transport companies could also be linked to an appeal to passengers to pay attention to cleanliness in the vehicles themselves.

However, the actual influence of communication measures on the technical precautions on the subjectively perceived risk of infection remains to be explored.

Second, improve air quality.

The coronavirus disease is an infectious disease that is mainly transmitted via droplet infection or aerosols in the air. For this reason air quality and regular air exchange are of paramount importance for the coronavirus disease and for comparable, future diseases. Currently, the most effective protection consists of wearing an FFP-2 mask. This measure can be supported by cleaning the air in the vehicles: Insofar as the air exchange rate cannot be sufficiently achieved by opening the vehicle doors or via the conventional air conditioning system, filters or UV-C modules in the air conditioning systems are suitable.

Since air purification systems and air conditioning systems cannot be retrofitted in vehicles in the short term in some cases, the extent to which these systems should be part of vehicle design in the long term should be examined.

Third, maintain conventional cleaning.

The newly developed cleaning and disinfection agents are mostly used for area-wide disinfection or to bridge cleaning cycles. According to the RKI, adequate cleaning is preferable to area-wide disinfection. Therefore, conventional cleaning should be maintained in the first instance. Other measures can be used as support. The Ordinance on Hazardous Substances Regulations (German: Gefahrenstoffverordnung) must be taken into account when selecting cleaning and disinfection agents. A suitable communication strategy must be developed to make these measures visible to the passenger (see above).

Increased cleaning and hygiene standards can also have a significant impact on how passengers feel when using public transport and should be pursued as an important quality criterion regardless of the pandemic.

Fourth, digitise services to reduce access barriers.

Digitalisation is one of those permanently effective developments that will have a significant impact on future mobility. Through targeted use, it can contribute to infection control and at the same time improve passenger communication, control the deployment of cleaning staff in a targeted manner, or avoid overcrowding through utilisation control (see below). For the most part, short-term implementation is not possible due to planning and tendering lead times. Therefore, the public transport authorities must work together with the transport companies to explore the options for implementing these in the medium and long term.

Artificial Intelligence as it is further developed specifically for use in public transport can be integrated in various control processes. An increase in the sense of security for passengers is possible. Targeted communication and education on the handling of the collected data are necessary to prevent passengers from feeling monitored by the video technology.

Fifth, to reduce peak traffic congestion, manage load factors.

Even before the start of the pandemic, capacity management was an important issue for many public transport authorities and transport companies in view of the full vehicles especially

during rush hours. The goal is to equalise peak traffic times in order to relieve vehicle capacities and speed up passenger flow.

The existing approaches to capacity management should be pursued and developed in the long term to give passengers the option of deciding whether to take a trip based on capacity data. In addition, it also offers the perspective of distributing the passengers more evenly within a vehicle. Valid forecasts and real-time information are necessary for successful implementation and acceptance by passengers.

In the long term, even in the face of new trends such as the increased use of working from home, capacity management can offer the opportunity to reduce the intensity of use of public transport in the peak hour in favour of extended peak hours. Alternative fare models can support this development (see chapter 4).

Capacity management will have a particular effect if it is accompanied by appropriate planning measures. As a result, passengers have the opportunity to switch to less busy trips at short intervals or to an alternative route. In rural areas a staggered school schedule to be worked out with the schools can also make a contribution. It also makes sense to offer fares that provide an incentive to use public transport at times that are less in demand (see chapter 4).

4 Alternative fare concepts

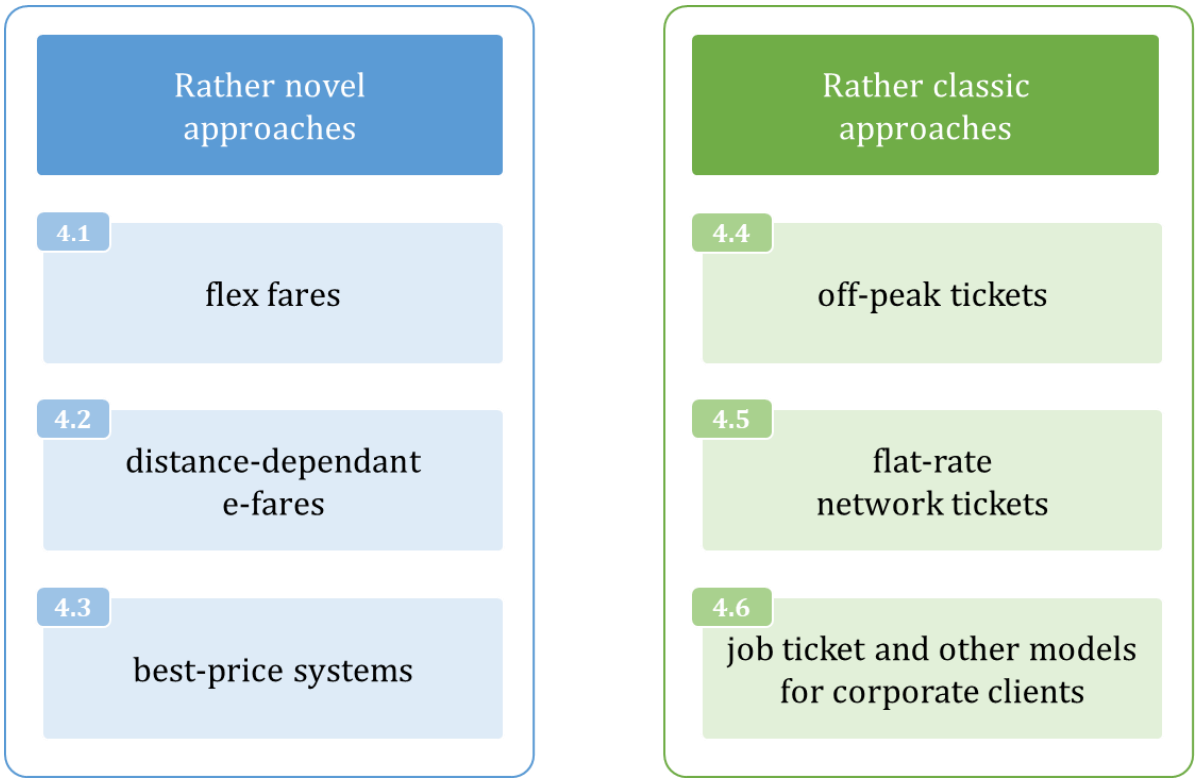
Chapter 2.2 has already shown how much the coronavirus pandemic in Germany has changed the choice of transport modes to the detriment of public transport. In particular, given that office work is increasingly being carried out at home this will lead to a permanent normalisation of atypical mobility patterns of working people. The same applies to leisure transport: The use of home shopping has increased in contrast to the previously very public transport-affine experience of shopping in the city centre. Many trips with occasional tickets (e.g. single tickets or one-day passes) are now replaced by only clicking once on the screen at home.

This is putting pressure on the numbers of customers and thus on the financing base. On the one hand, regular customers are looking for more flexible fares that fit better with a mix of office presence, home office and leisure mobility. On the other hand, fare incentives to (re)attract customers are becoming even more important, regardless of whether they are addressed to occasional or frequent passengers.

Compared to the period before 2020, which was already strongly influenced by the discussion of transition transport transition resulting in changes to public transport fares, the conditions have changed once again: First, there is simply more capacity for additional passengers. Secondly, questions of performance and cost-effectiveness have a different focus because it is possible that sticking to existing fares may cause more commercial damage than trying out new approaches. Many of the alternative fare concepts described below may well predate the coronavirus pandemic, but they take on new meaning under the new circumstances.

Overall, six fields of action have emerged with which the public transport sector is currently attempting to counter the Corona-related downward trends (see Figure 5):

Figure 5: Differentiation of alternative fare concepts according to fields of action



Source: own representation, Probst & Consorten Marketing-Beratung

These fields of action are described in detail in the following six chapters, each based on a few selected practical examples in Germany and other few countries. All case studies have exemplary approaches, of which there are certainly further variants. In each case, the key aspects and effects are highlighted. In order to assess their effects as much as possible on an up to date basis, numerous expert interviews were conducted with heads of transport associations and transport companies at the beginning of 2022, of which most are also named as direct contacts. [16]

All practical examples are examined on the basis of three central criteria:

- **Attractiveness and demand effect**: What aspects of the fare concept make public transport attractive to potential passengers? Does the model result in increasing (or, in the pandemic context, less sharply decreasing) passenger numbers?
- **Economic viability**: Is the fare system sustainable on its own or might public subsidies be needed? Might the granting of subsidies for these purposes lead to a lack of financing in different areas of the public transport system? Or does the model contribute to a broader funding base?
- **Capacity management (rush hour)**: Does the fare concept help to level out demand at peak times, which is particularly important in pandemic times (see also recommendation no. 5 in Chapter 3.4.3)?

4.1 Flex fares

“Classic” season tickets and subscriptions are primarily aimed at commuters who use public transport mostly during rush hours and thus significantly define the costs for the overall system. By contrast, part-time employees and/or those with a some use of home office, commute to the office only a few days a week and thus make a positive contribution to traffic avoidance. This promotes three trends that exert pressure for change on classic fare systems of public transport:

1. For some part-time commuters the subscription does not pay off, i. e. they sooner or later become non-contractual occasional users. However, since occasional fares are comparatively expensive, especially if other transport modes such as a car are available anyway, this increases the likelihood that previous public transport customers will turn away from public transport permanently.
2. For other part-time commuters (e. g. those travelling three days aweek) the season ticket remains the cheapest product in the standard fare – and yet they are dissatisfied. Their experience is that they ride less but pay exactly the same as commuters travelling five days a week. Such dissatisfaction can become a strong driver for cancellations as soon as a suitable occasion presents itself (e. g. the next price increase).
3. Those who commute less to work shift their mobility needs more to leisure time ("rebound effect"). The resulting trip patterns vary more in terms of time and space, so that the often rigid geographic validity of conventional season tickets is no longer sufficient and passengers tend to turn to the more flexible occasional fares – with the negative consequences for price perception and customer loyalty described under point 1.

Even before the pandemic, various public transport stakeholders had begun to develop approaches to close the perceived gap between occasional and season ticket fares. The coronavirus pandemic, which suddenly turned home office from the exception to the rule in many companies, has again strongly accelerated these activities – also because many assume

[16] We would like to take this opportunity to thank all those involved once again for their contributions.

that after the pandemic, more flexible working (in terms of location) will remain with us to a greater extent than before.

The various approaches can be roughly divided into two directions:

- Split fares follow the principle of "BahnCard" and enable the purchase of discounted occasional tickets upon payment of a basic price. The key parameters here are the discount amount, the basic price and the commitment period (from monthly bookings or cancellation to annual commitment as with the BahnCard). Some German transport associations, but also all Swiss transport associations, have gained experience for many years with the acceptance of the national BahnCard (or Swiss “Halbtax-Abonnement”) and/or their own discount cards. During the coronavirus pandemic, the discount cards aim at digital offers based on apps instead of (physical) discount cards for ticket purchases at ticket machines or from staff on transport vehicles. The advantage of split fares is the flexibility in terms of destination, i. e. any price level can be purchased as needed. On the other hand, a disadvantage especially from the perspective of former subscribers could be that a separate ticket purchase is necessary for each trip (instead of "just getting on") and that no cost control with fixed debit amounts or caps is possible. In those associations that have long relied on split fares often only moderate demand figures could be achieved.

- With contingent offers, passengers purchase a trip package that can be used as needed. This budget can be defined in terms of trips, days of use, route units or monetary units – there are few limits to creativity. Both service design and pricing have a strongly experimental character, since there is a lack of long-term empirical values in the entire public transport sector – with the exception of classic multi-use and stripe tickets (4-stripe, 10-stripe tickets, etc.). It is also not yet known which parts of the customer base will be attracted by more expensive, prepaid offers that nevertheless require validation/activation of each individual trip. There are major differences in the extent of the contract commitment and the validity of the contingent over time – from the one-time purchase of several day passes in advance, which can then be used over a very long time, to the annual subscription, which provides a certain usage contingent each month that expires at the end of the month. Geographic flexibility also varies from offers strictly related to price to offers of cash budgets that can be used at will.

The common goal of all offers is to keep migration from the classic loyalty products as low as possible and thus limit the economic damage to the industry. Ideally, previous occasional users should also be more strongly committed to and accustomed to using public transport ("upgrade"). Instead of overly specific offers only for part-time commuters, comprehensive, flexible products that cover both work and leisure purposes are therefore a good idea.

Most of the following case studies show that it is not yet possible to make reliable statements about the effects on passenger numbers and profitability. On the one hand, this is countered by the turbulent overall development during the various pandemic phases; on the other hand, the long term effects will show only in the future as the rather slowly changing mobility market is characterised by habits. As a result, the public transport sector faces the dilemma of either losing too many regular customers to other modes of transport by waiting too long or weakening the yield because of fare reductions and thus the financing of the overall public transport system by introducing new, possibly too bold offers. Too frequent readjustments should also be avoided so as not to alienate its passengers with constantly changing fare models.

On the other hand, there is the realisation that the new offers often remain niche products in the first few years, which neither completely turn ticket demand on its head nor trigger

unmanageable economic risks. The willingness to experiment therefore seems to be an important virtue – as long as the players are also prepared to take less successful offers off the market again or to make significant adjustments. It seems important to tailor the new offers to an uncomplicated way of getting around with a wide special validity, which is flexible enough to cover different patterns of use of ticket: "Yesterday I was at the office, today I'm at the home office, but I'm going to yoga in the evening. Tomorrow I want to go to the countryside!"

The following presents selected practical examples of flexible fare offers.

The "HandyFlexTarif 50" was piloted in the NVV in 2018 (Table 11). The testing group mainly included existing customers – a significant proportion of "genuine" new customers, however, was not represented in the pilot test. The goal was to motivate occasional passengers with a higher frequency of use and willingness to commit to more trips.

Table 11: HandyFlexTarif by Nordhessischer Verkehrsverbund (NVV)

	Nordhessischer Verkehrsverbund (NVV): **HandyFlexTarif 50**	
Initial situation before introduction	▶ classic cash fare (single, multi-use, day ticket) and classic season tickets, which are designed for very regular use	
Core of the measure	▶ seven-month pilot test of two types of fares, each with a relatively small group of test users, and a separate evaluation in 2018 ▶ subsequent focus on "HandyFlexTarif 50" with 5 Euro monthly basic charge for 50 percent discount on single trips ▶ can be cancelled monthly after a subscription period of 3 months ▶ sales only via **smartphone** to registered customers→ permanent introduction pending for technical sales reasons until further notice	
Evaluation	**Positive**	**Negative**
Attractiveness and demand effect	▶ positive development in the **frequency of use**: about 3 more trips per capita and month (increase of +54 percent)	▶ total potential of users who can be convinced to pay the basic fee and purchase via mobile phone still **unknown**
Economic viability	▶ additional trips and basic fee compensate for reduced revenue from discounted individual tickets → 22 percent **increase** in revenue in pilot group	▶ risk of **overestimation** of positive effects due to methodological limitations of the evaluation. ▶ **migration effects** of season tickets cannot be ruled out in case of permanent introduction
Capacity management (rush hour)	▶ –	▶ no effects in capacity management
More information:	https://www.nvv.de/der-nvv/aktuelles/pressearchiv/2018/nvv-verschiebt-projektstart-zu-neuen-elektronischen-tarifen-fuer-smartphones-um-sechs-wochen	
Contact:	Silvia Dittmar, NVV Tariff, Sales and Procedures of Revenue Sharing silvia.dittmar@nvv.de, +49 561 70949-21	

Source: own representation based on interviews and research, Probst & Consorten Marketing-Beratung

In contrast to comparable market tests (e.g. “ABO Flex” in Leipzig), extensive evaluation results could be derived at the “single-passenger level” in Northern Hesse. These suggest that the price discounts provide an incentive for increased use and that in total, the reduced revenues are compensated for by the high discount for single trips. However, the significance of these tests is limited – on the one hand because of the small sample and on the other hand because the previous sales of the test subjects in digital distribution were known but not in conventional distribution. On the basis of the data available it is not possible to tell whether passengers actually changed their behaviour as a result of the fare or whether it were essentially those who would have used public transport frequently anyway who opted for the pilot test. The revenue effect therefore cannot be clearly determined – nor can the longer-term effects.

In parallel another e-fare – the "HandyFlexTarif 25" – was tested. This granted a discount of 25 percent on sales of one-way tickets and day tickets in the following month for sales of at least 10 Euro. However, due to the poorer evaluation results the NVV does not want to pursue this variant any further.

VRR designed its FlexTicket (see Table 12) in the job ticket sector primarily for existing passengers, for whom a subscription is no longer economically viable due to home office, as well as for part-time commuters. The offer is initially designed as a pilot project for a period of two years. Interested parties order the FlexTicket via their company and purchase the (heavily discounted) 24-hour tickets from an online portal.

The subsidy is left to the discretion of the companies and varies considerably: while some companies do not pay any subsidy others pay the full or a partial amount. Some companies make the amount dependent on the length of employment.

As of February 2022 ten major customers with whom job ticket contracts already existed prior to the introduction had joined the pilot. Around 400 passengers took advantage of the offer. When designing the offer it was assumed that around two to three trips per week (and thus around eight to twelve per month) would be taken up. The initial results show that demand is significantly lower, with an average of around three tickets per month while at the same time there is steady income from the basic contribution. Influences from the pandemic and home office duties certainly play a role here.

59 percent of FlexTicket customers are passengers who have not previously purchased a job ticket under the company contract and a very high proportion are entirely new public transport customers. 41 percent of FlexTicket customers switch from other job tickets that continue to be offered by the companies. 70 percent of the switchers stated that without the FlexTicket they would have completely cancelled their ticket contract.

The Flex25 and Flex35 products (see table 13) were also introduced in response to increasing home office activity and are aimed at those passengers for whom a subscription is no longer economically viable. In principle, they work like a “BahnCard” in rail transport. The focus is on the private customer market having already covered the corporate client and job ticket segment with the FlexTicket. A key advantage of the products is that they can be used at all price levels – in comparison to a subscription, if the passenger commits to the most frequently used price level for a longer period of time. The offers are sold exclusively digitally via the VRR app. The basic fare is automatically renewed after 30 days and can be cancelled at any time. At the same time, the prices have been set in a way that the subscription remains viable more than 3.5 round trips per week.

