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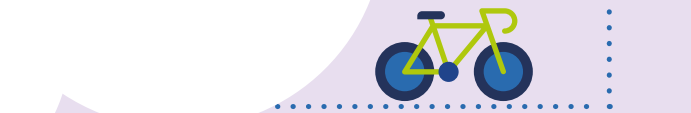

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2024

FOREWORD

Looking to the future, Luxembourg City faces major challenges in terms of mobility. The population is growing steadily, as are the demands on the mobility of the future. The role of Luxembourg City as the centre of its metropolitan region and the destination for 128,000 commuters every day (in 2020) is only set to grow in future. The city's attractiveness is what promotes this dynamic growth. The quality of mobility in Luxembourg City has already increased enormously in recent years, in particular thanks to the expansion of the tram network as the main axis and the corresponding modification and strengthening of the AVL network for better dispersion in the urban area, plus the continuous addition of cycle paths and traffic calming measures in residential areas. However, there is still room for improvement in some areas. The main task will be to increase eco- mobility through public transport and soft mobility.

The figures illustrate the challenge that lies ahead. Luxembourg City accounts for only two per cent of the Grand Duchy's area, and half of the city is made up of green space. Yet, the remaining one per cent is home to 20 per cent of the country's population. It is also home to 40 per cent of all jobs. Growth forecasts indicate that these figures will continue to rise sharply between now and 2035. The city's population will grow by 46 per cent compared with 2020, with a 30 per cent increase in jobs.

All of these people who live and work in Luxembourg City, as well as visitors, should have access to mobility of the highest possible quality. This will help to strengthen the city as the economic hub of its metropolitan area and the Greater Region. Guaranteeing that this happens requires forward planning. That is because the number of daily journeys made by people in Luxembourg City is expected to increase by one third. While there were 857,000 individual journeys made per day in 2020, forecasts predict that this will rise to 1,144,000 by 2035.

It is already clear that personal vehicles cannot and should not absorb this increase in mobility. Our roads are already stretched to their limits and cannot accommodate any more traffic. There is no potential for expanding the road network. Luxembourg City is working towards a mobility strategy that saves space, protects the environment and considers people's quality of life. Nevertheless, the building of roads will continue to play a role in future, especially with respect to connecting up the new developments planned for areas to the west and north-east of the city.

Naturally, the city should remain accessible by car. The greatest task, however, will be eco-mobility, i.e. public transport and soft mobility. Public transport should be able to accommodate the majority of the additional journeys that will be made in future. Public transport is already one of the most efficient ways to get around the city – with an extensive AVL bus network and the expansion of the tram. Public transport has been made significantly easier for people to use because it is provided free of charge. There is enormous potential to expand public transport further. It takes up the least amount of space for the number of passengers it can transport. There is good reason why the most important infrastructure initiatives contained in the Mobility Plan focus on expanding the public transport network and increasing its efficiency.

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Soft mobility also has an important role to play as an alternative way of getting around. Conditions for cyclists and pedestrians in Luxembourg City are already good. Bridges and lifts help make it easier to get around topographical hurdles, with plans to introduce more such amenities. Cycling has become a genuine alternative, thanks in part to vel'OH! While there are still gaps in cycling infrastructure, the cycle path network is being continuously improved and expanded. Soft mobility must be increased and promoted so that it can fulfil its role as a complementary form of transport. It has an important role to play in mixed-mode travel.

So-called "soft" initiatives can provide additional support for strengthening infrastructure for public transport and soft mobility. These are intended to influence the mobility behaviour of the population. Initiatives include creating an effective traffic management system that can manage personal vehicles and public transport efficiently and with as few disruptions as possible. Other soft initiatives include information campaigns and other mobility management tools tailored to specific target groups (e.g. businesses, new arrivals, commuters).

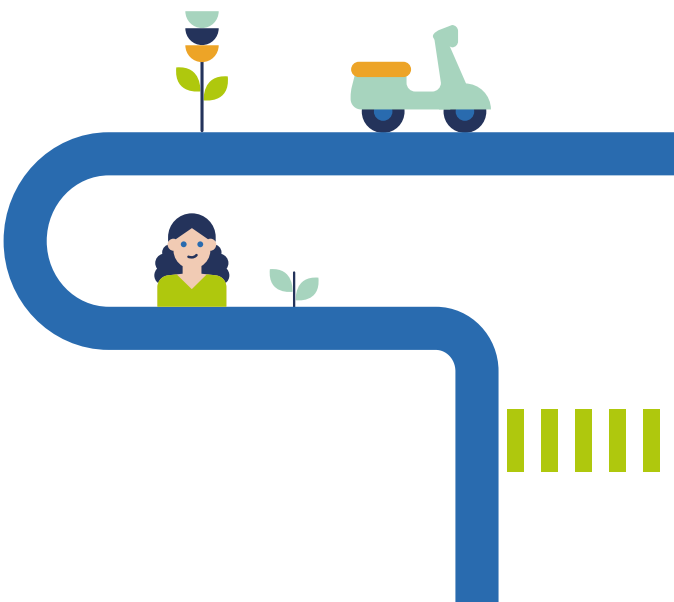
Additional offers can only be created and effectively exploited by combining soft initiatives with a comprehensive expansion of the existing infrastructure. This will enable Luxembourg City to overcome the mobility challenges that lie ahead.

This Mobility Plan addresses these challenges in detail and lays out Luxembourg City's strategy plan for urban mobility until 2035. This document is an important milestone in ensuring the city is well-equipped for the future.

Lydie Polfer
Mayor

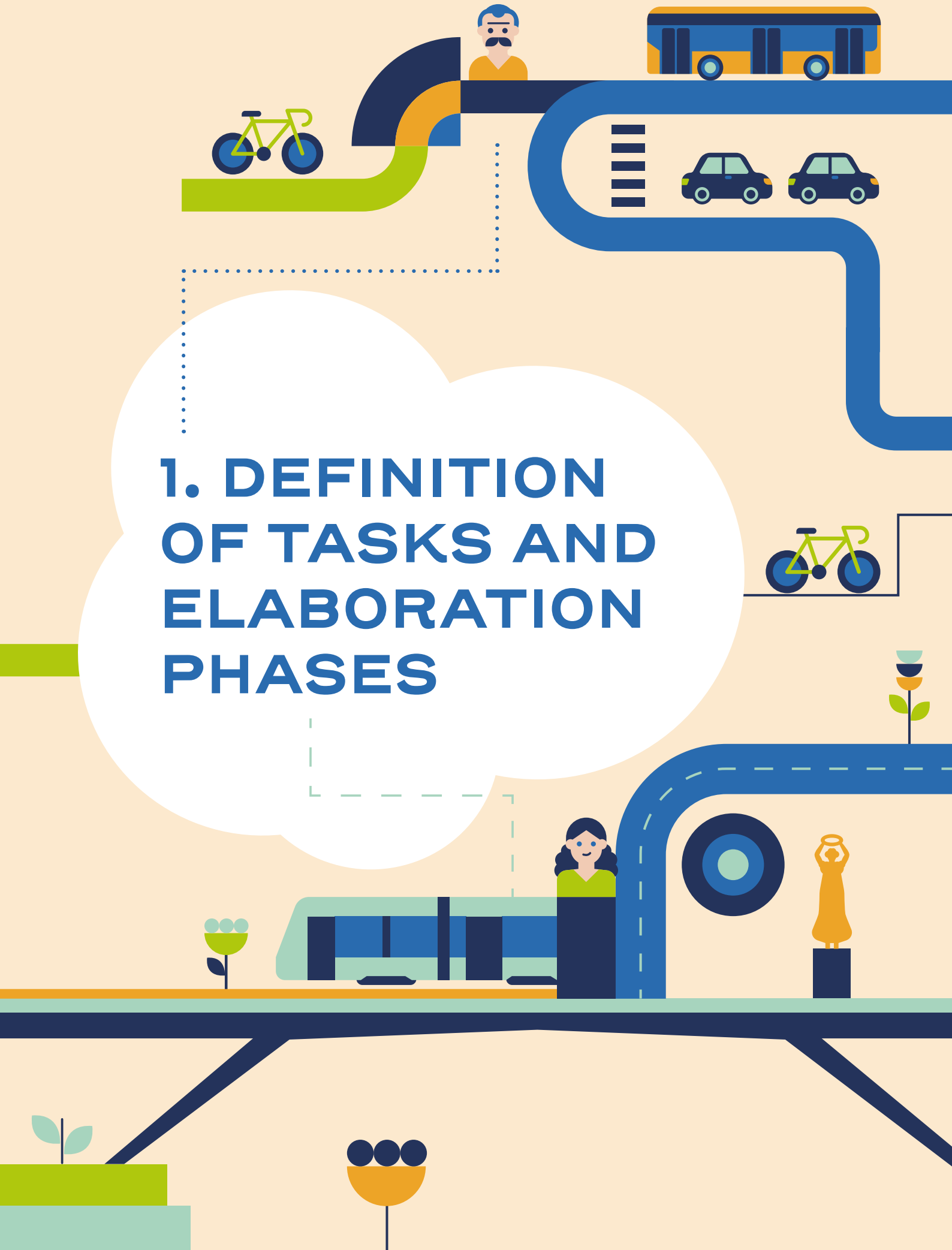
Patrick Goldschmidt
Alderman for Mobility

In order to improve readability, the masculine form has been used in this report for job titles and nouns which refer to people. These should generally be read as applying to all genders equally. The decision to use shorter forms was made for purely editorial reasons and is not intended to imply any value judgement.



LIST OF ILLUSTRATIONS

(Note: All illustrations can be found in the Appendix, illustrations in the text are labelled as graphics and numbered sequentially)



1. DEFINITION OF TASKS AND ELABORATION PHASES

1 DEFINITION OF TASKS AND ELABORATION PHASES

Luxembourg City is a metropolis in the heart of the Greater Region that is undergoing rapid growth. Some 133,000 people (as at end of 2022) live in the capital of the Grand Duchy. The greater urban area and the country as a whole have been constantly growing for years now. This challenge requires a refocusing of strategic development concepts. The Luxembourg City Mobility Plan is intended to meet these needs in the areas of mobility and transport.

The geographical location of the Grand Duchy – bordering France, Germany and Belgium – and the economic significance of the country for the wider region have an enormous impact on its mobility needs. As a commercial hub, Luxembourg City is a destination for many commuters. This means that there are a lot more people in the city during the day than there are outside of business hours. It is expected that the number of people living in the city and the number of jobs will continue to rise significantly in future, resulting in an increase in commuters.

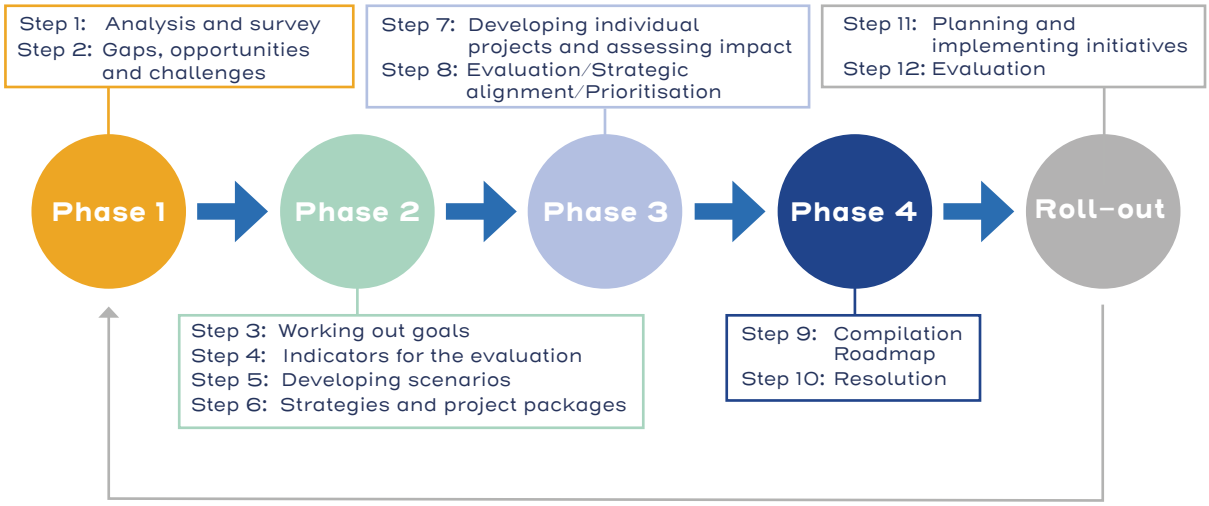
The city is of huge crossborder importance for the metropolitan region of Luxembourg as a whole. For that reason, the surrounding area and the huge numbers of commuters must be taken into account when drawing up a strategic roadmap for future urban mobility. This inter-connectivity between the city and its surrounding area also plays a role in existing projects and strategic plans for the same reasons. These projects and plans include:

- The sectoral plan for housing (*Plan sectoriel* "logement" – PSL)
- The sectoral plan for commercial areas (*Plan sectoriel "zones d'activités économiques"* – PSZAE)
- The sectoral transport plan (*Plan sectoriel "transports"* – PST)
- The tram (reintroduced in 2017, with plans for massive expansion)
- The planned *Tram rapide* which will connect the city directly with the area around Esch-sur-Alzette
- improving connections between neighbouring countries and Luxembourg City by upgrading bus and rail networks and the connected Park-and-Ride facilities (P+R) and expanding the regional road network
- Deliberations on introducing regional cycle highways

A map of the city layout, incl. districts, is presented in **Figure 1**.

This **Luxembourg City Mobility Plan** is based on the resolution passed by the College of Aldermen in 2017 (*Déclaration échevinale 2017–2023*). The aim of this resolution is to design a mobility plan. The mobility plan is intended to provide political decision-makers with information and guidance on how to act. It is also intended to provide impetus to other urban development and environmental initiatives. Developing mobility in Luxembourg City is of great import in political debates but also to all other areas of society. This development has been given a further boost in recent years by the introduction of free public transport nation-wide in March 2020 and the roll-out of the tram in Luxembourg City. The tram has also had a huge impact on traffic flows in the metropolitan region and has fundamentally altered the face of the city centre.

Taking into account all of these points, the implementation of **a coherent mobility strategy** for Luxembourg City marks a logical next step. The process of elaborating the mobility strategy involves stakeholders from politics, the general public and stakeholder associations, and must be aligned with municipal and national concepts that are already in place or still at an early stage. Of particular note here is the PST and the National Mobility Plan (*Plan national de Mobilité PNM 2035*[1]). The aim of the Luxembourg City Mobility Plan is to establish a medium and long-term strategy for managing mobility and transport in Luxembourg City. As a long-term process, it is intended to act as the primary tool for designing an efficient and future-ready transport system. The plan can be adapted in future to changing circumstances and challenges. The Mobility Plan is therefore the core of a process which aims to grow mobility, rather than a long-term static framework concept.



Graphic 1: Elaboration phases in the Luxembourg Mobility Plan

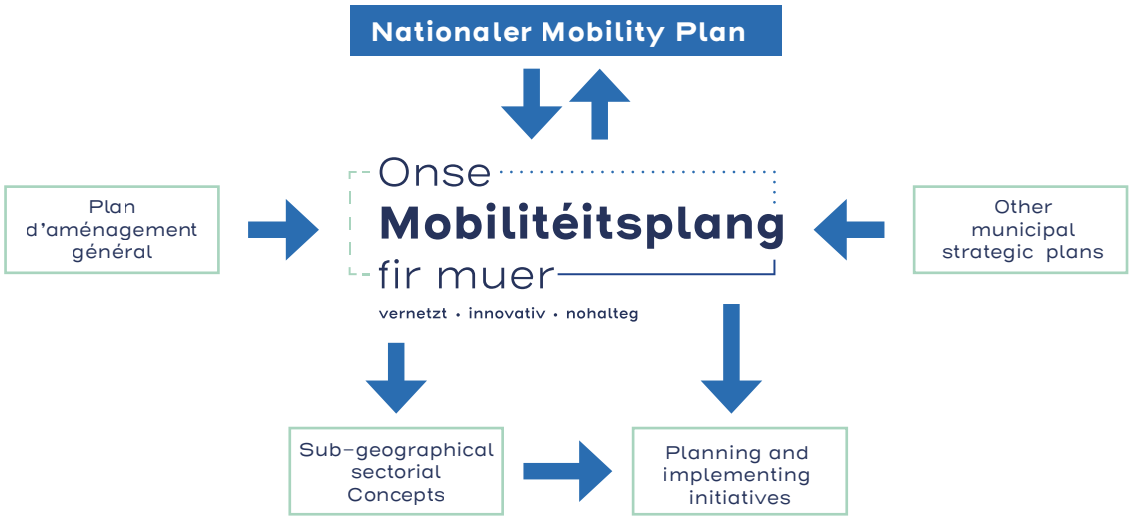
1 *https://transports.public.lu/dam-assets/publications/contexte/strategie/pnm-2035-buch-de.pdf*

Elaboration of the plan comprised four phases and a total of ten steps (see Graphic 1). The outcomes will be described and justified in detail in this document.

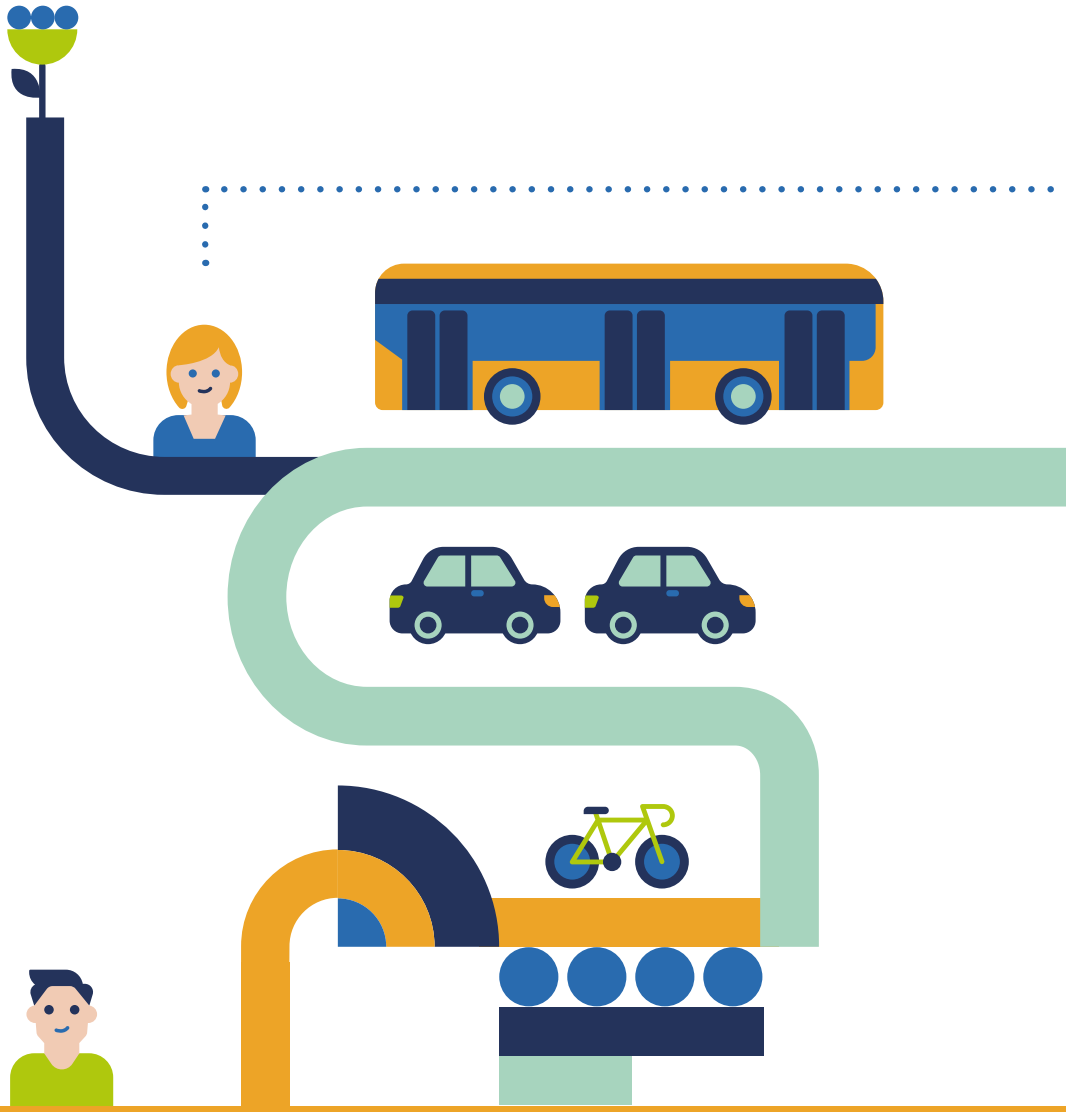
The steps proposed for elaboration of the Mobility Plan are based on the guidelines and EU criteria for preparing sustainable urban mobility plans (SUMPs). Particularly important aspects of these plans include a stronger focus on people and their living environment, an integrated and inter-disciplinary approach which incorporates all forms of transport, and the promotion of sustainable mobility. These plans take into account impacts on people's health and the environment, embedding short and medium-term approaches as part of a long-term strategy and involving the population and other stakeholders extensively. Planning for monitoring and evaluation also ensures that the plan constantly evolves.

In order to comprehend the Mobility Plan, it is essential to understand its strategic objectives. The aim is to guarantee the sort of mobility that is needed for rapid urban growth in such a way that quality of life and the environment are in no way harmed and in fact can be strengthened under growth conditions wherever this is possible or indeed necessary. The PNM 2035 is an important pillar in this respect. Moreover, findings and initiatives from the Luxembourg City Mobility Plan will be integrated into future versions of the PNM.

The strategic Mobility Plan cannot highlight all problems in detail or develop micro-initiatives for these issues. Instead, it is intended to provide strategic guidance for in-depth plans and concepts, such as sectoral sub-concepts on transport system management, district concepts (for additional traffic calming and increased quality of life in local areas) or plans regarding significant stand-alone projects (e.g. new tram routes). The Mobility Plan is a framework which defines the general direction of initiatives. However, the plan itself must also be adapted and updated at manageable intervals as circumstances evolve. This will be managed using the corresponding monitoring and evaluation tools.



Graphic 2: Synergies between the Mobility Plan and other plans



2. PUBLIC CONSULTATION

2 PUBLIC CONSULTATION

Goal–oriented strategic plans and concepts require extensive involvement from the general public and key stakeholders. This is particularly true of plans regarding the organisation of future mobility, which affect all citizens. Consultation ensures that their experiences and specific insights are incorporated into the process and that a rough consensus is reached regarding the general direction and content of the strategies and initiatives. For this reason, the Mobility Plan was prepared from the very beginning with public consultation in mind. The following method has been chosen for drawing up the plan and for the consultation and involvement process:

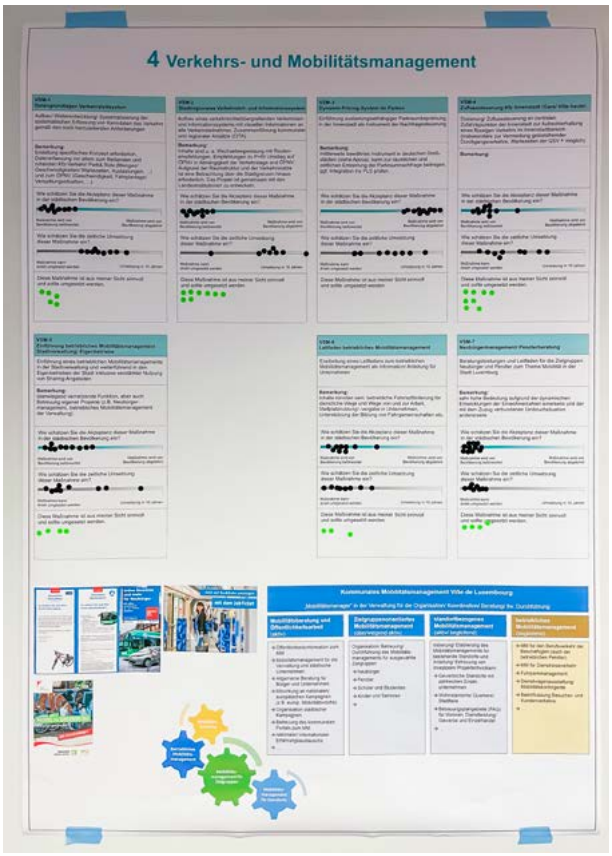
The plan was drawn up by a team of experts in close consultation with the *Direction Mobilité* acting as Team Lead. Luxembourg City municipal representatives were kept up to date on the progress of this work by the College of Aldermen and the Mobility Advisory Council. Each party on the Municipal Council appointed one member to this council. In addition, the College of Aldermen took on the task of setting out guidelines for the process moving forward, clarifying details where necessary. The Mobility Advisory Council oversaw the process across seven meetings. The experts provided content in their areas of expertise and held discussions with stakeholders. This resulted in suggestions and recommendations which were then properly reviewed and drawn up in the form of analyses, strategies and concepts.

Graphic 3: Consultation and involvement in drawing up the Luxembourg City Mobility Plan

National integration was ensured in a number of different ways. National plans (in particular the PNM and PST) were taken into account when drawing up principles and analyses and in the scenarios, strategies, concepts and initiatives. National authorities were also represented on the Mobility Advisory Council and consequently were able to provide the latest findings from ongoing processes. The graphic below illustrates the composition of the Mobility Advisory Council.

- **Administration** (Direction Mobilié (Service Circulation / AVL) / Direction Architecte / Délégué à l'environnement)
- **Municipal authorities** (1 representative / faction / party in municipal council – total of 5 representatives)
- **National authorities** (Ministére de la Mobilité et des Travaux publics (MMTP) / Police Grand-Ducale – Direction régionale „Capitaale")
- **Associations** / **clubs** (Union des Syndicats d'Intérêts Locaux de la Ville de Luxembourg (USILL) / ProVelo / Cluster for Logistics Luxembourg)
- **Commerce** / **trade** (Union Commerciale de la Ville de Luxembourg (UCVL) / Luxembourg for Finance

Graphic 4: Composition of Mobility Advisory Council



Impressions from the 6th Mobility Advisory Council in January 2023

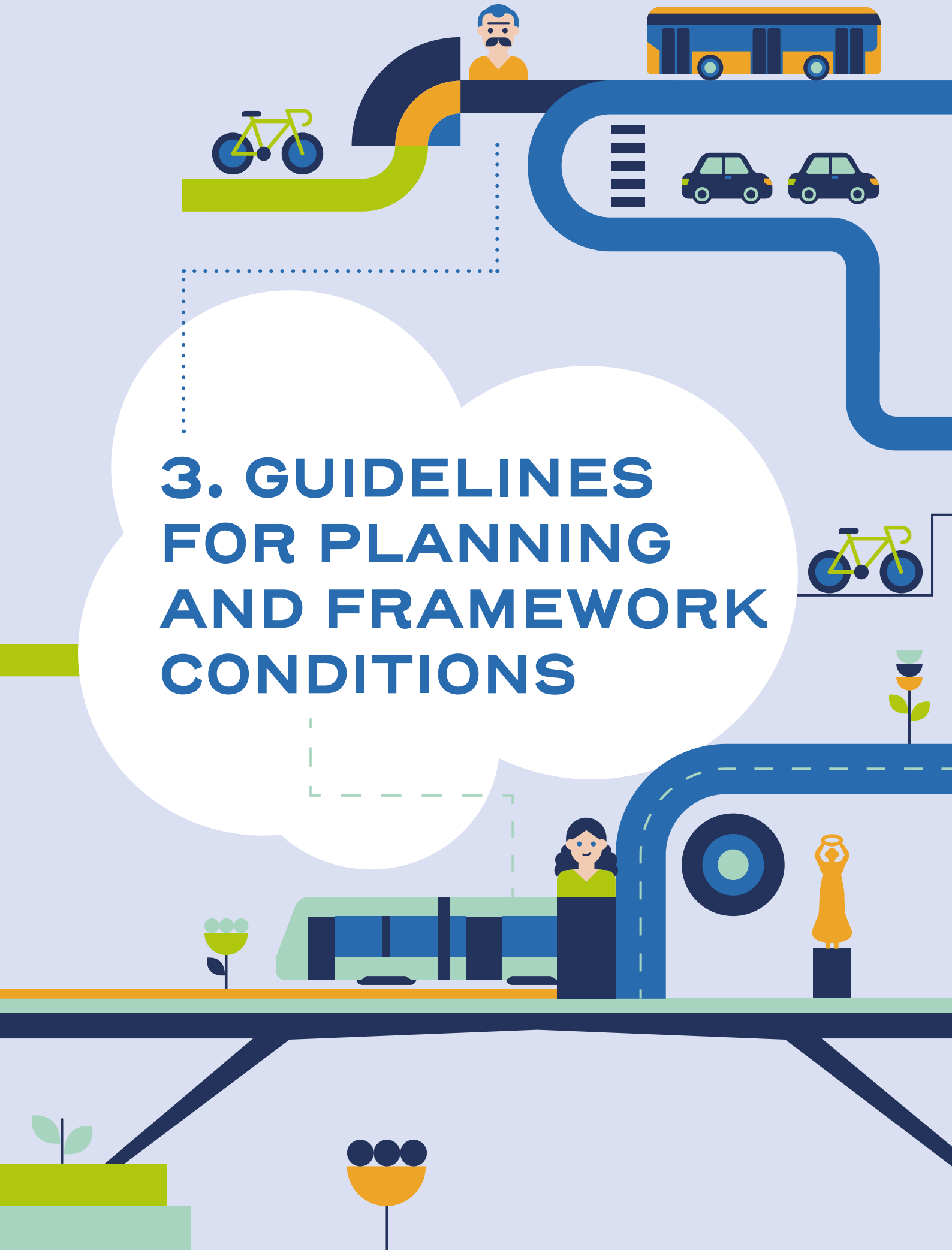
Graphic 5: Poster advertising the online survey

In addition to the Mobility Advisory Council, the general public was also involved extensively in drawing up the Mobility Plan. Public events were held in October 2021 and March 2022 with talks and discussions held in the *Grand Théâtre* and in the old tram depot (*Tramsschapp*). Between 150 and 200 people attended each event. The October 2021 event signalled the launch of an online survey which more than 8,400 people responded to. In addition to answers to the questions, around 4,250 comments were also submitted. The aim of the online survey and the kick-off event was to encourage residents to get involved by providing information on their personal mobility habits, giving their opinion on the quality of transport and describing their expectations. The results were integrated seamlessly into the analyses and concepts that were subsequently drawn up and can be viewed in a separate document (see website mobiliteitsplang.vdl.lu).

Commuters were also included in the survey due to their exceptionally high numbers. The contributions made by the general public during these discussions revealed very high expectations around the Mobility Plan, especially with regards to promoting environmentally friendly means of transport (public transport and active mobility (*mobilité douce*)) and designing transport routes that are well integrated into the residential environment.

A public event was held on 17 September 2022 at Place d'Armes in the heart of Ville Haute to ensure that members of the public who are less inclined to get involved were not overlooked. Five information stands provided residents with information on the core aspects of the mobility plan, while staff were on hand to chat about suggestions. This resulted in more than 200 intensive discussions. A sixth stand invited passers-by to leave suggestions on a pin board and discuss these with other visitors. All events were held as multilingual events (in French, German, English and Luxembourgish) in order to minimise linguistic barriers.

Impressions from public events on 13 October 2021 and 17 September 2022
(© Photos 1 and 2: Nader Ghavami/Maison Moderne)



3. GUIDELINES FOR PLANNING AND FRAMEWORK CONDITIONS

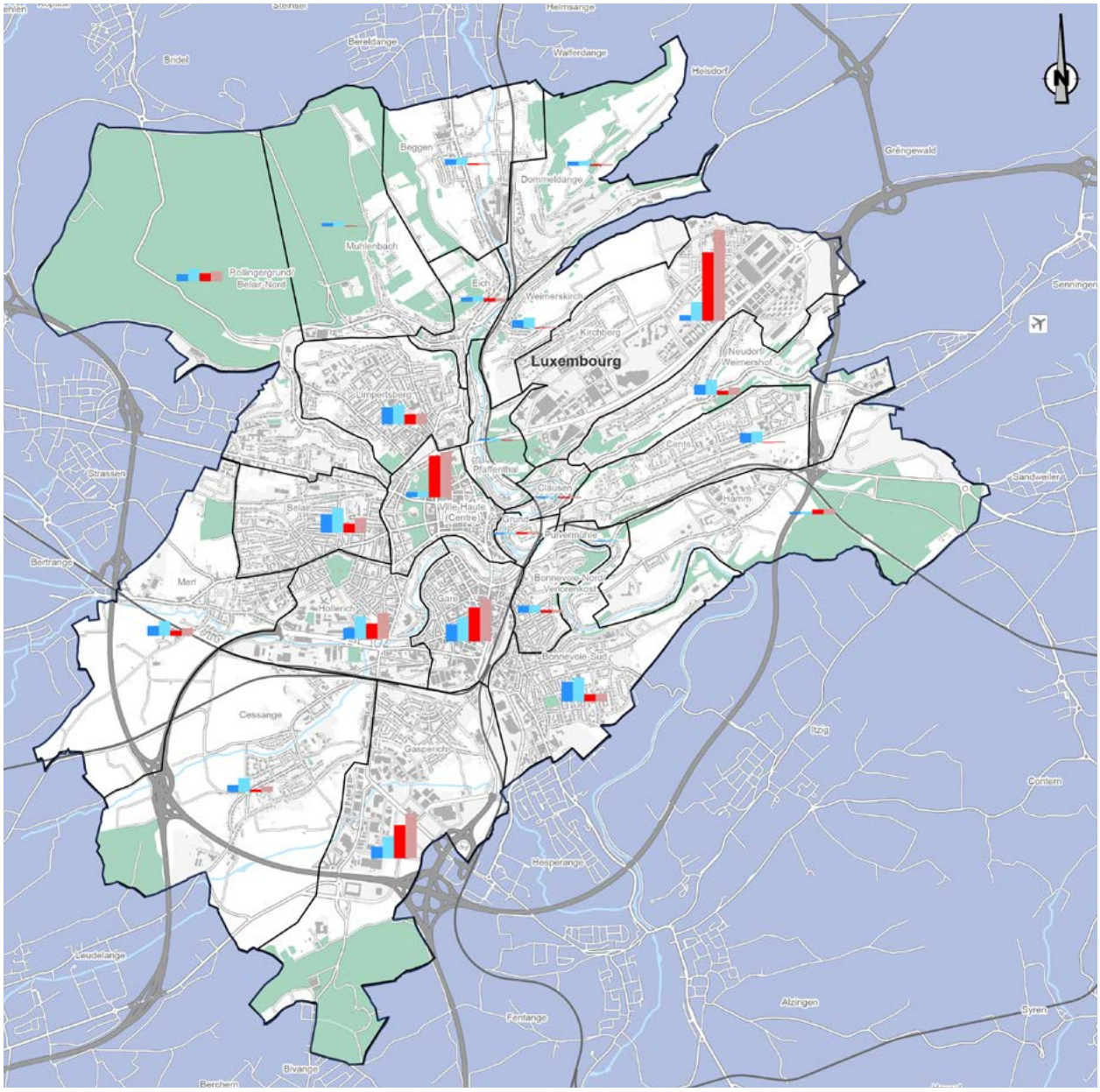
3 GUIDELINES FOR PLANNING AND FRAMEWORK CONDITIONS

Luxembourg City comprises the central part of the *Centre area* of the Grand Duchy of Luxembourg. However, mobility in the region extends beyond the borders of the country of Luxembourg into its neighbours of Belgium, Germany and France. Luxembourg City has a classic layout: a concentrated city centre which expands outwards towards the city limits, gradually becoming less dense. The built-up area transitions seamlessly into the surrounding municipalities. The area around Luxembourg City is characterised by smaller towns, as well as individual business parks and industrial areas (e.g. Findel Airport and the industrial areas of Leudelange and Munsbach). The 24 districts that make up the city differ in the density of buildings, jobs and population. Ville Haute (Oberstadt) has the highest density of jobs and retail outlets, while the surrounding districts such as Gare, Hollerich and Belair have more residents and a much greater mix of amenities. Purely residential areas tend to be located on the outskirts of the city. There is also a particularly high number of jobs in the three districts of Gasperich, Hamm and Kirchberg, which is additionally home to EU institutions.

The largest number of retail outlets can be found in Ville Haute. However, there are also two shopping centres within the city itself in Kirchberg (25,000 m²) and Cloche d'Or (75,000 m²). Two more retail locations covering a total of approx. 50,000 m² can also be found just outside the city gates in the neighbouring municipality of Betrange to the west. Other important transport destinations are spread around the city, such as the four hospitals, higher education institutions, national cultural institutes and sporting venues.

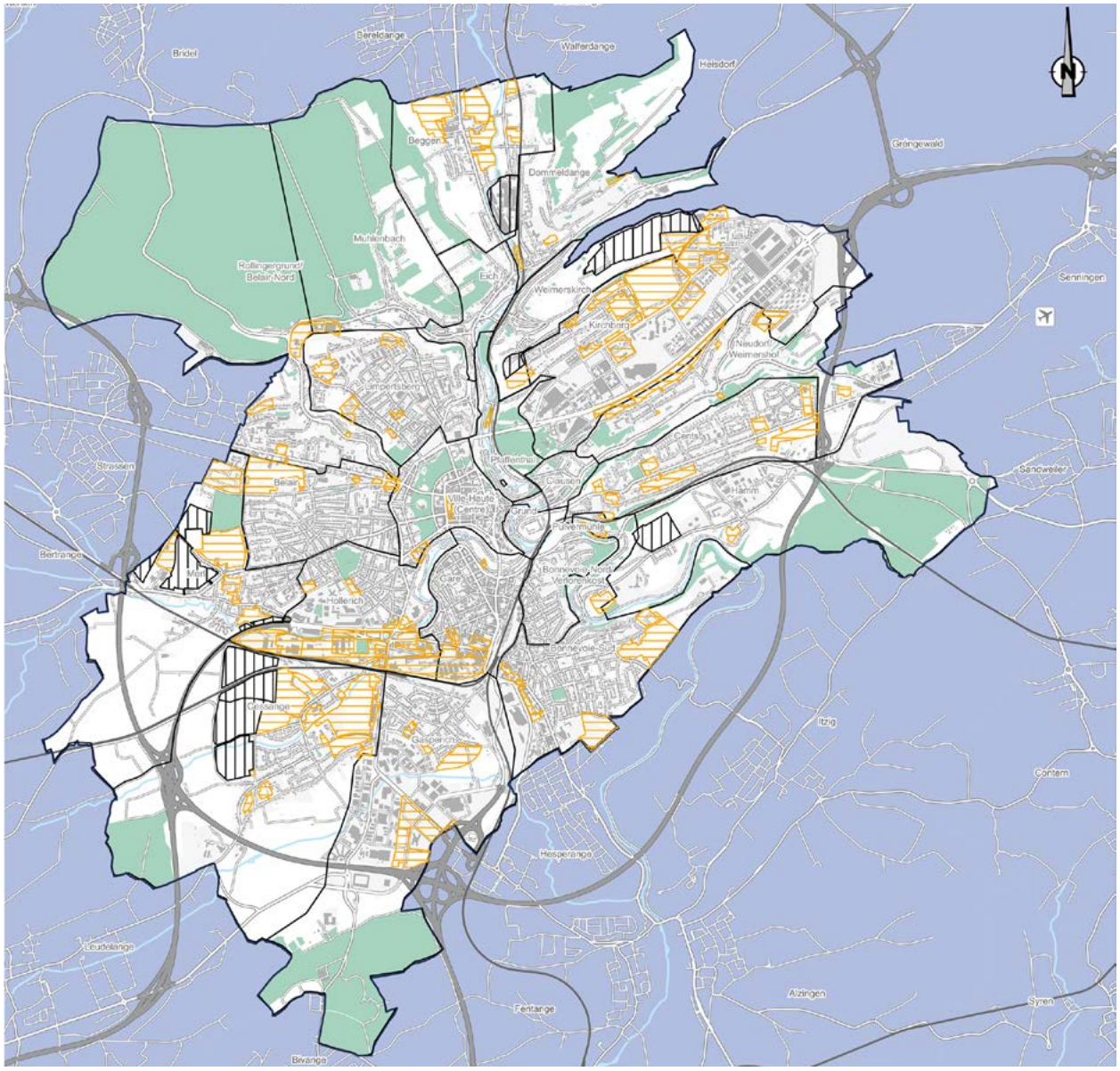
While large areas of Luxembourg City have already been built up, there are still plenty of large areas available for development. Some of these are converted areas or brownfields, while others are made up of agricultural land that has already been legally designated as building land in the General Development Plan (*Plan d'aménagement général* – PAG).

Over the past 20 years, the number of people living in Luxembourg City has grown just as rapidly as the number of jobs. According to forecasts for the next decade, this trend is set to continue. The PAG is based on an estimated 46% increase in the number of residents (from 123,391 in 2020 to 179,908 in 2035) and a 30% rise in the number of jobs (from 168,000 in 2020 to 218,583 in 2035) (c.f. **Figure 2**).



Graphic 6: Residents and jobs by district (reference year 2020 and forecast 2035)
Source *T* (CMT) 2021, c.f. Figure 2

In the short and medium-term, this growth will be focused largely around the districts of Kirchberg, Gasperich and Hollerich. Major constructions projects are already underway or are being planned in areas such as Nei Hollerich, Kirchberg-Laangfur and Kuebebierg. In the longer time, foreseeably from 2035 onwards, developments will be primarily centred around the south-west of the city, which is home to the largest areas of land identified for development (see Graphic 7). Urban boulevards will be built in Merl and Cessange to make these areas more accessible from the rest of the city.



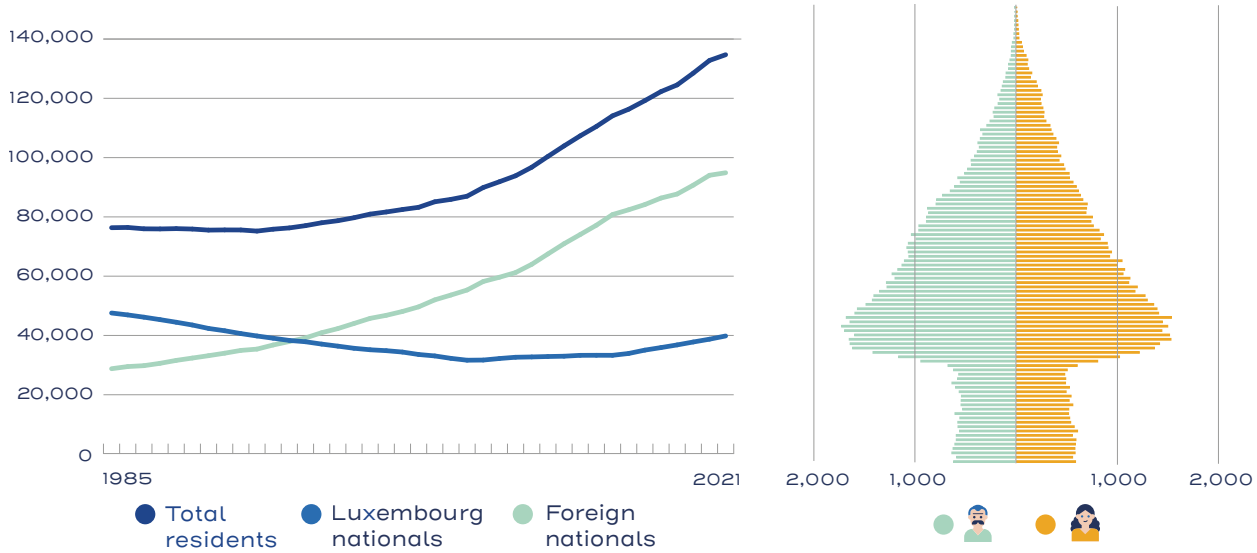
Short to medium-term urban development (PAP „nouveau quartier“) – 408,5 ha

Long-term development areas (Zone d’aménagement différée) – 141,3 ha

Graphic 7: Short, medium and long-term urban development – Source CMT 2021

This rapid urban development has a fundamental impact on the development of the country as a whole. After all, around 20% of the population and nearly 40% of jobs in the Grand Duchy are located within Luxembourg City. Because the city is of such major importance, national and municipal plans interact and influence one another. Therefore, one of the key challenges involved in the PNM 2035, which was published by the Ministry of Transport in spring 2022, is to manage existing and future mobility needs in connection with Luxembourg City. This requires lots of national-level initiatives, such as expanding train capacities or building a third lane on the A3 highway for buses and car-pooling. The PNM also proposed expanding public transport within Luxembourg City (in particular trams).

Luxembourg City's mobility requirements are also influenced by its topography. The city essentially comprises a large plateau, which is split in two from north to south by the deep Alzette valley, plus a few more smaller valleys. These are challenging conditions for non-motorised transport, with the result that costly infrastructure, such as lift facilities, is required to overcome these barriers.

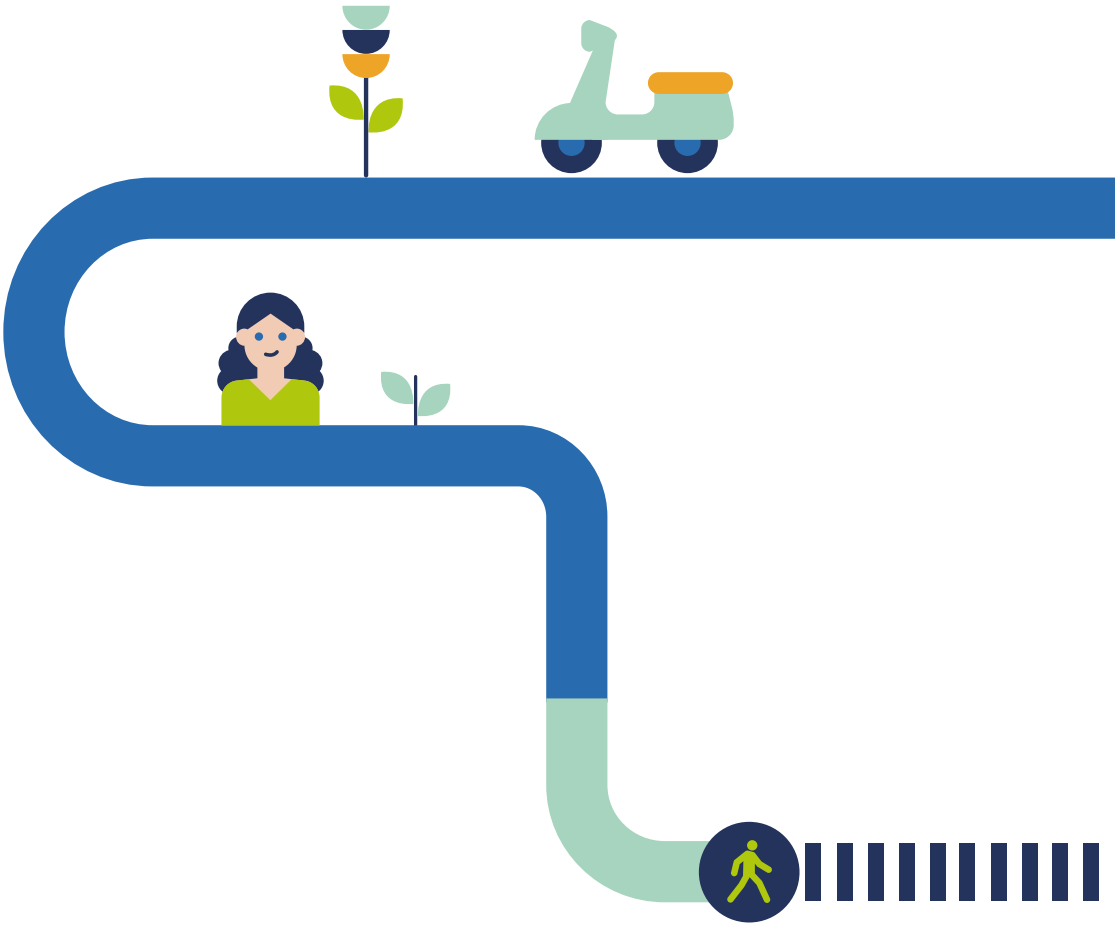


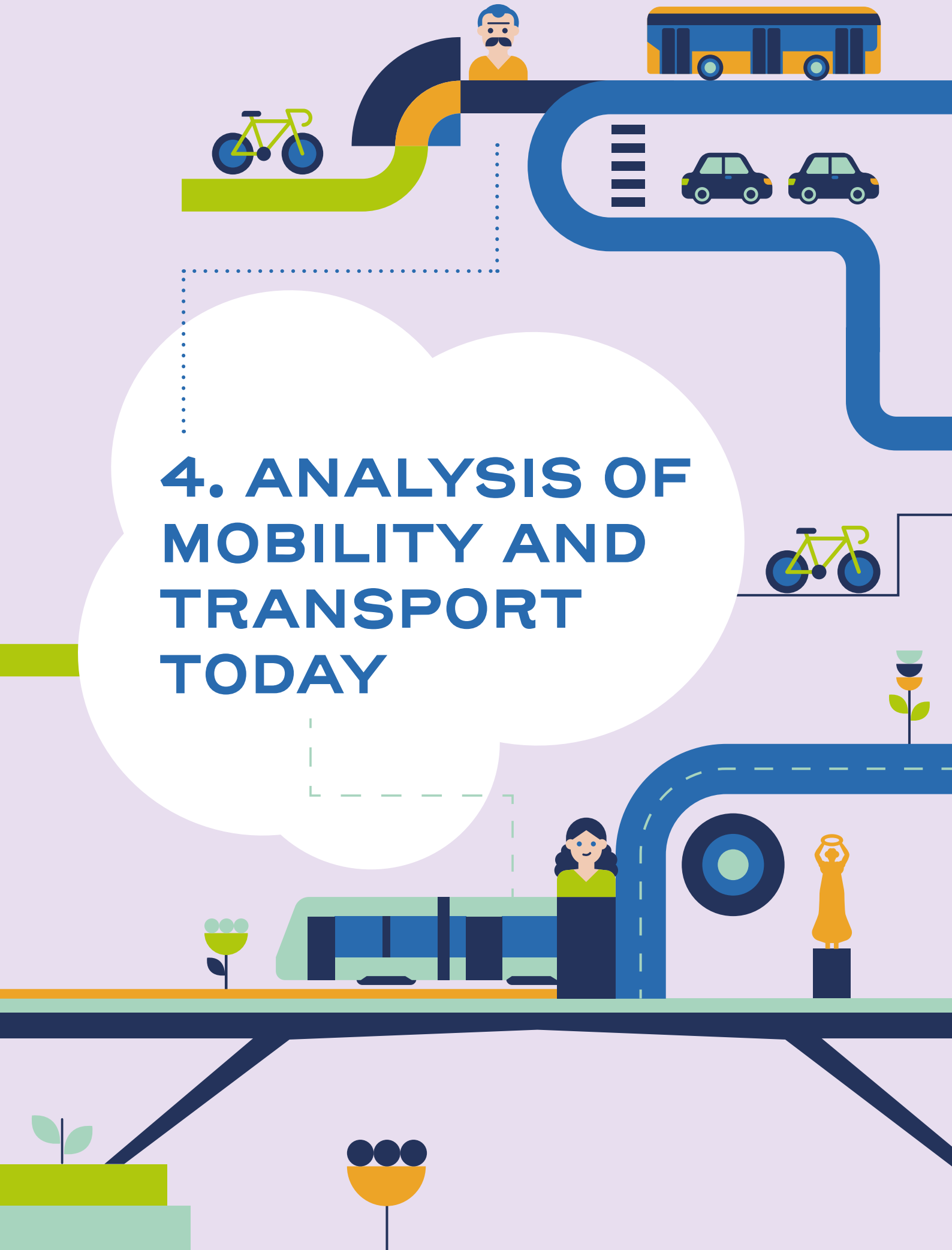
Graphic 8: Population trends in Luxembourg City 1985-2021 (left) Age breakdown of population in 2021 (right) (Source: VdL – *Etat de population 2021*)

The number of people living in Luxembourg City has grown extremely rapidly since the mid-90s, almost exclusively as a result of people moving to the city from abroad. This strong influx of migration can also be seen clearly in the age pyramid which indicates an extreme surplus of people of working age living in the city. Nevertheless, there are also many children and retired people living in the city, and their needs also need to be taken into account in the Mobility Plan.

