Modu 2.0

Sustainable Mobility Strategy

The Modu 2.0 Strategy was issued by:
Department of Transport, Directorate for Mobility Planning

Based on data from:
37,500 residents and cross-border workers who participated in the Luxmobil survey 2017
Department of Spatial Planning
Department of Public Works
Department of the Environment
Department of Transport
Ministry of the Economy, Directorate General for Energy
National Roads Administration
Luxembourg National Railway Company (CFL)
Verkéiersverbond
Luxtram S.A.
Statec

FOREWORD

Mobility is a basic human need and is a cornerstone of the economy. Few issues are as closely linked to practically everyone's daily life as mobility is. The mobility problems in our country and its neighbouring regions at certain times of the day are the result of several factors: economic growth, spatial planning that is hindered by the lack of available land, a clear delay in the development of transport infrastructures, planning guided by infrastructure rather than mobility needs, investments favouring the transport of as many vehicles as possible rather than that of a maximum number of people, and finally, the uneven use of roads and public transport during the day.

The root causes of these problems must be addressed. One of the main messages of the present update to the Sustainable Mobility Strategy is that it is possible to make substantial improvements to mobility in both the short and the medium term. While the State is catching up on infrastructure improvements, improving the quality of the public transport supply and drawing up a coherent multi-modal concept for mobility for 2035, in the meanwhile, the communes, employers and citizens can apply several measures described in this document.

The first two chapters present the figures concerning mobility resulting from the 2017 Luxmobil survey carried out in households and define the objectives for the 2025 Horizon.

Chapter 3 describes the "mobility toolbox", a set of about fifty concrete measures that all four "mobility players" can apply to improve the status quo. These players are the State, the communes, employers and citizens.

Chapter 4 reports on the progress made within the context of the main ongoing ground transportation projects.

Chapter 5 explains the method and tools used by the Ministry of Sustainable Development and Infrastructure (MDDI) to define a coherent vision for multi-modal mobility by 2035.

The saturation of the networks at peak times is not the only challenge faced by the transport sector. Almost two thirds of CO_2 emissions in Luxembourg come from diesel or petrol-run vehicles, a factor that is speeding up climate change. It is our responsibility as citizens to decide how many hours and minutes we spend travelling by car. There are alternatives to driving, such as active mobility options for short distances, the collective use of cars or public transport for longer distances, and the ever-increasing supply of zero-emission or low-emission cars. Making use of these choices would be the easiest way to prevent Luxembourg from banning the use of certain types of vehicles. Indeed, some of our neighbouring countries have already done this because European air pollution thresholds have been exceeded.

Dozens of families start off the year without knowing that one of their loved ones will fall victim to a road accident. Thousands of families care for someone suffering from a serious injury, sometimes for a few weeks, sometimes for the rest of their lives. We cannot accept this. Except in the case of regulated races, public roads are not to be considered racetracks or the backdrop to power struggles. They are a public space, and we must be aware of this when designing and using the roads. Everyone is entitled to be there and should feel safe and at ease. Indeed, travel is not only a personal necessity, it is also an opportunity to meet others. As a consequence, using public roads is a public act. Simple trips from one's private garage to an underground car park are no way to strengthen social cohesion.

As a result, it's high time we call our behaviour into question, even if we do so only once in a while, whether we are citizens, employers, political or technical players for a commune or for the State. Let's begin using the alternatives presented in the Sustainable Mobility Strategy so that we may reach the objectives set forth for mobility together.

[Signature]

François Bausch
Minister for Sustainable Development and Infrastructure (MDDI)

CONSULTATION DEBATE ON MOBILITY AT THE CHAMBER OF DEPUTIES

During the consultation debate on 19 April 2018, the deputies discussed the issue of mobility, with particular focus on ten questions that had been posed to them based on the figures provided in Chapter 1 of the present document.

The political parties unanimously agreed that mobility could only be improved by means of the implementation of many measures, and that additional effort should be invested in all types of transport to reach this aim.

To manage peak time traffic, one option could be to examine the possibility of staggered starting times in secondary schools. Another would be to encourage greater flexibility for employees' working hours, as long as this is done with their full consent and not at the expense of their social rights.

Every day, 250,000 unoccupied car seats enter the Luxembourg City area. Carpooling has been widely recognised as a cheap solution to this problem, as well as permitting a more efficient use of the existing road infrastructure. We are eagerly awaiting the launch of the "CoPilote" carpooling app. On the other hand, car-sharing has been mentioned as a new option: over a quarter of the individuals questioned in a recent survey said they would be willing to try it.

Specific quantified targets for 2025 for the modal shares for workers' trips to and from work or students' trips to and from school cannot be defined arbitrarily. Instead, these goals must be the result of realistic projections based on objective data. Whatever the targets, it is clear that the supply and quality of public transport must be significantly improved. Efforts must be made to reduce car usage as a means of transport for school, not only to reduce traffic flows, but especially for the good of the children and young people. Generally speaking, alternatives to the private car must be encouraged for very short journeys, i.e. between 1 and 5 kilometres.

The increase of the modal share of cycling for daily travel will only be achieved if safe, direct cycling infrastructures are provided. Dedicated cycle paths should be included in all new road infrastructure projects whenever possible.

In the same vein, measures to promote bus travel should be undertaken, by means of dedicated bus lanes or by giving right of way to buses at traffic lights. This would make public transport more appealing to users than private motor vehicles.

Many infrastructure projects are underway to improve public rail travel and increase its supply in the medium term. Insufficient information provided to rail travellers in the event of late or cancelled trains has been identified as a cause of exasperation for customers – an issue which must be resolved as soon as possible.

Spatial planning, parking space management, the creation of additional P&R lots for daily commuters, digitalisation, free public transport and the promise of self-driving cars have all been raised as mobility-improving tools considered essential by some and desirable by others.

The idea of launching a high-speed tram line connecting the two main urban areas of the country by 2035 has been welcomed with either interest or enthusiasm, depending on the political party. The deputies are awaiting the presentation of the final June 2018 study for further information, especially concerning the other means of transport considered for that same corridor.

Finally, numerous infrastructure projects for both road and rail transport have been put on the table. They are not listed here because they are more relevant to the Transport Sectoral Plan than the present Strategy.

(For the video and minutes of the meeting, please consult www.chd.lu.)

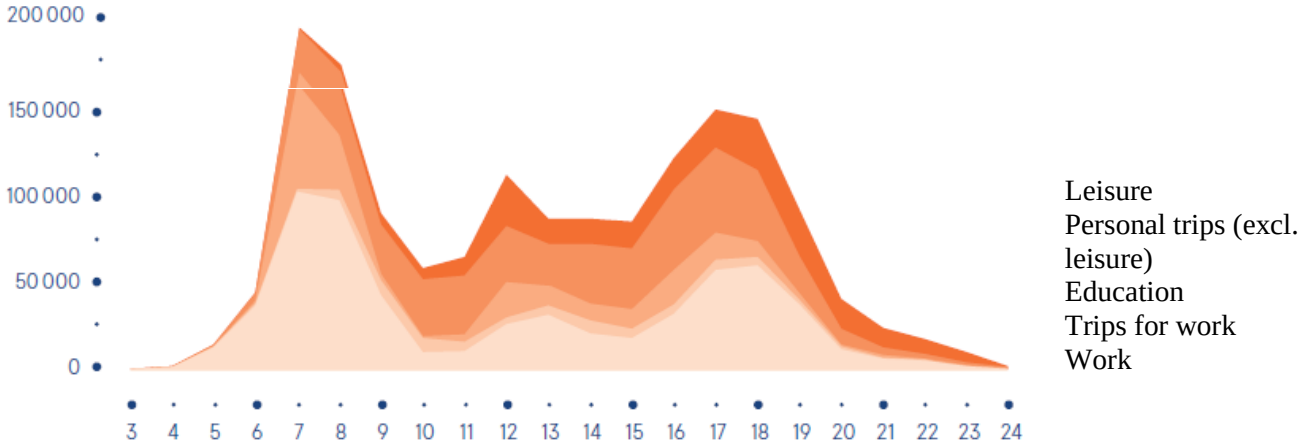
CHAPTER 1

MOBILITY FIGURES

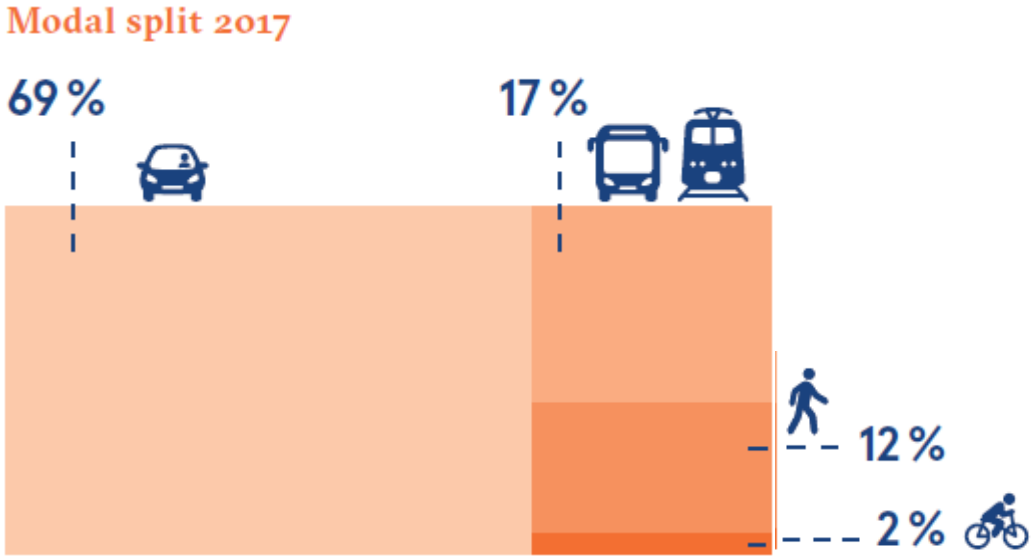
Objective data is useful in the discussion on mobility, because it is experienced differently by each individual.

Trips on weekdays, per time of arrival
(Luxmobil, 2017)

Three daily peaks are revealed:
- The peak in the mornings is the result of the combination of trips from home to the workplace and home to the place of education.
- The peaks at lunchtime and in the evening are not as severe. Half of them are return trips from work or school, and half are personal trips.



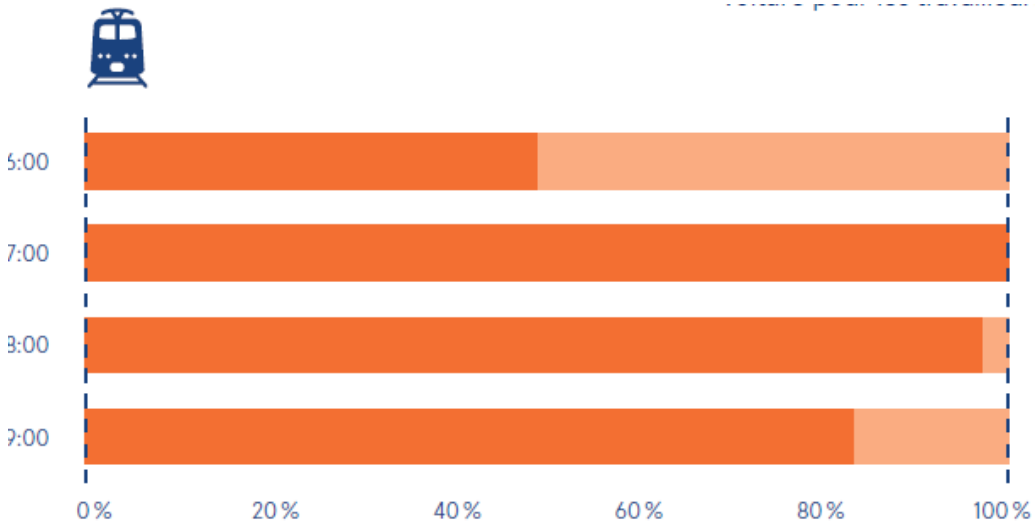
Usage of transport modes for all trips combined. Walking only accounts for a trip if it was entirely made on foot.



"250,000 UNOCCUPIED CAR SEATS ENTER THE LUXEMBOURG CITY AREA EVERY MORNING"

Occupancy rates

The occupancy rate in cars entering the area of Luxembourg City for home to work trips between 6 a.m. and 10 a.m. totals 1.16 persons per vehicle for inhabitants of Luxembourg and 1.22 persons per vehicle for cross-border workers.



Occupied seats
Free seats

CFL line 90, which travels between France and Luxembourg. Occupancy rates between 6 a.m. and 10 a.m.

Residents

- On average, residents travel 1 hour and 27 minutes a day. (Statec, 2016)
- Mobility represents 16% of households' average expenditure a year, of which 15% is for private vehicles. (Statec, 2015)
- 86% of the population travels on weekdays. (Luxmobil, 2017)
- On average, daily trips total 39 km. (Luxmobil, 2017)
- 6.5 % of adults never have a car available to them. 78.5% always have access to their own personal vehicle. (Luxmobil, 2017)

Home to work trips

	LU	FR	BE	DE
Average length	13 km	34 km	42 km	40 km
Average duration	34 min	54 min	51 min	49 min
Average speed	22 km/h	38 km/h	49 km/h	49 km/h

- Average trips between home and the workplace for the population aged between 18 and 65, for all modes of transport.
- 33% of residents' home-workplace trips are under 5 km. Half of these short trips are made by car.

Trips from home to school

	Primary school	Secondary school
Average length	3,5 km	11 km
Average duration	19 min	37 min
Average speed	11 km/h	18 km/h

- Average trips from home to school for all modes of transport.
- 37% of trips to secondary schools are under 5 km.
- 78% of trips to primary schools are under 1 km.

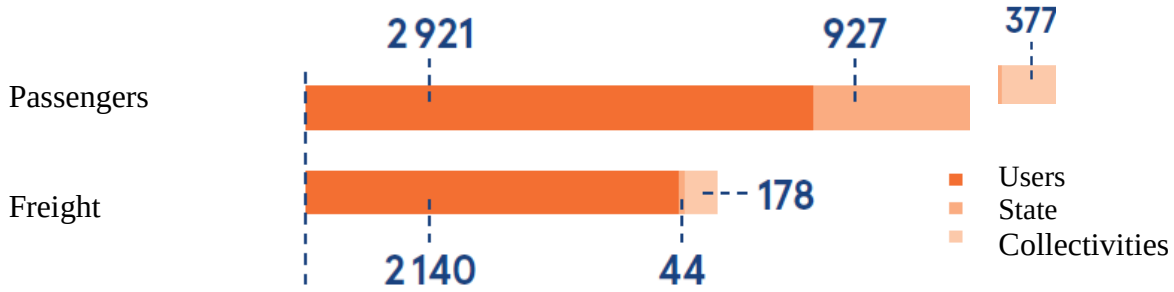
Vehicle fleets

285,000	bicycles used (MDDI TNS Ilres, 2017)
250,000	diesel cars (SNCA, 2017)
150,000	petrol cars (SNCA, 2017)
1,100	plug-in hybrid cars (SNCA, 2017)
1,000	electric cars (SNCA, 2017)
2,000	buses (SNCA, 2017)
82	passenger trains (CFL, 2017)
9	trams (Luxtram, 2017)

Infrastructures

Motorways	165 km
National roads	837 km
Local roads (CR)	1,891 km
Other roads	5,900 km
Main rail lines	451 km
National cycle lane network	611 km
Tram network (in service)	3.6 km

How much does mobility cost a year?
Transport balance in 2016, in millions of euro (MDDI, 2018)



The "Transport Balance" that the MDDI (Ministry of Sustainable Development and Infrastructure) is currently calculating for the reference year 2016 aims to reveal how much ground mobility costs Luxembourg per year and who is responsible for the payment of each share.