Table 12: Flex-Ticket for employees by Verkehrsverbund Rhein-Ruhr AöR (VRR)

	Verkehrsverbund Rhein-Ruhr AöR (VRR): **FlexTicket for employees**	
Initial situation before introduction	► job tickets only available as subscriptions valid every day ► no specific offer for part-time commuters with a lot of home office work	
Core of the measure	► piloting of a **split fare** from May 2021: a monthly basic amount of 20 Euro enables the purchase of a maximum of twelve 24-hour tickets at a discount of up to 70 percent, regardless of price level, to be used within 30 calendar days. ► **requirement**: company or corporate client contract for job tickets ► payment of the **basic amount** by employees or as **subsidy** by employers	
Evaluation	**Positive**	**Negative**
Attractiveness and demand effect	► potentially large demand leverage due to **attractive end-user price,** esp. if subsidy is assumed by company ► **retention** of passengers for whom the normal job ticket does not pay off → Proactive avoidance of dismissals	► **unknown demand effect** in the current pilot phase ► **complex price comparison** due to limitation to 12 tickets per month
Economic viability	► basic amount secures **financial basis**, even if trip contingent is not utilised ► pilot implementation **without start-up financing**	► unclear whether new customer and retention effects compensate for **cannibalisation** of normal job tickets ► **voluntary grant payment with** no specific incentive to increase employer co-funding
Capacity management (rush hour)	► –	► no effects in capacity management: employees must be explicitly mobile during the rush hour
More information:	https://www.vrr.de/de/presse/vrr-und-rheinbahn-bringen-mit-flexticket-mehr-flexibilitaet-ins-aktuelle-tarifangebot	
Contact:	Annika Marie Herold, VRR Marketing - Specialist Group Tariff annika-marie.herold@vrr.de, +49 209 1584274	

Source: own representation based on interviews and research, Probst & Consorten Marketing-Beratung

Table 13: Flex25 and Flex35 by Verkehrsverbund Rhein-Ruhr AöR (VRR)

	Verkehrsverbund Rhein-Ruhr AöR (VRR): **Flex25 and Flex35**	
Initial situation before introduction	▶ no specific fare offer between classic cash fares (single, multi-use, day tickets) and classic season tickets, which are designed for regular use	
Core of the measure	▶ introduction of a **split fare** consisting of a basic amount to be paid monthly and discounted one-way tickets as of 1st January 2022 ▶ available in two variants: **Flex25** (basic price 3.90 Euro per month and 25 percent discount on single and bicycle tickets), **Flex35** (basic price 8.90 Euro per month and 35 percent discount on single tickets, free bicycle transport) ▶ sale only via **smartphone** to registered customers	
Evaluation	**Positive**	**Negative**
Attractiveness and demand effect	▶ potential retention of existing passengers for whom a **subscription is no longer viable** ▶ flexible use of **all price levels** for work and leisure	▶ still **unknown** after introduction in January 2022 ▶ **variety of options** may increase complexity ▶ (still) no combination with e-fare eezy.VRR, which was introduced in parallel
Economic viability	▶ potential revenue still **unknown** after introduction in January 2022	▶ unclear whether new customer and retention effects offset **cannibalisation** of normal season tickets
Capacity management (rush hour)	▶ –	▶ no effects in capacity management
More information:	www.vrr.de/de/tickets-tarife/ticketuebersicht/flextickets	
Contact:	Annika Marie Herold, VRR Marketing – Specialist Group Tariff annika-marie.herold@vrr.de, 0209 1584274	

Source: own representation based on interviews and research, Probst & Consorten Marketing-Beratung

The Flex discounts were not initially combined with the "eezy.VRR" e-fare introduced at the end of 2021 (see chapter 4.2). This is still pending for technical reasons until further notice and could combine the opportunities of both approaches or prevent contradictory incentives as to which fare model the passengers with medium frequency of use should be attracted to.

The 6-day ticket in the Hannover region is an example of a contingent offer without a contract (cf. table Table 14). The purchase of 6-day segments can lead to passengers stocking up more and – once the ticket has been paid for – traveling somewhat more often without thinking twice. It is not yet possible to say how large such effects will be and whether they will also offset the higher discount economically, due to the coronavirus pandemic with fundamentally declining overall demand. Market research has also not yet been carried out on the question of what effect the offer has on customers with season tickets.

Table 14: 6-day ticket by Großraum-Verkehr Hannover GmbH (GVH)

	Großraum-Verkehr Hannover GmbH (GVH): **6-day ticket ("6er-Tageskarte")**	
Initial situation before introduction	► no specific fare offers between classic cash fares (single, multi-use, day tickets) and classic monthly/subscription tickets designed for regular use ► normal day pass attractively positioned for occasional passengers: "With 2 trips, a day pass is already worth it!"	
Core of the measure	► even greater discount when **stocking up with** 6-day passes ► introduction as of 1st January 2022 ► focus on **digital sales**; customer centre as fallback level	
Evaluation	**Positive**	**Negative**
Attractiveness and demand effect	► clear **incentive to stock up:** Daily price is approx. 1.75 times the price of the one-way ticket ► potential **additional use** if the ticket is already paid for ► continuous and **positive development** even without advertising campaign -–recently more than 3,000 tickets sold per month (multiplied by 6 days)	► relative **importance** still low: in the first year approx. 5 percent of all day tickets
Economic viability	► presumed **strengthening of revenue base** not measurable due to coronavirus pandemic	► possible **cannibalisation** of other segments not measurable due to coronavirus pandemic
Capacity management (rush hour)	► –	► no effects in capacity management
More information:	www.gvh.de/fahrkarten-preise/fahrkartensortiment/ticketdetailseite/6er-tageskarte/	
Contact:	Dominik Bublitz, ÜSTRA – Team Sales and Transport Association Dominik.Bublitz@uestra.de, +49 511 1668-2438	

Source: own representation based on interviews and research, Probst & Consorten Marketing-Beratung

The plan was to distribute the offer primarily via the GVH app. Sales at the GVH customer centre were to serve as a fallback level in exceptional cases. However, it has become apparent that acceptance of digital stocking has fallen short of expectations.[17] For this reason, sales are divided roughly equally between the two sales channels, the GVH app and the GVH Customer Centre. The tickets sold in the person-operated sales system are issued as individual sections, which then have to be validated. In contrast to comparable offers in other regions (e.g. 10-day ticket in the VVS), the sections of the 6-day ticket are issued without an expiration date.

[17] For example, comprehension problems arose, manifested in these questions: "How are the tickets to be validated?" or "Where are the tickets stored?".

The Rhein-Neckar-Ticket Flex (see table Table 15) is an example of a contingent offer with a fixed contract. The advantages of a subscription – a constant, automatically collected monthly fixed amount – are combined here with a slimmed-down range of services compared with the classic Rhein-Neckar-Ticket, which is valid every day. Only time will tell whether the thoroughly experimental price and service structure will will be accepted by customers.

Table 15: Rhein-Neckar-Ticket Flex by Verkehrsverbund Rhein-Neckar (VRN)

	Verkehrsverbund Rhein-Neckar (VRN): **Rhein-Neckar-Ticket Flex**	
Initial situation before introduction	▶ attractive network-wide annual travel pass, which pays off on longer routes even with just a few days of use per week (see chapter 4.5) ▶ no specific fare offer between classic cash fares (single, multi-use, day tickets) and classic season tickets	
Core of the measure	▶ basic price of 66 Euro/month enables network-wide travel on **eight freely selectable weekdays** and additionally **on all weekends**, extensive take-away options on weekdays from 7 p.m. as well as on weekends ▶ **personal subscription** with a minimum term of 12 months ▶ unused day segments expire at the end of the month ▶ introduction on 1st Jan, 2022 in response to the coronavirus pandemic ▶ available exclusively digitally via app	
Evaluation	**Positive**	**Negative**
Attractiveness and demand effect	▶ almost **30 percent discount** compared to the already very inexpensive standard subscription ▶ projected **potential of** 7,000-10,000 subscribers ▶ lasting **customer loyalty in** the subscription process	▶ demand still **very subdued** at the beginning of 2022 → Advertising campaign paused due to coronavirus pandemic and technical problems ▶ due to the annual commitment, use only makes sense with **a stable proportion of home offices**
Economic viability	▶ **additional revenues** due to increasing retention of former users of occasional tickets still unclear	▶ **reduced revenues** due to migration from the standard subscription, which previously payed off on longer routes from two to three days per week, still unclear
Capacity management (rush hour)	▶ –	▶ no effects in occupation management
More information:	https://www.vrn.de/tickets/ticketuebersicht/jahreskarte/rnt-flex/	
Contact:	Thomas Schweizer, VRN Head of Marketing and Tariff Department t.schweizer@vrn.de, +49 621 10770-112	

Source: own representation based on interviews and research, Probst & Consorten Marketing-Beratung

A fixed amount of 66 Euro is collected each month, entitling the user to flexible travel on about two days per week. The days of use are activated once in the app in the morning, whereupon the barcode of the network-wide day ticket can be presented at the ticket check. In addition, free rides on weekends and the inclusion of additional persons – analogous to the standard subscription – are possible. The number of inclusive days was deliberately set rather low at eight, since the classic Rhein-Neckar-Ticket (see chapter 4.5) with a network-wide price of only 92.50 Euro per month often only pay off after just a few days of use per week. The aim was to avoid too much migration away from the core product.

The market test of the price model "öV-Guthaben" (see table Table 16) is, along with other models – e.g. the “optional day pass” – a response of the Swiss public transport industry to changing mobility needs of passengers. As the national industry organisation, the Alliance SwissPass is accompanying the various pilot tests with a joint evaluation, the publicly available results of which form the basis of this and the following case study.

The credit model represents a contingent offer, which, unlike the example from the Rhine-Neckar region, is not calculated in days or trip numbers, but directly in monetary units – so the Switzerland-wide application for short and long distances can be relatively uniform. There is no contractual obligation in the strict sense – but the high entry costs of at least 800 francs mean that the passenger does have to pay a considerable amount in advance.

The fare, which is only sold via a check-in/out system ("automatic ticketing" via SBB EasyRide), also responds to the increasingly digital purchase of services. In addition, flexibility from the user's point of view is high due to the pay-per-use procedure, and at the same time a certain level of customer loyalty is achieved through the previously paid contingent. The discounting of the credit by 20 or 33 percent acts as a clear incentive here. According to an initial evaluation, the model is rated as simple and easy to understand. Because it is in the testing phase and it is available only to passengers invited to the pilot program, no evaluation of the economic efficiency can be made yet. The interaction with existing subscriptions would have to be taken into account in the longer term.

The Flexi-Abo from Mobilis (see table Table 17) also falls into the category of contingent offers with contractual obligations and is roughly similar to the Rhein-Neckar-Ticket Flex. It is characterised by a fixed number of days of use over a period of one year. Passengers can select the day flexibly, for example, for a regular change between office presence and home office or a part-time job with two to three working days per week. The "days of use" can be selected via a digital calendar.

The Flexi-Abo is offered in the zone categories of the existing annual pass with an attractive discount from the passenger's point of view. For 104 days of use, this is around 50 percent less compared to the annual pass and around 20 percent less for 156 days. For (almost) daily users of public transport the regular subscription will continue to be the most suitable product. Especially for the target group between subscription and occasional use the FlexiAbo could be interesting: Accordingly, there is a definite potential for migration from the existing subscription segment and at the same time an opportunity to increase the loyalty of occasional customers to public transport.

The Flexi-Abo was also publicly evaluated by the Alliance SwissPass. However, during the coronavirus pandemic reliable statements on the economic viability are unfortunately not available in this case either.

Table 16: "öV-Guthaben" by Schweizerische Bundesbahnen (SBB)

SBB CFF FFS	Schweizerische Bundesbahnen (SBB): **Public transport credit ("öV-Guthaben")**	
Initial situation before introduction	▶ "Halbtax-Abonnement" (cf. BahnCard 50) as the only fare offer between classic cash fares and classic season tickets ▶ regular market tests by Alliance SwissPass to develop customer-oriented fares and further develop the existing product range	
Core of the measure	▶ pilot since December 2021 with approx. 1,200 invited subscribers (duration: 15 months) ▶ purchase a credit of 1,000 or 3,000 Swiss Francs for a price of 800 or 2,000 Swiss Francs, respectively, via the Easy Ride function of the SBB app ▶ redeemable for personal single tickets/daily tickets ▶ credit expires after 1 year (refunded in test phase) or additional debit in case of exceeded credit balance	
Evaluation	**Positive**	**Negative**
Attractiveness and demand effect	▶ rated as simple and understandable from the users' point of view ▶ discounted credit leads to increased consumption, according to surveys ▶ flexible use for different needs, e. g. home office workers, bad-weather public transport users ▶ at the same time higher customer loyalty via prepayment and expiry date	▶ higher fare complexity due to additional fare products ▶ financial risk due to expiration of the credit in case of non-use within the term of one year
Economic viability	▶ no reliable statements on economic viability in test phase	▶ potential migration from regular subscriptions
Capacity management (rush hour)	▶ –	▶ no effects in capacity management
More information:	https://www.allianceswisspass.ch/de/ueberuns/Strategie-2025/Markttests-Preis-Sortiment	

Source: own representation based on interviews and research, Probst & Consorten Marketing-Beratung

Table 17: Flexi-Abo by Tarifverbund Waadt (Mobilis)

	Tarifverbund Waadt (Mobilis): **"Wahltage-Abonnement" Flexi-Abo / Day Selection Subscription**	
Initial situation before introduction	▶ „Halbtax-Abonnement" (cf. BahnCard 50) as the only fare offer between classic cash fares and classic season tickets ▶ regular market tests by Alliance SwissPass to develop customer-oriented fares and further develop the existing product range ▶ here based on the concept of the previous "national trip ticket"	
Core of the measure	▶ pilot phase since August 2021 (duration: 18 months); open participation ▶ subscription for 2 or 3 days per week (104 or 156 days of use per year) at discounted annual subscription price ▶ activate travel day until same day, change/cancellation until 23.59 the day before via SwissPass (Mobile App)	
Evaluation	**Positive**	**Negative**
Attractiveness and demand effect	▶ rated as simple and understandable from the user's point of view ▶ attractive user price due to subscription discount, especially for home office and part-time employees ▶ High flexibility due to short-term booking and change options	▶ higher fare complexity due to additional fare products
Economic viability	▶ assessment of financial impact still open	▶ potential migration from regular subscriptions
Capacity management (rush hour)	▶ –	▶ no effects in capacity management
More information:	https://www.allianceswisspass.ch/de/ueberuns/Strategie-2025/Markttests-Preis-Sortiment	

Source: own representation based on interviews and research, Probst & Consorten Marketing-Beratung

4.2 Distance-based e-fares

For twenty years now, many experts on public transport fares have been thinking about electronic fares that can overcome the current zone plans of many interconnected fares and make use of the willingness to pay. A new quality of perceived simplicity is to be achieved by merging the access and pricing logic, in which the specific pricing rules are "hidden" by simple access. A strictly distance-based principle of pricing is intended to cure the inequities of today's fare systems, where a shorter trip quickly becomes more expensive than a longer one simply because the former crosses a zone boundary and the latter does not. The restrictions of conventional zone-based fares, which are necessary for simplification, are thus to be abandoned.

In the mid-2010s, the first real pilot tests of kilometre-based e-fares were launched. Since then, corresponding projects have been launched in many places, partly as pilots with a limited number of participants, partly as an open offer for the mass market. On the one hand, there are differences in the choice of the distance measure: some fares calculate the exact linear distance between the starting and destination point (beeline), while others refer to the kilometres travelled or seek a mixed approach. In the case of electronic season tickets such as the Karlsruhe "Homezone", on the other hand, the focus is on the diameter of the area of validity.

However, the use cases differ in dealing with parallelism with conventional zone-based fares. In all cases, in fact, very significant price differences arise, both downward and upward. Over time different strategic directions emerge:

- The first e-fare pilots often assumed a complete changeover from the old zone-based fares to the new distance principle in the near future. This tended to underestimate the number of advocates of the old, familiar fare systems – on the one hand, because users are unfamiliar with electronic purchasing and tracking of their exact travel movements, and on the other hand, because the familiar sales channels and price levels obviously do not trigger sufficient pressure to change. In addition, quite a few users benefit from the price transparency and certainty of flat-rates, e.g. for an urban area, where there was also a noticeable headwind from the political sphere as soon as a single trip from the outskirts to the centre suddenly became more expensive than before.

- Other implementation projects assume a longer-term parallel offer of old and new fare worlds. Price differences were to be accepted, with the hope that satisfied e-fare users would accept a higher price for certain trips in return for convenient, performance-based billing. In reality, however, it has been shown again that passengers primarily optimise themselves in the case of a parallel offer, i.e., depending on the length of the trip, they sometimes choose one fare system and sometimes the other. In some cases, the only significant economic losses were that the overall e-fare sales volume was still manageable.

- A third approach is to deliberately link the two fare systems and set the conventional zone-based fare as a price cap for all trips. The performance-based, kilometre-based billing of the e-fare would then only apply if a trip were cheaper than in the zone-based fare – e.g. for short-distance trips and/or near zone boundaries. In all other cases, the e-fare apps would also charge the price of the zone-based fare, as it is also sold at ticket machines. This strategy promises e-fare users one-sided price advantages and is intended to accelerate the often slow transition to digital distribution channels. Complaints from passengers or politicians about rising prices on certain routes are largely avoided – but at the expense of economic efficiency. For this reason, this approach is almost universally perceived as a transitional phase, at the end of which there could be less zone-based fares. However, their use as a price ceiling makes it difficult to abandon the politically popular flat-rates at a later date. It seems more realistic to raise the zone-based fare disproportionately in the long term in order to expand the scope of the e-fare. But even for this strategy, the chances of implementation are limited in times of the transport transition.

What all use cases have in common is that they are only available digitally – mostly via special apps for automatic price recording that work on the principle of “Check-in-Check-out” or “Check-in-Be-out”. However, these apps would also be able to sell conventional zone-based fares, and in many places do so. The special feature of a kilometre-based e-fare is therefore not the elegance of the purchasing process, but explicitly the completely different price calculation. In some implementation projects, however, it is difficult to separate the effects from one another

when evaluating customer satisfaction. From the users' point of view, the mode of selling the ticket and the fare model belong firmly together.

In the next paragraphs, selected practical examples of distance-based e-fares are presented: two pilot tests for occasional passengers (RMVsmart, MVV Swipe&Ride), two mass market implementations for the same target group (VRN Luftlinientarif, eezy.nrw), and the KVV.homezone in Karlsruhe, designed for season ticket holders.