Conclusion

Luxembourg City continues to undergo extremely dynamic growth within the agglomeration of the country's Centre region. Moreover, the city boasts areas that will be significant for short, medium and long-term development, as well as considerable potential for densification. This enormous development potential nevertheless means equally high demands on the development of mobility and transport, which need to be anticipated and managed.





4. ANALYSIS OF MOBILITY AND TRANSPORT TODAY

4 ANALYSIS OF MOBILITY AND TRANSPORT TODAY

4.1 Mobility in Luxembourg City

4.1.1 Overview

Luxembourg City has access to a wide variety of data on mobility, such as from the 2016 Ilres study and the 2017 Luxmobil survey[1]. Most results relate to the whole of Luxembourg. However, it is not possible to simply apply these data to Luxembourg City with the mobility offers currently available, and empirical values from real-world experience must be used in some areas. In addition, the framework conditions for mobility in Luxembourg City have changed significantly since 2017. The following aspects, in particular, are worth highlighting:

- Launch of tram system in 2017
- Gradual development of the vel'OH! bike sharing system and, in particular, transition to e-bikes in 2018, with a more than seven-fold increase in user numbers by 2022
- Lasting impact of the coronavirus pandemic on mobility behaviour (changes in choice of routes and modes of transport)
- Free public transport introduced in February 2020

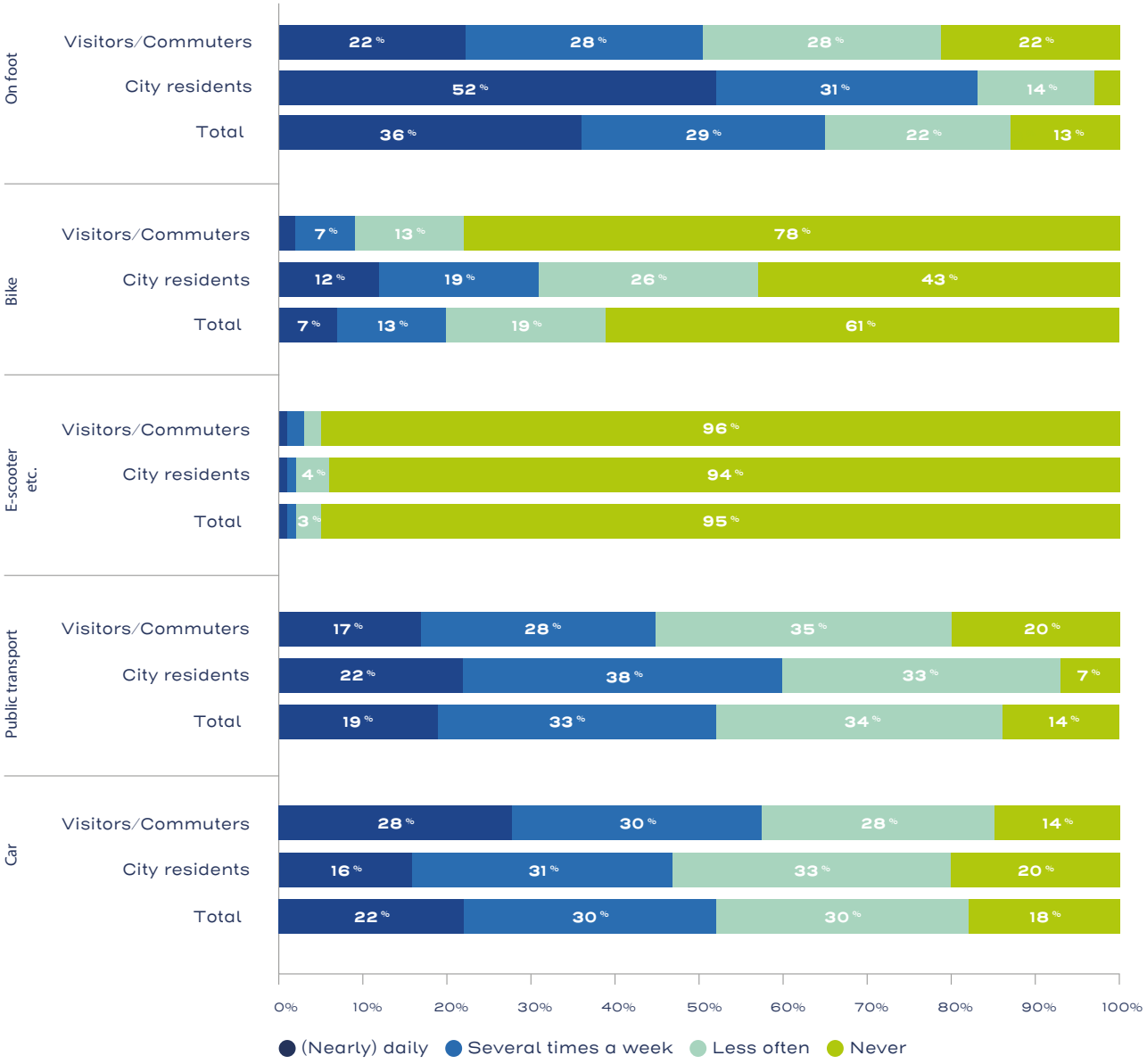
For this reason, an online survey was conducted as part of the public consultation on which mode of transport people choose. The results provided interesting data on mobility in Luxembourg City and backed up the empirical values described above. These data are explained in detail below.

1 *Enquête Luxmobil 2017, Initial results*
Presentation by Minister for Mobility François Bausch, December 2017

4.1.2 Results of online survey on mobility behaviour in 2021

An online survey was run between 14 October and 14 November 2021, focusing on mobility behaviour. Respondents also had the ability to submit comments on particular problems and suggested solutions. The survey was intended to encourage residents to engage with the issue of mobility. This laid the groundwork for continued public involvement in the drawing up of the Mobility Plan. The results of the survey are not statistically representative but they do paint a picture of the overall mood, which can be used as a basis for further discussions and offers important information for analysis and concept design.

The survey began by asking respondents about how frequently they chose each mode of transport each week (i.e. not limited to working days).



Graphic 9: Frequency of use of transport by city residents and visitors/commuters

The following rough findings are of particular interest:

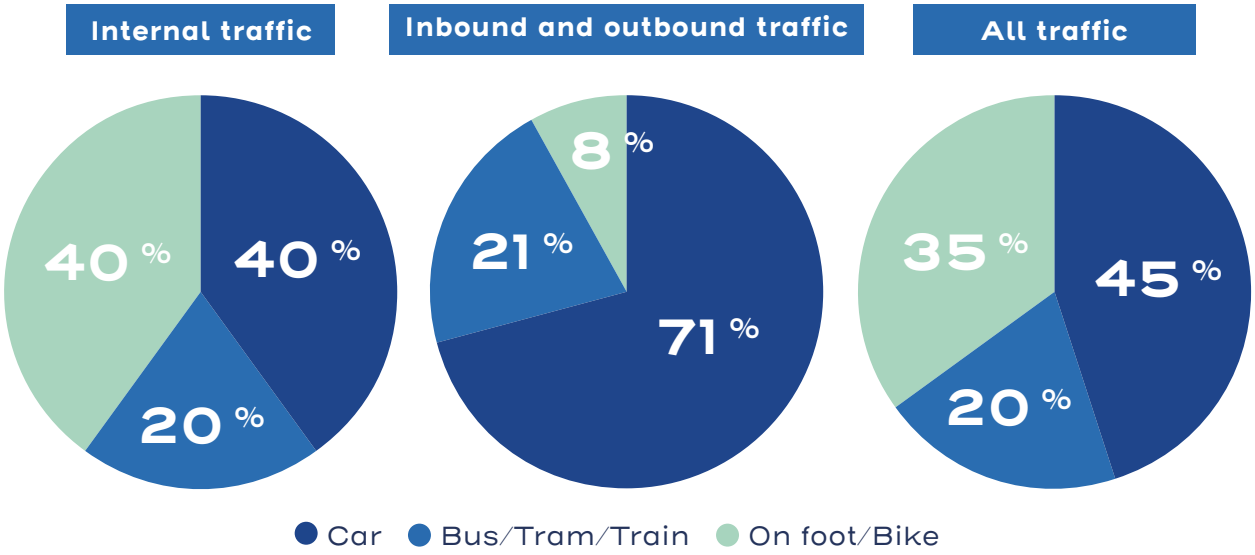
- Unlike visitors/commuters, city residents are more likely to choose active mobility. 83% of residents travel by foot (almost) every day or several times a week. However, this question is difficult to interpret since nearly every route travelled by car or public transport starts or ends with a walk. Additionally, these routes relate only to pedestrian routes in Luxembourg City.
- 31% of residents cycle (almost) every day or several times a week, while a further 26% cycle occasionally.
- Electric scooters have so far played only a minor role. This is likely due to the fact that there is not yet any form of public sharing system.
- Public transport is nearly as important to residents as motor traffic. 60% use public transport (almost) every day or several times a week, significantly more frequently than commuters.
- When it comes to motor traffic, we see the opposite trend. 58% of commuters use their car (almost) every day or several times a week. For residents, this figure is significantly lower, at 47%.
- Walking and cycling increased the most as a result of the pandemic. Over 88% of residents indicated that they have been walking or cycling more frequently since the pandemic. Use of cars remained almost unchanged, while public transport suffered significantly (56% less frequently than pre-pandemic). However, it is possible that this snapshot is no longer wholly accurate.

Overall, respondents are less inclined to use their car than was the case in the 2017 Luxmobil study, commissioned by the Ministry for Mobility, which surveyed residents of Luxembourg and cross-border commuters. It can be assumed that the changes in the framework conditions described above are increasingly leading to a change in the choice of transport as well. The various transport-related opinions and information from the survey will be examined in further analyses.

4.1.3 Workday Mobility 2020

The mobility of a city's population on workdays, and in particular the modal split of users across different modes of transport, is largely recorded empirically and is used to illustrate the status quo. Empirical data collection tends to focus on the workday modal split, such that traffic models based on these data take the levels of traffic on workdays to be the norm. By using these values in the model – both as the input value and the output value – it is possible to compare the current situation with potential future scenarios and thereby assess their impact.

When preparing the traffic model for the Grand Duchy, the data on choice of transport were cross-referenced with data from the 2017 Luxmobil in order to ensure the plausibility of the model. The model was then supplemented using data recorded on motor traffic and public transport, such that these values can be assumed to be realistic. Results for the modal split for 2020 were obtained using a calculation which took into account changes in the number of residents and jobs and in the means of transport offered in terms of road transport and public transport. However, there do not exist any direct reference data for the share of pedestrians and cyclists which could be used to confirm the results. The results were therefore cross-referenced with well-known and recognised systematic empirical sources.[2,3] The modal split produced using this calculation can be described as follows (deviations of approx. 5% may occur due to a lack of empirical data):



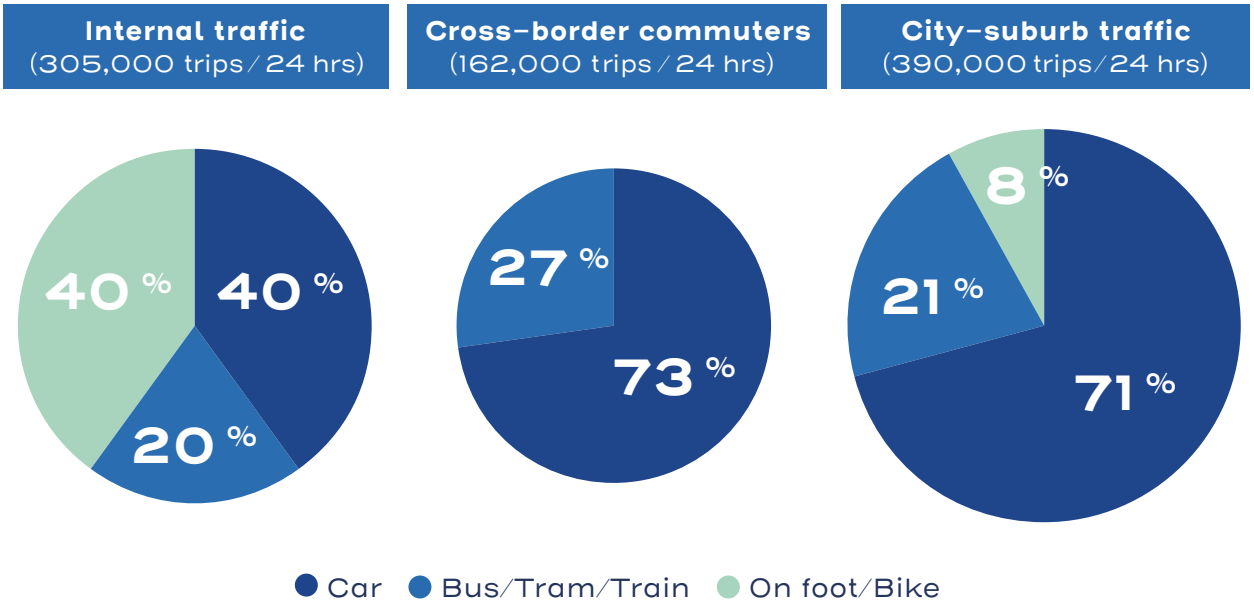
Graphic 10: Choice of transport among residents of Luxembourg City in 2020 (primary mode of transport in each case)

Within Luxembourg City, residents walk or cycle just as much as they take the car (either as a driver or a passenger). Public transport is currently used around half as frequently as the car for trips around the city. In travel between the city and its surrounding areas, on the other hand, the car absolutely dominates, while the share of pedestrians and cyclists is significantly lower due to the distances involved. Public transport is used to a similar extent for trips both outside of and within the city. Overall, the clear leader is motor traffic.

2 *"System repräsentativer Verkehrsbefragungen (System of Representative Travel Surveys)" (2018), TU Dresden (see https://tu-dresden.de/bu/verkehr/ivs/srv)*
3 *Cross-City Mobility Comparison 2015 (see https://skm-cvm.ch/de/Info/Fakten/Stadtevergleich_Mobilitat)*

4.2 Flows of commuter traffic to and from Luxembourg

The Grand Duchy is a destination for many commuters every single day and in particular Luxembourg City due to the number and attractiveness of jobs on offer there. In addition to commuters from the Grand Duchy itself, many workers also come from other countries on working days, in particular from France, Germany and Belgium. It is not possible to explicitly define the inbound and outbound commuters from the transport model. Data is, however, available on the numbers and modal split of all inbound and outbound traffic (commuters, visitors etc.) between Luxembourg City and the neighbouring municipalities, the rest of the country and other countries.



Graphic 11: Modal Split 2020 Cross-border commuters/city-suburb traffic compared with internal traffic

The graphic shows that there is significantly more traffic crossing the city limits than travelling within the city (81% more trips across city limits than within the city). It is also worth noting that cars account for a significantly higher proportion of the modal split here compared with inner-city traffic. Cars are used for 73% of commuters and 71% of city-suburb traffic, compared with around 40% for internal traffic. In terms of the scale of commuter traffic in Luxembourg City, there are virtually no comparable examples anywhere else. There are, however, many other cities where use of a car plays a major role in the modal split between the city and its surrounding areas (see System of Representative Travel Surveys by TU Dresden), due in part to the long distances involved and also the quality of public transport outside of the urban area.

4.3 Analysis of public transport

4.3.1 Basis for analysis of public transport

Public transport was assessed based on the following aspects in particular:

- Regional and inter-regional integration
- Large-scale access of the urban area
- Service frequency and operating times
- Accessibility (directness, number of changes, time from start point to destination)
- Available space and capacity utilisation
- Average tram and bus speeds
- Punctuality and reliability
- Accessibility and other conditions for use

It should be noted that the analyses refer to 2020 and that a number of changes have taken place since then.

4.3.2 Analyses and assessments of public (local) transport

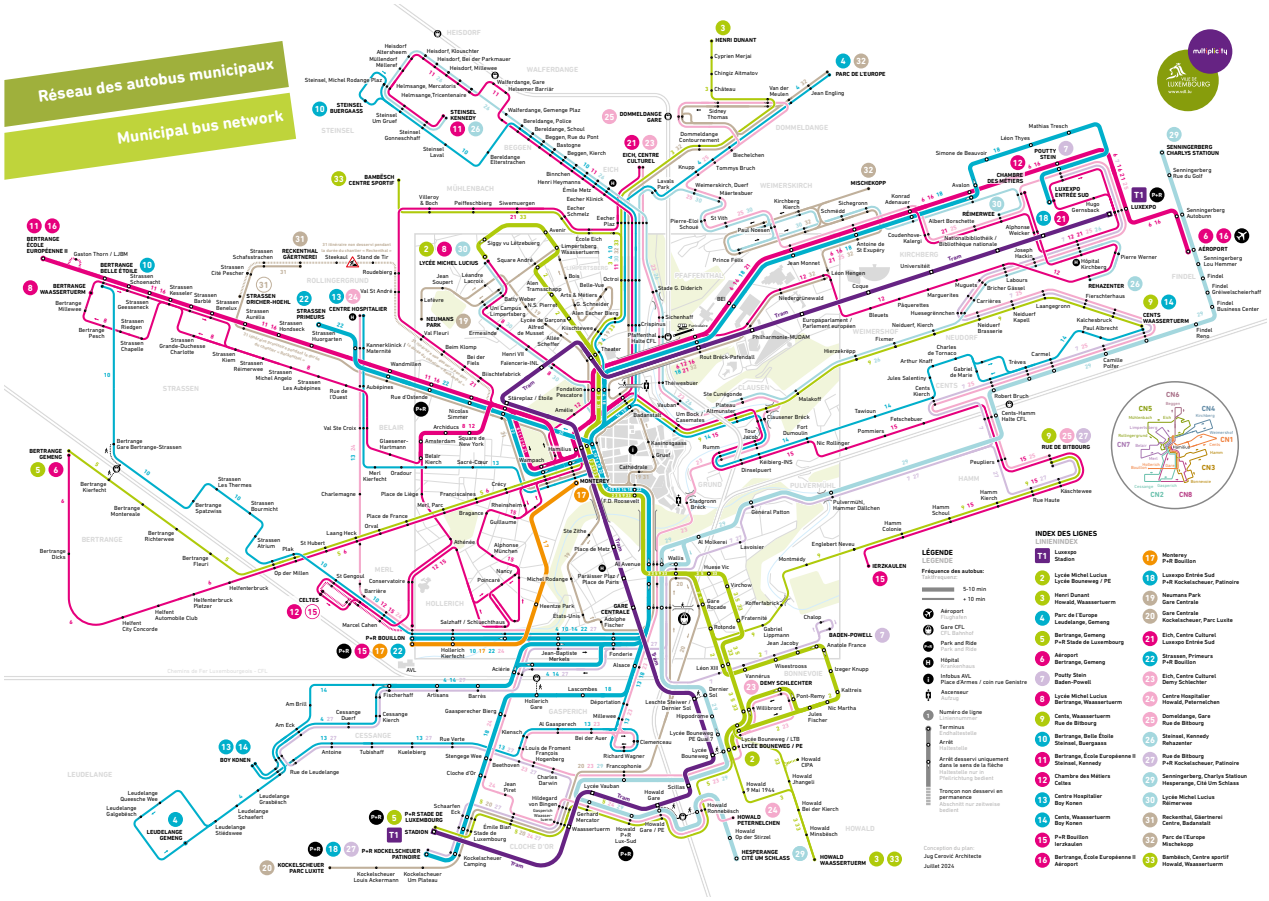
Regional and inter-regional integration

Luxembourg City is the capital of Luxembourg and the centre of the metropolitan area. As such, the city is a hub connecting various different train lines. The city is not located directly on one of the main European transport lines but it is connected to the line running to Paris thanks to its highly attractive direct TGV connection. However, reaching important parts of the commuter belt for long-distance cross-border commuting is not easy. For example, there are no direct or high-speed train connections to Frankfurt and Saarbrücken in Germany or to Belgium. There is, however, a dense network of train lines serving the area around Luxembourg and connecting it to neighbouring countries (Trier in Germany, Longwy and Thionville in France, Arlon and Liège in Belgium). Ten regional and high-speed train services run on these routes at very frequent intervals. In addition, there are buses to other major destinations, including inter-regional connections (e.g. direct bus routes to Saarbrücken).

A further characteristic of the current regional integration is the large number of regional bus routes (*Régime Général des Transports Routiers* – RGTR) connecting Luxembourg City to surrounding areas in all directions. This network is being gradually updated to reflect changing circumstances and requirements. Many connections take passengers right into the city centre and overlap with Luxembourg City's bus and tram networks (*Autobus de la Ville de Luxembourg* – AVL). The many direct connections produce parallel traffic routes, with the result that some stops (e.g. "Fondation Pescatore") are pushed to the limits in terms of their capacity. Nevertheless, changes during journeys cannot be avoided. Overall, Luxembourg City is easy to reach from the Grand Duchy and from neighbouring regions of other countries.

The public transport network in Luxembourg City in 2020 and improving connectivity

The municipal transport network between Luxexpo and the central train station is dominated by the tram, which became operational in 2017 and was expanded in 2020. A further extension to the line was completed in 2022, running to the "Lycée Bouneweg" interchange. The sections running to the southern terminus (*Cloche d'Or*) and Findel Airport are close to completion. Public transport in the city centre is complemented by municipal AVL buses and some RGTR lines that run through the city.

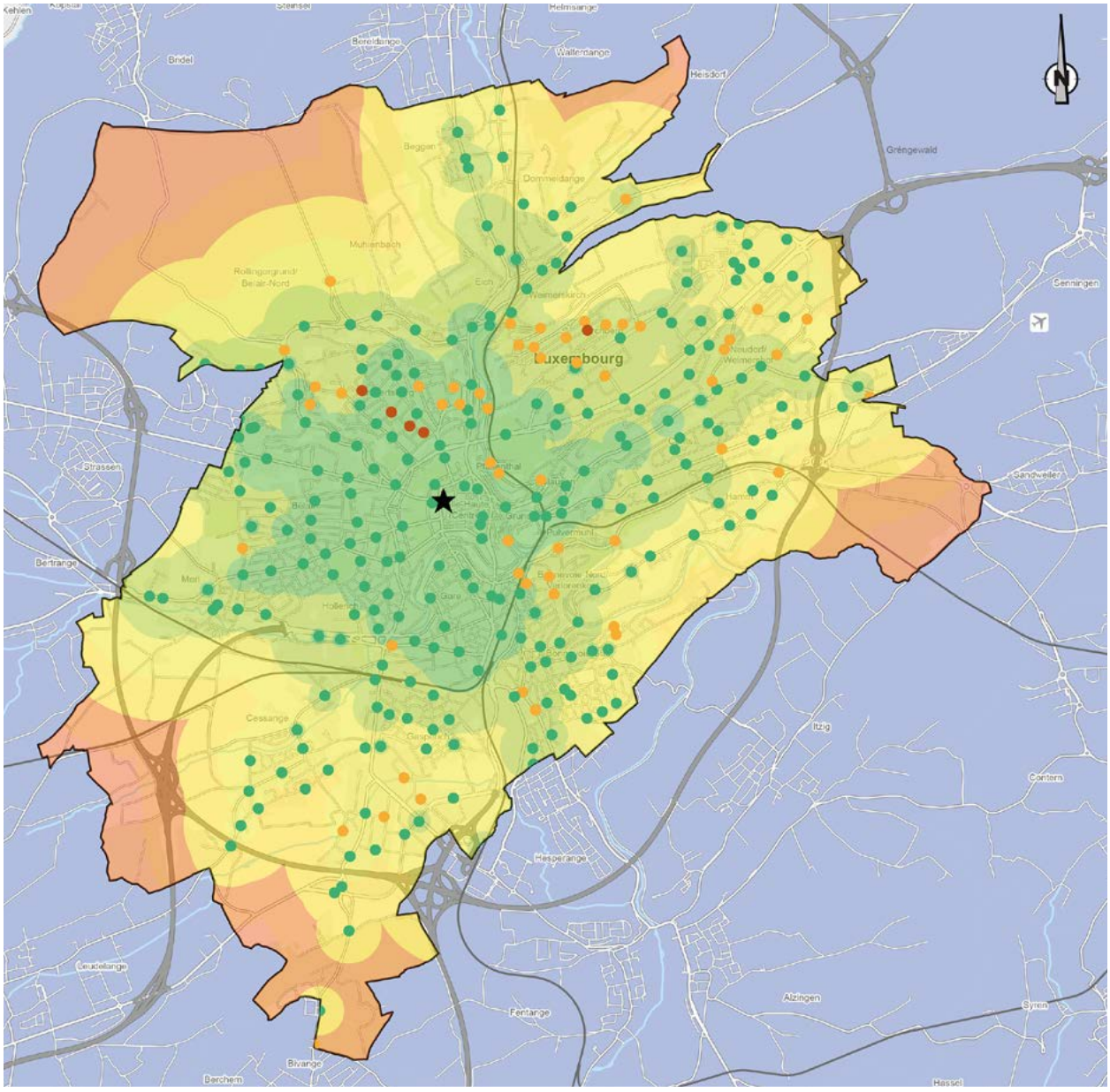


Graphic 12: Luxembourg City public transport network in 2024 (Source: bus.vdl.lu)

A 2020 analysis of the transport services available revealed nearly 100% coverage. As at 2020, 97% of the built-up urban area is within 300 m of a tram or AVL stop. This is generally considered to be a good level of coverage (see also Figure 3). The tram runs between approximately 5:00 am and 1:00 am, at four-minute intervals during peak times and eight or fifteen-minute intervals during off-peak times. AVL buses operate between approximately 5:00 am and midnight. These buses run every 10 to 30 minutes, depending on the time of day, demand and the importance of the line. Buses also run more frequently on sections of some of the more high-demand lines. Night buses run in all directions every 30 minutes on Fridays and Saturdays from the "Hamilius" stop. Departures of AVL buses and trams are displayed in real-time at bus and tram stops and in the Luxembourg City app "cityapp – VDL", keeping users continuously informed of departure and waiting times.

Accessibility within the city

Comprehensive analyses were carried out in order to assess the accessibility of the city by public transport, using the traffic model and geographical information systems (for an example assessment of specific stops, see Figure 4). Because the accessibility of the "Hamilius" stop was reviewed during the analysis of the accessibility of other stops, **Figure 4** is only an example.



Graphic 13: Qualitative accessibility analyses based on the "Hamilius" stop
(Data used: CMT model, www.geoportail.lu, AVL)

The analyses include statements on frequency during peak times, average occupancy of vehicles, and speeds per line. The analysis identified good accessibility in the districts of Bonnevoie, Limpertsberg, Beggen, Belair and Merl. Contrasted with comparable systems, the frequency of services and the seating capacity scores well. On some shorter sections, buses experience high demand during peak hours, well in excess of the number of available seats, leading to extreme stress on vehicle occupancy.

The average speeds achieved by the lines analysed are largely comparable to other systems. However, some lines occasionally achieve unsatisfactory travel times during peak times, primarily due to the waiting times at traffic lights and obstructions caused by joining regular motor traffic. Further approaches for optimising the existing initiatives could be elaborated as a result.

The structure of the transport network ensures that there are very good connections from the surrounding districts to the city centre (Ville Haute and the Gare district). Many lines within the city also create good direct connections between districts. In other areas, however, there is a lack of attractive connections between districts. For example, there is no way to travel between the western districts and the northern and southern areas of the city without changing at "Hamilius" and there is no direct, fast connection between Kirchberg and the southern areas around *Route d'Esch* and Gasperich.

Demand for public transport

Demand for public transport is highest on the tram line, which was expected and subsequently demonstrated in the *Cellule Modèle de Transport* (CMT) model calculations for the reference year 2020. The busiest route is between Ville Haute and *Place de la Gare*, with up to 35,000 passengers a day. Passenger numbers are slightly lower on routes towards Kirchberg, with around 20,000 to 25,000 passengers per day on public transport.

One tram currently has space for 76 seated passengers and 228 standing passengers. Many transport companies strive to achieve occupancy of around 60% during peak times in order to ensure that there is still sufficient space for buggies and wheelchairs. This means that each vehicle has space for around 182 passengers. Assuming trams run at 4-minute intervals, this gives a capacity of around 2,700 passengers per hour and route, or around 45,000 passengers per day (after applying certain other assumptions regarding occupancy during peak times). With around 35,000 passengers between Ville Haute and the central station, the tram achieved occupancy of around 80% in 2020. Under these conditions, some trams become incredibly full during peak hours.

While it is conceivable that services could run more frequently than every 4 minutes (services already run every 3.5 minutes during peak hours, for example), this would increase the risk of disruptions to the service and would reduce reliability. Accommodating the anticipated increase in passengers in the medium and long-term is therefore only possible to a limited extent or by accepting significant drops in quality.

Bus transport satisfying demand

Buses also experience the highest occupancy between Ville Haute and the Gare district, operating along the bus corridor that runs parallel to the tram via *Avenue de la Gare* and *Bvd. F. D. Roosevelt*. These bus lines transport around 15,000 passengers a day. In addition, some of the different bus corridors that connect up to the various districts see around 10,000 passengers per day. (e.g. *Côte d'Eich*, *Route d'Arlon*, *Avenue du Dix September*, *Val de Hamm*, *Route d'Esch*, *Route de Thionville*, *Bvd. K. Adenauer*). As mentioned above, these numbers are very much manageable with the space currently available on these vehicles.

The desired maximum occupancy rate is achieved in some areas during peak times. Given the large number of different lines in the city centre, it is virtually impossible to increase the frequency of service or create new lines. Instead, the existing bus services must be optimised in order to manage the increasing numbers of passengers in future:

- Reduce external interferences
- Continue optimising transport processes
- Create alternative public transport options

Speeds and obstructions on public transport

A major indicator of the quality of public transport is the speeds achieved, in particular when compared with motor traffic. The main factors here are the feasible route speed, waiting times at traffic lights, density of stops, and loading and unloading of passengers. In some situations, the assessment may also include other technical aspects. Speeds on tram and bus lines were analysed separately using different sets of data. The tram achieved an average speed of just over 17 kph during the morning rush hour. This is more or less the median speed achieved in comparable cities in Germany and indicates good-quality transport.

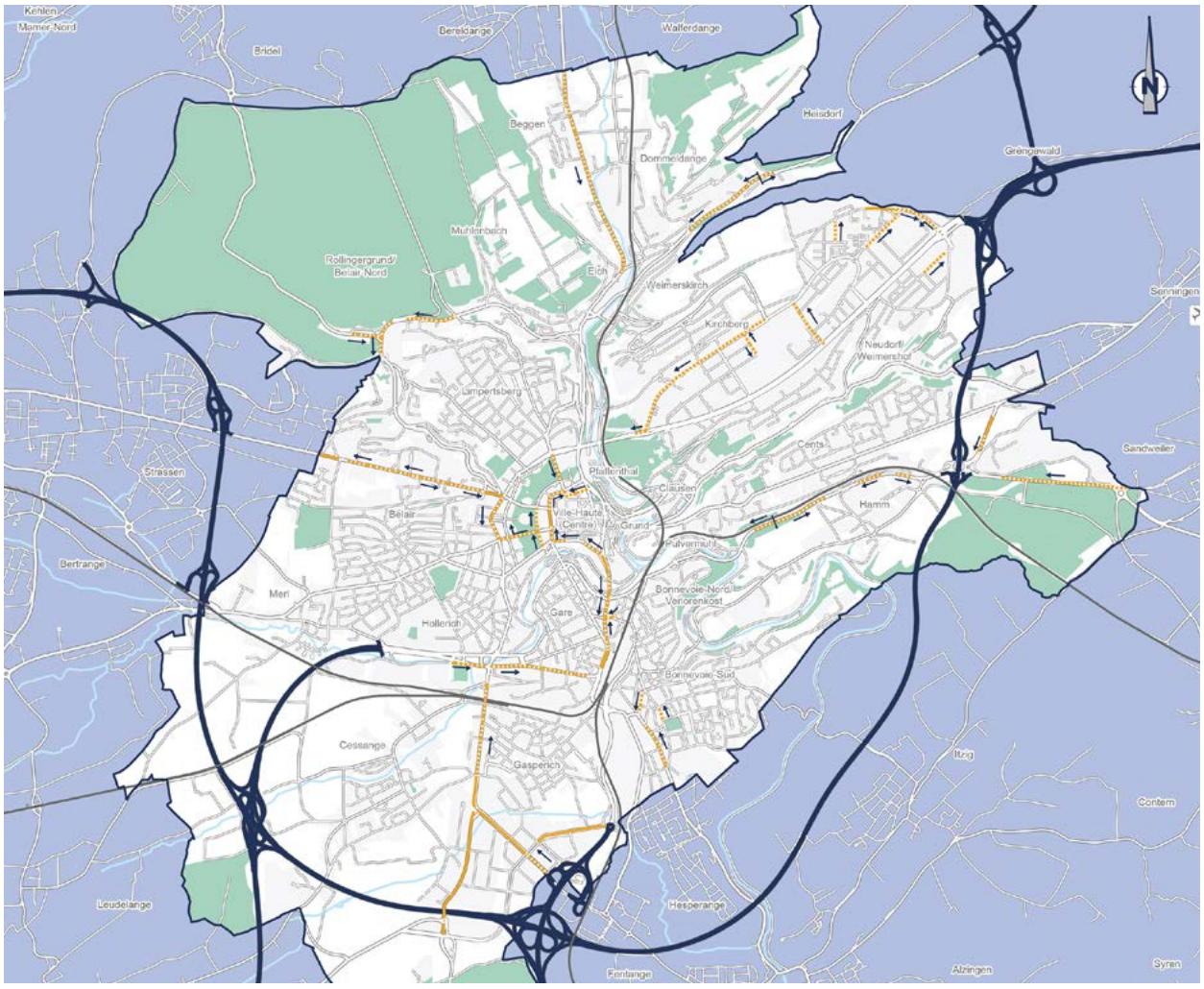
Total travel time is made up of different individual factors.

- 55% of the travel time cannot be influenced. This element is comprised of the distance which the tram covers and losses created by braking and setting off at the stops.
- 9% of the total travel time is defined by operational guidelines which frequently relate to safety, e.g. lower maximum speeds at junctions and in areas with poor visibility.
- 26% of total travel time results from calling at the stops. This element is influenced by the loading and unloading of passengers, charging times and the number of stops. It corresponds to standard figures. Since stops are already designed to be accessible, the loading and unloading of passengers is mostly quick and easy. Time is lost on sections without overhead power lines, in particular if only a few guests are embarking and disembarking. On these sections, the tram sometimes takes longer to charge than it takes to load and unload passengers. Minor improvements could be made here by introducing innovations in technology. Nevertheless, only small overall reductions in waiting times at stops can be achieved.

The impact of traffic lights

Traffic lights also inevitably influence journey time. The time lost at traffic lights accounts for a full 10% of total travel time during peak hours. When the tram system was rebuilt, however, all traffic lights on the route were upgraded to the latest technology and fitted with efficient control programs to speed up public transport. By international standards, the flow of trams at traffic lights is exemplary. Trams in Dresden, for example, currently experience a time loss of 19% at traffic lights despite a good system for prioritising public transport. This analysis takes into account the overall high volume of traffic in the city centre and the high density of nodes.

The tram also achieves good results in the analysis as a whole. In terms of journey speed, the tram achieves a rating of C on a scale from A (very good) to F (over capacity), even during peak times. Levels of Service (LOS) down to level D are considered acceptable. This level should be maintained even during peak times.



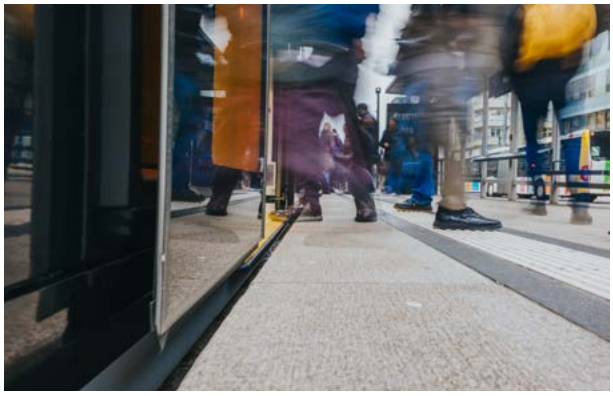
Bus lanes in both directions Bus lane in one direction

Graphic 14: Bus lanes in the city (as at 2023)

Comparable analyses were conducted for buses based on data provided by AVL. Most lines achieve a Level of Service of B and C, meaning an average travel speed of between 14 kph and 18 kph. The LOS decreases partially during peak hours. This was to be expected since buses share numerous sections of the road network with motor traffic. An overall finding is that bus transport can be given greater priority. An appropriate way of doing this would be to expand bus lanes and give buses greater priority at traffic lights. This would enable buses to reach their destinations faster – or at least as quickly, even if the number of passengers increases in future.

Interchanges and stops

When it comes to the quality of the public transport system, it is important that passengers have unobstructed access for embarking at stops, with no large gaps, steps or similar obstacles. During construction of the new tram line, the stops were designed to be of high quality and fully accessible. There is level access and only a very small gap between the edge of the platform and the tram. Embarking and disembarking from the tram is very convenient for everyone.



Photos: Tram and bus stops – © Ville de Luxembourg – Fränk Schneider

Bus stops, on the other hand, are in need of improvement, as indicated by the analysis. Not all stops are fully accessible. Sometimes there is no level access or the gap between the bus and pavement is too wide. This means that at some stops, wheelchair users are unable to embark and disembark from the bus without assistance, while passengers with walking frames and buggies have difficulties. Generally speaking, however, all stops are structurally intact.

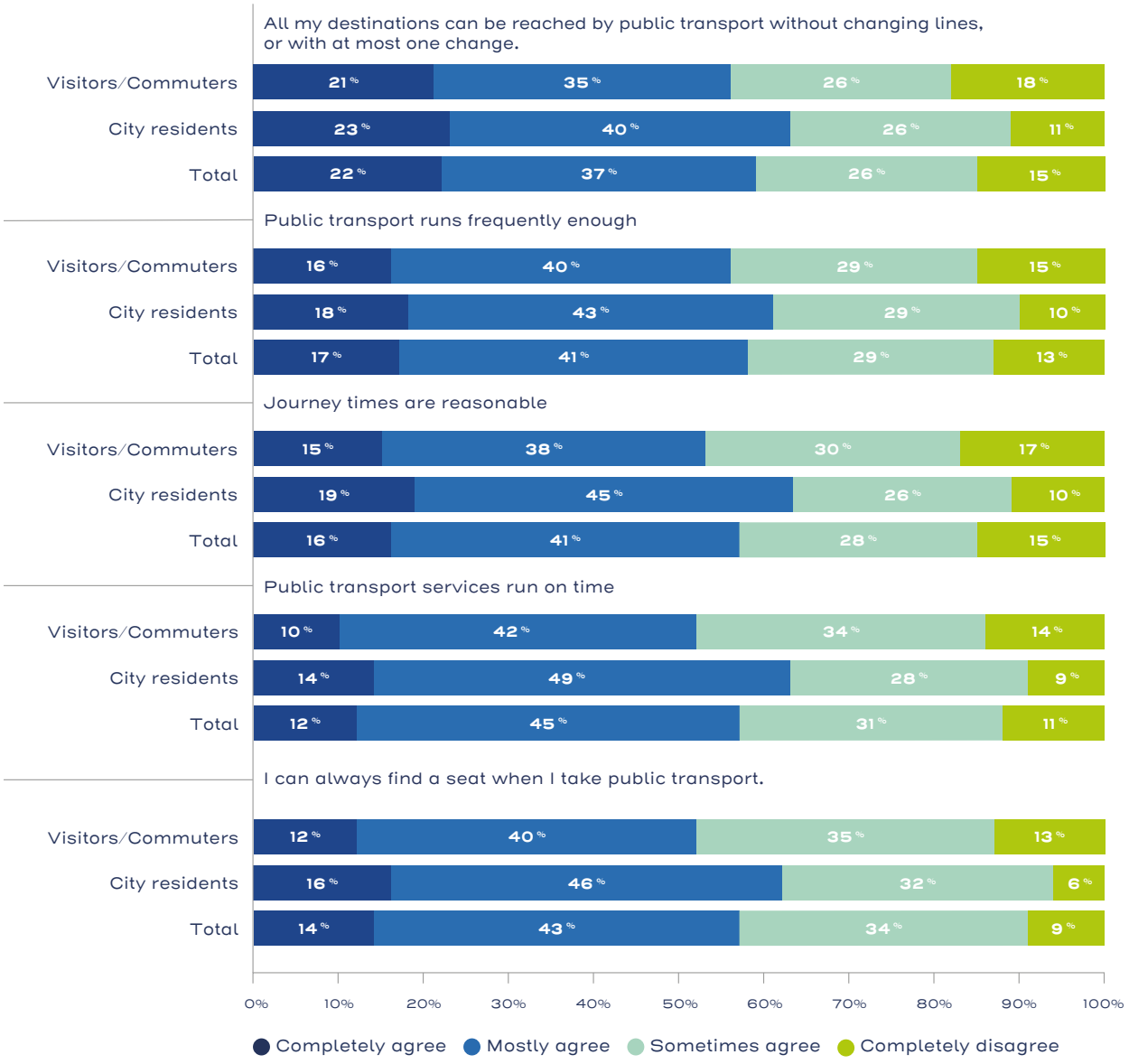
Main transport hubs

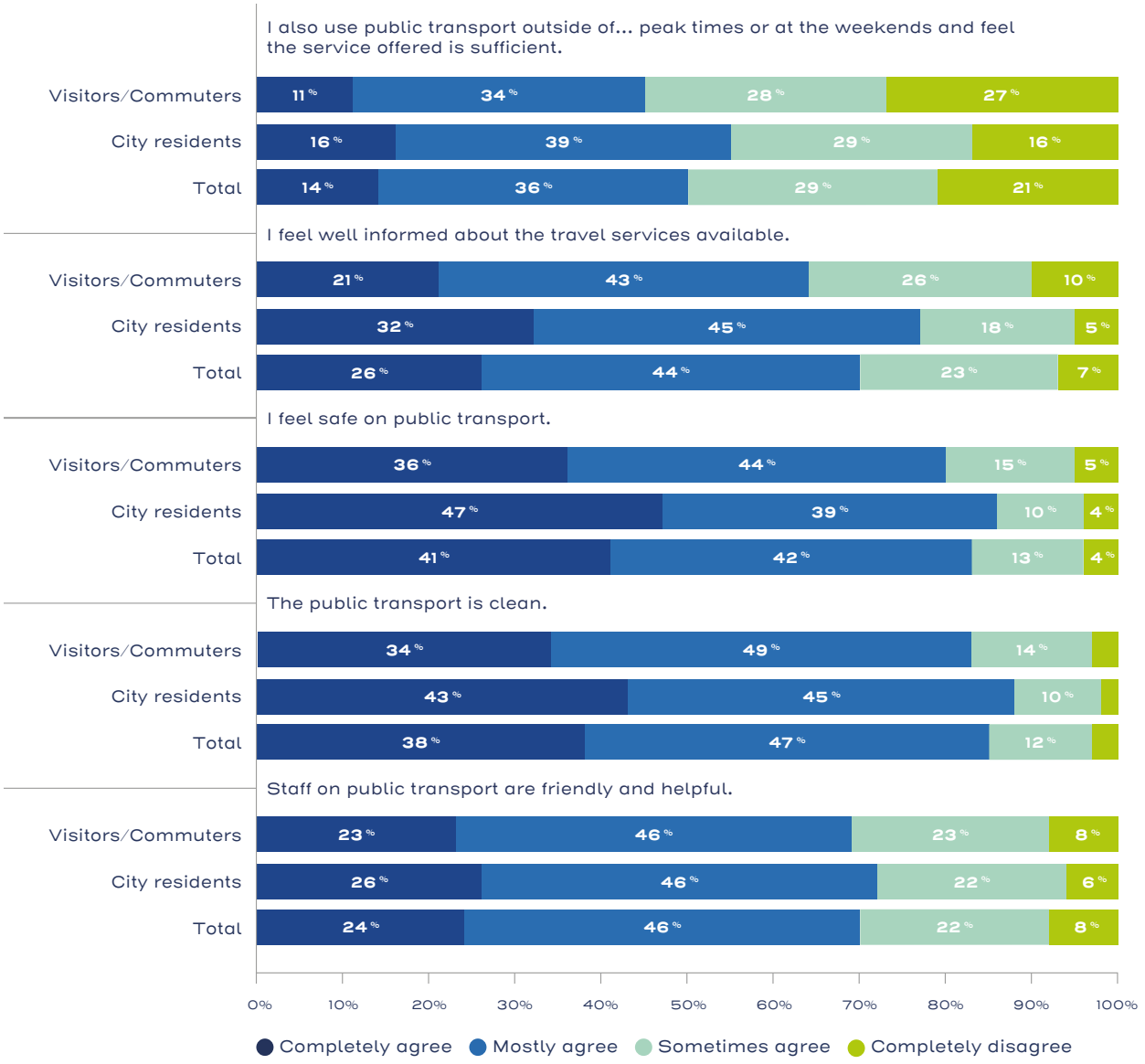
The different modes of transport offered in the city are connected by important interchanges, in particular the train stations (Luxembourg Central Station, Dommeldange, Cents–Hamm, Hollerich, Howald and Pfaffenthal). All train stations are of a modern standard. The Pfaffenthal and Cents–Hamm stations were recently modernised. The Central Station is still undergoing renovation. There are plans to modernise Hollerich. There are also a number of other hubs connecting the city's AVL buses, trams and regional bus lines (RGTR). These include the "Luxexpo", "Cloche d'Or" and "Étoile" stops, which have also been upgraded to meet the latest requirements.

Photos: © Ville de Luxembourg – Fränk Schneider & Tom Jungbluth

4.3.3 Opinion on public transport according to the online survey

Opinion on the state of the public transport system among commuters/visitors covers both inner-city and regional transport. Therefore, the statements provided by city residents are more relevant when assessing the city's public transport system. That said, there are overall no significant differences of opinion between commuters/visitors and city residents. 56% of commuters/visitors always or mostly reach their destination without having to change and the same number rate the service as sufficient or mostly sufficient. Meanwhile, a full 63% of residents reach their destination largely without changing, with 61% rating the service as sufficient or mostly sufficient. Around the same number consider journey times to be (largely) adequate.
Respondents were very positive about cleanliness (approx. 85%), safety (approx. 83%) and the friendliness and helpfulness of staff (approx. 70%).





Graphic 15: Opinions on public transport, from online survey

The service scores less well outside of peak hours and on weekends, with only around half of respondents rating the service as good. Punctuality also comes under criticism, more so from commuters/visitors than residents.