- The cost of **passenger** transport totals approx. 4.2 billion euro, 2.9 billion euro of which are covered by the passengers themselves (private vehicles representing the largest share of said amount) and 0.9 billion euro are covered by the State (in addition to the taxes and revenue from transport). Third parties (e.g. healthcare expenses for someone suffering as a result of noise pollution caused by traffic) cover 377 million euro of the total amount.

This means that the person travelling covers 69% of the cost of his/her travel. The remaining 31% are subsidised by society (i.e. the State and collectivities).

- For ground **freight** transport, the overall expenditure totals 2.36 billion euro, 91% of which are covered by the transport companies and 9% by society.

"EVERY KILOMETRE COVERED ON FOOT OR BY BICYCLE SAVES SOCIETY 6.9 EUROCENTS."

External costs (in eurocents per person per km): Costs that are not covered by the travelling person but by the State and collectivities (costs relating to the environment and accidents).

External profit (in eurocents per person per km): Reduction in healthcare expenditure, not for the travelling individual but for everyone who contributes to the healthcare system.

CHAPTER 2

TARGETS FOR 2025

The strategic objective for 2025 is to reduce congestion at peak times with a 20% increase in travellers compared to 2017. The Luxmobil household survey has allowed to identify the necessary actions that must be undertaken to reach this target, grouping them into four specific objectives.

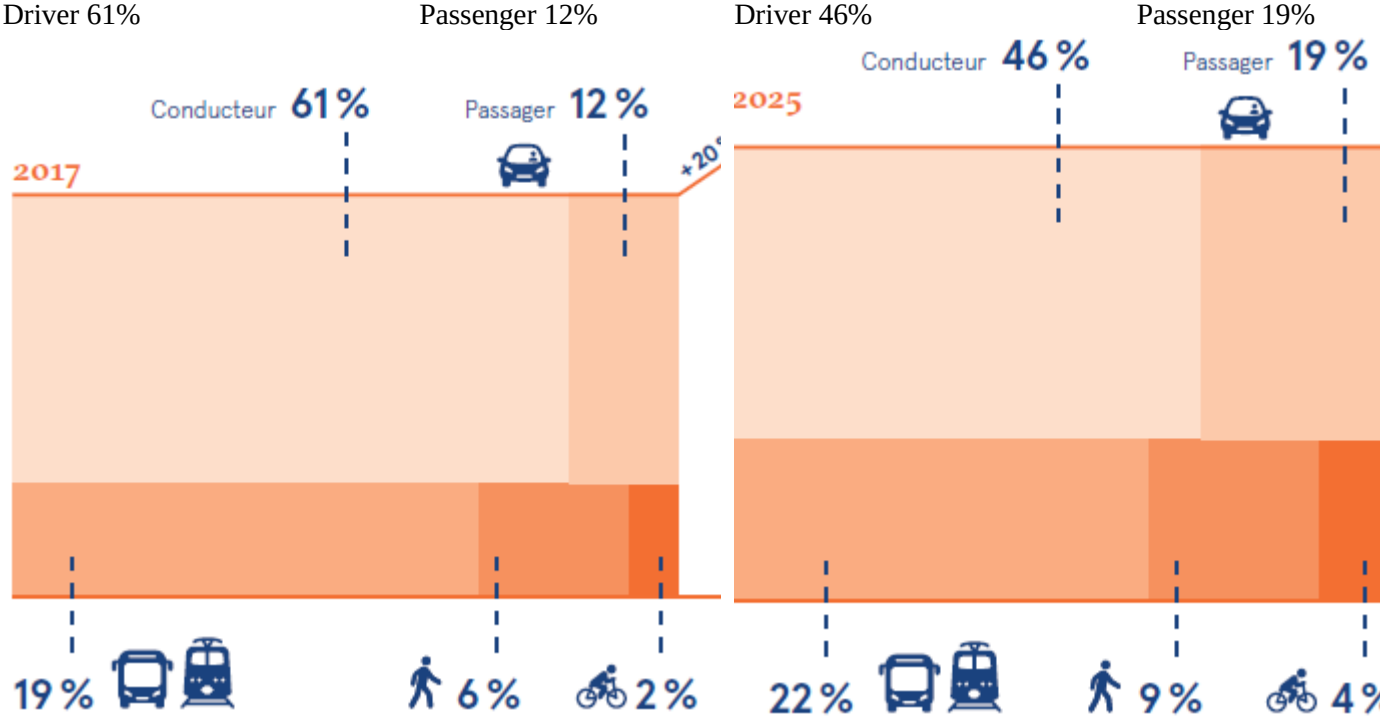
Objective 1

Modal shares for trips from home to work

Actions:

- Increase the number of passengers using public transport by 50% by means of new CFL infrastructures and the restructuring of the RGTR network.
- Perform 95% of trips from home to work under 1 km long on foot (56% in 2017).
- Perform 10% of trips from home to work under 5 km long by bicycle (5% in 2017).
- The remaining 65% of trips from home to work performed by means of a private vehicle will benefit from less congestion on the roads and the average occupancy rate per vehicle will be above 1.4 passengers.

Driver 61% Passenger 12% Driver 46% Passenger 19%



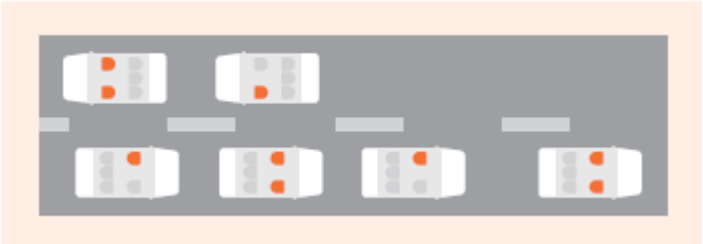
For the purpose of comparison: Without growth, by 2025, the aforementioned actions would result in a 26% modal share for public transport, a 42% share for private vehicle drivers, a 17% share for passengers in private vehicles, a 5% share for cycling and a 10% share for trips made on foot.

Objective 2

Vehicle occupancy rate

Action:

- Increase the average occupancy rate per vehicle for home to work trips to 1.5 persons (compared to 1.2 persons in 2017). This is the equivalent of two people in one car out of two.



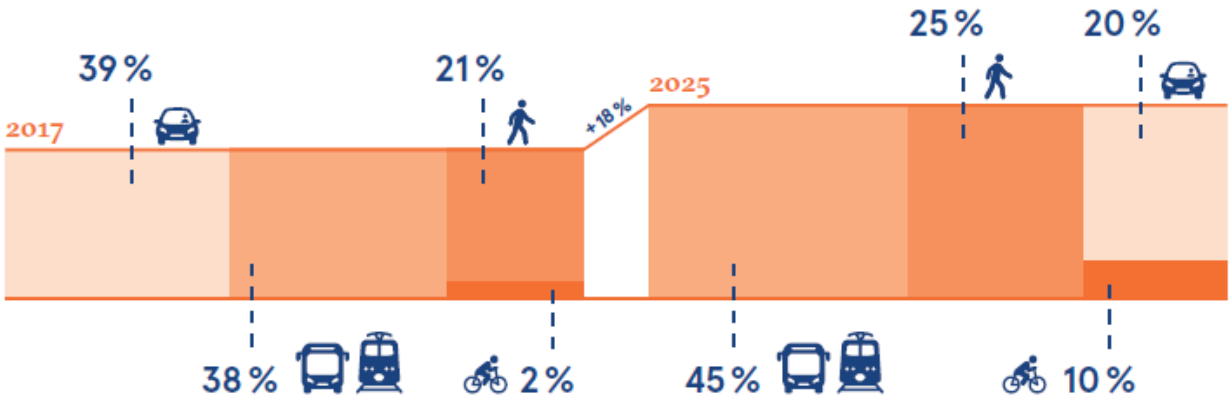
Objective 3

Modal shares for trips from home to school

Actions:

With the exception of the 5% share of students with reduced mobility for whom school can only be accessed by car, the long-term objective is for all students to go to school on foot, by bicycle or by public transport. In the meanwhile, by 2025, the following actions can be undertaken:

- 75% of trips from home to school under 1 km (58% in 2017) should be made on foot.
- 15% of trips from home to school under 5 km (3% in 2017) should be made by bicycle.
- 50% of trips from home to primary school (29% in 2017) should be made by bus or train.
- 77% of trips from home to secondary school (70% in 2017) should be made by bus or train.



For the purpose of comparison: In Switzerland, the modal share for these trips on foot total 55%. For trips by public transport, the share is 24%. For those by car or on mopeds, the share is 10 %. Finally, the modal share for cycling is 8% and for other means of transport, it is 3%. (BFS, 2017)

Objective 4

Increase the appeal of public transport

Actions:

- Bring train cancellations down to under 1 out of 100 (1 train out of 40 was cancelled in 2017).
- Reduce the number of late rail connections with a delay of 6 minutes or more by 25% (compared to 2017).
- At peak times, ensure that the duration of express bus trips between the first stop and the final stop is lower than the same trips made in private vehicles.

Other mobility objectives

Road safety:
"Vision zéro": 0 road-related deaths, 0 severe road-related injuries.
Road Safety Action Plan

Public transport for all:
Inclusion: Obstacle-free access for persons with reduced mobility in all transport infrastructures and modes.
Convention on the Rights of Persons with Disabilities, United Nations

Air quality:
2005 to 2030: Reduction of NO_x emissions by 83%; reduction of non-methane volatile organic compounds (NMVOC) by 42%; reduction of fine PM2.5 particulate matter by 40%.
Directive of the European Commission

Decarbonisation of road traffic:
2005 - 2030: Reduction of greenhouse-gas emissions (GHG) by 40%. In Luxembourg, 64% of CO_2 emissions caused by humans are generated by the transport sector.
Paris Climate Agreement

Spatial planning:
Organised and harmonious spatial planning.
Master Programme for Spatial Planning ("Programme Directeur de l'aménagement du territoire")

Third Industrial Revolution:
The "mobility" pillar of the strategic "Rifkin" study.
www.troisiemerevolutionindustrielle.lu

Were the modal share objectives of 2012 achieved?

In 2012, a dual objective was defined within the framework of the Global Strategy for Sustainable Mobility (MoDu) to be reached by 2020: a target of 25% for non-motorised trips (on foot or by bicycle) and out of the remaining 75%, one quarter should be performed by public transport, i.e. 19% of all trips. However, the figures of 2012 were based on calibrated data extrapolations from 1995 (inhabitants) and 1997 (cross-border workers), not on a recent household survey. The calculation method for the specific modal shares was not specified, especially in the case of trips on foot. The targets were not specifically aimed at peak times, but on the trips overall.

The Luxmobil household survey on mobility carried out among inhabitants and cross-border workers demonstrated that in 2017, the share of motorised trips made by public transport was 20%. The share of active mobility was 24% (including trips on foot to and from a vehicle), and 12% (for trips made exclusively on foot). Modu 2.0 adopted the second approach for the calculation of the modal shares. Modu 2.0 takes into account the excessive congestion on roads and railroads at peak times recorded in 2018 and sets specific targets for peak times with specific actions.

CHAPTER 3

The mobility toolbox

Mobility is the result of both personal choices and collective decisions. It would be delusional to believe that one single tool (such as infrastructure) or a single player (like the State) could improve mobility as required.
Sustainable mobility bearing the future in mind and which is also appealing to the citizen can only be achieved if all players involved in mobility take their share of responsibility.

Th 4 mobility players

The key message of the present update to the national Modu 2.0 Strategy is that it will only be possible to improve mobility sustainably in Luxembourg within a reasonable timeframe if all public and private players join hands and implement concrete actions. In this chapter, such actions are proposed for all 4 mobility players. They are colour-coded as follows:

Employers and education bodies are destinations of travel at peak time in the morning and the origin of travel at peak time in the evenings.	**The State** sets forth the legal framework. It guides the development of mobility by means of spatial planning, investments in selected transport infrastructures and the supply of public transport.
Citizens can choose freely between the various means of transport at hand and can regularly rethink their choices.	**The communes** plan **public spaces** that can encourage their inhabitants to choose one means of transport over another.

Spatial planning

Both on a national and a communal level, traffic is the logical consequence of the location of inhabitants' homes, workplaces, leisure activities, schools and shops. Pooling these locations geographically is the most economical way to improve mobility.

"It will only be possible to reconcile economic growth and mobility if the State and the communes adopt a joint approach."

 Did you know…?

In Switzerland, to get a permit for a large-scale industrial or residential project, the applicant must present a **mobility concept** that is compatible with the existing system. Simple access to the roads network is not considered sufficient for the required mobility concept.

On the communal level, and together, on the national level, the **General Development Plan (PAG)** is the instrument by means of which a commune can generate either traffic or mobility. If a school or a supermarket is built on the edge of the commune, it will generate traffic, whereas pooling functions (e.g. education and shopping) in the same area and densifying the neighbourhoods around the main public transport stops will generate mobility.