In 2015, the Verkehrsverbund Rhein-Neckar (VRN) introduced the very first fare based on beeline distances, which means straight distance between the origin and destination of the trip,(see table Table 18). Initially it was introduced only in the Heidelberg urban area, then two years later in the entire network area. In doing so, it set the trend for a particularly catchy e-fare formula: The linear distance between start and destination is simply measured (via GPS tracking), rounded up to whole kilometres, and then billed using a linear pricing formula. However, it was not just the system that was surprisingly simple, the pricing was also deliberately set so that passengers would save money on average. On city services, for example, you had to travel seven kilometres or more to pay more than with a "paper ticket" – which is significantly above the average distance travelled in cities like Mannheim or Heidelberg. An online price calculator also allowed a quick comparison.

Despite this pricing policy, which was very customer-friendly in the first few years, and despite an intensive communication campaign that lasted for years, it must be noted that the majority of passengers in the VRN were hardly impressed by the new fare model. Many target groups in the VRN are already provided with flat-rate annual subscriptions (see chapter 4.5), so that the proportion of regular customers is considerably larger than in many other associations. In 2019, the third year after the e-fare was introduced, the comparatively few occasional passengers – the clear majority, of course, when measured against the total population – made about 97 percent of their trips on the conventional fare based on zones and only 3 percent on the beeline fare. While there have been high annual growth rates, it is based on a rather small number of users, which cannot be solely due to digital-only sales: For example, more conventional zone-based fare tickets could be sold via mobile app than trips on the automatically billed beeline fare. Even the coronavirus pandemic has not accelerated the trend to switch from zone-based to beeline tickets.

With the 2022 VRN fare reform, the prices per kilometre were raised, but a comprehensive best-price system was added.[18] Among other things, this leads to an automatic capping of each individual trip at the respective cheapest ticket price of the zone-based fare. This is intended to eliminate incentives for selective use. Instead, there is now a guarantee: anyone using the beeline fare will never pay more per trip than they would at the ticket machine, but often less. Unfortunately, no findings on demand effects are yet available for this innovation, which was only recently introduced at great expense in terms of sales technology.

Similarly early as the VRN, the Rhein-Main-Verkehrsverbund (RMV) also launched a pilot project for a distance-based e-fare (see table Table 19), which is expected to continue until 2023 with 30,000 test users and has been further developed several times. The fare model, which remained essentially unchanged, was designed to be able to replace the zone-based fare completely, and therefore was based on other prerequisites:

[18] The daily and monthly best prices, which will also be introduced in 2022, are discussed in more detail in chapter 4.3.

Table 18: VRN beeline fare by Verkehrsverbund Rhein-Neckar (VRN)

	Verkehrsverbund Rhein-Neckar (VRN): **VRN-beeline fare (VRR-"Luftlinientarif")**	
Initial situation before introduction	▶ zone-based fare with 7 price levels, city fares with large "zones" ▶ political demands for an attractive short-trip ticket, esp. in Heidelberg	
Core of the measure	▶ **2015**: Pilot test of beeline fare in Heidelberg ▶ **2017**: Expansion to the interconnected area via two different apps, with parallel offer of the zone-based fare ▶ a kilometre (direct route) cost 0.20 Euro plus the basic price of 1.30 Euro per trip (price status 2019) ▶ **2022:** automatic **price capping for the zone-based fare** for each single trip (price of the 5-trip ticket up to fare stage 2, above that one-way ticket)	
Evaluation	**Positive**	**Negative**
Attractiveness and demand effect	▶ the principle of beeline distances is **intuitively understandable** ▶ **prices** set **quite favourably**, e. g. all trips in major cities up to 6 kilometres were made cheaper (before 2022)	▶ **manageable demand**: in 2019, only about 3 percent of all trips by passengers without a subscription took place on the beeline fare ▶ no demonstrable **increase in demand** due to generally restrained usage
Economic viability	▶ potential for **better retention** of occasional users exists, but cannot be quantified from the data	▶ certain **revenue shortfalls** for those switching from the traditional fare ▶ **profitability per trip lower** than in the zone-based fare, also due to selective use (before 2022) ▶ disproportionate extension of the zone-based fare failed ▶ **short-trip ticket** anyway introduced in Heidelberg with municipal subsidy
Capacity management (rush hour)	▶ –	▶ no effects in capacity management
More information:	https://www.vrn.de/tickets/ticketuebersicht/luftlinientarif/	
Contact:	Thomas Schweizer, VRN Head of Marketing and Tariff Department t.schweizer@vrn.de, +49 621 10770-112	

Source: own representation based on interviews and research, Probst & Consorten Marketing-Beratung

Table 19: RMVsmart by Rhein-Main-Verkehrsverbund (RMV)

	Rhein-Main-Verkehrsverbund (RMV): **Pilot project RMVsmart**	
Initial situation before introduction	▶ comprehensive zone-based fare with fixed price levels ▶ criticism of price jumps at zone borders	
Core of the measure	▶ **pilot with 30,000 test users** (April 2016 to probably December 2023) ▶ detailed **route kilometre fare** for regional rail transport and underground, but flat-rate prices for tramway and buses depending on the traffic region ▶ originally **calculated in a revenue-neutral manner** in the event that the entire occasional fare was to be converted to the pricing model ▶ **multi-use incentives** added later (split fare with 50 percent discount, dynamic discount levels depending on sales), not in focus here ▶ **sales via app**, but basic concept also designed for conventional channels	
Evaluation	**Positive**	**Negative**
Attractiveness and demand effect	▶ **positive customer satisfaction** according to market research → but rather through discount models added at a later date ▶ **price differentiation** core area vs. rural area → 50 percent discount on distance-based price	▶ **no price stopper** relative to the known zone-based fare, e.g. for longer trips in the city area ▶ **controversial incentives**: detours cost extra, precise billing is thwarted in bus/tram → bus-rail interchanges tend to become more expensive
Economic viability	▶ potential exists to **improve retention** of occasional users	▶ **no revenue neutrality**: in the first year, many of the routes actually used were cheaper than in the zone-based fare ▶ incentives for **selective use** between old and new fare through parallel offer
Capacity management (rush hour)	▶ time-of-day pricing was tried briefly, but not followed up on	▶ –
More information:	https://sites.rmv.de/rmvsmart	
Contact:	Susanne Bieling, RMV Head of Transport and Finance Division S_Bieling@rmv.de, +49 6192 294-300	

Source: own representation based on interviews and research, Probst & Consorten Marketing-Beratung

- To protect data privacy, permanent tracking of the position during the trip was rejected. Instead, the route must be determined by using a route planner before the trip begins. In case of tickets purchased before the trip, there are always opportunities for undercutting the fare, i.e., fraudulently buying a different route than the one the passenger intends to travel. Especially in the case of connections not taking the direct route, which certainly exist in the wide-meshed rail network and in such a heterogeneous transport area as the RMV region, RMV wanted to avoid these false incentives at all costs. For this reason, a distance-based fare was selected for all rail routes, based on the distance travelled, which – in contrast to a beeline fare –charges additional costs for all detours. Suburban and metro trains were assigned to the rail lines, too.
- In the future, sales should be possible not only via app, but also at vending machines and bus printers. The complexity of the required relation matrix would have overtaxed the storage capabilities and response times of conventional sales technology (bus printers, control devices) for all of the approximately 14,000 train and bus stops in the RMV. Moreover, in inner-city traffic, relatively small distances between stops only lead to a small price reduction. Both of these factors led to the decision to exclude all bus and tramway stops from the distance-based fare. Instead, they were given flat-rates, each with only two price levels (trip in one municipality, trip across several municipalities – each differentiated between large, medium and small cities).

However, the two pillars of the fare model led to some undesirable incentives. For example, the advertising message of much more precise, fairer distance billing applies only to rail routes, while regional bus routes are sometimes priced even more roughly than in the conventional fare. In addition, transfer connections between the two fare systems tend to be disadvantaged: Those who quickly hop on a city bus for a few stops after a long subway or train ride pay a significant surcharge for this outward trip – an effect that is relatively contrary to the usual pricing policy of the transport associations.

As a result, there was mixed feedback in the initial period of the pilot phase: Besides many positive opinions, the sometimes significantly higher ticket prices compared to the zone-based fare were criticised, both by passengers and by local politicians. According to the project evaluation, in the end the resulting fare is more decisive for users than the fare logic itself. They reacted accordingly and seemed to largely avoid the e-fare on the more expensive routes, which undermines the actually revenue-neutral adjustment of the price parameters. In subsequent years, RMV responded with further discount models that are only available in the e-fare and that generally make the price structure more favourable. Particularly popular here is the RMVsmart50 fare option, which has led to increased demand (with some loss of revenue) – but is one of the split flex fares as defined in chapter 4.1 and is therefore not discussed in depth here.

In the meantime, the pilot trial, which was launched with great emphasis in 2016, has been partly overtaken by time. A revision of the conventional zone-based fare, which was demanded by politicians, provided for a mitigation of the largest price jumps at zone borders with the help of intermediate price levels. The 365 Euro tickets for students and retired people, which were introduced by the Hessian state government, emphasise a completely different aspect with a state-wide flat validity than a precise, performance-based kilometre fare. In addition, the job ticket for state employees was introduced with a state-wide validity, which attracted more passengers to the flat-rate job ticket segment. Thus, the basic assumptions of RMVsmart, namely the complete replacement of the zone-based fare as well as the sale also in conventional channels, may not develop – which can be a completely legitimate outcome of experimenting in pilot projects.

The Munich Transport and Tariff Association had also launched an e-fare pilot project in 2020 (see table Table 20), which is attracting industry-wide attention. Like RMVsmart, this is intended as a learning project, in which technology and acceptance are tested. Initially, a beeline fare similar to the VRN approach was used as a basis, with an additional quality component that favours connections to less well-connected stops: There, 21 (instead of 31) cents per kilometre will be charged, plus a basic fare of 1.02 (instead of 1.31) Euro per trip. Since the beginning of 2022, a second group of test users has also been created, which will test an approximated route kilometre fare – under the term "smoothed route", which adds up the individual linear distances between all the stops passed through. However, there are no empirical values for this second fare model yet, i. e. all statements made here refer to the direct beeline.

The MVV deliberately decided against a "test for cheaper options" as a price stopper for the standard fare in order to test the extent to which willingness to pay can be skimmed off on longer routes. In fact, most trips take place in the urban area of Munich and there on the shorter routes. Most trips remain below the price of the conventional single fare ticket or the 10-stripe ticket, with many users also accepting a more expensive trip if they know that they are saving on average. However, these more expensive trips cannot compensate for the loss of revenue due to the shorter trips. Approximately 30 percent also use the conventional fare in parallel if it is cheaper, while the rest use the e-fare exclusively. This confirms the experience in Frankfurt: most users who would be willing to pay more (e.g. because they regularly have to travel from the outskirts to the city centre) quickly drop out of the pilot project. A small group of users is nevertheless willing to pay more because the comfort justifies the price.

The additional daily caps of 8.20 Euro (up to 20 kilometres) and 12.40 Euro are intended to send a message of fairness, even if many rarely achieve this in the test. The majority of the pilot customers are classic infrequent and occasional riders: On average, four trips are made per month, with a focus on one to three trips, but also a notable group of people with eight to ten trips or more. According to the comprehensive project evaluation, at least 10 percent of trips would not be made if the new fare model with the convenient Fairtiq app did not exist – but even this is not enough to fully offset the reduced revenue.

The MVV intends to test further variants of the e-fare by 2023. It will focus solely on digital sales. Consequently, a complete abolition of the zone-based fare, which to a certain extent limits the profitability of the e-fare, will hardly be possible after the end of the project phase. Only after the conclusion of the pilot phase will it become clear how the tension between the two approaches to fares will be further developed in order to attract more passengers to the digital fare and at the same time improve its profitability.

Table 20: MVV Swipe&Ride by Münchner Verkehrs- und Tarifverbund (MVV)

	Münchner Verkehrs- und Tarifverbund (MVV): **Pilot project MVV Swipe&Ride**	
Initial situation before introduction	▶ fare based on ring zones with price jumps at zone borders as well as long range of flat-rate fares (large "core zone M") ▶ politicians wanted "Europe's most modern fare system"	
Core of the measure	▶ **pilot project with approx. 9,000 test users** (October 2020 to probably December 2023) ▶ since 2020: **beeline fare with quality component** → Reduced kilometre rate if origin and/or destination stops are outside the high-frequency served core network ▶ variant from 2022: Distance measure as "**smoothed distance**", i.e. approximation to a distance-per-kilometre rate ▶ **daily cover**: "cost airbags" without reference to the standard fare ▶ **multi-use incentives**: rewarding the intensity of travel in the next month ▶ sale **only via app**	
Evaluation	**Positive**	**Negative**
Attractiveness and demand effect	▶ the principle of beeline distances is **intuitively understandable** ▶ evaluation: passengers, who mostly save, are **satisfied** ▶ **positive demand effect**: 10 percent of trips would not have been made without e-fare and convenient app	▶ **no price stopper** relative to the known zone-based fare (except daily cap), e.g. for longer trips in the city area ▶ evaluation: Passengers who pay more **quickly bail out**
Economic viability	▶ **higher price per kilometre** than VRN or RMV ▶ potential for **better retention** of occasional users still unknown ▶ technically comparatively **simple implementation**	▶ incentives for **selective use** between old and new fare through parallel offer ▶ certain **revenue shortfalls** unavoidable → could only be completely overcome by abolishing the zone-based fare
Capacity management (rush hour)	▶ **incentives for off-peak travel** planned for third pilot year	▶ –
More information:	https://www.swipe-ride.de/	
Contact:	Roko Sosa, MVV Tariff and Distribution Roko.Sosa@mvv-muenchen.de, +49 89 21033-229	

Source: own representation based on interviews and research, Probst & Consorten Marketing-Beratung

North Rhine-Westphalia has had a beeline fare since December 2021 (see table Table 21), which covers the largest area nationwide. In a two-year effort, the state government and all four fare

areas agreed on a uniform e-fare structure, which nevertheless leaves a few degrees of freedom for all fare areas. For example, price parameters are adjusted differently, and the cap on the standard fare is also handled in a different way: At Verkehrsverbund Rhein-Ruhr (VRR) and in some Westphalian city transport systems, there is such a price stopper per trip, but not in the majority of regions. As a result, every passenger in North Rhine-Westphalia can use his or her app to travel anywhere in the state and will always be charged the correct e-fare, regardless of the fare zone in which he or she is traveling. For trips across fare areas, the basic price of the North Rhine-Westphalia fare of 1.60 Euro comes into play, while the linear kilometres of the individual fare areas are simply added together – although in the background, this is anything but "simple" because the specific linear distance on the network map has to be divided up among shapeless network areas. The revenue distribution also changes fundamentally compared to the situation before, especially on cross-fare area relations.

For the launch of the e-fare, the company initially decided against additional features such as dynamic fares that depend on the time of day or other approaches that could be assigned to the fields of action of flex fares, best price systems or flat-rate network tickets. The focus was on a fare model that was as simple as possible with a convincing "story" in order to bring a positive usage impulse to the market after almost two years of the coronavirus pandemic. In the process, some revenue shortfalls were consciously accepted and partly borne by the state and partly by the special-purpose associations in the fare areas. Optimistic forecasts assume that 80 percent of occasional passengers will switch within the next five years – although no one can know whether the switch will actually be on such a scale, taking into consideration other examples with a similar practice (e.g. VRN).

The individual associations have tended to calculate their e-fare parameters in a revenue-neutral manner (with differences in detail). On the other hand, the e-fare is cheaper than the conventional North Rhine-Westphalia fare for the vast majority of trips across fare zones. The expectation of some passengers that all trips will be cheaper with the e-fare must nevertheless be disappointed. As with any major fare conversion, cases of hardship cannot be completely ruled out, despite an extensive mitigation support program. Precisely because of the parallel application of different approaches with regard to price adjustment and capping, there will certainly be exciting findings from North Rhine-Westphalia in the coming years. It will show to what extend the influence of such a price stopper on the attractiveness of the fare model turns out to be.

Part of the state funding is also used for sales implementation. Here, fare modules were developed in accordance with the “VDV-PKM” standard for mapping the e-fare in North Rhine-Westphalia. In addition, a central software core ("CiBo NRW") was implemented by the North Rhine-Westphalian Center of Competence for Digitalisation (KCD) and offered to all interested transport companies and fare areas for integration into their existing apps. Its use is not mandatory, but it makes it easier for the diverse public transport stakeholders to offer the innovative e-fare through their own channels – instead of losing their existing clientele to central portals. This proved to be a decisive key to the enforceability of the new fare model among local players.

Table 21: State-wide e-fare "eezy.nrw" in North Rhine-Westphalia

	Competence Center Marketing NRW (KCM) and all fare areas in NRW: **State-wide e-fare "eezy.nrw"**	
Initial situation before introduction	▶ four network fares as classic zone-based fares (VRR, VRS, AVV, WT) ▶ NRW fare for trips across networks, based on "Deutschlandtarif" plus integrated connecting ways at origin and destination	
Core of the measure	▶ since the end of 2021: **uniform nationwide e-fare billing** with certain degrees of freedom for all four fare areas as well as the national fare ▶ a **kilometre (direct route)** costs between 0.20 and 0.27 Euro (depending on the fare area) ▶ plus 1,30 to 1,60 Euro **basic fare** per trip (depending on fare area) ▶ **different price caps** depending on the fare area: in VRR for all one-way ticket price levels, in some Westphalian city fares also for the one-way ticket, in addition everywhere daily caps between 19 and 30 Euro ▶ only digital sales via **various apps,** supported by common software ▶ developments planned concerning season tickets, contingent etc.	
Evaluation	**Positive**	**Negative**
Attractiveness and demand effect	▶ the principle of beeline distances is **intuitively understandable** and even applicable across fare networks ▶ **6 to 7 percent increase in demand** forecast in the occasional segment → still open ▶ initially a **lot of positive feedback** and gratitude for a solution without fare limits	▶ in some fare zones **no price stopper** relative to the known zone-based fare
Economic viability	▶ prices adjusted to be **revenue-neutral in some fare areas** ▶ potential to **keep occasional users** still unknown	▶ **lower yield** per trip compared to the conventional **NRW fare** → trips across fare zones not adjusted to be revenue-neutral ▶ **state subsidy** of up to 100 million Euro over 11 years for distribution technology and reduced revenues for trips across fare zones → reduced revenues within fare zones not included
Capacity management (rush hour)	▶ designed for later development stages	▶ not integrated so far
More information:	https://eezy.nrw/de/	
Contact:	Eduard Rollmann, Head of NRW Marketing Competence Center Eduard.Rollmann@vrs.de, +49 221 20808-723	

Source: own representation based on interviews and research, Probst & Consorten Marketing-Beratung

The recently introduced so-called “home zone”-based fare (see table Table 22) represents an attempt to design a distance-based e-fare specifically for the needs of frequent passengers. The core idea here is also to overcome the previous zone plans, although the product is deliberately designed as a parallel offer, i.e. the classic annual pass for the Karlsruhe city area or other price levels are not abolished. However, for those customers who tend to be disadvantaged by the zone plan, for example if they had to pay a lot for a monthly or annual pass for shorter connections across the zone boundaries, the home zone can be an interesting alternative.