4.3.4 Assessment: Strengths, weaknesses and challenges in public transport

Strengths	Weaknesses
• Good and dense network of lines and stops, with outstanding coverage • Lots of direct connections and mostly no more than one change required within the city • Runs frequently throughout the day • Night services every 30 minutes from "Hamilius" stop in all directions • Mostly a good amount of available seating capacity everywhere • Cleanliness, safety and friendliness of staff • Modern vehicles with good equipment for prioritising public transport and real-time tracking • Good conditions for further prioritisation and quality monitoring (software, traffic computer, control devices, etc.)	• Capacity at limit on certain bus and tram lines • Some stops at full capacity • Liable to disruption due to sharing road with motor traffic and impact of roadworks • Currently no alternative tram routes (lack of network redundancy) • Isolated gaps in prioritisation of buses (bus lanes and traffic lights) • Not many direct connections (orbital routes) between outlying districts without having to travel through centre • Some connections between outlying areas and inner-city destinations in need of improvement

Taking into account the future development of the city, the main challenges in public transport are as follows:

- As the population grows, and with it the number of jobs in Luxembourg City, the demand for public transport will also increase substantially. Motor traffic must not be allowed to increase to the same degree if the city is to remain functional despite this anticipated growth (see Scenarios chapter). A greater number of passengers must be transitioned from motor traffic to public transport. Infrastructure and capacities must therefore be adapted.
- In particular, it is important that a second, high-performance public transport connection running north to south be developed in order to cope with future passenger demand and guarantee sufficient alternative routes (network redundancy).
- The division of responsibilities between regional transport (especially the RGTR bus service) and city transport (AVL and tram) must be revised in order to avoid parallel services, inefficiency and congestion at stops. The AVL network and the tram must be the first choice for passengers using public transport within the city. The number of changes required should be kept to a minimum and changes should be optimised (designing interchanges and continuing to coordinate AVL, LUXTRAM and RGTR services).
- City bus services must be sped up in order to make public transport more competitive and more attractive. Obstacles and disruptions on public transport as a whole must be identified as quickly as possible and resolved promptly. Public transport in Luxembourg City must achieve the image of a system that is reliable at all times. To achieve this, potential disruptions, e.g. from motor traffic, must be reduced.

4.4 Analysis of road network and motor traffic

4.4.1 Overview of analyses of road network and motor traffic

Analyses of the road network and motor traffic looked at the following aspects:

- Regional and inter-regional integration and types of roads
- Structure of the road network within the city
- Volumes and structures of traffic
- Capacity/flow of traffic on the road network
- Road safety
- Speeds and extent of traffic calming in residential areas
- Condition and design of streets/quality of road spaces

As with public transport, the road network cannot be examined in isolation. For that reason, this analysis also considers its integration into the regional road network, in particular the highways.

4.4.2 Assessments of the road network and flows of motor traffic

Regional and inter-regional integration and types of roads

The road network in Luxembourg City and the surrounding area is illustrated in **Figure 5**. The road network in the Grand Duchy of Luxembourg is divided into:

- Highways (*Autoroutes*)
- National roads (*Routes nationales*)
- State roads with a feeder function to the wider network (*Chemins repris*)

The road network is characterised by the A1, A3, A4, A6 and A7 highways. These roads feed into a ring road running around Luxembourg City which is currently incomplete in the north-west only. The A3 from the south and the A4 from the south-west continue past the ring road and into the city. Many national roads lead directly from the surrounding areas into the centre of Luxembourg City. These roads are supplemented by state roads. They create connections to the surrounding municipalities and also cross-connections within the city between the national roads.

Within the city itself, the roads are additionally categorised according to their function. These categories are:

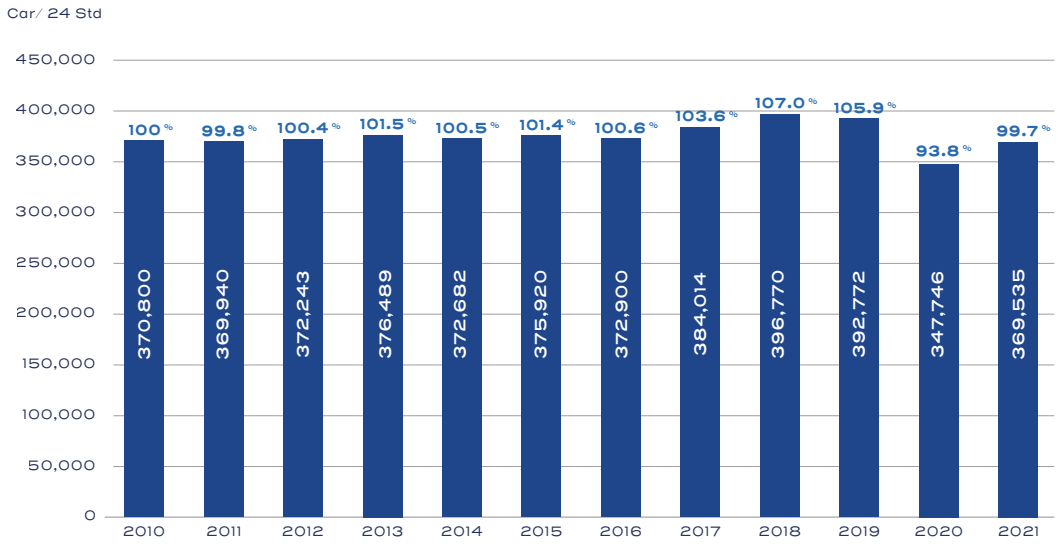
- Highways
- Main roads with primary connecting function
- Auxiliary main and connecting roads
- Access roads

Overall, the layout of the road network is logical and easy to understand. Main roads and auxiliary main roads (jointly referred to as national or state roads) lead from the outer-lying areas and highways into the city centre and are linked by additional connecting roads.

There are only a few connections between the districts that do not pass through the centre. This is mainly due to the topography and development of the city. Most road connections are therefore situated in the compact city centre. The density of classified roads is also very high and not all original classifications reflect their current function. For example, a "main road" may have developed into an "auxiliary connecting road". In some cases, the original function is almost entirely inconsistent with the design of the road. The *Rue de Glacis*, for example, is categorised as national road N52 and runs through 30 kph zones, while the CR 215 (Av. du Bois) and CR 217 (*Av. de la Faïencerie*) cross Limpertsberg even though nearby alternatives exist in the N12 (*Rue de Rollingergrund*) and N55 (*Rue de Mühlenbach*). At the same time, the CR 226 (*Itzigersté*) between Itzig and Bonnevoie falls under a lower category. Last but not least, the route which the A4 takes into the city centre to the *Nouvelle Route d'Esch* is questionable, although it has now been resolved that this route will be redesigned.

Volumes and structures of traffic

As a first step, traffic volumes were analysed in order to provide a basis for further analyses. This analysis was based on data from counters in Luxembourg City.



Graphic 16: Trends in traffic volumes at the Luxembourg City limits

Between 2010 and 2016, the total volume of traffic remained more or less stable. It only began to grow significantly in 2017 and 2018. In 2019, and in particular in 2020, traffic levels fell dramatically due to the coronavirus pandemic. They returned to 2010–2016 levels in 2021 and have now got back to their pre-pandemic levels. The population and the number of jobs and commuters is increasing. However, this increase is being partially cushioned by new initiatives, like free public transport, and new forms of employment such as working from home.

The feeder roads that are used the most are:

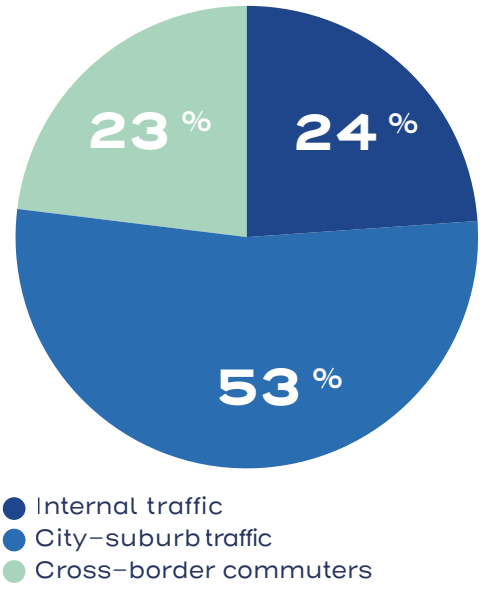
- N 51a coming from the west via A1 — 66,100 vehicles/ 24 hrs
- A4 approach (*Autoroute d'Esch*) — 45,500 vehicles/ 24 hrs
- A3 approach (*Autoroute de Dudelange*) — 39,900 vehicles/ 24 hrs
- *Boulevard F.-W.-Raiffeisen* — 33,500 vehicles/ 24 hrs
- *Val de Hamm* coming from the west via A1 — 29,100 vehicles/ 24 hrs
- *Rue de Longwy* east of A6 — 23,000 vehicles/ 24 hrs

The following road sections are the most used in the city centre:

- *Pont Grande Duchesse Charlotte* — 50,000 vehicles/ 24 hrs
- *Nouvelle Route d'Esch* — 45,800 vehicles/ 24 hrs
- *Boulevard de la Foire* — 44,800 vehicles/ 24 hrs
- *Pénétrante Sud* — 32,300 vehicles/ 24 hrs
- *Rocade de Bonnevoie* — 30,200 vehicles/ 24 hrs
- *Avenue John F.-Kennedy* — 29,900 vehicles/ 24 hrs

HGV traffic is generally well below 5% of total traffic. No network-related issues caused for or by HGV traffic were identified.

Data from the traffic model for 2020 indicate that only around 24% of motor traffic remains within the city without crossing the city limits. Roughly the same amount of traffic travels between the city and other countries. More than half of traffic (53%) travels between the city and the areas around the city, and comprises commuters from the surrounding area and residents of Luxembourg City.

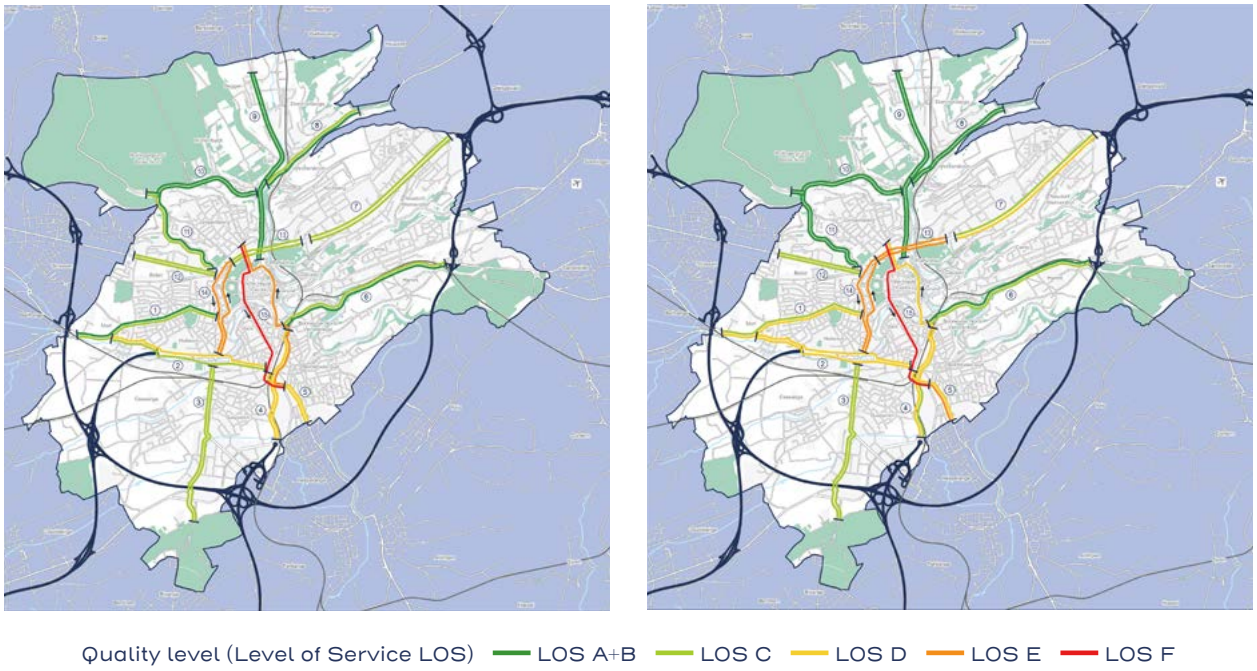


Graphic 17: Breakdown of journeys made by motor vehicle within Luxembourg City

Further analyses of the traffic model revealed that the city is also used for so-called "long-distance" inbound and outbound journeys. For example, there are significant traffic flows from within the city centre towards Kirchberg, instead of via the highway running around the city. This primarily relates to flows of traffic from the south (A3), south-east (A4) and west (N5/N6).

Capacity and flow of traffic on the road network

As a first step, journey speeds on the road network at peak times were analysed in order to assess capacity and traffic flow. This was achieved by compiling data for 15 road sections using Google Maps routing services in order to derive the Level of Service (LOS). The result (see Graphic 18) shows that capacity in the inner city is largely exhausted during morning and evening peak hours. In fact, the LOS reaches the lowest possible grade, F[5], on the section from Glacis to Pont Jean-Pierre Buchler via the Central Station. Other roads in the city centre achieve an LOS of E (the north-south Rocade de Bonnevoie/Rue du Laboratoire/Pont Viaduc/Tunnel René Konen/Boulevard Royal route in the east and the Route d'Esch/Boulevard Joseph II/Boulevard de la Foire route in the west). These east-west and north-south connections overlap in the city centre. It can therefore be inferred that the Ville Haute and Gare districts no longer have any reserve capacity. However, the graphic also shows that the approach and exit roads do not exhibit any serious shortcomings.

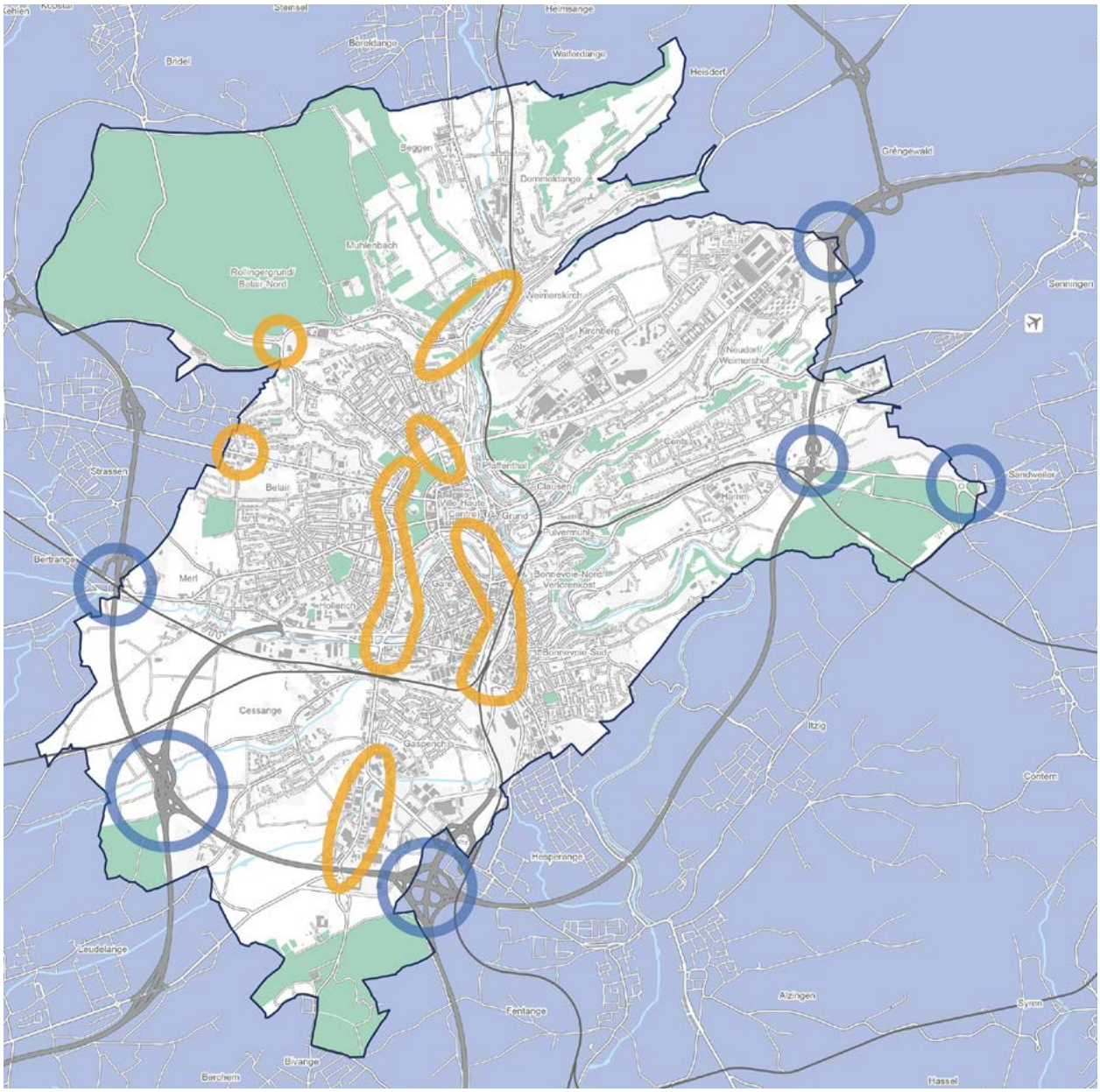


Graphic 18: Analysis of Level of Service, January 2021 (left, morning peak; right, evening peak)

Ultimately, however, an "objective" assessment of the flow of traffic was difficult to achieve due to the impact of the pandemic on traffic. As a result, certain problem areas could not be elaborated properly in the above analyses. Additional analyses based on empirical values and local knowledge produced the necessary findings (see Graphic 19). These analyses looked at several highway junctions and connection points at the city limits, as well as *Route d'Esch* in the south (up to *Bvd. Friedrich-Wilhelm-Raiffeisen*) and the hubs around *Route d'Arlon/Rue des Aubépines* and *Rue de Kopstal/Rue de Rollingergrund*.

[5] *LOS scale from A (very good) to F (over capacity)*

Regardless of the analyses conducted, other areas may also experience over-capacity or disruptions to traffic flows for a variety of different reasons, though these cannot be classified as daily disruptions.



Inner-city areas with capacity reserves largely exhausted

Peripheral network areas with recurring disruptions to traffic and clearly exhausted capacity reserves

Graphic 19: Areas of the road network with consistent capacity bottlenecks

Speeds and traffic calming

The analysis also investigated the maximum speed limits for city road traffic (see **Figure 6**). Speeds over 50 kph are only permitted on a few approach roads in areas with little or no development. Large sections of the city's districts, on the other hand, are subject to traffic calming measures, designated as 30 kph zones or even "shared spaces" where the maximum speed limit is just 20 kph. Many new bicycle boulevards have been designated since the analysis, e.g. on *Rue des Trévires*. The maximum speed limit here is also 30 kph. In some districts, there are still road sections situated within central residential areas where the speed limit is 50 kph, e.g. in Bonnevoie and Belair. Overall, however, good progress has been made on traffic calming.

Photos: Traffic calming in the city and its residential areas © Ville de Luxembourg – Fränk Schneider

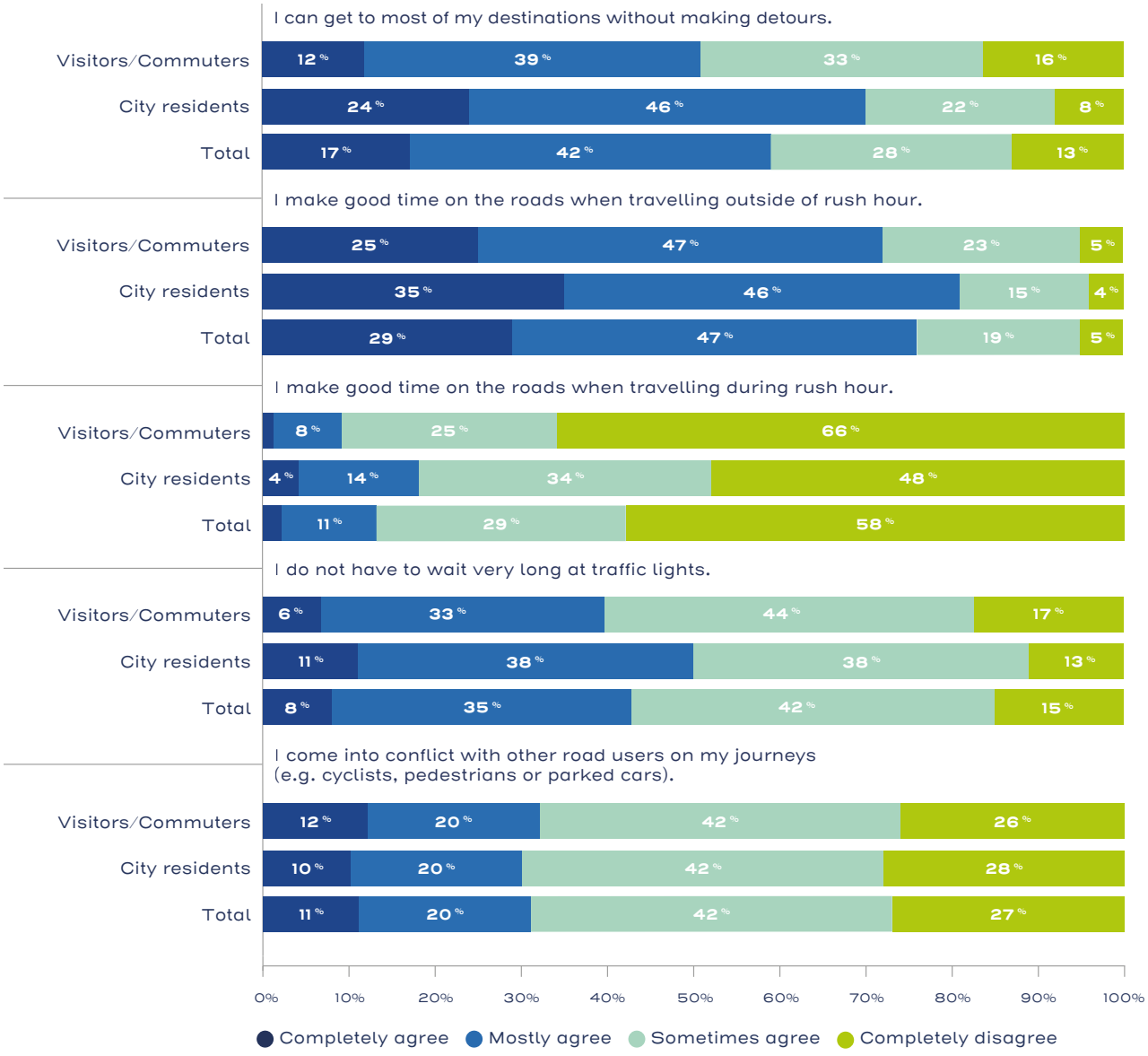
Condition and quality of road spaces

The condition of the roads in Luxembourg is generally good, both in the residential areas and in the main traffic zones. While data for a more in-depth analysis was not collected, there is no serious road damage observable.

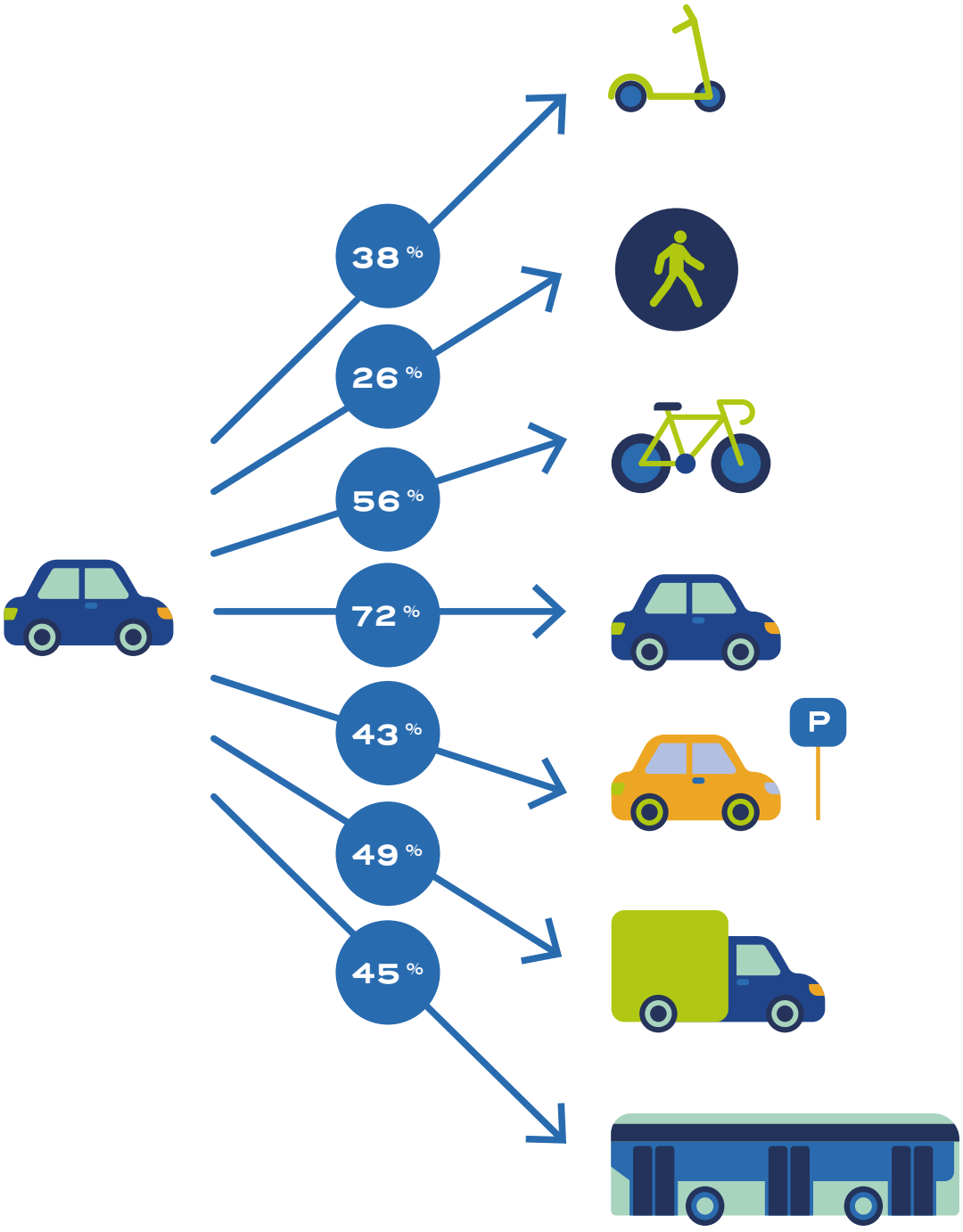
The quality of road spaces varies. Newer roads take into account the needs of all road users. Due to the difficult conditions, this is achieved to varying degrees. Often, older main roads have been optimised for motor traffic, with parking spaces on the side of the road (e.g. *Route de Thionville*, *Rue de Hollerich*, *Bvd. Grande Duchesse Charlotte*). This leaves little room for other road users, especially cyclists, or for greening measures. Combined with heavy traffic, this can have a negative impact on quality of life. Good design and greening can generally be found in the residential areas, in 30 kph zones and shared spaces.

4.4.3 Public opinions on the road network and motor traffic

During the online consultation, residents voiced their opinions on the road network and motor traffic. The results depend above all on where the respondents are from. Residents of the city indicate that it is easy to reach their destination (70%), while just 51% of visitors and commuters are generally able to reach their destination without making a detour. Overall, respondents indicate that they can get around in the city very well (approx. 76%) outside of peak times. The complete reverse is true during peak times. 87% indicate that they cannot get around the city well at all. Additionally, around 43% of respondents feel that waiting times at traffic lights are (too) long. 31% of drivers regularly come into conflict with other road users – primarily other drivers, cyclists or delivery vehicles.



Graphic 20: Public opinion on road traffic, from online survey



Graphic 21: Frequency of conflicts between drivers and other road users

In addition, a desire for even greater traffic calming measures in residential areas was expressed emphatically at public consultations. Residents feel that the heavy traffic and the speed of vehicles in many areas are unpleasant and unsafe.

4.4.4 Assessment: Strengths, weaknesses and challenges related to the road network/motor traffic

Strengths	Weaknesses
• Well-structured and comprehensible road network within city • Largely efficient roads from city limits into city centre • Road network in good condition • New road spaces are high-quality • Extensive traffic calming measures across wide area	• Highway on ring road is too unattractive, meaning that long-distance inbound and outbound traffic passes through the city centre • Lack of orbital routes between certain city districts and few alternative routes (redundancy) • Capacity in city centre largely exhausted • Some discrepancies between classification and actual function of road

Taking into account the future development of the city, the **main challenges with respect to the road network and motor traffic** are as follows:

- The state authorities ensuring the highway through the country has excellent capacity on a permanent basis in order to keep the city free of through traffic and long-distance traffic (both originating and terminating in the capital) and to reduce traffic from other surrounding areas.
- The road network in the city centre has reached the limits of its capacity. It is not possible to expand the road network in order to accommodate increasing volumes of traffic due to the topography and urban development. The challenge lies in how to transition some of the motor traffic to public transport and active mobility so that the road network remains functional even in the event of rapid growth.
- The new urban development sites must be efficiently integrated into the road network and the public transport and active mobility networks.
- Where possible, peripheral connections must be strengthened in order to ease congestion in the city centre.
- The road network is subject to heavy use and there is a lack of alternative routes. Therefore, traffic guidance systems of the highest level are required. Highways and the immediate surrounding area must also be taken into account here.
- A number of roads will require extensive renovation over the next few years, including for the better integration of public transport and active mobility. One of the main criteria here should be the local residents' quality of life.
- Consistently heavy use of the road network is intensifying pressure on the "back roads" and creating through traffic in heavily populated residential areas. This must be prevented in order to maintain and continue improving quality of life.
- The categorisation of roads and the responsibilities associated with each category must be updated to reflect current circumstances and future requirements.

4.5 Analysis of stationary traffic

4.5.1 Overview and significance of stationary traffic

The analysis of stationary traffic begins by describing the current options, their utilisation, the way in which parking spaces are organised and the technology systems. Strengths and weaknesses are then evaluated and challenges for the future are derived. The connections between stationary and moving traffic must also be taken into account here. The following aspects are analysed below:

- Availability and occupancy of parking spaces
- Availability of parking spaces at home and at work
- Organisation and management of parking spaces
- Resident parking
- Parking guidance system and digital information
- Luxembourg City regulations for the creation of parking spaces

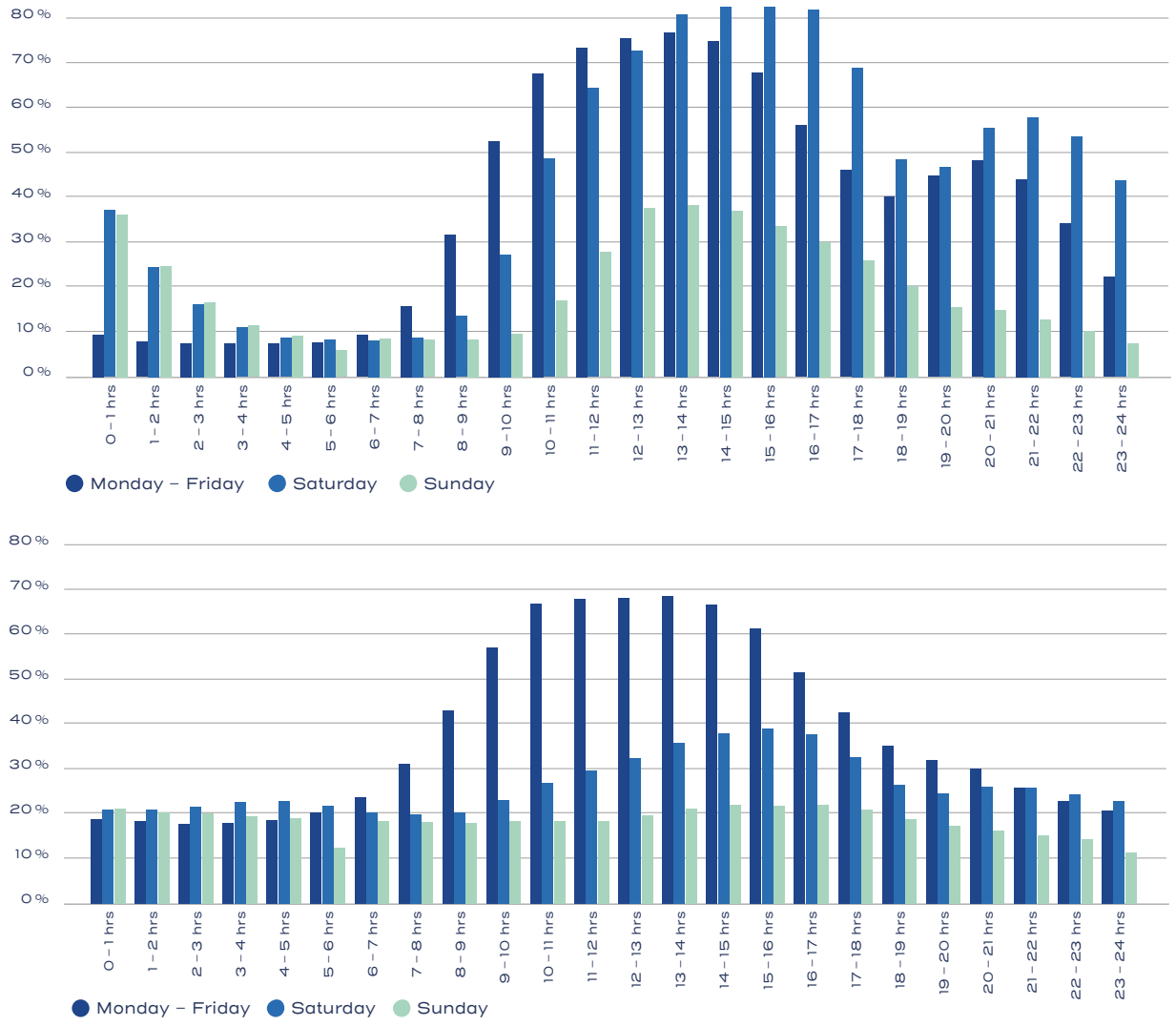
Availability and occupancy of parking spaces

Existing parking spaces are illustrated in **Figure 7**. Infrastructure in the city centre and larger-scale infrastructure, e.g. in residential areas and P+R, are described below.

The **city centre, comprising the Ville Haute and Gare districts**, has a total of 12 underground garages, multi-storey car parks and large car parks.

- 2,082 parking spaces in Ville Haute
- 1,932 in the Gare district
- 1,150 at the Glacis (the only large surface parking lot – all other parking spaces are situated in underground garages and multi-storey car parks)

Graphic 22 below shows the average occupancy of the relevant multi-storey car parks in the city centre (as at 2019). For Ville Haute, the graphic shows combined figures for the St-Esprit, Knuedler, Monterey, Royal-Hamilius and Théâtre underground garages. The figures for the Gare district relate to the Gare, Martyrs, Nobilis, Rocade, Wedell and Neipperg multi-storey car parks.



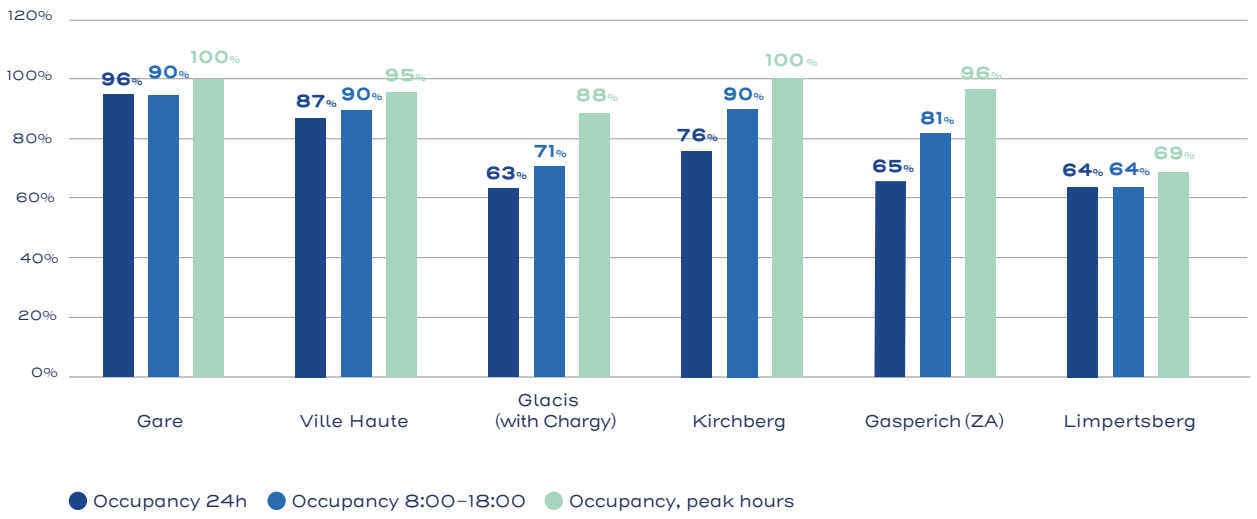
Graphic 22: Occupancy of public multi-storey car parks and underground garages in the Ville Haute (top) and Gare district (bottom) (2019)

The multi-storey car parks and underground garages in Ville Haute are very full (75%) during the day from Monday to Friday. They are busiest on Saturdays (83%). This does not mean that there are always free spaces available in every car park. Capacities at the Knuedler multi-storey car park are frequently exhausted but there are usually free spaces nearby. These are signposted by the dynamic parking guidance system displays. Generally speaking, there is still sufficient reserve capacity.

There are also on-street parking spaces, 275 in Ville Haute and nearly 1,700 in the Gare district. These spaces are used significantly more on working days than the multi-storey car parks and underground garages (>85% on average, as at 2019). At peak times, all on-street spaces in both districts are occupied, while the multi-storey car parks still have available capacity. Parking is busiest in the evenings.

The parking options available in other districts (with the exception of Kirchberg) largely consist of on-street parking spaces. There are around 32,500 public on-street parking spaces around the entire city. Data on occupancy on working days (as at 2019) are available for Kirchberg, Limpertsberg and Gasperich. Parking spaces in the commercial districts of Kirchberg and Gasperich are between 80% and 90% occupied between 8:00 and 18:00, with occupancy even reaching 100% during peak times. Limpertsberg, which is more of a residential area, is significantly less busy and has reserve capacity even during peak times.

The situation in Kirchberg is unique. In addition to its on-street parking, which experiences 100% occupancy, this district also has plenty of additional options and reserve capacity in public multi-storey car parks. In addition, there is no data available on the number and utilisation of non-public parking spaces (owned by businesses and commercial locations).



Graphic 23: Occupancy of on-street parking on public roads

Four P+R facilities are located around Luxembourg City (see **Figure 7**):

- P+R Gare de Dommeldange: well connected to train services and various bus lines.
- P+R Luxembourg Sud (A and B): close to Howald station, but poorly connected to the station itself. Multiple bus lines call at the car park and offer good connections overall.
- P+R Bouillon: well connected by AVL and RGTR buses
- P+R Stade de Luxembourg: well connected by AVL and RGTR buses

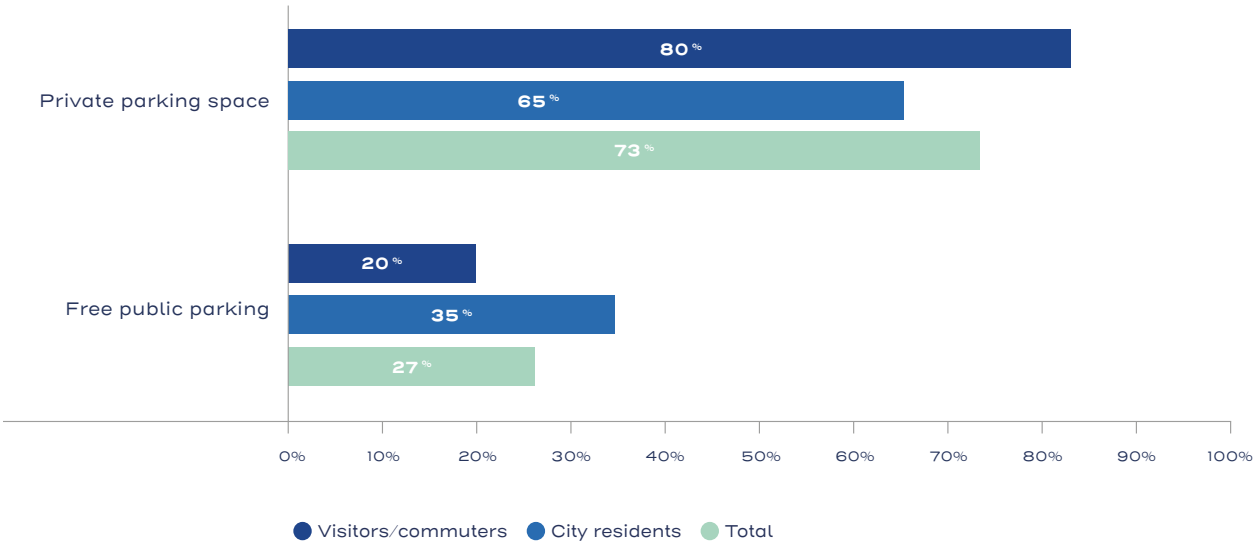
The "Gare" and "Gernsback" (next to Luxexpo) multi-storey car parks can also partially be used for P+R purposes thanks to their connections. However, there are no special fares available here for P+R. The "Gare" multi-storey car park is very well integrated into the public transport system, with ideal access to trains, buses and trams. Gernsback is also served by the tram and a number of AVL and RGTR lines. There is also the P+R Kockelscheuer car park (municipality of Roeser) which is situated just next door to Luxembourg City and is connected by AVL and RGTR buses.

Documentation is available on occupancy rates at the Bouillon, Kockelscheuer and Luxembourg Sud (A and B) P+R facilities for 2019. The car parks were nearly at full occupancy (93% to 97%) Mondays to Fridays, but there was significant reserve capacity on weekends. The P+R Gare de Dommeldange also tends to be very busy, as is clear from data collected on-site. It must be assumed that the P+R Bouillon is partially used incorrectly. Due to its location close to the city centre, its free parking spaces are used to reach nearby destinations instead of changing to public transport.

The current occupancy of many P+R locations can be viewed online at parking.vdl.lu or in the cityapp – VDL.

Availability of parking spaces at home and at work

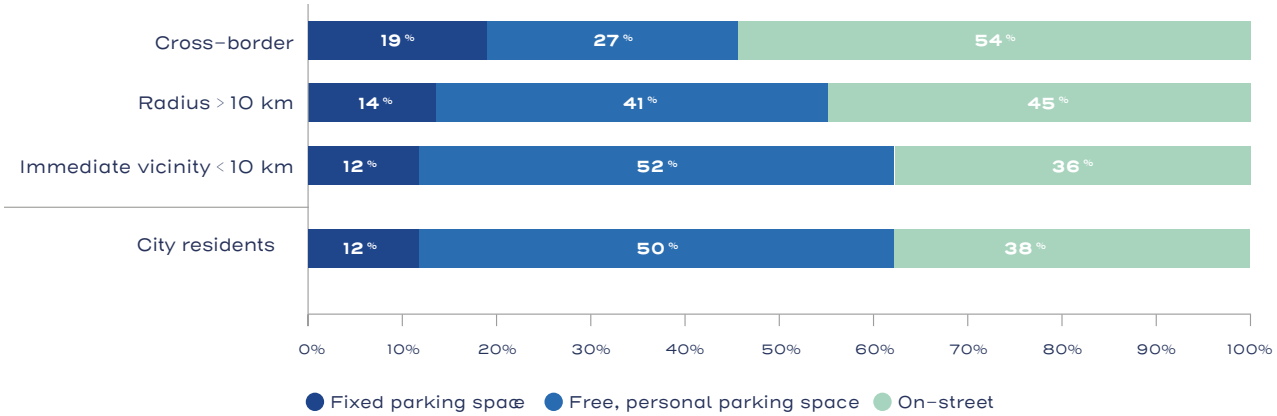
The online survey provided information on availability of parking spaces at respondents' homes and workplaces (see Graphics 24 and 25).



Graphic 24: Availability of parking spaces at place of residence

80% of visitors/commuters surveyed have a private parking space at **their home**. The remaining 20% park their vehicle on a public road where they live (outside of Luxembourg City). Among city residents, 65% still have a private parking space, while 35% rely on public on-street parking. Overall, availability of private parking spaces appears to be very high for residents of Luxembourg City.

55% of commuters also have a permanent or reserved parking space **free of charge at their place of work.** This percentage is highest for visitors/commuters travelling from the immediate vicinity, at 64%. The figure for city residents is also high, at 62%. This observation is important for mobility concepts because this situation makes taking the car an attractive option and reduces the incentive to use public transport.



Graphic 25: Availability of parking spaces and parking space type of respondents at their place of work

Parking space management and parking fees

Public parking spaces in Luxembourg City are available 24/7 and fees apply. They are divided into the following zones:

- **Orange** Zone: maximum stay 2 hrs, fee €2/hr, Mon–Fri 8:00–18:00
- **Yellow** Zone: maximum stay 3–5 hrs, fee €1/hr, Mon–Fri 8:00–18:00
- **Green** Zone: maximum stay 5 hrs, 1 to 3 hrs: fee €2/hr, then €1.5/hr, Mon–Fri 8:00–18:00
- **Violet** Zone: maximum stay 10 hrs, fee €0.5/hr, Mon–Fri 8:00–18:00

Spaces in multi-storey car parks and underground garages in the Ville Haute and Gare districts generally cost between €2/hr and €2.40/hr, or roughly the same as on-street parking.

Resident permits and resident parking

The rules regarding resident parking are rather lenient compared with other countries and cities.

Resident permit-holders can park in the zone covered by their permit for free and in other sectors for up to two hours free of charge. Priority spaces for residents are prohibited by city and national regulations, meaning that parking is always a mix of residents and other groups.

Residents of Luxembourg City may apply for a resident parking permit. The first permit per person is issued for free, while a second permit costs €60 and a third €120 per year. Residents do not have to provide any special evidence to obtain a permit (e.g. evidence that they do not have access to a private or rented parking space on their property).

Parking guidance system and digital information

Luxembourg City has a contemporary, dynamic parking guidance system. This system manages all major underground garages, multi-storey car parks and surface car parks in the Ville Haute, Gare and Kirchberg districts. Signage directs drivers to currently available spaces, meaning it can influence drivers' choices. It cannot, however, be used to pursue strategies beyond this. It could potentially be used, for example, to give people an early indication that the city centre is currently very busy, encouraging them to switch to P+R. The occupancy of on-street parking is not currently recorded either.

Up-to-date information on the occupancy of most multi-storey car parks, underground garages and P+R facilities is available on parking-vdl.lu and in the cityapp – VDL.

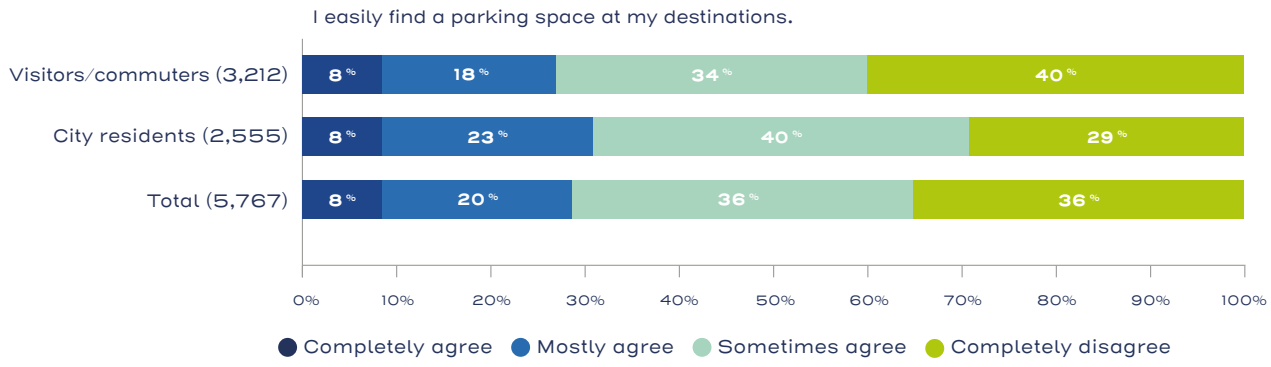
Parking regulations and stipulations for development plans

Parking regulations in Luxembourg City are set out in the General Development Plan (*Plan d'aménagement général* – PAG) and are significantly more restrictive than in most surrounding municipalities. For residents, the PAG stipulates between 0.8 and 1.2 spaces **per residential unit**, while some neighbouring municipalities require at least 2 and do not stipulate a maximum. The regulations in Luxembourg City place equally tight restrictions on commercial parking spaces, providing for one parking space for **office spaces** between 175 m² and 300 m². **Retail** is required or permitted to have one parking space per 100 m². Again, neighbouring municipalities provide for significantly more spaces and are less restrictive when it comes to setting limits.

In addition, Luxembourg City has certain special regulations in its historic districts where it is possible to have no parking spaces at all in exceptional circumstances or as part of pilot projects, e.g. for car-free zones. In recent urban development tenders, the stipulated ratio was 0.5 parking spaces per residential unit. Examples include the redesign of the Josy Barthel Stadium on *Route d'Arlon* and the Kuebebierg development in Kirchberg. In these areas, Luxembourg City is attempting to limit additional motor traffic through restrictive parking regulations.

4.5.2 Stationary traffic from the perspective of residents and visitors/ commuters

The online survey also asked respondents about stationary traffic, which was the subject of sometimes controversial discussions at public consultations. The graphic below shows how easy it is for drivers to find a parking space on reaching their destination.



Graphic 26: Availability of parking spaces at respondents' destination

Only 28% of drivers indicated that it is always or mostly easy to find a parking space. This score is slightly higher for residents than for visitors/commuters. This assessment contradicts some of the results of the availability analysis. This is likely due to the fact that respondents' expectations are higher than the actual possibilities.

At the public consultations, stationary traffic was also accused of taking up a lot of space and was mentioned as a factor that disrupts other forms of transport and other uses. Corresponding discussions can also be found in the chapters on walking and cycling.