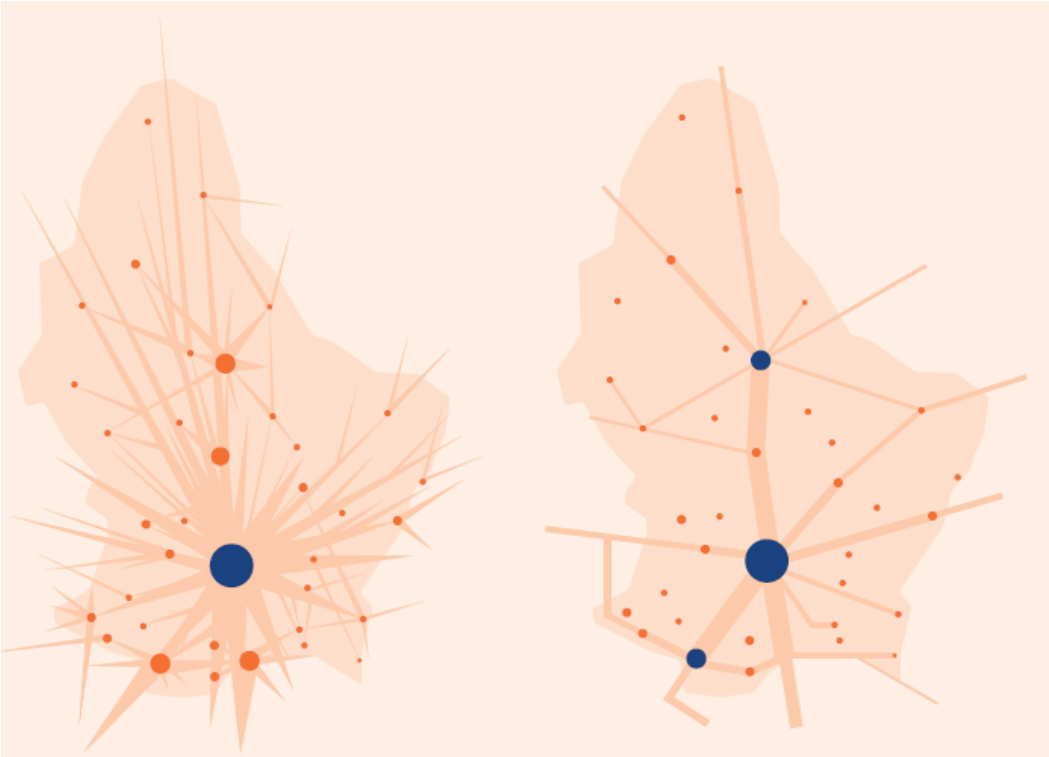
- The State defines the **constitutional and legal frameworks** for spatial planning. These can contribute to **coherent** spatial planning in the communes and national development strategies.
- The State can disassociate economic growth from road congestion by **systematically placing establishments that generate large amounts of travel** (industrial areas, secondary schools, cultural centres, sports halls, universities, hospitals, etc.) **as close as possible to the main public transport stops**.
- In the same vein, the State's long-term commitment to **develop specific, high-scale axes specifically for public transport** can influence the choices of the private sector as to the location of their businesses or the construction of housing.

Diffuse and disorganised scenario
(MDDI, 2018)

In the current diffuse and disorganised spatial planning scenario in Luxembourg, in which the availability of land dictates the location and dispersal of sites with different functions, traffic is the link between villages that are empty during the day and town centres that are deserted at night. Traffic jams have become the main gathering location in the public space.

Organised and harmonious scenario
(MDDI, 2018)

In three areas ("Agglo NORD", "Agglo LUX" and "Aglo SUD"), the bodies that generate the most traffic have been pooled and highly appealing public transport routes will be set up to connect them to the main residential areas of cross-border workers. This will allow economic growth to act as a benefit to quality of life of citizens, both in rural and in urban areas.



Traffic and mobility
The term "traffic" is to be understood as the movement of vehicles. "Mobility" is seen as the possibility and ease through which areas can be accessed. Consequently, mobility is a factor contributing to quality of life. Traffic only represents mobility which actually takes place (mainly motorised trips). Therefore, more mobility does not necessarily go hand in hand with increased traffic. For instance, the establishment of a village grocery store will increase the mobility of residents who do not own a car without increasing traffic levels. (Indeed, it may even reduce traffic by preventing motorised trips to shops that are further away.)

On the other hand, excessive motorised traffic may reduce mobility levels, both for the passengers in the vehicles (traffic jams) and for so-called vulnerable players, i.e., walkers and cyclists, especially children. Food for thought: people choosing their holiday destination usually find out about the mobility options in a given location and try to avoid traffic when on their way there.

Urban planning and traffic flows

Urban planning, spatial planning for public spaces and traffic regulations influence people's choice of transport. In order to promote motorised traffic in private vehicles, car parks must be close to the target destinations and motorised traffic at junctions must flow easily. Public transport on roads will be used more at peak times if priority lanes are provided for public transport and if access to public transport stops is easy. Cycling can be promoted by means of safe, direct, uninterrupted, convenient and clearly-marked bicycle paths. Finally, walking, which livens up public spaces, is encouraged if the spaces are designed on a human scale, with interesting ground floors that are interconnected by short, obstacle-free routes that are shielded from motorised traffic. Public space is limited, so ideally, measures promoting the use of the targeted modes should be combined with measures discouraging users from modes that should be reduced.

(MDDI)

"56% of inhabitants do not know any public space in their area of residence that is regularly used by local adults."
(MDDI, TNS Ilres, 2017)

(MDDI)

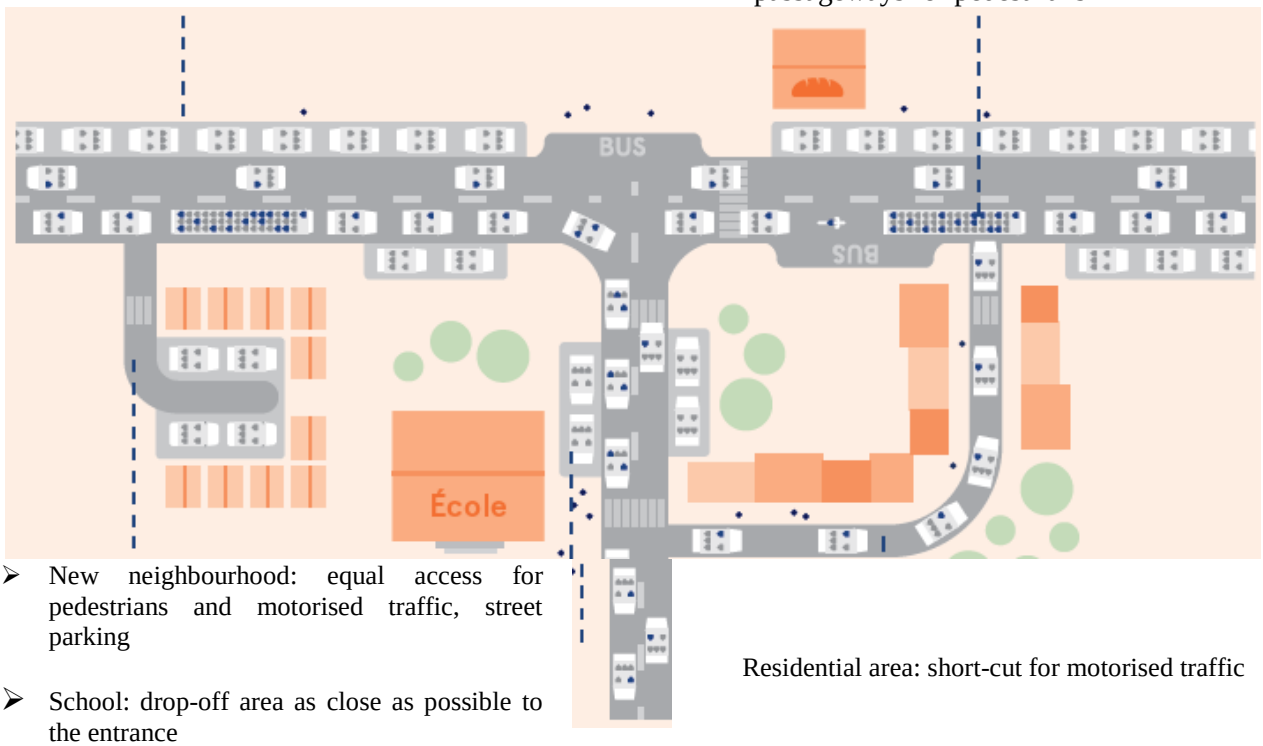
- In collaboration with the citizens, communes can draw up a **multi-modal mobility plan** and a related action plan. The Directorate for Mobility Planning ("Direction de la Planification de la Mobilité") of the MDDI can be consulted on such matters.

- Measures implemented by the communes to promote sustainable mobility will benefit from the **Climate Pact**.
www.pacteclimat.lu

- The renovation of existing roads and the planning of new neighbourhoods represent **ideal opportunities to rethink mobility**.

Promoting vehicle traffic in town:

- Parking spaces in public areas as close as possible to private destinations
- Exits from secondary roads: right of way given to motorised traffic, detours and dedicated passageways for pedestrians

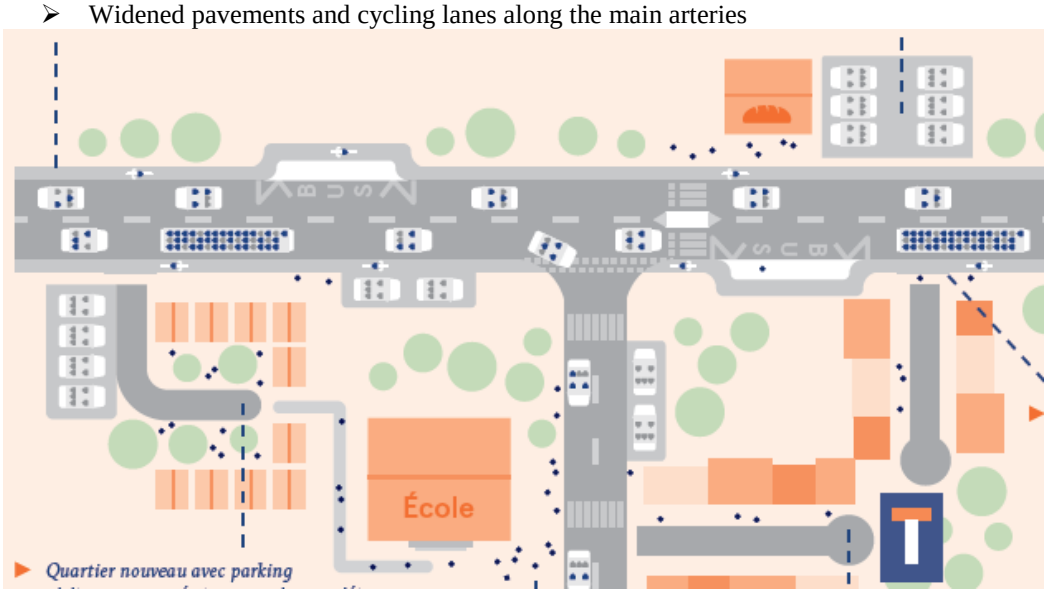


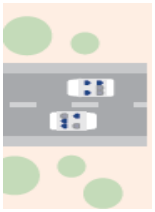
- New neighbourhood: equal access for pedestrians and motorised traffic, street parking
- School: drop-off area as close as possible to the entrance

Residential area: short-cut for motorised traffic

Promote walking and cycling in town:

- Widened pavements and cycling lanes along the main arteries
- Grouped parking for local shops





- Continuous pavement that can be crossed by vehicles
- New neighbourhood with grouped parking for visitors and short-cuts for pedestrians
- Wide, secured pavements to access to the school
- Dead-end for motorised traffic with a passage for pedestrians and cyclists

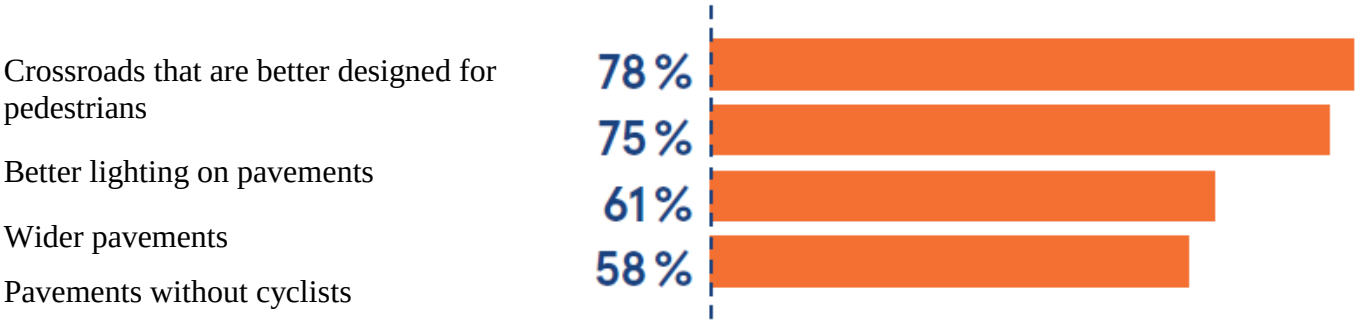
Attract pedestrians back to town centres

Public spaces can only be lively if they are full of pedestrians. Towns and villages that prioritise the rights of pedestrians over those of motorised traffic give their inhabitants a better quality of life and cleaner air, as well as benefiting local shops.

The presence of children is an undeniable indicator of the quality of a public space.

Children prefer to go to primary school on foot or by bike, instead of being driven there. This allows them to arrive at school fully awake and exercised.

What would make you walk more on a daily basis? (Top 4) (MDDI, TNS Ilres, 2017)



"Twenty minutes of active mobility a day (i.e., two 300-metre walks there and back) significantly reduce the risk of contracting diabetes type 2, heart disease, breast and colon cancer, depression and dementia. In Luxembourg, 30% of trips under 1 km are made by car."

(WHO, MDDI)

Walking is the mode of transport that requires the least space. It is also the quickest way to cover stretches of up to one kilometre, depending on the availability of parking spaces for other modes of transport.

The communes are responsible for the design of pavements, even along state roads, so they are **also responsible for the appeal of walking**. Communes can:

- Ensure direct, secure pavements with a **sufficient space** to allow at least two prams, two wheelchairs, two walking frames or two children's scooters to pass each other.
- **Ensure that zebra crossings are lit and that waiting times at traffic lights for pedestrians are as short as possible.**
- Design all **pedestrian pathways so that schoolchildren can go to primary school** or to school bus stops on their own.

- Inhabitants can **ensure that pavements are obstacle-free,** e.g. of parked vehicles, overgrown hedges or bins.

- The communes or the town can plan public spaces to **promote walking in a pleasant atmosphere**, e.g. by placing parking spaces within 100 to 300 metres (except for persons with reduced mobility) from the local attractions and ensuring that traffic levels there are lower.

Make space for cyclists

55% of inhabitants cycle. If high-quality cycling infrastructures were created, they would cycle more and reduce their share of car usage, namely for short trips. (MDDI, TNS Ilres, 2017)

Inhabitants who have cycled over the past 12 months would be willing to cycle more instead of using their car, if:

- There were more cycling lanes that were separate from motorised traffic (90%).
- There were fewer dangerous segments or cuts in the cycling paths (90%).
- If there were more respect between cyclists and other road users (87%).
- If crossroads were better adapted to cyclists (85%).