Commercially, it is more likely to appeal to younger, digital-savvy customer groups who are used to short contract periods from other online services. That is why the home zone rate initially only started with a 28-day offer, i. e. the rate expires automatically every four weeks. One can then flexibly decide whether to suspend, buy the fare again in the configuration already selected or readjust the scope. For this purpose, the KVV has put a lot of effort into developing a new type of app function that allows to draw a circular area of validity on the map with two fingers and move it around. All the stops so marked could be travelled to but the passenger is responsible for not traveling beyond it. Unlike classic zone boundaries, which are often also municipal boundaries, no town signs or other elements of fare communication inform the passenger about the end of his or her individual area of validity. Opinions will probably differ on this type of booking process: Some will find it great fun as well as perceive some kind of self-efficacy, while others will probably find it far too complicated.

The example of the Karlsruhe city area shows that there are not automatically price advantages: The regular monthly ticket for 68 Euro is valid for a whole month in the entire city area. For the same money, you get a 28-day home zone ticket for downtown Karlsruhe, which has a diameter of about 5.6 kilometres – and thus, in purely mathematical terms, covers only one seventh of Karlsruhe municipal area, albeit a particularly relevant part in terms of traffic. Those who tend to travel longer distances in a fare zone or have frequently changing destinations will often find it cheaper to use the classic fare. If on the other hand, passengers travel only a small part of the city on a regular basis, they can save money with the home zone but loses free mobility and may need a connecting ticket if they have a doctor's appointment at the other end of town. Due to the completely different geographical areas of validity an automatic price comparison between the two fare systems cannot be implemented; instead, passengers must compare for themselves which is the best option for them.

At present, there is still a lack of empirical data on the passenger response to the innovative home-zone-based fare. The goal of complementing the existing fare system and softening its greatest injustices for regular customers, who are particularly negatively affected, seems entirely achievable presumably combined with manageable lower revenues and a certain expansion of the regular customer base. The home-zone-based fare can presumably not serve as a complete replacement for classic season tickets, which continue to play a major role as a price anchor for existing customers and local politics. At most, this would only be feasible with a significantly more favourable pricing formula, which would result in drastically lower revenues.[19]

[19] The implementation of very low prices would make such a precise fare system rather superfluous and, from a commercial point of view, would rather argue in favour of flat-rate network tickets without the possibility of "cherry-picking," as described in chapter 4.5.

Table 22: KVV.homezone by Karlsruher Verkehrsverbund (KVV)

	Karlsruher Verkehrsverbund (KVV): **KVV.homezone**	
Initial situation before introduction	▶ classic zone-based fare (combs) with zone counting and flat-rates for certain transport areas (e.g. Karlsruhe city area or network area) ▶ beeline fare as an alternative pricing model in the occasional fare, but no comparable spatially flexible fare offers for frequent passengers	
Core of the measure	▶ end of 2021: **new season ticket fare without zone limits**, initially only as a 28-day ticket, later also with other validity periods ▶ **area of application as a circular area** on the map ▶ **flexible pricing** based on diameter and density of public transport services in the area covered → calculation based on defined price formula automatically in the app ▶ maximum price: 125 Euro for 28 days ▶ sales exclusively via **app with graphical support** for defining the scope and ad hoc price calculation	
Evaluation	**Positive**	**Negative**
Attractiveness and demand effect	▶ **attractive pricing formula** especially for regular shorter trips across zone borders ▶ **elegant operability** of the app gives the feeling of having more influence on their own costs ▶ real **additional use effect** cannot yet be quantified	▶ **price comparison necessary**: not automatically cheaper than classic season tickets in the classic zone-based fare ▶ **no automatic warning** when the individual scope is exceeded ▶ partial **cancellation of option benefits** in leisure traffic ▶ so far no offer with **permanent subscription commitment**
Economic viability	▶ potential for **broadening the regular customer base** exists, but is still unknown	▶ defensive predictions: up to 4 percent of network revenues could be lost due to **windfall profits**
Capacity management (rush hour)	▶ would later be integrable with approaches from chapter 4.4	▶ at the moment no capacity management due to all-day validity
More information:	https://www.kvv.de/homezone.html	
Contact:	Benjamin Bock, Authorized Signatory and Head of Marketing and Tariff Benjamin.Bock@kvv.karlsruhe.de, +49 721 6107-5030	

Source: own representation based on interviews and research, Probst & Consorten Marketing-Beratung

4.3 Best-price systems

Best-price systems are billing models that have an automatic price cap per day, week and/or month built in. This capping can either be exactly aligned with the conventional daily, weekly or monthly tickets, but can also be defined independently. Subsequent billing takes place for trips made in a monthly period, for example.

Often, such best price guarantees are understood as part of an e-fare, although a distance-based e-fare (see chapter 4.2) can be just as much the basis as any other conventional fare system. Strictly speaking, a best-price cap can even be seen as a pure marketing instrument if simply the standard fares are applied, as the Stuttgart case study shows. At the very least, however, such approaches lie between fare incentives and sales convenience functions.

Best-price systems have been experimented with in several pilot projects for at least 15 years. But it is only in recent years that they have been increasingly introduced in practice – which also has to do with the enormous technical effort required for error-free billing that is transparent for the user. Anyone communicating a comprehensive best-price promise has to define very precisely all the rules according to which optimisation takes place – and think through every footnote that can arise from the combination of different rate offers. For this reason, some best-price systems deliberately limit themselves to individual selected components, e.g. only a daily cap, in order to keep the complexity for users and providers within limits.

The consensus in the public transport industry seems to be that annual optimisation in comparison to the particularly favourable subscription rates would not be effective. The numerous regular customers who travel on a permanent basis with subscriptions or job tickets, pay fixed monthly amounts and can simply get on board without any further sales activities. They should not be “lured” out of their existing rates.

The best-price incentives are rather aimed at passengers with regular but variable trip volumes, similar to the flex fares described in chapter 4.1. For these, daily, weekly and monthly caps primarily act as a safety promise in the sense of a price stopper – even though most users very rarely reach these price limits. Consequently, the economic damage that can result from foregoing individual "overpayments" is often small. A balanced economy appears possible, provided that users actually increase their number of trips due to the convenience, fairness and price certainty of the best-price systems. The public transport industry is currently gathering experience in this regard, and the coronavirus pandemic, which has led to more changeable usage patterns, could reinforce the need for such offers.

Three selected practical examples of best-price systems are presented below, each with a different focus.

In the city of Münster, one of the few German smart card systems with validators for occasional passengers was set up in 2013 with federal funding. Thus, it was possible to experiment with best-price incentives at a very early stage, with the fare model being limited to a daily cap (see Table 23). Regular passengers are referred to the digital subscription products, for example, the FlexAbo (see chapter 4.1).

Table 23: 90 minute ticket with daily cap by Stadtwerke Münster (SWMS)

Stadtwerke Münster	Stadtwerke Münster (SWMS): **90 minute ticket ("90 MinutenTicket") with daily cap**	
Initial situation before introduction	▶ conventional city fare with single and day tickets ▶ especially low-priced 10-stripe ticket as advance booking product	
Core of the measure	▶ **2013**: introduction of the **PlusCard** as a "VDV-KA chip card" that is activated by check-in at the validator when boarding the city bus ▶ contract model for occasional users: only 2.20 Euro for **90 minutes of free riding**, including return and round trips (price status 2022) ▶ **day cap at 4.90 Euro,** i. e. at just over two 90 minute tickets ▶ monthly billing by direct debit ▶ parallel, significant increase in single and day tickets on paper and gradual abolition of the 10-stripe ticket	
Evaluation	**Positive**	**Negative**
Attractiveness and demand effect	▶ Germany's **most-used e-fare** relative to population ▶ **strong price advantages** compared to paper tickets ▶ day capping becomes a **confidence booster**	▶ one-time **registration** with direct debit mandate required to benefit from daily capping → alternative prepaid variant without registration does not offer daily capping
Economic viability	▶ successful **counter-financing** through increase in paper tickets ▶ **low losses** due to daily capping → is rarely achieved in reality	▶ high **investment in chip card infrastructure** required to settle the daily surcharge → use of subsidies
Capacity management (rush hour)	▶ –	▶ no effects in capacity management
More information:	https://www.stadtwerke-muenster.de/privatkunden/mobilitaet/abo-und-ticketuebersicht/tickets/90-minutenticket/vorteile.html	
Contact:	Frederick Koddenberg, SWMS Transportation Economics Department Manager f.koddenberg@stadtwerke-muenster.de, +49 251 694-2824	

Source: own representation based on interviews and research, Probst & Consorten Marketing-Beratung

With time and a lot of effort of communication, the 90 minute ticket has developed into Germany's most successful e-ticket: Just three years after its introduction about 14 percent of Münster's population had activated the 90 minute fare on their PlusCard – and that is without counting the many schoolchildren, students or adults with subscriptions out of the population. The primary incentive to switch to the e-fare was certainly the increasingly extended price advantages – a one-way ticket now costs 3.30 Euro and is only valid for one outward trip, while the 90 minute ticket for 2.20 Euro is even suitable for quick errand trips including the return trip. The daily cap has also contributed to the attractiveness of the fare model, as it promises security and makes a price comparison with other occasional tickets before boarding in the morning unnecessary. The daily cap is also noticeably lower than the prices for day tickets on

paper, which cost between 5.40 and 8.00 Euro for one person. However, experience shows that the daily cap is very rarely reached, i. e. most occasional users get by with using one or two 90 minute tickets for trips on public transport during the day. Therefore, the challenges for this guarantee promise were less in the economic area than in the correct billing of passengers.

New developments are emerging precisely through the “eezy.Westfalen” project in the context of eezy.nrw (see chapter 4.2, Table 21): With the North Rhine-Westphalian-wide beeline fare, short trips in the Münster urban area will now be even cheaper, while the familiar price caps (2.20 Euro for 90 minutes, 4.90 Euro for a day) will be continued. In this way, Stadtwerke Münster will be able to move away from the expensive chip card system in the future and continue its successful e-fare in a modified form via smartphone app.

Five years ago Stuttgarter Straßenbahnen (SSB), as the municipal transport company of the state capital, wanted to lower the fare barriers to access and offer an increase in convenience when purchasing tickets. At that time, an extensive test of a best-price approach was launched (see Table 24), which has since been made available to all interested passengers. Best-price billing was based on the conventional zone-based fare and applies to all standard products from short-haul to monthly tickets, i. e. in particular also single, daily and weekly tickets. The products are charged exactly as described in the fare regulations. Thus, the "SSB BestPreis" is "only" a sales solution that increases convenience through a uniform purchasing process and also provides security against incorrect purchases. The background to this is the finding of comprehensive market research that today's non-users do not primarily find the amount of the ticket price, but rather the lack of information about the product range and the effort required to find the right ticket, a hindrance to accessing public transport. The "SSB BestPreis" was intended to reduce this barrier to access without increasing the "fare jungle" with new fares. There was no longer any need to familiarise oneself with the fare system before starting a trip to find the right ticket.

Passengers select any public transport trip in the SSB Move app before starting it. Instead of a conventional ticket, which they would have to pay for immediately, they select a best-price ticket if they are interested. The first trip booked in this way automatically starts a 30-day period to which the price optimisation then applies. After the 30 days have elapsed, a multi-stage algorithm in the background system calculates which ticket combination would be the cheapest overall. The passenger is then billed for this combination, which also shows the savings compared to the regular single fares.

What sounds simple to the passenger is highly complex in the background: SSB have put a great deal of development effort into the optimisation algorithm and the billing logic. Nevertheless, the evaluation of the pilot phase proved that the effort payed off: Most users expressed satisfaction, and this apparently led to about 13 percent more public transport trips than they had previously made during the comparison period. The bottom line was that the profitability was slightly positive, i. e., the additional sales compensated for the loss of revenue due to the very customer-friendly fare optimisation. Thus such a best-price approach, if done well, can drive demand from occasional passengers in the spirit of transport transition without diminishing the funding base of public transport.

Table 24: Best-price in the SSB Move App by Stuttgarter Straßenbahnen AG (SSB)

	Stuttgarter Straßenbahnen AG (SSB): **Best-price ("BestPreis") in the SSB Move App**	
Initial situation before introduction	▶ normal zone-based fare with "active pre-decision whether to buy single, daily, weekly, monthly tickets etc. ▶ classic ticket apps from the network and transport companies	
Core of the measure	▶ 2018-2020: **two-year pilot phase** limited to 20,000 test users ▶ 2021: activation in the SSB Move app → participation in the best price procedure is **optional for all users** and is available parallel to the classic immediate purchase of any ticket ▶ the user **only** buys **single trips** from the trip planner for immediate departure, which are booked to an interim account ▶ **invoicing of the cheapest price combination** per 30-day period in retrospect → across the entire network for all tickets from short-haul to monthly travel passes, but not the subscription segment	
Evaluation	**Positive**	**Negative**
Attractiveness and demand effect	▶ best price **promotes confidence** and increases **comfort** ▶ **no active thinking** about the right product → always the same purchase process for each trip ▶ Pilot evaluation: approx. **13 percent increase in the number of trips made** by test users compared to the before period	▶ **operating effort**: each trip must be booked separately at the trip planner ▶ not suitable for all customers, e.g. **not** suitable **for taking along additional passengers**
Economic viability	▶ pilot evaluation: **price savings from** optimisation slightly **overcompensated** by additional demand	▶ high **development effort**, e.g. to map price combinations with connection tickets
Capacity management (rush hour)	▶ –	▶ no effects in capacity control
More information:	https://www.ssb-ag.de/tickets/ticketkauf-und-beratung/ssb-move-app-mit-bestpreis/	
Contact:	Dominik Gangl, SSB Market Research, Tariff and Marketing Strategy Dominik.Gangl@ssb-ag.de, +49 711 7885-8634	

Source: own representation based on interviews and research, Probst & Consorten Marketing-Beratung

The beeline fare at Verkehrsverbund Rhein-Neckar (VRN), which is already described in chapter 4.2, Table 18, shows that best-price approaches can of course also be combined with kilometre-based e-fares – unlike in the Stuttgart case study. In order to convince as many occasional passengers as possible of the innovative beeline fare, the best-price promise is limited to the (anyway registered) users of this e-fare who are travelling by check-in check-out/be-out procedure.

In 2017 to 2021 there was already a daily and a monthly fare cap but they were designed as a flat-rate for the entire network area. In particular, they were significantly higher than the prices of a daily or monthly ticket in Mannheim/Ludwigshafen or Heidelberg city transport networks, where the beeline fare was used particularly often. For people who used public transport almost exclusively in their home town, the price caps were thus ineffective. This changed in the course of the 2022 fare reform due to the new capping limits, which refer exactly to the cheapest offers of the zone-based fare (apart from the attractive annual passes, which are considered in chapter 4.5). Specifically, the regular monthly travel pass as well as the daily price of the 5-day ticket were selected, i. e., the daily cap is even below the price of a single-day ticket (see Table 25). An advantage for the implementation was that during the 2022 fare reform the number of price levels could be significantly reduced, especially for monthly travel passes.

Table 25: VRN beeline fare with best-price function by Verkehrsverbund Rhein-Neckar (VRN)

	Verkehrsverbund Rhein-Neckar (VRN): **VRN-beeline fare ("Luftlinientarif") with best-price function**	
Initial situation before introduction	▶ since 2017: VRN beeline fare → for details, see case study in chapter 4.2, Table 18 ▶ until 2021: only daily cap at 12 Euro and monthly cap at 90 Euro for all trips within the network ▶ maximum 1 additional passenger at full price	
Core of the measure	▶ **price guarantee from 2022**: capping for the cheapest offers on paper ▶ max. price **per day**: 4.16 to 12.40 Euro depending on price level ▶ max. price **per month**: 46.90 to 133.90 Euro depending on price level ▶ **billing per calendar month** afterwards ▶ **max. 4 additonal passengers** with 50 percent discount, but without daily / monthly cap	
Evaluation	**Positive**	**Negative**
Attractiveness and demand effect	▶ compared to before now also **financially attractive fare caps in urban traffic** ▶ **demand effects** still **unknown**	▶ capping limits do not (yet) apply for passengers, i.e. **no family/ group day tickets** applicable
Economic viability	▶ **revenue effects** after introduction in January 2022 still **unknown**	▶ high technical **development effort**→ Price combinations with connection tickets initially discarded
Capacity management (rush hour)	▶ –	▶ no effects in capacity management
More information:	https://www.vrn.de/tickets/ticketuebersicht/luftlinientarif/	
Contact:	Thomas Schweizer, VRN Head of Marketing and Tariff Department t.schweizer@vrn.de, +49 621 10770-112	

Source: own representation based on interviews and research, Probst & Consorten Marketing-Beratung

Nevertheless, the complexity of error-free best-price billing was also noticeable in the VRN. In order to contain the development effort in the implementation phase in the second half of 2021, other interesting functions were postponed for later, such as best-price optimisation across additional passengers, which would then have been based on family/group day tickets. Also, no connection tickets have been billed so far, which means: a passenger who, for example, has already reached the monthly limit for Mannheim city transport and then takes a single trip to the surrounding area still pays the full price for this longer trip and not just the price share from the Mannheim city limit. In reality such cases are probably manageable and of limited importance, but they are particularly complicated in terms of correct, precise billing – especially in the case of a beeline fare, where it would first have to be defined at which point on the map exactly the connecting ticket starts to count.

However, the challenges in detail should not distract from the great opportunities in terms of a comprehensive quality promise in passenger communication. The beeline fare, which was only moderately used before the coronavirus pandemic (see case study in Chapter 4.2, table 18) could receive an additional boost as a result. Only after some time will it be possible to evaluate the demand effect and economic viability more precisely.

4.4 Off-peak tickets

This field of action describes fare offers with exclusion times in (some) peak periods. These are also known as "off-peak tickets" and have been in use for decades in some cases. They appear in the form of a classic season ticket (e.g. subscription with an exclusion time before 9 a. m.) or a day ticket (e.g. state tickets of “Deutschlandtarif” with exclusion times from Monday to Friday before 9 a. m.). Such offers often pursue two parallel goals:

First, directing traffic away from the peak hour, which is crowded in many places, can potentially reduce the costs of public transport operations, which are largely determined by the peak hour schedule. In most cases, however, only the morning peak hour is excluded, as multiple cut-off times per day would be difficult to communicate. Of course, only a small proportion of trips can really be shifted – those who have to be in the office at 8 a.m. are unlikely to be deterred from doing so, even by price incentives.

