PTV Group

PUBLIC TRANSPORT

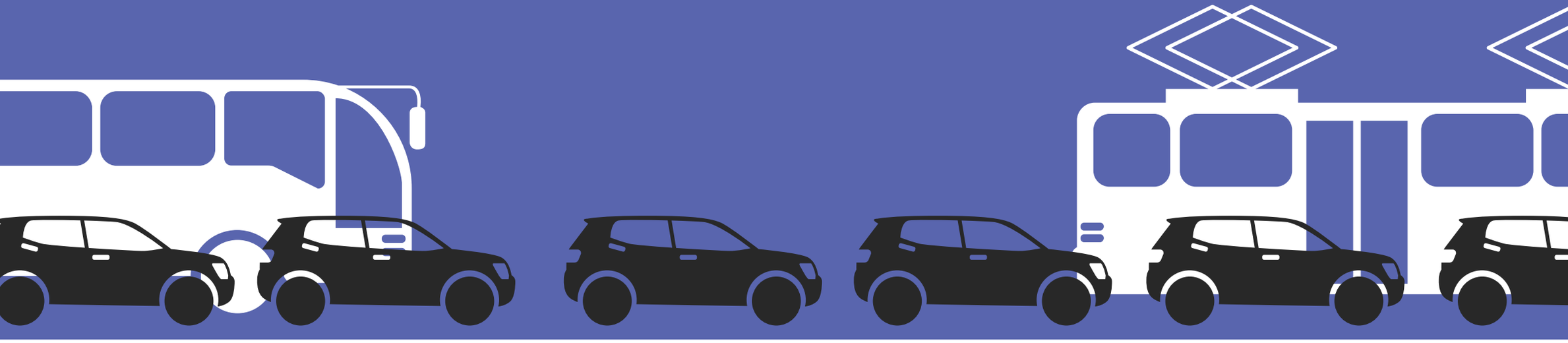
playbook

Comeback of a jack of all trades:

How public transport provides climate-friendly, accessible and efficient mobility 

Everyone is talking about **public transport** again. No wonder, since it has the potential to become an **indispensable climate saver.**

Moreover, public transport is a **highly efficient** means of transport and thus ideally suited for cities plagued by **traffic jams.**



In this playbook, you will learn how to **make the most of public transport** and how to **inspire people to use it**.

Experts and enabler of public transport: **our interviewees**

Endre Angelvik is Executive Vice President Radical Innovation at Ruter As, the Norwegian transport authority responsible for the districts of Oslo and Akershus. He advocates for sustainable freedom of movement. In the process, he values a smart interlinking of different means of transport – regardless of whether this involves classic means of transport such as bus and train or modern concepts such as ridepooling and bike sharing.

Nejc Geržinič is an employee of the Smart Public Transport Lab of the TU Delft in the Netherlands. His primary task is researching mobility behavior, especially with regard to public transport. He focuses mainly on the effects of on-demand services such as buses on call and ridepooling.

Group of experts

Antonio García Pastor is Director of Operations at one of the largest public transport operators in Spain, Avanza by Mobility ADO. In the course of his career, he has advised about and planned all forms of public transport; today his focus is on bus transport. At the UITP, he is Chair of the Bus Committee.

Katharina Pötter is Mayor of the City of Osnabrück and sits on the supervisory board of the Stadtwerke Osnabrück in Germany. These institutions are working hand-in-hand to achieve sustainable mobility by promoting the electrification of public transport.

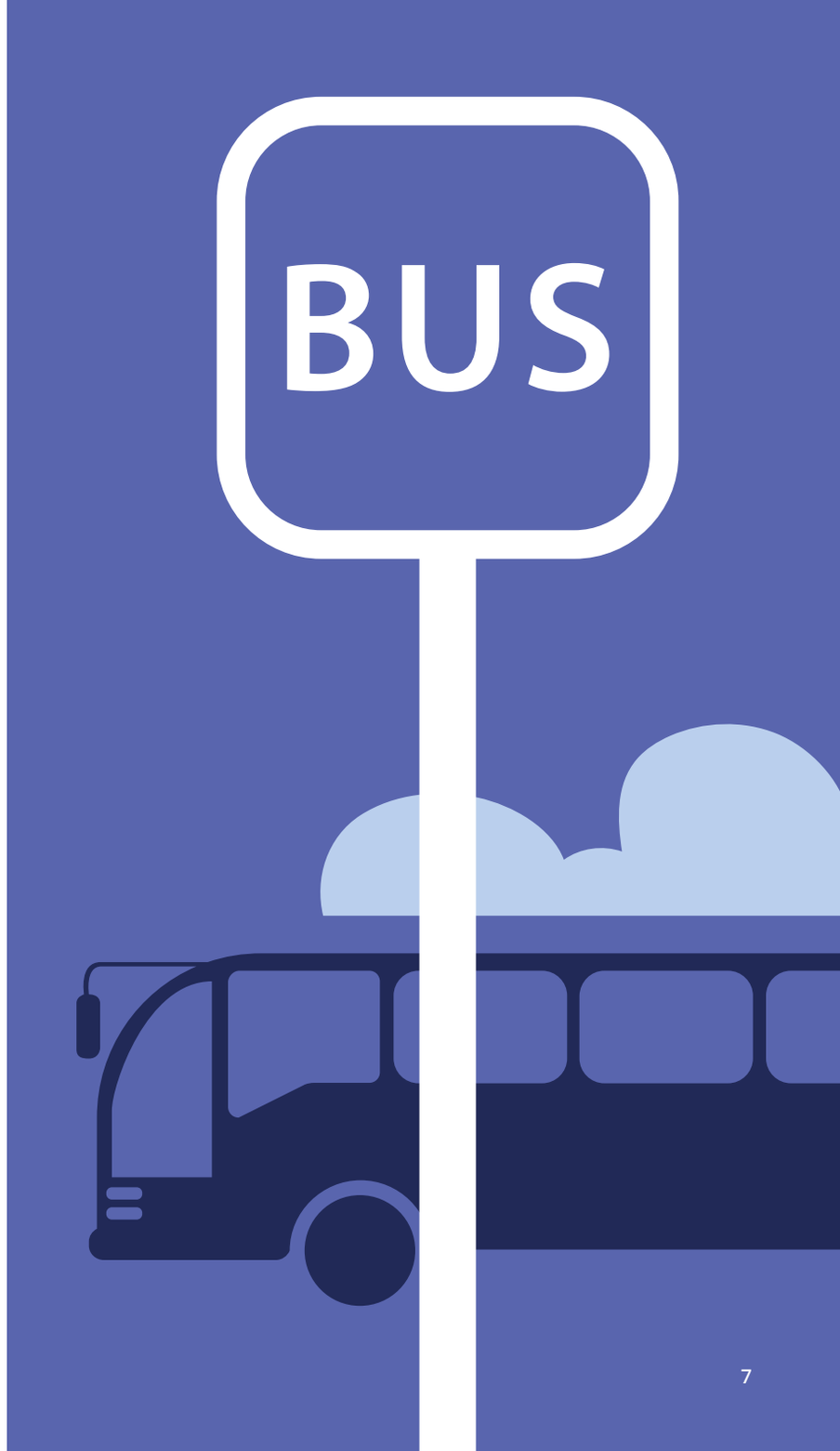
Prof. Dr. Alexander Pischon is Chairman of the Management Board of the Verkehrsbetriebe Karlsruhe and the Albtal-Verkehrs-Gesellschaft, as well as sole Managing Director of Karlsruhe Verkehrsverbund GmbH.
This business economist, who holds a doctorate in business administration, has also gained experience with the Deutsche Bahn and is particularly committed to the attractiveness of one of the largest public transport networks in southern Germany.

Farnaz Tepper is Principal Product Manager at PTV. Her primary objective is to develop tools that empower public transport service designers, simplify their daily tasks, and ultimately enhance the quality of services provided to the public.

Group of experts

Janet Veldstra is Assistant Professor for Behavioral and Social Sciences at the University of Groningen in the Netherlands. She is researching barriers and enablers for sustainable mobility.

Peter White is Emeritus Professor of Public Transport Systems at the University of Westminster in London, UK. He's the author of the book "Public transport: Its planning, management and operation," and he is researching which factors affect the use of public transport.



Jam-packed buses, delayed trains –
for many people, public transport
evokes negative associations.

That’s too bad, for actually it deserves applause.

Public transport doesn’t just take people from point A to point B;
instead, it's an indispensable part of an inclusive
and sustainable society. Public transport offers people
the opportunity to participate in social life,
no matter what their income, how old they are,
or whether they have physical disabilities.

“Public transport offers people access to critical activities such as work, education, shopping, and leisure activities,” says Peter White, Emeritus Professor of Public Transport Systems at the University of Westminster in London, UK.

“By providing this access, it brings people together and strengthens social cohesion.”

In addition, public transport uses road space very efficiently: For example, while a classic solo bus takes up about 30 square meters of space and can transport up to 70 people, a car requires about 12 square meters. It would take 14 cars to transport the same number of people. Even if each car holds five passengers, the cars take up about six times more space than a single solo bus.

“Another benefit is the environmental aspect,” says Peter White. **“Public transport consumes less energy per passenger kilometer than a car, and emits less carbon dioxide and fewer harmful pollutants.”**

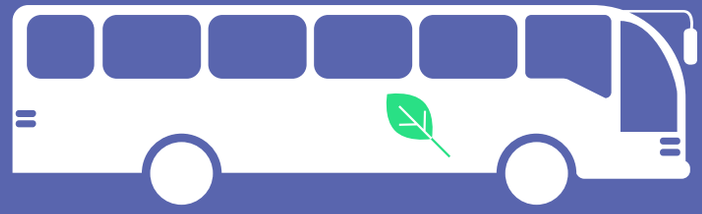
In total, transport consumes about one-fifth of all CO_2 emissions worldwide. But the street is a true environmental polluter: With six million tons of CO_2, approximately two-thirds of climate-damaging greenhouse gases are produced here.[2] Passenger transport accounts for about 45 percent.[3] And although people's environmental awareness continues to grow, individual cars are the number one means of transport. Here, every trip where you leave the car at home and take public transport instead generates fewer greenhouse gases and other harmful pollutants such as fine dust and nitrogen, especially if the lines are electrified.

>> See interview with Katharina Pötter, Mayor of the City of Osnabrück (see p. 30–31)

Big bus, small space

Let's be realistic:
Neither solo buses nor cars are always full.
On average, a car carries 1.5 people.[1] A solo bus can hold up to 70 people. Let's assume that its load is 20% of capacity; that it transports 14 people on average.

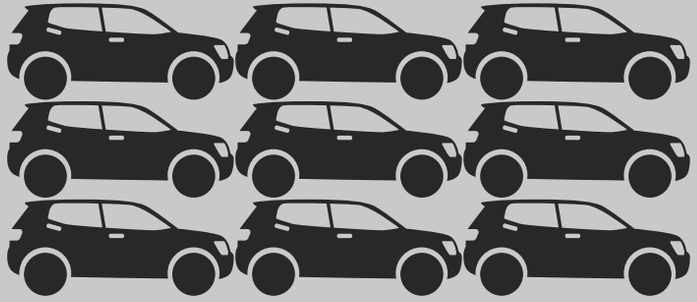
20% of capacity = 14 people



1 solo bus

30 m²

Occupancy rate of 1.5 people



~ 9 cars

~87 m²

~ 3 times the space

Road space **needed**

Such numbers are impressive, but also kind of hard to imagine, right? To visualize how the road space needed differs by mode of transport, we created an animation in PTV Vissim and Viswalk.