(MDDI, TNS Ilres, 2017)

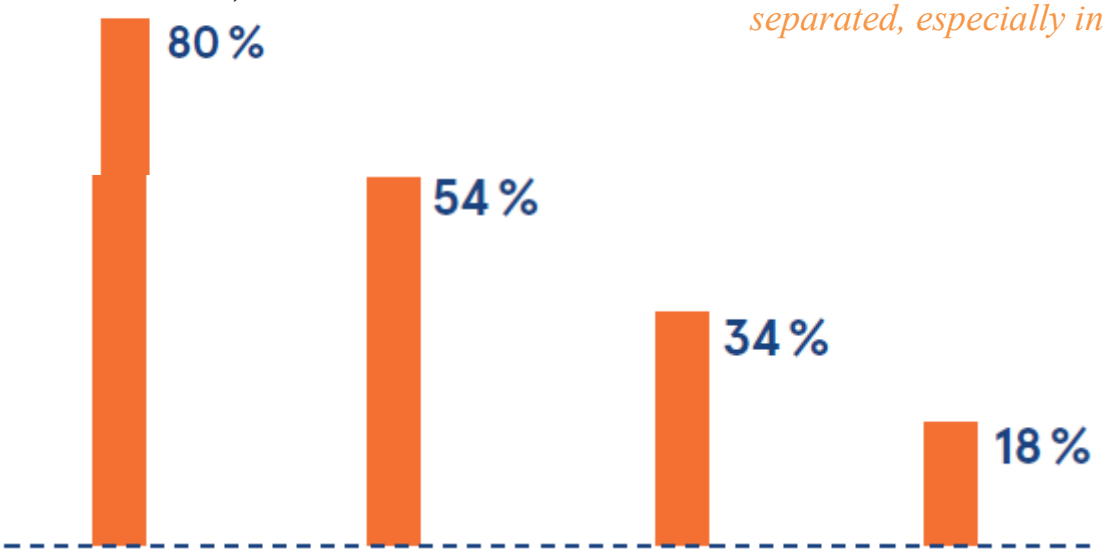
"51% of all trips performed by inhabitants of Luxembourg are shorter than 5 km. One third of trips below 1 km and two thirds of trips between 2 and 5 km are made by car."

➢ The State can integrate **cycling as a means of transport** in the **transport supply**. It can set up an attractive national cycling network for both daily trips as well as for bicycle tourism in rural areas, ensuring **coherent links** between this network and the international and communal networks. Finally, the State can adopt a **regulation** that promotes cycling.	➢ The communes can collaborate with each other by using the MDDI's Soft Mobility Department ("Cellule Mobilité Douce"), in order to create a **communal cycling path network**: 1. Analysis of the **adequacy for cycling** of the public roads network as a whole. 2. Definition of a safe, continuous communal **cycling path network** allowing cyclists to cycle anywhere on a daily basis. 3. **Marking dangerous sections** or gaps in the planned cycling routes. 4. Planning and **resolution of problems** while works are ongoing on specific sections. 5. **Signposting and advertising.**

Potential for cycling depending on the quality of the infrastructures

Willingness of people who have cycled over the past year to begin cycling daily, depending on the infrastructures provided.
(MDDI, TNS Ilres, 2017)

"Cycling has become more popular, especially electric bikes, so safety and ease of use must be taken into account: cyclists and pedestrians should be separated, especially in urban areas."




Bicycle on a bicycle path that is separated from motorised traffic


Bicycle on a bicycle path delimited only by markings on the ground, or bicycle in a 20 or 30 km/h speed limit area

Bicycle on a bus lane, or on a suggested bike lane, or in an area with limited traffic with a maximum speed of 50 km/h


Bicycle in heavy traffic, without a reserved cycling space

Employers can encourage cycling for daily trips by:

- **Providing safe parking for bicycles**, **changing rooms** with showers and the provision of **company bicycles**;
- Offering employees tax benefits for **leased bicycles**.

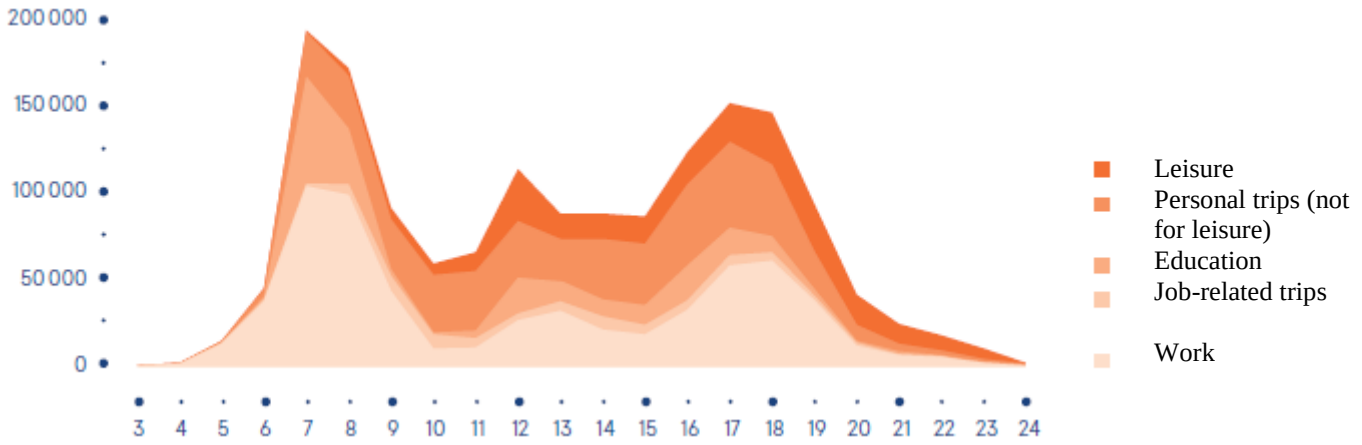
www.clever-fueren.lu

- Whether citizens travel on foot, by bike, motorbike or in a car, they can contribute to promoting cycling. Everyone can play their part in promoting cycling – a mode of transport that is beneficial to society – by **respecting all road users**.
- A first hurdle is to prevent the usage of the private car for trips **within a given town** or residential area.

Managing peak times

Most traffic-related problems only occur at peak times in the mornings and in the evenings. It would be cheaper to extend these peak times by lowering their peaks than adapt the infrastructures.

Trips during the week per time of arrival
(MDDI, 2017)



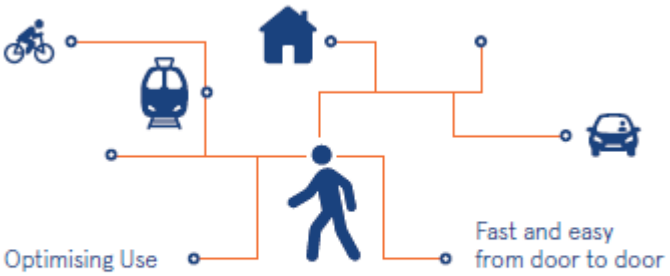
- **Timetables in secondary schools**. Staggering lesson starting times in some secondary schools would reduce traffic at peak times and would prevent school transport delays. School holidays are proof of the impact such a measure could have.

- **Flexible working times and telework**: By organising team switches outside peak times, and if possible, offering employees flexible timetables, time-saving accounts and the option of telework (from home, satellite offices or co-working sites), as well as by promoting car-sharing, employers can considerably contribute to improving traffic flows at peak times.

"Staggering timetables, fewer unoccupied car seats, promoting ways of using road space economically."

Did you know…?

Thanks to the *Beter Benutten* ("Better usage") program in the Netherlands, where the public and private sectors collaborated to reduce road traffic, a **19% road congestion reduction** was achieved in the busiest areas of the network.
www.beterbenutten.nl/en



Beter Benutten (Ministerie van Infrastructuur en Milieu)

- **Delivery times and urban logistics**. The delivery of merchandise outside peak times and the delivery of wares in small-capacity vans or cargo-bikes outside peak times improve traffic flows and decongest town centres.

Client service and internal company organisation:
Teleconferences; telework

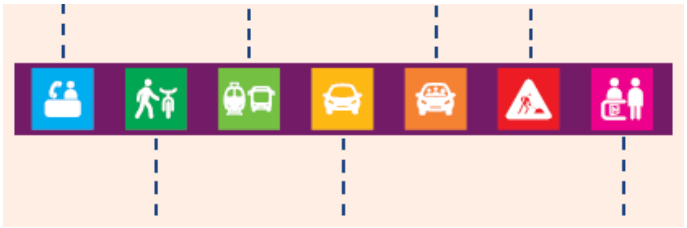
Public transport:
Improvements to the supply (trains, buses), e.g. mPass

Car-sharing:
Reduce the level of private car usage

Urban planning:
Guarantee high-quality urban planning (secure cycling and pedestrian areas)

- Whether alone, in clusters, or in collaboration with the *Verkéiersverbond*, employers can draw up a **mobility plan for their companies**, with concrete measures to improve their employees' mobility.

www.mobiliteit.lu



Soft / active mobility:
Infrastructures, "Mam Velo op d'Schaff" ("Cycle to work") action

Vehicle fleet:
e.g. integration of car-sharing, parking management

Communication and information:
Advice on mobility

"mConcept", Verkéiersverbond

The car as a mode of transport

Private cars are the most expensive, space-consuming and air-polluting mode of transport per transported individual, so they should be used more efficiently. Carpooling and car-sharing are both economical options for households. In addition, these systems could considerably reduce traffic jams at peak times and free up parking spaces in town centres.

"Every morning, 250,000 empty car seats enter the area of Luxembourg City."

Carpooling

What is carpooling?
It is the usage of a privately-owned car used by several people for the same trip.

What is the advantage of carpooling?
A person who travels in someone else's car instead of using his/her own saves money and helps reduce traffic congestion.

How does it work?
Sometimes, the driver and passengers already know each other (e.g. family members, colleagues) and decide to share the same car for the same trip.

Another option is for people who do not know each other personally to use a carpooling portal (phone app or website) on which users enter their trip details.

How much does it cost?
The driver and passengers agree on a price. Free or cheap rides costing only a few euro can be offered, as suggested by the carpooling app.

[1] Parking space reserved for carpoolers

[2] Carpoolers

[3] Reserved lane for carpoolers in North America.

- Wherever there is a demand, communes can provide **parking spaces** to pick up and drop off carpoolers.

- Private users can save money and sometimes benefit from carpooling incentives (e.g. reserved parking spaces at the workplace) **for both the driver and passengers** who communicate their travel plans on a carpooling portal. [2]

- By encouraging their employees to create **a community on a carpooling site** such as CoPilote and offering **preferential parking options** to carpoolers, employers can save parking spaces on their premises as well as help reduce traffic in the area at peak times. [1]

In addition to offering the **CoPilote carpooling portal** for Luxembourg and the neighbouring regions, the State can **reserve lanes on sections of the motorway for vehicles with three passengers or more (carpoolers and buses)**. [3]

Car-sharing

What is car-sharing?
Car-sharing vehicles are parked in specific locations. They are available for hire for short trips (a few hours).

What is the advantage?
Households can save money by replacing the private car they use the least by car-sharing.

How does it work?
Once a client has registered as a user with a car-sharing company, he/she can book a car on his/her smartphone. The car can be locked and unlocked by means of the user's membership card. A contact key and a fuel-filling card are located in the vehicle. [1]

How much does it cost?
In addition to the monthly subscription fee (ranging from 0 to 30 euro), trips are invoiced according to the number of kilometres driven and their duration. The fuel, insurance, maintenance and depreciation of the vehicle are included in this price. Parking at the locations of departure and arrival is free and guaranteed. Depending on the chosen subscription option, car-sharing is beneficial for maximum five trips a week. The system is not designed for daily trips to and from work.

[1] The vehicle is unlocked by means of the membership card (MDDI)

➢ Communes can strike a partnership with a car-sharing company and **provide spaces for two or more cars in highly-populated areas**. From experience, it has been proven that a well-located car-sharing vehicle frees up parking spaces, because it can replace up to ten private cars, namely people's second cars, which are often parked in public spaces.	➢ Before buying a private car, residents of a town where car-sharing is offered can **evaluate whether this service can meet their needs** and compare the expenses of both options (e.g. the average monthly expense of a private car amounts to approx. 500 euro).

Car-sharing systems: station-based or free-floating?

In a station-based system, the car must be returned to the location it was taken from. This is ideal for people wanting to use a private car occasionally and makes it very easy for the following user to plan his/her trip. [2]

In a free-floating system, the vehicle can be dropped off anywhere within a pre-defined zone, offering greater flexibility to users. The larger the zone, the less the system is appealing for the following user because he/she will only find out where the car is located at the last minute.

This system is only economical in city centres with at least one million inhabitants (e.g. Berlin, Munich, etc.), because the cost of recovering the cars scattered across the pre-defined zone is the equivalent of a taxi ride.

Car-sharing with electric cars or cars with combustion engines?

Electric cars are best for station-based systems because the batteries are recharged between the trips. For cars with combustion engines (petrol or diesel), drivers may need to fill the tank up during their trips.

2 CFL Flex (CFL)

"Private cars that are not driven for 22 hours a day represent over one seventh of households' costs."

- Employers can **provide car-sharing vehicles to their employees** for their professional trips outside working hours. This alternative to leasing will encourage more employees to use public transport to travel from home to work.

Parking management

Parking management can influence the distribution of modal shares and the occupancy rate in vehicles at peak times, reduce unwanted parking, use public and private land for more useful purposes, cut the cost of construction and diminish the production of inert waste resulting from underground parking lots.

"The likelihood of finding a parking space at the place of arrival greatly influences users' choice of transport at their point of departure. In Luxembourg, 60% of employees have a parking space at their place of work."

A coherent parking strategy is one of the key tools communities can use when it comes to mobility. In addition to the **availability of parking spaces for persons with reduced mobility (PRM) and for bicycles**, other efficient measures can be taken, such as:

- **Replace lay-by parking by separate grouped parking lots**. This prevents parking manoeuvres on the street and provides space to create bus lanes, larger pavements and bicycle paths, thus contributing to improved road safety and encouraging walking and cycling.
- Placing bus stops, car-sharing stations and bicycle parking lots **closer to people's destinations than the entrances to car parking lots** makes alternative modes of transport more appealing to users.
- The introduction of **residential parking** by issuing a limited number of parking permits depending on the availability of parking on private land frees up spaces in public areas for those who need them.
- **Paid parking spaces** in shopping areas generate a greater turnover in the number of visitors, thus benefiting local shops. Specific types of parking meters can allow shops' clients to park for free.
- In communes where parking spaces on public land is regulated, neighbourhoods where residents who wish to have fewer private cars can be created by issuing **waivers for the minimum number of spaces per housing unit**. Such homes would also be cheaper to build.
- A restrictive policy for **parking spaces reserved for administrative buildings** (e.g. one space per 175 m^2 of built-up surface area in an urban area) encourages employers to set up company mobility plans and reduce peak time traffic.

Which of the two options below would you choose, considering both homes are identical, with a private parking space inside the building? (MDDI, TNS Ilres, 2017)

62 %
would choose the home which has space in front of the building where children can play and a public parking lot 100 metres away.

The option in the left picture was preferred by Luxembourgish and non-Luxembourgish residents in all regions of the country, all age groups, sexes, and socio-economic status combined.

38 %
would choose the home with street parking spaces in front of the building, with a public space where children can play located 100 metres away.

"The prevalence of private cars can be explained by the fact that over the past sixty years, everything has been set up to ensure that the car should become the most appealing mode of transport to go from one building to another. By moving parking spaces 100 to 300 metres away (with the exception of PRM spaces) from the targeted destinations, a better balance between the modal shares could be achieved."

In view of land prices in the country, companies could use their **parking surfaces** more economically:

- By **reserving spaces for carpoolers**, bicycles and shared company cars;
- By **sharing the parking surface** with neighbouring players who need them at other times of the day or the week (e.g. supermarkets, cinemas, sports centres, etc.).