4.5.3 Assessment: Strengths, weaknesses and challenges in stationary motor traffic

Strengths	Weaknesses
• Good availability of spaces in city centre • Spaces available across entire city in multi-storey car parks, with capacity reserves • No major bottlenecks in residential areas • Comprehensive management, with parking fees • Availability of P+R on many important access roads • Dynamic parking guidance system for the Ville Haute, Gare and Kirchberg districts • Online information on availability of spaces in multi-storey car parks and P+R	• Public parking above capacity in some areas • Space required to provide public parking often in conflict with other road users and other uses • Parking space management does not fully meet current requirements • No direct P+R services on eastern and western access roads

The **key challenges** for **stationary traffic** are therefore as follows:

- The number of spaces available in the inner city is sufficient and in principle should not be increased, so as to avoid additional traffic. Focused parking management should control supply and demand so that the centre remains easy to reach.
- Avoiding unnecessary motor traffic in the inner city must be a priority in the parking strategy.
- Sufficient parking must be provided in order to ensure that all areas of the city are accessible – but this must be coordinated with efforts to avoid excessive levels of traffic. Dialogue with the population is important here so as to avoid making unrealistic promises.
- Park+Ride services should be developed into a fully-fledged system all around the city. This requires coordinating services on the city outskirts with those in the city and in the surrounding areas.
- Parking regulations should be harmonised, in collaboration with neighbouring municipalities. The settlement structure and quality of public transport connections should be taken into account.

4.6 Analysis of bicycle traffic

4.6.1 Basis for analysis of bicycle traffic

Cycling is the mode of transport that has undergone the most significant growth in recent years. Increasingly congested road networks, changing levels of environmental awareness, and also newcomers to the joy of cycling have resulted in major absolute growth in many cities and countries around Europe. Luxembourg City is also experiencing a renaissance in cycling. A comprehensive cycling concept was prepared back in 2006/2007 and updated in 2011/2012. Many projects have been rolled out since then, some of them spectacular. As part of the development of the mobility plan, the current situation was analysed in relation to 2021. This analysis was based on comprehensive GIS documents for the city, supplemented by our own surveys.

The analyses looked at the following aspects in particular:

- The cycling network, including its structural and organisational design
- Parking facilities
- Accessibility analyses
- Traffic volumes
- Safety and conflicts

The cycle hire system is explicitly addressed in Chapter 4.8.

4.6.2 Analyses of bicycle traffic

Cycling network and cycling facilities

The cycling network connects up major destinations. The routes were defined by Luxembourg City. Cyclists should be able to reach their destination without detours as far as possible. For that reason, bike lanes often run along main roads because these were generally designed to be the shortest routes between important starting and end points. The current network can be viewed at velo.vdl.lu.

The quality of the connections between the city and its surrounding areas is not consistent across the whole network. Well-developed national cycle routes run:

- North through the Alzette valley towards Walferdange and onwards towards Mersch and Ettelbrück
- North-east via Senningerberg towards Niederanven and Junglinster
- South-east towards Hesperange
- West towards Bertrange and Strassen

Connections running east towards the airport, towards Sandweiler and Contern, and south-west towards Leudelange and onwards towards Dudelange and Esch, however, are inadequate. Since these routes are shared by cyclists and motor traffic, there is a high risk of conflicts. This is aggravated by the high volumes of motor traffic and the high speeds reached by these vehicles.

There are a variety of types of bike lane in the city. Many routes already have separate bike lanes or bike paths. Other options includes bicycle boulevards, protected bike lanes or mixed cycling and pedestrian paths. The needs of cyclists have been taken into account as far as possible on redesigned and newly constructed roads in particular. There are bike lanes almost everywhere in Kirchberg, as well as in Cloche d'Or, in Ville Haute and in the Gare district.[4] Bicycle boulevards have also recently been created, such as on *Rue de Trévires*, *Val St. Croix* and *Rue de Bragance*.

Photos: Light and shade on Luxembourg's cycling network © Ville de Luxembourg – Fränk Schneider

However, many main roads with high volumes of traffic do not yet have separate bike lanes. Elsewhere, cycling infrastructure does not satisfy current requirements and bike lanes are too narrow or in poor condition. Parked cars also frequently block the way for cyclists. Despite the positive trends of recent years, the cycling network must be made more attractive and expanded further.

On the positive side, the lifts in the city help cyclists manage the changes in elevation. The Panoramic Elevator which takes users from Pfaffenthal to Ville Haute and the lift from Ville Haute to the Grund can also be used by cyclists. The Pfaffenthal–Kirchberg Funicular helps to extend the cycling network and allows cyclists to avoid making detours to cope with the huge changes in elevation.

4 *Av. de la Liberté including the Pont Adolphe, Av. de la Gare with onward connection via the Pont Viaduc and Bvd. Franklin D. Roosevelt.*

Parking facilities for bikes

Parking facilities for bikes are also crucial to any cycling network. They must be user-friendly, with sufficient space and protection against weather and theft. Their attractiveness is also determined by their location. Our analysis focused primarily on public facilities since these are the only facilities for which data are available. However, private facilities in residential areas and in apartments, workplaces, schools, shops and other hubs also play a role in the cycling network.

Photos: bikebox and parking facility – © Ville de Luxembourg – Fränk Schneider

Bikeboxes can be found throughout Luxembourg City and the Grand Duchy. These boxes are a secure parking option as they require an access card. The Ministry for Mobility has installed six of these boxes at four locations across the city (as at 2023): two at the Central Station (North and South), one at the Hamm train station, one at Luxexpo and two at the Pfaffenthal train station (station and in Kirchberg). Luxembourg City has installed an additional three boxes at *Place du Théâtre* (Ville Haute), at the Victor Hugo Hall (Limpertsberg) and in Dernier Sol (Bonnevoie). There are also covered parking facilities and numerous on-street bike racks around the city (see **Figure 8**). The multi-storey car parks have additional parking for bikes (e.g. Fort Neipperg).

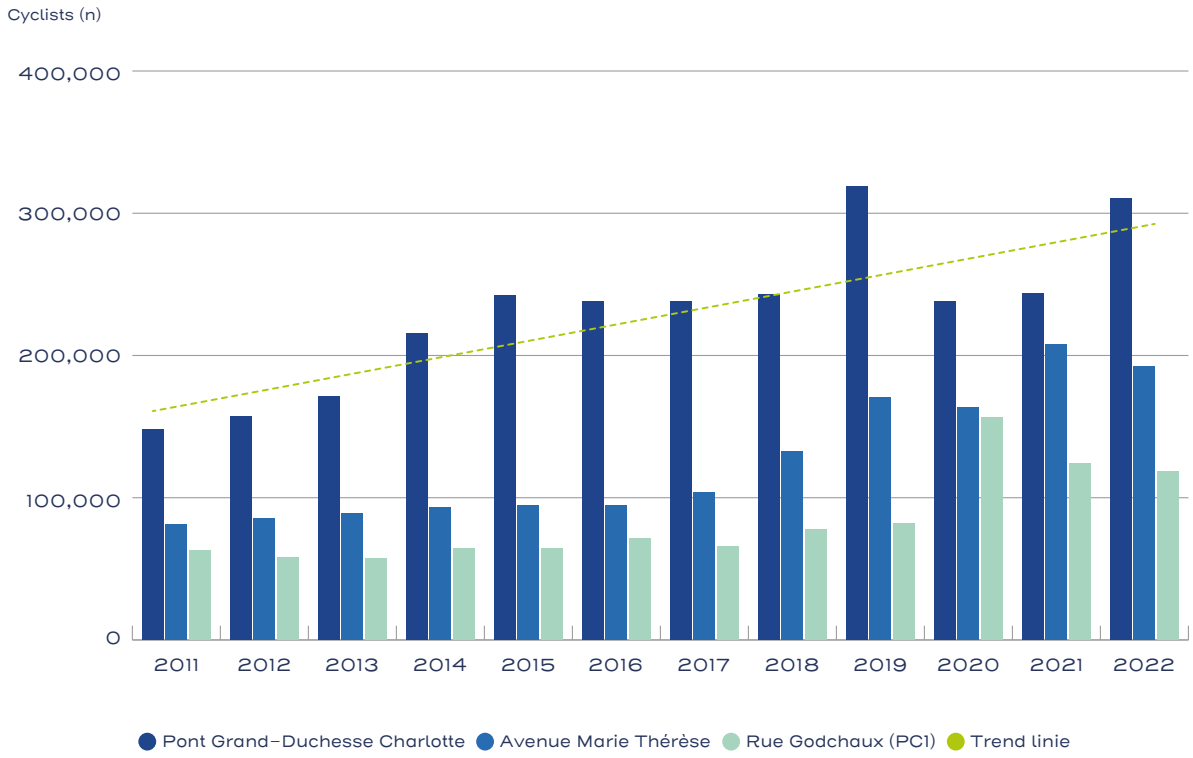
Overall, there is room for improvement. Around 1,300 parking spaces for bikes are of good quality. The need for facilities will increase significantly in future, in particular around the hubs, the train stations and public transport interchanges, and as a whole.

Accessibility within Luxembourg City

In principle, Luxembourg is ideal for cyclists. Distances are short, with the city only being around seven kilometres wide. Neighbouring municipalities can also be reached by bike. While conditions are less than ideal due to the deep valleys and changes in elevation within the city, technologies like lifts or pedelecs can help. There are more and more e-bikes on the roads. As a result, the city's outer districts and neighbouring municipalities are generally easy to reach. **Figure 9** illustrates accessibility by bike compared with pedelec. Most destinations are already easy to reach with an ordinary bike. With a pedelec, it takes less than 20 minutes to reach the city centre, Central Station or *Place de la Constitution*, even from the very edge of the city. Cyclists can cross the entire city in half an hour. However, many sections lack separate bike lanes (see above).

Evolution in the numbers of cyclists

Luxembourg City has a network of permanent counting stations for cyclists. As at March 2023, there were 16 permanent counting stations[5]. The data from these stations indicate the trends in bike traffic in recent years (see Graphic 27 "Selected permanent counting stations"). Between 2010 and 2020, bike traffic at some stations nearly doubled. Figures vary from station to station (everyday or leisure traffic) and from year to year (primarily 2019 and 2020 due to the coronavirus pandemic).



Graphic 27: Trends in numbers of cyclists at selected permanent counting stations

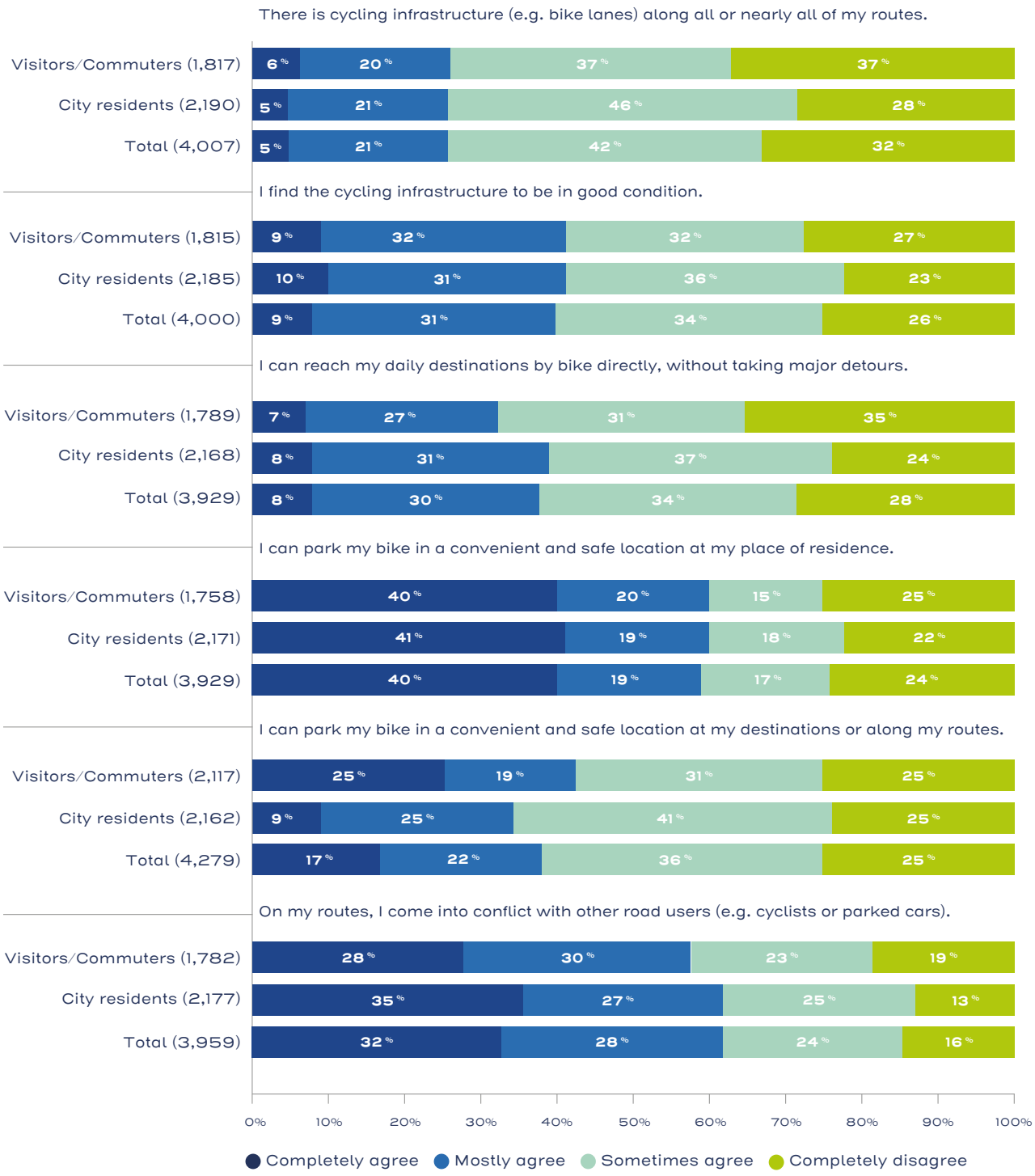
4.6.3 Public opinion on cycling

The online survey on the Mobility Plan also looked at cycling. Respondents were asked whether or not they own a bike and were surveyed on the length and purpose of their bike journeys. A full evaluation of all responses can be found at mobiliteitsplang.vdl.lu. Cycling was also raised as an issue at the public consultations.

At this point, we would like to focus on the attractiveness of cycling in the city. Respondents are somewhat dissatisfied with infrastructure, complaining that there are not enough bike lanes and that some are in poor condition. In addition, respondents cannot reach their destinations directly by bike and have to take detours. Residents and visitors/commuters largely agree on this point.

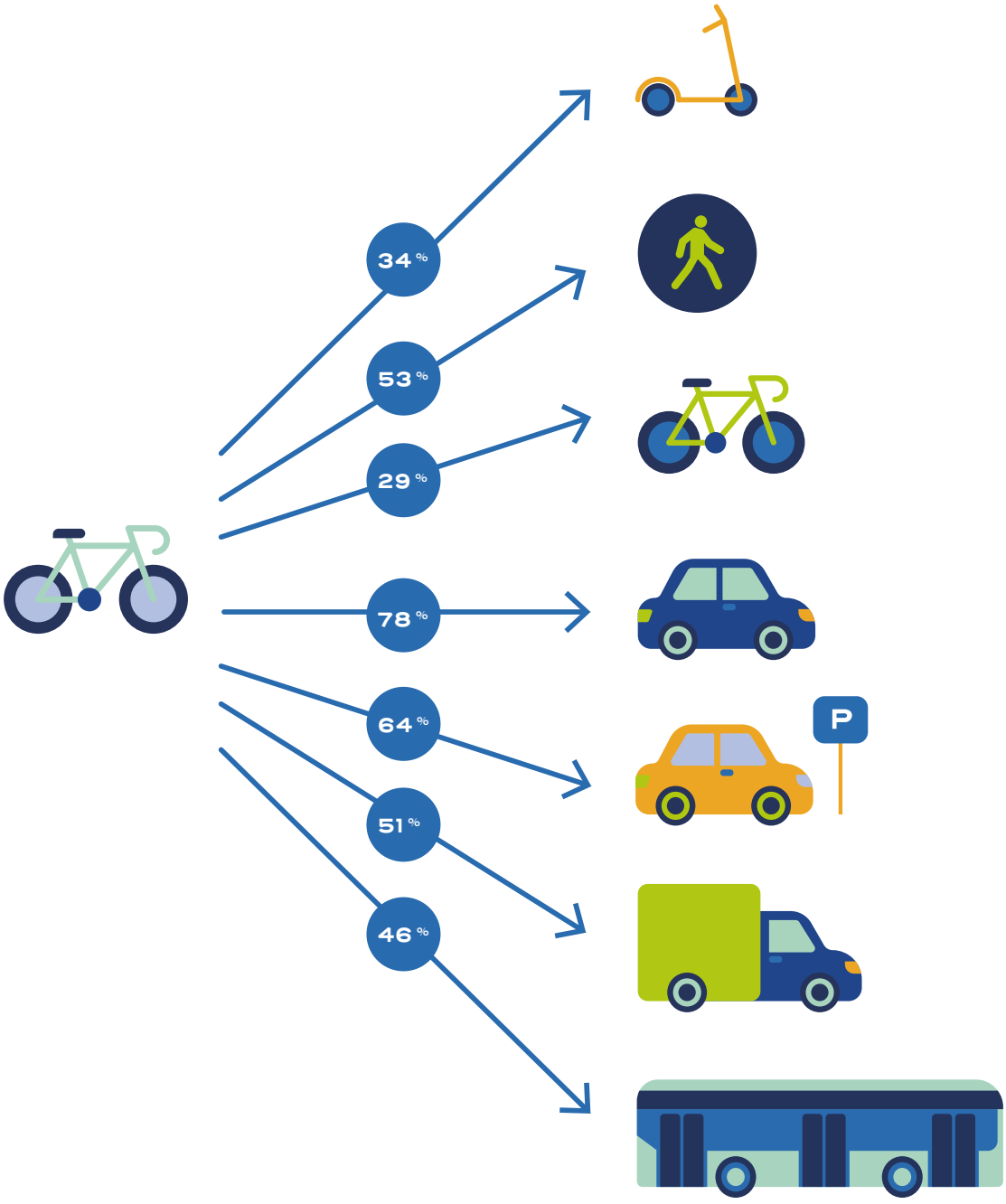
5 *See https://www.vdl.lu/en/getting-around/bike-or-foot/cycling-routes-and-bike-parking*

Residents and visitors/commuters rate the parking facilities where they live as good. They are significantly less happy with the facilities at their destination. City residents are more critical here than visitors/commuters.



Graphic 28: Opinions from the online survey on cycling

60% of respondents regularly come into conflict with other road users. A follow-up question provided further details (see Graphic 29). According to the results, conflicts occur most frequently with motor traffic (moving and stationary), followed by pedestrians, delivery vehicles/goods movement and public transport. However, cyclists also come into conflict with one another. The high number of conflicts with electric scooters is noteworthy – especially when considering the low number of journeys made with electric scooters.



Graphic 29: Frequency of conflicts between cyclists and other road users

4.6.4 Assessment: Strengths, Weaknesses and challenges for bicycle traffic

Strengths	Weaknesses
• Size of city means conditions for cycling are good • Gradual optimisation of existing network • Lots of good examples of high-quality and user-friendly cycling infrastructure • Lifts and funicular for dealing with changes in elevation • Secure parking for bikes largely available at important public transport interchanges • Excellent bike hire system (see Chapter 4.8)	• Still plenty of gaps in network • Incompatibility of mixed traffic with motor vehicles (and pedestrians), resulting in reduction in quality and increase in conflicts • Not enough public parking facilities in some places

The **challenges** for **cycling** are therefore in particular:

- The biggest challenge will be continuing to grow the network, with good and safe cycling paths on the route and at junctions.
- More parking facilities with more spaces need to be installed at more locations. Bikeboxes will soon be insufficient, especially at public transport hubs, as international experience shows.
- Networking with neighbouring municipalities must be improved significantly in order to promote cycling between the city and the surrounding areas as well.
- While the number of cyclists is already increasing, it must be promoted further – at all levels and among all groups. However, appropriate resources (financial/staff) must be provided for this within the public administrations.
- More cyclists will also lead to more accidents. Empirical data are required in order to identify and eliminate causes of accidents.

4.7 Analysis of pedestrian traffic

4.7.1 Basis for analysis of pedestrian traffic

Generally speaking, the importance of pedestrian traffic and walking is greatly underestimated. While the distances covered are shorter and therefore pedestrians make up a smaller portion of total traffic, a full third of all journeys made by residents are made exclusively on foot. This does not include all pedestrian traffic to public transport stops and often to parking spaces as well. Getting around on foot is even more important for children and older people in particular. Strategy designs must therefore take pedestrian traffic into account. The focus here is on the global strategy since pedestrians otherwise account for a very small proportion of traffic. The city already analysed pedestrian management[6] back in 2015. These surveys and assessments were primarily used to elaborate recommendations relating to planning for the tram.

The following analyses illustrate the situation with respect to pedestrian traffic. Topographical conditions and structural barriers play a particularly important role here.

4.7.2 Pedestrian traffic in Luxembourg City

Topography and barriers within the city

There are numerous topographical and structural barriers in the city. These include valleys, railway lines, main roads and buildings (see **Figure 10**). Many obstacles affect both cyclists and pedestrians (see also Chapter 4.6.2 Bicycle traffic). Lifts and the large number of bridges in the city help people manage the changes in elevation. However, barriers are also posed in some areas by the size of apartment blocks. Plans for new development areas can include more routes for pedestrians between these blocks. Main roads are generally safe to cross thanks to traffic lights, pedestrian crossings or centre islands. Overall, this aspect is rated as good. However, new requirements may arise as the city grows.

Width and condition of pavements

Excellent infrastructure for pedestrians has been taken into account in redesigned and newly constructed roads in particular, e.g. the roads in Kirchberg and *Avenue de la Liberté*.

Photos: Accessibility and spacious pavements on new main roads – © Ville de Luxembourg – Fränk Schneider & Tom Jungbluth

6 *Audit on quality of pedestrian traffic management in Luxembourg City, commissioned by the City of Luxembourg BSV Büro für Stadt– und Verkehrsplanung Aachen, May 2015*

In many other areas, however, pavements are very narrow. Trees, lampposts and signage pose additional barriers, with the result that in some areas the width of the pavement is actually below the minimum width required for wheelchairs, buggies and walking frames. The condition of pavements, however, is generally rated as very good.

Areas with priority for pedestrians

As the city's commercial centre, Ville Haute is largely pedestrianised. There are no other large pedestrian areas within the city, but there are a number of spaces that are predominantly reserved for pedestrians (e.g. Place de Paris following its redesign). In addition, a lot has been done to make residential areas nice and safe for pedestrians, in particular traffic calming measures. Traffic-calmed zones (shared spaces) are signposted and designed accordingly. These initiatives make pedestrians safer and reduce both conflicts and noise. They also make it nicer to live in the area.

Other specific problems

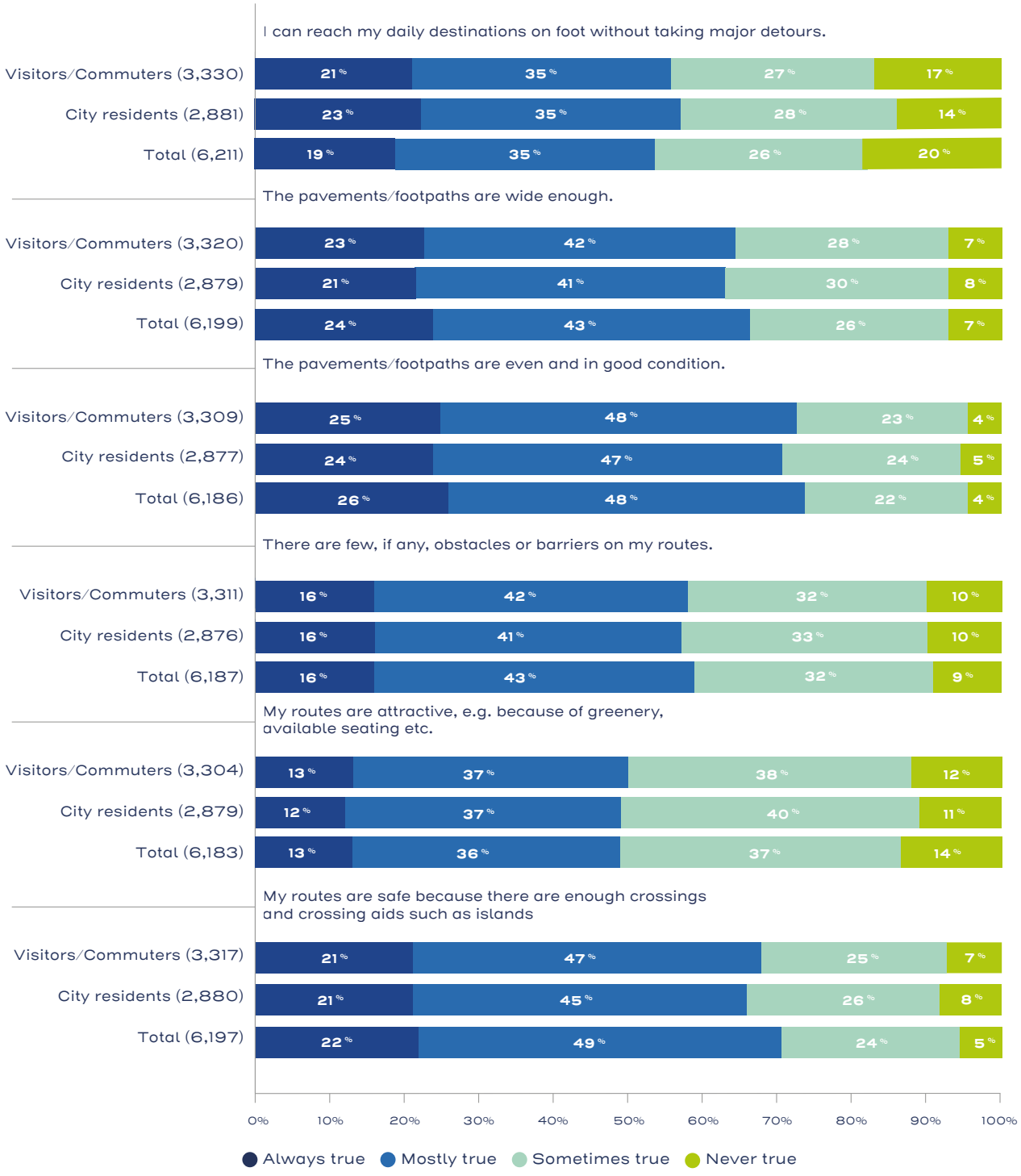
With regards to quality, comfort and safety for pedestrians, the following aspects were also discussed on the Mobility Advisory Council and at public consultations:

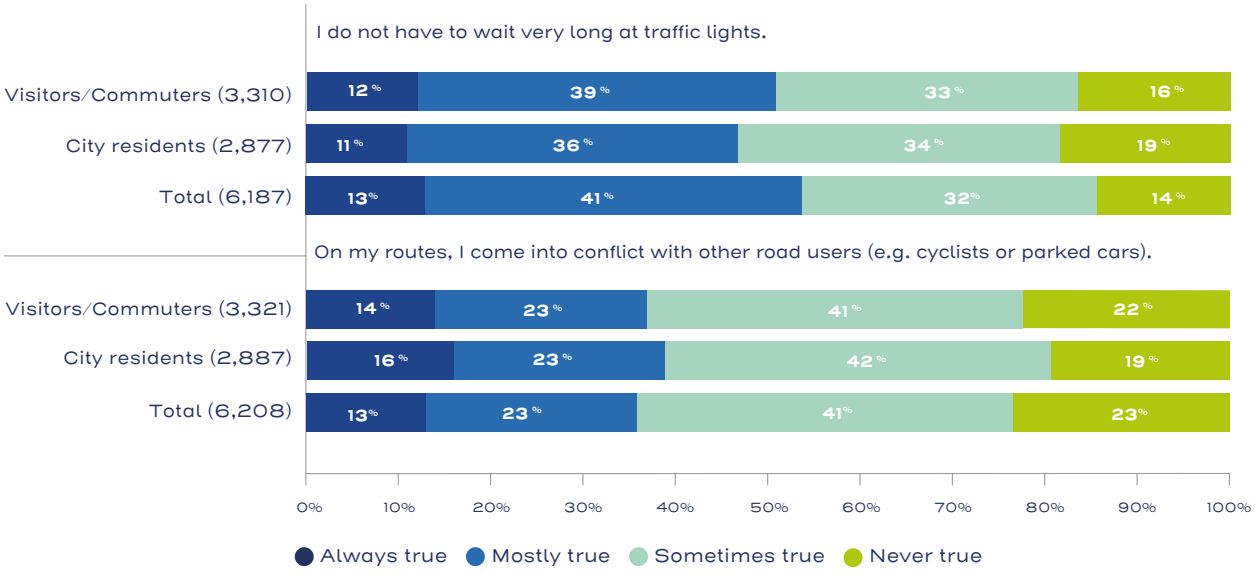
- Pedestrians are required to press the button at traffic lights and sometimes have to wait a long time
- Pedestrian crossings must be clear and have good visibility

These aspects can only be analysed once a more in-depth analysis has been conducted. There are also very positive examples of waiting times at traffic lights, in particular (e.g. *Av. de la Liberté*). We should examine whether a new audit on pedestrian traffic (including road safety) would be useful for developing an action plan.

4.7.3 Public opinion

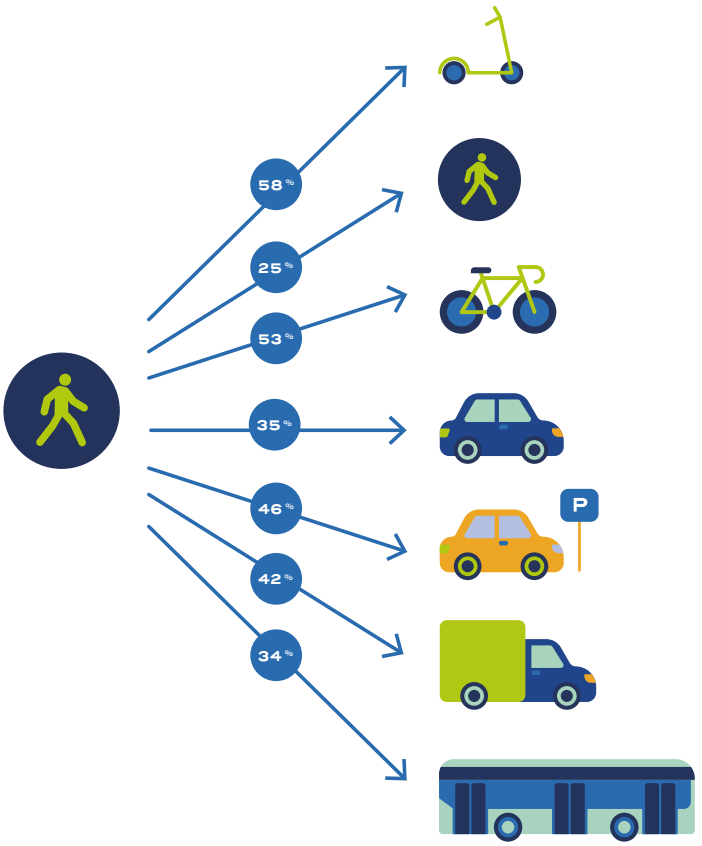
Compared with other means of transport, the results of the online survey are better when it comes to getting around on foot. A significant majority say that pavements are wide enough and in good condition. They are also rated as safe because of the traffic lights, zebra crossings and other infrastructure for crossing the road. Most pedestrians come into conflict with other road users only occasionally, if at all.





Graphic 30: Public opinion on getting around on foot, from online survey

Other aspects come in for greater criticism. These include the need to make detours, obstacles on pavements and waiting times at traffic lights. Some complaints also relate to pavement design, greening and availability of seating.



Graphic 31: Frequency of conflicts between pedestrians and other road users

Pedestrians experience significantly fewer conflicts with cars than cyclists do. The primary nuisance for pedestrians is stationary traffic. Pedestrians most frequently come into conflict with electric scooters and bikes. One reason for this is certainly the fact that areas used by pedestrians are frequently used by mixed modes of transport – whether legal or illegal, such as bikes using the pavement.

4.7.4 Assessment: Strengths, weaknesses and challenges for pedestrian traffic

Strengths	Weaknesses
Extensive infrastructure for crossing busy roads (traffic lights, islands) • New infrastructure with high-quality construction and design • Structural condition generally very good, even on older pavements • Generally high quality of public space • Public space gradually being made more accessible • Extensive traffic calming measures in residential areas	• Width of older pavements does not always satisfy current requirements • Some improvements needed in terms of taking pedestrians into account at traffic lights (e.g. shorter waiting times)

The **challenges** for pedestrian traffic are therefore in particular:

- Gradual elimination of bottlenecks and barriers
- Preventative elimination of dangerous situations

4.8 Mixed mode and multi-modal solutions, other aspects

4.8.1 Overview

In order to reduce car use, it is important to establish mixed mode and multi-modal solutions. [7] Sharing services play a major role here. These services allow people to use cars without owning them. This benefits the general public (fewer parking spaces occupied) and users (no need to purchase a car). However, these services must be easy and convenient to access so as to avoid barriers to use. The analyses also take into account the significant increase in demand that can be anticipated. Specifically, the analyses consider the following aspects:

- Car-sharing services
- Bike-sharing services
- Access to mobility services
- Availability of public charging stations for electric cars within the city

7 *Multi-modality involves using different means of transport for different routes (e.g. taking the train to work, driving to the gym, cycling to the pharmacy).*
Mixed modality means connecting up different means of transport (e.g. driving to the P+R and then taking the tram to work).

4.8.2 Analyses conducted

Car-sharing in Luxembourg City

The main car-sharing service in Luxembourg City is Carloh. Compact and mid-size cars can currently be hired from one of 25 stations around the city (see Carloh website[8] and **Figure 11**), with electric vehicles also available at select stations. An additional service is provided by Flex, a subsidiary of the national railway operator (*Société nationale des chemins de fer luxembourgeois* – CFL), which currently has ten stations.

Services should be expanded so that an available sharing vehicle is no more than 300 metres away in residential areas. This has not yet been achieved in all areas. Trends in demand must be taken into account when expanding these services. In addition, some stations are not easy to spot. One reason for this is that legal conditions make it hard to use public spaces for car-sharing services. For that reason, car-sharing is currently limited to private land which is only available to a very limited extent.

Bike-sharing in Luxembourg City

Luxembourg City has an exemplary bike hire system for e-bikes in its vel'OH! system. There are currently some 100 stations around the city, and this number has increased successively in recent years. They are widespread in public spaces and offer lots of bikes (currently around 1,100 in total). The rates are attractive and access is easy. After registering for a short or long-term subscription, bikes can be used for free for the first half-hour, after which they are charged at the applicable rate. The number of users and the number of bikes being hired has increased dramatically in recent years. The expansion of the system to neighbouring municipalities has also been very positive, with the system now also available in Bertrange, Hesperange, Strassen, Walferdange, Leudelange, Mamer and Niederanven.

The number of users also saw another sharp increase following the transition to e-bikes in 2019. Seven times as many journeys were made in 2022 as in 2018, making vel'OH! a resounding success that promotes cycling in Luxembourg City long-term.

Photos: vel'OH! hire stations – © Ville de Luxembourg – Fränk Schneider

8 *See https://www.carloh.lu/en/*

Access to sharing services

The providers of the sharing services (Carloh, Flex and vel'OH!) all offer easy access to their services via apps. However, there is not currently one combined app for different providers and different means of transport. This is not conducive to mixed–mode and multi–modal transport.

Public charging stations for electric cars in the city

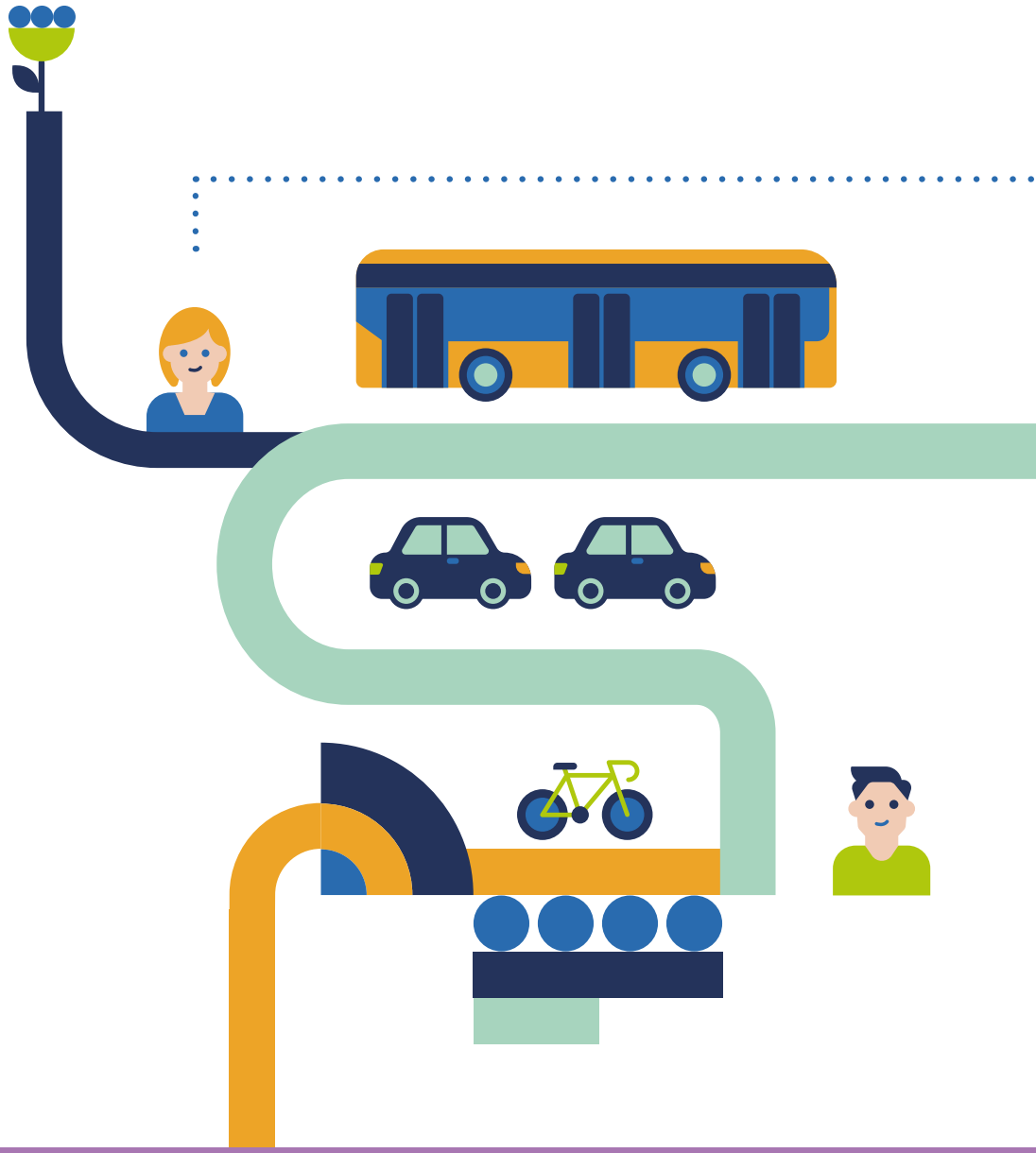
Expanding e–mobility in Luxembourg City will require a sufficient network of charging stations. Work is currently underway, albeit slowly. There are currently 607 public charging stations in the city (Chargy and other providers, as of November 2023). For comparison, there are currently around 25 petrol stations in the city with a large number of pumps. The next step is to produce a reliable calculation of how many charging points will be needed in future, a number which depends on a variety of factors, such as developments in e–mobility and charging times.

4.8.3 Assessment: Strengths, weaknesses and challenges for mixed modality and multi–modality

Strengths	Weaknesses
• Availability of established car–sharing services • E–bike sharing system with strong public presence • Individual mobility services easy to access • Network of public charging stations for cars covers almost entire city	• Car–sharing services not available in all areas of city • No combined mobility services in the form of "Mobility Hubs" • Multi–modal and mixed–mode routes force users to use different apps

The challenges facing mixed modality and other innovative approaches are:

- Car–sharing services should be available in all areas and visibility in public spaces should be improved. Distances to these services should be similar to distances to public transport stops. Demand should be increased, in addition to supply, so that the supply is economical long–term.
- User–friendliness should be increased by combining mobility services into "Mobility Hubs", under a single umbrella brand where applicable. Options here include offering other logistics services.
- It should be possible to access individual services via one global mobility app.



5. THE GOALS OF THE MOBILITY PLAN

5 THE GOALS OF THE MOBILITY PLAN

5.1 Principles for defining the goals of the Mobility Plan

There are a number of different basic principles that must be taken into account when setting goals for transport development initiatives. These include sustainable urban development, in which mobility plays a role. This basic principle can be derived from the UN's Sustainable Development Goals, which Luxembourg has signed up to. In the area of transport, the most important goals are:

- Goal 3: Good health and wellbeing (safety on the roads, protection against noise and environmental pollution caused by traffic, quality of life)
- Goal 9: Industry, innovation and infrastructure (accessibility, connectivity, and creating, expanding and interlinking networks)
- Goal 11: Sustainable cities and communities (reducing environmental impact, promoting public transport and active mobility, design of infrastructure and living environments, socially responsible transport, mobility for all)
- Goal 13: Climate action (reducing harmful transport emissions)

Graphic 32: UN Sustainable Development Goals

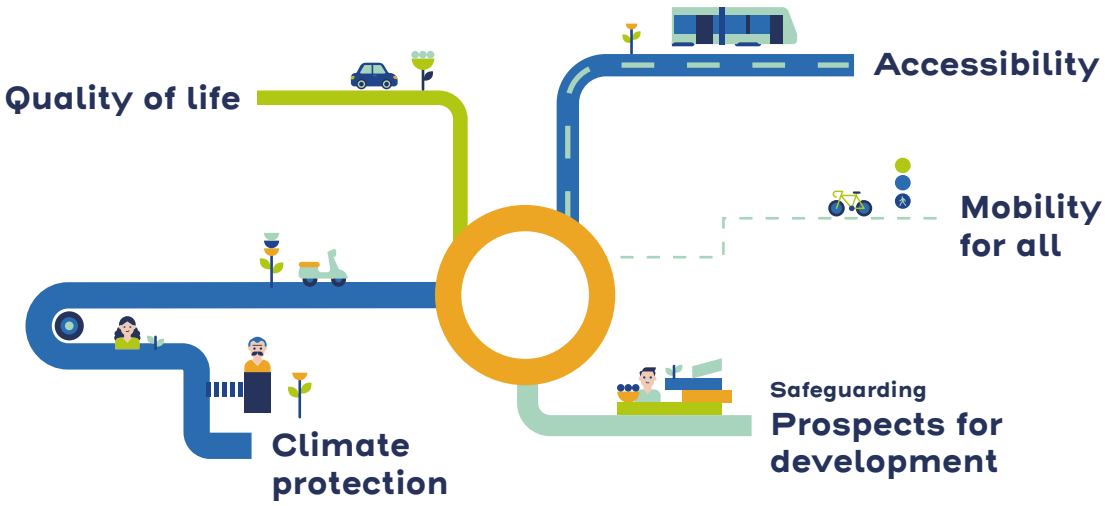
The "New Leipzig Charter" also addresses the issue of mobility, stating[1]:

"Urban transport and mobility systems should be efficient, carbon-neutral, safe and multi-modal. Active and low-carbon forms of mobility and logistics should be promoted including a modal shift to public transport, walking and biking. This includes a greater proportion of people walking, cycling or using public transport. Public transport should be accessible, affordable, clean, safe and attractive for all. To reduce transport and mobility needs, a polycentric settlement structure should be as compact and dense as possible while supporting multiple uses including housing, retail, production and transport. In the spirit of a city of short distances, this will promote a mix of residential, retail and production uses."

These fundamental goals constitute a declaration of intent and important guidance, but are in no way binding for Luxembourg City. The goals described below are fundamentally based on the Mission Statement of the College of Aldermen (Déclaration échevinale 2017-2023). This mission statement is the most concrete document for transport planning in Luxembourg and has the most binding effect. Particular areas of focus include:

- Continuing to develop the tram network
- Coordinating the bus network with the tram network
- Promoting walking and cycling
- Promoting mixed-mode mobility
- Motor traffic as a consistently important part of urban mobility

The goals described below were defined in dialogue with the general public and the Mobility Advisory Council. They were discussed and elaborated with the College of Aldermen. The outcome was acknowledged by the College of Aldermen and presented to the general public.



Graphic 33: Proposed goals for the Mobility Plan from public consultation on 13 October 2021

1 New Leipzig Charter – The transformative power of cities for the common good
Declaration by EU ministers responsible for urban matters, 2020 (also signed by Luxembourg)

5.2 Primary goals and sub-goals

5.2.1 Safeguarding the central importance of the city through regional and inter-regional accessibility

One important goal is to safeguard Luxembourg City's position as the centre of the metropolitan region long-term. To achieve this, the city must be well connected with its surrounding areas and easy to reach. The mobility required for this must be ensured long-term, even if population structures change. Key players in this regard are the State of Luxembourg, neighbouring municipalities and regional associations. Luxembourg City will campaign for the following goals to be taken into account in state and regional strategies:

- Attractive regional and inter-regional public transport connections and services that meet demand
- Functional highways
- Reducing congestion from regional motor traffic in Luxembourg City by optimising the transition from regional to city transport
- Strengthening cycling in the city and surrounding areas with attractive infrastructure
- Good integration of the airport

5.2.2 Securing the mobility required for the desired development initiatives

The population and economy of Luxembourg City are constantly growing. According to forecasts, the population will increase by 46% (approx. 57,000 residents) and jobs by 30% (approx. 51,000) between now and 2035. The areas for these developments are set out in the PAG. Further developments are expected beyond 2035. If the city is to be able to manage these trends, its transport system must undergo productive further development. This process should be as efficient as possible and use minimal space and resources. In particular, the following individual goals should be pursued:

- Maximising use of public transport and active mobility with tram and supplementary bus network as a powerful backbone
- Ensuring that all means of transport can be used to reach all parts of the city and heavily frequented areas
- Guaranteeing the function of the road network
- Effective integration of newly developed districts and areas into the overall network system (public transport, active mobility, road network)
- Attractive linking of different modes of transport
- Promoting active mobility as particularly environmentally-friendly

5.2.3 Mobility for all

Mobility is an important shared resource and the foundation for participation in society. Ensuring mobility for all is therefore a high priority. "All" means regardless of age and physical restrictions, social status, background or resources and income. The following individual goals are particularly relevant for the Mobility Plan:

- Maximum accessibility: Accessibility should allow persons with physical or sensory restrictions to be independently mobile. Accessibility also makes mobility easier for children and the elderly.
- Ensure mobility for all, regardless of social status and income. Free public transport in Luxembourg is a strong foundation. The affordable and practical e-bike hire system, vel'OH!, also plays a role here. Carloh allows people to use cars without owning them. Walking is also being promoted on a big scale, another fundamental element of ensuring mobility for all.

5.2.4 Maintaining and improving quality of life

The rapid urban development described above must be in harmony with a high quality of life. Indeed, the goal is to gradually improve quality of life. The negative effects of traffic must be minimised, even when faced with significant growth. Fair burden-sharing can play a role here. Important sub-goals include:

- Taking into account all functions and all users when designing and using traffic areas
- Maintaining or creating attractive public spaces in order to improve living standards and foster friendly neighbourhoods
- Creating living space instead of traffic areas in residential neighbourhoods > shift away from designs that focus too heavily on traffic
- Managing and diverting traffic in order to avoid "rat running" through sensitive areas of the city or to avoid through traffic (in residential areas)
- Developing new districts and spaces with good public transport connections and good pedestrian and cycle routes

5.2.5 Protecting basic needs

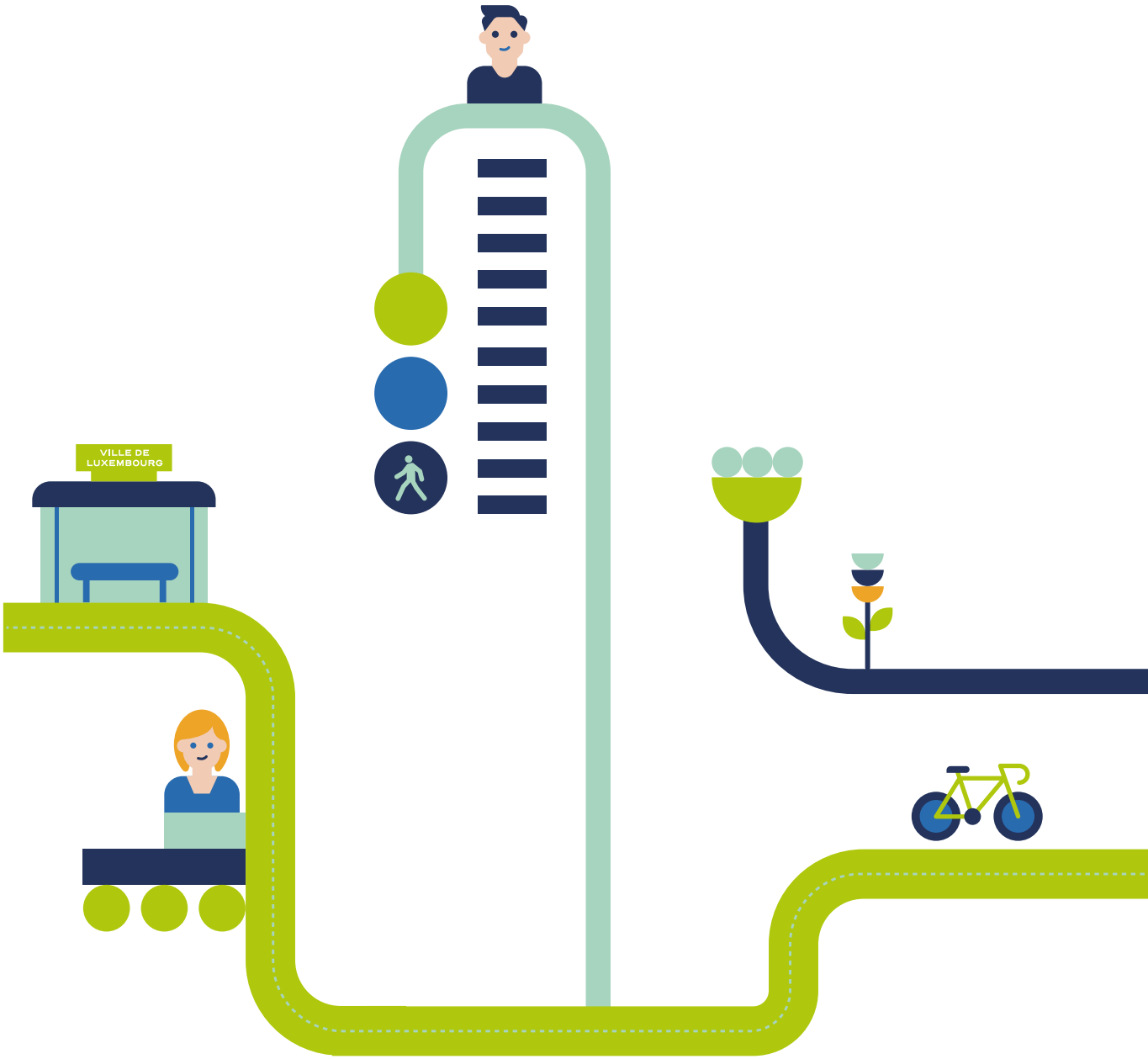
Protecting basic needs poses major challenges to society in terms of protecting both people as individuals and the climate and environment. Individual goals which should be pursued in this context include in particular:

- Maximum road safety and physical safety for all road users – Goal: "*Vision Zero*" (no traffic fatalities)
- Reducing impact of emissions (noise and air pollutants) on health and complying with limits
- Reducing harmful environmental emissions
- Reducing use of space and resources

5.2.6 Additional focus of the Mobility Plan

One of the aims of urban planning is to achieve a high level of **mixed use** with connections close to where people live, resulting in optimum accessibility thanks to **short distances**.