It shows 200 people each pass through a traffic light in different ways, which means

an average of 1,5 people in 133 private cars

20 passengers in 10 buses

40 passengers in 5 trams

200 cyclists

200 pedestrians

The road has the same width for all means of transport – 3.50 m. Everyone starts moving at the same time.
How does the different space requirements in combination with the different maximum speeds and acceleration capacities affect the traffic flow? Which group is fastest?

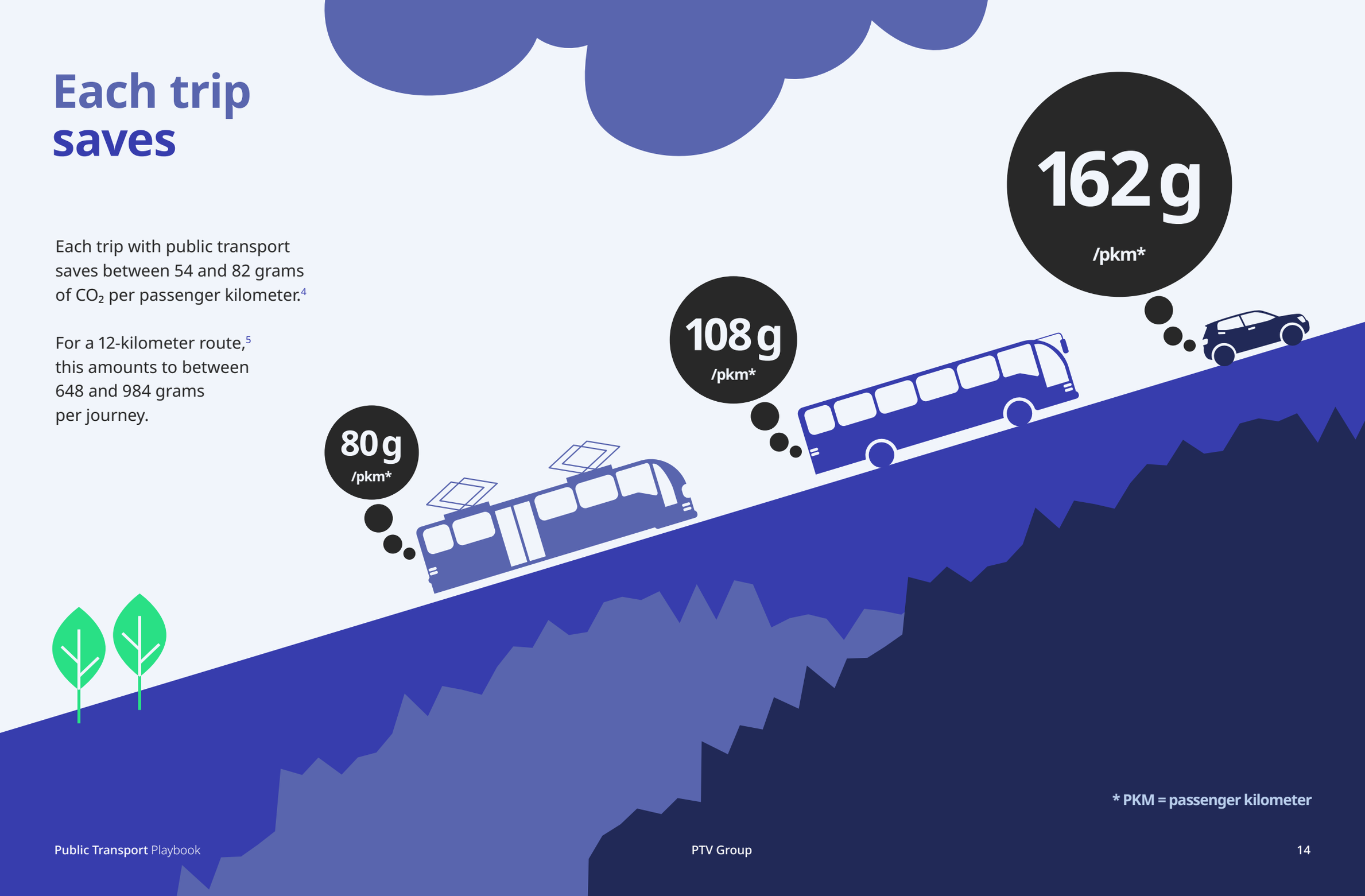
Scan to watch simulation video:


Why aren’t more people switching to public transport
?

Each trip saves

Each trip with public transport saves between 54 and 82 grams of CO_2 per passenger kilometer.[4]

For a 12-kilometer route,[5] this amounts to between 648 and 984 grams per journey.



* PKM = passenger kilometer

Public transport vs car – a question of convenience?

Comfortable, flexible, and time-saving – that's how most people rate driving a car. Public transport doesn't score as high; it's generally considered to be too slow and burdensome. "A car offers spontaneous mobility," says Nejc Geržinič, employee at the Smart Public Transport Lab of the TU Delft. Car drivers decide when they get in their vehicles and drive off. Public transport can hardly keep pace with this spontaneity.

"To make public transport more attractive, you need high frequency and good coverage," explains Nejc Geržinič.

“If a transport line runs every five to ten minutes, it comes close to the feeling of being able to travel whenever you want to.”

But providing such services costs money, especially since operating times have gotten longer in recent decades. “Once upon a time, public transport covered the routes to work in particular,” says Nejc Geržinič. “Today we think more in terms of mobility chains: People don’t just travel to work in the morning and back home in the evening. They do errands on the way, meet with friends, and engage in leisure activities.” If you go out in the evening, you want to come home reliably, even at night.

The more the better. The example of East Anglia, in England’s east, confirms this. There is a bus line between the cities of Peterborough and Norwich. “A few years ago, the line was improved," reports Peter White. “Whereas there used to be just a few buses a day, the bus now runs about twice an hour. The greatly improved service has resulted in more passengers. This in turn justifies continuing to expand the service step by step.” For example, there are now variants that provide a faster connection between certain towns on the route by omitting others.

Another example is the use of minibuses. “In the UK we have gained experience with minibuses that operate at a high frequency,” says Peter White. Instead of a large bus that runs every half hour, the operators used minibuses and let them run every 10 or 15 minutes. “We found that doubling the frequency (for example, by halving the headway) can lead to a passenger increase of 40% in a year,” reports the professor emeritus of the University of Westminster.[6]

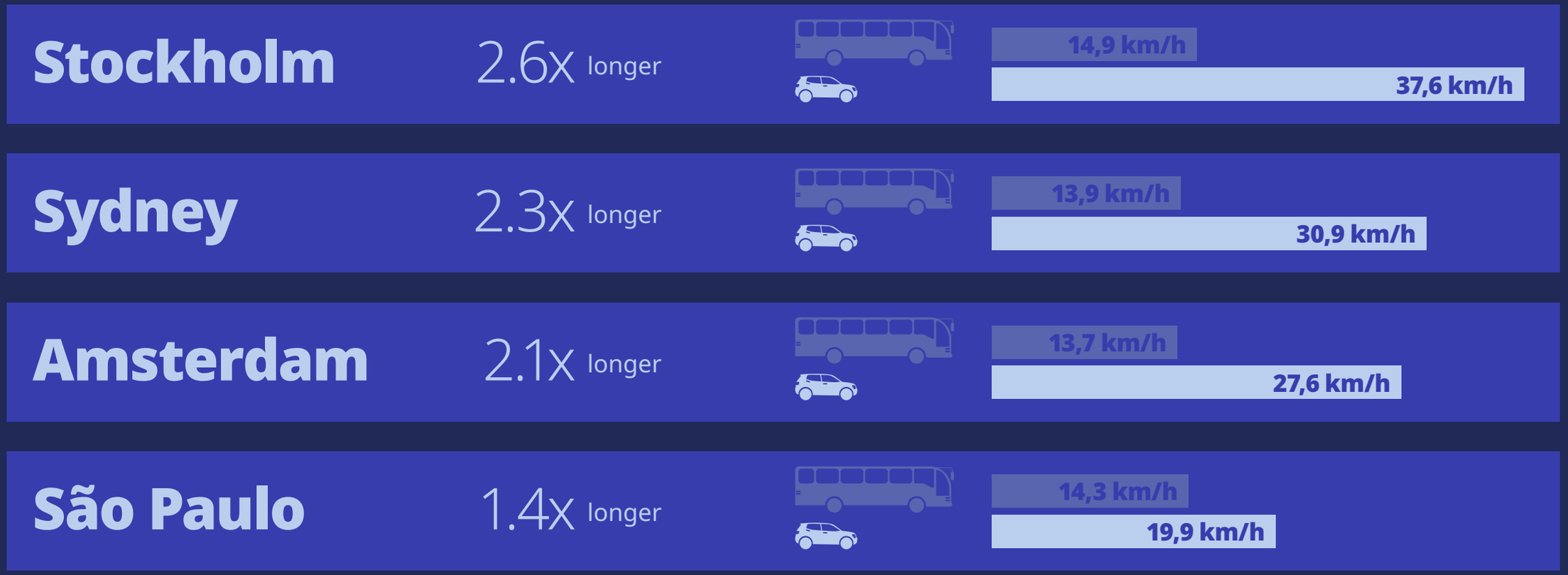
“In order for people to switch from cars to public transport, the lines must run reliably according to the announced timetable and offer the most direct and frequent service possible,” emphasizes Peter White.

For especially in rural regions and suburbs with a low population density, using a car usually saves a great deal of time. But even in the city, users have to prepare for longer travel times when they take the bus and train. Studies in various cities around the world show that users travel twice as long on average with public transport.[7]

So how can public transport be speeded up?

Racing for the pole position with regard to travel time

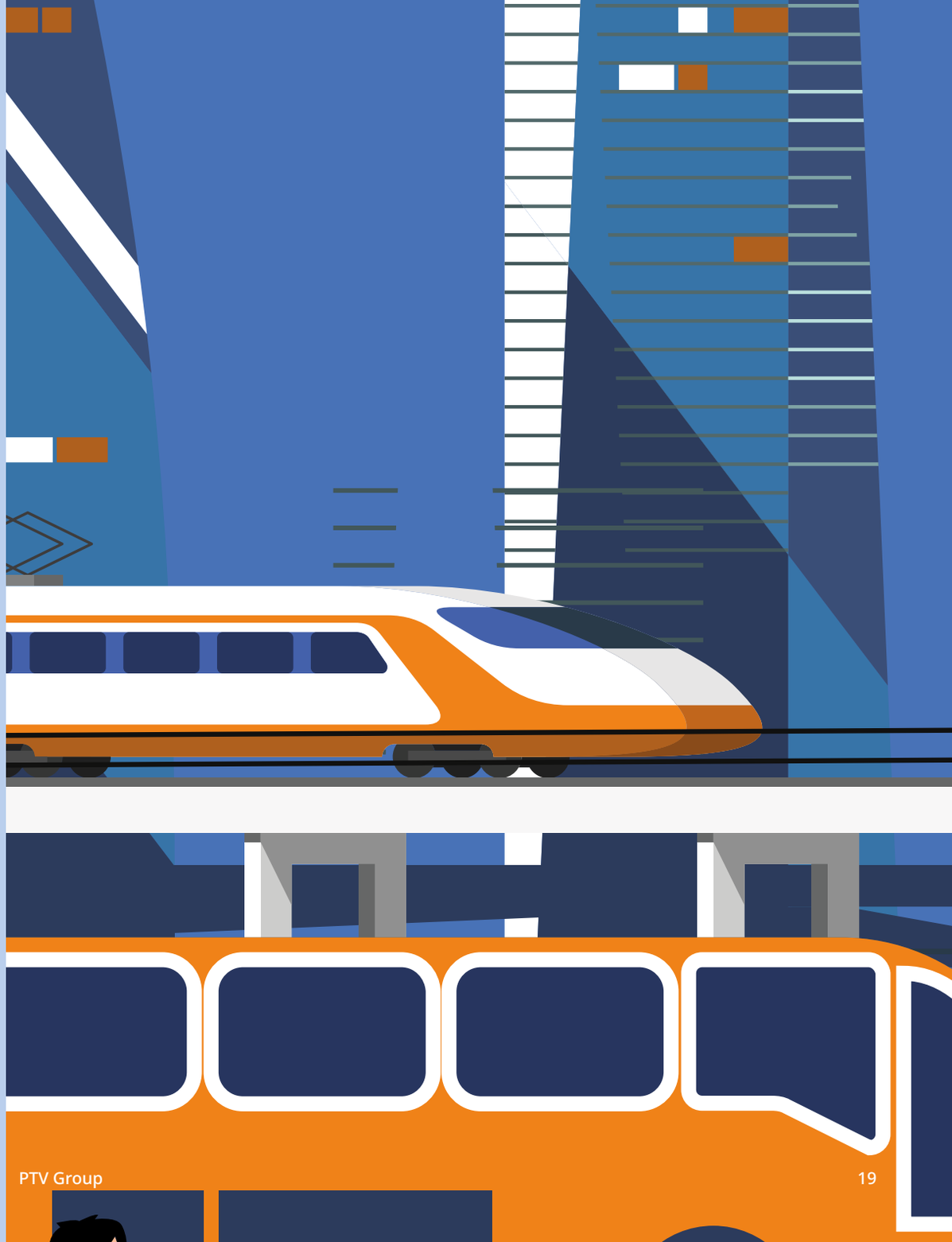
Scientists have compared the travel times of public transport with those of cars in different cities[8]. Here are the results:



Right of way for buses and trains

Public transport is losing time, especially at stops and traffic signals.
Anyone who wants to advance public transport must prioritize it on the roads.

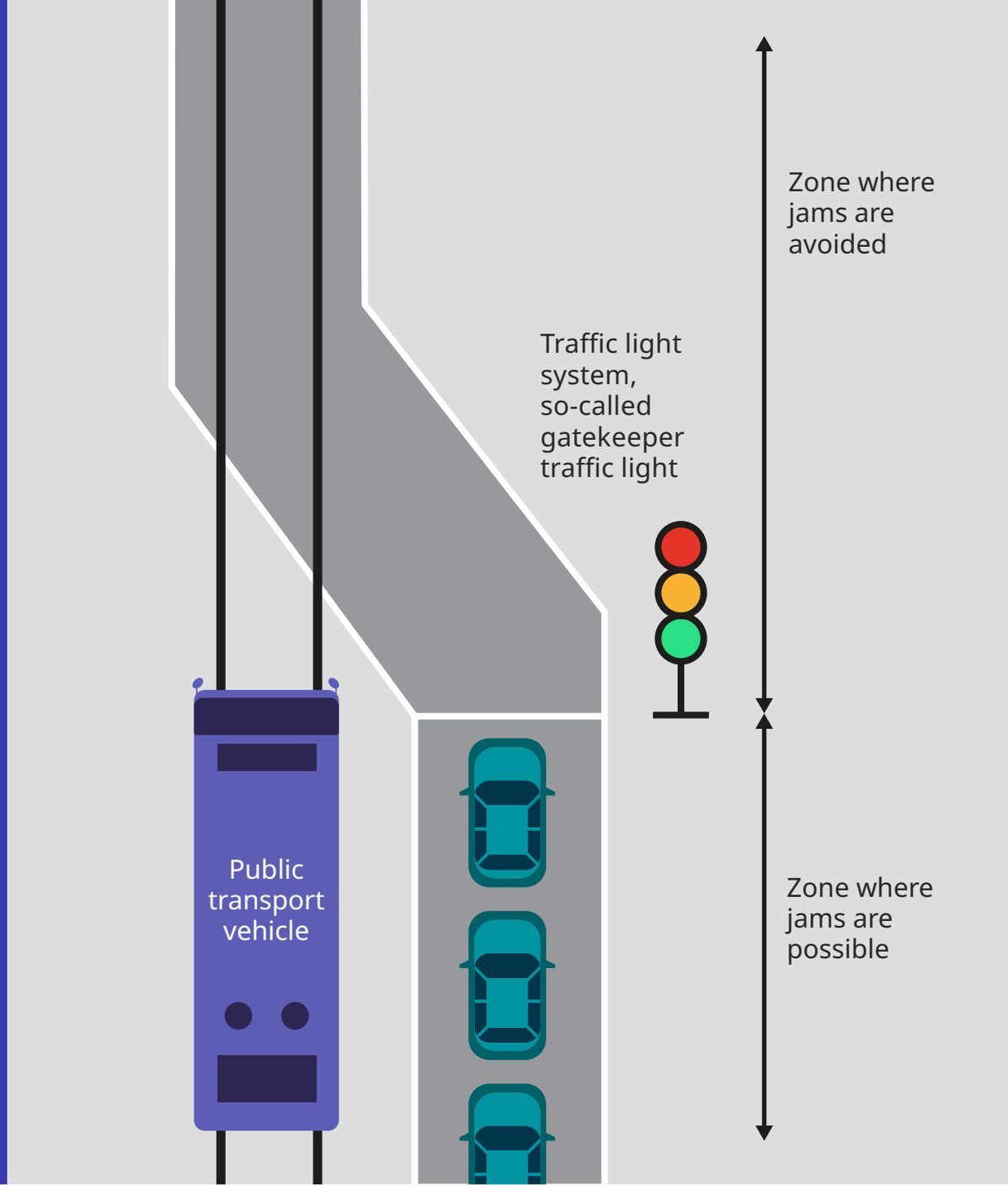
This is the only way to accelerate public transport. This can be realized in many ways.



Priority at traffic lights

Stop on red, go on green.

This also applies for buses and trains. If a traffic jam forms at an intersection with a traffic light, it can take several green cycles until the vehicle may cross. This is also how a few minutes' delay can add up quickly.[9]



Public transport-friendly intersections therefore feature a demand-oriented lane layout. **“At some intersections, a kind of bypass may be useful, allowing buses to overtake vehicles waiting at a traffic light,”** explains Antonio García Pastor, Director of Operations at Avanza Group ADO, and Chair of the UITP Bus Committee.

In addition, what’s critical is the right dimensioning: While too-narrow radii ensure that buses cannot get around the corner quickly, large-scale designs generally have a counterproductive effect on public transport, for they require long intermediate times and complex signal programs.

Many intersections use a fixed-time control: Regardless of the prevailing traffic, the traffic light switches its green cycles according to a defined program. This impedes public transport-friendly measures. Nevertheless, there are possibilities for making these intersections more public transport-friendly. For example, by selecting the shortest possible cycle time, incidental wait times on red are also shorter. By extending the green cycles in the direction buses are going, there is a greater chance that they can pass without stopping at the intersection.

“Intersections are good places to get on or off a bus,” says Antonio García Pastor.

“To prioritize public transport, people like to place stops behind intersections. This way it's clearer when the bus is at the traffic light.” If you develop a “green wave” for adjacent intersections, you should also consider the times at the stops.

If an intersection uses vehicle-actuated signal control, it can be used to prioritize public transport: If the detectors record an approaching bus when the traffic light is green, the controller extends the green cycle. This way, the bus can cross the intersection without braking. If the bus approaches a red traffic signal, the signal control shortens the green cycles for the other directions. In addition, the control systems can change the sequence of the cycles and prioritize the direction in which the bus is traveling.

A tribute to the bus

Trams are experiencing a renaissance in many cities. Nevertheless, buses are still the number one means of public transport.

Antonio García Pastor works as Director of Operations at one of the largest public transport operators in Spain, Avanza Group ADO. He is also Chair of the Bus Committee of the UITP and believes that buses play an important role.

At the UITP, you are Chair of the Bus Committee. What role do buses play in public transport?

Antonio García Pastor: Especially in Southern Europe, trams have disappeared from cities step by step in the last 50 to 60 years. They have made space for motorized individual transport. That's too bad because trams are generally very attractive to their users. Some cities are trying to restore their tram networks or develop new ones. That's good, for you should not underestimate the extent to which a tram can help a city burnish its image. It's more difficult to "transport" this positive image for buses. Nevertheless, buses play a critical role in public transport. On the one hand, in many ways they are more cost-effective than trams. On the other hand, buses offer incredible flexibility with regard to where and when they can go: A bus doesn't require rails. It can be used everywhere in road traffic. And as the operator, I can adjust the quantity, frequency, and schedules very easily. But it's important to emphasize that trams and buses are not enemies: They must complement one another in order to achieve sustainability goals and persuade people to leave their cars at home.

How can buses improve their image?

Antonio García Pastor: Among other things, trams are attractive because they are very spacious. The space on buses, by contrast, is more limited. That can't be easily changed. What you can change are the conditions under which buses are on the road: You need to create a bus-friendly infrastructure and implement appropriate prioritization measures so that buses will reach their destinations on time. Users must see that the buses travel at a good speed from one stop to the next. They must see that buses, in contrast to other road users, do not have to wait at traffic lights and that everything flows smoothly.

In addition to traffic flows, are there other ways to make buses more attractive?

Antonio García Pastor: Buses have come a long way in recent years. For example, "kneeling" buses make getting on and off easier by lowering the part of the bus where passengers board. Buses could also radically improve their image by going electric, for this makes buses more environmentally friendly. And buses profit from technological developments such as apps. They tell passengers when the next bus will arrive. This real-time data makes them easier to use, and therefore makes the bus system more attractive.

Fast on the route

Road space is limited. Road users compete for their share, as does public transport. “If you want to prioritize buses, you first have to provide a clear economic case,” explains Peter White of the University of Westminster.

“Established evaluation methods help to evaluate time savings for bus users. Allowance can be made as well for the longer journey times of different modes, but a net reduction in personal travel time will usually result.” If public transport prioritization can be justified, special bus lanes not only reduce the average travel time, they also reduce fluctuations in delays.