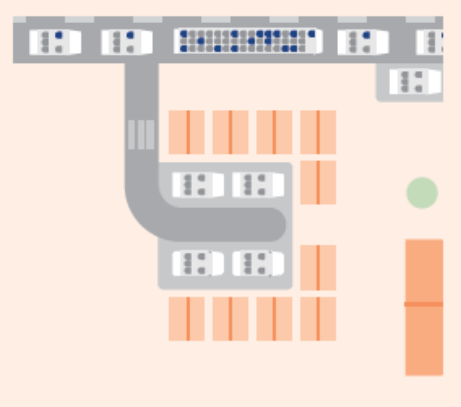
- The State can design and manage **public buildings** to encourage people to use public transport, bicycles or walk there instead of using their private cars (including State employees).

In parking lots located near stations and interchanges, the State can offer **discounts to public transport users**.

Residential area

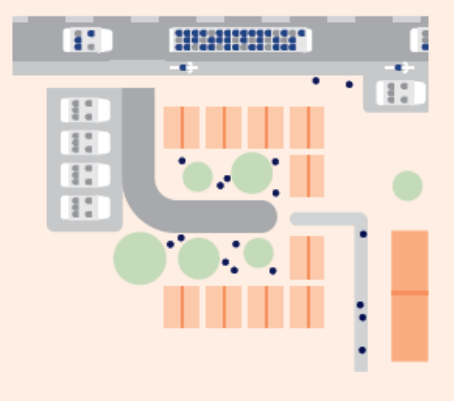
Lay-by parking:

- Public parking as close as possible to the homes. Cars dominate even in streets that have little traffic.



Residential area parking lot:

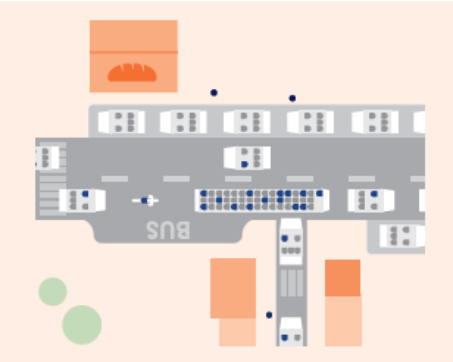
- User-friendly area allowing children to play.
- Promotes walking and cycling.



Main street

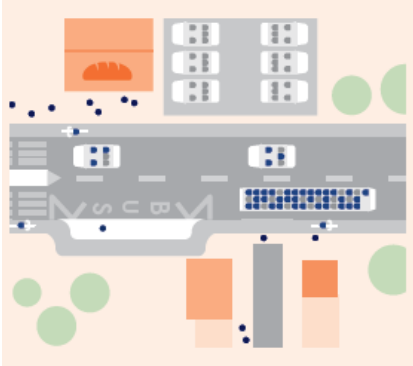
Lay-by parking:

- Permanent public parking that is misused by people who park there long-term, use Park & Ride, company car parking, the sale of second-hand cars, etc.



Grouped parking lot:

- Public parking for specific uses, e.g. short-term parking for local shops.
- Better quality of life in town. Additional free space for cycling paths and wider pavements.



The number of cars that are regularly parked in public spaces although their owners have a private parking space totals approx. 33% in rural communes, 40% in Luxembourg City and in the Southern region and 48% in the suburban communes. Owners state that their car parking space is either already occupied by another vehicle or by something else, making it difficult to access. (MDDI, TNS Ilres, 2017)

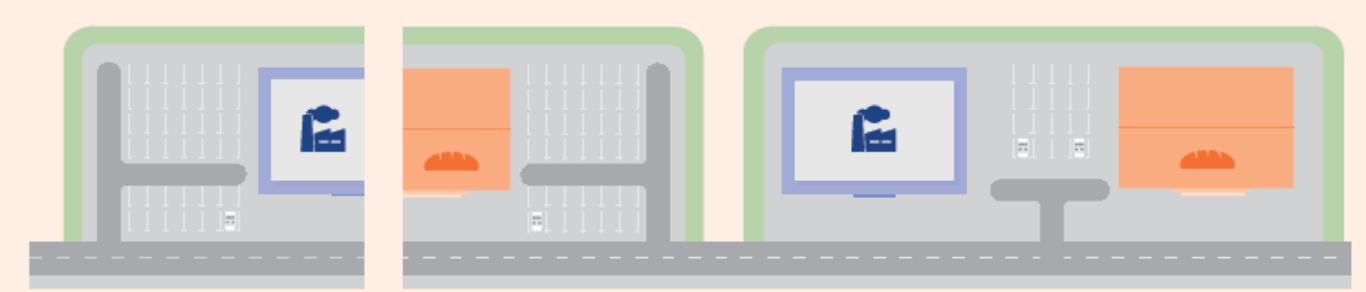
Mixed area

Private parking space for every company:

- Excessive supply, especially at night, weekends, etc.

Shared parking lots:

- Cheap management of parking areas.



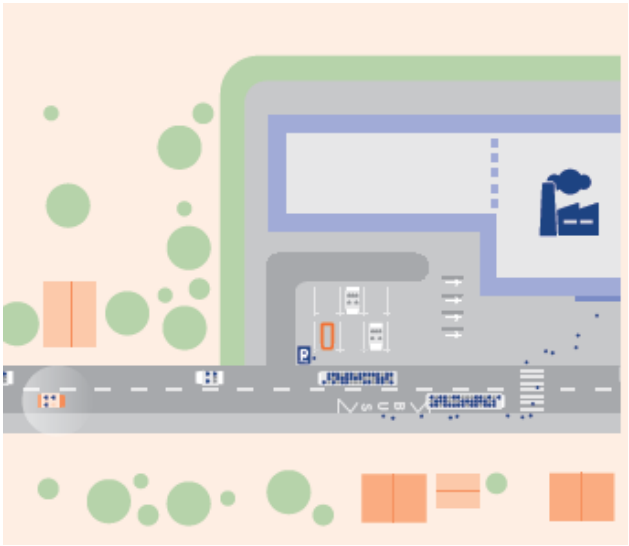
Companies

Parking for individuals:

- Requires maximum space.
- Encourages the use of the private car.
- Contributes to congestion at peak times.

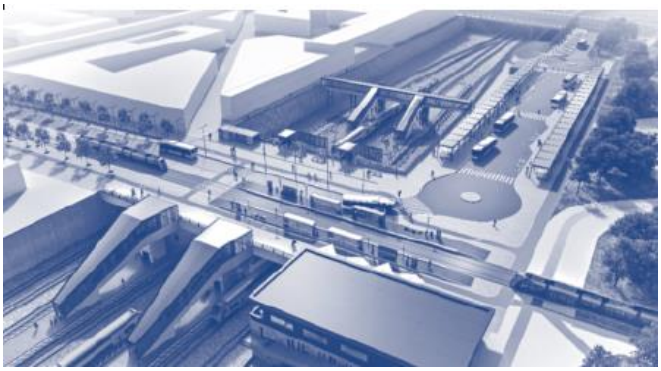
Parking spaces for specific purposes:
(e.g. carpooling or car-sharing for company cars):

- Considerably reduces the space required.
- Improves traffic flows at peak times.
- Is cheaper for both employers and employees.



Pleasant multi-modal travel

If the time spent at bus stops, stations or interchange hubs is both pleasant and useful for passengers, then multi-modal travel can become a true asset.



Howald interchange hub (MDDI, 2016)

"In the Netherlands, 82 % of rail travellers make purchases in train stations on a daily basis."

(Nationale Spoorwegen, 2014)

- Depending on their competencies, the communes and the State can design the interchange hubs to ensure that **travellers are sheltered from bad weather and are always well informed** (Verkéiersverbond).
- At best, **services can be provided** for the benefit of commuters and residents in the neighbourhood.
- **Homes and workplaces** that generate the least motorised traffic are located at an interchange hub, or at least at less than 300 metres from one.

Have your already thought of…?

Transfers are not unpleasant due to the public transport supply itself. Getting off a bus to go to a railway platform is not necessarily more unpleasant than parking one's car and getting out for a daily task such as shopping, going to a restaurant, taking one's child to the nursery or going to the gym. If such services were offered at the hubs, transfers would not be considered an inconvenience, but as a time-saver.

Mobility as a service

By informing users on matters such as the duration of trips, their cost, the distance and their environmental impact, users can choose mobility services depending on the various options available.

[1] *Dynamic public transport display screen (MDDI)*

- To inform **clients and employees in real time** about public transport departure times near their sites, employers and public building administrators can install an information display screen at the entrance of their building. Once the screen is connected to the internet (at the expense of the owner), the Verkéiersverbond will display all the relevant information on the panel for free. [1]

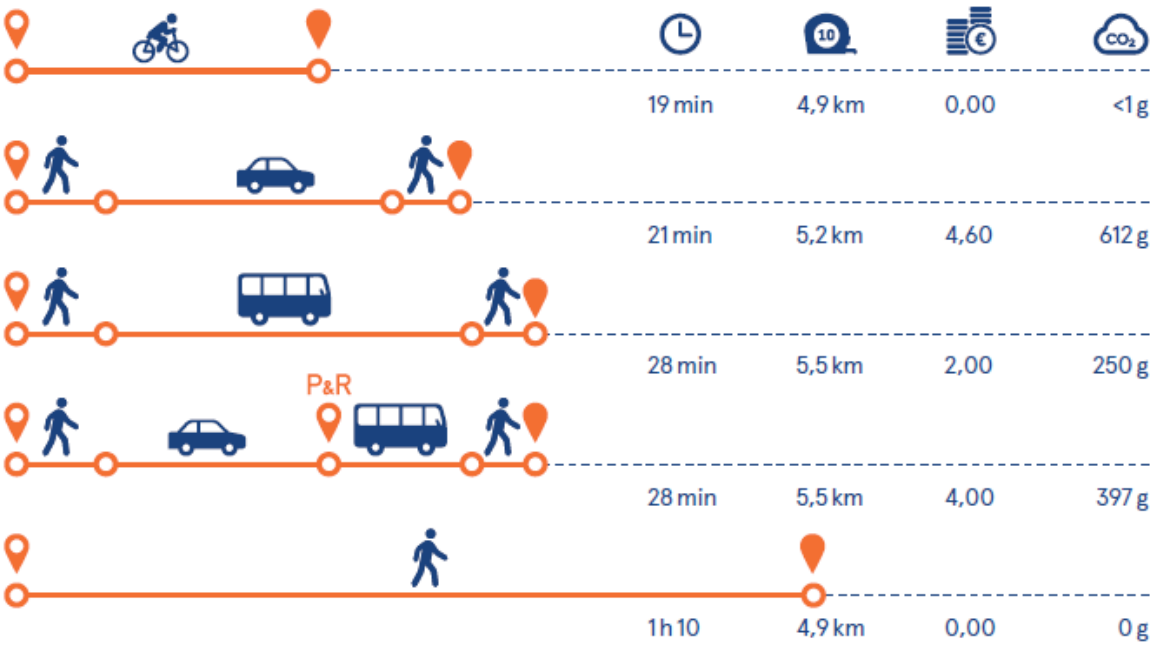
www.mobiliteit.lu

- Before a trip, the user can consult a mobility app as a service. Thanks to a multi-modal itinerary calculator operating in real time (see picture below), the app will display all options available for the user's trip. This will include combinations of different types of transport, including walking, cycling (including shared bikes), private cars, carpooling, car-sharing, taxis, buses, trains or trams. The user can then **select which option suits him/her best** depending on his/her priorities, e.g. speed, convenience, cost, etc.

www.mobiliteit.lu

Multi-modal route planner:

How can I get from to ?



Mobility at hand thanks to your smartphone and mKaart:

Information in real time:

- Automatic receipt of information on delays, roadworks, or other disturbances for the planned trip.
- Information in real time on traffic conditions and departure times of public transport.
- Occupancy rates for P&R lots.
- Availability of charging points or shared bicycles at bike-share stations.

Purchase and management of tickets:

Access to other mobility services:

- P&R, car-sharing, bike-sharing, mBox, Chargy, etc.

Public transport

Public transport is the most efficient means to transport the greatest number of people on a given trip. There are numerous options available. The most appropriate mode of transport for one situation may not be the same as in another.

"Luxembourg offers the cheapest public transport rates in Western Europe, in comparison with other public transport networks in countries of comparable size."

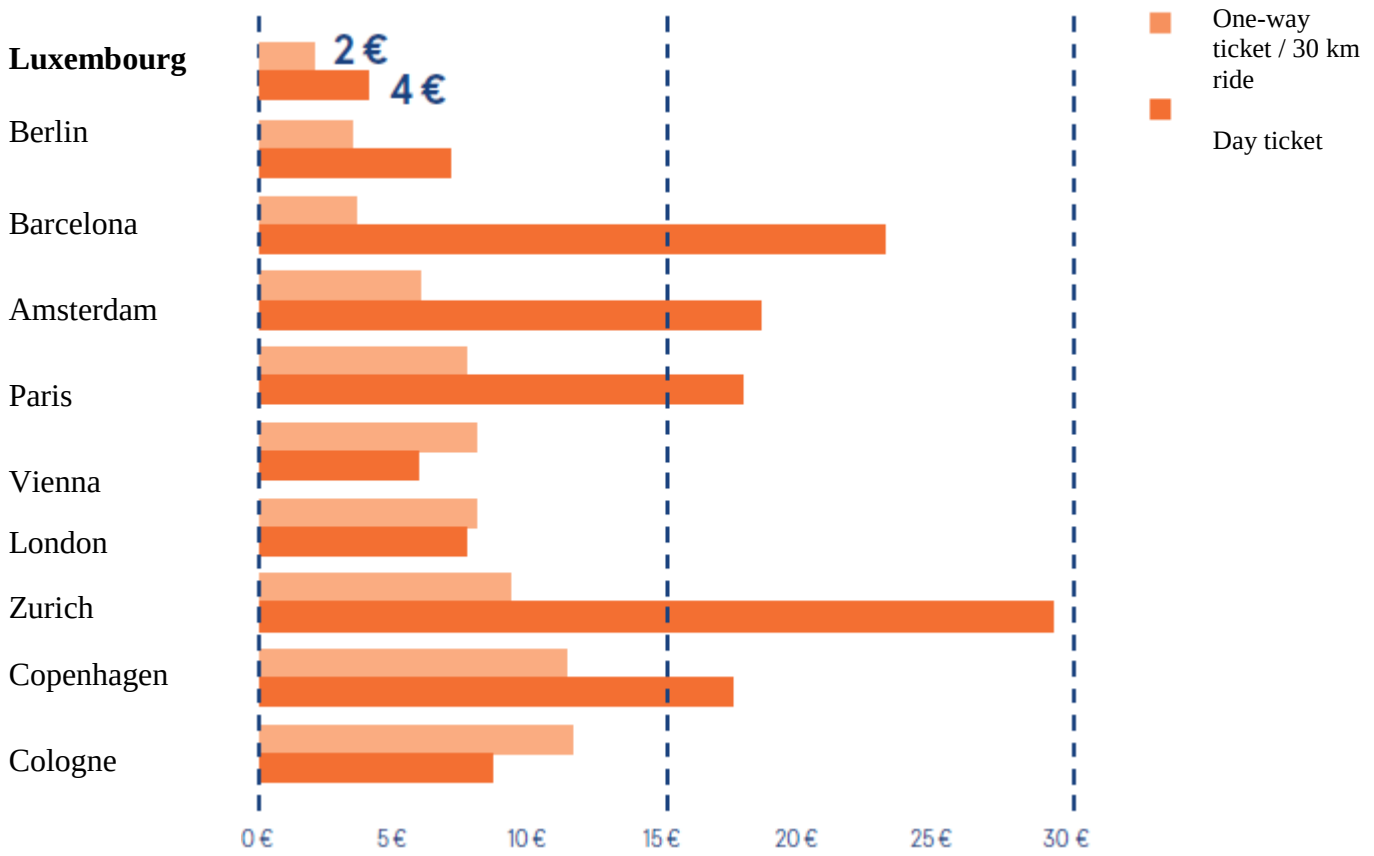
- **The State funds a multi-modal public transport network** in Luxembourg. In specific cases, the State finances a portion of the operative costs of public transport for cross-border commuters.
- **The State is planning a coherent short-term, medium-term and long-term public transport system**, in accordance with the demands of households and as projected by the Department for Spatial Planning.
- The State **ensures that the offer is appealing to users**, while remaining open to suggestions from the communes. For instance, on an express line, the more stops there are, the less efficient it will be for longer trips.