Avoiding non-essential travel (both people and goods) can ease congestion on the transport system but cannot be influenced by municipal mobility planning.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6. FUTURE TRAFFIC DEVELOPMENTS AND SCENARIOS

6 FUTURE TRAFFIC DEVELOPMENTS AND SCENARIOS

6.1 Principles and objectives of the scenario analysis

Mobility concepts and transport development plans are usually drawn up with the help of scenarios. This method makes clear future trends in transport, such that different approaches can be developed. Conclusions for the best possible strategy can then be elaborated. This method was also chosen for work on the Luxembourg City Mobility Plan. The different scenarios are addressed below. Some show the impact of certain initiatives. Others show the consequences for transport as a whole if a certain number of users choose a different means of transport. Scenarios on use of space were not produced, because the PAG is binding in this regard, in particular with regards to trends in numbers of residents and jobs between now and 2035 (identical to the PNM 2035).

The scenarios were created based on the transport model of the Grand Duchy and Luxembourg City. This model is managed by the CMT. The quantitative calculations were performed directly by the CMT. This transport model was also used to evaluate initiatives taken within the framework of the PNM 2035. This ensures that the evaluations in the PNM 2035 and the Luxembourg City Mobility Plan are conducted on the same basis. It thus becomes apparent how initiatives and strategies influence one another.

Due to the enormous rise in population and jobs that is expected between now and 2035, important goals for the scenario work carried out for the Luxembourg City Mobility Plan include:

- Describing/calculating the basic “mobility needs” for 2035
- Testing alternative approaches and focuses with regards to the impact on the transport system and reviewing how viable this is for the city
- Developing strategies to guarantee the conditions required for transport to manage the forecast/politically desired trends in urban development
- Drawing up a rough concept for the transport networks, including rough assessments of systematic performance

The (hypothetical) model status 2020 (which does not take into account the impact of coronavirus on mobility) and Base Scenario 1 for the year 2035, which primarily takes into account only those measures that are guaranteed at time of calculation, were used as reference models for the new scenarios

6.2 Trends in transport between 2020 and 2035 (Base Scenario 1)

As described above, we first developed a (hypothetical) **Reference Scenario 2020**. This scenario depicts the traffic and transport situation in 2020. The scenario was adjusted to eliminate the impact of the Coronavirus pandemic and take into account the change in transport infrastructure that has taken place since (compared with the standard reference year 2017 which was previously used). The most important changes are the launch of the tram service and the introduction of free public transport.

Base Scenario 1 depicts the growth in traffic expected between now and 2035 if no further action is taken. The scenario includes the population and job trends between now and 2035 described in Chapter 3 (see Figure 2) and the following initiatives which had already been guaranteed for implementation by time of analysis:

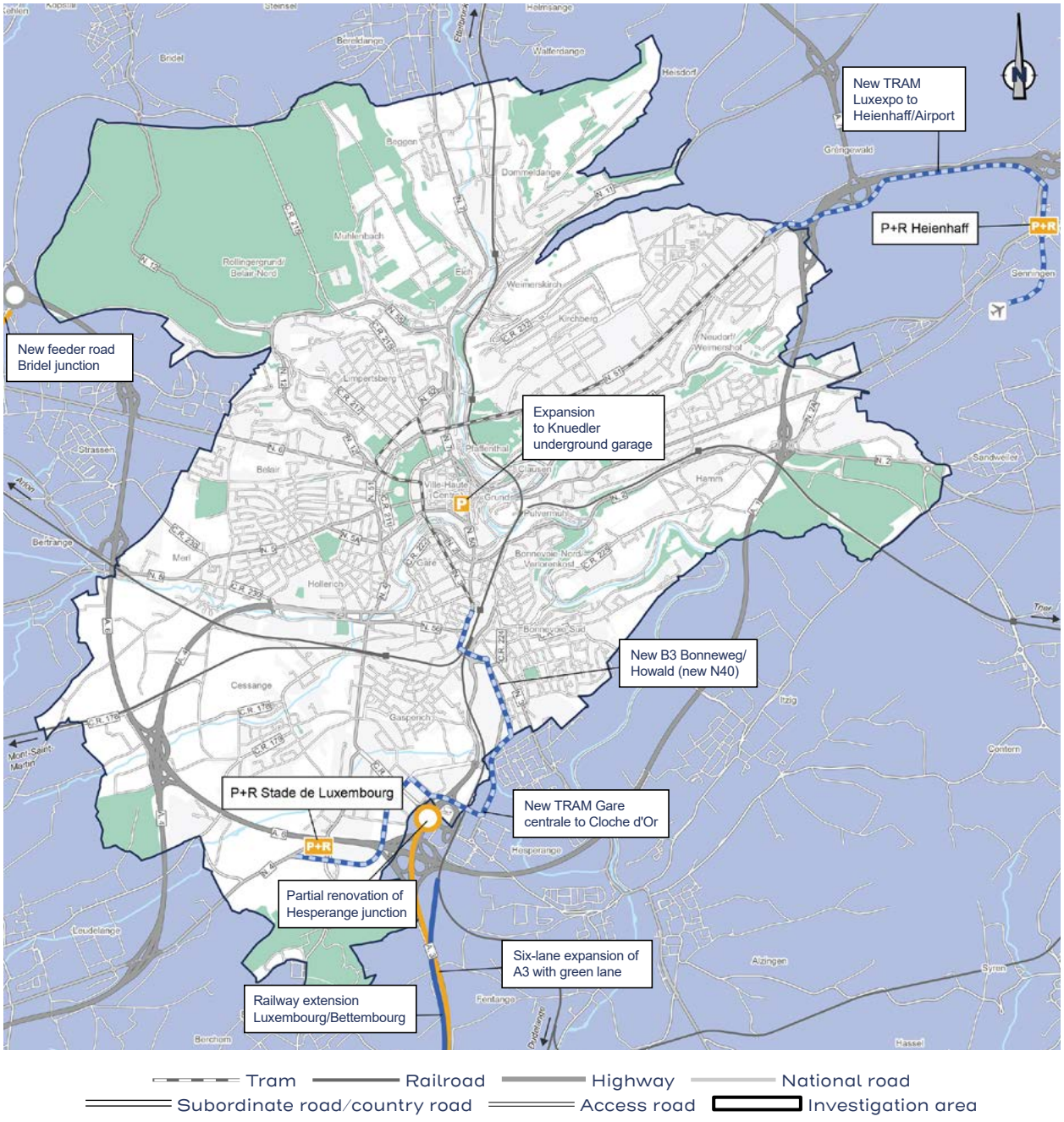
Regional initiatives (these fall outside of the remit of the City of Luxembourg but have a particularly big impact on traffic within the city):

- New rail connection Luxembourg – Bettemburg, and associated rail services[1]
- Three-lane expansion of A3 around the Aire de Berchem / Gasperich junction, with bus and car-pool lane (*covoiturage*) along entire stretch (under construction)
- Road feeder to Bridel junction in Strassen
- Extending existing tram line north-east to Findel Airport (under construction) and Heienhaff
- RGTR 2022 Service Concept
- Heienhaff Pôle d'échange (interchange station) with 2,000 new P+R parking spaces

1 CFL Operating Concept 2028 with improved service to Thionville and Metz

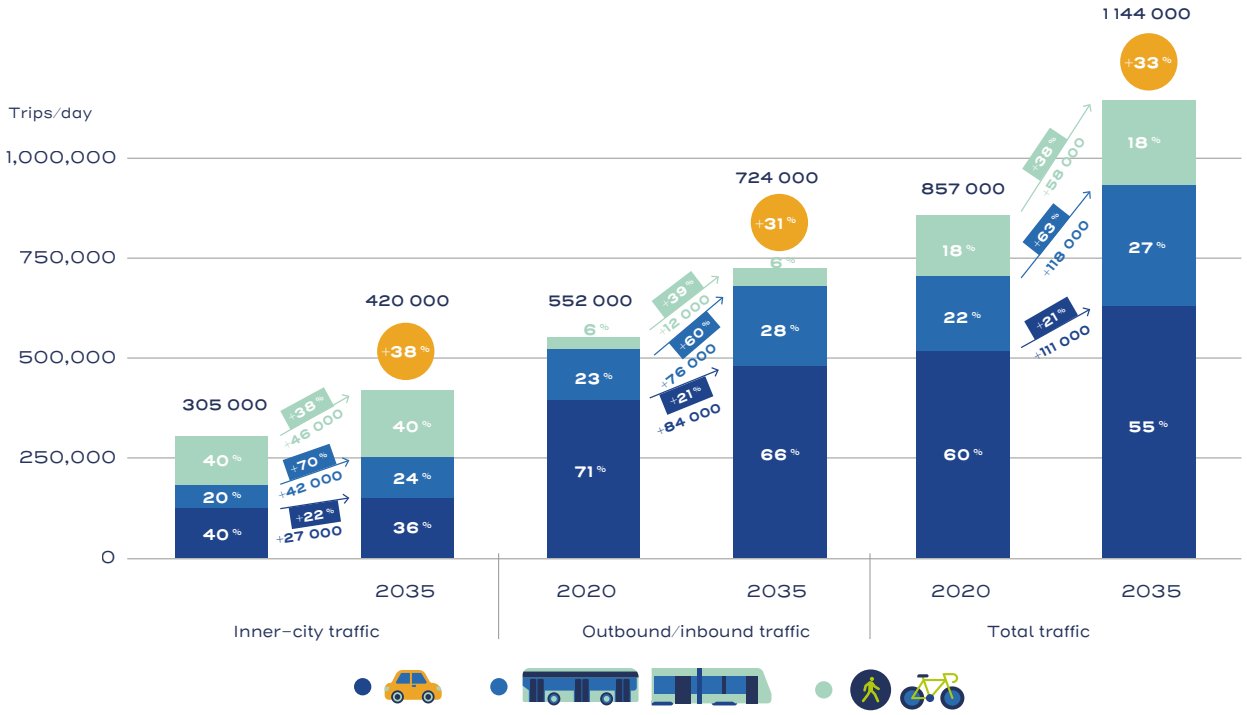
Initiatives in Luxembourg City:

- Extending tram line south to Stade de Luxembourg (operational summer 2024)
- New N3 Bonnevoie/Howald (new N40, already partially operational)
- Extending and expanding various P+R facilities, in particular Stade de Luxembourg P+R (2,000 spaces)
- Expanding the Knuedler multi-storey car park (already complete)



Graphic 34: Initiatives in Base Scenario 1

Compared with Reference Scenario 2020, the changes in the modal split and volume of traffic in Base Scenario 1 can be described as follows:



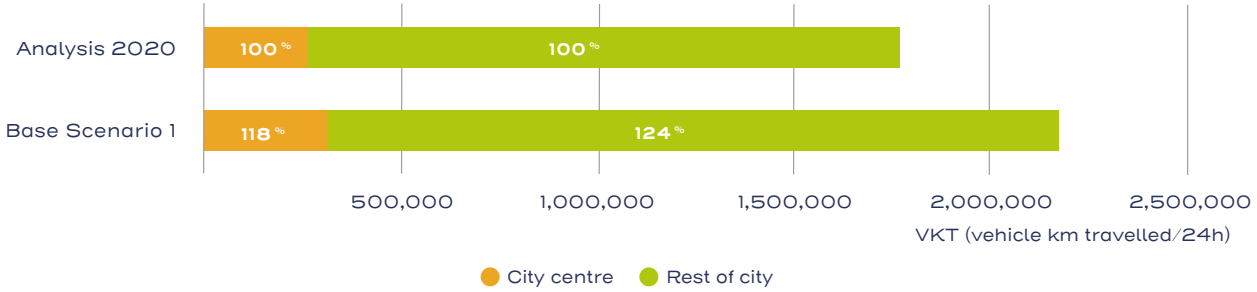
Graphic 35: Comparison of modal split and volume of traffic in Base Scenario 1 vs 2020

The growth of the city is expected to result in an **increase in total volume of traffic across all means of transport** of 33% between now and 2035. Inbound and outbound traffic (origin or destination of journey outside the city) will increase slightly less (+31%), while inner-city traffic (origin and destination within the city) will increase more (+38%).

The initiatives highlighted are already leading to a significant **change in the modal split**. Motor traffic as a percentage of total traffic will fall by 5%. This figure will increase by 5% for public transport, while it has been assumed that the figure for active mobility will remain roughly the same at 18% of total traffic.

Despite a reduction in its share of the modal split, the **number of absolute journeys made using motor vehicle is expected to increase significantly**. Passenger journeys (number of people as total of driver + passenger(s)) will increase by 21% in total traffic (with virtually no difference between inner-city traffic and inbound and outbound traffic). Taking into account the rise in occupancy (1.4 persons per vehicle instead of 1.2 according to PNM), the volume of motor traffic will increase by 20% (not illustrated).

The studies show that **vehicle kilometres travelled (VKT) in motor traffic** will also increase, both in the city as a whole and in the inner city. Traffic flows (in VKT/24 hrs) in Ville Haute and the Gare district will increase by 18% compared with 2020, and by 24% for the city as a whole. These increases cannot be managed, in particular in the inner city area.



Graphic 36: Comparison of VKT in Base Scenario 1 vs 2020

The shift in the modal split will result in significant challenges for public transport in Base Scenario 1 alone. According to Figure 35, a 5% modal shift to public transport would be equal to **a 63% increase in passenger trips on public transport**! Some of this growth is already visible, with trams and certain bus lines experiencing very high occupancy at peak times.

Although the modal split was initially assumed to be constant, an absolute **increase in demand in pedestrian and bike traffic of 38%** between now and 2035 must be assumed (number of trips). Cycling, in particular, will therefore be significantly more prevalent on the streets. Conflicts between cyclists riding in mixed traffic with vehicles and pedestrians will increase enormously – as will the number of accidents – if critical situations are not alleviated.

Conclusion regarding Base Scenario 1

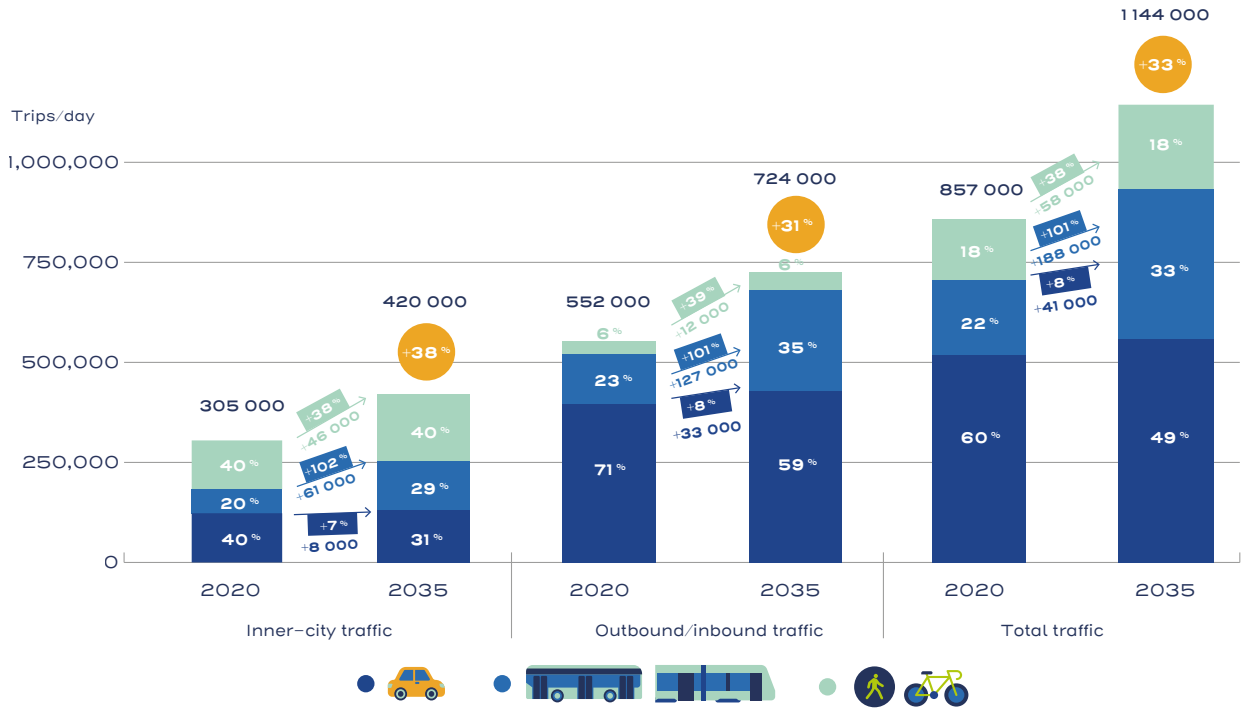
The increase in population, jobs and associated infrastructure (schools, retail etc.) will lead to heavier traffic. This will pose enormous challenges to the city in terms of developing a functioning and efficient mobility system. Since there is only limited space available, e.g. for expanding the tram network, the transport options identified currently and in Base Scenario 1 (modal split) must be evaluated critically. An increase in motor traffic in the inner city area (as forecast) cannot be accommodated since there is no space for expanding roads. This would result in disruptions to traffic lasting longer and taking up more space.
Current public transport options will be pushed to the limits of their capacity during periods of high demand, which will lead to a reduction in quality (occupancy/available space). The service must be expanded significantly if it is to account for a greater share of traffic. Unlike the road network, there is the potential to realise this expansion. A significant increase in demand for cycling can also be identified.

6.3 Basic requirements for the public transport of the future – Base Scenario 2

Current traffic flows and findings from Base Scenario 1 show that motor traffic in the city must not be allowed to increase. The question, then, is which traffic flows can be transitioned to public transport in order to avoid this. In a hypothetical **Base Scenario 2**, (private) motor traffic was "frozen" at its 2020 level, with additional users diverted to public transport.

Changing urban structures must be taken into account in the modelling. That is because every development of new areas within the city creates traffic, which is then spread across the road network as the situation demands. Basic Scenario 2 continues to assume that only the initiatives described in Base Scenario 1 will be implemented. Newly developed areas will be integrated into the nearby existing network of main roads. No further adjustments will be made to public transport services for the time being. The number of trips made using (private) motor transport will remain roughly constant (as a defined assumption for the scenario).

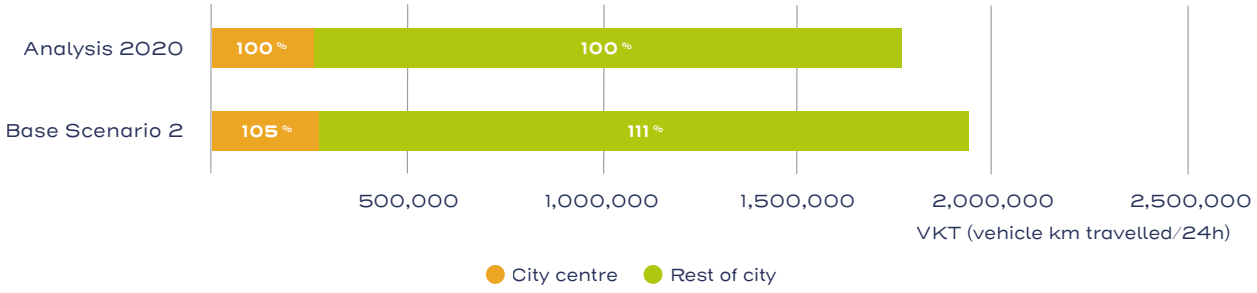
Changes in the modal split and volume of traffic for Base Scenario 2 can be described as follows:



Graphic 37: Comparison of modal split and volume of traffic in 2035 in Base Scenario 2 vs 2020

In order to achieve roughly the same number of trips by motor transport as in 2020, **motor traffic** must fall by around 11% **as a percentage of total traffic** (from 60% in 2020 to 49% in 2035). This takes into account the increased occupancy rate of 1.2 to 1.4 persons per trip by motor transport. The reduction in inner-city traffic and inbound and outbound traffic is roughly the same.

If all of these trips are diverted to public transport, we get an **increase in passenger demand on public transport** of more than 100% compared with 2020, i.e. more than a third higher than in Base Scenario 1. This highlights the real challenges facing public transport as a result of the underlying growth of the city. Moreover, motor traffic still increases slightly in this scenario, albeit to a manageable degree. The road network would have to be adapted accordingly.



Graphic 38: Comparison of VKT in Base Scenario 2 vs 2020

No assumptions were made regarding changes in active mobility compared with Base Scenario 1 (consistent share of 18% of modal split on all trips), hence Base Scenario 2 produces the same 38% increase in number of trips compared with 2020.

Conclusion regarding Base Scenario 2

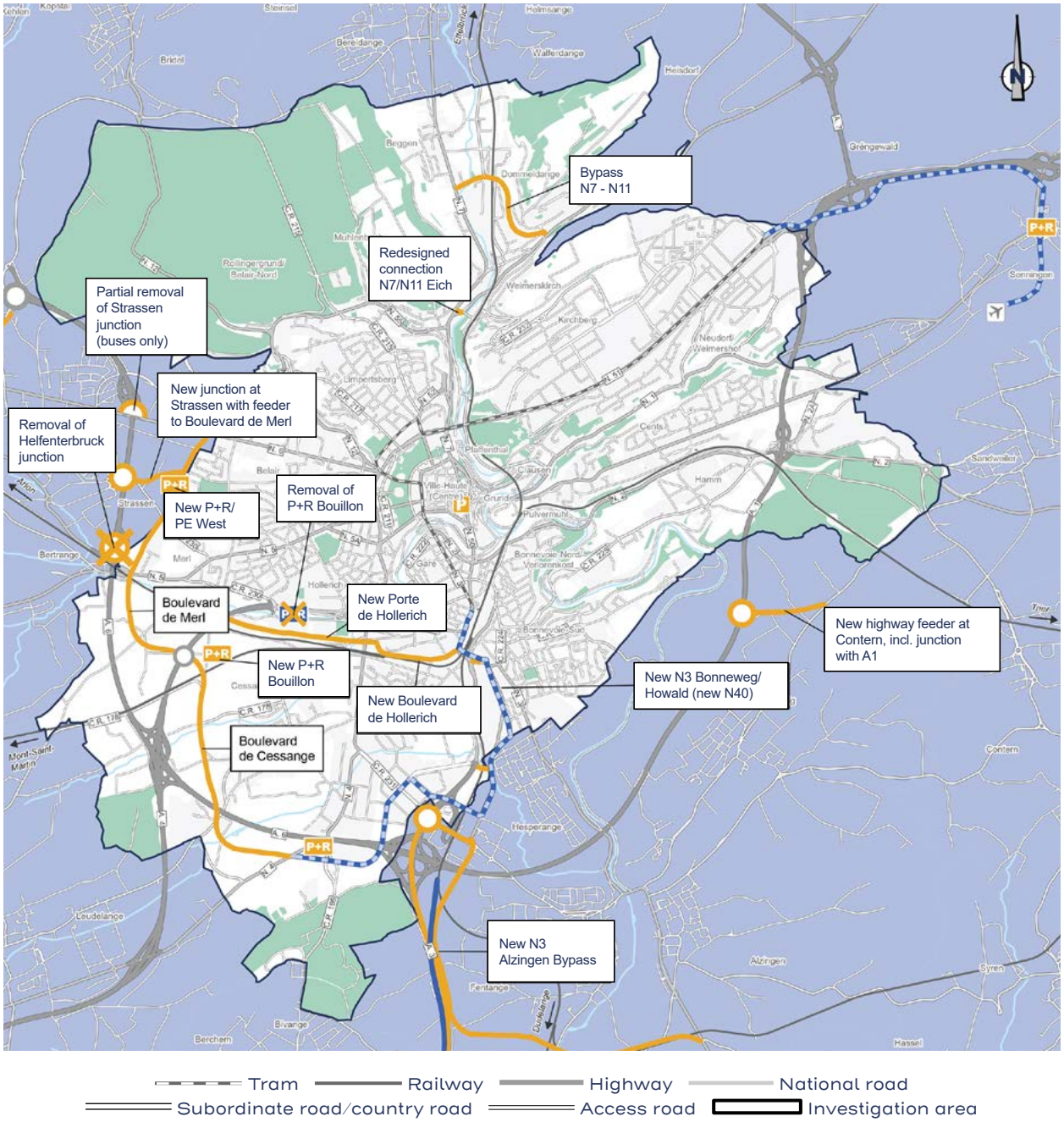
If the current number of trips made using motor transport on the road network remains roughly constant, the demand on public transport will once again increase significantly. Overall, passenger demand is expected to double, an increase that cannot be accommodated with existing public network routes and services.
A next step must be to elaborate on the extent to which a more effective public transport service can absorb a significant increase in demand in future and what percentages can be accommodated by active mobility, in particular cycling.

6.4 Impact of expansions to road network required due to urban structure – Base Scenario 3

In the (simplified) Base Scenario 2, no significant expansions are made to the road network. However, this is essential in order to connect up the new areas of the city. There are also additional initiatives planned by the National Roads Administration (Administration des ponts et chaussées) that were not taken into account in Base Scenario 1, because the necessary planning permission and financing have not yet been secured. **Base Scenario 3** examines, in particular, the potential fundamental impacts of these initiatives as a whole. It elaborates the possible effects of these initiatives when it comes to easing the burden on the inner city. The public transport system is unchanged compared with Base Scenario 1 in order to show the genuine impact of these road building initiatives. The proportion of active mobility is also unchanged.

The following initiatives have already been discussed in Luxembourg City in recent years and are at various different stages of planning (see also Chapter 7.4.3). **Base Scenario 3** is based on these initiatives (see graphic below):

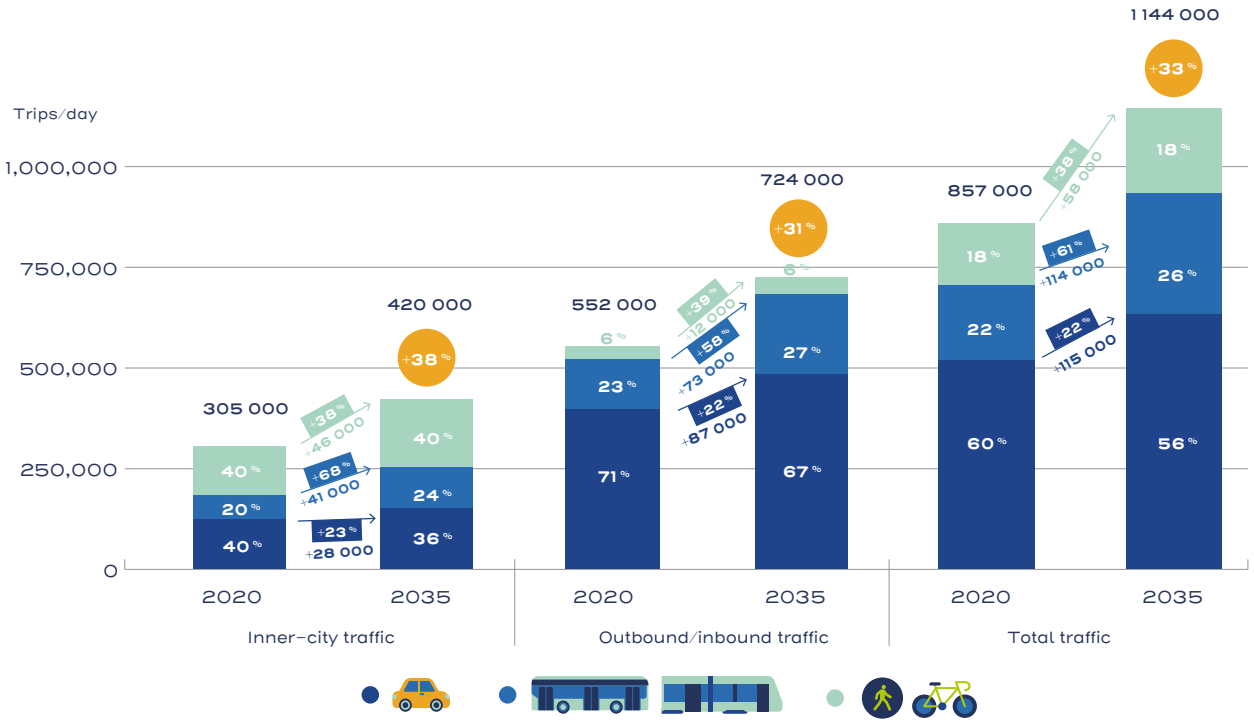
- All public transport initiatives already taken into account in Base Scenario 1 (expansion of CFL, extending tram north and south, adapting RGTR bus service)
- Construction of the following roads (regional and inner-city) which were already taken into account in Base Scenario 1:
    - Three-lane expansion of A3 around the Aire de Berchem / Gasperich junction, with bus and car-pool lane along entire stretch (under construction)
    - Road feeder to Bridel junction in Strassen
    - N3 Bonnevoie/Howald (new N40, already partially operational)
- The following additional new roads and conversions of existing roads at regional level:
    - Contern highway feeder incl. junction with A1
    - N3 bypass in Alzingen
    - New interchange in Strassen with feeder to *Boulevard de Merl*
    - Existing interchange in Strassen (partial removal, for buses only)
    - Helfenterbruck interchange (removal)
- The following additional new roads and conversions of existing roads within the city:
    - N7 – N11 bypass (with tunnel)
    - *Boulevard de Cessange*
    - *Boulevard de Merl*
    - *Boulevard de Hollerich*
    - *Porte de Hollerich*
    - Redesign of N7/N11 connection in Eich
- Additional P+R facilities:
    - New P+R/PE West
    - New P+R Bouillon and removal of existing P+R Bouillon



Graphic 39: Initiatives in Base Scenario 3

The changes in the modal split and volume of traffic in Base Scenario 3 can be described as follows:

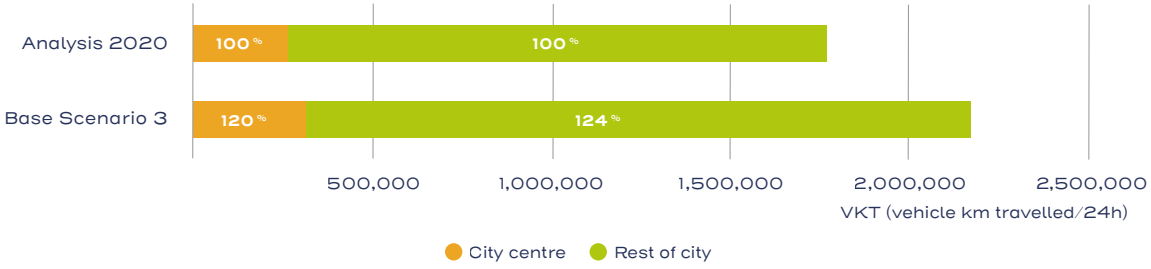
While the extensive expansion of the road network **will not result in an increase in motor traffic** as a percentage of the modal split compared with 2020, it will achieve a slightly lower reduction compared with Base Scenario 1 (4% decrease instead of 5%).



Graphic 40: Comparison of modal split and volume of traffic in 2035 in Base Scenario 3 vs 2020

In terms of absolute numbers, however, the **volume of motor traffic will increase** significantly and more than in Base Scenario 1. This means that expanding the road network, which will be necessary as a result of the structural changes, will lead to a general shift towards motor transport. This result was to be expected since public transport services were not expanded to the same degree as the road network.

Base Scenario 3 was also used to investigate whether the new roads connecting different areas of the city (in particular *Bvd. de Merl / Bvd. de Cessange*) will ease congestion in the inner city. However, this could not be confirmed based on the calculations. On the contrary, there are further (now unmanageable) increases in motor traffic in Ville Haute and the Gare district. This can be derived from the burdens (vehicles/24 hrs) calculated on selected sections. Traffic flows in the inner city area (VKT/24 hrs) increase by 20% compared with 2020.



Graphic 41: Comparison of VKT 2035 in Base Scenario 3 vs 2020

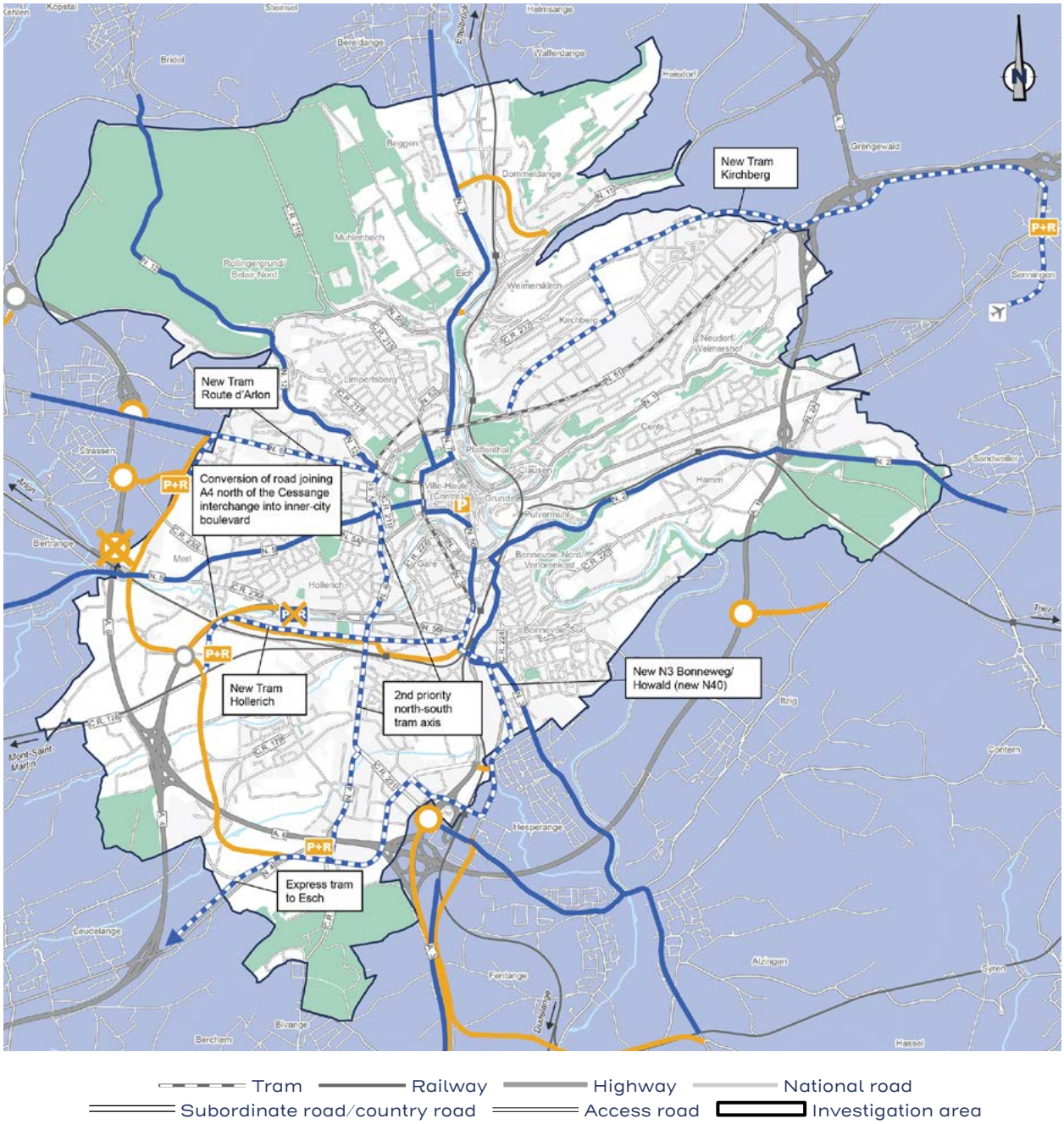
Conclusion regarding Base Scenario 3

As a whole, the road-building initiatives planned in the PNM do not help to ease congestion in the inner city. On the contrary, the trend is for them to increase it (without further expanding public transport and active mobility). The construction initiatives in question close gaps running across the city between its different districts (e.g. Bvd. de Merl and Bvd. de Cessange, which have the potential to ease congestion) and create radial detours (e.g. new N3/N40 with Alzingen bypass and extension between Bonnevoie and Howald). These initiatives are necessary for the road network to function at all and for connecting up the newly developed areas.
However, road-building initiatives alone are not enough to ease traffic and ensure the road network in the inner city continues to function. Alternative options, such as public transport and cycling, must therefore be improved. Organisational initiatives are also required in order to limit through traffic in residential areas and long-distance inbound and outbound traffic passing through the inner city.

6.5 Impact of making sustainable improvements to public transport – the "Planning Scenario"

A Planning Scenario was designed based on the findings obtained from the Base Scenarios. At the core of this Planning Scenario is a significantly higher-quality and more effective public transport system. Without going into detail on the individual initiatives at this juncture (see Chapter 7), the **basic assumptions** can be briefly summarised as follows:

- All public transport and road network initiatives and the P+R facilities described in Base Scenario 3 (incl. initiatives from Base Scenario 1);
- A high-performance public transport network with corresponding services (incl. high-performance tram routes from "Cloche d'Or" to "Etoile" via *Route d'Esch*, from "Etoile" to Bvd. de Merl/P+R West via *Route d'Arlon*, from Luxembourg Central Station to Hollerich/P+R and in Kirchberg via *Bvd. Konrad Adenauer*);
- High-performance inner-city AVL bus lines to supplement the tram service;
- Reorganisation of the RGTR service in light of inner-city services (largely avoiding parallel routes and lines passing through the entire city ("cross-city routes")/changing to city transport at the *pôles d'échange*);
- Converting the road which joins the A4 north of the *Cessange* interchange into an inner-city boulevard;
- Adapting the efficiency of motor transport for the future public transport lines (reallocating space to public transport)

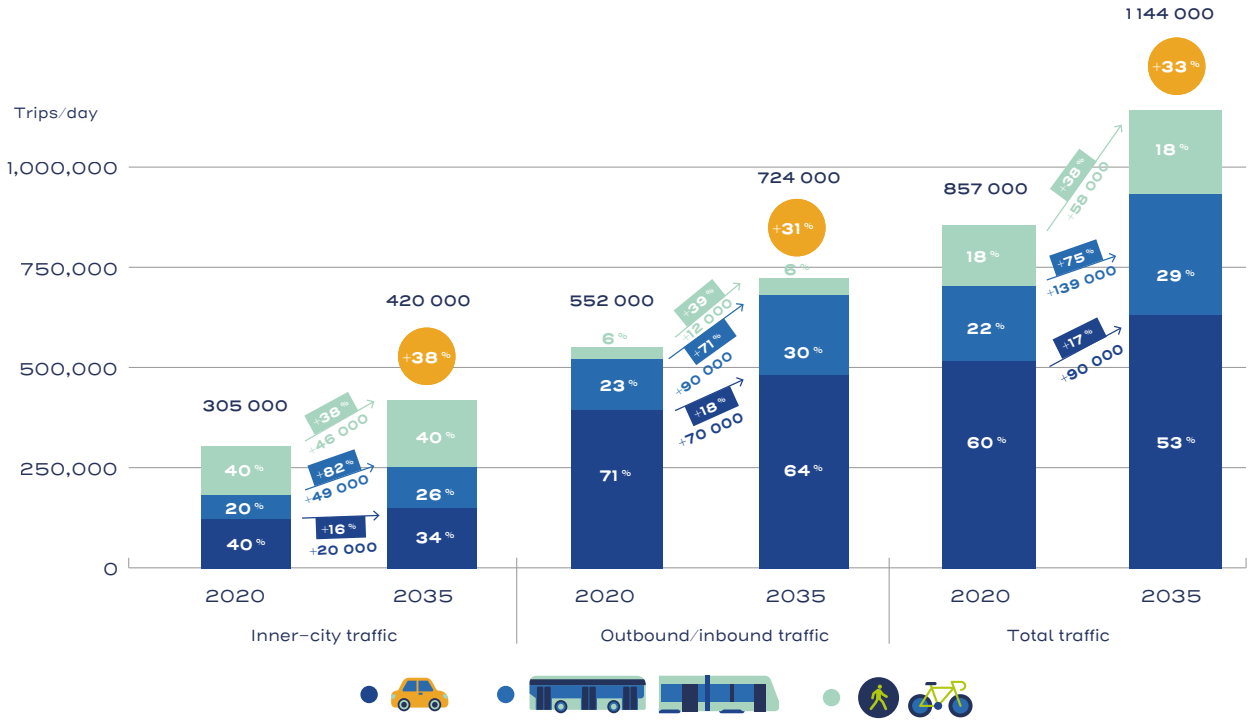


Graphic 42: Initiatives in the Planning Scenario

The Planning Scenario does not include the tram orbital from P+R West via *Bvd. de Cessange* which is currently under discussion. According to the PAG, large areas in Merl and Cessange will only be developed from 2035 onwards. It was therefore not considered necessary to include a tram service in this scenario. However, a bus service adapted for the level of demand forecast for 2035 was included.

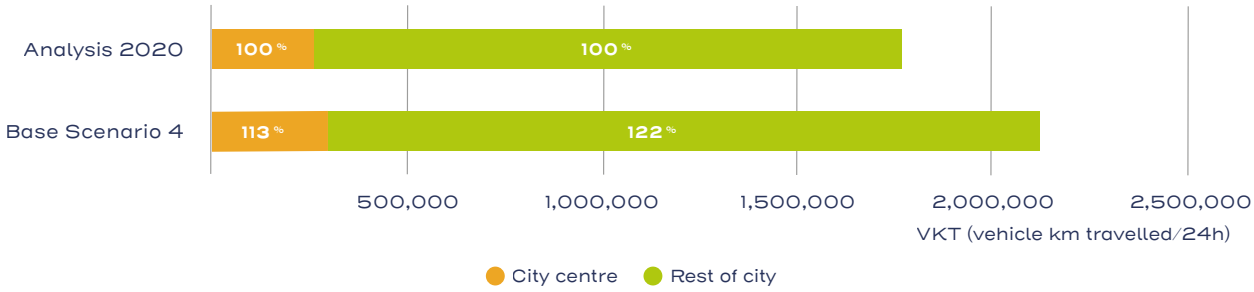
Changes in the modal split and volumes of traffic in the Planning Scenario can be described as follows:

According to the Planning Scenario, the wide-ranging public transport initiatives will have a lasting impact. 7% of the modal split can be transitioned from motor traffic to public transport compared with 2020 (total traffic), 3% more than in Base Scenario 3. This shows clearly the effectiveness of prioritising improvements in public transport services. A similar impact is observed with regards to inner-city traffic (–6%) and inbound and outbound traffic (–7%). However, this is not enough to avoid an increase in motor traffic compared with 2020 (see goals in Base Scenario 2). The total **volume of motor traffic** (passenger trips) will increase by 17% (inner-city traffic +16%, inbound and outbound traffic +18%).



Graphic 43: Comparison of modal split and volume of traffic in 2035 in Planning Scenario vs 2020

While the increase in traffic in the inner-city area is lower than in Base Scenario 3 (113% vs 120%), traffic is significantly heavier than in 2020. The road network will not be capable of handling this increase in traffic effectively.



Graphic 44: Comparison of VKT in Planning Scenario 4 vs 2020

Conclusion regarding Planning Scenario

A noticeably improved and more efficient public transport system has the potential to shift the modal split significantly in favour of public transport (compared with 2020 and Base Scenarios 1 and 3). There is no realistic alternative to this scenario, since the road network would not be capable of absorbing the additional traffic in a manner that is viable for the city. Unless the public transport system is expanded, traffic flows will inevitably experience disruptions which will bring into question the basic functioning of the entire transport system.
That said, expanding the public transport system alone is not enough to achieve the goal sketched out in Base Scenario 2. Consequently, the Planning Scenario shows what public transport services are absolutely essential (pull measures for public transport) in order to absorb the increased demand for mobility.
However, in order to achieve these goals, this significantly improved public transport service must be supplemented by a long-term improvement in active mobility. Cycling is particularly important here. In addition to developing infrastructure for pedestrians and cyclists, push measures (incentivising people to avoid taking the car) may be particularly useful, alongside mobility management activities aimed at promoting eco-friendly modes of transport. Not only will this promote active mobility in general, it will also increase demand on public transport.
The necessary scope and effect of the new public transport services can be derived from this scenario. It also shows the size of the gap in the modal split which must be closed through additional initiatives in order to reduce motor traffic by a sufficient amount.

6.6 Considerations for a Preferential/Target Scenario 2035

6.6.1 Preliminary remarks

The method for preparing the Preferential or Target Scenario differs from the previous scenarios (Base Scenario 1, Base Scenario 3 and Planning Scenario) which were prepared based on planned transport measures. This scenario does not evaluate any additional initiatives. Instead, it is intended to show the extent to which some motor traffic could be transitioned to other modes of transport. Part of this method involves drawing on experiences from other comparable cities.

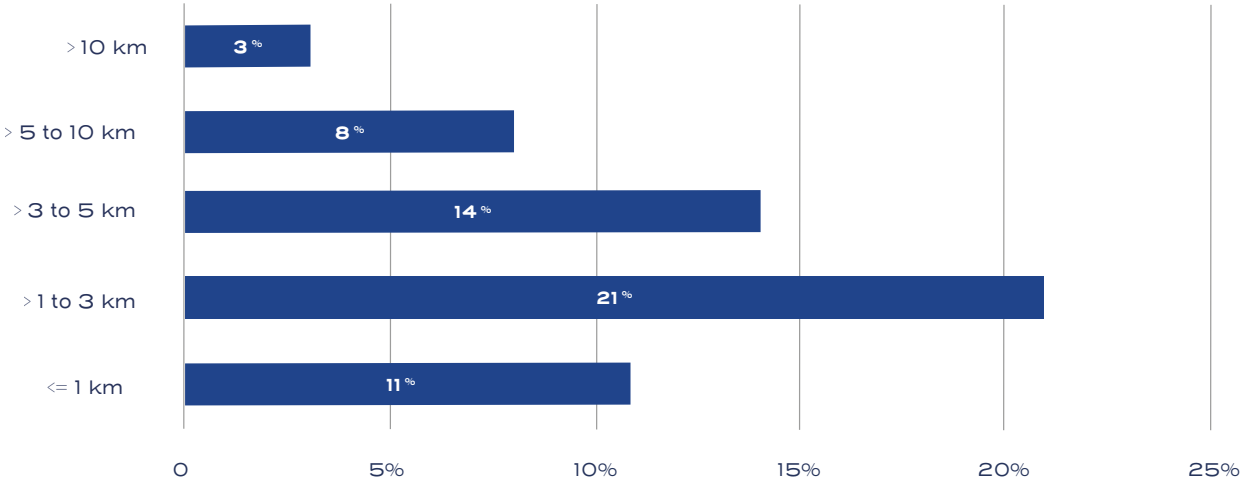
6.6.2 Areas of potential for active mobility

Distances in Luxembourg City and its surrounding areas are comparatively favourable for walking and cycling. Many destinations within the city are easy to reach on foot. It is also often easy to get around within the different neighbourhoods by foot or to walk from one district to the next or into the city centre (Ville Haute and Gare districts).

Almost all neighbouring municipalities in the immediate area are no more than five kilometres from Ville Haute or the Gare district as the crow flies. Because of this proximity, cycling is also an attractive option, especially to the north (Walferdange), south-east (Hesperange) and west (Bertrange and Strassen). The city measures between seven and eight kilometres across. As a result, all routes within the city are easy to cycle, even when taking into account the slight detours. However, the topography can result in longer detours in some areas.