Special bus lanes can be implemented in different ways. For example, as:

1. **Dedicated bus lanes**
2. **Bidirectional bus lanes**
3. **Contra-flow bus lanes**

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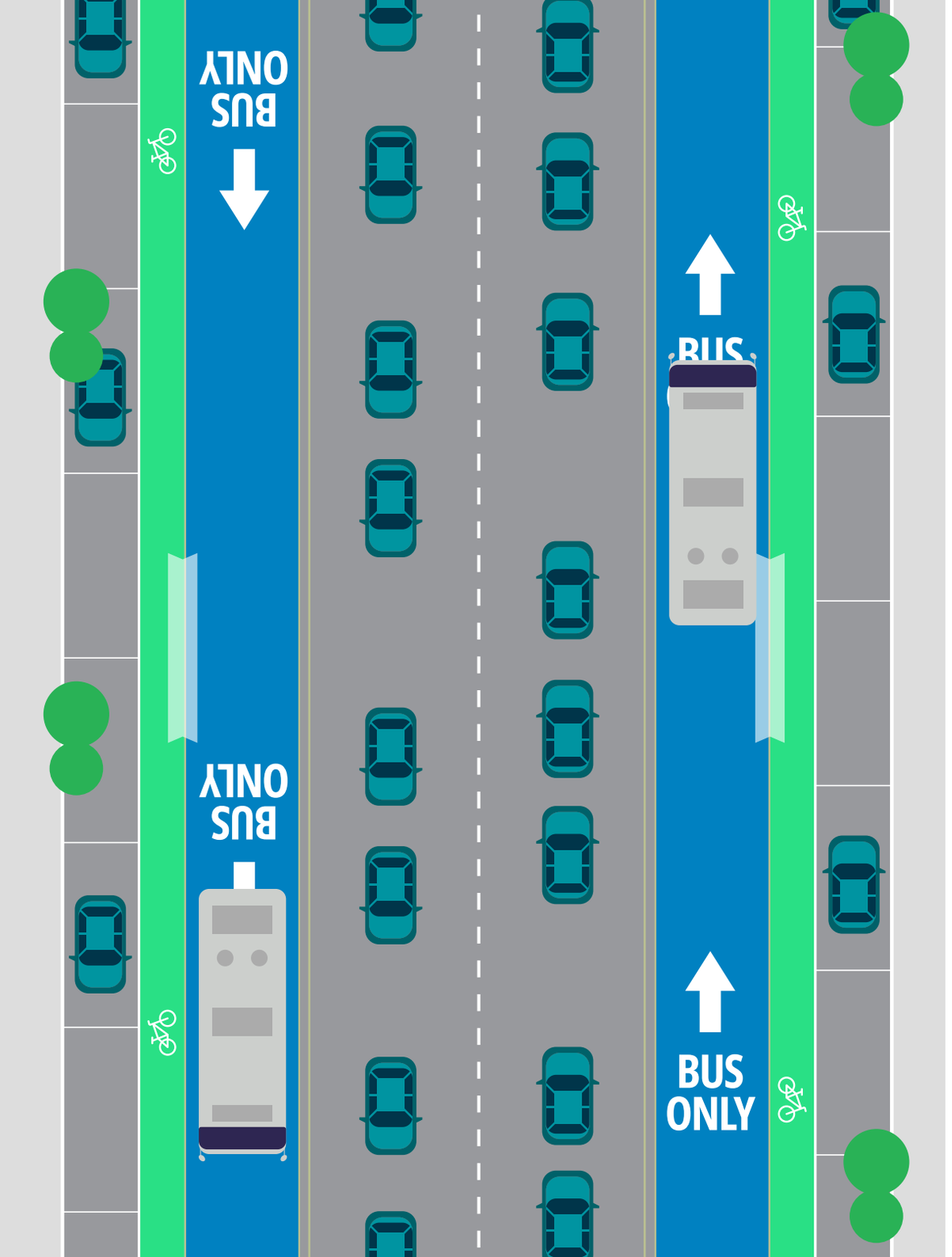


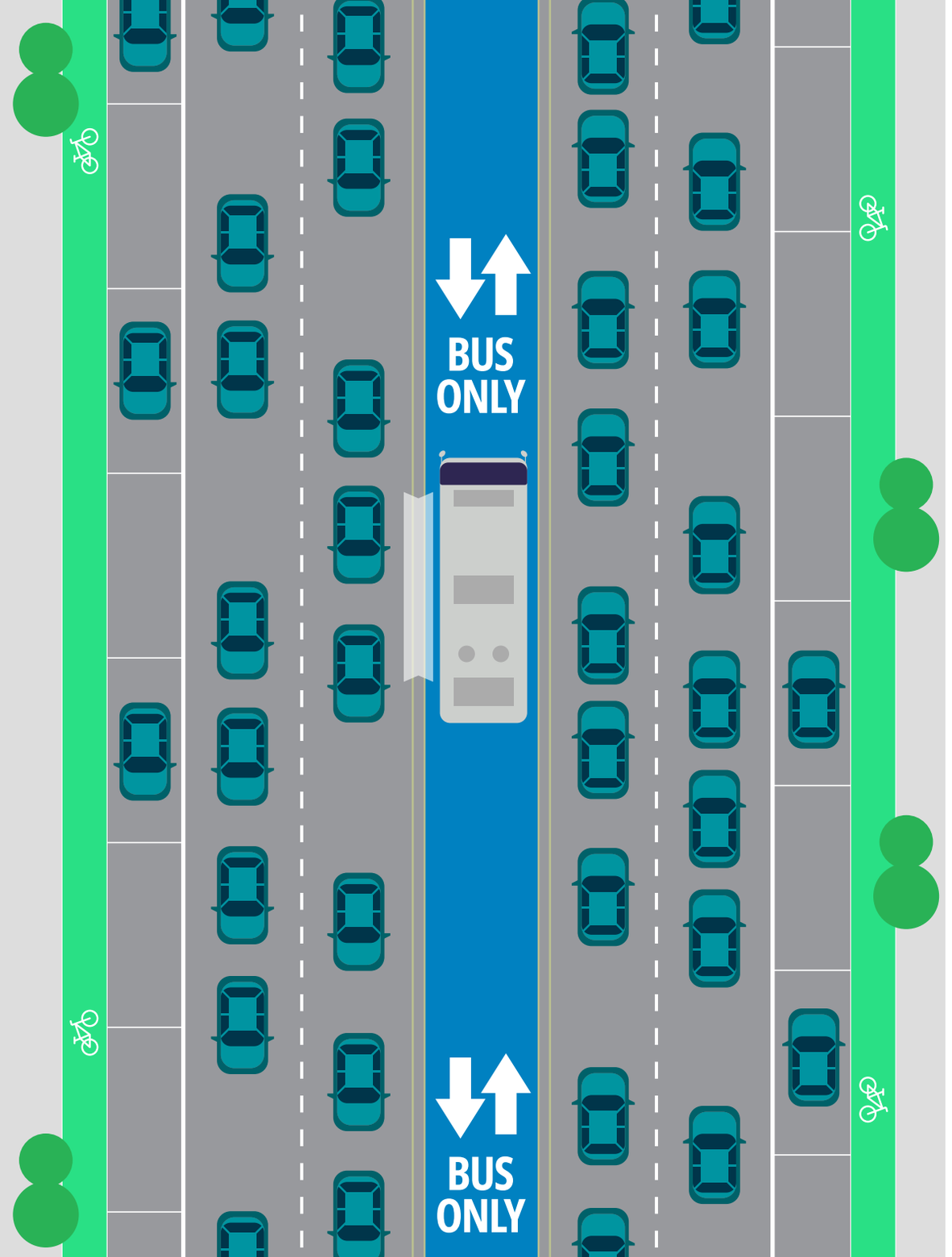
1

Dedicated bus lanes

Dedicated bus lanes ensure that buses do not get stuck in general traffic. Marked explicitly for bus traffic, they separate it from other traffic.

Bus lanes are especially attractive for areas with high passenger demand: Since they offer greater capacity and at the same time ensure reliable service, they reduce delays on the route.

If you combine them with bus rights-of-way on traffic light systems, the result is fast, uninterrupted service. This way, the bus enjoys an advantage over other road users and becomes more attractive to users.[10]



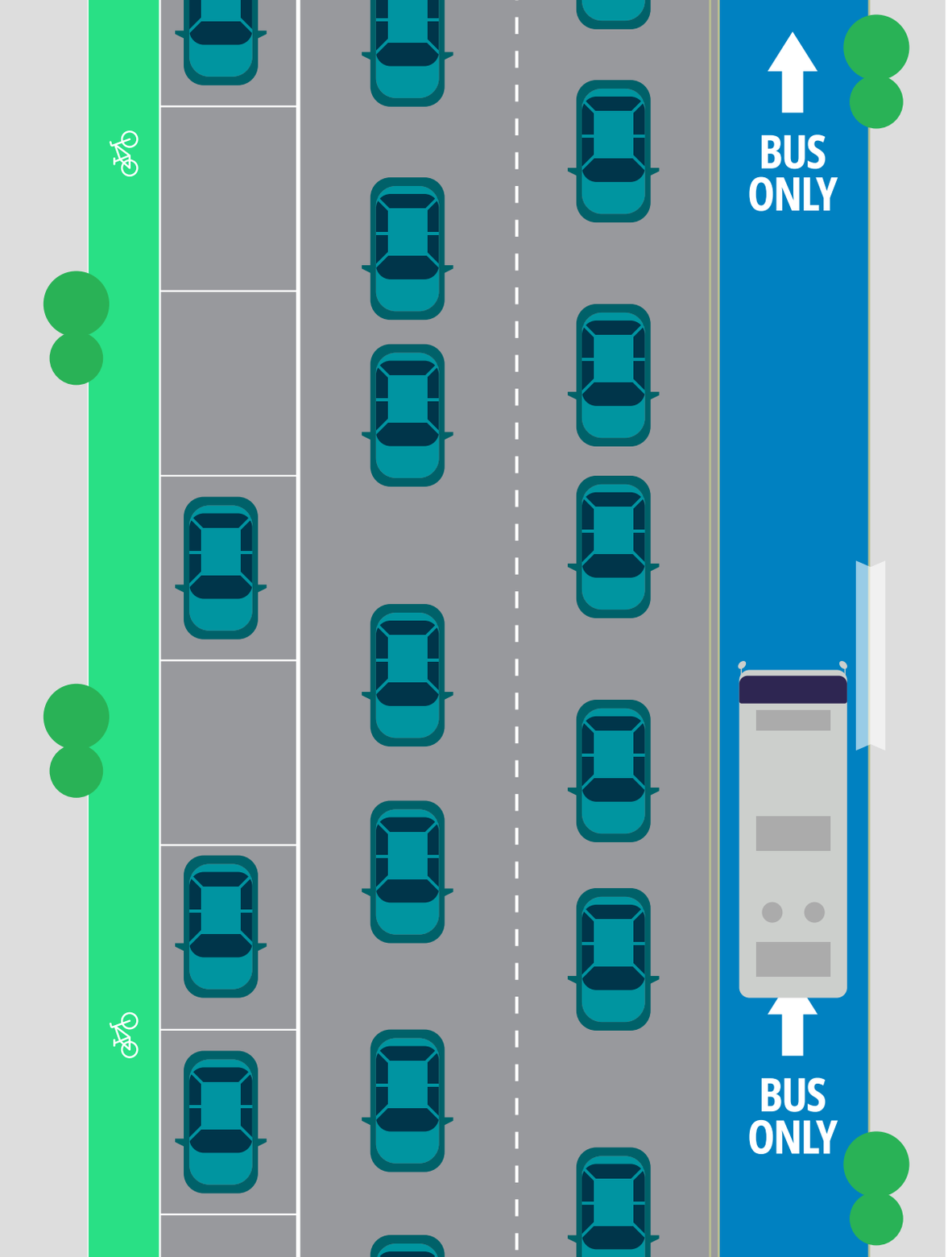
2

Bidirectional bus lanes

“In some cities the roads are very narrow. We are gaining more experience with bidirectional bus lanes here,” says Antonio García Pastor. Bidirectional bus lanes are a variant of dedicated bus lanes.

“There is a single lane available for buses, on which they travel in both directions,” explains Antonio García Pastor.

“Traffic light systems control in which direction buses may travel on the lane at any given moment.”