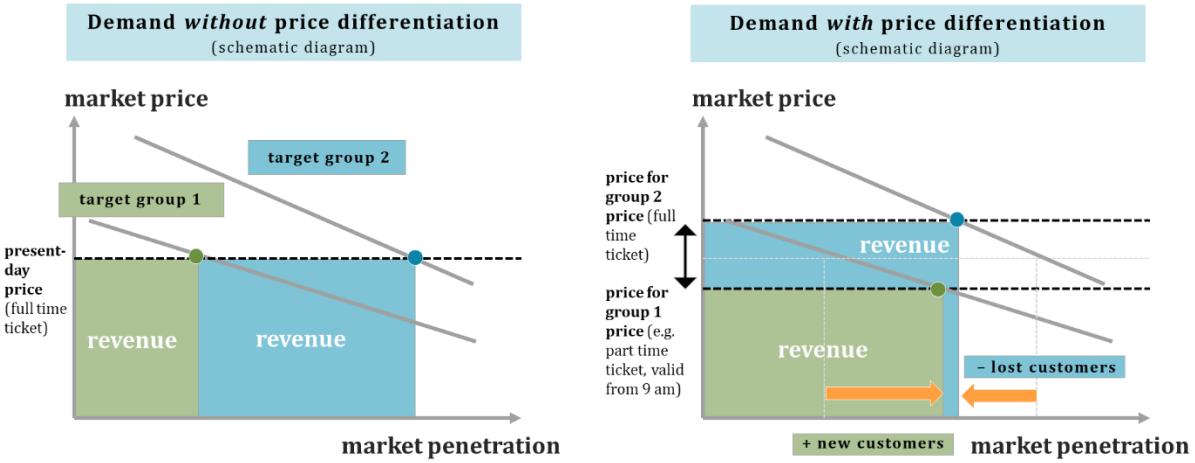
Second, an exclusion time is potentially useful for differentiating fares based on willingness to pay, and thus for making more targeted offers to different passenger groups. Ideally, this strengthens the ridership and funding base. The boost in demand from new passengers and additional trips will contribute to this, leading to a stabilisation of revenues in the medium to long term. However, the price spread between rush hour commuters and more price-sensitive target groups (e.g. retired people, people working in the household or home office with pronounced leisure mobility) must not be misunderstood as a one-sided price reduction in favour of the latter group: This would indeed increase passenger numbers, but at the expense of revenues. Rather, an independent fare offer for the aforementioned target groups, who travel less frequently on average and are less willing to pay full price, allows the standard fare for traditional commuters to be set higher. This leads only to manageable losses in demand there and can ideally be further cushioned by accompanying measures (e.g. job ticket incentives, see chapter 4.6).

During the coronavirus pandemic, demand management beyond rush hours had briefly gained in importance – with the general caution of the population causing the situation to ease even without fare incentives. As a result, the public transport industry had not yet included off-peak tickets into fare measures. In the medium term, however, the aspect of price differentiation will become increasingly important as more and more regular passengers forego daily trips during

the morning rush hour but maintain or even increase their need for leisure mobility on public transport. Thus, the weights between the target groups are shifting. In public transport fare systems that have so far operated without off-peak discounts, today's "mixed fares" are therefore coming under increasing pressure.

Pricing attractiveness for all regular passengers is often far from financially viable, while targeted price stimuli for price-sensitive markets not only require a smaller counterpart financing volume but can also achieve more new public transport trips per Euro. The aim is to use aggressive pricing to attract massive numbers of new passengers to public transport and motivate existing ones to use it more. Figure 6 illustrates the mechanism of action of additional demand through price reduction and additional revenue from new customers and selective price increases – as a result of differentiation of the product range.

Figure 6: Economic effects when differentiating between full-time and off-peak ticket



Source: own representation, Probst & Consorten Marketing-Beratung

In particular, day tickets or season tickets valid from a defined time limit (e.g. 9 a. m.) offer opportunities for action in terms of fares. The visual price signals create a good basis for marketing messages. Within the framework of the fare measure, the price increase in other ticket segments, which is rather unpopular with the public (but necessary for counter-financing), can be legitimised in this way with the noticeable increase in attractiveness for many passengers.

With regard to changing working models and the associated less pronounced morning rush hour, the time limit of the exclusion time on workdays should also be evaluated when setting the fare. As a rule, an exclusion time of up to 9 a. m. is customary in the industry, but in some cases 8 or 10 a.m. is also possible. Regionally, it should be examined whether a shortening of the exclusion time and bringing it forward can lead to increased demand – without strongly cannibalising existing revenues in the classic segments.

Selected practical examples of off-peak tickets are presented below.

Embedded in an overall package of various measures, the price of the 9 a. m. season ticket in Nuremberg was massively reduced in 2016 – from 11 to 22 Euro price difference to the full-time ticket, which became only marginally more expensive (see Table 26). The core idea was to noticeably increase demand in price-sensitive markets through a targeted price reduction. On the one hand, the counter-financing came from the additional 9 a. m. subscriptions, which primarily came from the occasional passenger segment. On the other hand, a selective increase in tickets with a low commitment (e.g. one-way ticket) and the increase in parking fees created

corresponding push effects toward public transport use and contract commitment. The need for these price hikes, in turn, could be justified in particular by the "Freizeit-Abo" (leisure season ticket) for flexible travel from 9 a. m., which is extremely attractive at 35 Euro. The political goal of a more attractive annual pass could thus be met without a drastic price reduction for the mass market of commuters.

Table 26: 9 a. m. season ticket by Verkehrs-Aktiengesellschaft Nürnberg (VAG)

VAG	Verkehrs-Aktiengesellschaft Nürnberg (VAG): **9 a. m. season ticket ("9-Uhr-Jahresabo")**	
Initial situation before introduction	▶ 2012: sharp increase in all prices by approx. 12 percent ▶ 2014: further sharp increase stopped by city council → desire for attractive annual pass, more passengers and additional revenue ▶ Personal 9 a. m. subscription with approx. 20 percent discount compared to annual subscription in the city area (44 vs. 55 Euro)	
Core of the measure	▶ 2016: comprehensive reform of the product portfolio in city price level A ▶ a. o. **doubling of the 9 a. m. discount** → price reduction to 35 Euro ▶ full-time subscription and job ticket updated with inflation ▶ monthly / weekly tickets, single and day tickets significantly more expensive in some cases	
Evaluation	**Positive**	**Negative**
Attractiveness and demand effect	▶ **massive increase in demand for** the 9 a. m. subscription → doubling of sales figures after just a few years ▶ **little migration from full-time subscribers**, but mainly development of new customer groups for subscription retention	▶ smaller migration effects from monthly / weekly tickets, but with a clear net increase in passengers
Economic viability	▶ noticeable **increase** in revenues ▶ more steady revenue in the long term due to **more loyal customers**	▶ 9 a. m. cut **probably** caused **revenue shortfall in isolation**, but was more than offset by accompanying measures that only became feasible because of the attractive 9 a. m. subscription
Capacity management (rush hour)	▶ the additional demand desired by transport policy was primarily realised outside the morning rush hour	▶ no drop in demand in the rush hour → classic commuters do not change their behaviour
More information:	https://www.vag.de/tickets-abo/alle-tickets/detail/ticketinfo/detail/tickets/9-uhr-jahresabo-pro-monat	
Contact:	Hermann Klodner, VAG Head of Marketing Hermann.Klodner@vag.de,+49 0911 283-4695	

Source: own representation based on interviews and research, Probst & Consorten Marketing-Beratung

The evaluation two years after the changeover already showed the success of the strategy. It was also evident that the increased attractiveness of the part-time ticket was not at the expense of the customer base for full-time subscriptions and, moreover, that the decline in demand for other fare products was moderate. These results impressively showed that there is a market for the additional retention of occasional passengers that is rather poorly tapped in fare systems with conventional subscription prices without off-peak differentiation.

Münster was the first major German city to consistently develop e-fare offerings: In 2013, Stadtwerke Münster (SWMS) started with the introduction of the “FlexAbo” and the “90 MinutenTicket” (see chapter 4.3, Table 23) into the digital fare world. Münster is known as a "bicycle city" with rather low public transport usage. Bus services faced highly variable demand due to the weather, with the peak hour of 7 to 8 a. m. being very busy due to school traffic. The central concern was to lower the commitment threshold for season tickets for price-sensitive and occasional passengers with volatile demand, and thus to bind noticeably more passengers permanently. The aim was to find a subscription model that would also pay off for multimodal users who prefer to cycle when the weather is nice.

At the same time, the price-volume effect was to ensure economic success. For this purpose, the so-called FlexAbo (see Table 27) was introduced as a low-cost flat-rate (introductory price 29 Euro, today after nine years at 36 Euro) for all trips after 8 a. m. As a special usage benefit, trips before 8 a. m. are billed according to actual usage – and this automatically. So there is no need to buy an expensive individual ticket if a doctor's appointment or a business trip forces you to get up early. In addition, each monthly bill is capped at the price of the full-time subscription.

Strictly speaking therefore the FlexAbo would be the best rate model with the lowest price for all subscribers of Stadtwerke Münster. Nevertheless, even after many years, only quite a few product changes occurred. Apparently, the full-time subscription, which continues to be successful in parallel, is simply more convenient for many customers, with whom they pay a clear monthly price and do not have to check in with the chip card for every trip. In this respect, there was not only a differentiation according to willingness to pay, but also according to convenience – with the result being a significant increase in subscription revenues as a stable financing basis for the public transport network.

A case study from Westphalia is exemplary for off-peak offers for day tickets, such as those offered by some network fares and in particular the “Deutschlandtarif”. The reason for the further development of the occasional fare was a noticeable drop in revenue, especially in the local area, which could not be explained by migration to other ticket segments. Therefore, there were many indications that the price level in the cash fare was no longer attractive enough for many occasional users. The goal was to attract or win back passengers by offering a low-threshold service. The focus is primarily on individuals, families (children are included) and small groups for leisure and errand trips. However, commuters, who usually travel during rush hour, should not be “lured” out of the attractive subscription rates.

After evaluating various approaches, the transport association of Münsterland/Ruhr-Lippe region (as one of the predecessors of today's Westfalentarif GmbH) decided to relaunch the existing 9 a. m. day ticket (TaTi) and place it below the price of two single tickets as a focus product (see Table 28). At the same time, the price level of the single and 4-stripe tickets was gently raised in order to create clear incentives for the 9 a. m. day ticket, but also to counter-finance the price reduction. One year after implementation, successes were visible: Within one year, rides on the 9 a. m. day ticket increased by 28 percent and revenues by 21 percent, while rides on the single ticket and 4-stripe ticket decreased by 4 percent and revenues increased by 1

percent, as predicted. The positive development then stabilised in subsequent years, i. e. the revenue declines were sustainably reversed with the "TaTi strategy".

Table 27: FlexAbo by Stadtwerke Münster (SWMS)

Stadtwerke Münst	Stadtwerke Münster (SWMS): **FlexAbo**	
Initial situation before introduction	▶ classic full-time subscription (today at 49 Euro per month) ▶ classic 9 a. m. subscription (no longer relevant today)	
Core of the measure	▶ **2013**: introduction of the **PlusCard** as a "VDV-KA chip card" that is activated by check-in at the validator when boarding the city bus ▶ introduction of a **"flexible subscription"**: valid from 8 a.m. on weekdays, otherwise all day (today at 36 Euro per month) ▶ flat **daily surcharge** for trips before 8 a.m. (today 1.50 Euro), validated by check-in with the subscription chip card at the start of the trip and automatically debited on the monthly bill ▶ monthly maximum price **("price stopper")** at the level of the classic full-time subscription (today at 49 Euro / month)	
Evaluation	**Positive**	**Negative**
Attractiveness and demand effect	▶ approx. **1,000 new subscriptions** in the bicycle city of Münster ▶ **Streamlining the product range** with clear price signals	▶ digital feature of the daily surcharge is **used rather rarely** → 8 a. m. limit is sufficient for many passengers ▶ **Higher annual cancellation rate** compared to classic subscription
Economic viability	▶ rising, steady **subscription revenues** ▶ after many years, **hardly any migration** from the full-time subscription, although the FlexAbo promises savings	▶ high **investment in chip card infrastructure** required to settle the daily surcharge → Use of subsidies
Capacity management (rush hour)	▶ traffic from the **7-8 a. m. peak hour** could be shifted to 8-9 a. m. to some extent ▶ less pronounced afternoon peak compared to the classic subscription	▶ –
More information:	https://www.stadtwerke-muenster.de/privatkunden/mobilitaet/abo-und-ticketuebersicht/abos/flexabo/vorteile.html?o=1%253futm&cHash=8afb5d0b43760738d7f3db56777e7dd2	
Contact:	Frederick Koddenberg, SWMS Head of Transportation Department f.koddenberg@stadtwerke-muenster.de, +49 251 694-2824	

Source: own representation based on interviews and research, Probst & Consorten Marketing-Beratung

The introduction was accompanied by an intensive marketing campaign, in which the offer was stylised by a comic figure in a hero costume ("TaTi") and drew attention to the advantages of the

revised fare on vehicles and with giveaways. In the field of tension with the 24 hour ticket introduced later, the 9 a. m. day ticket remains by far the more important fare product, since most leisure and errand trips take place outside the morning rush hour anyway.

Table 28: 9 a. m. day ticket (TaTi) by WestfalenTarif (WT)

WESTFALENTARIF	WestfalenTarif (WT): **9 a. m. day ticket ("9 Uhr TagesTicket", "TaTi")**	
Initial situation before introduction	▶ Differentiated product range for occasional passengers (one-way ticket, 4-stripe ticket, day ticket variants) available ▶ In some cases, unclear usage incentives, e.g. when it comes to the question of which product is the best for a round trip	
Core of the measure	▶ 9 a. m. day ticket placed as **focus product** for occasional passengers ▶ particularly favourable **price below two single tickets** due to no validity in the morning rush hour ▶ more expensive **24-hour ticket** for all passengers who need to be mobile all day long	
Evaluation	**Positive**	**Negative**
Attractiveness and demand effect	▶ attractive for **passengers travelling alone**: already worthwhile for the round trip ▶ very attractive for **families & groups**: 5-person variant often pays off already for two passengers ▶ noticeable **increase in rides and revenues** in the segment of cash fares for occasional users	▶ 9 a. m. day ticket also valid all day on weekends → **unclear distinction** from 24-hour ticket on weekends
Economic viability	▶ **measure is self-supporting**: counter-financing through additional customers and in part through higher prices for single, 4-person and 24-hour tickets ▶ **fewer sales transactions** (no ticket purchase for return trip)	▶ –
Capacity management (rush hour)	▶ smooth shift of leisure trips from morning rush hour → not concretely measurable	▶ –
More information:	www.westfalentarif.de/tickets-abonnements/gelegenheitsfahrer	
Contact:	Matthias Hehl, Managing Director Westfalentarif matthias.hehl@westfalentarif.de, +49 251 4059-22	

Source: own representation based on interviews and research, Probst & Consorten Marketing-Beratung

4.5 Flat-rate network tickets

When the pandemic situation allowed, many transport companies and associations launched various "thank you" campaigns for their loyal customers. For example, Verkehrsverbund Oberelbe (VVO) extended the validity of all season tickets to the summer vacations in 2020 and 2021.[20] In September 2021, subscribers were even able to use public transport throughout Germany in the participating transport network at no additional cost as part of a VDV campaign.[21] Reward measures of this kind are based on a flat-rate spatial validity of season tickets covering a very large fare area – packaged here as a time-limited campaign to extend existing subscriptions.

A special case of a flat-rate network ticket is certainly the so-called 9 Euro ticket[22] offered throughout Germany from June to August 2022. Here, only a marginal monthly price is charged for a public transport ticket valid throughout Germany – but explicitly not in order to improve the financing basis of public transport, but to relieve the population of price shocks triggered on the mobility market by the war in Ukraine. The massive underfunding of the public transport system is thereby accepted in the short term and compensated for by the federal government. The 9 Euro ticket represents a great opportunity for passenger recovery after the coronavirus pandemic, without such a radical pricing approach being realistically sustainable. Still completely unclear are the longer-term effects of the 9 Euro ticket on the German public transport fare landscape, although some trend toward more flat-rate network tickets (with more economical pricing approaches), such as those examined in this chapter, may well be triggered. This will depend, among other things, on the eagerly awaited evaluation results, the transferability of which to normal conditions and price ratios will then have to be critically examined.

Flat-rate network tickets are also available in some transport regions in Germany and abroad, irrespective of the pandemic – without any promotional character and instead on a permanent basis. In principle, almost every public transport fare system has a network-wide valid season ticket in the highest price category – except that these are often very expensive and are only suitable for very few people who actually make long public transport trips in this fare zone almost every day. Instead, this chapter will focus on network-wide season tickets, which are particularly inexpensive and make many other – not necessarily all – price levels redundant, thus simplifying the fare landscape. Price tier capping that starts very early can lead to several effects:

- Previous long-distance commuters save a lot of money. Therefore, flat-rate network tickets are often among the most expensive measures in the field of alternative fare concepts.
- Remote workers - who precisely because of the long commuting distance - are increasingly taking to working from home. They refrain from cancelling their subscription as long as it pays off for a usage on just a few days a week.
- Commuters on medium-distance trips, for example between a large city and the immediate surrounding area, do not necessarily save (a lot of) money, but are given a much larger area

[20] https://blog.vvo-online.de/dankeschoen-sommer/

[21] https://www.besserweiter.de/abonnentinnen-koennen-bundesweit-und-ohne-weitere-kosten-den-oepnv-nutzen.html

[22] The 9 Euro-Ticket is a special offer for local public transport in Germany. The offer is available for June, July and August 2022. The tickets are valid for all bus and second-class train trips on local public transport throughout Germany. The ticket costs 9 Euro for each month. Long-term ticket and other subscription holders can apply for the reimbursement of the price difference.

of validity, especially for their leisure mobility. At previous possible zone jumps, additional tickets are no longer necessary.

- Commuters on short trips, for example in the city, may not benefit from the network ticket in terms of price, but can make their leisure mobility much easier for a manageable extra charge. A few monthly trips to other destinations can “pay” for the network ticket. Many people have a substantial willingness to pay for the so-called option benefit – according to the motto: "I could go anywhere now" – which can be addressed with a network ticket.
- The same is true to an even greater extent for people who do not regularly commute to work and who primarily travel within the local area in their daily lives (e.g. retired people, students): Their lower frequency of use often makes a subscription interesting only because of its flexible, network-wide usability. For this reason, flat-rate network tickets are often launched only or as a first step for delimited target groups outside of commuters.