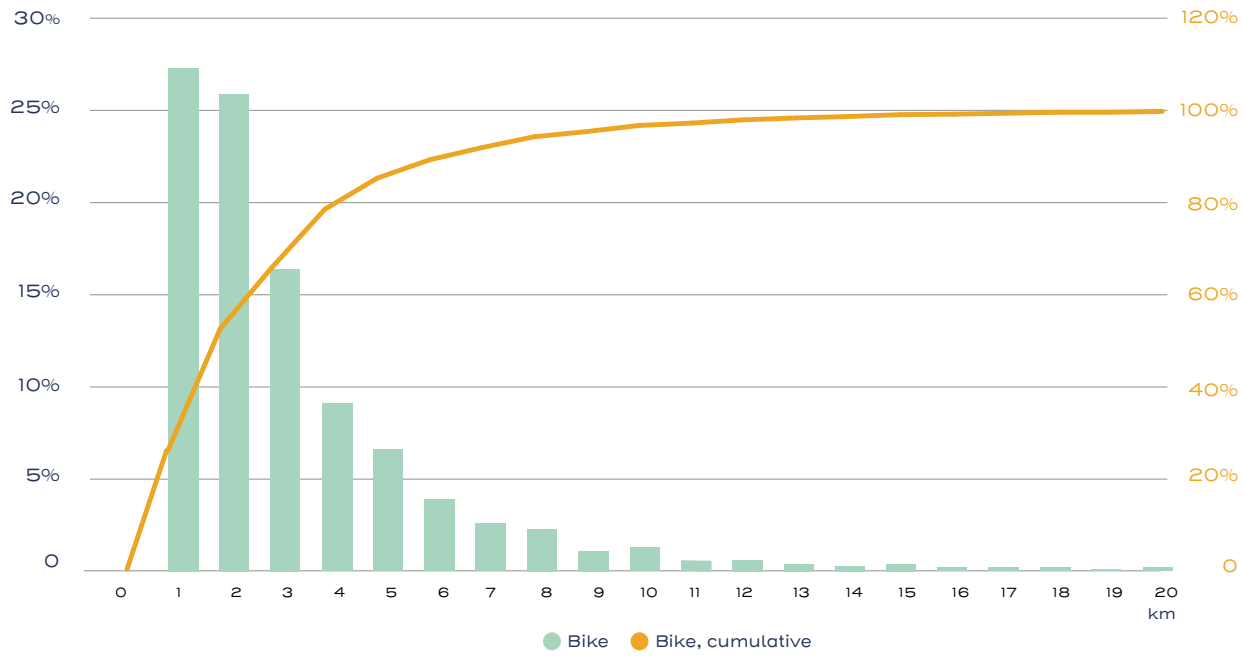
Empirical studies from Germany[2] show that cycling is still very much a viable option even over real distances of up to ten kilometres (and further). Graphic 45 shows the distance-based modal split for regional centres with up to 500,000 inhabitants and hilly topography. Regional centres are cities with greater regional significance. 20 cities of this type were evaluated, although the analysis did not take into account high numbers of pedelecs or existing cycle highways since these are very new developments. It can therefore be assumed that there is significant potential for further increases in future.

2 *Mobility survey of the " System repräsentativer Verkehrsbefragungen SRV", (System of Representative Travel Surveys), TU Dresden, conducted periodically every 5 years. The most recent survey in 2018 covered 118 investigation areas comprising 135 cities and municipalities.*



Graphic 45: Percentage of trips made by bicycle, breakdown by distance (SrV 2018, Regional centres with up to 500,000 inhabitants and hilly topography)

The percentage of people travelling by bike drops off dramatically for distances over ten kilometres. This is also confirmed by the subsequent assessment of average cycling distances (see SrV). Over 85% of all trips made by bike cover no more than five kilometres. 96% of all trips made by bike are under ten kilometres.



Graphic 46: Breakdown of distances travelled by bike (SrV master data, n=93, 241 trips by bike)

In terms of estimating the potential for Luxembourg City, this means:

- The distances involved when **travelling within** Luxembourg City are short (max. approx. 8 km). Therefore, cycling could account for significantly more than 10% of the modal split in future. Evaluating the SrV, we get a mean value of 20.5%. For distances of up to five kilometres, the PNM 2035 has set a goal of 20% for cycling. Looking at the SrV, this is realistic. The goals contained in the PNM can therefore also be adopted for Luxembourg City.
- The distances involved in **inbound and outbound traffic** to/from neighbouring municipalities generally do not exceed twelve kilometres. The PNM 2035 has set a goal of 10% for cycling for distances of between five and fifteen kilometres. The SrV produces a modal split of 10.6% in this regard, which is also consistent with the national objective for Luxembourg. Luxembourg City is therefore also assuming that there is the potential to achieve 10% for cycling for trips between the city and neighbouring municipalities.
- Other destinations within the **Grand Duchy of Luxembourg** are significantly further away. Here, inbound and outbound trips begin outside the neighbouring municipalities assessed above. The distance here therefore ranges from less than 12 to a maximum of 20 kilometres. Evaluating the SrV, we get a mean value of 5.1% for cycling as a percentage of total traffic. The PNM 2035 does not stipulate any specific goals for these distances as the base level of 2017 was clearly too low. Luxembourg City assumes a potential modal split of 3% for cyclists.
- There is no potential for bike traffic in **cross-border commuting** due to the distances involved.

Cross-referencing these considerations with numbers of trips produces the following potential for increasing the modal split shares of active mobility:

- Approx. 5% within the city
- Approx. 2% between the city and surrounding areas
- And thus approx. 4% of total traffic

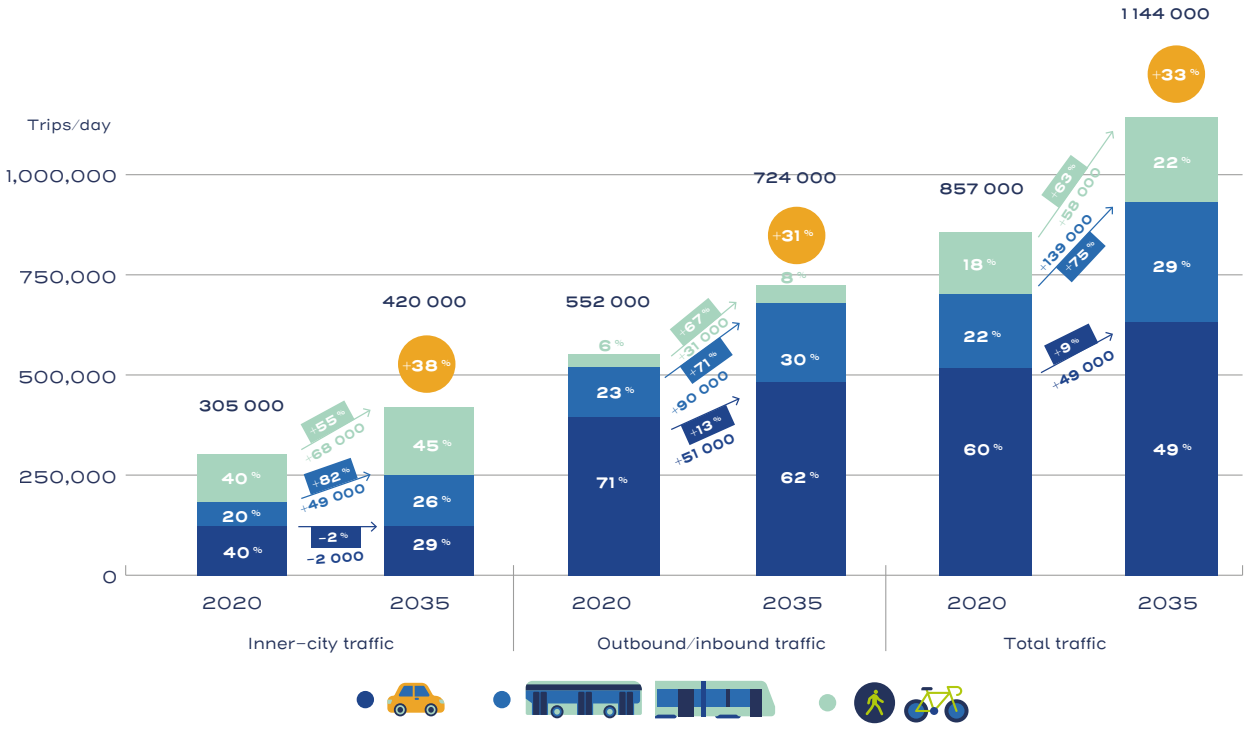
Whether this potential can actually be realised depends to a significant degree on whether the conditions for cyclists can be improved, in particular by expanding the network in the city and connections between the city and surrounding areas (see Chapter 7 for specific requirements).

6.6.3 Effectiveness of push measures

Push measures generally make driving more expensive (parking fees and other taxes) or limit driving (reallocating public space to non-car traffic, introducing speed limits, restricting the number of parking spaces etc.). In some cases, the impact on the modal split is well over 5%. Push measures should be seen as an additional incentive for people to make use of new transport options. Experience has shown that simply providing new options ("pull measures" on public transport, cycling infrastructure etc.) are insufficient and that this move should be supplemented by the introduction of push measures. Push measures can increase the percentages of people using public transport and active mobility that were produced in the Planning and Preferential/Target Scenarios. It is important, however, to actually implement the relevant options from these scenarios so as not to produce any gaps in service.

6.6.4 Modal split and volume of traffic in Preferential/Target Scenario 2035

The Preferential/Target Scenario did not take these push measures into account separately as this would have required entirely different modelling. The distance-based potential for active mobility (see Chapter 6.6.3) was, however, applied to the model, assuming that drivers would switch to active mobility (in particular cycling).

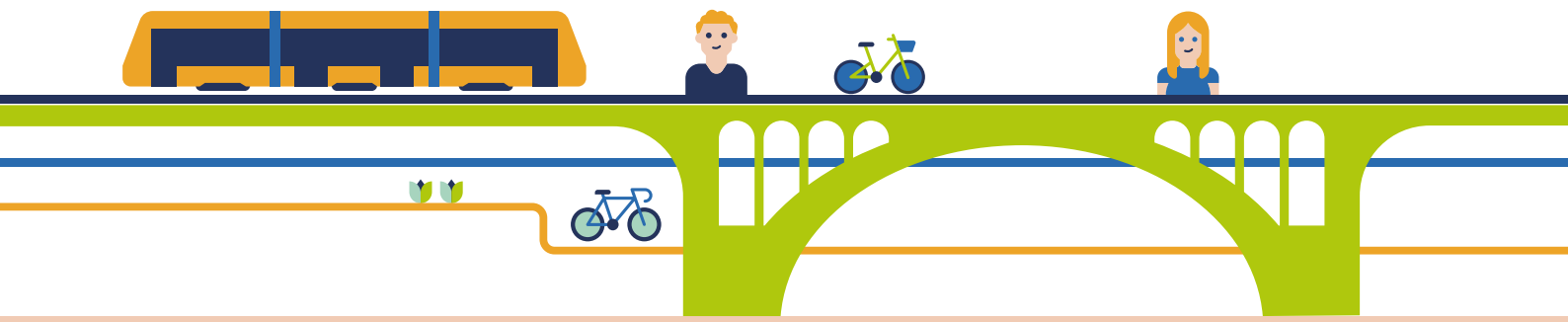


Graphic 47: Comparison of modal split and volume of traffic in 2035 in Preferential/Target Scenario vs 2020

This ultimately produces a noticeable decrease in the volume of motor traffic within the city. Inbound/outbound traffic and total traffic remain more or less constant. The increase in vehicle occupancy rates (see the PNM 2035) was taken into account. The minimum goals set for the modal split (see Base Scenario 2) are therefore achieved in the Preferential/Target Scenario. The increase in congestion in the inner city area is minimal compared with its level in 2020 and almost identical to the level in Base Scenario 2 (106%).

Conclusion regarding Preferential/Target Scenario

The Preferential/Target Scenario shows that the target set for 2035 of "freezing" volumes of motor traffic at their 2020 levels is feasible. This requires, on the one hand, the promotion of active mobility long-term. It also requires comprehensive improvements to services and efficiency in public transport (according to initiatives in the Planning Scenario). Additional push measures could accelerate this promotion of public transport and active mobility. Mobility management could also play a role here by influencing users' choice of transport. There are also other areas of potential that can be unlocked, something which is absolutely essential for ensuring development continues beyond 2035.

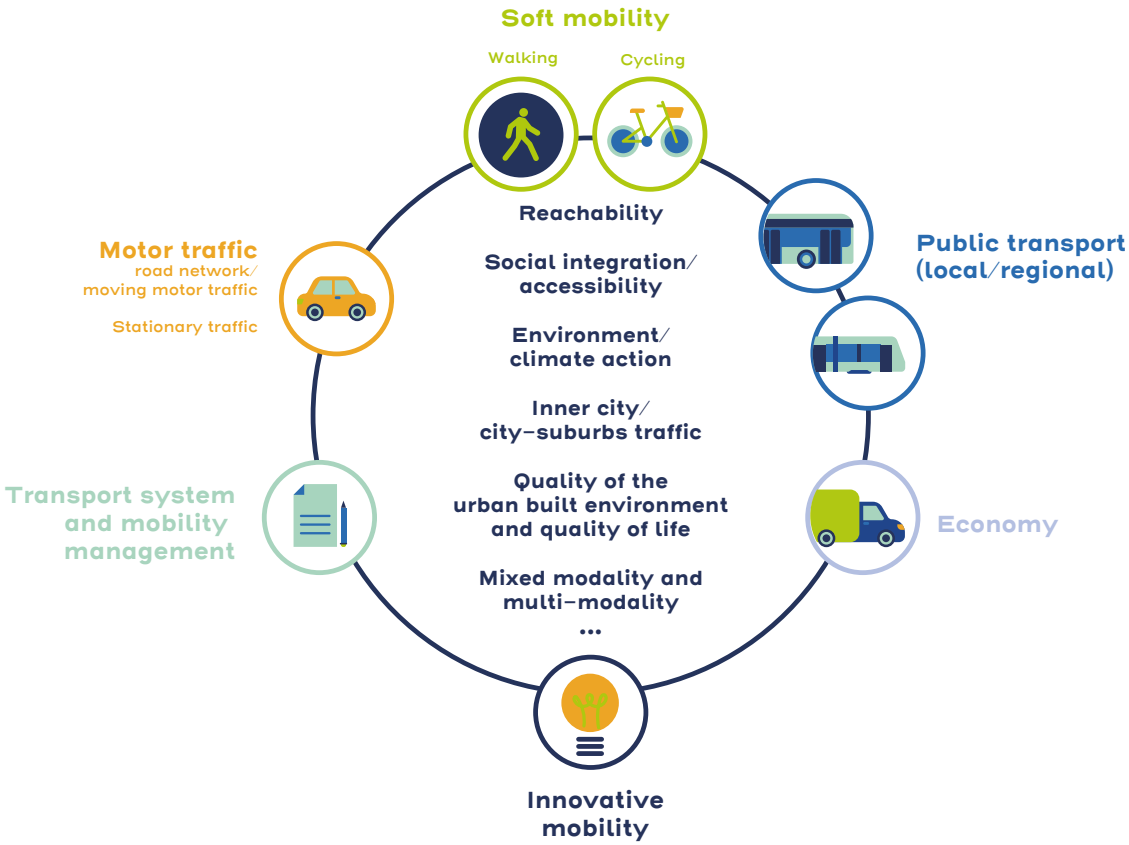


7. STRATEGIES AND INITIATIVES FOR THE MOBILITY OF THE FUTURE

7 STRATEGIES AND INITIATIVES FOR THE MOBILITY OF THE FUTURE

7.1 Basic strategies and requirements

The analysis phase itself made clear which areas require action with regards to the Luxembourg City Mobility Concept. Some issues must be looked at with regards to traffic and transport as a whole. For this reason, these issues are highlighted as a separate action area – in addition to the action areas of classic modes of transport (motor traffic, public transport, cycling and walking). Six action areas were identified as key areas for Luxembourg City:



Graphic 48: Action areas in the Luxembourg City Mobility Plan

The Active Mobility action area comprises all strategies and initiatives that address cyclists and pedestrians. Cycling can be developed using concrete initiatives, while pedestrian traffic is only planned from a strategic perspective. In each case, concrete initiatives must be elaborated based on these strategies and then successively implemented.

Public transport is an absolutely key **action area** within the Mobility Plan. The increase in the need for mobility can only be accommodated through a huge increase in public transport, and in cycling and walking. This network must be further improved in order to achieve this, as is clear from the analyses and scenarios (see Chapter 6). Three primary initiatives were identified here.

1. Public transport networks and services in Luxembourg City should be made more efficient.
2. Cooperation between the different public transport systems (AVL, LUXTRAM, CFL, RGTR) will be optimised.
3. Quality of service must be guaranteed for the passengers.

The Motor Traffic action area looks at the road network, as well as at moving and stationary traffic (parking). This action area looks at:

1. Further developing a functioning core network which can be used to drive to all areas of the city. The network of main roads must be managed in a safe and secure manner that is viable for the city.
2. Traffic in residential areas ("auxiliary network"), e.g. organisation of traffic and traffic flows.
3. Available and well-organised parking. In reality, destinations can only be reached if there is parking. At the same time, stationary traffic takes up lots of public space and good parking options make driving more attractive (> more motor traffic). Influencing the demand for parking therefore constitutes a central control mechanism in modern mobility plans, without which it is impossible to achieve a general transport system that is viable for the city. The Mobility Plan highlights the underlying strategies for influencing stationary motor traffic.

The Innovative Mobility action area looks primarily at mixed modality. This action area focuses on strategies and initiatives for avoiding unnecessary car journeys and using space efficiently by introducing sharing services. It also addresses the issue of providing charging infrastructure for e-mobility.

The **Commerce** action area looks at the mobility needs of businesses and industry. The focus here is on whether these needs are sufficiently met by other action areas and what additional strategies and initiatives could be considered.

The Transport System and Mobility Management action area addresses two issues.

1. The aim of transport management is to make efficient use of infrastructure and to provide users with the best possible information by employing cross-modal approaches. The main objective is to ensure the functionality of the networks during normal operation and also under changing conditions and when disruptions occur.
2. Mobility management aims to influence the mobility behaviour of individual groups. Transport service offerings alone are not enough to encourage people to change their mobility behaviour. Targeted information campaigns can help to influence people's perception of subjective mobility and their decisions.

7.2 Regional and inter-regional initiatives and framework conditions

The National Mobility Plan (PNM 2035) was published in 2022 under the headline "Using Infrastructure Efficiently". The PNM provides a national framework which must be taken into consideration when developing the transport system in Luxembourg City. Nevertheless, the Luxembourg City Mobility Plan has its own focuses and priorities, because investigations have highlighted the specific needs of the city and because decisions should be made as locally as possible (principle of subsidiarity).

The focus of the PNM 2035 is to develop public transport, cycling and pedestrian traffic. Particular emphasis is placed on the aspects of mixed-mode and multi-modal use of the road network. The latter, in particular, is based on the complaint that in recent years the road network has been unilaterally designed to accommodate motor traffic. However, as a "public space", it should be possible for all users to make use of the road network; this is one of the aims of the PNM. The Luxembourg City Mobility Plan also intends to focus on these same issues and to plan initiatives accordingly.

For Luxembourg City, the most important approaches set out in the PNM 2035 are the following:

- Improving the efficiency of public transport services to and from Luxembourg City (expanding railway lines and train stations, increasing seating capacity on public transport, continuing to develop regional bus services in the urban area etc.)
- Improving regional accessibility on the road network
- P+R initiatives and developing mixed-mode interchanges (pôles d'échange – PE)
- Creating attractive cycling routes connecting Luxembourg City to its surrounding areas (in particular cycle highways)

Some of the building initiatives contained in the PNM relate directly to the city. These have been largely integrated into the municipal Mobility Plan since they affect initiatives in the city. There are also other initiatives which relate to areas outside of the city (the City of Luxembourg is not involved) but which nevertheless affect the city, e.g. the construction of a new Alzingen bypass, the Contern highway feeder. These initiatives are included for informational purposes.

Elsewhere, the initiatives in the municipal Mobility Plan deviate from the PNM. Urban development is a particular area of focus when it comes to developing public transport and mixed-mode interchanges. Deviations are mainly due to different levels of knowledge. The local analysis of the city's Mobility Plan is more detailed than the general PNM 2035.

The approaches that have been taken from the PNM 2035 have been modified and integrated into the action areas below.

The PNM 2035 acts as the foundation for mobility planning and is subject to regular updates over time. This meets the requirements of modern mobility planning. Approaches from the city's Mobility Plan will likely be included in future versions of the PNM 2035 where these are relevant for the country as a whole.

7.3 Public transport

7.3.1 Basic challenges in public transport

The expected increase in population and jobs will generate more traffic. While around 0.86 million trips[1] were made each day in Luxembourg City in 2020, forecasts predict this figure to rise to 1.14 million trips by 2035. That is an increase of around 33%, which the road network cannot accommodate as it has limited capacity and potential for expansion (see Chapter 6). For that reason, this additional traffic must be entirely absorbed by public transport and active mobility. Since the distances involved are often too great for cyclists and pedestrians, public transport will form the backbone of the transport system. There are no alternatives, especially for longer distances, such as travelling between the city and surrounding areas and cross-border commuting. Public transport will accommodate this additional traffic.

The scenarios (Chapter 6) have shown that use of public transport can increase to around 29% as a percentage of total traffic[2] by 2035 (compared with 22% in 2020) if significant improvements are made to bus and tram services. This is essential if we are to keep volumes of motor traffic at more or less their current levels (2020). Other initiatives can also be introduced. Traffic in Ville Haute and the Gare district will only continue to function in future and will only be acceptable to residents and visitors if public transport makes optimum use of the available space and absorbs the future increase in volumes of traffic. Under certain conditions, this could even improve quality of life.

The targeted increase in use of public transport from 22% to 29% is an enormous challenge:

> 2035: 1.14 million passenger trips/day x 0.29 = approx. 0.33 million passenger trips on public transport/day
> 2020: 0.86 million passenger trips/day x 0.22 = approx. 0.19 million

Buses and trams must therefore serve 75% more passengers than in 2020.

AVL buses still have some free capacity even during peak times (see analysis for 2020). Nevertheless, some lines are at capacity during peak hours despite running frequently, mainly those running into the centre, west towards *Avenue du Dix Septembre* (Lines 5 and 6) and north towards *Côte d'Eich* (Lines 10 and 11). Line 29 (Luxembourg Central Station – Findel) has also grown since 2023 to become one of the most congested sections of the AVL network. It is almost impossible to increase the frequency of services or number of lines since bus stops and road space cannot accommodate more buses. The tram network between Ville Haute and Luxembourg Central Station also has almost no unused capacity during peak hours.

As such, a 75% increase in passenger numbers between now and 2035 poses a challenge. Huge efforts are required in order to create the necessary capacities. The Preferential/Target Scenario therefore defined and evaluated a massive expansion to the public transport system. Assumptions were made regarding expansions to the tram network and regarding priority bus routes as a working hypothesis and not in order to make decisions regarding buses or trams at this juncture. Further investigation into street planning and potential volumes of traffic are required in order to find the best solutions. The basic concept for the public transport network described below, comprising bus and tram routes, is presented in **Figure 12**.

1 *Total of all inner-city and inbound/outbound traffic in Luxembourg City across all modes of transport in passenger trips per average workday, including commuters travelling to/from the city*
2 *In relation to all inner-city and inbound/outbound traffic in Luxembourg City across all modes of transport in passenger trips per average workday, including commuters travelling to/from the city*

7.3.2 Overall structure of public transport and division of responsibilities

Operation of the public transport network relies on a number of companies and individual components. For users, the service should be coherent and should appear to be "single-source", with a standardised and easy-to-understand user interface. This is only possible if all stakeholders cooperate properly. The same applies to the planning and roll-out of coordinated lines and timetables by transport operators (AVL, LUXTRAM, CFL, RGTR).

The PNM 2035 has already defined the following plans for the inter-connectivity of public transport:

- CFL will continue to manage the bulk of traffic coming into the city in future. Initiatives have already been planned for expansions and for an increase in services.
- Regional RGTR buses will manage this outside of the rail network. Various bus lines will get high-level service corridors (CHNS[3]). These will be connected to the city network at the pôles d'échange (PE).
- The A3 highway will have a "green lane" for regional buses, long-distance buses and car-pooling.
- There are plans for the tram to connect important city destinations directly to the PEs and to serve those routes with the highest demand. The PNM 2035 stipulates a large number of expansions to the network for this purpose.
- The city tram line will also connect up the Esch-sur-Alzette area via a high-speed tram line running along the highway. This will enable the tram to also take on a regional transport role and will make it possible to get from Esch-sur-Alzette to destinations in Luxembourg City without having to change.
- Regional buses will no longer enter the city centre

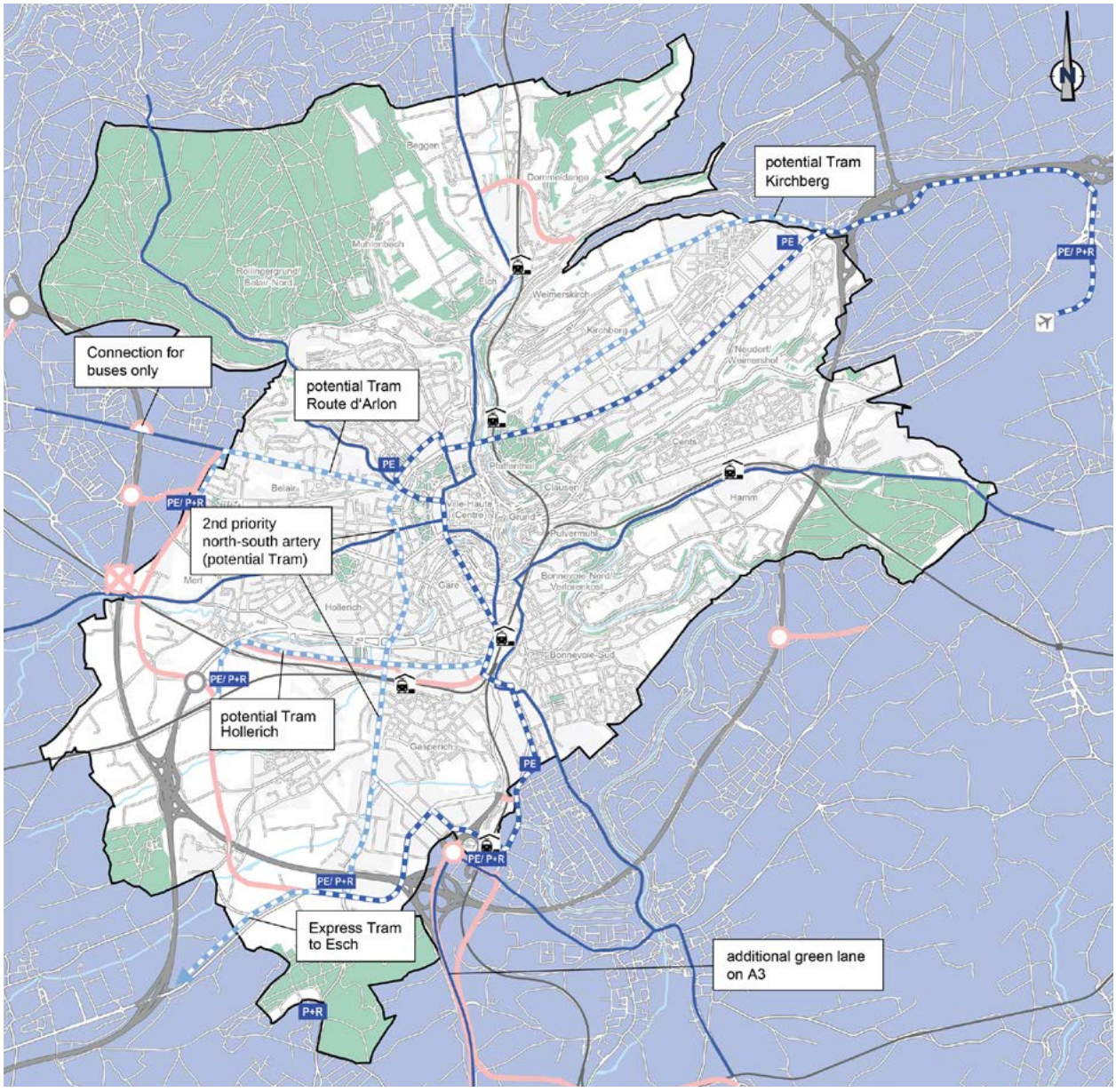
Demand will also increase for AVL city buses. Services must be continuously adapted – to changes in the structure of the city and to new regional transport services. Until the tram lines have been completed, AVL buses must also serve those routes which the tram will run on once operational. Coordination between the AVL, LUXTRAM, RGTR and CFL services is therefore an important and urgent matter.

3 Corridor à haut niveau de Service

7.3.3 Potential developments on the tram network

Current expansions of the tram network

Currently, the tram runs between the "Luxexpo" PE and "Lycée Bouneweg" PE. The future transport network will include the extension to Findel Airport, with a P+R at Heienhaff, and to *Stade de Luxembourg*, also with a P+R service. Both extensions are part of the PNM 2035 and are already under construction. The section between PE "Lycée Bouneweg" and the P+R Stade de Luxembourg will be operational in summer 2024. This tram route will undoubtedly be one of the most important elements in the city's future public transport system since it will connect up popular destinations such as the airport, Kirchberg, Ville Haute, Gare, Bonnevoie and the activity zone in Cloche d'Or. Passenger numbers will nearly double between now and 2035 (on *Pont Adolphe* section compared with 2020). By this time, trams should be running approximately every four minutes. A greater frequency during peak hours could only be accommodated on this route with losses in quality and reliability.



Graphic 49: Overview of route concept for public transport

Second north–south connection

A second major artery for public transport must be created. This artery should run through the city centre along *Route d'Esch*. This will ease congestion on the tram line between Ville Haute and the Gare district and will help manage the increase in demand. The Preferential/Target Scenario provided for an additional tram line between *Place de l'Étoile* and the new *Stade de Luxembourg* P+R as a working hypothesis. The specific route, its design and the fundamental decision of bus vs tram must be addressed in more in–depth investigations.

In principle, however, this second north–south public transport connection should create an alternative route between *Place de l'Étoile* and Cloche d'Or – a faster and more direct connection between these two popular destinations on the outskirts of the city. This was one of the suggestions arising from forums such as the public consultations and the Mobility Advisory Council. At the same time, the connection can divert traffic away from the main connection between *Bvd. Royal* (south of *Av. Émile Reuter*) and *Avenue de la Liberté*. This alternative route may also help the public transport network to remain functional even in the event of major disruptions or roadworks. This public transport artery should be largely given its own space, independent of motor traffic, as a way of minimising time lost at stops and traffic lights as far as possible. This artery will be given an attractive connection to the CFL at the renovated Hollerich train station.

Extending the tram to Hollerich

There are plans to establish large P+R facilities at the new distributor junction west of the A6 and at the remodelled A4 highway feeder in Hollerich. These services will offer alternatives to driving into the city. To achieve this, the P+R services must be connected to a functioning and attractive public transport network, taking passengers into primary destinations in the city centre.

Around Hollerich, it would make sense to create this connection soon by establishing a tram route. This should be integrated into planning for the redesign of the district. The tram should connect the new P+R Bouillon to the modernised Hollerich train station and Luxembourg Central Station so that all major destinations in the city can be reached using the P+R.
Where urban development projects have already been planned, the tram route can be integrated into these plans simply and cost–effectively. These districts should be low–traffic neighbourhoods. A good public transport connection is also attractive for new residents and investors.

In January 2024, financing was approved (projet de loi) for the first stage of construction between Place de la Gare and *Route d'Esch*. The idea of a direct connection between the P+R Bouillon and Ville Haute via *Route d'Esch* (second efficient north–south route) without taking a detour via *Place de la Gare* still makes sense. This could be implemented as a city bus line at present or by a tram line in the medium to long–term.

It is expected that passenger numbers between the modernised Hollerich train station and *Place de l'Étoile* will be identical to those currently observed on the tram between Ville Haute and Luxembourg Central Station. It will be impossible to satisfy this demand without a second north–south connection. A second north–south connection can help to ensure that the centre of the city remains accessible long–term.

Tram via Route d'Arlon to P+R West

The PNM 2035 proposes an additional tram route via *Route d'Arlon*, terminating at the new P+R West. The city's Mobility Plan also recommends connecting the P+R West with a tram line via *Route d'Arlon*. This makes sense on account of the urban development projects planned along *Route d'Arlon* and with a view to improving the quality of public transport overall.

Long-term, the PNM 2035 also advocates for extending this tram via the planned *Bvd. de Merl* and the planned *Bvd. de Cessange* towards Hollerich or Cloche d'Or. Conditions should be created to ensure that this proposed route is feasible. Expanding the tram would be a good response to anticipated construction projects. Additionally, a bus corridor (AVL and RGTR) along *Bvd. de Merl* and *Bvd. de Cessange* could satisfy demand in this area until these developments are completed (foreseeably from 2035 onwards), as shown in the models. However, this requires that these lines serve the three planned PEs, plus P+R West, P+R Bouillon and Cloche d'Or. This will enable passengers coming from the surrounding areas to reach a wide range of destinations via public transport quickly and with only one change.

Extending the tram in Kirchberg

A large number of areas in Kirchberg on both sides of *Bvd. Konrad Adenauer* and further along on *Bvd. Pierre Frieden* are undergoing development. These areas are entirely outside the 300-metre catchment area for the tram and are currently served by AVL and RGTR bus lines.

A new tram line via *Bvd. Konrad Adenauer* and *Bvd. Pierre Frieden* could more or less fully connect these areas, as a tram stop would be no more than 300 metres away and fewer changes would be required. In principle, there is potential for a tram due to the density of land use, as shown in the scenarios. A branch such as this could also be easily integrated into the wider network, preventing overcrowding on *Bvd. John F. Kennedy*. This route is also one of the proposals contained in the PNM 2035. In January 2024, financing (project de loi) was approved for the first stage of construction between PE Pfaffenthal and the new Laangfur district (up to *Bvd. Pierre Frieden*).

Modernisation of CFL station in Hollerich

Another important part of the overall concept is the modernisation of the CFL station at Hollerich, as proposed in the PNM 2035. The aim is to move the station so that it connects to *Route d'Esch* and to turn it into a modern PE with a convenient tram connection. This is being undertaken as part of the urban regeneration project *Porte de Hollerich*. In future, trains running on the (Longwy –) Pétange – Luxembourg and (Arlon –) Mamer – Luxembourg lines will stop in Hollerich.

This will create new and attractive options for changing from the CFL to continue on towards Cloche d'Or, *Place de l'Étoile* and Kirchberg – similar to the *Pôle d'échange* at the Kirchberg funicular. It may also ease congestion on the tram in the inner city area.

7.3.4 Further development and optimisation of the AVL, LUXTRAM and RGTR networks

Strong and fast feeder traffic from the surrounding area (CFL and RGTR) and good dispersion within the city form the basis of any efficient concept. In the city centre, this is achieved via the main arteries, comprising the tram and additionally the AVL buses. This type of operating concept is in line with the PNM 2035.

The aim is to keep traffic away from Ville Haute and the Gare district as much as possible – with no more than one change and sufficient seating capacity. Passengers travelling on RGTR buses should change to AVL and the tram at a PE on the outskirts of the city as far as possible. After this change, this second means of transport should take them to their destination in the city as directly as possible. A **working group should be established to plan transport networks accordingly**, and to manage and coordinate these lines. In doing so, this working group must take into consideration the different stages of the public transport expansion project.
Sensible network concepts take into account demand for transport and expected traffic flows. Conversely, considerations around transport networks can also be referred to when evaluating infrastructure initiatives (tram routes, bus lanes, etc.). The initiatives that have been planned in this regard are as follows.

Optimising tram network

Efforts should be made to increase the number of direct connections on those routes with the highest demand. We do not describe a concrete target network here as the state of the network and opportunities for improvements depend on the individual initiatives that are approved. Nevertheless, it is very important that the tram network is gradually improved and so this goal will be enshrined in a separate initiative.

Coordinating tram network concepts with AVL and RGTR bus lines

A major challenge will be to coordinate the AVL and RGTR route networks with the expansion phases of the tram network, P+R services and PEs. We must define a tram network that is adapted to the respective expansion status and levels of demand.

The RGTR network must be adapted to the respective expansion progress and route network offerings of the tram (and AVL). Parallel bus and tram routes should be avoided. Sections of the network that are in high demand should be predominantly served by the tram, without the need to change. The tram should connect the most important destinations in the city to those *pôles d'échange* that are served by regional buses.

The AVL network must also be continuously adapted to reflect the current progress of the tram expansion. Provided suitable routes are planned, AVL buses can even serve high-demand routes that are not directly connected by tram so that these areas can still be reached easily and directly by public transport. Where necessary, buses can also create additional direct connections on alternative routes (e.g. on the route from Luxembourg Central Station to Hamilius via *Avenue de la Gare*), while at the same time easing congestion on the tram in this area.

In addition, more direct orbital connections should be created between popular districts of the city which are not served by the tram.

Guaranteeing high frequency of service and connectivity

Public transport services in the city will be shaped by demand, with high frequency of service at peak times and overlapping schedules for different lines. Generally speaking, the aim is for individual lines to run every 15 minutes on their basic schedule. Services should run no more than every 30 minutes at off-peak times and on lines with lower demand. Where this does not make sense with respect to time and space, the network should be supplemented by on-demand services.

Previously, the target has been a maximum occupancy of 2.4 standing passengers per square metre at peak times. Buses and trams should not be allowed to become more congested in future, even if in extreme cases individual trips are able to accommodate up to 4 passengers per square metre over brief stretches. Currently, more than 97% of the area of the city has a bus or tram stop within a 300-metre radius. This is a good level of coverage and should be achieved for bus and tram stops in future as well.

Timetable synchronisation/Quality of changes

Timetable synchronisation and the quality of experience when changing from one mode of transport to another at the *pôles d'échange* (PE) are both important factors. For this reason, they are enshrined in their own initiative as part of the Luxembourg City Mobility Plan. Changes at the *pôles d'échange* should be as convenient as possible, especially for commuters (direct change). The PNM 2035 also prioritises this concept. Operators should stick to their timetables to ensure that important changes can actually be made with a **high degree of reliability**. This applies even if services run at regular intervals of between 15 and 30 minutes. Public transport connections that require passengers to change are only attractive to commuters if they are reliable. For services that run at longer intervals (morning and evening services), concepts for timetable synchronisation should be optimised. This must be supplemented by real-time travel information, with a standardised user interface and suitable alternative options in the event of a disruption. This must work across all modes of transportation.

7.3.5 Prioritising public transport

Speeding up buses on radial access roads

Reliable and disruption-free city bus services with efficient and expandable main arteries are important. This means that the access roads on the national roads will remain vital to the bus network. Specifically, this relates to the following six roads (see also **Figure 12**):

- N2 from Sandweiler (east) with *Val de Hamm* and *Bvd. d'Avranches*, and connection to N1 towards Findel via *Rue de Trèves*
- N3 from Hesperange (south-east) via *Route de Thionville* following old N3 route as relief road due to construction of new N3/N40
- N5 from Bertrange (south-west) via *Route de Longwy*, *Avenue du Dix Septembre* and *Avenue Monterey*
- N6 from Strassen (west) via *Route d'Arlon* to *Place de l'Étoile*
- N12 from Bridel (north-west) via *Rue de Kopstal* and *Rue de Rollingergrund* to *Place de l'Étoile*
- N7 from Béreldange (north) via *Rue de Beggen* and *Côte d'Eich*

On these arteries, public transport is competing with motor traffic and, in some areas, active mobility for space, resources and capacities. *Côte d'Eich* and *Avenue du Dix Septembre* are among those access roads which currently experience the highest volumes of AVL bus services. In order to avoid the need to change, city buses on *Route d'Arlon* and *Route d'Esch* will be hugely significant long-term, even if the tram is expanded. For dispersion of traffic in the centre to function, passengers disembarking from regional buses must change to AVL buses and the tram at the *pôles d'échange*. However, AVL buses coming from Strassen, for example, still have to drive to the centre via *Route d'Arlon* in order to avoid the need for multiple and short-distance changes.

AVL buses must be routed via these arteries and in some places connected up in order to create an attractive and direct connection between the city and its surrounding areas that requires as few changes as possible. High-level service corridors (CHNS) for buses make sense here. Public transport infrastructure on these arteries must be optimised so that these buses can travel without delays and disruptions despite motor traffic. Initiatives include bus lanes, good bus stops and traffic lights that are optimised for public transport. Buses must be given priority over general motor traffic. In-depth studies are required here in order to draw up the best possible overall solution for competing means of transport on each individual artery. Planning must also take into account long-term network concepts and strategic guidelines for motor traffic.

Prioritising public transport on a wide scale

City buses running on the main access roads act as an efficient complement to the tram network in terms of connecting up the city. City buses also play a major role in connecting up the city's residential areas. Many passengers travelling within the city and out into the surrounding areas are only able to get around without changing because of the different destinations and timetables on the different lines on the main network that overlap each other.

This is why all bus lines have a significant impact on one another. In order to guarantee reliability of services and schedules, the entire network must be disruption-free as far as possible. Appropriate measures should therefore be investigated and implemented for prioritising public transport on the main arteries between the districts of the city. The tools available range from bus lanes and bus/tram stop concepts to prioritisation at traffic lights etc.

7.3.6 Other technical issues

Accessibility

Accessibility for passengers with reduced mobility should be improved across all public transport services in the city as part of network improvements. This will enable the elderly, persons with physical disabilities and passengers travelling with buggies to make even better use of all public transport services. Accessibility also allows passengers to embark and disembark more quickly. While accessibility is already very good, the differences in the boarding height of buses and trams should be taken into account in future modernisation projects and – if feasible – suitable standard solutions should be developed, including with respect to the potential for routes, and therefore also bus/tram stops, to be shared.

Delay and disruption management

A systematic, detailed and comprehensive delay and disruption analysis allows us to identify pain points on the network and to target these for investigation. Solutions may only be required in specific areas. Appropriate technological systems should be developed or existing systems expanded in order to monitor the quality of prioritisation of public transport at traffic lights across the city.

AVL and LUXTRAM already use computer-assisted management systems (RBL and ITCS respectively) to monitor their operations. In addition, the URBIC® quality tool was created as a web application for monitoring prioritisation of public transport at all intersections along the tram route. This tool monitors and continuously improves the reliability of the technological systems and the quality of prioritisation of public transport at traffic lights and along the entire line.

These systems should be expanded in order to ensure comprehensive and systematic prioritisation of public transport long-term and in order to optimise operations in the city. At a later time, data from ITCS and URBIC® could potentially be made available via suitable interfaces to enable cross-modal transport system management.

Standardised user interface for passenger information

A standardised user interface with real-time digital information for the entire public transport network and car and bike-sharing services is a highly convenient tool for (mixed-mode) users. There are a number of different channels that have to be managed here: app and website, plus displays at stops and on vehicles.

Reviewing shared bus and tram routes

In some sections, buses and trams have to share the same roadway since there is only limited space available. This system already works well on *Bvd. Royal* between *Place de Bruxelles* and Hamilius. Feasibility studies should be conducted for further sections where heavy bus traffic is expected, despite the extension of the tram network (e.g. *Route d'Arlon*). There are a number of detailed technical issues involved here. These should be discussed in working groups, e.g. problems with overhead power lines/charging at stops, design, issues with vehicles joining/leaving traffic, density of vehicles, etc.

Zero-emissions fleet

The use of state-of-the-art, environmentally-friendly technologies should be expanded across the fleet of vehicles. In future, all public transport should produce zero emissions locally. However, this will depend on whether renewable energies can be fully used for running and charging these vehicles. Nevertheless, the vehicles used should be state of the art. At time of writing, e-mobility has the best potential for satisfying these expectations. Furthermore, practical systems of this type are already available on the market. Work will therefore continue on electrifying the bus fleet continuously by procuring new vehicles and building charging stations. Among other aims, all AVL lines should be electrified by the end of 2025.

In addition, all buses should be fitted with CCTV, the ITCS control system and automatic counters by the end of 2024.

7.4 Development of road network and motor traffic

7.4.1 Basic strategies for the road network and motor traffic

The growth of the metropolitan region of Luxembourg City imposes a number of different strategic requirements on developments on the road network. These requirements are based on the objectives and are as follows:

- The City's Mobility Plan takes some of its plans for expanding the road network from the PNM 2035. These projects are being implemented directly outside of the city, with some happening on the outskirts of the city itself, and are helping to ensure that Luxembourg City remains accessible, including by car. These plans are already at an advanced stage and have largely been accepted. They form the basis for further considerations.
- Nevertheless, the road network in the area around Luxembourg City must remain functional. Alternative routes are required. This will ensure that the city remains accessible even in the event of disruptions in the network and will avoid traffic being diverted through the inner parts of the city. The surrounding highways, in particular, should distribute traffic from the surrounding areas to the city in the best way possible in order to avoid congestion in the city centre. This is primarily the responsibility of the state.
- Plans for the road network in Luxembourg City should, in particular, create the infrastructure that is required for the city to grow (see PAG). The focus here is on the districts of Merl, Cessange, Hollerich, Gasperich and Bonnevoie.
- A fundamental expansion of the road network in the heart of Luxembourg City (in particular in Ville Haute and the Gare district) is not possible. The aim, here, should be to ensure basic functionality. In addition, space must be created for public transport and active mobility.
- Ensuring urban road traffic becomes increasingly city-friendly is a major strategic challenge. The aim is to increase safety and improve quality of life. This requires initiatives in residential districts and on the main arteries.
- Current structures and responsibilities for the road network must be revised in light of future requirements so that, in future, work is efficient and concepts are standardised. The division of responsibilities for the road network between the city and the state is in particular need of clarification. To do this, roads must be re-classified according to their type and function.
- In order to optimise use of the road network and minimise disruptions, a cross-modal transport system management approach is required that integrates area or network-specific control methods and functions at the highest level.

7.4.2 Initiatives in the areas surrounding Luxembourg City

As discussed above, the PNM 2035 contains a number of initiatives relating to the road network around Luxembourg City which have an impact on the city itself. These must be taken into account when developing further concepts. The initiatives are enshrined in Base Scenarios 1 and 3 and can also be found in the Planning and Preferential/Target Scenarios. They are explained in detail below. An illustration of the road network and the initiatives explained below can be found in **Figure 13**.

N3 bypass in Alzingen

The State of Luxembourg is planning to build a new route for the N3. The new route will run west to the A3 south of Alzingen, before turning north. It will cross the A1 east of the Gasperich junction and connect to *Rue des Scillas*. This will reduce volumes of traffic in the localities of Alzingen, Hesperange and Fentange long-term. The route will be connected to the city's road network by the new N40 (*Rue des Scillas*).

The most important impact from the perspective of Luxembourg City is that traffic flows coming from the south-east will be deliberately diverted to the new N40 inside the city. Because this route will be fast and high-capacity, it may incentivise people to drive and create additional motor traffic (car route higher quality than public transport and active mobility).

However, this initiative also offers good potential for subsequently easing traffic levels on Route d'Esch so that the additional high-performance public transport route described in Chapter 7.3 Public transport can be created.

Partial conversion of the Hesperange junction

As part of the reorganisation of the road network in the south of Luxembourg City (such as building the new *Bvd. de Kockelscheuer* and connecting the N3 from the south/N40), the Hesperange junction, which connects the city's road network to the A3/A1, is also being remodelled. Work on this project has already begun.

Contern highway feeder

In accordance with the PNM 2035, a new feeder for the A1 highway will be built from the commercial areas in Contern, east of Luxembourg City, including the construction of a new junction. This will create a significantly better connection between these large commercial areas and the road network – and, in particular, the highway. Luxembourg City will benefit from decongestion at the Hamm interchange (Irrgärtchen roundabout), an area which the 2020 analysis already identified as congested.

Junctions for joining the A6 around Strassen

The junctions for joining the A6 highway to the west of Luxembourg City are undergoing an extensive redesign. At the core of this redesign is the construction of a new junction in Strassen between the previous junctions at Strassen and Helfenterbréck. Once completed, the new junction will connect to *Rue de Strassen* in the south, rather than joining *Route d'Arlon*. The feeder will run east and connect to the new *Boulevard de Merl*.

As a result of these works, part of the old Strassen junction will be redesigned and in future will be reserved for buses, according to the PNM 2035. In addition, the existing Helfenterbréck junction will be completely dismantled.

The works on these junctions will solve several issues here. The new arteries of *Boulevard de Merl* and *Boulevard de Cessange* will also create an efficient way of joining the highway. All of these measures together will ensure that traffic in Strassen and in the west of the city is well dispersed.

7.4.3 Initiatives in Luxembourg City

Construction of new N40 Bonnevoie – Howald

The construction of the new N40 will extend the Alzingen bypass to connect it to the *Rue de Gasperich / Rue des Scillas* intersection and will run east past the rail yard of the train station via the new *Boulevard de Kyiv* towards *Route de Thionville*. Together with the Alzingen bypass, this will create a new, high-efficiency feeder from the regions south-east of Luxembourg City into the Gare district. To the north, *Rocade de Bonnevoie* and *Place de la Gare*, which has undergone a redesign in recent years, combine with the hubs around *Pont Jean-Pierre-Buchler* to create an effective system. These new roads will ease congestion on *Route de Thionville*, in particular, sections of which run through heavily built-up residential areas.

The first sections have already been completed (between PE "Lycée Bouneweg" and *Pont Buchler*). The remaining sections are currently under construction and are expected to be completed by the end of 2024.

Boulevard de Hollerich/Porte de Hollerich

As part of the development of the new district, the road network in Hollerich is undergoing a complex redesign. Previously, the two carriageways on Nouvelle *Route d'Esch* (N56/N56a) were separated on some sections. In future, they will be brought together and turned into an inner-city Boulevard (*Bvd. de Geesseknäppchen*) east of the roundabout where the road meets *Rue de Merl*. The current *Rue de Bouillon* will be removed from the new district and replaced by a green corridor. In future, this new urban artery (*Porte de Hollerich*) will accommodate all means of transport. Running to the south, it will connect to *Nouvelle Route d'Esch*, while it will be extended east to form the new *Boulevard de Hollerich*, running parallel to the railway tracks as a peripheral road until it joins the *Pont Jean-Pierre-Buchler*.

Boulevard de Merl

According to the PAG, there are many areas for development in the west of the city (Merl and Cessange), yet some of these are not expected to undergo development until after 2035. An orbital road in the west of the city was conceived as a way of connecting up these areas, leading from *Route d'Arlon* in the north to *Route d'Esch*, south of the A6 highway, via the A4. *Bvd. de Merl* forms the main part of this connection in the north, between *Route d'Arlon* and the junction with the A4. This road is being designed as a high-performance, inner-city *Boulevard* for all means of transport. Plans are for it to connect to the wider road network through *Rue de Strassen*, *Rue de Longwy* and the A4.