3

Contra-flow bus lanes

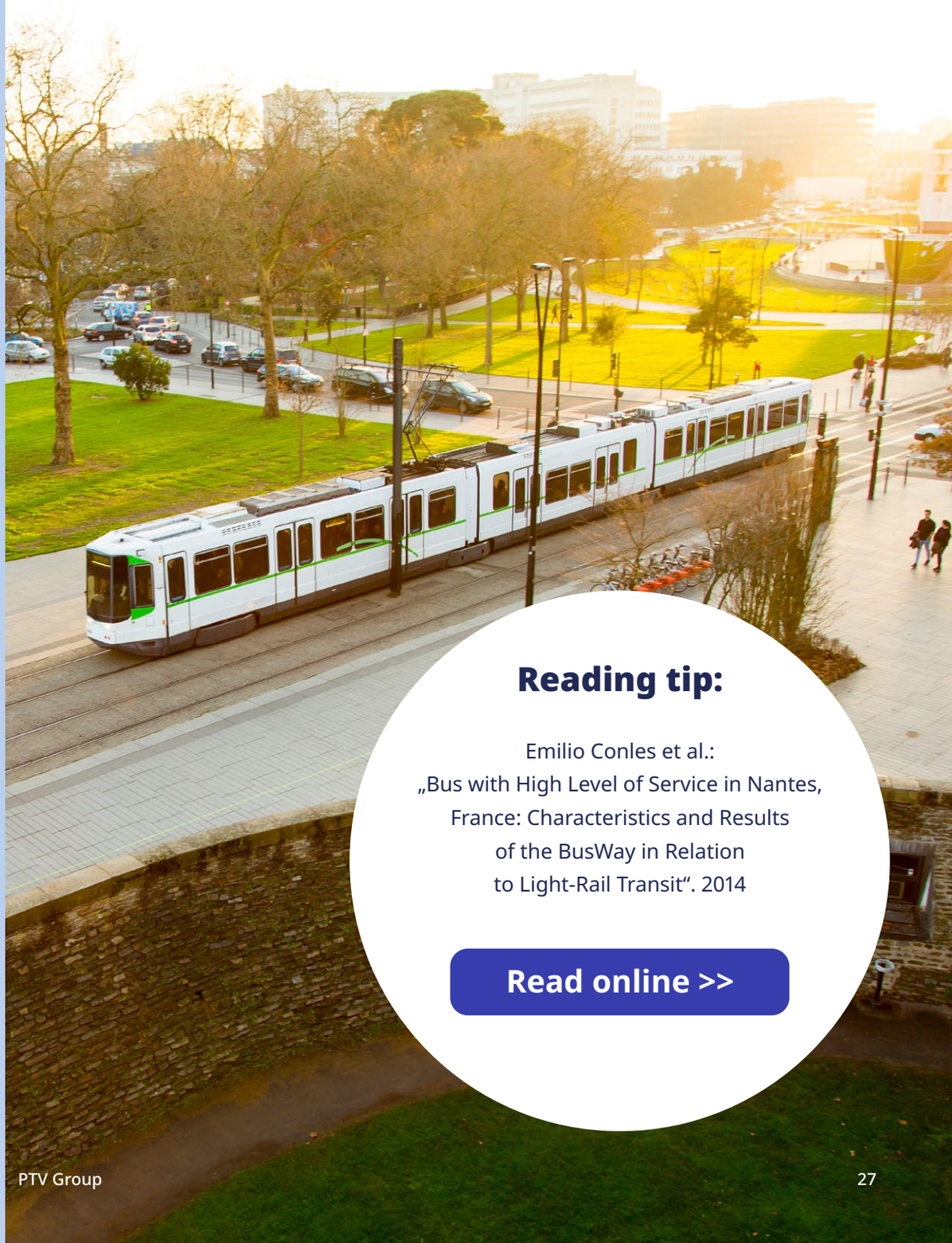
Contra-flow bus lanes are dedicated special lanes that run against the general direction of travel. As with bicycle traffic, this way, buses can travel on one-way streets against the direction of travel.

Depending on how the traffic is managed, this can have a positive effect on the route of a bus.

Example of Nantes, France: Interplay of different special lanes

Nantes is a French city that uses different layouts for its bus traffic. The public transport network in and around Nantes includes three tram lines. They connect various suburbs and peripheral areas with the city center. What was missing was a line for the southeast corridor.

Since another tram was not economically feasible, Nantes developed a bus line with a high level of service (BHLS), the BusWay.[11]



Reading tip:

Emilio Conles et al.:
„Bus with High Level of Service in Nantes, France: Characteristics and Results of the BusWay in Relation to Light-Rail Transit“. 2014

Read online >>

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The BusWay runs for about 14 kilometers. Just 14% of the route is in mixed traffic. For the rest, there are dedicated lanes available, some in the middle of the road, some on the side, and some that are contra-flow bus lanes. The bulk of the dedicated bus lanes are two-lane. The BusWay uses bidirectional bus lanes on 7% of the route.

The result: With BusWays, Nantes has succeeded in creating an equivalent alternative to the tram network. BusWay even offers its service in shorter cycles. Thanks to the optimal infrastructure, the line achieves a slightly higher operating speed. During the week, BusWay is even more punctual than its counterpart on the rails. Line 4 has been fully electrified since 2019.

BHLS & BRT

Bus lines with a high level of service (BHLS) are Europe's answer to the concept of bus rapid transit (BRT), which is widespread in North and South America, as well as in Asia and Australia.

Although this comparison is appropriate, there is a significant difference: Due to the dense urban structure in Europe, BHLS generally run on the same level as the other road users. This concept is striving for balanced usage of the road space. However, this has some effects on the capacity and speed of the BHLS.[12]

The secret e-bus capital of Germany

For public transport, the city of Osnabrück is focusing on e-mobility. "We are the secret e-bus capital of Germany," says Mayor Katharina Pötter about the city's pioneering role.

In 2021, the e-buses that were already in use consumed almost four million kilowatts of green electricity. Vehicles with combustion engines would have consumed more than 1.1 million liters of diesel.

In Osnabrück, two-thirds of all buses are already electric. And the city is working on further electrification. What is motivating you to approach e-mobility in bus transport so quickly?

Katharina Pötter: Our concern is good public transport services that run frequently and whose buses do not just run along the city's main axes. Accordingly, we have created connections across the entire city. However, if we want to achieve a transformation, it's not enough to expand public transport. We must also use sustainable transport. Even if we don't know yet which drive technologies will prevail in 20 or 30 years, we have decided to focus on e-mobility. That's the path we're taking.

What added value does the e-fleet bring the citizens of Osnabrück?

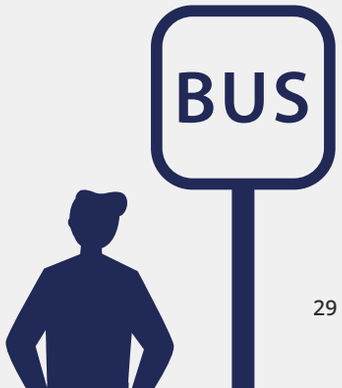
Katharina Pötter: On the one hand, we have set ourselves the goal of being climate-neutral by 2040. In the city center, traffic plays an essential role. And thus so does local public transport. On the other hand, people benefit from noise reduction, for the e-buses are very quiet. This way electrification of the bus fleet contributes not only to reducing emissions, but also to a positive development in noise emissions.

In Osnabrück it's the municipal utility that operates the e-fleet. How does the cooperation between the city and the municipal utility work?

Katharina Pötter: Both the city and the municipal utility understand that we can only be climate-neutral in general and achieve a transformation in particular if we work together. It's advantageous that the municipal utility is 100% municipal, so it can approach these topics at the company. We have the same goals, agree on all planning steps, and integrate the decision-making process.

Changing to e-mobility also costs money. How difficult is it to get funding?

Katharina Pötter: Getting funding is not easy. It's very complex since there are many different funding options. You have to examine the big picture. For example, there's the Federal Ministry for the Environment, which promotes the procurement of electric buses. And there are EU funds for which you can apply from the state of Lower Saxony to build charging infrastructure. In addition, you also have to examine which funding can be combined. That's another whole topic. Our colleagues have learned a whole lot and they have succeeded in helping us achieve a funding rate of over 50%.



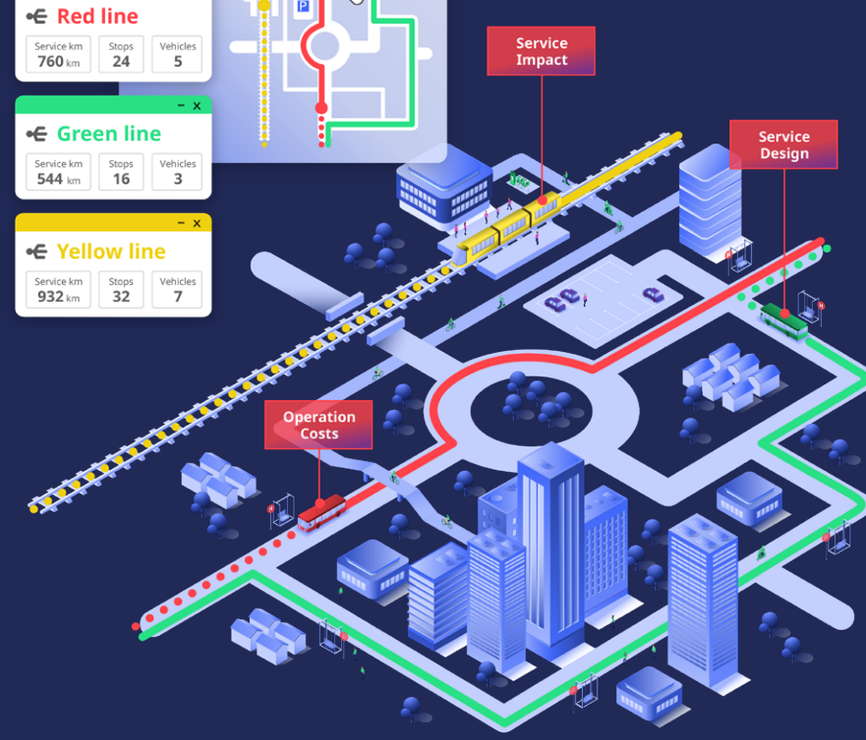
Efficient when stopping

In addition to signals at intersections, stops are critical for fluid travel. If the bus has to turn into a bay and then make its way back into traffic, it loses time. By contrast, if it stops on the road to let people get on and off, it can travel on quickly.

When stopping on the road, bus bulbs offer special convenience for both drivers and passengers:
At the bulb, the bus stop extends to the edge of the road or even protrudes slightly into the road, which means that the bus can approach it by driving in a straight line. If the bus stop is also barrier-free, the bulb and doors are at the same height. People with mobility issues can get on without having to go up steps or step over gaps.

“If buses approach stops at night, the stops should be well-lit and also in well-lit areas,” says Antonio García Pastor. “This makes users’ lives safer.”

But aside from the lighting, where should stops be placed? How should lines run, and what is the best service frequency?



Planning tool for public transport

Prompt adjustments of schedules and connections are a challenge for public transport. PTV Lines is a state-of-the-art web-based tool that makes it easy to design new public transport services and optimize existing ones. This way, planners can try out their ideas quickly and see right away what the effects of network and schedule changes would be on public transport services. You can create several alternative scenarios, evaluate these, and make sound decisions.

More about PTV Lines >>

Effective public transport planning

“A critical planning tool is modeling software that you can use to analyze the lines and the positions of stops,” says Antonio García Pastor. This makes it possible to combine GIS, local, and demand data. “Today, there's a lot more data available than there was in the past,” says the Chair of the UITP Bus Committee. Mobile phone data helps to identify people's most important movements from one part of the city to another. Another valuable data source is information from the ticketing systems.

“In addition to the various data sources, it's increasingly important to involve citizens,” says Antonio García Pastor. “In the process, you come into contact with people, learn what their needs are, and what this means for the stops and line planning.”

Public Transport Planning with PTV Visum

Is it worth introducing a new line or building new stops? Which frequency serves the demand and creates an attractive service? What would the emissions saving be? PTV Visum is the only professional traffic planning software that provides a highly detailed representation of all modes of public transportation such as bus, tram, underground, taxi, rail, and train. From investing in new lines or stations to managing schedules, PTV Visum allows you to develop economically feasible, demand and service-oriented transport services.