A favourable mixed price across the above-mentioned target groups is possible primarily because all users of the fare product pay jointly for the flat-rate area of validity, even if it is not exhausted in most cases. In the event that very large-area season tickets are introduced, however, fares for small-area local mobility should not be completely replaced, if possible, in order to continue to enable gradations that are relevant from the user's point of view.

The introduction of flat-rate network tickets generates increasing passenger numbers – partly through induced trips, partly through a shift from private transport. There are also significantly more contractually bound customers, although the price-volume effect is usually not sufficient to counter-finance the flat-rate system. Without substantial public subsidies, such models are hardly conceivable, so that, viewed in isolation, the funding base of public transport tends to be reduced rather than broadened.

The model of flat-rate network tickets fits in well with the changes in public transport use in the context of the coronavirus pandemic: if, in times of the pandemic, the commute to work is increasingly eliminated due to home office or short-time working arrangements, the possession of a public transport season ticket is often called into question – especially if it is only valid for the necessary relation between home and the workplace. If the trip to work takes place less frequently, the same distance must also be covered less often by public transport – the route reference in the use of public transport is reduced. In contrast, season tickets that are valid throughout the entire network, the entire region or even the entire federal state and beyond make it obsolete to decide on a specific route or to reissue the existing season ticket. From the user's point of view, this increases flexibility. At the same time, it is more likely that flat-rate network tickets will also be used for leisure trips, thus retaining their "justification" even if fewer trips are made to work.

Interestingly, in its attempt to make fare design more pandemic-resistant the flat-rate is in clear contrast to the desire for more individual, flexible fares as described in particular in chapters 4.1, 4.2 and 4.3. This illustrates very clearly the classic dilemma between simple fares with little need for explanation on the one hand and fair, flexible fares on the other. Commercially, both approaches are justified, but they are difficult to combine: If you want to make your network subscription particularly inexpensive, you should not create any other alternative offers that are all too attractive in terms of price, if only for reasons of financial viability.

Below, three selected practical examples of flat-rate network tickets from Germany and Austria are presented, which were designed independently of the pandemic situation, but nevertheless bring advantages for the changed mobility behaviour.

For a long time, the Rhine-Neckar Transport Association (VRN) has taken a different approach by accepting most of the subscriptions offered at the level of the transport association (see table 29) and thus assumed a special role within the German associations at an early stage. The commercial approach consisted in the formation of attractive mixed prices, which emphasise the transport network of the Rhine-Neckar region and invite to "discovery trips" into the surrounding area. In the city transport systems, there are also citywide annual passes for regular passengers, although these have a much smaller market significance. This indicates that people whose place of residence and place of work coincide can often be convinced of the advantages of network tickets.

Table 29: Rhein-Neckar-Ticket, Job-Ticket, "Karte ab 60", MAXX-Ticket by Verkehrsverbund Rhein-Neckar (VRN)

	Verkehrsverbund Rhein-Neckar (VRN): **Rhein-Neckar-Ticket, Job-Ticket, "Karte ab 60", MAXX-Ticket**	
Initial situation before introduction	▶ offers have existed in part for approx. 30 years as elementary components of the VRN fare	
Core of the measure	▶ **Rhein-Neckar-Ticket** as an all-inclusive annual pass for all passengers (92.50 Euro) → only a few price levels remain in the local area (esp. urban transport) ▶ **"Karte ab 60"** for older people, **Job-Ticket** in companies with company contribution and **MAXX-Ticket** for pupils/apprentices are valid throughout the network for less than 50 Euro each → offers are already worthwhile in the city transport system	
Evaluation	**Positive**	**Negative**
Attractiveness and demand effect	▶ particularly **high subscription rate** among all passengers in network comparison ▶ flat-rate tickets also as an **incentive for leisure time use** → high utilisation of leisure transport on weekends ▶ significantly **easier** for passengers: "just get on board"	▶ partly **discussions about fairness** and a downward shift in price perception → Why do short-haul routes cost the same as long-haul routes?
Economic viability	▶ high sales figures with **stable fare revenues** ▶ no explicit counter-financing through grants	▶ rather **moderate total revenues** per inhabitant in network comparison
Capacity management (rush hour)	▶ –	▶ no effects in capacity management
More information:	https://www.vrn.de/tickets/ticketuebersicht/index.html	
Contact:	Thomas Schweizer, VRN Head of Marketing and Tariff Department t.schweizer@vrn.de, +49 621 10770-112	

Source: own representation based on interviews and research, Probst & Consorten Marketing-Beratung

Despite its age, this pricing policy can be a response to changing passenger needs and habits – especially when working from home means that the commute to work is more frequently eliminated and the ticket can still be used for trips within the network area. However, it is difficult to delineate the economic impact because the introduction took place too long ago. It must be assumed that the customer's willingness-to-pay is not fully exploited. Thus, the VRN is foregoing a high yield per passenger trip and is focusing more on generating additional demand and "luring" passengers into long-term subscription across all stages of their lives. Before the coronavirus pandemic, it could be observed that even with very attractive prices, a certain degree of market saturation occurs, for example among retired people, who seem to be turning to individual transport even more today than ten or twenty years ago. Consequently, low network prices are not a "cure-all", but they are a strong measure for a targeted strengthening of the overall public transport system.

With the fare reform in 2020, the Salzburger Verkehrsverbund (SVV) has significantly reduced the price of public transport use for frequent passengers and provided all season tickets with flat-rate validity areas. The motivation for the introduction of the subsidised tickets was a political compromise to cancel a very expensive road construction project.

There is a choice of myRegio tickets for the selected region or the entire federal state for use around the clock (see Table 30). The SVV fare reform is thus exemplary for a type of flat-rate network ticket, which not only created flat-rate regional tickets for the entire whole network (here congruent with the province of Salzburg), but also for short and medium distances without a specific route reference. This promotes flexible everyday mobility without having to purchase the highest price level.

The pricing was supported by state funds, making massive price reductions possible. Previously, the annual season ticket for everybody for the entire state of Salzburg, for example, cost 1,539 Euro – with the myRegio Ticket, it will only cost 595 Euro (in 2020). As a result, around 21,000 myRegio annual tickets could already be sold at the beginning of 2020. For people with pupil/apprentice, student or senior citizen status, low-priced flat-rate tickets were already offered before this reform.

With the introduction of the so-called "KlimaTickets" in Austria, enforced by the federal government, the annual ticket for the entire state of Salzburg dropped again to only 365 Euro and is now marketed as "KlimaTicket Salzburg". By the end of 2021, around 7,000 KlimaTickets for the state of Salzburg had already been sold.[23] Tickets for single regions or combinations of regions are now only offered as weekly or monthly passes.

The KlimaTickets introduced and promoted by the Austrian federal government (see Table 31) are the preliminary conclusion of a development that began in 2012 in the city of Vienna with the 365 Euro ticket there. Since then, price reductions for flat-rate annual tickets have been initiated in many federal states (see, for example, the Salzburg case study above). Starting from an already lower price level compared to Germany, political pressure led to many imitators and ultimately to an overall approach by the federal government.

[23] https://www.derstandard.at/story/2000132160770/bislang-mehr-als-130-000-klimatickets-in-oesterreich-verkauft

Table 30: myRegio Tickets by Salzburger Verkehrsverbund (SVV)

	Salzburger Verkehrsverbund (SVV): **myRegio Tickets**	
Initial situation before introduction	► classic ticket range with route-related season tickets (weekly, monthly and annual passes) ► network validity only in the local area (e.g. core zone city of Salzburg)	
Core of the measure	► introduction of myRegio tickets as network tickets, available for one or two regions or the entire province (all six regions); in the city of Salzburg, the city zone was expanded to include surrounding communities ► flagship product annual pass, but also as weekly / monthly pass ► target group offers for pupils, students and retired people generally valid throughout the state	
Evaluation	**Positive**	**Negative**
Attractiveness and demand effect	► **price reduction** makes annual passes attractive even for medium frequency of use ► increase from previous 8,000 to over **30,000 annual passes** → often "upgrade" to more generous validity ► flat-rate tickets also as an incentive for **leisure time use,** even with a lot of home office work	► –
Economic viability	► –	► **reduction of** the passenger **financing share** ► **state subsidy** of up to 6 million Euro per year (not yet including KlimaTicket Salzburg)
Capacity management (rush hour)	► –	► no effects of capacity management
More information:	https://salzburg-verkehr.at/tickets-preise/zeitkarten/myregio/	
Contact:	Johannes Gfrerer, SVV Managing Director, johannes.gfrerer@salzburg-verkehr.at, +43 662 87 57 87	

Source: own representation based on interviews and research, Probst & Consorten Marketing-Beratung

Table 31: "KlimaTicket Ö" by public transport industry and federal government in Austria

KlimaTicket	Public transport industry and federal government in Austria: **"KlimaTicket Ö"**	
Initial situation before introduction	▶ ÖBB "Österreichcard" only valid for railroads (regular price 1,944 Euro) ▶ Price capping of annual tickets varies in the network fares; in most cases more expensive than the KlimaTicket Ö	
Core of the measure	▶ originally planned as "1-2-3-KlimaTicket" with level 1 valid for one federal state, level 2 for two federal states and level 3 for the whole of Austria ▶ introduced as "KlimaTicket Ö" with 3 Euro per day with nationwide validity for train and bus ▶ Target group-specific offers for young people, retired people and a variant for families ▶ currently stage 1 already introduced in almost all federal states (365 Euro)	
Evaluation	**Positive**	**Negative**
Attractiveness and demand effect	▶ massive **fare reduction** also for all semi-regular users ▶ noticeably **more customer loyalty:** expected purchase volume for the first year already significantly exceeded after 2.5 months ▶ distance-related public transport ticket not very relevant for home offices – flat-rate tickets also as an incentive for leisure time use	▶ significant downward shift in price perception
Economic viability	▶ real profitability not yet assessable	▶ **reduction** of the **passenger financing share** ▶ **federal subsidy** estimated at 252 million Euro annually ▶ complex compensation arrangements by the federal government as a result of complex financing negotiations
Capacity management (rush hour)	▶ –	▶ no effects of capacity management
More information:	https://www.klimaticket.at/de/	

Source: own representation based on interviews and research, Probst & Consorten Marketing-Beratung

The Austria-wide KlimaTicket costs only 1,095 Euro per year – and there is a further discount of around 25 percent e.g. for younger and older people. About two and a half months after its

introduction, the target of 100,000 tickets has already been clearly exceeded.[24] The immense subsidy requirement is estimated at up to 252 million Euro for 2022 and will be covered by the ÖBB subsidies.[25] Even if reality may still lead to different results in detail, the weakening of the financing basis by passengers is nevertheless obvious. In addition to the flat-rate per se, the very aggressive, striking pricing is primarily responsible for this effect.

In comparison, most tickets in level 1 were purchased in the federal state of Vienna – almost 43,000 – by December 2021. In the provinces, the heavily discounted price of one Euro per day has an even greater impact. This makes the previously more expensive annual tickets in the associations redundant. The KlimaTicket has certainly received a positive response in the pandemic and transport transition context. In terms of the population as a whole, however, the uptake to date still leaves room for improvement, for example in comparison with the Swiss "Generalabonnement".

4.6 Job ticket and other models for corporate clients

In times of the pandemic, numerous employees shifted their activities to the home office or were subject to short-time work. In addition to the trip to work, other – also private – travel purposes were eliminated due to contact and travel restrictions or changed habits. For regular public transport customers, this can quickly lead to questioning the ownership of a season ticket: "Does my ticket still pay off if I no longer or rarely travel to the office?" However, if the price of the season ticket is low from the customer's point of view, and it pays for itself with just a few trips per week, this consideration is very likely to lead to cancellation of the subscription less frequently.

One way to keep the season ticket price low is to issue it as a discounted job ticket. Conventional job ticket models are often characterised by the fact that the transport company grants a volume discount if a certain number of tickets are purchased by a company. This means that employees receive a slightly discounted offer compared to a regular subscription, sometimes even with worse usage conditions (e.g. by eliminating transferability). The commercial charm of such bulk discounts thus remains low, as there is a lack of effective incentives to significantly increase ticket uptake among the workforce. Large companies at locations easily accessible by public transport, which can take these discounts for virtually nothing in return, are advantaged.

A much more attractive price for the end-user – and thus much greater demand leverage as well as protection against cancellations in phases with a high proportion of home offices – is made possible by the job ticket models described in the following section. In these models, employers are encouraged to contribute financially to the public transport costs of their employees. A monthly subsidy for the job ticket or a basic amount to be paid for all employees are either mandatory or are provided with a strong incentive – usually in the form of a considerable discount on the part of the transport company.

The models with clear employer engagement were designed independently of the coronavirus pandemic, and yet they enjoy a high degree of relevance, especially due to increased home office rates. Several case studies demonstrate their growing success even during pandemic times. It can be assumed that the popularity of home office work will continue in the future – likewise, the favourable user prices are also attractive for part-time employees. For the transport companies, such a model means an additional financing pillar via company participation, which is particularly important in times of crisis.

[24] https://www.derstandard.at/story/2000132160770/bislang-mehr-als-130-000-klimatickets-in-oesterreich-verkauft

[25] https://www.derstandard.de/story/2000130686827/kreative-buchfuehrung-fuers-klimaticket-werden-oebb-zuschuesse-umgewidmet

The concept not only offers attractive prices for commuters, but also benefits companies: As beneficiaries of a good public transport system, they benefit from the accessibility of their location by bus and train and may save enormous expenses for company parking spaces if a good portion of the workforce comes to work in an environmentally friendly manner – up to including the possibility of reductions in parking space statutes granted in some cities if a job ticket agreement is in place. In times of a shortage of skilled workers, an employer subsidy for the job ticket that is free of tax and social security contributions can increase employer attractiveness without incurring additional none-wage labour costs ("gross equal to net"). In addition, companies improve their CO_2 footprint by actively supporting the use of public transport by their workforce.

Such models of co-financing by beneficiaries are also applicable to other major customers or corporate clients such as landlords. Here, the landlord subsidises the tickets of his tenants and in return receives a discount from the transport company. Similar to an employer, the housing industry also benefits from good public transport connections to its own residential locations and from a reduction in the number of car parking spaces required. This noticeably reduces construction costs[26] and, in some cases, can make densification in urban areas possible. Initial approaches to large-scale customer models in the housing sector are being conceived or piloted in various transport regions – but no firm findings can be formulated at this stage.

In the following, three selected practical examples of successful job ticket models are presented, two of which are characterised by a high monthly mandatory employer subsidy per ticket and one by a basic employer contribution determined on the basis of the previous subscription rate. This is followed by a current practical example of a so-called tenant ticket.

With the new job ticket in Schleswig-Holstein (see Table 32), employers take a significant share of the public transport costs of their own employees – their financial participation is always higher than the discount offered by the transport companies. The resulting attractive end-user price usually leads to a significant increase in volume at each company and thus to an overall positive return despite the noticeable discounts. The move away from mere volume discounts also allows smaller companies to profit from the benefits of this fare. Instead of their size, the financial commitment of the companies is now rewarded, which motivates many employers to think about tax-free ticket subsidies in the first place.

The NAH.SH-Jobticket was designed independently of the crisis situation and successfully launched in the middle of the pandemic year 2021: Nine months after its launch in April 2021, the target of 1,000 job tickets was exceeded by more than a factor of six. Despite the increasing home office rates, it was thus possible to "lure" many companies into a contract for the first time and to significantly increase the acceptance rates in the companies compared to before.

The model is highly likely to be self-sustaining in the future. The state is supporting the launch with start-up funding of up to 2 million Euro, which will serve as a risk hedge for possible revenue shortfalls during the introductory phase on the one hand and enable the establishment of a dedicated sales team on the other. Additional staff have been recruited for active key account sales of the ticket. In times of a shortage of skilled workers and increasing climate awareness, the new fare model is very suitable to businesses in Schleswig-Holstein.

[26] Parking costs account for approximately 10 percent of construction costs in rental housing .

Table 32: NAH.SH-Jobticket with high mandatory employer subsidy by Nahverkehrsverbund Schleswig-Holstein (NAH.SH)

NAH.SH	Nahverkehrsverbund Schleswig-Holstein (NAH.SH): **NAH.SH-Jobticket with high mandatory employer subsidy**	
Initial situation before introduction	▶ company contract with small discounts of 6-10 percent depending on company size → little price difference compared to regular subscription ▶ rather small number of companies under contract	
Core of the measure	▶ adjustment in **April 2021:** opening up to smaller companies by reducing the minimum purchase from 10 to just 5 tickets ▶ **monthly subsidy from the company** of at least 15 Euro for each ticket – higher than the discount granted by the transport company (10 Euro) ▶ **incentive for higher participation:** 20 Euro discount by the transport companies with at least 30 Euro subsidy by the employer	
Evaluation	**Positive**	**Negative**
Attractiveness and demand effect	▶ **great demand leverage** due to attractive end-user price 25 or 50 Euro below standard fare → in Kiel from 2.50 Euro p. month ▶ subsidised ticket is worthwhile for **a small number of days of use**, e.g. for home offices ▶ **more contracting** through access for smaller companies and greater discount incentives ▶ **sales target significantly exceeded** just nine months after launch despite pandemic	▶ access to the contract is dependent on the employer's commitment → but this also makes it more probable ▶ not all existing companies migrated to the new model with subsidy yet
Economic viability	▶ **third pillar* financing** by companies as beneficiaries of a good public transport system ▶ calculated as self-financed ▶ **strong growth in acceptance figures** and **high proportion of new customers**	▶ **start-up funding from** the state to cover risks at the transport companies – not needed in the longer term ▶ additional need for sales staff to be taken into account, can be financed by additional revenue
Capacity management (rush hour)	▶ –	▶ no control effect due to usually fixed start of work
More information:	https://www.nah.sh/de/fahrkarten/jobticket/ https://wimikiel.com/2022/01/27/rasanter-start-in-neun-monaten-landesregierung-mit-jobticket-sh-hochzufrieden/	
Contact:	André Petersen, NAH.SH GmbH, Tariff and Distribution andre.petersen@nah.sh, +49 431-66019-55	

* Financing from sources other than tax and ticket sales, for example through levys, which companies get charged for the benefit of using a public transport system with certain standards ("third pillar financing").

Source: own representation based on interviews and research, Probst & Consorten Marketing-Beratung

In order to make the NAH.SH-Jobticket easy to obtain for users, the ticket is issued either as a paper ticket or as a modern mobile phone ticket. The latter is particularly popular – around three quarters of tickets are ordered digitally. Together with the high discounts and the very low effective user prices in the city transport systems, it was possible to achieve a pleasingly high proportion of new customers of around 60 percent of all tickets ordered.