Scenario modelling for 2035 shows that the volume of motor traffic varies heavily on some sections. The traffic expected to the south of the feeder from the new Strassen junction will also be easy to manage with two lanes. Nevertheless, it should be noted that not all new buildings will be finished by 2035, meaning that the additional traffic they will create is not included in the forecast. The requirements for expansions must, however, be clarified during subsequent planning. The forecasts must be updated, taking into account development plans after 2035 and transport policy goals according to the Preferential/Target Scenario.

The construction of the new *Bvd. de Merl* is directly related to efforts to open up and connect the development areas in Belair and Merl. The new highway junctions and the P+R/PE West are also part of these efforts. The plan is for these measures to also connect to the tram route via *Route d'Arlon*. For that reason, *Bvd. de Merl* is being prioritised over *Bvd. de Cessange*.

Boulevard de Cessange

Bvd. de Cessange is intended to be a continuation of *Bvd. de Merl* heading south. Since this area will not undergo development until a later time, this road will not be built until after completion of *Bvd. de Merl*. *Bvd. de Cessange* joins *Boulevard de Merl* immediately to the east of the A6, crossing the A6 to the east of *Croix de Cessange* and then turning east. It connects to *Route d'Esch* to the south of the A6 and also provides connections to various smaller roads (*Rue de Merl*, *Chemin de Roedgen*, *Rue de Cessange*).

The volume of traffic forecast for 2035 can be easily managed on a two-lane section, although this is contingent on traffic forecasts being updated to account for areas that will be developed after 2035.

N7/N11 connecting road

There are plans to potentially create a cross-connection in the north of the city between *Rue d'Eich / Rue de Beggen* (N 7) and *Route d'Echternach* (N 11), north of the Arcelor Mittal industrial complex. On the N7, this connection would start where the road intersects with *Rue de la Cimenterie*. After crossing the railway line, it is joined by *Rue de la Station* which runs parallel to the railway heading south. Further on, it turns west (new road section with tunnel) and then joins the N11 near the intersection with *Rue Antoine-François Van Der Meulen*.

The plan is for this connection to improve connectivity between the districts of the city and also connectivity to the highway (at Waldhaff) via the N11. At the same time, it is hoped that this move will ease congestion in Beggen and on *Route d'Echternach* between the Dommeldange bypass and *Rue d'Eich*.

In the scenarios, traffic volumes are eased on both of these road sections. Congestion is significantly eased on the aforementioned section of the N11 and also on the N7 between the current branch of the N11 and the intersection with *Rue de la Cimenterie*. However, there is not currently sufficient evidence to indicate that connectivity with the A7 at Waldhaff would be improved as desired. The volumes of traffic estimated on *Route d'Echternach* towards the A7 do not indicate any significant increases that would allow such a conclusion to be made. Additionally, this move could potentially lead to a greater need to expand the junction at Waldhaff. The new connecting road increases congestion on the Dommeldange bypass and later on *Route d'Echternach* down to the intersection with *Rue Antoine-François Van Der Meulen* to a level that would require a four-lane expansion.

It is not yet possible to fully assess the effectiveness of this initiative in light of the objectives of the mobility concept based on the results currently available. **This initiative should therefore be put on ice for the time being**. Further investigations should be undertaken to clarify specifically what effects the initiative would have and whether these in fact justify the extensive construction work, large financial spend and environmental impact.

Redesign of the N7/N11 connection in Eich

Initiatives have been planned to simplify the transport network in Eich. The connection between *Rue d'Eich* and *Rue Auguste Laval* / the Dommeldange bypass, including the branch towards Kirchberg and the connection to *Rue Emile Metz*, is very complex. There are plans to untangle these connections in order to allow traffic to flow better and alleviate a pain point. This is not expected to have any impact on the road network in the city as a whole. However, it should be noted that conflicts may arise here with the N7/N11 connecting road. This presupposes that primary traffic is redirected "diagonally" from *Côte d'Eich* in the south to the Dommeldange bypass. However, this does not correspond to the basis for the impending optimisation which affects a smaller area. Nevertheless, plans should continue with the redesign of the N7 and N11 connection since, as mentioned earlier, there is still a need for clarification regarding the N7/N11 connecting road. Additionally, there would foreseeably be a significant gap between implementation of these two projects.

Redesign of the entrance to the A4

The continuation of the A4 north of *Croix de Cessange* as a way of getting into the city was initially designed to be an extension of the highway up to the edge of the built-up area of Luxembourg City. Currently, the road remains a highway right up to the partially levelled *Rue de Merl/Rue de Bouillon* roundabout.

However, according to the PAG, vast areas of Cessange are undergoing new development and consequently the fact that this road has the characteristics of a highway is becoming more and more of a problem. It is therefore suggested that the highway end immediately to the north of *Croix de Cessange* and then be developed and redesigned here as an inner-city Boulevard (*Bvd. de Geesseknäppchen*). The junction with *Boulevard de Merl / Boulevard de Cessange* is a good location for this. This means removing or redesigning the road for around one kilometre after the Merl roundabout. It should also be considered in this regard whether it is actually necessary to manage traffic without intersections, or whether intersections (with traffic lights) might not be better suited to the future situation in the inner city. This could save space.

Adapting inner-city streets to eco-mobility requirements

The scenarios have shown that transport must take up as little space as possible, especially in the inner city. This requires the redesign and re-organisation of roads in some areas, especially on the main public transport arteries. All modes of transport must be taken into account here as far as possible. Compromises will have to be made where it is not possible to provide separate areas for all means of transport due to a lack of space. The following premises/priorities must be observed here:

- On the **main public transport arteries** (see Chapter 7.3), separate traffic areas must be planned for each mode of transport as far as possible. Specifically, this means separate routes for buses and trams. Sharing space should only be an objective if this will not have any adverse effect on the performance of public transport.
- Buses can join general motor traffic, provided this does not result in bus transport becoming less reliable.
- Motor traffic requires at least one lane in each direction in order for buildings on the outskirts of the city to be accessible and traffic in the city centre to function.
- Pavements must be planned on both sides of the street. These pavements must comply with the minimum dimensions (see Chapter 4.7.2), with wider footpaths planned where necessary. Cars using pavements for parking should generally be avoided. Shared footpaths and bike lanes are permitted in exceptions only. Specifically, they must be sufficient in width (in line with regulations) and pedestrian and bike traffic must be minimal.
- Where motor traffic is heavy, separate lanes must be set up for cyclists. These will keep cyclists safe and ensure a high-quality cycling experience. Where this is not possible (insufficient space), mixed use on the roadway with cyclists and motor traffic is feasible. However, in this case the maximum speed for motor traffic must be reduced to 30 kph.
- Cyclists should not be permitted to use bus lanes on the busiest public transport arteries.
- Generally speaking, on-street parking should be de-prioritised in favour of the requirements set out above. In particularly problematic areas, efforts should be made to compensate for lost parking spaces in other areas (neighbourhood car park or alternative parking spaces as applicable).
- The demands of goods transport must be taken into consideration as far as possible in public spaces (loading zones etc.) if no private land is available. However, innovative city logistics approaches should be used here.

7.4.4 Organisational and other initiatives

Reviewing hierarchy and classification of road network

The significance and hierarchy of roads changes constantly over the course of a city's development. For that reason, roads must occasionally be reclassified so that their classification reflects their actual role in the road network. A road's classification determines which authority has jurisdiction over it. In developing the Mobility Plan, it makes sense to review the current classifications and to adjust these in line with the real-life situation. This is usually a very time-consuming process because new financial agreements must be made any time jurisdiction of a road changes. The current **hierarchy** applied to the city's road network is as follows:

- Highways
- Main roads (*Route principale*)
- Auxiliary main and connecting roads (*Rue collectrice*)
- Access roads (*Rue de desserte*)

For the most part, the current classifications are a good reflection of the actual roles of the roads in Luxembourg City (see **Figure 5**). However, classifications should be reviewed for the following roads in particular:

- *Bvd. Konrad Adenauer (Route principale)*: starts and ends at *Av. John F. Kennedy* > should therefore instead be classified as a connecting road (*Rue collectrice)*
- *Bvd. Pierre Frieden* (currently *Rue de desserte)* in Kirchberg should instead be classified as a connecting road (*Rue collectrice*).
- *The Rue collectrice* function is more evident on *Rue Cents / Rue de Trèves* than on *Rue de Neudorf.*
- Reclassification will be required in the west of the city in future due to the construction of *Bvd. de Merl* and *Bvd. de Cessange*. Planning, including network connections, is not yet complete.
- *Rue de Bridel* (running parallel to *Rue de Kopstal* – N12) has no additional connecting function > downgrade to *Rue de desserte*
- *Av. de la Gare*: has lost previous importance following redesign and changes in traffic management resulting from construction of tram > classify as *Rue de desserte*
- *Av. de la Faïencerie* and *Av. du Bois* passing through district of Limpertsberg have no special connecting functions (alternatives available nearby) > downgrade to *Rue des desserte*
- Downgrade A4 north of *Croix de Cessange* to *Route principale*
- Reclassification around Hollerich, too, due to construction of new district (e.g. *Néi Hollerich* or *Porte de Hollerich*)

This list contains only some of the possible reclassifications and is not exhaustive. **Figure 13** contains a preliminary suggestion for categorising the future road network. This suggestion assumes that the initiatives described will be implemented.

Implementation of the initiatives described in Chapter 7.3 (Public transport) will also produce new functions for a number of roads. Where these initiatives result in a de-prioritisation of motor traffic, some former *Routes principales* will have to be downgraded to *Rues collectrices* or even *Rues de desserte*. However, these roads still possess an important function for the running of the city as public transport arteries.

On some roads which are marked as a *Route nationale* or *Chemin repris*, it is already clear that their **classification** no longer reflects their function. These should be reclassified as a priority. Examples include:

- N1 (*Rue de Neudorf*) and N1a (*Rue de Trèves*)
- Parts of N52 (*Rue de Glacis*)
- *Rue Henri Dunant* (CR 233)
- *Rue d'Itzig* (CR 226)
- *Rue de Strassen*, in tandem with *Rue de Merl* (CR 230)
- Reckenthal (CR 230)
- Parts of *Route d'Esch* (between *Bvd. F.W. Raiffeisen* and the new stadium/N4)
- *Rue de Bridel* (CR 215)
- *Bvd. de la Pétrusse* (CR 222)
- *Rue de Strasbourg* (CR 223)

Downgrading/upgrading could also be performed as part of a comprehensive reclassification process. The layout of Luxembourg City's road network has historical roots. Highways, national roads (*Route nationale*) and state roads (*Chemin repris*) lead into the city centre. This runs contrary to modern developments in transport and promotes through traffic in the city. Currently, ten national roads pass through the narrow inner city area.

A comprehensive overhaul is required. The national roads will be removed up to the city outskirts where they will connect to the city's transport network through PEs and P+R (road and public transport network). This is essential to ensure that the city remains easily accessible. Inner-city roads will therefore fall under the sole responsibility of Luxembourg City, as they should (principle of subsidiarity). The maintenance and development of all inner-city roads would therefore fall under the remit of the municipal authorities. Similar trends have been evident in other countries for years. Classified roads, for example, have been systematically relabelled in city centres and responsibility handed over to local authorities. This allows road networks to be developed efficiently and consistently.

Speed limit concept for road network

Volumes of traffic, use of space and speed limits determine the impact motor traffic has on safety and quality of life. High speeds lead to increases in noise levels and the number and severity of accidents. For that reason, many European cities have reduced speed limits on non-main roads in recent years, primarily in residential areas. These days, the 30 kph zone in residential areas is absolutely synonymous with traffic calming in these areas. The standard speed limit on main roads is usually 50 kph. Higher speeds are permitted on wider sections. Depending on national regulations, 30 kph zones are less common on main roads.

Nevertheless, many places are attempting to further reduce their standard speed limits, including on main roads. That is because studies have shown that:

- This increases road safety ("*Vision Zero*": avoiding road fatalities and serious injuries)
- Cardiovascular diseases caused by traffic noise decrease
- Respiratory diseases caused by air pollution fall
- Overall quality of life improves

Examples include the so-called "shared spaces" which have been introduced in many places (Luxembourg, France, Switzerland, Austria and elsewhere).

The goals contained in the Mobility Plan include clear guidelines on road safety, public health, and safeguarding and improving quality of life. This means that a binding speed limit concept is required for the entire road network. This concept should be based on the existing legal framework. The following proposals could be used to initiate discussions when drawing up the concept:

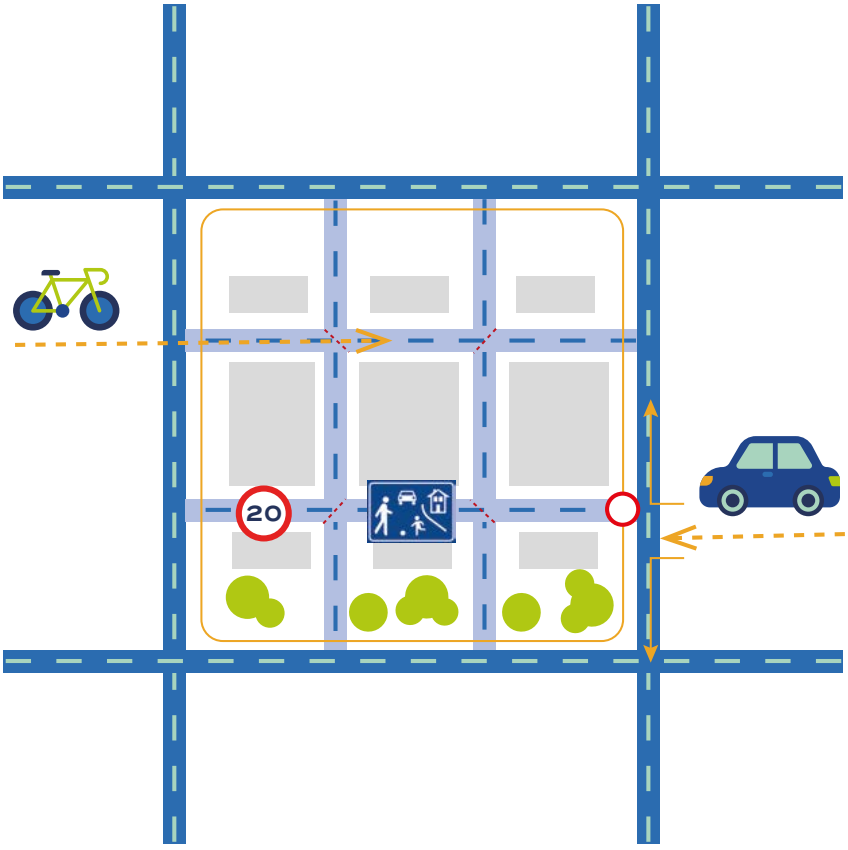
- The standard speed limit for *Routes principales* and *Rues collectrices* within the city will remain at 50 kph.
- Higher speed limits (max. 70 kph) will be permitted on main roads only (not connecting roads), subject to the following conditions (all requirements must be met):
    - Separate road facilities exist for cyclists
    - There are no safety concerns (because there is sufficient infrastructure in place to guarantee road safety)
    - Buildings are set far back enough from the roadway
    - Noise limits are not exceeded (in accordance with the EU Environmental Noise Directive)
    - There is sufficient open space nearby for residents living on this section of road to relax (parks that are not affected by street noise etc.)
- It will be permissible to limit the speed limit (normally to 30 kph) on *Routes principales* and *Rues collectrices*, subject to the following conditions (only one criterion must be met as a minimum):
    - Regular bike traffic is expected and there are no cycling facilities (NB: dashed white lines and coloured road markings do not constitute cycling facilities)
    - Residential buildings are close to the road (areas on side of road are narrow) and noise limits according to the EU Environmental Noise Directive are exceeded
    - Pedestrians cross the street frequently because of a shop (or similar) on the road
    - The road has kindergartens, schools, senior care homes or other facilities used by people with physical or sensory restrictions
    - There are accident clusters with complex causes
- Where public transport has its own lane, this mode of transport could potentially have a higher speed limit (e.g. 50 kph in bus lanes, 30 kph for motor traffic and 70 kph on tram lines). Feasibility must be assessed on a case-by-case basis.
- The standard speed limit on *Rues de desserte* is 30 kph. Different speed limits can be applied, subject to the following conditions:
    - Higher speed limit (max. 50 kph) if public transport would otherwise be too slow
    - Lower speed limit at hazardous locations
- Generally speaking, the applicable zone speed limit applies within zones (in accordance with the *Code de la route* (traffic code)).
- Low-speed zones will be defined based on the *Code de la route*.

Speed limits depend heavily on the classification of a road and vice versa. For that reason, speed limits and road classifications should be developed in tandem in future.

Easing the volume of motor traffic in residential areas

Speed limits have already been reduced in nearly all residential zones (**30 kph zones and 20 kph in shared spaces**). These are very good starting conditions for ensuring traffic conditions are fitting for residential areas in Luxembourg City. Nevertheless, the public are calling for further decongestion, as is evident from the public consultation (online survey and public events). This is also in line with international trends. A common example is the "superblocks" in Barcelona. Only residents and delivery vehicles may drive within the block, at a maximum speed of 10 kph. Similar examples can be found in Germany (*Kiezblocks* in Berlin), Belgium, Austria, Switzerland, the UK and other countries.

While the more residential districts in Luxembourg are traffic-calmed zones, they are still open to through traffic (motor vehicles). This should be significantly more restricted in future, although the needs of public transport, emergency services, delivery transport and disposal services must also be taken into consideration.



Graphic 50: Principle of a superblock[4] (the signage shown is only an example)

Potential sub-measures include:

- Reducing speed limits (max. 20 kph) and creating shared spaces (*zone de recontre/ Begegnungszone*) or residential zones (*zone résidentielle*)
- One-way roads and turn restrictions prohibiting through traffic
- Physical barriers for motor traffic (diagonal barriers etc.)

4 *Source/Copyright: Changing Cities e.V. – https://www.kiezblocks.de*

7.5 Stationary traffic

7.5.1 Preliminary remarks

The availability of parking influences whether or not people drive, and therefore also the total volume of traffic. In total, there are 50,360 publicly accessible parking spaces in the city. These are broken down as follows:

- Approx. 32,500 on-street parking spaces
- Approx. 9,200 in multi-storey car parks and underground garages
- Approx. 2,180 in surface-parking facilities
- Approx. 6,550 P+R spaces (incl. P+R Beggen and P+R Kockelscheuer)

All parking spaces are currently managed or regulated. The maximum stay and hourly fees vary. P+R spaces are free for the first 24 hours, after which they are charged at €10 per day.

There are also private parking spaces. The city has only limited control over these. Public parking spaces, on the other hand, can be used to manage traffic. At the moment, hardly anyone leaves their car at home for fear of not finding a parking space. There are usually spaces available. However, the scenarios have shown that additional push measures are required in order to incentivise people to swap the car for public transport or cycling. Consequently, additional parking spaces should not be created, even with population growth. This applies, in particular, to Ville Haute and the Gare district which are already at the limits of their capacity because of motor traffic.

Approaches to managing stationary traffic can be assigned to one of the following categories

- Initiatives in newly developed areas
- Initiatives in existing districts
- Regulations on resident parking
- Developing control mechanisms for inner-city demand

7.5.2 Initiatives for stationary traffic in newly developed areas

The PAG contains binding regulations on the number of parking spaces in newly developed areas. Luxembourg City can directly manage these numbers itself. Specific guidelines can be defined in the *Schémas directeurs* (master plans), e.g. on the location and design of parking spaces. When doing so, the following aspects must be taken into account:

- The requirement to provide parking should be revised. A sliding scale can be introduced for the number of spaces required in new developments, taking into account the location of the development and public transport connections. The current parking regulation is already very restrictive, especially compared with some neighbouring municipalities. Luxembourg City should advocate for a more restrictive approach outside of the city to avoid incoming traffic. A national strategy for reducing traffic should be pursued. That way, municipalities with generous parking rules would not have any competitive edge when it comes to attracting businesses. Reducing the number of parking spaces does, however, require consistent improvements to public transport services, car-sharing and active mobility. These improvements reduce dependence on motor traffic.
- Outdoor car parks and neighbourhood garages should be promoted to reduce the number of private parking spaces buildings require. Where possible, parking spaces should not be any closer than the nearest public transport stop. Nevertheless, distances of more than 300 metres should be avoided.

7.5.3 Initiatives for stationary traffic in existing districts

Even in existing districts, the PAG defines limits for the number of parking spaces per zone and use. The design and specific location of these parking spaces is regulated in the Existing Development PAP (*Plan d'aménagement particulier "quartier existant"* – PAP QE). The City can manage these spaces too. Depending on the quality of public transport connections, a sliding scale (see above) could also be introduced here for parking spaces on new development projects. Generally speaking, however, the goal is to instead relocate stationary traffic. For example, underground garages and outdoor car parks could replace on-street parking along the sides of roads. This space could then be used to build a bus or cycle lane if these are more important for the transport network. Even if buildings, parks or similar facilities are built, parking lanes could be removed as long as new parking spaces are created no more than 300 metres away.

7.5.4 Revising the regulations on resident parking

The current regulations on resident parking represent only a very small guarantee that residents will find parking, as non-residents also have free access. This encourages unwanted driving. Resident parking regulations should give residents priority not just over commuters but also over residents of other districts. They should also help make people more aware of their use of transport. With that in mind, the resident parking regulations should be revised, e.g. reducing the size of resident parking zones, reviewing the cost structure and framework conditions etc.

7.5.5 Strengthening parking management as a control mechanism

Parking management has a number of different tools it can use to manage traffic. These must be expanded and utilised to a greater extent.

- Adapting city-wide parking management:
    - Make further improvements to how maximum stay and parking fees are defined per district, differentiate between public on-street parking and parking in covered and surface car parks. A distinction must be made here between districts with lots of offices and retail facilities (e.g. Ville Haute, Gare, Kirchberg, Gasperich) and residential districts (e.g. Cessange, Bonnevoie-Sud, Neudorf, Dommeldange).
    - Ensure a minimum number of short-stay public parking spaces to guarantee function of retail/service providers and delivery/drop-off function
    - Increase time periods during which users must pay to park on public parking spaces (currently weekdays 8:00 – 18:00)
- More efficient management of parking occupancy using data on user behaviour

7.6 Cycling

7.6.1 Basic strategies for cycling

Cycling is key to satisfying the future mobility needs of Luxembourg City. Although plenty of cycling infrastructure has been built and expanded over the past twenty years, there is still lots of potential. Until the turn of the century, bikes were used almost exclusively for sport in Luxembourg. Nowadays, however, cycling is a major part of everyday life. Luxembourg City has good conditions for cycling: short distances around the city and largely flat routes on the plateaus. Cycling therefore has the potential to become a real alternative to driving. Even climbs and longer routes of up to 15 kilometres are easy to cycle now, thanks to the increase in e-bikes. There are three types of initiatives that can be used to promote cycling:

- Consistently expanding and optimising existing cycle network
- Creating parking facilities for bikes that are high-quality and meet demand
- Improving conditions and comfort for cyclists

Particular attention should be paid to the different needs of the various user groups:

- Commuters
- Schoolchildren & students
- Cargo bike users (private & commercial)
- Elderly people
- Sport & recreational cyclists

7.6.2 Consistently expanding and optimising existing cycle network

A continuous, uninterrupted cycle network is essential if cycling is to play its part as a mode of transport. The cycle network is comprised of multiple components:

- Cycle highways and city-suburb routes in order to create better connections for surrounding areas
- Main cycle network in the city
- Secondary routes
- Access network between main and secondary routes

Cycle path planning is based on the following principles (for cycle highways, city–suburb routes and main/secondary network):

(1) Coherence & (2) directness:

- Continuous and uninterrupted
- Direct connections to destinations
- Just as fast as driving thanks to directness of route (door–to–door journey time)

(3) Attractiveness & (4) comfort:

- Avoidance of demanding climbs
- High–quality road surface
- Roads maintained and paths gritted in winter

(5) Safety

- Avoidance of conflicts with cross traffic at junctions
- infrastructure separate from other modes of transport (e.g. cars, buses, pedestrians)
- Reduced speed (e.g. of cars) in conflict areas, e.g. crossings
- Cycling infrastructure clearly marked for other road users as well (e.g. pictograms)

Alongside the main and secondary network, the **access network** is responsible for the dispersion of cyclists, allowing them to get to their destinations directly. The access network covers "the final metres" from the main route to the destination. The distances involved are short (<500 metres). This means that the quality does not need to be as high as on the main and secondary network. The access network can be characterised as follows:

- Does not require separate infrastructure in residential areas
- Can join mixed traffic with pedestrians in exceptional cases where there is insufficient space (provided the footpath/cycle lane is wide enough and only used by a few pedestrians). This also requires a nearby main route that is used by the main bike traffic.

Taking these aspects into account, the following initiatives (some of which are combined) should be implemented:

Cycle highways and city–suburb routes

Adequate infrastructure is required in order to improve the overall accessibility of destinations in Luxembourg City. This can also make commuting from the surrounding areas (<15 km) by bike more attractive. Primary responsibility for planning and building roads outside of the city limits lies with the Luxembourg National Roads Administration (in collaboration with the relevant municipalities). General cycling infrastructure can be implemented in the form of cycle highways or city–suburb routes (same function, different development):

Cycle highways:

- Usually two-way cycle path, 4 m in width
- Straight or designed for minimum speed of 25 kph on turns
- Direct routes, minimal climbs
- No or few crossings thanks to specialised infrastructure in the form of bridges and underpasses
- Separate from pedestrian traffic
- Clear visual separation as "Vëlosexpresswee"

City-suburb routes, on the other hand, do not meet all of the above criteria and should only be planned where cycle highways cannot be created without going through unreasonable efforts.

The following arteries shall be expanded as a priority as **cycle highways**. They are intended to make the city as a whole more accessible:

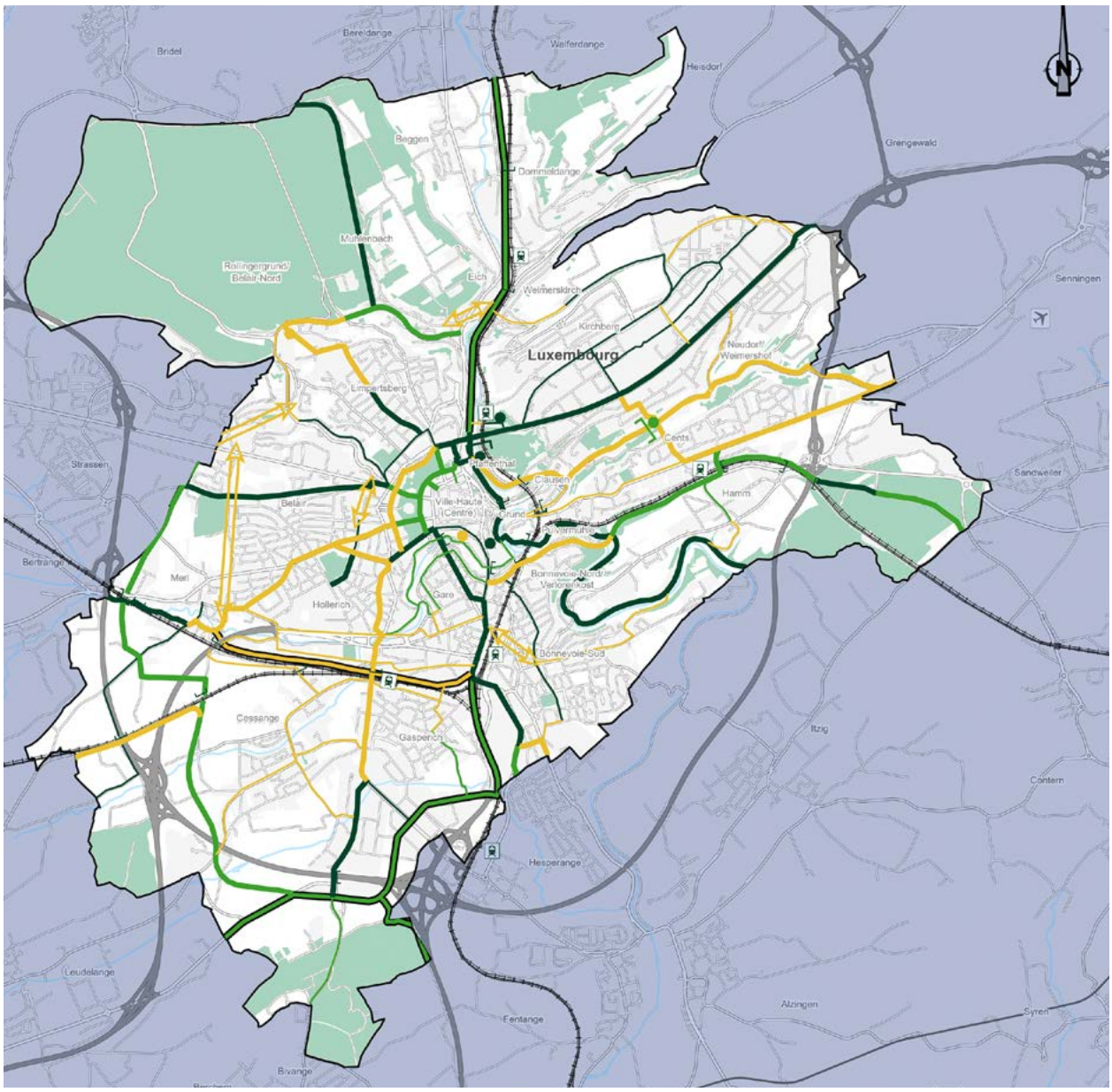
- Connection **heading north towards Mersch** in order to connect up northern Alzette Valley. Continuation to Nordstadt (planning underway/partially implemented by National Roads Administration based on PNM)
- Connection **heading south towards Esch/Alzette and Dudelange** in order to connect up Greater Luxembourg City and southern region (planning underway/partially implemented by National Roads Administration based on PNM)
- Connection **heading west towards Bertrange, Strassen and Helfent** in order to connect up residential areas and important destinations for workers. Continue connection to station as crossing-free artery along existing Bertrange-Hollerich-Luxembourg Central Station railway line.

Some central city-suburb routes **already exist** and do not require any major improvement:

- Connection eastwards towards Senningerberg
- Connection south through Alzette Valley towards Hesperange
- Connection north-west towards Bridel

Other central city-suburb routes must be **created from scratch**:

- Connection eastwards towards Findel in order to connect up airport and important current and future destinations for workers
- Connection eastwards towards Sandweiler in order to connect up residential areas in municipalities of Sandweiler and Contern and commercial zones in these same areas
- Connection south towards Howald in order to connect up residential area and important destinations for workers. This is already underway up to the city limits with the construction of the new tram.



Existing Infrastructure
- Elevator
- Train Station
- Bridge
- Main axes
- Secondary axes
- Railroad

Infrastructure already planned
- Elevator
- Bridge
- Bicycle express ways (laut PNM 2035)
- Main axes
- Secondary axes

Infrastructure to be planned
- Elevator
- Bicycle express ways
- Main axes
- Secondary axes
- Corridor for cross-connection
  Deviations from the route proposals possible during detailed planning

Graphic 51: Proposed cycle network (see also **Figure 14**)

High-quality, uninterrupted and well-marked main cycling network

The main inner-city cycling network is the backbone of the city's cycling infrastructure. All important destinations are connected to the network more or less directly, with additional connections to the cycle highways and city-suburb routes. The network is conceived as follows:

- Separate (built) infrastructure in the form of cycle lanes in each direction on both sides of the road or two-way cycle lane
- Cycle lanes running through residential areas

The following sections, in particular, must be upgraded in order to close gaps in the main cycling network.

- Cents – Kirchberg with bridge over Neudorf Valley (with local lift facility) and connection to *Rue de Neudorf* – Grund artery
- Expand Station – *Val de Hamm* – Hamm with connection to city–suburb routes towards Findel and Sandweiler/Contern
- Howald and Hesperange connection on *Route de Thionville* artery
- North–south artery *Place de l'Étoile* – Hollerich – Gasperich – Cloche d'Or on *Route d'Esch* artery
- Expand north–west artery Rollingergrund – Limpertsberg/Ville Haute – Kirchberg (e.g. installing lift facility to connect Villeroy & Boch premises (see PAP))
- Merl – Belair – Ville Haute cross–connection on *Route de Longwy* – *Avenue du X. Septembre* artery
- Artery through new district in Hollerich (*Porte de Hollerich / Bvd. de Hollerich*)
- Hollerich – Geesseknäppchen – *Route d'Arlon* connection on *Boulevard Pierre Dupong* artery
- Eich – Rollingergrund – Belair – Merl corridor (route still awaiting review)

Selective improvements to main network

Certain parts of the cycling infrastructure on existing arteries must be upgraded to meet modern–day design principles (see above). This includes:

- Optimising north–south Dommeldange – Ville Haute – Central Station – Bonnevoie/ Hesperange/Cloche d'Or – *Stade de Luxembourg* artery
- Optimising west–east Strassen – Belair – Limpertsberg/Ville Haute – Kirchberg artery

Markings on main routes

All cycling infrastructure, but in particular the main cycle routes, must be clearly marked and signposted so that all road users can identify them and in order to significantly improve and highlight their presence in the road network. Guidelines must be developed accordingly (e.g. for signs and pictograms/special markings around conflict areas etc.).

Expanding/improving secondary arteries

Secondary arteries and feeder routes span a fine–mesh network between the main arteries and provide selective localised improvements:

- Special one or two–way cycle path where traffic is heavy or advisory cycle lanes where traffic is light, including within 30 kph zones
- Ensure cycling network is indicated by markings or easy–to–read signage as a minimum
- Greater focus on cyclists' needs at traffic lights (no need to press button at lights, short waiting times, green waves for cyclists where applicable)
- Clear, unambiguous situations at crossings, mitigate known points of conflict

7.6.3 Create high-quality parking facilities for bikes which meet demand

Parking facilities – at origin and destination – can also influence whether or not users decide to cycle Bicycles are sometimes very valuable, e-bikes even more so. These users therefore require parking facilities that are as secure as possible. Specifically, a detailed concept should address the following aspects:

- Expanding parking facilities at train stations/central locations, with a significant increase in capacity according to future requirements (safe and convenient)
- Creating sufficient parking facilities around the inner city, at sports and cultural venues, public facilities, schools etc. according to demand
- Creating protected on-street parking by existing residential buildings (e.g. bikeboxes/ bike hangars/hooks)
- Defining quality standards for bike parking facilities according to type of facility/ availability of space/size plus equipment and accessibility (depending on importance of parking). Also, taking into account requirements for e-bikes or cargo bikes
- Creating sufficient parking by writing new provisions into buildings regulations (*Règlement sur les bâtisses, les voies publiques et les sites* – RBVS)

7.6.4 Improving conditions and comfort for cyclists

In addition to cycle lanes and parking facilities, there are many other individual aspects which can determine the success or otherwise of cycling strategies. Examples of initiatives include:

- Reducing conflicts between cyclists and parking cars > redesigning hazardous areas (e.g. risk created by opening car doors or "blind" reversing)
- Improving signage, making cycle network easy to navigate, especially at intersections > consistent application of "Waymarking Cycle Routes in Luxembourg" („Wegweisenden Beschilderung der Radrouten in Luxemburg")
- Improving winter maintenance, especially on main network
- Ensuring sufficient lighting, especially in urban areas and on main routes > improve "sense of safety"
- Increasing services (e.g. bike repair service, air pumps, bike wash stations, water dispensers) etc. at central hubs and important destinations

7.7 Walking

7.7.1 Strategy for walking

Walking is the primary mode of transportation. That is because virtually every journey begins and ends with at least a short walk. Walking is rarely considered as a primary mode of transportation because the distances involved are too great. Nevertheless, there is a great deal of potential for walking in the city. Walking takes up minimal space and is environmentally-friendly, making it excellent for the city. In addition, walking is open to everyone, regardless of age or income. Improvements to pedestrian infrastructure will therefore benefit all residents of and visitors to the city. This requires a city-wide strategy which can be used to gradually draw up individual initiatives which will then be implemented locally.

The following areas were identified as the most urgent action areas. The analysis takes into account the results of the public consultation and the work of the Mobility Advisory Council.

- Ensuring walkways are sufficiently wide
- Removing barriers
- Improving safety and reducing conflicts
- Improving attractiveness of walking

7.7.2 Initiatives and packages of initiatives for walking

Ensuring wide walkways

Work on ensuring that walkways are wide enough for their purpose involves the following aspects in particular:

- Ensuring a width of 2.50 m, of which at least 1.80 m must be kept free for pedestrians > removing or relocating existing obstacles such as advertising, junction boxes, terraces etc.
- Providing for additional width in special use areas, e.g. in front of shop windows, at bus stops etc.
- Preventing bottlenecks and illegal parking

Removing barriers for pedestrians

Traffic, buildings and differences in elevation pose major barriers to walking. The following packages of initiatives must be transformed into individual initiatives and gradually rolled out in order to remove these barriers:

- Build additional bridges over valley sections (e.g. the planned connection from Cents to the Kirchberg Plateau), additional lift facilities (e.g. in Neudorf in connection with the aforementioned bridge connection or at Gëlle Fra/*Place de la Constitution*)
- Create shortcuts for pedestrians through blocks of buildings when designing new-builds
- Close gaps in pedestrian network
- Consider shorter waiting times for pedestrians at traffic lights and longer green light cycles (in particular on wide roadways > all road users must have sufficient time to cross the street at a comfortable pace)
- Continue to consistently apply regulations on accessibility in relation to new-builds and conversion projects
- Create additional crossing options at selected points > on main arteries, the nearest pedestrian crossing should be max. 150 m away (i.e. max. 300 m between crossings)

Optimising green light cycles and waiting times at traffic lights

Since walking is the slowest mode of transport, waiting times at traffic lights account for a large percentage of total journey time. This means that short waiting times and sufficiently long green light cycles for crossing roads make walking more attractive. Traffic lights must therefore be optimised further with respect to pedestrians.

Initiatives for minimising conflicts

The following approaches must be rolled out successively in order to make walking safer and minimise conflicts with other road users as far as possible:

- Separating traffic flows so that walkways do not have to be shared with cyclists or (e-)scooters > mixed traffic in exceptions only (minimal space available and low numbers of pedestrians and cyclists)
- Prioritising main pedestrian arteries with continuous walkways (*trottoir traversant*) at intersections with secondary streets

Further initiatives for improving attractiveness of walking/accessibility

In order to make walking more attractive, the relevant infrastructure must keep on improving. The following approaches, in particular, have a role to play here:

- Defining uniform standards for walkways when planning new-builds (e.g. development plans/PAP-NQ) or conversion of existing infrastructure
- Ensuring accessibility
- Gradually improving design of public spaces (incl. greening/furniture and lighting) > more pleasant to use
- Ensuring that walkways are in good condition at all times by implementing regular inspections and maintenance
- Paying greater attention to needs of pedestrians during construction projects in public spaces

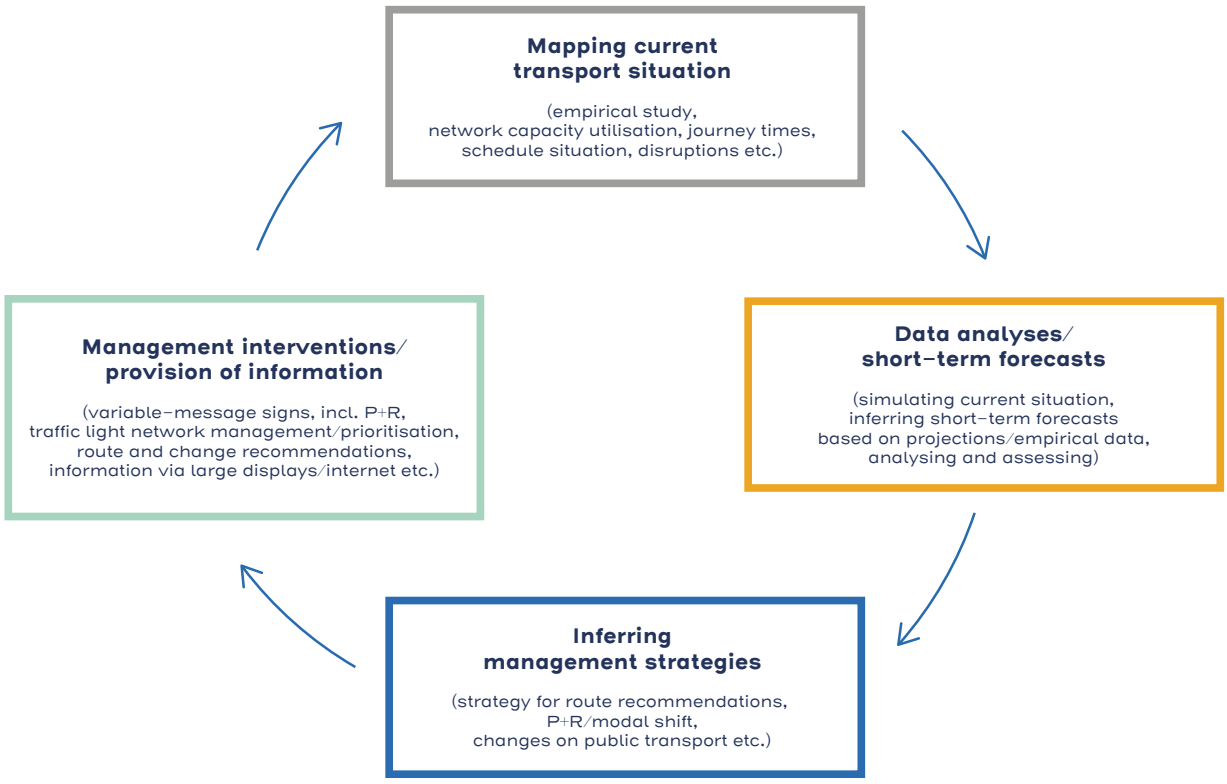
7.8 Transport system and mobility management

7.8.1 Basics of transport system management

Transport system management and mobility management refer to two different strategies, although both concern the same action area. **Transport system management** ensures that transport infrastructure is managed efficiently, such as by routing traffic. It aims to:

- Efficiently exploit traffic and transport infrastructure
- Ensure that the road network functions without disruptions
- Ensure reliability of services and schedules on public transport
- Ensure the best possible response to disruptions through lower-level control measures
- Provide real-time information and short-term forecasts for users

This results in the following transport system management control loop:

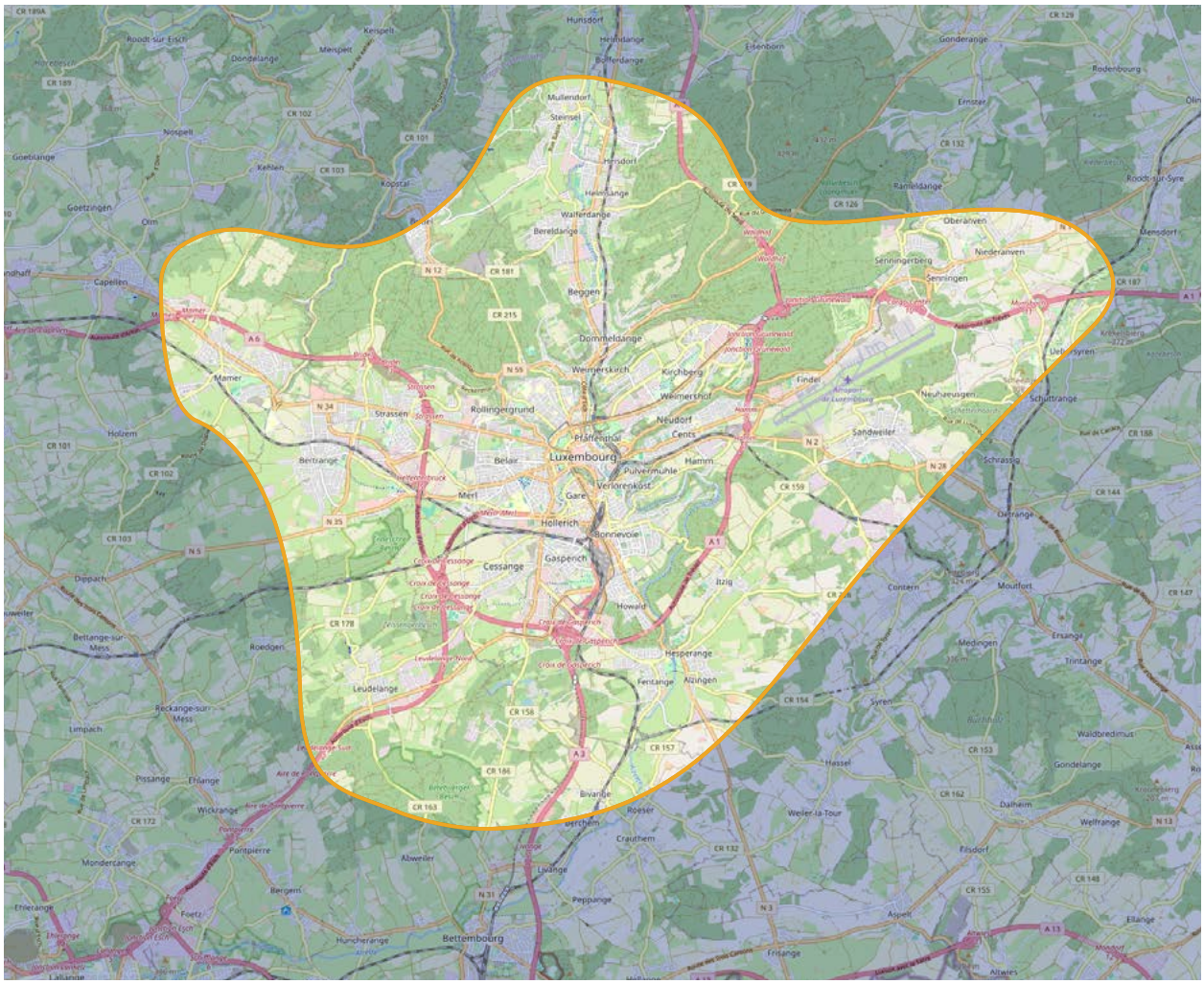


Graphic 52: Transport system management control loop

Transport system management begins by measuring comprehensive sets of data. This provides a picture of the current situation which is mapped out in a simulation model that is capable of making predictions so that the effects of fluctuations in traffic, disruptions and other influencing factors can be identified early. Strategies are then developed for influencing the network (across all modes of transport). These strategies can be utilised as pre-defined strategies for standard cases or generated "on the fly" according to a specific situation. This is the basis for making specific interventions in network management and the provision of information via the different channels, e.g. online channels and displays on buses and trains or at roadsides, in-car sat navs (*on-board units*). The subsequent changes in the traffic situation are then recorded and re-analysed.

7.8.2 Spatial delineation for a transport system management technology for Luxembourg City

Luxembourg City is the centre of the greater urban area and is tightly interwoven into its neighbouring municipalities. The border is fluid in some areas, while transport infrastructure is heavily inter-connected. The highways form a three-quarter ring road around the city, with some branches heading into the city itself. These serve an important distribution function.



Graphic 53: Initial considerations on delimitation of the investigation area for strategic transport system management

Traffic heading towards the city should remain on and be distributed via the highway ring road as far as possible to eliminate through traffic in the city in future (see analysis of problem, e.g. from A4 to Kirchberg via Ville Haute). The traffic situation on the highways therefore plays a major role for Luxembourg City.

Conclusion: These considerations make it clear that initiatives must extend far beyond the city in order to be meaningful and effective.