Learn more and test it for free >>

In urban areas, population density is quite high, so many people live in the catchment area of a bus stop. “Here it’s relatively easy to operate a high-quality public transport line that generates good demand,” explains Nejc Geržinič of the Smart Public Transport Lab of the TU Delft.

“For even outside of rush hour, there are enough people to justify running service every ten or fifteen minutes.”

But the picture looks different in rural areas. “Here, on-demand services have great potential to supplement public transport services,” says Nejc Geržinič. Such services include models such as buses on call, group taxis, and ridepooling. In less densely populated areas, the flexible services can include delivery services for areas that are not on major transport corridors: “If, for example there is a train line that runs every half an hour, the on-demand service to the train could only run if someone requests it by telephone or via an app,” says Nejc Geržinič. What’s important is that these services do not compete with conventional public transport services.

“Some ridepooling services were born in the hope that car drivers would switch to public transport,” says Nejc Geržinič.

The idea behind this: The flexibility of ridepooling attracts motorists and teaches them how to use public transport. “However, reality usually looks different,” reports Nejc Geržinič. “It’s not normally the motorists who use the ridepooling services. Instead, public transport users take advantage of these services.” If they travel in smaller vehicles instead of buses and trains, this creates more traffic on the road and thus more emissions. That’s counterproductive, for then, public transport cannot display its environmentally friendly strengths.

In addition, on-demand services can’t be scaled as well as conventional public transport services. “The benefit of public transport is that it can transport many people in one vehicle,” says Nejc Geržinič. “This also has a positive effect for operation since it requires relatively low staffing levels.”

Oslo relies on diversity

Norway is at the forefront of sustainability and environmental protection. Accordingly, the country is focusing on e-mobility.

“But electrification alone will not be enough to fix our environmental problems,” says Endre Angelvik, Executive Vice President Radical Innovation at Ruter As. Ruter As is completely municipally owned and serves the Norwegian regions of Oslo and Akershus.

Many people responsible for public transport are setting themselves the goal of increasing the number of passengers. What goal has Ruter set for itself?

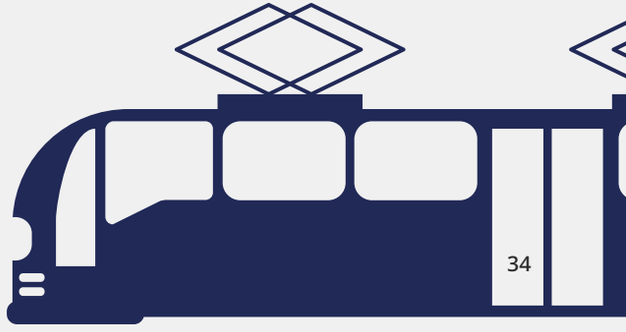
Endre Angelvik: Ruter believes in multi-modal transport. Customers can purchase tickets for the entire Oslo public transport network from us: Our services include buses, trams, subways, trains, and boats. In addition, we offer on-demand services for paratransit and school transport, and we use minibuses and taxi services for all of this. In recent years, we have also started to integrate rental bicycles and e-scooters into our services. Our vision is to create sustainable freedom of movement. To achieve this vision, we don’t need to increase passenger numbers, but rather we must curb the use of private cars. And we in Oslo are using all the means necessary to achieve this goal. For example, Oslo has long had a toll system and it uses the toll system actively to promote public transport and make using private vehicles more difficult and expensive. Instead of parking spaces, Oslo is creating pedestrian zones, expanding bicycle paths, encouraging bike sharing and helping people purchase their own bicycles.

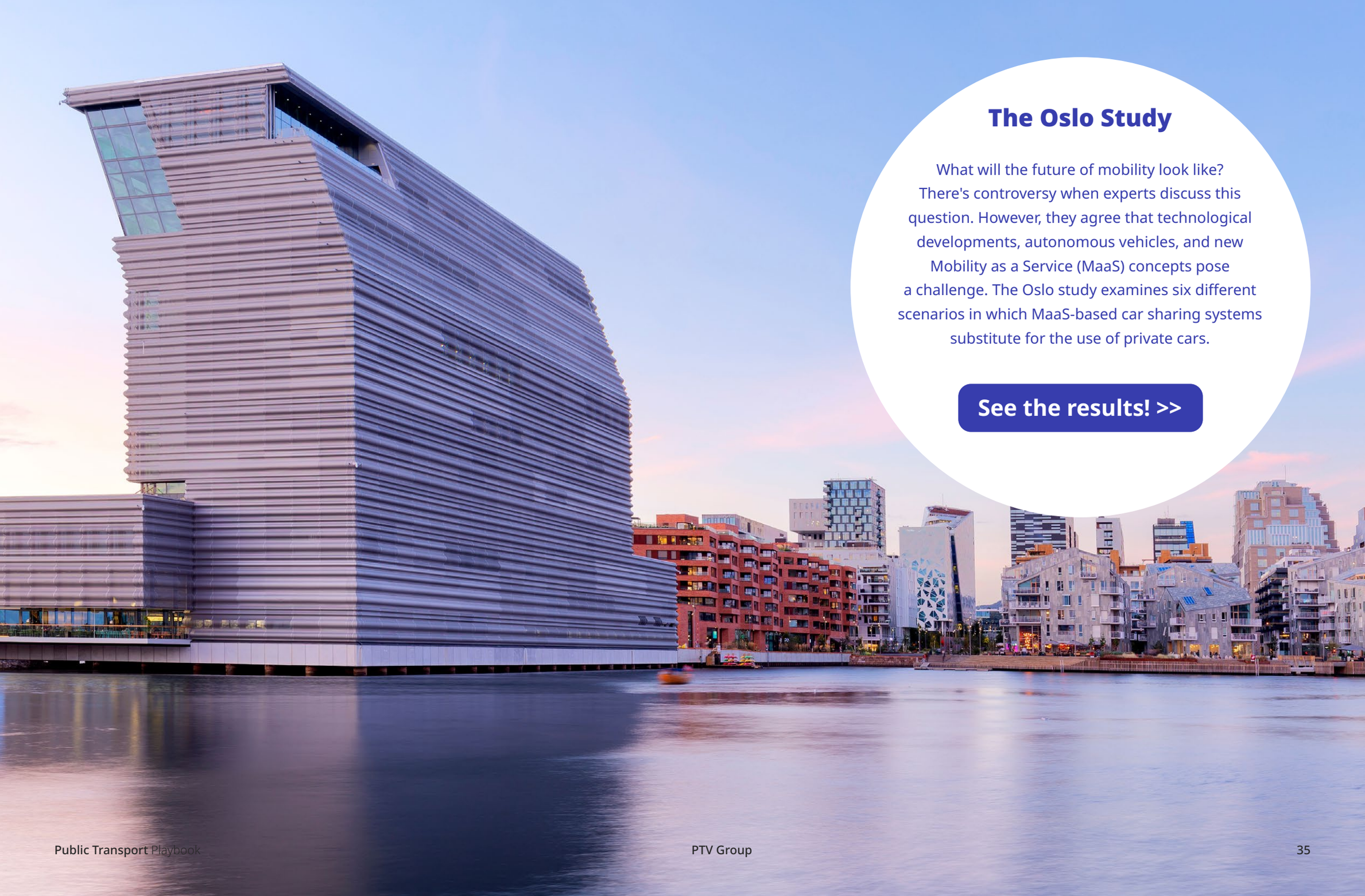
If people can travel faster with their own cars than with other means of transport, they are less willing to give up their cars. How is Ruter dealing with this?

Endre Angelvik: We must seek new solutions for these cases. That’s why we have examined on-demand ride sharing in the course of the so-called Oslo study. The Oslo study takes a look at the future. In this future, autonomous vehicles and Mobility-as-a-Service-based car-sharing models will replace private car ownership. The simulation shows that we could reduce traffic by 31% at best in this way. However, this assumes that public transport users do not change their choice of transport, but rather continue to use public transport services.

How do you imagine the user experience for such a Mobility as a Service (MaaS) in the future?

Endre Angelvik: It should be possible to book such a service digitally or using a mobility app. I imagine that the app will also inform me if I am currently very close to a subway station and my destination can be reached on foot from a subway station. The concern is always to reveal sustainable alternatives. If we succeeded in increasing the occupancy rates of passenger cars via new services such as MaaS-based car sharing, this would dramatically change the entire transport system. For the better.





The Oslo Study

What will the future of mobility look like? There's controversy when experts discuss this question. However, they agree that technological developments, autonomous vehicles, and new Mobility as a Service (MaaS) concepts pose a challenge. The Oslo study examines six different scenarios in which MaaS-based car sharing systems substitute for the use of private cars.

See the results! >>

Getting people excited about public transport

Regardless of whether on-demand service, optimized bus route or extended tram network – it always takes a certain amount of time before users adapt to a new public transport service and adjust their usual mobility behavior – especially if they own a car.

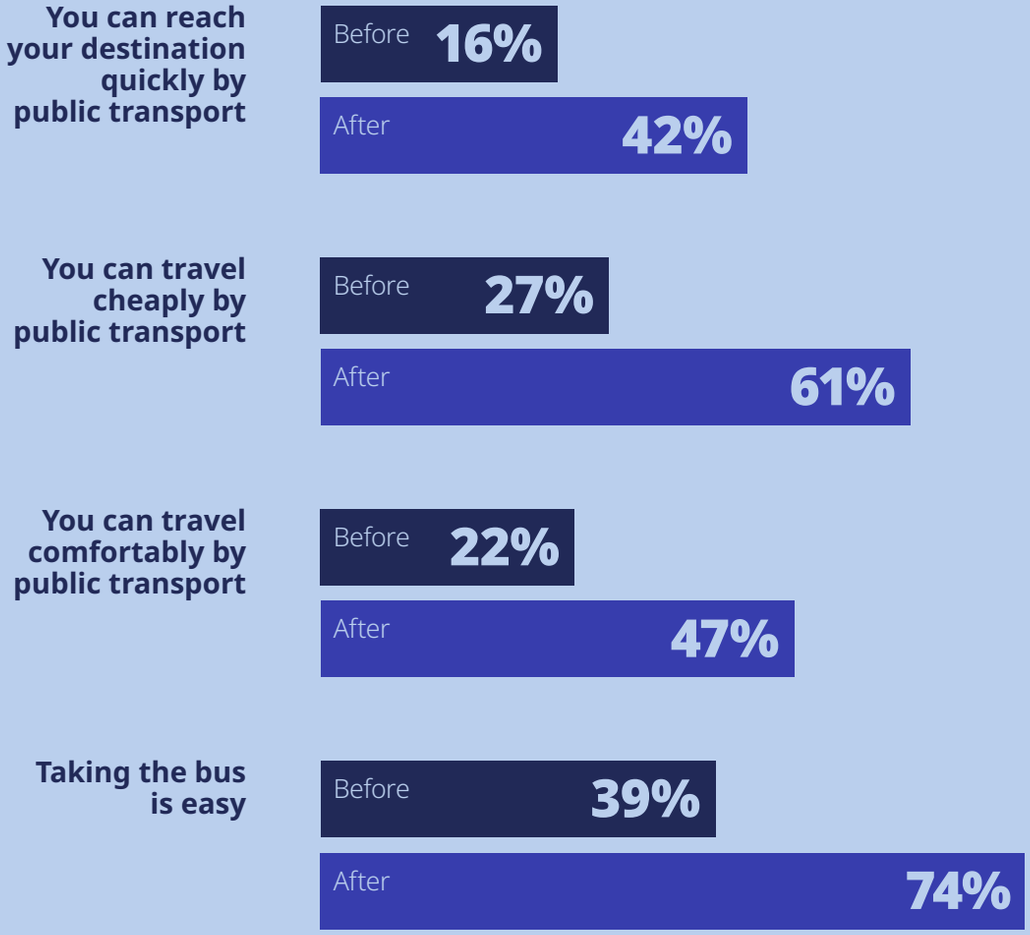
“A private car is a longer-term investment that you make with a view to five to ten years. Precisely in suburbs or sparsely populated areas there are often two vehicles per household,” says Nejc Geržinič.