- Communes can **improve access** to public transport by guaranteeing direct footpaths and cycling paths to the stops and ensuring that the waiting areas are practical and pleasant.

- Communes can **inform their citizens about the public transport supply**. In addition to providing the timetables and fares in their publications, they can include photos of the stops and destinations that can be accessed from there.

- If the demand is high enough (i.e. justifying the operating costs), communes can connect the RGTR networks on their territory by means of **communal bus routes**. For occasional rides, taxis can be used because they would be more economical.

Public transport fares for a one-way ticket covering 30 km and a daily ticket for the entire network:
(MDDI, 2018)

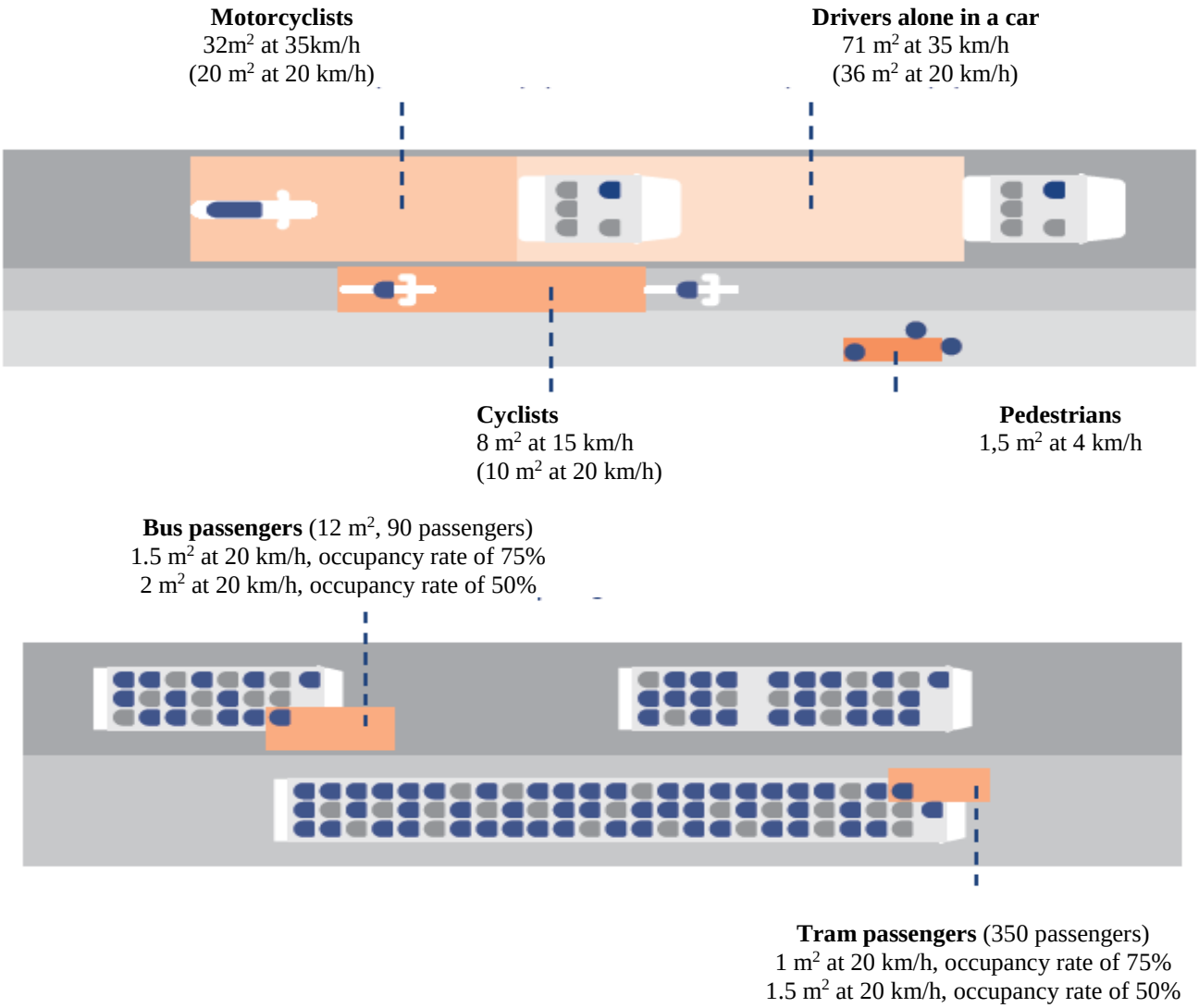


- Employers can encourage employees to use public transport by paying a portion of their **annual Verkéiersverbond mPass**.
- By providing **company vehicles at the workplace** for potential professional trips during working hours, employers can encourage their employees to use public transport for their home to work travel.

- **Using public transport** (like any other form of transport) represents a learning curve. Interested users can consult the following:
  - Download the Verkéiersverbond's "**mobiliteit.lu"** app;
  - Plan and carry out their **first trip without any specific time constraints** (e.g. at the weekend), using the app to consult the timetables and buy the ticket;
  - **Test** different times of departure and transfer options **until the ideal one is found** for daily travel.

"Even with an occupancy rate of only 50%, public transport uses 20 to 30 times less public space per transported individual than cars transporting one person only."

Space usage per transported individual, per mode of transport, at the usual speed and at 20 km/h in urban areas:
(MDDI, 2018)



Six questions to find the best mode of public transport for a specific trip

1. Does the transport capacity reflect the projected demand?

For any given mode of transport, its hourly capacity is higher if the vehicles are larger, the interval between the departures of these vehicles is short, and their speed is high. Typical capacities are demonstrated for the various modes of transport in the table below.

2. Is the commercial speed of transport as high as possible?

The commercial speed of transport is higher if the flow of vehicles is prioritised compared to other means of transport, distances between stops are long and waiting times at stops are short. The table below provides an overview of the commercial speed expected from the various modes of transport.

3. Is the cost-benefit ratio acceptable for the long term?

The more structured the mode of transport for the territory and the higher the transport capacity, the greater the importance of calculating its cost-benefit ratio in the long term, including operational costs, infrastructure costs, and the financial and environmental costs vs. benefits.

4. Is the mode of transport adequately integrated in an urban context (i.e. ease of access and therefore more appealing to a larger number of people)?

A means of transport that is very fast between towns but that has to stop frequently to drop off and pick up passengers outside the towns because it cannot be adequately integrated into the urban context (e.g. systems on stilts or requiring large corridors) can sometimes be less appealing than a somewhat slower mode of transport that picks up and drops off its passengers in urban centres, thus preventing awkward transfers between modes of transport during the trip.

5. Can the constraints to operation and particularly the space occupied by the vehicles before and after their service at the terminal be managed?

In principle, it is easy (especially for road vehicles) to increase transport capacity by increasing the number of rides performed. However, this often represents a problem for the parking of a large number of vehicles at the terminal and increases the operation costs significantly. Thus, the choice of a mode of transport must also take into consideration the balance between high frequency, available space at the terminals and the cost of investment and operation.

6. Is the mode of transport the best considering the type of flow transported and the context in which it must be integrated?

For instance, cable cars can be an efficient solution to ensure the continuous flow of passengers wanting to climb a hill. On the other hand, cable cars are not appropriate to transport a large and infrequent number of passengers (e.g. such as those coming off a train).

Public transport modes and their characteristics (MDDI, 2018)

	MODE	HOURLY CAPACITY (PASSAGERS PER HOUR AND PER DIRECTION)	OPTIMAL USAGE DISTANCE (KM)
	Walking	15,000 (3m space)	<2 km
	Cycling	9,500 (3m space)	1 -6/7 km
	Electric bike	6,000 (3m cycling lane width)	2-15 km
	Car	1000 - 1200 (1.2 persons per car, urban arteries)	5 - 100 km (and more)
	On-demand transport	15 - 25 (minibuses, hourly intervals)	10 - 20 km
	Coach	200 - 300 (seats only – Departure every 15 mins)	15 -50 km
	Standard bus	900 – 1,000 (Departure every 5 mins)	2 - 15 km
	Articulated bus	Up to 2,500 (Departure every 5 mins) Up to 7,000 (Departure every 3 mins)	2 - 15 km 2 -15 km
	Tram Express tram / interurban tram	2,000 – 3,000 (Departure every 6 mins)	10 - 25 km
	Underground /Monorail	>10,000 Depending on frequency and type of vehicle	3 - 20 km (more in larger towns)
	Train	Up to approx. 18,000 Depending on train length and frequency	>10 km
	Cable car	Up to 2,500 (10 to 25/trip)	2 - 5 km

	AVERAGE OR COMMERCIAL SPEED (KM/H)	OTHER DEFINING CHARACTERISTICS
	4 - 5 km/h	
	10 - 20 km/h	The usage distance and average speed are very dependent on available structures
	Approx. 20 km/h	The usage distance and average speed are very dependent on the available infrastructures
	15 - 35 km/h (in towns)	In urban areas, the capacity depends on junctions, amongst others
	20 - 25 km/h	For areas with low and irregular demand
	40 - 50 km/h	Rural areas, lines using motorways, regions without railway access
	16 - 20 km/h (with reserved lanes)	Longer distances possible in periurban areas / rural areas without railway access
	16 - 20 km/h (with reserved lanes)	
	18 - 22 km/h (with reserved sites)	
	30 - 45 km/h	Top speed approx.100 km/h. Direct connection between town centres
	30 - 45 km/h	Usually, large distances between stations (>1 km). Complex urban integration
	40 - 100 km/h (depending on distance and stops)	The capacity and speed depend greatly on the available infrastructure
	15 - 18 km/h	Efficient for point-to-point usage with constant demand and to overcome obstacles

Financial incentives

Financial incentives can promote sustainable mobility in novel ways or simply consist of reviewing existing incentives to improve sustainable mobility.

"If average households made their annual purchases one after the other, their total expenditure between 3 November and 27 December would all be related to private vehicles and those made between 28 and 31 December would be related to other transport services."

(MDDI calculations based on Statec data from 2017)

- Communes can reward their residents by giving **additional subsidies** to local associations that have carried out specific actions to promote sustainable mobility within the context of the traffic they generate. Indeed, local associations play a key role in influencing social behaviour.

- After housing, mobility represents the second highest expense for households. Many could improve their financial position by **using more sustainable mobility solutions** and rethinking their potentially excessive dependence on their private cars.

- The State can check **whether tax advantages, taxes and subsidies** relating to mobility support the objectives of the present strategy or reduce the problems it is trying to resolve.

- Employers can encourage the usage of public transport by contributing to the payment of **mPass** cards for their employees.

- Employers can include **"mobility perks"** in their remuneration packages for employees other than shared company vehicles, e.g. car-sharing, mPass, free parking for carpoolers, leased bicycles, etc.

Cleaner road transport

Vehicles running on alternative fuels do not have a direct impact on mobility itself. However, they reduce greenhouse gas emissions and the emission of other noxious substances from motorised road traffic.

"Chargy" charging station

- Citizens who worry about climate change can decide to make some of their **daily trips on foot, by bike or on public transport**.
- Whether as a driver or as a passenger, **carpooling** on repeated trips such as travelling from home to work cuts their carbon footprint by half.
- When **buying a new car**, opting for a zero-emissions vehicle or a low-emissions vehicle is rewarded by tax advantages.
  www.clever-fueren.lu

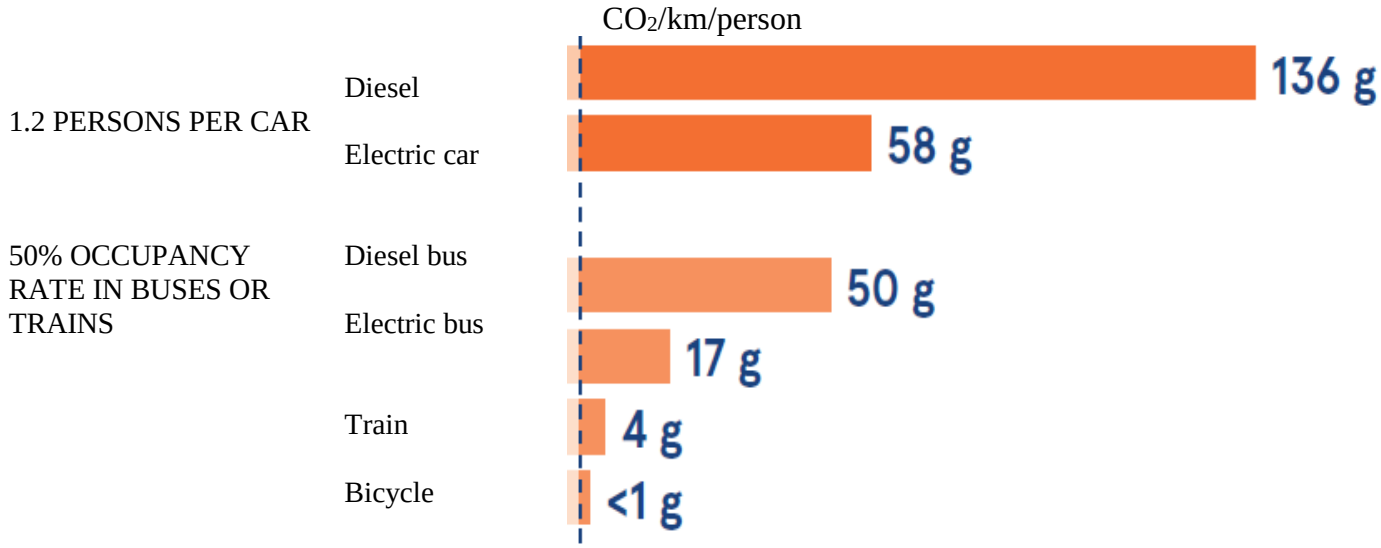
- Communes and employers can reduce their carbon footprint by purchasing **zero- or low-emissions vehicles** for their own fleet (cars, vans, buses, waste trucks, etc.). Tax advantages may also apply.
  www.clever-fueren.lu
- In addition to the 1,600 "Chargy" charging stations installed by the State and network managers, communes and companies can install further **"Chargy OK"** stations.
  www.chargy.lu

"Over a full lifecycle of 200,000 km, an electric car generates less than half of the CO_2 emissions a diesel car does. This includes the emissions from replacing the electric car batteries. This gap will become even greater with the ascent of renewable energy sources."