The VBB-Firmenticket (see Table 33) was already successfully introduced in 2019 independently of the coronavirus pandemic. The minimum purchase was significantly reduced compared to the Schleswig-Holstein model, which means that access is now easier for smaller companies, of which there are particularly many in Berlin and Brandenburg. The job ticket enjoys a high level of acceptance, particularly in the cities. In rural regions with less developed public transport services, market penetration is lower.

In contrast to the NAH.SH -Jobticket, the mandatory subsidies were set somewhat lower so as not to overburden companies' willingness to pay. However, an evaluation of the ticket model showed that around 90 percent of the employers surveyed pay at least 15 Euro as a monthly subsidy per ticket. Accordingly, the willingness of employers to pay is apparently easily 15 Euro per user per month in many cases – or even higher, so that a further expansion of the subsidy levels is being considered.

For the fare zone Berlin AB (city area), for example, the user price with 15 Euro company subsidy and 8 Euro discount by the transport company is an attractive 40.42 Euro per month – this pays off from just over three single trips per week and is therefore also very suitable for part-time employees and home offices.

The JobTicket MAXI in Kassel and North Hesse (see Table 34) is an example of an alternative way in which employers can contribute to the ticket costs of their employees. No subsidy is paid for each ticket actually purchased; instead, a fixed monthly base contribution is agreed upon, which is transferred by the company as a basic fee. This is based on the number of employees and the previous use of public transport in the company, which is influenced, for example, by the quality of the public transport connection, the availability of parking spaces and the working time model. If all employees who were already using public transport regularly before the introduction of the JobTicket MAXI switch to this fare, the basic contribution is intended to compensate for the losses caused by the drastic discounting of user prices (urban area of Kassel from 70 to 30 Euro, regional transport from up to 175 to 50 Euro). The economic risk on the part of the transport company resulting from the discounting is thus minimised.

In addition, however, ticket demand increases significantly on the basis of the highly attractive ticket prices. This additional revenue can more than compensate for the partial loss of cash fare revenue from the employees and thus leads to additional revenue and more passengers at the same time.

Some other transport associations also have job ticket models with a basic contribution. The special feature in Kassel, however, is the base fee, which is individually aligned to the framework conditions of a company and requires prior recording of the public transport use of the employees. This makes the model potentially attractive, for example, for rather poorly connected companies with a low public transport usage rate. For example, even during the coronavirus pandemic, a number of new MAXI contracts were signed after more and more companies actively addressed green mobility among their employees. There are now twelve company contracts with over 2,000 end customers, although the strong internal competition from the other, equally successful job ticket contract models in the NVV as well as the limited size of the Kassel metropolitan area with approximately 200,000 inhabitants must be taken into account here.

Table 33: VBB-Firmenticket with high mandatory employer subsidy by Verkehrsverbund Berlin-Brandenburg (VBB)

	Verkehrsverbund Berlin-Brandenburg (VBB): **VBB-Firmenticket with high mandatory employer subsidy**	
Initial situation before introduction	▶ old job ticket model with small discount of 5 percent ▶ low market penetration, especially in cities outside Berlin, but even there rather moderate; stagnating demand over many years	
Core of the measure	▶ adjustment in **September 2019**: opening up for smaller businesses by reducing monthly minimum purchase from 50 to just 5 tickets ▶ **monthly subsidy from the company** of at least 10 Euro for each ticket – higher than the discount granted by the transport company (4 Euro) ▶ **Incentive for higher participation**: 8 Euro discount by the transport company with at least 15 Euro subsidy by the company ▶ abolition of the old volume discount model as of 31st December 2022	
Evaluation	**Positive**	**Negative**
Attractiveness and demand effect	▶ **large demand lever** due to attractive end-user price ▶ subsidised ticket is already worthwhile for **a few days of use**, e.g. for home offices ▶ **more contracting** through access for smaller companies and greater discount incentives ▶ increasing **market penetration** in all cities	▶ access to the contract is dependent on the employer's commitment → but this also makes it more probable ▶ **lengthy transition period** for migration of existing corporate customers from the old to the new model – justified by the uncertain economic situation of corporate customers due to the pandemic
Economic viability	▶ **significant additional revenue** from the product even during pandemic periods ▶ **third pillar financing** of companies as beneficiaries of good public transport → 90 percent of companies voluntarily pay the **higher subsidy** of at least 15 Euro	▶ **additional personnel requirements** in sales must be taken into account
Capacity management (rush hour)	▶ –	▶ no control effect due to usually fixed start of work
More information:	https://www.vbb.de/tickets/sondertickets/vbb-firmenticket/	
Contact:	Gabriela Felder, VBB Center for Local Transport and Quality Management gabriela.felder@vbb.de, +49 30 25414-345	

Source: own representation based on interviews and research, Probst & Consorten Marketing-Beratung

Table 34: JobTicket MAXI with base contribution by Nordhessischer VerkehrsVerbund (NVV)

	Nordhessischer VerkehrsVerbund (NVV): **JobTicket MAXI with base contribution**	
Initial situation before introduction	▶ old ticket models with 7 to 10 percent discount for 5 or more employees ▶ or individual agreements with up to 25 percent discount for solidary acceptance by all employees of a company; financial participation of the company remained open	
Core of the measure	▶ **adjustment of the JobTicket products in 2016** with the levels MINI (without subsidy), MIDI (similar to NAH.SH or VBB) and MAXI → the latter level is to be considered here ▶ MAXI model: **attractive flat-rate** for employees in two price levels (city area monthly for 30 Euro, all of North Hesse for 50 Euro) ▶ agreement on a monthly **base contribution** based on the number of employees and the previous subscription rate in the company, which is paid by the company regardless of the actual ticket use ▶ for companies with 30 or more employees, without minimum purchase	
Evaluation	**Positive**	**Negative**
Attractiveness and demand effect	▶ **large demand leverage** due to very attractive end-user prices ▶ particularly **easy to understand** and flexible to use by dispensing with complex price levels (no relation reference) ▶ discounted ticket is already worthwhile for **a few days of use**, e.g. for home offices ▶ **increasing demand** also during coronavirus pandemic	▶ access to the contract is dependent on the employer's commitment → but this also makes it more probable
Economic viability	▶ **shortfall in revenue** due to discounting is **compensated for** with base contribution ▶ **additional revenue** from additional tickets sold only because of attractive end-user prices	▶ -
Capacity management (rush hour)	▶ –	▶ no control effect due to usually fixed start of work
More information:	https://www.nvv.de/tickets-preise/tickets/ticketsimueberblick/jobticket	
Contact:	Imre Petrik, NVV Tariff, Distribution and Revenue Sharing Procedure imre.petrik@nvv.de, +49 561 70949-22 Alexander Geiger, Kasseler Verkehrs-Gesellschaft (KVG) – Market Research alexander.geiger@kvg.de, +49 561 3089-186	

Source: own representation based on interviews and research, Probst & Consorten Marketing-Beratung

From the user's point of view, the price level “KasselPlus” within the JobTicket MAXI is more than 50 percent cheaper than the regular annual subscription – the signal price of the equivalent of about one Euro per day is tempting. For the NVV network, the easily communicated flat-rate corresponds to a saving of between 40 and 70 percent.

With the "MieterAbo" pilot project, which is unique in Germany on this scale (see Table 35), the transport company moBiel, a wholly owned subsidiary of Stadtwerke Bielefeld and the leading mobility service provider in Bielefeld, wants to break new ground in the financing of public transport by users and beneficiaries – in this case tenants and landlords. Existing findings from the geographically smaller "SennestadtTicket" project could be extended here to the whole of Bielefeld. The goal is to achieve continuous growth in the number of regular passengers and to develop the pilot project into a financially sustainable fare offer in the long term.

The two-year pilot project is being carried out jointly with two major landlords, "Baugenossenschaft Freie Scholle eG" and "BGW Bielefelder Gesellschaft für Wohnen und Immobiliendienstleistungen mbH”. The MieterAbo itself is a solidarity-financed ticket and only affects their new tenants, i.e. it does not initially apply to existing tenancy agreements. The two housing companies together manage around 17,000 apartments in Bielefeld. BGW expects about 1,200 new tenants per year, Freie Scholle 400 to 500.

When a tenancy agreement is signed, one of the household members, who may be more than one adult, receives a personal subscription to the city price level BI (except for student residences). The MieterAbo, which is calculated at 15 Euro per month, is subsidised by the housing companies to the tune of 2.50 Euro, leaving 12.50 Euro for new tenants (instead of 62 Euro for the regular Bielefeld subscription rate). The MieterAbo is valid for the entire duration of the project or until the end of the rental period, based on an additional agreement under private law between the housing company and the tenants. In addition, tenants over the age of 18 have the option of obtaining their own personal subscription to price level BI at a price of 30 Euro ("MieterAbo+").

The automatic availability of the subscription is intended to encourage tenants to live without their cars and to use alternative, more environmentally friendly services such as bus and tramway as well as the other sharing services, some of which offer discounts with the MieterAbo. This is intended to sustainably strengthen the environmentally friendly transport modes in the modal split of tenants. For the housing companies, this is an opportunity to offer their tenants a cost-effective additional benefit and, in the long term, to include the mobility costs in the operating costs.

The project is currently in the middle of the pilot phase, which is why it is not yet possible to make any well-founded statements about its cost-effectiveness. After the conclusion of the pilot phase, the accompanying evaluation will be analysed and the need for adjustments in case of a transfer to the standard fare will be examined. The current lack of options for purchasing connecting tickets beyond Bielefeld to the surrounding area will be put to the test, as will the price itself.

Table 35: Solidarity-financed MieterAbo by moBiel

	moBiel (Bielefeld): **Solidarity-financed MieterAbo**	
Initial situation before introduction	▶ tenant ticket as "bulk purchaser subscription" identical to job ticket ▶ with a 10 percent discount, not very attractive in terms of price, therefore rather low demand	
Core of the measure	▶ **pilot for new tenants** of BGW Bielefeld and Freie Scholle (October 2021 to September 2023), then possibly transfer to standard rate ▶ one permanent ticket per apartment in the city of Bielefeld at a **solidarity-financed price** (12.50 Euro instead of the regular 62 Euro) ▶ for additional household members optional tickets for 30 Euro each	
Evaluation	**Positive**	**Negative**
Attractiveness and demand effect	▶ very **favourable price** from the user's point of view ▶ validity / transfer regulations as for a **full city fare level** season ticket ▶ utilisation increases due to **mandatory acceptance**	▶ no **transferability,** i.e. person-bound to tenant ▶ currently not available for traffic beyond Bielefeld **into the region** ▶ not available for existing tenants
Economic viability	▶ **financial participation of** the landlords (2,50 Euro per month) ▶ potentially **additional revenues** possible if the user price is adjusted to at least compensate for prior use ▶ **evaluation** for economic viability is currently in the making	▶ potentially **lower revenues if** the windfall loss outweighs the benefits or if the discount is too large
Capacity management (rush hour)	▶ –	▶ no effects in capacity management
More information:	https://www.mobiel.de/tickets/spezielle-tickets/mieterabo/	
Contact:	David Heidenreich, moBiel GmbH – Head of Transport Management david.heidenreich@mobiel.de, +49 521 51-7836	

Source: own representation based on interviews and research, Probst & Consorten Marketing-Beratung

4.7 Summary and recommendations

In recent years, the public transport industry has found partly similar, partly different answers to the challenges faced by classic public transport fare systems. From the perspective of retaining and (re-)attracting passengers in the fading coronavirus pandemic, the objectives that were already formative for the transition to environmentally friendly transport are basically confirmed: Fares should be made more attractive on the one hand, and on the other hand they should also have a more tailored effect. However, this must not trigger a commercial fiasco with high requirements for public service compensation – because this would counteract the recommendations of a massive expansion of services, which were described, amongst other things, in chapter 3.4.3.

Looking at the largest competitor to public transport, the private motorised transport, not only car availability has increased during the pandemic, but the cost structure for a car is also gradually changing: the strong promotion of electric cars means that fixed costs will dominate in future. The relevant variable cost part of car use – formerly fuel costs – continues to decline (Kasten 2018: 5), so that the competitive situation will become even more challenging and classic price increases in public transport will be increasingly difficult to implement in the mobility market.

Fare design in public transport is always based on the balancing of conflicting goals and conflicting requirements of the various passenger segments, as well as from politics and public transport operations. After the coronavirus pandemic, therefore, some recommendations can be formulated, but no universal recipes that fit the actual challenges and previous fare strategies everywhere. The following six findings are striking:

Firstly, the familiar subscription relationship continues to work in and after the pandemic.

The classic subscription is not gone. It has not only saved the public transport industry (along with the bailout funds) from an even higher decrease in passenger numbers, but it simply offers the most pleasant way to use public transport: just get on, no need to think – at predictable prices that are of little consequence on the bank statement. The choice of transport modes is and remains mostly a matter of habit, and thus it is enormously important for the public transport system to relieve its regular customers as many decisions as possible. The trend towards flat-rate fares could even intensify after the three-month application period of the 9 Euro ticket, even if such a radical pricing approach cannot be a permanent offer.

More heterogeneous usage patterns can very well continue to be served by flat-rates, as long as they are simple – in the sense of being as flexible as possible in terms of location – and attractively priced. However, subscription rates must adapt to changing needs. For example, low-priced offers that perhaps exclude rush hour are an attractive way to significantly expand the loyalty of regular customers. Networks that have very limited, route-based fares should also consider how they can give frequent passengers with season tickets more freedom for more flexible leisure mobility – for example, but not necessarily through flat-rate network tickets. Last but not least, the price ratio between occasional and season tickets, which should tend to be lower than in the past given increasingly atypical work patterns, is also an important control variable.

Second, hold beneficiaries such as employers or landlords more accountable.

The main demand shock from the coronavirus pandemic relates to changing work behaviour in the area of office jobs under the keyword "home office". In the context of employee mobility, more and more public transport companies are benefiting from fare models that actively involve employers in ticket financing. For companies, good public transport is a locational advantage, a

contribution to a reduced CO_2 footprint, a component for recruiting skilled workers, and a problem solver – because company parking spaces also cost money if a large proportion of the workforce stays at home on Fridays.

The same applies to the housing industry. Here, it makes sense to dare a new quality of fare integration, for example, the integration of such offers into the parking space statutes. This has a positive impact on the competitive situation of public transport and ensures that the costs of parking are kept to a minimum.

This "third financing pillar" is still the ideal way to resolve the dilemma of attractive subscription prices and the high system costs of peak-hour commuters. The best way to maintain or even increase profitability is to shift price components to other groups that derive indirect benefit from the public transport service. With the help of digitalisation, which can increasingly automate many manual processes in key account management, more and more "smaller bulk purchasers", i. e., medium-sized companies or smaller players in the housing market, can be integrated into beneficiary financing. Far too few transport areas are still tapping into this field of action systematically and with contemporary, bold rate models.

Third, more courage in commercial approaches seems called for, but without just lowering prices.

Many of the approaches described take economic risks: Often, the yield per trip is reduced in the hope of triggering a sufficiently large demand impulse. Traditionally, however, the pure price-volume effect is hardly sufficient for counter-financing, so there must be other "game changers" in addition to attractive prices – be it simplicity, fairness, usability or gamification. The cost forecasts for the 9 Euro ticket, which will be launched in June 2022, show that price reductions cannot be financed on their own. According to all scientific findings, the price is simply not decisive enough for the choice of transport modes, but rather the quality of the offer and comfort from door to door dominate.

After the coronavirus pandemic, however, there is less to lose: Now more than ever, experiments and learning projects are called for. Learning can also be done from foreign pilot projects – whereby a balanced view of strengths and weaknesses is necessary, which sometimes differs from the public PR messages. Looking at the economics and interactions in the product range is still important and should be considered in any migration strategy from the old to the new fare world.

Fourth, the contradiction between precision and generality remains undecided so far.

Some of the novel fare concepts are driven by the assumption that very precise, performance-based billing will generate great enthusiasm in the passenger market. However, accuracy is not automatically rewarded; it also complicates novel fare models. A suitable customer base can be found for every innovation, which does not automatically equate to a breakthrough on the mass market. In particular, models that remain limited to individual (digital) sales channels unfortunately often prove very slow in terms of customer acceptance and require perseverance. In addition, there is still plenty of room for more flat-rate fare models, which can also be commercially successful.

Fifth, fare diversity is increasing, but a simple basic fare remains the trump card.

Customer needs are becoming more diverse and, in some cases, more contradictory. That is why the variety of fare models per traffic area is increasing rather than decreasing. Whether flex fares, kilometre fares, best price systems or off-peak offers: Something is always being added without the old disappearing. This diversity can be quite reasonable in times of heterogeneous usage patterns.

However, the parallelism of conventional and new types of fare models is forcing selective use. New models must promise price advantages in order to be accepted by the market – and the old standard fare is often difficult to raise politically. The reference fare in the public perception is usually the fare at the ticket machine or from the driving personnel (exception: long-distance traffic). This should not be neglected and should be kept attractive primarily through its simplicity.

Sixth, it is better to have few approaches, but to have them well developed – and to cooperate when in doubt.

In this chapter, various fare concepts were presented, all of which have their charm. However, by no means should all of them be implemented at the same time in a transport region. Rather, it should be limited to a few fare innovations with a clear strategy. Otherwise, commercial contradictions are quickly triggered, leading to customer confusion and declining profitability.

New types of fare models, especially those implemented digitally, cause work. The more complicated and equitable a fare model is, the more effort goes into developing and operating the associated distribution system. Many public transport operators are too small on their own to manage these efforts with convincing results – and nothing is more detrimental to the success of a fare model than an implementation with weaknesses in ease of use. In many cases, it can be sufficient to improve the quality of distribution first – and to charge the old, familiar fare at the better distribution channels.

Another way out is to join forces: More cooperation between transport associations and transport companies, but also cross-association, state wide or nationwide cooperation can provide a more stable basis for convincing innovations. Many of the challenges facing new, more digital fare and sales models are very similar in many places. Many duplicate investments could still be saved here.

5 Conclusion and outlook

Like a burning glass, the coronavirus pandemic focuses attention on existing deficits and challenges - in public transport, for example, these include hygiene and cleanliness deficits. Simultaneously, like a catalyst, it reinforces developments that have already begun - these can include digitalisation or the renewed increase in suburbanisation. It is important for the further development and future of public transport to use the insights gained during this period as an opportunity to further develop public transport services in a passenger-oriented manner. Only in this way, public transport will be able to make its indispensable contribution to achieving the climate targets in Germany.