“A ‘test period’ of a few months is generally not enough to consider giving up one or both cars. For most people, this is a life decision, and it takes a long time to adapt your lifestyle accordingly.”

Sweden triggers mobility change

The Swedish municipalities of Motala and Linköping started the experiment:[13] They were seeking study participants and asked them first about their current mobility habits. The majority of respondents (69%) were motorists, who used multimodal transport for just 7% of their trips and most often combined bicycles and cars. One-quarter of respondents (26%) were public transport

30 people tested riding the bus for two weeks.
In the process, their attitudes toward public transport changed for the better:



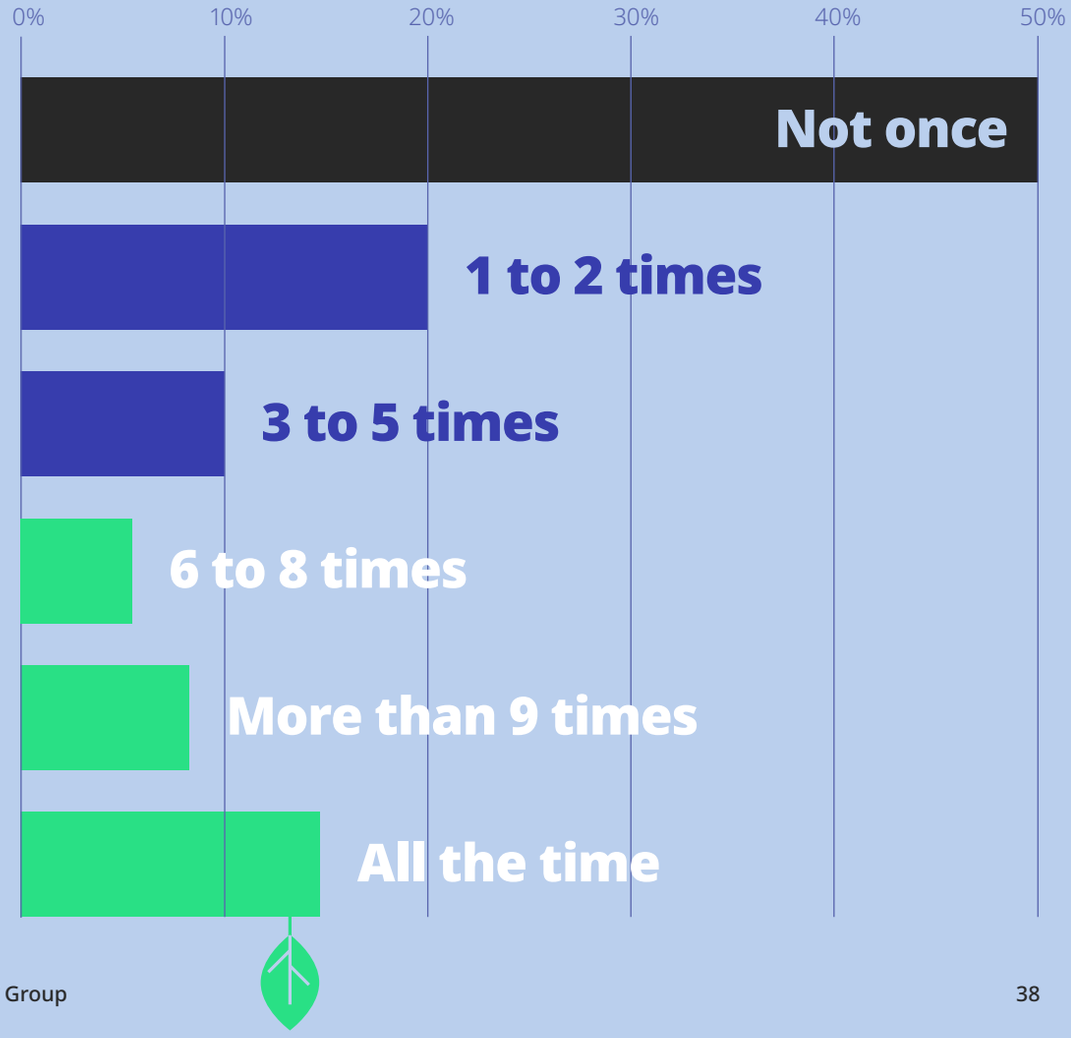
users. They combined just 2% of their trips with other means of transport. The rest of those surveyed were cyclists (4%) or used cars as a passenger (1%).

Then the municipal administrations reduced the number of participants to about 40 people and asked them about their attitudes toward public transport. In addition, participants received a free public transport ticket that they could use for two weeks. About 30 people made use of this. After two weeks, the municipal administrations asked the participants again about their attitude toward public transport.

With a positive result: While previously only 16% of respondents believed that public transport would get them to their destination quickly, after the test, the figure was 42%. Previously, just 22% of respondents believed that riding the bus is pleasant; after the test, the figure was 47%. And previously, only 39% of respondents thought it was easy to travel by bus; after the test, the figure was 74%.

Three months later, the municipal administrations contacted the participants again. Here it became clear that half of all participants were still using public transport. The other half resumed their previous behavior patterns and thought buses were too slow as compared to cars and not comfortable enough. Nevertheless, the Swedish study demonstrates how important it is for public transport to talk to people in order to change their behavior.

Three months after the test, the municipal administrations asked the test subjects how often they had used public transport in the past two weeks:



Overcoming a lack of willpower

“People can only abandon habitual behaviors if they feel an inner conviction that they are up to the new situation,” explains Janet Veldstra, Assistant Professor for Behavioral and Social Sciences at the Dutch University of Groningen. “We call this achieving self-efficacy.” Precisely for people who believe that they are unable to use public transport, offering free tickets can help convince them to the contrary.

However, this is not a cure-all: “With such tests, we also see that many people fall back into old behavior patterns,” says Janet Veldstra.

“So far we can only assume what the reason for this is: Either the free ticket triggers only an economic incentive, or the time span is too short to adapt behavior.”

Added to this is that people act irrationally. “The psychologists Daniel Kahneman and Amos Tversky have demonstrated conclusively that people are not ‘Homo Oeconomicus’,“ says Janet Veldstra. "There are cognitive distortions that influence our actions. These include loss aversions, for example.” With a loss aversion, people perceive a loss more violently than a gain. Even if public transport offers a convenient direct connection, many people feel they lose something by having to do without their cars. And thus also everything they associate with driving. The focus should be on shaking off cognitive loss aversions.

“In addition to attractive public transport services, public transport operators must work on the image of public transport,” says Janet Veldstra.

“The automobile industry demonstrates how this works. It creates positive associations in people’s minds. We need to achieve the same for public transport.”

For example, this can involve cooperations with companies on site, who offer their employees a free or reduced-price public transport ticket. Or good marketing can do the trick.

“For many people, the financial incentive is not enough to encourage them to change from their cars to public transport,” explains Janet Veldstra.

“It's more the identity that they can express with their mobility behavior.” Therefore, advertising for public transport should create an identity.

Public transport advertising could demonstrate how, as a loyal public transport rider, you can reduce your ecological footprint and reduce CO2 emissions. It could show how much less space public transport requires and how the space created this way could be devoted to improving the quality of urban life.

With its campaign “Because we love you,” the Berliner Verkehrsbetriebe (BVG) shows how this works: Here, buses with funny slogans travel through the regions. Here are some examples: “45 m2, no kitchen, no bath – for EUR 60.66/month,” “With us, the chauffeur is included” “We've decided to give up smoking,” and “Emissions impossible.” This is how the climate rescuer public transport makes everyone smile.

The Karlsruhe Model
- an examplary model for connecting the region

Accessibility is one of the most important aspects of attractive public transport services. Although transport networks in city centers are usually extensive, there is often no good connection to areas in the region. Rail transport provides a particular challenge, for it is generally linked to different rail systems. “The Karlsruhe model is a pioneering solution,” says Prof. Dr. Alexander Pischon, managing director of various transport companies in southern Germany.

Connecting these areas with tram-trains not only connects the region with city centers without requiring transfers, but it also integrates state-of-the-art transport services into mobility offerings.

The Verkehrsbetriebe Karlsruhe (VBK) and the Albtal-Verkehrs-Gesellschaft (AVG) provide the tram and railway network for the KVV. What do you as the operator do to inspire more passengers to use public transportation?

“First and foremost, we offer a very dense rail network with transfer-free connections from the region directly to Karlsruhe city and vice versa. Our city trams serve many stops along the way, so they offer an extremely good regional network centered around Karlsruhe. Within the city, we have one of the best headway-based service in Germany in terms of the number of inhabitants. In the city center during rush hour, a train runs every few minutes. And the strong rail network is complemented by bus services in districts of the city and especially to areas around Karlsruhe. We are always working to enhance our network, to make it more attractive, which means that we’re successively integrating state-of-the-art mobility services such as on-demand transport, shared bicycles, and car sharing services, and we’re testing autonomous shuttles with research institutes.”

What’s special about the “Karlsruhe model”?

“Whereas in most cities around the world, passengers from surrounding regions arrive at the main train station and then have to transfer to trams there to reach the city center, here, passengers can simply remain where they are. We offer passengers transfer-free connections from the region directly to the Karlsruhe city center and we have also expanded this model in the region to the city centers of Heilbronn, Bad Wildbad, and Wörth am Rhein. This works thanks to the special two-system technology of our tram-trains, which can run as railways and trams. After the successful invention of this system in Karlsruhe about 30 years ago, the model has been copied in other cities around the world. It makes public transportation easy, comfortable, and thus attractive.”

For a sustainable mobility transformation, the concern is to inspire young people to use public transportation. State-of-the-art apps and techniques are the means of choice. How can these services be linked to your offerings?