7.8.3 Concrete proposals for initiatives

Initiatives for developing transport system management have been defined as follows:

Collecting data on traffic guidance system

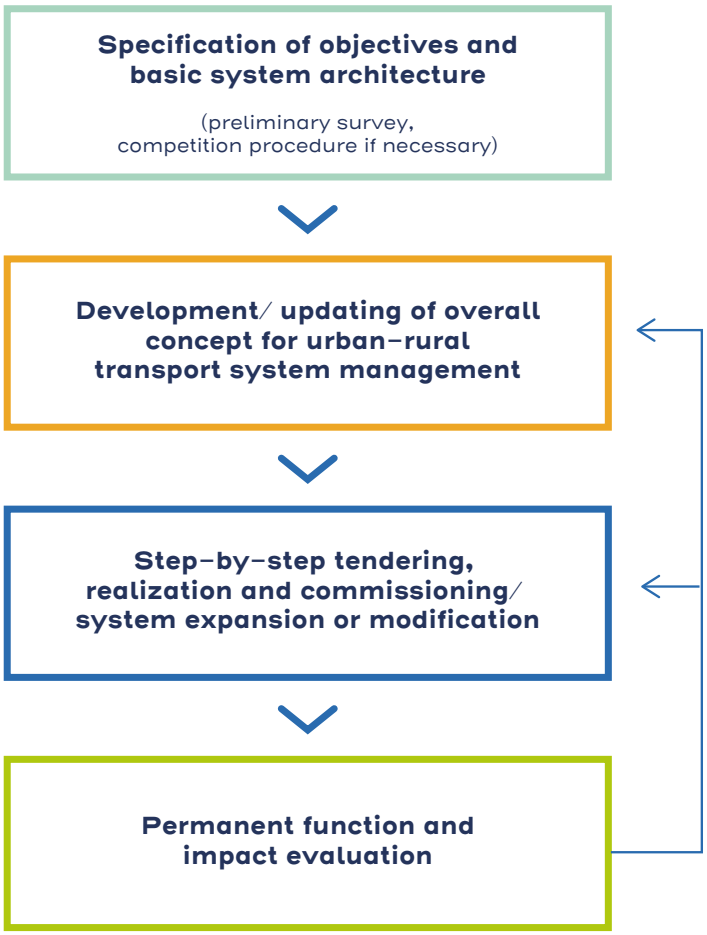
Developing network-wide transport system management requires huge volumes of real-time data. The National Roads Administration already records the volumes of traffic at certain locations (e.g. with permanent counting stations). At present, the permanent counting stations in Luxembourg City only count cyclists. While vehicle detectors at traffic lights embedded in the road surface itself do record volumes of motor traffic, more data is required and the existing data must be analysed. Different agencies have different data. These data sets must be collated and analysed. This requires a state-of-the-art data collection system. An initial rough concept for the system architectures should define the requirements of this system. That said, setting up a system like this is complex and time-consuming. Implementation should therefore be gradual and in line with priorities. The following data, in particular, must be collected:

- How many vehicles are on the road and what types
- How fast vehicles are travelling and how congested road sections are
- How long waiting times are at traffic lights
- Occupancy at P+R facilities
- Occupancy at critical (public) parking hubs
- Timetable status of individual public transport vehicles
- Occupancy on public transport
- Numbers of cyclists
- Occupancy of major public bike parking facilities

Developing a wider metropolitan traffic guidance and information system

The development of a wider metropolitan traffic guidance and information system is a joint effort by multiple different stakeholders. The City of Luxembourg itself is a key player. The goal remains to ensure the functionality of traffic and transport in Luxembourg City. However, other stakeholders are also involved:

- The National Roads Administration (responsible for highways and national roads)
- Public transport operators (AVL, LUXTRAM and RGTR)
- CFL
- Car park operators (to be informed as a minimum)



Graphic 54: Steps for rolling out a wider metropolitan traffic guidance and information system

First, a preliminary study should be undertaken in order to define the specific goals for the City of Luxembourg and all other stakeholders involved. An initial system architecture will then be designed based on this study. The study could also analyse which primary data are needed so that the empirical basis can be established at an early stage. Once the overall concept has been elaborated, it can be rolled out step–by–step. Monitoring and evaluation tools must be defined at an early stage. This will guarantee successive outcome monitoring and will also ensure that the system continues to develop. In principle, the traffic guidance and information system should be used for pursuing the following strategies:

- Recording data on real traffic flows
- Network–wide real–time simulation of traffic (flowing and stationary motor traffic and public transport)
- Creating a short–term forecast model for mapping trends in build–ups of traffic and evaluating discontinuities/disruptions to flows
- Developing specific standard strategies for reacting to recurring build–ups of traffic
- Dynamic development of strategies wherever special disruptions occur
- Implementing strategies in concrete initiatives (for management and providing information, e.g. influencing traffic lights, prioritising public transport, metering, variable–message signs, cross–mode recommendations etc.)
- Providing user services (e.g. P+R, guaranteed bike parking, booking for car–sharing and on–demand services etc.).

7.8.4 Basics of mobility management

The aim of mobility management is to influence people's behaviour. Mobility management aims to inform people of alternatives and target specific areas for incentivisation or disincentivisation. There are a number of initiatives that could be beneficial to mobility management (see Graphic 55). However, these initiatives require sufficient staff and a corresponding structure, e.g. a separate department within public administration.

The involvement of public authorities in each of the four pillars of mobility management varies.

Municipal mobility management Ville de Luxembourg

"Mobility Manager" in the administration for organisation/ coordination/consultation/partial execution

Mobility consulting and public relations
(active)

- Informing the public about MM
- Mobility management for the administration and city bodies
- General advice for residents and companies
- Participation in national/ European campaigns (e.g. European Mobility Week)
- Organising city campaigns
- Managing the municipal MM portal
- National/international exchange of experience
- ...

Mobility management based on target groups
(predominantly active)

Organising/supervising/carrying out mobility management for selected target groups

- New residents
- Commuters
- School pupils and students
- Children and seniors
- ...

Location-specific mobility management
(active/complementary)

Initiating/establishing mobility management for existing locations and guiding/managing investors/project developers

- Commercial locations with many individual companies
- Residential locations/districts/ neighbourhoods
- Development areas (PAG) for housing, services/commerce and retail
- ...

Mobility management for businesses
(complementary)

- MM for commuter traffic for workers (including business commuters)
- MM for business travel
- Fleet management
- Company car equipment/mobility quotas
- Influence on visitor and customer traffic
- ...

Graphic 55: Pillars of municipal mobility management

The first pillar comprises the basic duties of mobility management. These apply regardless of individual projects within the Mobility Plan.

The second pillar is mobility management that is aligned with specific target groups. Here, the focus is on new residents and commuters.

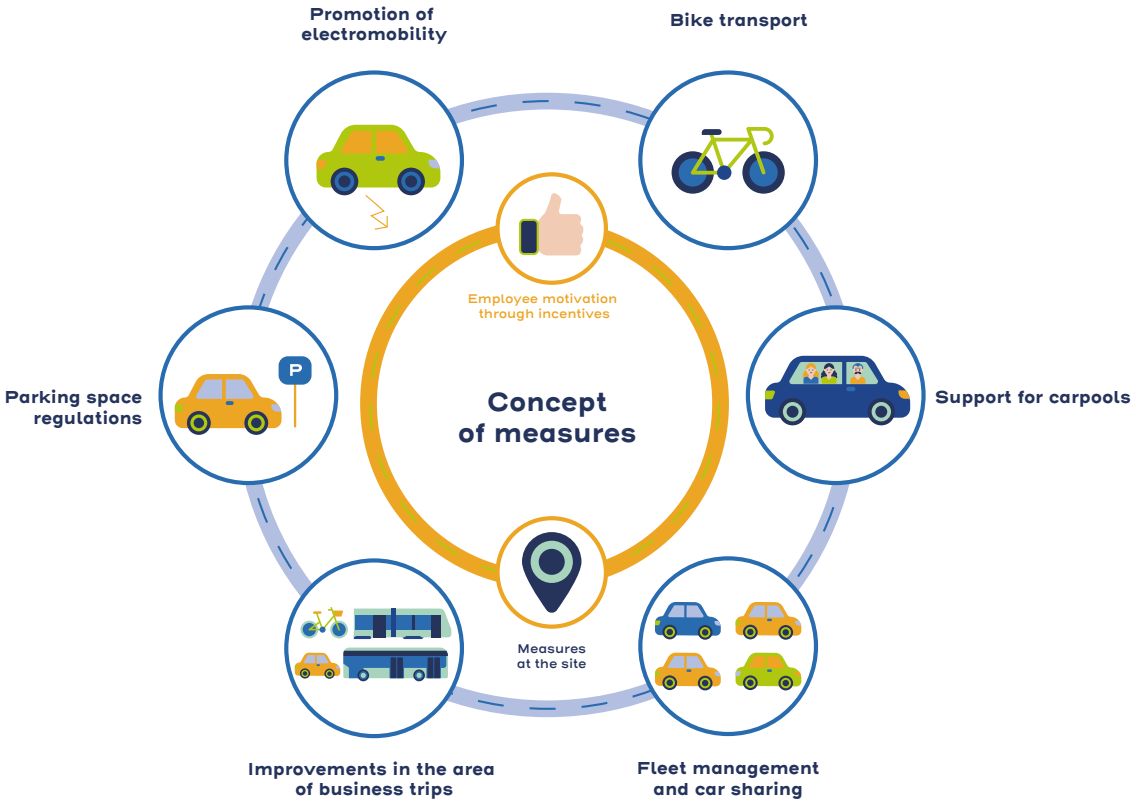
- **New residents:** Major life changes (e.g. moving house) make it easier to change mobility routines. Entrenched behaviours are much harder to change. That is why this is the main area of focus for mobility management. New residents must be informed of the options available to them and be incentivised to act sustainably. For example, new residents could be provided with the following when registering with their local authority:
    - Information pamphlets
    - City maps (city bike map and public transport map)
    - Mobility vouchers (sensible examples in Luxembourg include vouchers for car-sharing)
    - Information on the municipality's website

- **Commuters:** Commuters must be kept regularly up to date about the options available to them, such as through campaigns and projects:
    - Flyers and pamphlets
    - Information on the website
    - Cost calculator
- A guidebook for commuters is particularly useful

Location-specific mobility management (Pillar 3) supports ongoing projects and investors > Coordination with local mobility concepts for newly developed areas.

Corporate mobility management (pillar 4) is the responsibility of businesses. The importance of this has not yet reached everyone, however. The city's public authorities can help with this.

- Specifically, it is the job of the Mobility Manager – together with business associations – to raise awareness among businesses and managers.
- Companies can also be provided with informational materials.
- The goal is for businesses to think about sustainable mobility long-term.
- **A corporate mobility management handbook** is of immense help to businesses and is already in use in several countries. In Germany, Austria and Switzerland, public authorities and business associations have prepared guidelines to give businesses a helping hand.
- It makes sense for Luxembourg City to draw up guidelines that reflect its conditions too.
- The best way to do this is to collaborate with business associations
- who can act as advocates and dramatically increase acceptance of the guidelines.
- It is important for business associations and the Mobility Manager **to act as a point of contact** for businesses in case of questions.



Graphic 56: Examples of corporate mobility management initiatives

7.9 Interchanges, mixed modality and innovations

7.9.1 Overview

The “interchanges, mixed modality and innovation” action area looks at transitions, with methods for optimising the process of switching between different modes of transport. These methods include P+R services and changes between different public transport lines. Promoting e-mobility also falls under this action area.

7.9.2 Park+Ride (P+R)

P+R is a convenient way for drivers to change to public transport at the outskirts of the city. In Luxembourg, this is particularly interesting for commuters coming from outside the city – from neighbouring municipalities and other surrounding areas, and from neighbouring countries. The ideal P+R facility functions as follows:

- P+R should be as close as possible to the commuter’s origin/starting point:
    - At train stations
    - At bus stations/stops (if there is a good bus connection into the city)
- Between a user’s origin and the P+R:
    - The car is often the most convenient form of transport (especially in rural areas)
    - Cycling is also becoming more important
    - Flexible and micro-transit public transport is important
- Need for P+R in surrounding areas (Grand Duchy and possibly neighbouring countries), especially in sparsely populated regions

Luxembourg City does not have any direct control over this. It is feasible to conduct a study of commuter needs. The results of this study could then be used as a starting point for discussions over new P+R facilities with the state and the relevant municipalities.[5]

Establishing P+R facilities on the outskirts of the city should only be considered as a second option. Demand is influenced by the following factors

- Attractiveness of city–suburb connections, with change to the city's public transport system
    - Reliable, sufficient capacities, fast
    - Access to all modes of transport
    - Well–managed public parking (incl. P+R)
- Number of private parking spaces and terms of use (in particular at places of work)
    - It is not possible to "reliably calculate" the number of P+R spaces needed. It must be possible to increase or decrease demand as needed.

Generally speaking, passengers commuting from Luxembourg City should not be provided with a P+R service. The train stations and PEs must be easy to reach on the city's public transport, on foot and by bike. Luxembourg Central Station is well–connected and the existing parking capacities are essentially sufficient for giving the population of the city good access to regional and long–distance services. There is no need to provide an additional service for daily commuters travelling to the surrounding areas.

Establishing new P+R locations

There are four new P+R facilities for Luxembourg City enshrined in the PNM 2035 to ensure that services are available for commuters coming from all directions. New P+R locations are to be established as follows:

- P+R/PE West with approx. 3,000 spaces (part of the PNM 2035)
- P+R Heienhaff with approx. 4,000 spaces (part of the PNM 2035)
- P+R/PE Bouillon with approx. 2,000 spaces (relocation, part of the PNM 2035)
- P+R Stade de Luxembourg with approx. 2,000 spaces (part of the PNM 2035, already complete)

Figure 15 shows the location of the new and existing P+R facilities. Some of the new P+R locations will act as important interchanges for connecting to public transport services. These are described below.

Strategy for ensuring that use of P+R is tailored to target groups

Even around P+R facilities, Luxembourg City is densely built–up, meaning there is a high risk of incorrect or improper use of these services. The aim of P+R is to ease commuter congestion in the city. However, if residents or people working nearby take up some of these spaces, then the P+R is not fulfilling its purpose. In fact, it is having the opposite of its intended effect as having affordable parking so close by encourages people to drive.

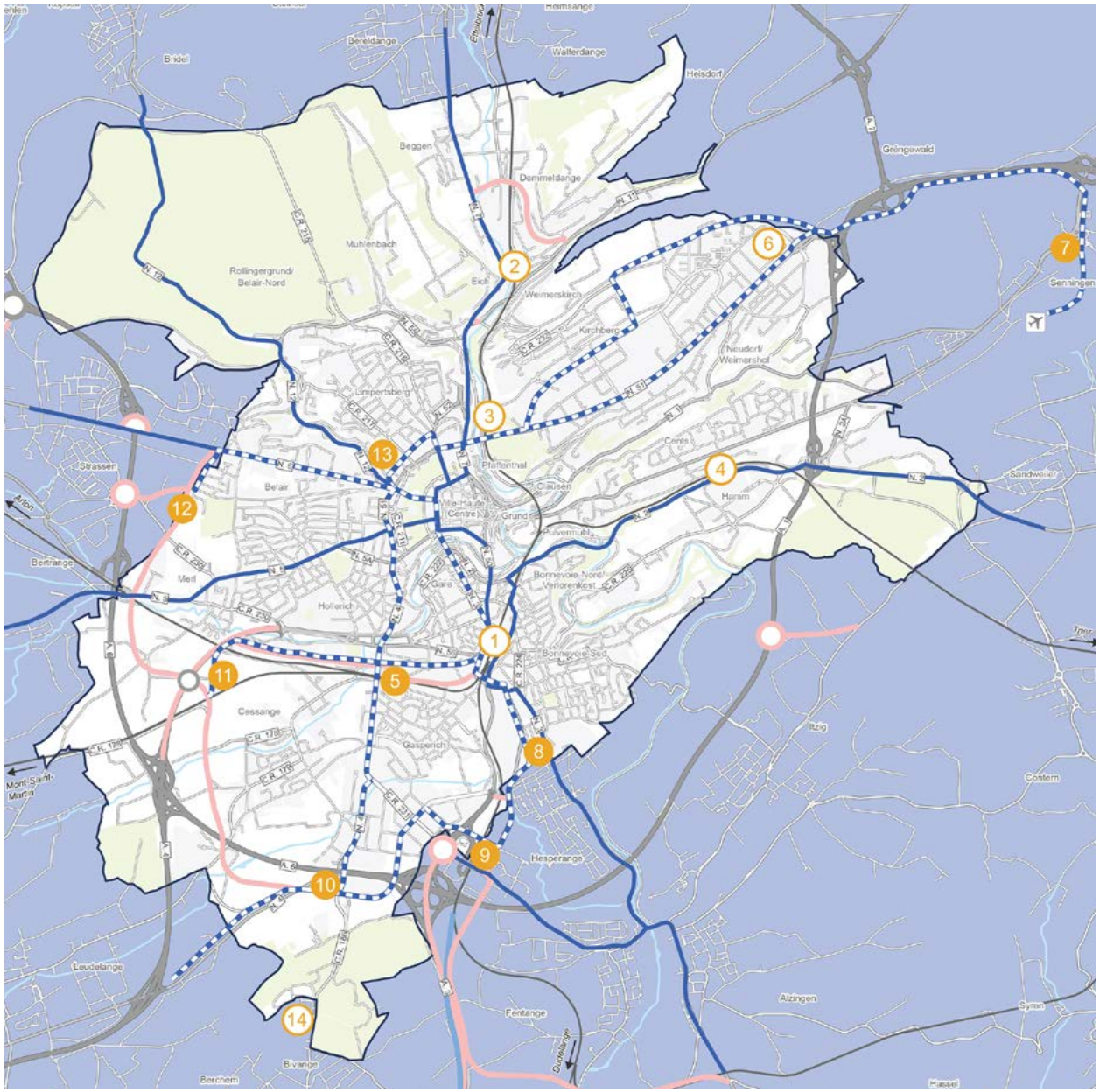
In some cities, P+R services can only be used with a public transport ticket. This is not an option in Luxembourg because public transport can be used without a ticket. Other strategies must therefore be developed so that P+R facilities are available to their intended target group. Modern digital technologies should make this relatively easy.

5 *A good example is the city of Heidelberg which analyses commuter structures and transport services in order to assess commuters' access to public transport. Based on this analysis, the city advocates for the relevant municipalities to expand regional P+R facilities where necessary.*

7.9.3 Developing public transport interchanges

The attractiveness of public transport depends on aspects such as changes. Train stations are, of course, the most important interchanges. They allow passengers to change from regional and long-distance services to the city's public transport and bike or car-sharing schemes. The importance of these interchanges is increasing with the development of the tram and bus network. While the desire is to establish as many direct connections as possible, many routes will still require changes even in future. Acceptance of public transport is therefore contingent on the following factors:

- Short change (direct, comfortable walk)
- Speed of change
- Attractiveness of surroundings
- Additional services where applicable (facilities, gastronomy)



9 New/ upgraded interface

Graphic 57: New/ significantly upgraded public transport interfaces

Key interchanges in the city

Graphic 57 and **Figure 15** show the key interchanges in the city (current and planned). Some stations and interchanges are in good condition and are only being adapted to new requirements as and when. Others require comprehensive upgrades. These are:

- **Further improvements to Howald station** (no. 9 in graphic) to create multi-modal interchange
  - Direct tram connection to *Cloche d'Or* from station
  - Shorter distance to buses (on *Rue des Scillas*)
  - Multi-modal options must also be provided for accordingly
- **(New) Hollerich station** (no. 5 in graphic)
  - Connecting more rail lines (previously only towards Pétange). The train to Arlon will stop here
  - Future connection to tram line towards P+R Bouillon
  - and to proposed tram via *Route d'Esch* (towards Kirchberg and Cloche d'Or)
    - Massive decongestion of Luxembourg Central Station as primary interchange between CFL and municipal public transport
- **P+R Heienhaff** (see no. 7 in graphic)
  - P+R with new interchange for AVL, tram and RGTR
  - Tram line to end at Findel airport (Luxexpo – Airport section already under construction)
- **P+R/ PE Stade de Luxembourg** (no. 10 in graphic):
  - Tram line to soon end at Stade de Luxembourg – Findel.
  - Additional plans to connect to fast tram (tram rapide) towards Esch (in accordance with the PNM 2035) and new tram line via *Route d'Esch*
  - AVL and RGTR services to also be integrated
    - Major importance of interchange for traffic coming from south/south-west
- **P+R Bouillon** (no. 11 in graphic)
  - Existing P+R multi-storey car park in Hollerich to be demolished
  - To be replaced by new P+R/PE Bouillon between Merl and Cessange
  - Future terminus for tram running via new Hollerich station
  - Connection to (orbital) public transport services via *Bvd. de Merl/Bvd. de Cessange*
- **P+R/ PE West** (no. 12 in graphic)
  - New P+R hub on *Bvd. de Merl* following redesign of highway junctions
  - Future terminus for tram running via *Route d'Arlon*
  - Connection to RGTR regional buses and AVL city buses
- **PE Lycée Bouneweg** (no. 8 in graphic)
  - "Lycée Bouneweg" tram stop is a new interchange
  - Tram already operational
  - Change to buses (AVL and RGTR)
- **PE Stäreplatz/ Étoile** (no. 13 in graphic)
  - Already an important interchange
  - Tram is connected to buses (AVL and RGTR)
  - Tram running via *Route d'Esch/Route d'Arlon* will also be integrated here in future
    - Greater importance for interchange

7.9.4 Mixed modality and innovation

Expanding car-sharing services

Analysis has shown that there are still significant gaps in the car-sharing system in the city (see **Figure 11**). The aim should be to ensure that nearly all residents have access to (location-specific) sharing services (max. 500 m away, around 300 m in densely built-up areas).

For that reason, the service as a whole should be expanded first. In some areas, this may not make sense due to a lack of demand at present but this is subject to change.

The legal barrier, however, is presently an issue and a fundamental one at that. According to the law, public spaces may not be used for (privately operated) car-sharing. This means that currently only private land can be used for car-sharing stations (and availability of private land is limited). Alternatively, spaces could be "rezoned" – a very costly and time-consuming process. The State of Luxembourg must therefore amend the regulations by law as a matter of urgency so as not to further inhibit car-sharing. Other countries have already taken this step, e.g. Germany with the Act on Priority of Car-Sharing (CsgG of 2017).

Promoting car-sharing

Other approaches to promoting car-sharing aim to:

1. Expand the system by engaging third parties (in particular investors in residential areas)
2. Simplify the way, in which people can access sharing services
3. Pass relevant road regulations to promote car-sharing

This initiative can be explained as follows:

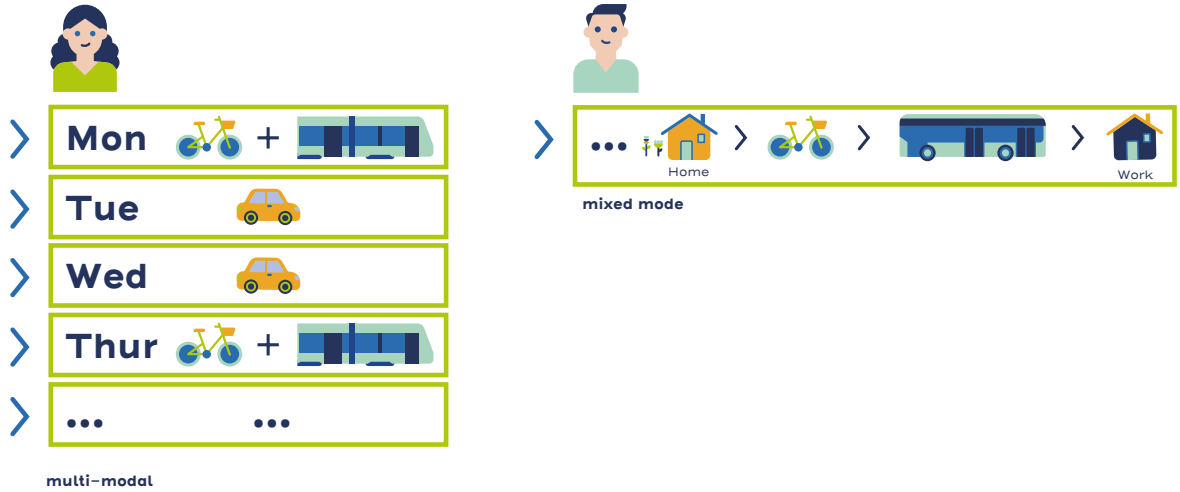
1. Investors act as partners who facilitate car-sharing in new residential areas. However, there are a few things to bear in mind here. While car-sharing can incentivise people to change their mobility, the public benefit is relatively limited. A desirable model, therefore, would be one whereby areas are set aside in new residential areas for public car-sharing. Investors have a financial stake in providing the vehicles. These costs are passed on to the tenants or purchasers of the apartments. It must be determined whether the necessary legal framework already exists or if changes must be made.

2. Car-sharing is truly convenient if it requires only one platform to book and pay for services from multiple operators (currently there are two). Lots of different services with different interfaces and payment systems tend to be off-putting. For that reason, the existing mobility apps should be developed further so that users only need one platform for booking, ideally for different services (e.g. all sharing services).

3. The third method brings together legal aspects of highways management. Aspects to consider include setting aside areas exclusively for parking car-sharing vehicles and reduced parking fees for car-sharing vehicles. However, this also requires amendments to the legal framework. These aspects are addressed by laws such as the CsgG in Germany (see above).

Mobility hub concept

Sustainable mixed and multi-modality means being able to select and use the most suitable mode of transport for every journey or the most convenient combination of modes of transport on a route.



Graphic 58: Multi-modality/Mixed modality after Von der Ruhren et al. (2003)

In this model, access to modes of transport should require as little space and organisation as possible. They are packaged together at so-called *Mobility Hubs*. In light of their importance, they could also be referred to as "Future locations of shared mobility". Major factors influencing the success of these mobility hubs include bold and recognisable design with a good network of localised services.

For Luxembourg City, there are two main tasks at hand here:

- Developing existing and planned train stations and interchanges (*pôles d'échange*) into large, fully-fledged mobility hubs
- Consolidating various sharing services in the area around mobility hubs, with tiered mobility services

Different modes of transport and services must be offered here depending on size and catchment area. At all **major train stations and interchanges**, sharing services should, of course, also be available in addition to public transport services. At the heart of these facilities is bike parking infrastructure that is big and attractive enough. Bike servicing facilities could also be considered as additional services. Commuters could then not only park their bike safely during the day, they could also have it cleaned and repaired. Additional services could include charging stations, luggage storage services, parcel lockers and other functions.

Other stations generally need significantly fewer services. Car and bike-sharing services, the majority of which are currently spread over a wide geographical area, should be brought together at these hubs, ideally at a busy public transport station. Every densely populated district of the city should have an easy-to-reach mobility hub. Secure bike parking facilities (from simple bike racks to bikeboxes) and parcel lockers might also make sense here.

E-charging station concept

It must be assumed that e-mobility will play a much greater role in future than is currently the case. This means that in the long term there will be a need for greater charging capacities than are currently available, in terms of both overall charging capacity and locations where vehicles can be charged. A stronger municipal strategy is required in this regard. This move should avoid costly developments which might create an increase in congestion in public spaces and create the wrong incentives.

7.10 Commercial traffic

7.10.1 Importance of commercial traffic for Luxembourg City

As described above in Chapter 3, Luxembourg City is an international hub for finance and services and is home to several EU institutions. As a result, commercial traffic in the city comprises less heavy industry and large-scale logistics compared with other metropolitan areas, and therefore fewer HGVs. Nevertheless, the percentage of total trips and vehicles which commercial traffic accounts for is regularly underestimated. It can account for a full 25% to 40% of motor traffic, even if HGV traffic makes up only a minor portion of this. The overwhelming majority of commercial traffic (by number of vehicles) is made up of cars and vans.

It is therefore particularly relevant for road traffic concepts to make appropriate allowances for commercial traffic as the bedrock of a functioning, collaborative society, and additionally for the strategic development of the Mobility Plan to involve considerations on the viability of commercial traffic with the city.

7.10.2 Initiatives for the Economy action area

Industrial and commercial site assessment

The PAG highlights potential areas for development for Luxembourg City, broken down according to potential use. Since the road network in the city is particularly congested, it is recommended that transport "impact assessments" be conducted at select commercial sites. This applies to commercial sites which currently have very low or zero occupancy. The aim of this assessment is not to change the status of these sites, but instead to infer useful information for establishing industrial and commercial enterprises. This can help to identify and avoid issues and conflicts with the surrounding area before they arise. Recommendations could include:

- Preferred sector
- Volume of traffic still requiring action
- Need for additional transport services or infrastructure (public transport)
- Tips on corporate mobility concepts

It does not appear necessary at this stage to differentiate between traffic flows or to conduct capacity assessments.

Defining priority network for HGVs

While commercial traffic in Luxembourg is largely not defined by heavy goods traffic (see above), this traffic must still be properly managed. A road network should therefore be defined which HGVs can use according to the *Code de la Route* without weight or size restrictions. The aim is to facilitate those flows of traffic that are required in order for the city to function and to help decongest residential districts. The priority network must be coordinated with the new hierarchy and classification (see Chapter 7.4.4).

Inner-city logistics concept (Gare/Ville Haute)

The aim of modern city logistics concepts is to reduce the environmental impact and number of conflicts caused by the delivery of goods to inner-city locations. Transferring goods from large HGVs and vans to vehicles that are more appropriately sized for inner-city transport (cargo bikes, electric utility carts etc.) at so-called *micro hubs* reduces the presence of HGVs in the inner city (which is usually restricted to certain times of day), while at the same time making delivery services more flexible. The inner-city logistics concept must be drawn up with the involvement of relevant stakeholders (retailers and business owners in the inner city). This initiative could also create additional benefits for the general public, e.g. if parcel lockers were installed at these *micro hubs* or if delivery services were also used to ship goods from the inner city (purchases) to their respective buyers.

8. MONITORING AND EVALUATION

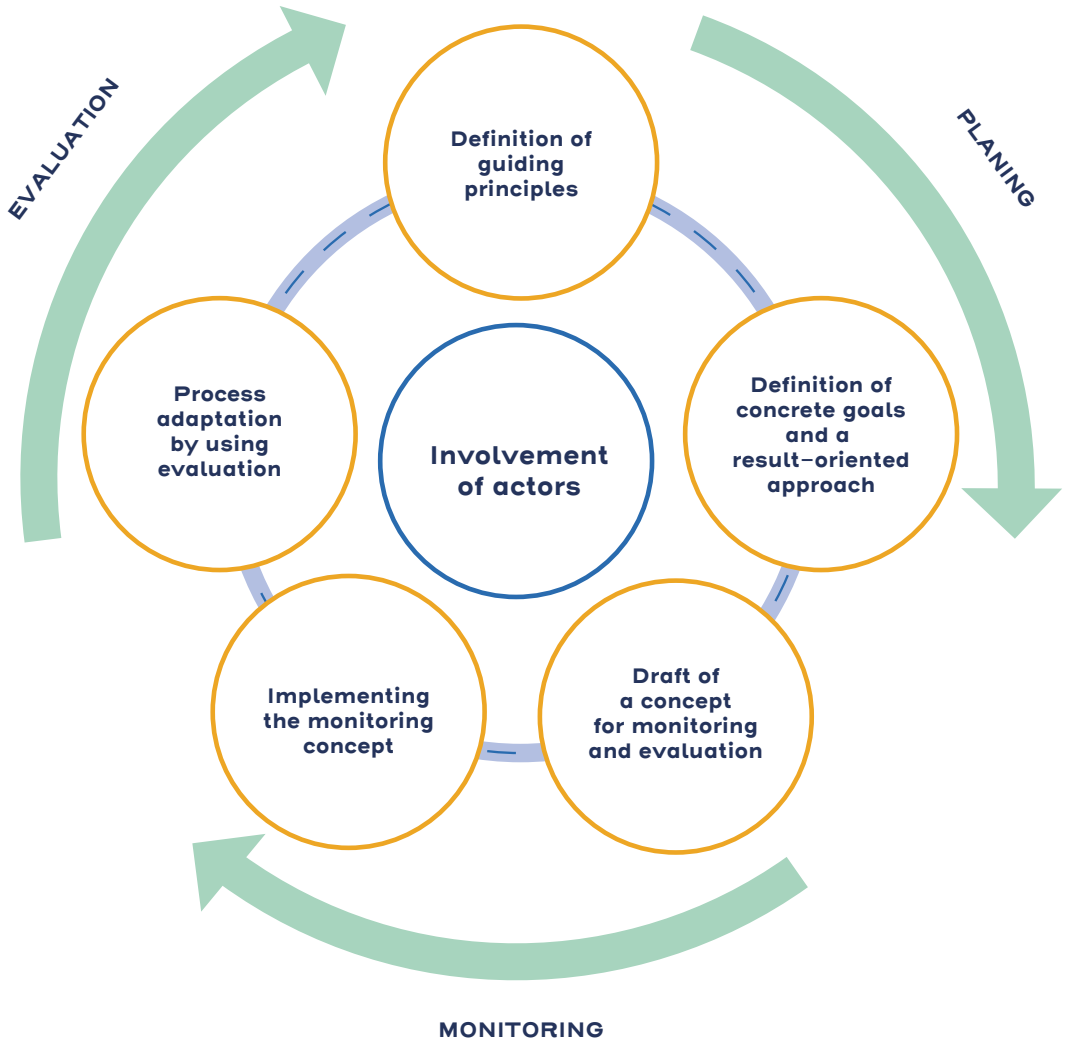
8 MONITORING AND EVALUATION

8.1 Description of monitoring and evaluation process

Monitoring is important for assessing the progress of the Mobility Plan and whether this progress and the effects of the Mobility Plan are consistent with expectations and objectives. We must also assess whether or not the underlying framework conditions have undergone any changes. Two methods of monitoring can be applied here:

1. Status monitoring regarding roll-out
2. Continuous impact monitoring based on select indicators

The aim is for it to be possible to take corrective and counter-measures at an early stage, to initiate any necessary revisions or to ensure that the correct strategies are still being pursued. Continuous monitoring also enables the city authorities to keep the public and local political actors up to date on progress.



Graphic 59: Categorisation of monitoring and evaluation

The following questions play a key role in the monitoring and evaluation process:

1. Are the framework conditions (in particular with respect to trends in population, jobs and mobility) still the same as they were when the forecasts and Mobility Plan were drawn up?
2. What is the current status of the roll-out of the initiatives in the Mobility Plan (status monitoring)?
3. What effects have been achieved so far? Continuous monitoring describes the overall impact of the Mobility Plan. Impact monitoring assesses the effect of individual initiatives.
4. What obstacles to the Mobility Plan and individual initiatives can be identified and how can these be combated?

8.2 Indicators/criteria for monitoring

Indicators have to be defined for the continuous monitoring of transport and traffic trends so that changes and developments can be demonstrated. The Mobility Plan describes the desired direction of development and the desired objectives. Monitoring criteria include:

1. Periodical analysis and calculation of the modal split (trend).
2. Analysis of trends in individual modes of mobility (volumes of motor traffic and cyclists, public transport, pedestrians)

Suitable monitoring criteria cover all areas of focus contained in the Mobility Plan as far as possible and do not rely on availability of data. Monitoring should not be too costly or time-consuming. It must therefore be based on data that are already available or which can be automatically generated in future. The office in charge of monitoring collects, compiles and evaluates these data. This requires the owners of data to cooperate and periodically update their data.

8.3 Additional information on monitoring and evaluation

Additional information is provided below on obtaining relevant data for the different indicators.

Mobility data as key indicators

Mobility data play an enormously important role in transport planning. Data on the modal split, frequency, length and purpose of trips, plus other data on individual mobility are essential. They make it possible:

- To establish a foundation for a realistic mapping of existing demand in the transport model. This generally requires differentiated workday mobility data. These data can also act as a basis for making reliable traffic forecasts.
- To establish a basis for defining a clear position and running benchmark testing against other cities.
- To establish a foundation for inferring future challenges and strategies.
- To identify trends in development and thus to establish a basis for evaluation.

A periodically recurring, systematic mobility survey has not been implemented in Luxembourg by time of writing. The 2017 survey (Luxmobil) recorded data in the city and in the country of Luxembourg. However, this survey does not satisfy the requirements for providing a solid foundation for transport modelling, for evaluations or for comparing cities.

Data on volumes and quality of traffic

Data on volumes and quality of traffic must be generated automatically as far as possible. For Luxembourg City, this means, in particular, establishing a network of automatic counters for motor traffic (see Chapter 7). Travel times and speeds can be calculated based on mobile phone data in order to determine the quality of traffic. Similar models have been developed for bike traffic. These models track a large number of cyclists and can be used to generate differentiated route logs (route, speeds/waiting times).

Data on cycling

While internal operator statistics provide huge sets of data for public transport, describing conditions for cyclists is trickier. Trends in numbers of cyclists can be described using the permanent counting stations. Additional counting stations should be set up at important locations. To describe the range of cycling facilities available, it is sufficient to count the facilities and record their standard. This can be supplemented by information drawn from conclusions on projects that have been implemented. Mobility surveys provide information on numbers of cyclists as a percentage of the modal split. Other important aspects, such as safety and satisfaction, are described below.

Data on road safety

Evaluating progress on road safety (goal: "Vision Zero") requires relevant information. Anonymised data is essential to efforts to integrate aspects of road safety into deliberations on strategies. The most important data here are:

- Location-specific accident statistics, with designation of accident blackspots. Annual and year-on-year statistics (3-year reviews) are commonly used for this purpose.
- Information on severity of accidents
- Information on types of accidents
- Information on parties involved in accidents (by mode of transport only)

It is essential to have information on the involvement of pedestrians and cyclists, in particular with a view to promoting active mobility. By analysing types of accidents, it may also be possible to draw conclusions on preferred concept standards or traffic solutions that should be avoided.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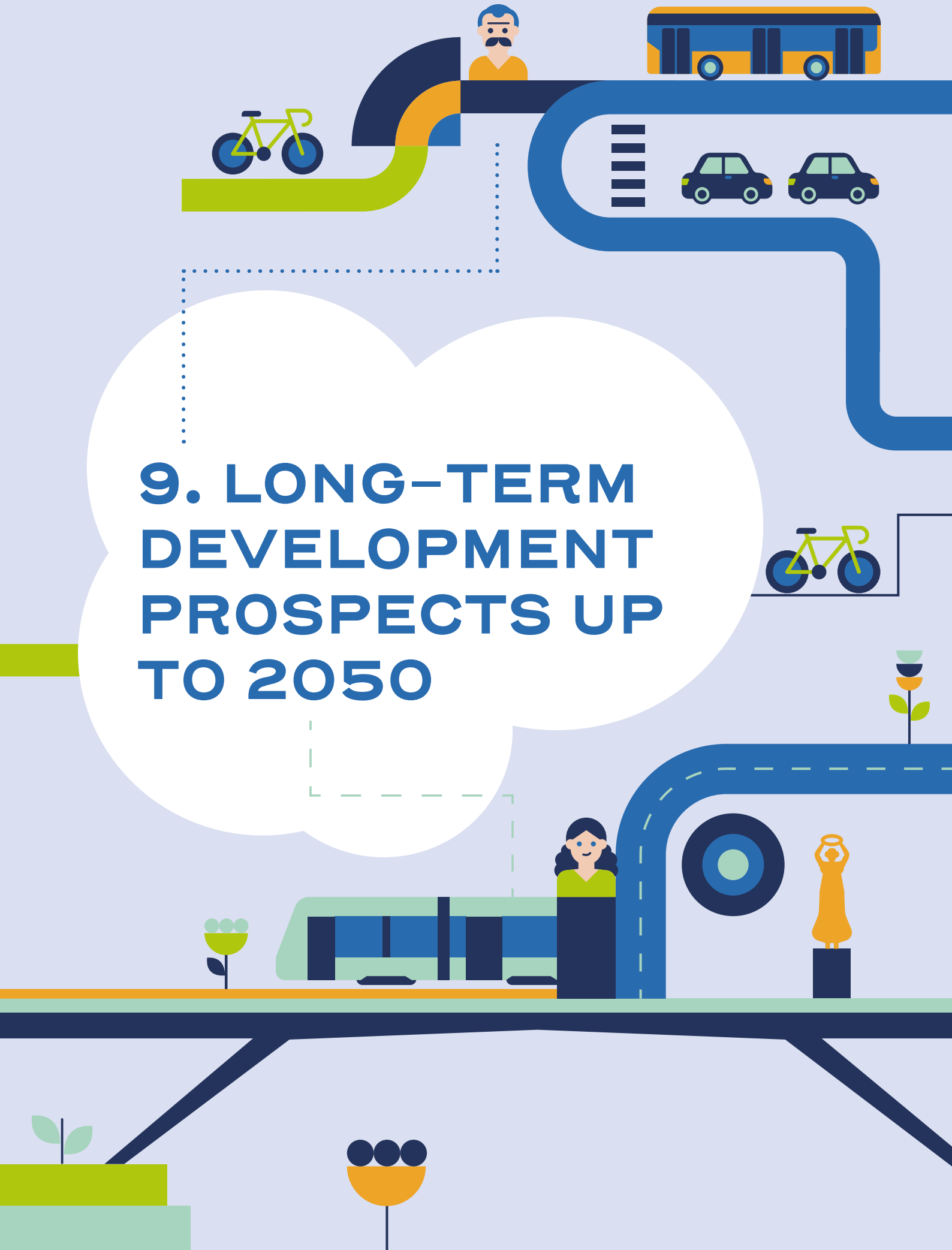


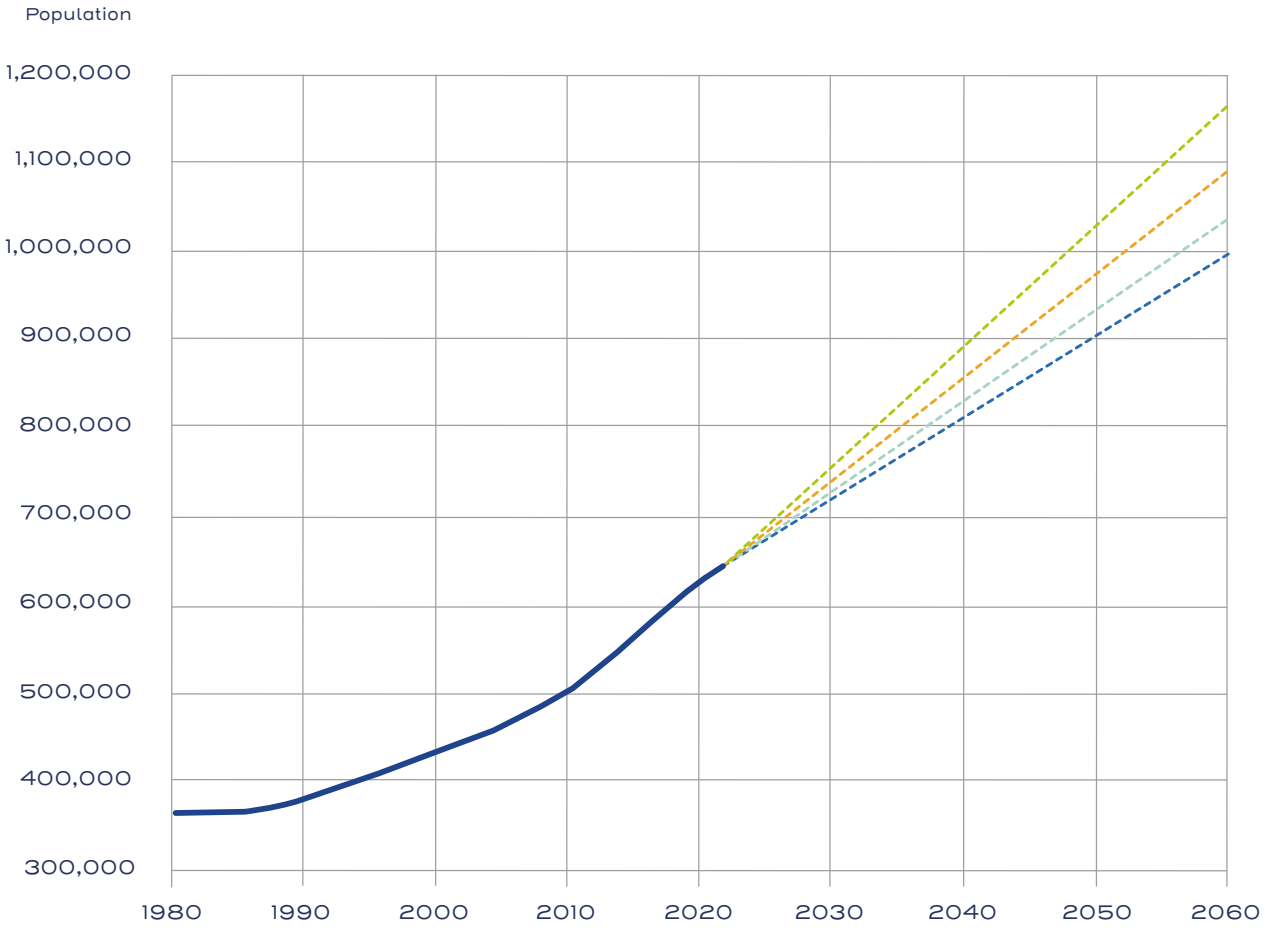
9. LONG-TERM DEVELOPMENT PROSPECTS UP TO 2050

9 LONG-TERM DEVELOPMENT PROSPECTS UP TO 2050

9.1 Urban and regional development

Current forecasts and planning guidelines for long-term development prospects (2035 to 2050) assume that the population and number of jobs in Luxembourg City and in the country will continue to grow. The national statistics agency, STATEC, is assuming that the population of the Grand Duchy will grow to between roughly 900,000 and 1,030,000 – depending on the underlying assumptions concerning economic growth. The number of jobs will rise to between approx. 650,000 and 780,000.[1]

According to the national guidelines, Luxembourg City and its surrounding areas will be at the heart of this growth. As a privileged area of development, it will absorb a significant amount of this growth and the utilities that this entails.[2] The long-term land reserves and potential for densification that this growth requires already exist in the form of designated development areas (*zones d'aménagement différé* – ZAD pursuant to the PAG), plus current and future industrial and commercial areas.



Graphic 60: Population forecast for Grand Duchy of Luxembourg until 2060 (Draft PDAT 2023, p. 22)

1 *See Draft PDAT 2023, pp. 22 et seq.*
2 *See Draft PDAT 2023, pp. 70 et seq.*

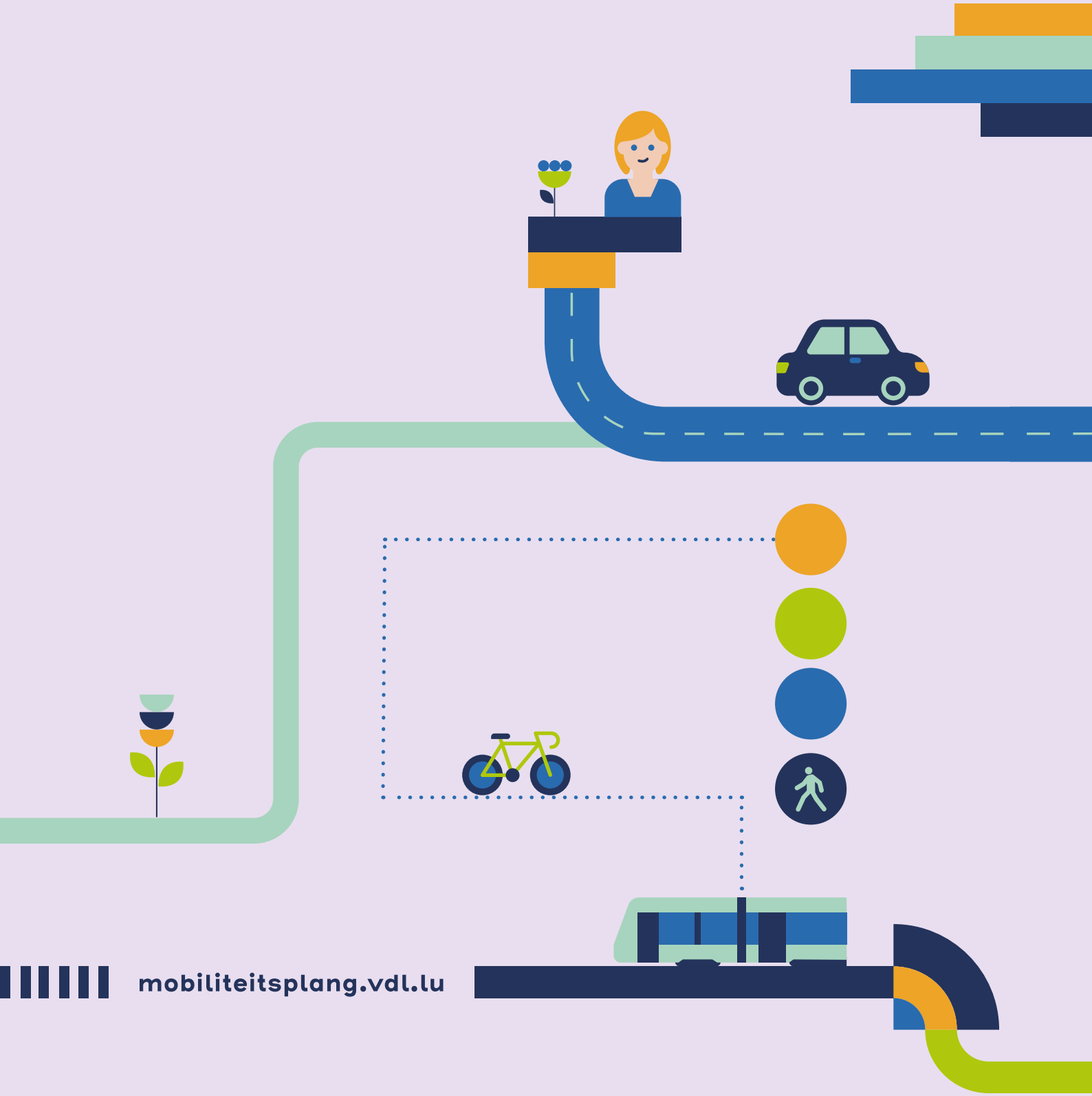
With long-term growth in and around Luxembourg City, traffic will continue to increase. Development will also need to be denser and the need for green spaces and areas for relaxation will grow. Rainwater harvesting and the unsealing of land must also be intensified if the city is to become more resilient. Mobility and transport must therefore help to save space in future. This tendency can be observed in all international metropolises that are experiencing similar developments.

At the same time, residents, commuters and visitors will place ever greater demands on the quality of the urban space. Tolerance for negative impacts such as road noise and potential hazards caused by traffic will diminish. A desire for more space for creating pleasant areas (urban greening and tranquil areas) is also expected.

9.2 Guidelines and methods for developing mobility and transport beyond 2035

The current Mobility Plan (presented here) plays a decisive role for Luxembourg City in this context. It lays the groundwork for ensuring that in future, public transport and active mobility will be capable of accommodating these additional services and the increase in congestion. The scenarios show that Luxembourg City will not be able to cope with any increase in motor traffic between 2020 and 2035, despite growth in the population and the economy. This finding is a defining principle in planning and applies to the period after 2035 as well. To that end, the most important strategic approaches with respect to managing traffic and transport after 2035 are described once more below.

- Luxembourg City is and will remain a destination for a huge number of commuters, with this figure expected to rise by 2035 and beyond. High-performance, attractive public transport from the region is a top priority, not least in light of the heavy burden placed on the city's road network as a result of commuters and visitors.
- Strategies for preventing traffic will have to take on a significantly greater role in future. Notable strategies with respect to commuter traffic include mobile working and working from home. Co-working spaces in Luxembourg City and all the surrounding areas could also help to slash the number of work-related journeys.
- In Luxembourg City, the main driving factor behind the "15-minute city" is the density of availability of daily goods and services. However, a dense and attractive network of paths for pedestrians and cyclists is essential in this regard. This Mobility Plan already draws attention to the fundamental needs for this, although these should be updated as new districts are connected up.
- We must also assess in good time whether the tram is suitable for additional city-suburb connections (e.g. to Strassen). Where a potential for corridors is identified, spaces should be reserved as soon as possible in order to facilitate subsequent developments. The country must push forward with planning the relevant strategies in order to make this a reality.



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