Specifically, this report identified which measures increase protection against viruses by improving air quality. Intensifying cleaning can also improve hygiene. In principle, the capacity management measures that have long been in the testing and development stage are also a good way of enabling passengers to avoid overcrowded transport modes. However, they can only be effective if the service offers sufficient alternative options. Finally, the digitalisation of customer services can also avoid direct customer contact while maintaining services.

Innovative, bolder fare design can also help to halt and reverse the alarming downward trend in public transport demand. Increasingly varying patterns of using public transport suggest that fare models must also adapt to the new circumstances. In the process, familiar fare ideas are coming back into focus, such as attractive job tickets with a subsidy from the company or inexpensive subscription rates for all those who can also travel outside of rush hour. Not only online service providers, but even the car industry is suddenly discovering subscription models - so flat-rates that allow "driving without thinking" as in the private car can be as modern as ever, even in public transport. Especially with the experience of the 9 Euro ticket, such ticket models could become even more interesting for passengers and politicians.

In addition to “new wine into old bottles”, ere are many interesting ideas in the area of digital, flexible rate and billing models that can be part of an answer. What is needed here is more courage in trying things out and learning - if necessary - also in cooperation with others in neighbouring regions. What is important are positive messages that show that the public transport industry is adapting to the new times and providing incentives for use of public transport without losing sight of its contribution to an overall broader funding base for the public transport system as a whole. In doing so, many public transport stakeholders need to adopt a two-pronged approach: The energy for change should flow into new offers but the mass of passengers initially remain with the old fares, which must not be neglected. Effective fare strategies therefore require not only the right instinct, but also staying power.

The bottom line is that all of these measures can help to increase protection against the coronavirus and also against other viruses. However, since the objective risk of infection in public transport is low even without these measures, these measures will only be reflected in an increased appreciation of public transport and in rising passenger numbers if they are supported by appropriate information and communication measures.

Beyond such concrete findings, the coronavirus pandemic provides an impressive experience of a vulnerable society and economic structure. It helped to raise the profile of resilience, understood as the ability to respond appropriately to a crisis. The events of the past two years also suggest that attention should not be focused solely on the issue of health and the functioning of the healthcare system. The consequences of climate change continue to be present in society - see the flood disaster in Rhineland-Palatinate and North Rhine-Westphalia in July 2021, which cost the lives of around 200 people and whose infrastructure damage will have to

be repaired over several years. And the war of aggression on Ukraine makes Germany's dependence on energy imports and the danger posed by nuclear power plants particularly clear. Energy self-sufficiency and the expansion of sustainable energy systems are accordingly gaining in urgency.

Accordingly, spatial and transport planning that strives for resilient structures must follow a more comprehensively defined concept of resilience (cf. Ibert et al. 2022). Crises that challenge resilience may not be specifically foreseeable in detail. But they cannot be considered entirely surprising either. Most of the vulnerabilities uncovered in the coronavirus pandemic were already known beforehand.

Spatial and transport planning need a vision and goals that match them. This facilitates the identification of deficits and challenges in planning practice. And it helps to classify trends and use them to achieve goals. In this respect, planning committed to resilience must be goal-oriented, formulate these goals as intersectorally as possible, establish continuous learning via monitoring and evaluation systems, and limit dependencies with the concrete measures.

With this in mind, transport planning needs to reduce dependence on cars and trucks and use energy efficiently in the transport system. The advantages of non-motorised modes of transport became evident in the pandemic. Their operating conditions must be improved accordingly in the future. Therefore, not only more traffic facilities such as bicycle lanes or crossing aids are needed, but also a quality of urban space in which non-motorised people feel safe and comfortable (cf. ARL 2021). This is only conceivable by reducing car and truck traffic and can only be achieved through a transport strategy that integrates all modes of transport and takes place across all planning levels (cf. Grischkat / Mönch / Stein 2021). Public transport must also be assigned a role in this strategy.

In this respect, the pandemic confirms that a change in propulsion technology and a decoupling of car ownership and car use are not sufficient to pursue the goals of resilience or environmentally friendly transport transition. In addition, there must be a division of labour among the environmentally friendly transport modes must be coordinated in a way which resemble the division of labour: non-motorised modes of transport primarily serve local areas, and public transport has a networking function that connects settlements and regions (Eichmann / Günthel / Stein 2021: 72ff.). Since migration from cities to their surrounding areas has increased since the middle of the last decade, concepts for "suburbia", which has so far been inadequately served by public transport, are particularly important (Priebs 2020: 153ff.). Conceptually, public transport should thus also be integrated into a vision in these areas that reconciles compactness and mixture (cf. the concept of the “Umlandstadt” in UBA 2021b).

For a certain time, there was hope that the pandemic had triggered an external shock that would be overcome after a limited period of time. In the meantime, however, the realisation is gaining ground that the "new normal" (DLR 2021b: 1) has been reached for the time being. This is all the more true since, at the time of reporting (May 2022), it is not yet possible to predict when the pandemic will be over. Against this background, it is alarming that although public transport has recovered from the initial lockdown, with passenger numbers and transport performance falling by around 50 percent, these performance indicators are now relatively constant at around 25 percent below the pre-pandemic situation.[27] A doubling of passenger numbers, set out in the German government´s coalition agreement and the resolutions of the Conference of Transport Ministers, can by no means be achieved by 2030 under the current circumstances.

[27] Cf. passenger transport statistics at destatis.de.

6 List of references

ARL – Akademie für Raumforschung in der Leibniz-Gemeinschaft (2021): SARS-CoV-2-Pandemie: Was lernen wir daraus für die Raumentwicklung? Position paper of the ARL 118. Hannover.

Bundesinstitut für Bevölkerungsforschung (2021): Fakten zur demografischen Entwicklung Deutschlands 2010-2020. Bericht des Bundesinstituts für Bevölkerungsforschung. https://www.bib.bund.de/Publikation/2021/pdf/Fakten-zur-demografischen-Entwicklung-Deutschlands-2010-2020.pdf;jsessionid=F5F8F570ABE0BEE7248A54E1000CC418.2_cid380?__blob=publicationFile&v=5 (19.04.2022).

Conduent Transportation (2021): Conduent Transportation and MZ Technologie Expand Exclusive Partnership to Offer Holostop® Contactless Button Globally. https://www.news.conduent.com/news/conduent-transportation-and-mz-technologie-expand-exclusive-partnership-to-offer-holostop-xae-contactless-button-globally (03.12.2021).

DLR (2021a): Vierte DLR-Erhebung zu Mobilität & Corona: Hintergrundpapier. https://www.dlr.de/content/de/downloads/2021/vierte-dlr-erhebung-zu-Mobilitaet-corona-hintergrundpapier.pdf?__blob=publicationFile&v=1 (31.03.2022).

DLR (2021b): Fünfte DLR-Erhebung zu Mobilität & Corona: Hintergrundpapier. https://www.dlr.de/content/de/downloads/2021/fuenfte-dlr-erhebung-zu-mobilitaet-corona-hintergrundpapier.pdf?__blob=publicationFile&v=4 (31.03.2022).

Eichmann, V.; Günthel, D.; Stein, A. (2021): Ein Netz für die Verkehrswende. In: RaumPlanung 212, 3/4-2021, pp. 72-77.

Eicker, R.; Salomon, W. (2021): Investigation of the effectiveness of antimicrobial photocatalyst-coated hand-contact surfaces in passenger transport vehicles under everyday conditions. In: International Journal of Infection Control, 17, 1, International Federation of Infection Control, Craigavon, pp. 1-7.

Fage, S.; Faurschou, A.; Thyssen, J. (2014): Copper hypersensitivity. In: Contact Dermatitis 71, Wiley, Hoboken, S. 191-201.

Fraunhofer-Institut für Betriebsfestigkeit und Systemzuverlässigkeit LBF (2020): Keimen geht es an den Kragen: Fraunhofer LBF entwickelt optimierte Kunststoffoberflächen für die UV-Desinfektion. https://www.lbf.fraunhofer.de/de/presse/presseinformationen/kunststoffoberflaechen-uv-desinfektion.html (24.02.2022).

Friedrichsen, A. (2020): Künstliche Intelligenz im Personennahverkehr. Wie intelligent ist KI wirklich? In: Der Nahverkehr, 38, 12, DVV Media Group, Hamburg, pp. 34-37.

Grischkat, S.; Mönch, A.; Stein, A. (2021): Das räumliche Potenzial der Verkehrswende. Und die Aufgaben des Umweltverbunds bei seiner Ausschöpfung. In: PlanerIn, 2021, 1, Vereinigung für Stadt-, Regional- und Landesplanung e.V., Berlin, pp. 59-61.

Ibert, O.; Baumgart, S.; Siedentop, S.; Weith, T. (2022): Planning in the Face of Extraordinary Uncertainty: Lessons from the COVID-19 Pandemic. In: Planning Practice & Research, 37, 1, Taylor & Francis Group, London, pp. 1-12.

IBP (Fraunhofer-Institut für Bauphysik) (2021): Risikoeinschätzung zur Ansteckungsgefahr mit COVID-19 im Schienenpersonen- sowie im Straßenpersonennah- und -fernverkehr. Berichte des Deutschen Zentrums für Schienenverkehrsforschung, Nr. 12. Dresden. https://www.dzsf.bund.de/SharedDocs/Downloads/DZSF/Veroeffentlichungen/Forschungsberichte/2021/ForBe_12_2021.pdf?__blob=publicationFile&amp%3Bv=3 (01.03.2022).

IRK (2020a): Das Risiko einer Übertragung von SARS-CoV-2 in Innenräumen lässt sich durch geeignete Lüftungsmaßnahmen reduzieren. Stellungnahme der Kommission Innenraumlufthygiene (IRK) am Umweltbundesamt. https://www.umweltbundesamt.de/sites/default/files/medien/2546/dokumente/irk_stellungnahme_lueften_sars-cov-2_0.pdf (31.03.2022).

IRK (2020b): Einsatz mobiler Luftreiniger als lüftungsunterstützende Maßnahme in Schulen während der SARS-CoV-2 Pandemie. Stellungnahme der Kommission Innenraumlufthygiene (IRK) am Umweltbundesamt. https://www.umweltbundesamt.de/sites/default/files/medien/2546/dokumente/201116_irk_stellungnahme_luftreiniger.pdf (31.03.2022).

Kasten, P. (2018): Ein Kostenvergleich zwischen batterieelektrischen und verbrennungsmotorischen Pkw als Klimaschutzoption für das Jahr 2030. Ed. Agora Verkehrswende. Berlin.

KBA (2021a): Der Fahrzeugbestand im Überblick am 1. Januar 2021 gegenüber dem 1. Januar 2020. https://www.kba.de/DE/Statistik/Fahrzeuge/Bestand/Jahrebilanz_Bestand/2021/2021_b_ueberblick_pdf.pdf?__blob=publicationFile&v=1 (11.04.2022).

KBA (2021b): Pressemitteilung Nr. 2/2021. Fahrzeugzulassungen im Dezember 2020 – Jahresbilanz –. https://www.kba.de/SharedDocs/Downloads/DE/Pressemitteilungen/DE/2021/pm_02_2021_fahrzeugzulassungen_12_2020.pdf?__blob=publicationFile&v=2 (11.04.2022).

KBA (2022a): Der Fahrzeugbestand im Überblick am 1. Januar 2022 gegenüber dem 1. Januar 2021. https://www.kba.de/DE/Statistik/Fahrzeuge/Bestand/Jahrebilanz_Bestand/2022/2022_b_ueberblick_pdf.pdf?__blob=publicationFile&v=3 (11.04.2022).

KBA (2022b): Bestand nach Fahrzeugalter. Zeitreihen. https://www.kba.de/DE/Statistik/Fahrzeuge/Bestand/Fahrzeugalter/2022/2022_b_alter_kfz_zeitreihen.html;jsessionid=B9F1FB87DAAEBA35303DF8FFFC974CDB.live21301?nn=3524968&fromStatistic=3524968&yearFilter=2022&fromStatistic=3524968&yearFilter=2022 (11.04.2022).

Nobis, C.; Kuhnimhof, T. (2018): Mobilität in Deutschland – MiD Ergebnisbericht. Studie von infas, DLR, IVT und infas 360 im Auftrag des Bundesministers für Verkehr und digitale Infrastruktur (FE-Nr. 70.904/15). http://www.mobilitaet-in-deutschland.de/pdf/MiD2017_Ergebnisbericht.pdf (19.04.2022).

Nöth, F.; Steinrücke, P.; Konradt, T. (2022): Durchführung und Monitoring nachhaltiger Hygiene-Maßnahmen in U-Bahnen, Bussen und Straßenbahnen in Nürnberg. In: Verkehr und Technik, 75, 1, Erich Schmidt Verlag, Berlin, pp. 21-24.

Polívka, J. (2021): Die (Post)-Corona-Stadt: Mitten in der Transformation der Innenstädte. In: Forum Wohnen und Stadtentwicklung, 2021, 5, Bundesverband für Wohnen und Stadtentwicklung e. V., Berlin, S. 275-278.

Priebs, A. (2020): Qualifizierung von Stadtrand und Suburbia durch schienengebundenen Nahverkehr. In: Hannemann, C. et al. (ed.): Jahrbuch StadtRegion 2019/2020. Wiesbaden, pp. 153-173.

Pütz, T. (2020): Berufsverkehr in Krisenzeiten. Wie Homeoffice und Kurzarbeit die Mobilität beeinflussen können. In: Informationen zur Raumentwicklung, 2020, 4, Franz Steiner Verlag, Stuttgart, pp. 82-95.

RKI (2020a): Epidemiologisches Bulletin - Aktuelle Daten und Informationen zu Infektionskrankheiten und Public Health (Stand: 7. Mai 2020). https://www.rki.de/DE/Content/Infekt/EpidBull/Archiv/2020/Ausgaben/19_20.pdf?__blob=publicationFile (31.03.2022).

RKI (2020b): Hinweise zu Reinigung und Desinfektion von Oberflächen außerhalb von Gesundheitseinrichtungen im Zusammenhang mit der COVID-19-Pandemie (Stand: 3. Juli 2020). https://www.rki.de/DE/Content/InfAZ/N/Neuartiges_Coronavirus/Reinigung_Desinfektion.html (03.02.2022).

RKI (2021): Epidemiologischer Steckbrief zu SARS-CoV-2 und COVID-19. https://www.rki.de/DE/Content/InfAZ/N/Neuartiges_Coronavirus/Steckbrief.html;jsessionid=DE4F3F4307860C0D7BAB27859DDF8120.internet081?nn=13490888 (31.03.2022).

RKI (2022): COVID-19-Fälle, die einem Ausbruch zugeordnet werden, nach Meldewoche und Infektionsumfeld. https://www.rki.de/DE/Content/InfAZ/N/Neuartiges_Coronavirus/Daten/Ausbruchsdaten.xlsx?__blob=publicationFile (11.02.2022).

Ruhrbahn GmbH (2021): ZÄPP-die Ruhrbahn App verstehen und nutzen. https://app.ruhrbahn.de/fileadmin/user_upload/downloads/ZAEPP-Schulung-2021.pdf (31.03.2022).

Sembach, M. (2021): Raumluftdesinfektion im Nahverkehr. In: Der Nahverkehr, 39, 1+2, DVV Media Group GmbH, Hamburg, pp. 6-9.

Siedentop, S.; Stroms, P. (2021): Stadt und Land: Gleichwertig, polarisiert, vielfältig. Metastudie i. A. der Zeitstiftung Ebelin und Gerd Bucerius. https://www.zeit-stiftung.de/f/Neuigkeiten%202021/Metastudie-Stadt-Land-Beziehung_2021.pdf (19.04.2022).

Sunder, M.; Hagen, T.; Lerch, E. (2021): Mobilität während und nach der Corona-Krise. Erneute Analysen für Deutschland. https://www.frankfurt-university.de/fileadmin/standard/Hochschule/Fachbereich_1/FFin/Neue_Mobilitaet/Veroeffentlichungen/2021/corona2_30092021_0030.pdf (19.04.2022).

TU Berlin [ed.] (2021): Gute Luft in Bus und Bahn. Studie von Charité – Universitätsmedizin Berlin und TU Berlin untersucht quantitativ Aerosolausbreitung in ÖPNV-Fahrzeugen. https://www.tu.berlin/ueber-die-tu-berlin/profil/pressemitteilungen-nachrichten/2021/maerz/aerosol-test-gute-luft-in-bus-und-bahn/ (28.10.2021).

UBA (2021a): Mobile Luftreiniger: Nur als Ergänzung zum Lüften sinnvoll. https://www.umweltbundesamt.de/themen/mobile-luftreiniger-nur-als-ergaenzung-lueften (31.03.2022).

UBA [ed.] (2021b): UMLANDSTADT umweltschonend – Nachhaltige Verflechtung von Wohnen, Arbeiten, Erholung und Mobilität. Dessau-Roßlau.

UITP (2021): Report. Win Back Passengers. Facts, Figures and the New Normal. https://cms.uitp.org/wp/wp-content/uploads/2021/11/Win-back-passengers_Final-version-1.pdf (08.12.2021).

VDI (2021): Anforderungen an mobile Luftreiniger. Expertenempfehlung VDI EE 4300-14 2021. https://www.vdi.de/richtlinien/anforderungen-an-mobile-luftreiniger (30.05.2022).

VDV [ed.] (2020): Empfehlungen zur Reinigung des Innenraums von ÖPNV-Fahrzeugen und weitere Maßnahmen zur Verhinderung der Ausbreitung von Infektionskrankheiten. VDV-Mitteilung 8002. https://knowhow.vdv.de/documents/8002/ (31.03.2022).

Vogel, S.; Fornauf, L.; Brauner, A.; Oetting, A.; Jung, C. (2021). Auslastungsprognose für Fahrzeuge des S-Bahnverkehrs. In: Der Nahverkehr, 39, 11, DVV Media Group GmbH, Hamburg, pp. 33-38.

VZBV [ed.] (2021): Öffentlicher Verkehr und Corona. Repräsentative Bevölkerungsbefragung durch das Forsa-Institut. https://www.vzbv.de/sites/default/files/downloads/2021/01/21/praesentation_ergebnisse_umfrage_oev-final.pdf (19.04.2022).

WZB, Motiontag, Infas (2021): Mobilitätsreport 05. Bleibt alles anders? Alltagsmobilität im zweiten Corona-Jahr. Ergebnisse aus Beobachtungen per repräsentativer Befragung und ergänzendem Mobilitätstracking bis Ende Juli. https://www.infas.de/fileadmin/user_upload/PDF/infas_Mobilit%C3%A4tsreport_05_WZB_7331_20210824.pdf (19.04.2022).