“Our services are gradually becoming more digital. This creates entirely new possibilities for our passengers. And it creates new opportunities and ways to link various forms of mobility with one another. For example, our app kvv.regiomove offers all services quickly and easily from a single source, from multimodal connection searches to the purchase of a suitable ticket to the booking of car sharing for the last mile to the front door. That’s smart. That’s easy, and in my opinion, that’s how public transportation has to be to encourage people to switch. Of course, always paired with reliable, good services.“

Technology in action:

Find some best practices on how PTV software empowers public transport around the globe 

Technology as enabler to plan and optimize public transport

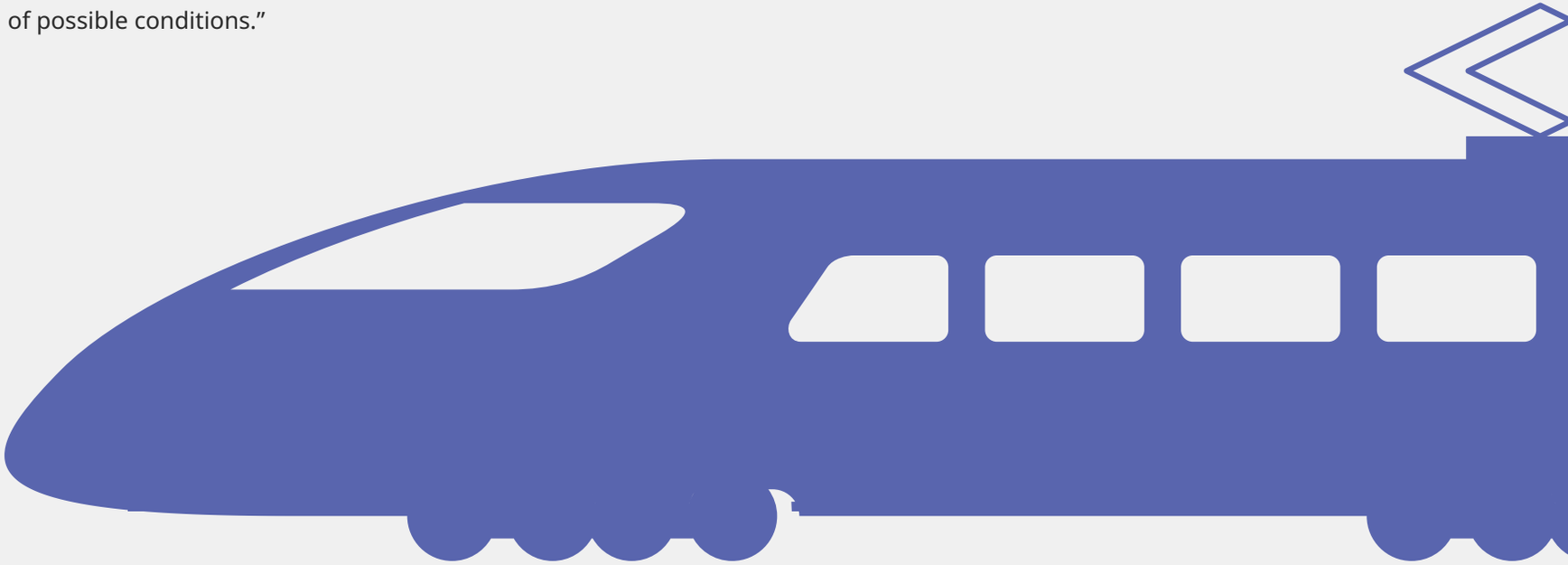
Public transport planning is too complex - and implementing the output may be way too expensive - to simply base it on gut feelings or excel sheets. Passengers expect a high-quality and convenient ride, operators need to provide economically viable services, and authorities need to match their citizen's needs with political topics, talking about accessibility and a sustainable modal split.

Meeting all these interests at the same time is challenging. Besides, planning must be of high level to be judicially approved.

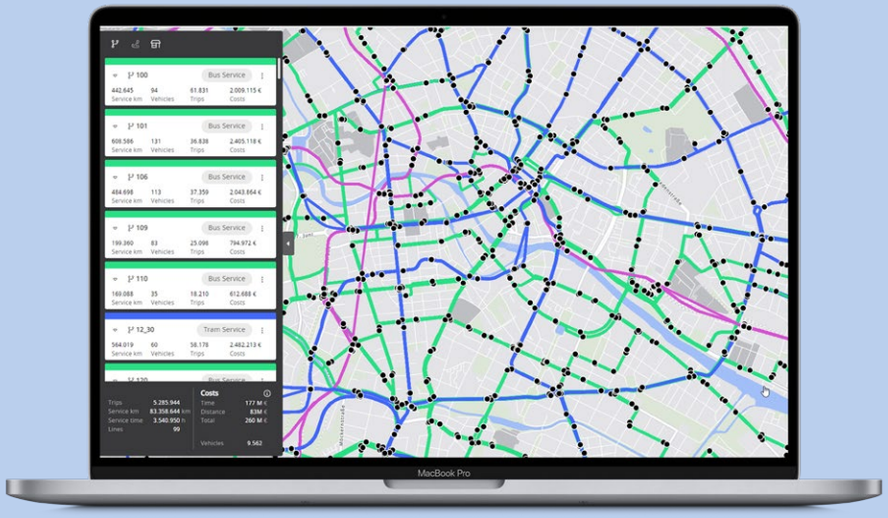
„In most cases, public transport planning is not about finding a single "ultimate" solution. It is rather about considering a range of possible measures, policies, and conditions, before suggesting suitable actions to political or commercial decision-makers," **explains Farnaz Tepper, Principal Product Manager at PTV Group.** "Digital modeling tools enable planners to quickly develop different scenarios for public transport and to test them under a range of possible conditions."

"If you are limited in your resources and knowledge of modeling software, but still want to improve your public transport planning, PTV Lines is the ideal starting point," says Farnaz Tepper. "The cloud-based software is intended for quick service planning of public transport networks and timetables. And the best thing is: It does not require advanced knowledge of mobility modeling."

Advanced planners, however, should consider the use of a more comprehensive software solution that covers a wider range of uses cases. "PTV Visum is a multimodal software that is used for the entire public transport planning," explains Farnaz Tepper. "Models created in PTV Visum can be used for strategic planning of all aspects of public transport."



Quick and easy public transport planning with PTV Lines



What is it?

A web-based tool for service planning of new and existing public transport lines. Planners can quickly test measures for network design and timetables and understand their effects on the service. It is easy to set up and edit stops, line routes and timetables and to visualize ideas. You get instant feedback of the estimated operational costs and can intersect your supply with your GIS data.

Who is it for?

PTV Lines is ideal for public transport service planners, working for public transport operators or for the public authorities responsible for public transport services.
To use PTV Lines, planners do not need prior knowledge of complex modeling software.

What are the main use cases?

- Planning and testing of seasonal timetables
- Reacting to temporary changes to the public transport network, e.g. when a major event or a construction site requires a detour of a nearby bus line
- Adjusting services due to connection optimization

Advanced public transport planning with PTV Visum

What is it?

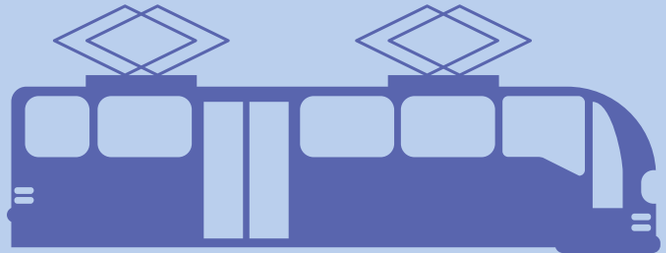
A modeling software for comprehensive and strategic public transport planning. Users gain insight not only about planning of lines and schedules, but also many other aspects of public transport work. Being a multimodal planning suite, PTV Visum considers all modes of mobility, including cars, bicycles, ride–sharing services, and more – and the interaction between them.

Who is it for?

PTV Visum is used by a variety of mobility industry stakeholders. These can be, but not limited to, the strategic planners of public transport services, operators, authorities, decision-makers, investors, and procurement officers.

What are the main use cases?

- **Model and analyze scenarios**
  - What impact hold your network and infrastructure development for their surrounding
- **Analyze mode shift**
  - How many people switch between public transport and other mobility modes based on planned measures
- **Ticketing and pricing policies**
  - Use of passenger survey and *e-ticketing* data to adjust your offer
- **Cost-benefit of new measures**
- **Convince your stakeholders with solid facts and figures**
- **Line bundling**
  - Extensive analyses in graphical and tabular formats
  - Decarbonization - strategic planning of e-bus fleets and the required infrastructure
- **Fleet planning and procurement**
  - Optimize the quality of service and fleet
- **Punctuality analysis and crowding effects**
  - Provide better performance and increased punctuality
- **Station capacity and passenger flows**
  - Untap *capacity* bottlenecks in your station
- **How to divide revenue between operators**
  - Analyse real passenger behaviour and *split revenues*



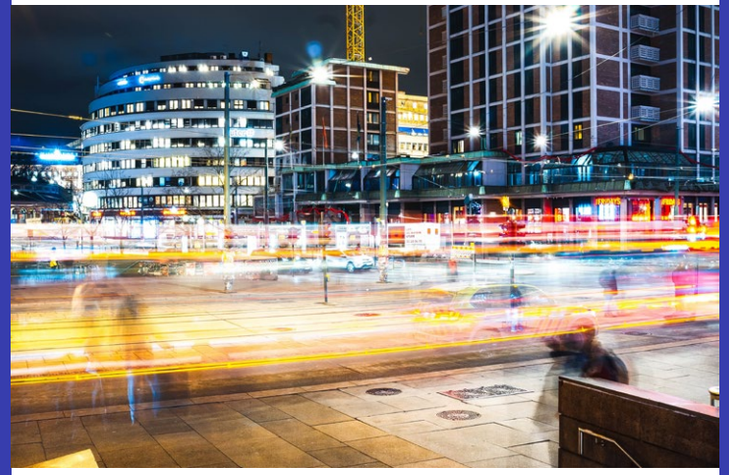
Technology in action

Barcelona ensures good quality mobility for decades to come

In Barcelona, an economic hub squeezed between mountains and sea, every transportation change must be well-analysed before implementation.

Learn more >

How shared mobility and AVs may change transport in cities



The Oslo study reveals what impact the latest technology trends like autonomous driving and shared mobility will have on future mobility in the capital of Norway.

Learn more >

Sustainable public transport: 5 ways to achieve it

How can public transport become more sustainable and help tackle climate change? Find out how PTV software can help transport and urban planners.

Learn more >

Technology in action

Pedestrian simulations support major expansion at Amsterdam's railway hub

Amsterdam Centraal station is the busiest railway hub in The Netherlands. **PTV Viswalk** software was deployed to simulate the expected pedestrian flows.

Learn more >

Swiss Federal Railways uses Activity-Based Modeling to plan future travel

In 2018, PTV Group and SBB initiated a collaboration for the development of an ABM of Switzerland, using **PTV Visum** software.

Learn more >

Network-wide models help Wales improve public transport across all modes

More recently, Transport for Wales has been using **PTV Visum** models to assess the impact of Covid-19 on travel patterns and its decarbonisation targets.

Learn more >

Technology in action

Planning on-demand services beside public transit

A study in the U.S. city of Portland, supported by PTV Group modeling, shows how technology helps mobility planners and operators to evaluate the impact of various scenarios.

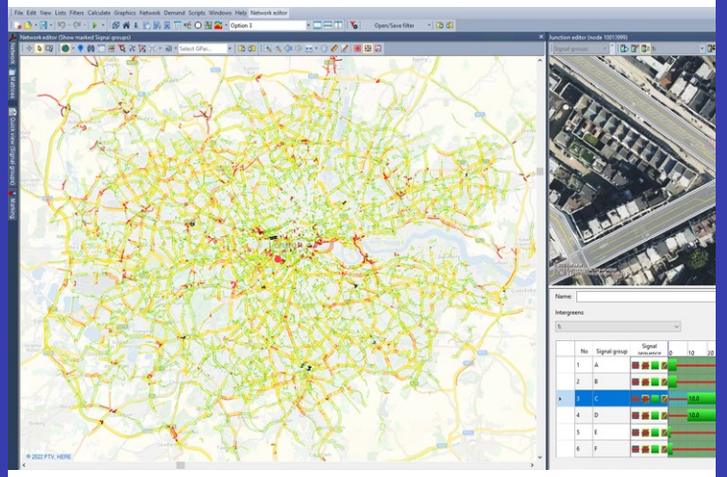
Learn more >

Creating a public transport system from scratch

Setting up a Public Transport system in a culture dominated by cars was a specific challenge to the Abu Dhabi DoT. Therefore, a Bus Planning Model was created using **PTV Visum**.

Learn more >

The New Standard for Traffic Model Runtime



Transport for London (TfL) builds one of the largest and most detailed junction-based highway models in the world with **PTV Visum**.

Learn more >

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