A technology-neutral policy

The Government does not promote just one alternative type of fuel, in this case electric mobility. Other alternatives may also contribute to greening road transport. For instance, if the production of hydrogen from electrolysis by means of electricity generated solely from renewables were to become competitive, hydrogen batteries could play an important role in the future.

CO_2 emissions per transported person for a motorised vehicle's full lifecycle, i.e. 200,000 km
(Mobitool.ch and Transport & Environnement, 2017)



Well-to-tank

These emissions are generated before the vehicle has even been driven to produce (i.e. the "well") and transport the fuel to the vehicle's tank (i.e. "tank"). Any production of fuel, including electricity from renewables, generates so-called "well-to-tank" emissions.

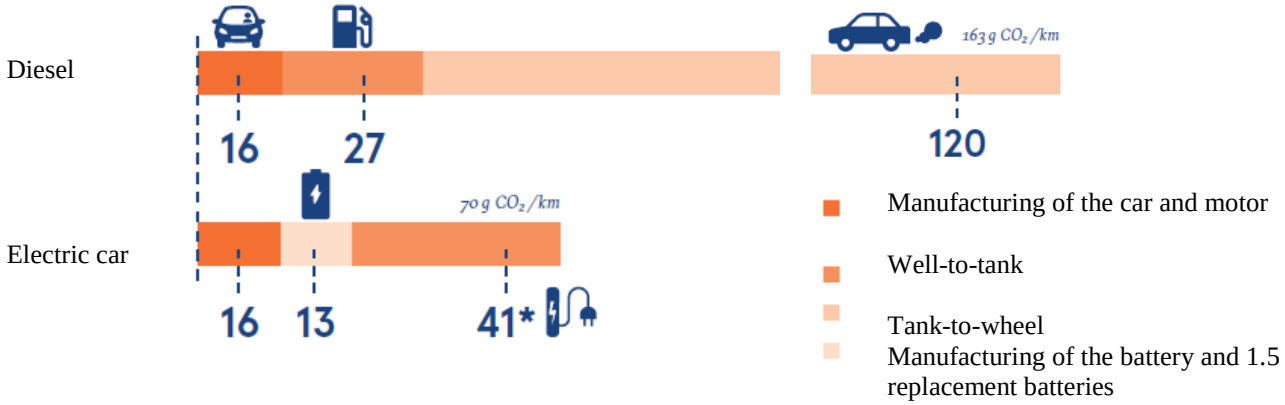
To compare the CO_2 emissions for the full lifecycle of two different vehicles, the emissions generated during the production of the vehicles themselves must be considered. In the case of electric vehicles, emissions generated by the production of the batteries (and replacement batteries) must be included in the calculations.

No exhaust (MDDI)

Tank-to-wheel

These are the emissions that are produced locally by the vehicle's engine to transfer part of the power contained in the battery or the tank to the wheels. Electric cars and cars running on hydrogen batteries do not have an exhaust. This means that they do not produce local tank-to-wheel emissions of air-polluting particulates resulting from combustion (CO_2, NO_X, SO_X, fine particulates, etc.).
These vehicles generate only one third of the fine particulates that combustion engines emit. These emissions are the result of brake and tyre abrasion.

CO_2 emissions per vehicle for a full lifecycle of 200,000 km
(Transport & Environnement, 2017)



* 203 g CO_2/kWh for the electricity consumed in Luxembourg (ILR, 2016). Well-to-tank CO_2 emissions for an electric car consuming 20 kWh/100 km total 40.6 g/km.

Chapter 4

ONGOING PROJECTS

Although a coherent sustainable mobility strategy is indispensable, only its implementation will allow us to progressively reach the defined objectives. This chapter provides an overview of the status quo of the main ongoing projects.

SPATIAL PLANNING

The Law of 22 March 2018 on Spatial Planning, the Sectoral Master Programme, land use programmes and the Master Programme for Spatial Planning in Luxembourg all aim to make a more streamlined use of the country's 2,586 km².

Law of 22 March 2018

The new law on spatial planning paves the way for the application of new Sectoral Master Programmes (PDS) and makes the Land Use Programme (POS) more flexible.

Sectoral Master Programmes

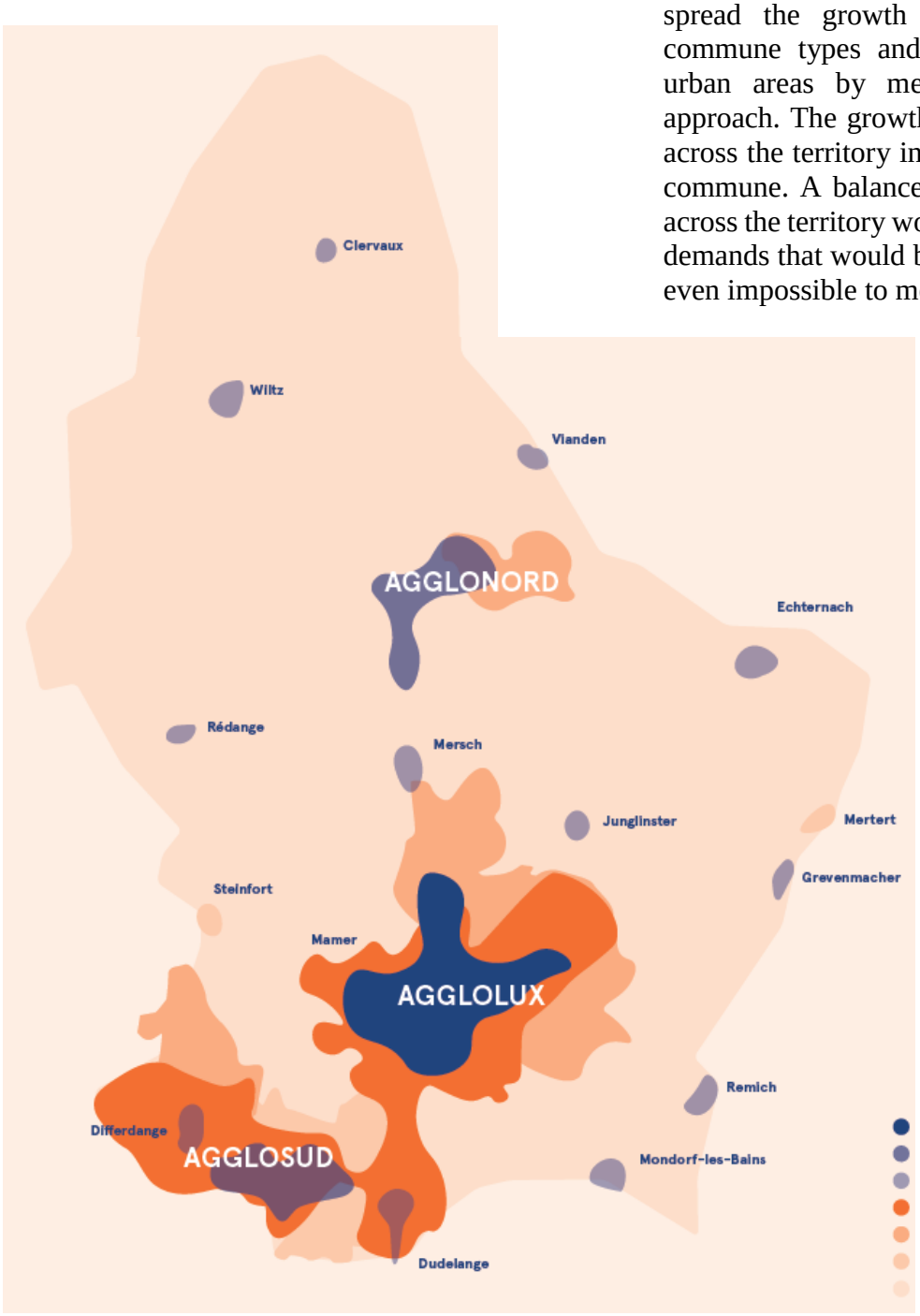
The Law of 22 March 2018 allows the relaunch of the four Sectoral Master Programmes, i.e. housing, transport, landscaping and economic activity zones. The feedback from the communes, the Higher Council on Spatial Planning, the consultation bodies and the public was all taken into consideration. The Master Programmes permit the reservation of land for specific uses, e.g. transport infrastructure projects.

The Master Programme for Spatial Planning (PDAT)

The Master Programme for Spatial Planning (PDAT) provides the State and communes with guidelines for action for the development of the country. By means of a partial devolution of decision-making powers by the Ministry in charge of spatial planning, the recast Master Programme for Spatial Planning (PDAT) in 2019 will take the citizens' list of recommendations into account. This list was drafted in 2018 by over 300 citizens, cross-border workers, ministerial and communal representatives and experts within the context of "regional labs" that were organised according to subject matters (i.e. basic functions, quality of life, resilience, resources, social and territorial cohesion). It allowed the regional contributions to be pooled into an overall national approach.

"DECOUPLING ECONOMIC GROWTH FROM A RISE IN TRAFFIC CAN ONLY BE ACHIEVED THROUGH GREATER GEOGRAPHIC CLOSENESS OF HOMES, WORKPLACES, LEISURE ACTIVITIES AND SHOPS."

Types of communes according to organised and harmonious spatial planning as in Scenario 3
(MDDI, 2018)



"Organised and harmonious" scenario

As opposed to diffuse and disorganised development (whether directed or theoretical), organised and harmonious spatial planning opens the door to sustainable growth options in Luxembourg, given its role as the economic driver in the Greater Region in the context of the Third Industrial Revolution. This scenario plans to spread the growth of employment based on commune types and strengthen the three main urban areas by means of a joint communal approach. The growth of the population is spread across the territory in accordance with the type of commune. A balanced spread of homes and jobs across the territory would inevitably drive mobility demands that would be very expensive and maybe even impossible to meet.

ON-DEMAND TRIPS

Thanks to the Verkéiersverbond's telematic "mLive" project, the "mKaart" and the smartphone have become cornerstones of multi-modality in Luxembourg.

Travel information in real time

Since March 2018, the times of departure of all trips on public transport can be consulted in real time on mobiliteit.lu (website and app), as well as on dynamic display screens on buses, amongst others. This information is also shared with other information channels such as CFL, TICE, AVL, Google Maps, Moovit, etc. The information is provided as open data.

www.mobiliteit.lu

- Departure according to the timetable and expected delay in minutes.
- Users can receive notifications in the case of delays during their trips.
- Construction sites or other delays on the line.

App: mobiliteit.lu

3 Control room (Verkéiersverbond)

1 mTicket app (Verkéiersverbond)

2 mKaart

Tickets and fares
Thanks to the "mLive" project, tickets and passes for public transport can not only be purchased at sales points or on the bus, but also via the "mticket" app, via **www.mshop.lu** or from 15 automatic dispensers. [1]

Multi-modal route planner
The new multi-modal route planner will inform users about all options to make a trip from A to B (as from June 2018). Based on real-time information, the route planner displays the best options by combining public transport, private cars, carpooling, car-sharing, private bicycle or self-service bicycles, Park & Ride, Bike & Ride etc.

mKaart
"mKaart" fulfils numerous functions, pooling public transport tickets, access to "mBox" bicycle stalls or "Chargy" charging stations. Access to other mobility services (Park & Ride, car-sharing, self-service bicycle stations, etc.) is in the pipeline. "mKaart" will become an open pass for mobility-related services. [2]

Control rooms
In the event of disturbances on the network or other incidents, the control rooms will be able to transmit optimal information to travellers and they will do their best to ensure that connections can be made as planned. [3]

ALTERNATIVE FUELS

Luxembourg has begun its transition to a zero- or low-emission fleet.

Private, leasing and company cars

For individual citizens, the Government has set up a 5,000 euro tax rebate for zero-emission vehicles (electric cars and hydrogen-fuel cell cars), a 2,500 euro tax rebate for plug-in hybrid cars with under 50 g CO_2 emissions per km and a 300 euro tax rebate for bicycles and Pedelecs25. Tax advantages are also provided for leased vehicles and company cars that use alternative fuels.

www.clever-fueren.lu

Public electric charging stations

By 2020, there will be a national network composed of 1,600 "Chargy" charging stations for electric cars and plug-in hybrid cars. It will be set up by the administrators of the distribution network. The charging points will only use electricity generated from renewable sources. They will be equipped with type 2 plugs and their charging capacity will be up to 22 kW.

www.chargy.lu

Parking space with a "Chargy" charging station (MDDI)

Taxis and buses

Following the reform of the taxi sector in 2016, only zero-emission vehicles are eligible for additional licences.

At the end of 2017, 38 electric taxis received licences (i.e. 7.4% of the taxi fleet). This measure contributes to reaching the EU-wide targets for NO_x emissions in urban areas. The RGTR, Luxembourg City, Differdange and Echternach also launched pilot projects with electric and hybrid plug-in buses.

State-owned vehicles

A fleet of approximately 2,000 vehicles is directly operated by ministries and other administrations.

In 2017, a pilot project was launched to use more electric vehicles. As from 2018, every new vehicle purchased by the State must be electric or a plug-in hybrid, unless a waiver has been approved.

"IN 2020, WITH AT LEAST TWO CHARGING STATIONS PER COMMUNE AND OVER 800 CHARGING STATIONS AT PARK & RIDE LOTS, LUXEMBOURG WILL HAVE THE MOST DENSELY-NETWORKED CHARGING STATIONS SYSTEM FOR THE GENERAL PUBLIC IN THE EUROPEAN UNION."

Electric bus in Luxembourg City (MDDI)

ACTIVE MOBILITY

Since the creation of the MDDI's Soft Mobility Department ("Cellule Mobilité Douce") in 2014 and the Sustainable Mobility Division ("Division de la Mobilité Durable") at the National Roads Administration ("Administration des Ponts et Chaussées") in 2015, the Ministry has been taking the needs of pedestrians and cyclists into consideration in all its projects.

Laws and regulations

- Law on the national cycling path network, with the addition of cycling axes through towns (2015). Draft law to provide additional safety on the network and for the introduction of "express cycling paths" (2018).
- Modifications to the Highway Code: signposting for cycling itineraries (2016), pavement crossings, non-compulsory cycling paths, 1.5 m lateral distance when overtaking bicycles, cycling routes, children on bikes on pavements, etc. (2018).
- Tax advantages for private and leased bicycles set forth in the Tax Reform (2016).
  www.clever-fueren.lu
- Luxembourg's Declaration regarding cycling as an environmentally-friendly mode of transport (Luxembourgish Presidency of the Council of the European Union in 2015).

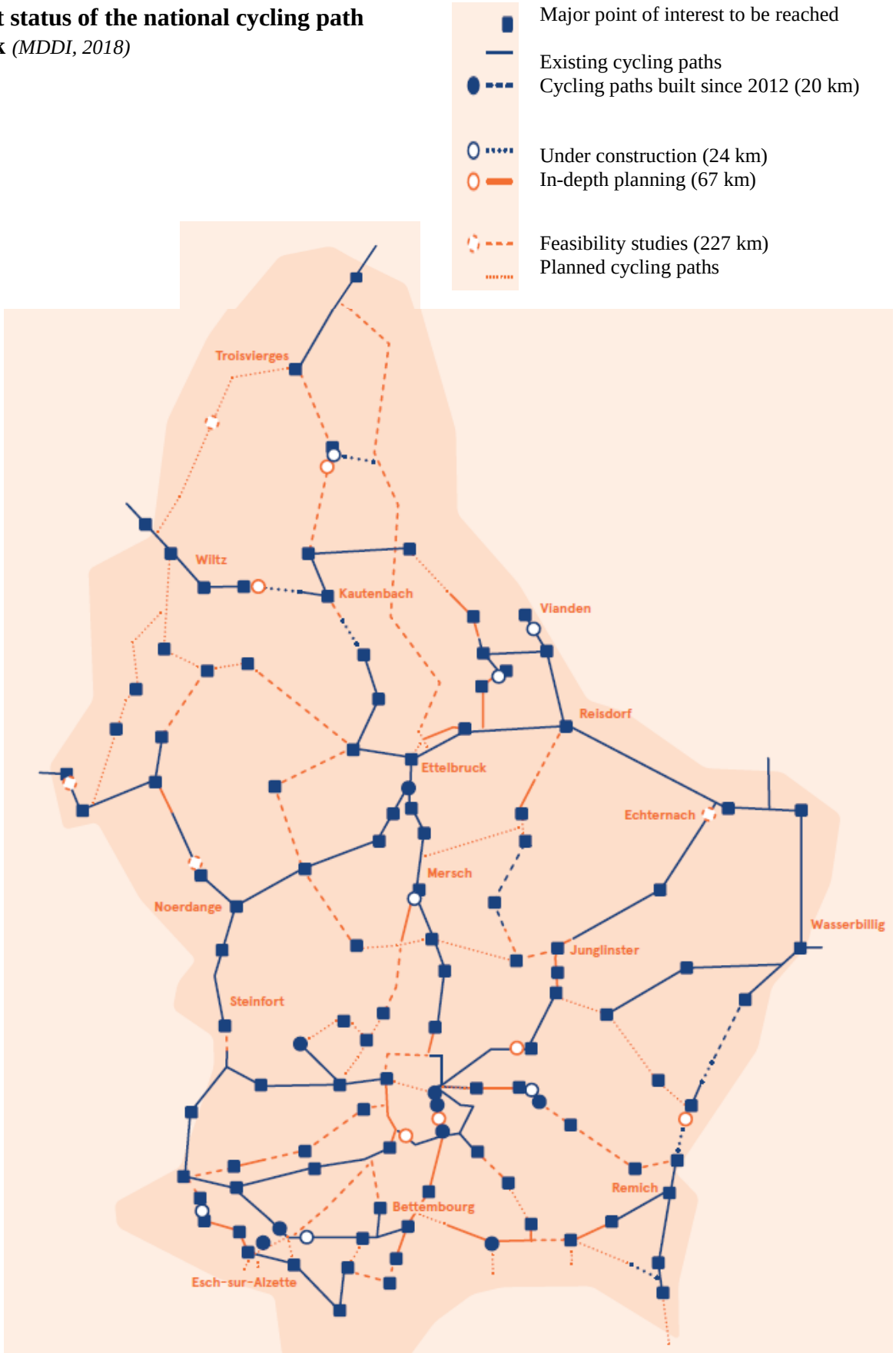
"24 KM OF CYCLING PATHS ARE UNDER CONSTRUCTION FOR THE NATIONAL CYCLING LANE NETWORK; 294 KM OF CYCLING PATHS ARE CURRENTLY BEING PLANNED. EVERY YEAR, ABOUT 1,000 SIGNS ARE BEING PUT UP FOR CYCLISTS."

Separate cycling path on Avenue John F. Kennedy (MDDI)

Infrastructure (examples)

- National cycling path network (see map).
- Locked mBox bicycle parking lots (CFL).
- Cycling lane along the tram line in Kirchberg (FUAK, 2017).
- Inter-communal cycling path network covering 175 km (19 leading communes, Leader Lëtzebuerg West and Leader Atert-Wark).
- Panoramic Pfaffenthal lift (Luxembourg City, 2016).

Current status of the national cycling path network *(MDDI, 2018)*



Appropriateness of public roads for cycling

An MDDI project is underway, in collaboration with the member communes that are parties to the Nordstad, DICI and Uelzechtdall conventions, the Syndicat Pro-Sud and GECT Alzette-Belval, with the support of Dutch consultants and the Luxembourgish Cycling Initiative (Lëtzebuerger Vëlos-Initiativ).

Map of cycling conditions (Extract, MDDI)

- No motorised traffic (inexperienced cyclists).
- Little motorised traffic, e.g. max. 30 km/h zones (beginner cyclists).
- Good conditions on a main road (experienced cyclists).
- Bad conditions on a main road (danger zones on the cycling network).

The cycling conditions of approximately 4,000 km of public roads have been examined in the three largest urban areas of the country since 2016. A map has been drawn up which is similar to alpine skiing maps. These maps show the communes and the National Roads Administration which danger zones need to be addressed to create a continuous, safe cycling network by means of construction.

Development of the mBox network

The network of locked bike sheds that is free to access for mKaart holders is continually being extended. In 2018, there were 21 mBox sheds with 660 bike spaces. The construction of 12 more mBoxes is currently being planned.

www.m-box.lu

mBox at the Central Station (CFL)

Traffic reduction

The reduction and slowing down of traffic are two key measures to improve safety and convenience for pedestrians and cyclists. Since 2014, stretches of state roads have been adapted in town centres and in front of schools, under the condition that the communes redesign the road space at their own expense in line with the criteria defined by the State.

Quality control and consultancy

- Since 2014, the Soft Mobility Department has provided consultancy services regarding over 300 bridge and road projects to the Administration of Public Buildings in order to optimise conditions for pedestrians and cyclists. It also provides consultancy services to other players, such as the CFL, Luxtram, the Kirchberg Urban Planning and Spatial Planning Fund (FUAK) and the Belval Fund ("Fonds Belval"). One of the main duties of the Soft Mobility Department is to provide consultancy services to communes whenever requested.
- The Sustainable Mobility Division provides consultancy services internally on the National Roads Administration's projects. It also processes permit applications for matters relating to roads, paying special attention to the needs of persons with reduced mobility, pedestrians, cyclists and public road transport.
- The email address pistescyclables@pch.etat.lu allows users to share their issues with the National Roads Administration concerning national cycling paths. A photo with a description of the situation and the location must be provided by the sender.

Crossing pavements

This measure has already been implemented in most European countries and has been enshrined in the Highway Code since 2018. It allows the creation of an appealing pedestrian and cycling path along a main road. At the entrance of some max. 30 km/h areas or crossroads, cars must drive over an elevated pavement, whereas in the past, pedestrians had to make a detour via an underpass.

Best practices

The Soft Mobility Department analyses international best practices, then adapts them to the Luxembourgish context. It also provides assistance to the parties concerned in the implementation of:

- Surfaces to be used for cycling paths (2014).
- Parking options for bicycles and hired bicycles (2015).
- Making public buildings easily accessible to cyclists and pedestrians (2016).
- Adequate cycling infrastructures for typical spaces and roads in Luxembourg (2018).
- Examination of the benefits of active mobility in cost-benefit analyses for long-term transport projects (2018).

Crossing pavement (MDDI)

RESTRUCTURING THE RGTR NETWORK

In order to reach the objectives for the public transport modal share, it is crucial to improve and restructure the supply of the RGTR (Régime général des transports routiers) bus network.

The network in 2018

- The RGTR network is currently composed of 342 lines, of which 139 are school bus lines and 39 are aimed at specific activity zones. For the purpose of comparison, the bus network of Berlin serves a population four times that of Luxembourg, with half the number of bus lines (154 BVG lines).
- The RGTR is the largest public transport provider in Luxembourg in terms of the number of passengers on workdays, with approximately 125,000 passengers a day (excluding TICE, AVL or other communal bus lines).

"OVER THE PAST DECADES, 342 "ON-DEMAND" LINES HAVE BEEN ADDED TO THE RGTR NETWORK, MAKING IT DIFFICULT TO UNDERSTAND FOR CLIENTS. 60 % OF PASSENGERS ARE TRANSPORTED ON 27 LINES."

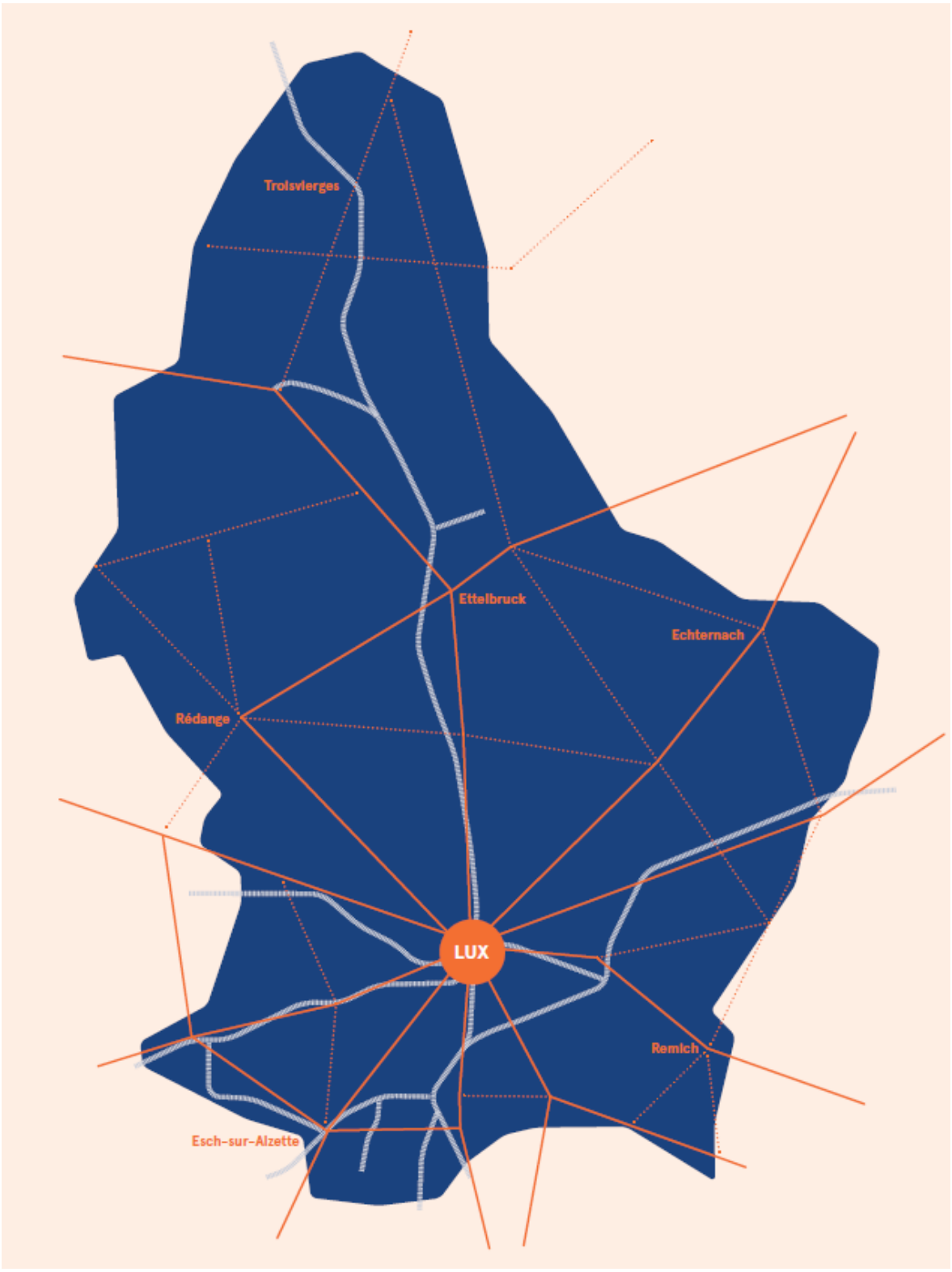
The new network (as from 2019)

- The new network will operate in a hierarchy with an easy overview, namely by means of the line numbers. The bus lines will be numbered according to the regions and type of line operated (express, regular and feeder buses).
- On the main arteries linking the regional centres to Luxembourg City, buses will operate like trains. Lines stopping at each stop will alternate with express bus lines that will only stop at the main stops.
- In order to cover rural regions, secondary lines will be added to this structured network.
- Connections between buses, trains and trams will be made easier.

Priority for buses by means of traffic lights and bus lanes

- Since 2017, thanks to an MDDI software programme, the sections on which right-of-way measures for buses would be the most beneficial to RGTR clients have been identified. In order to adapt to space constraints, some projects will consider the usage of dynamic two-direction bus lanes granting buses priority in the most congested direction (e.g. on the N11 between Gonderange and the Waldhaff interchange).
- Granting right of way to buses is very important for the success of the new network, particularly express lines, and will depend on the capacity of buses to transport passengers faster at peak times than private cars.

Organisation of the future RGTR network (MDDI, 2018)

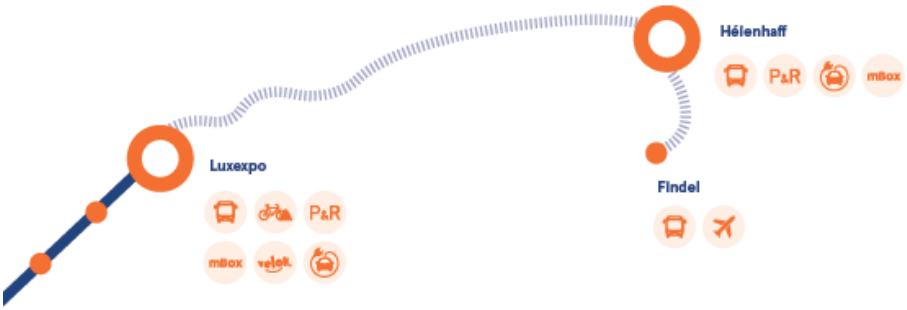


THE TRAM AND INTERCHANGES

While progress is made on the works for line 1, new interchanges will become operational, which will require adaptations on the level of the bus network.

PLANNED SERVICES FOR THE VARIOUS SECTIONS OF TRAM LINE 1:

Avenue de la Liberté (Luxtram)



Héienhaff interchange (P&Ch)

Cloche d'Or interchange (P&Ch)

Multi-modal interchange
Stop

End of works in:
12/2017
2018
2020
2022

Bus
Train
Airport
Park & Ride
Electric charging station
Car-sharing
Bike-sharing
Secure bike sheds
Bicycle parking spaces

PARK & RIDE (P&R)

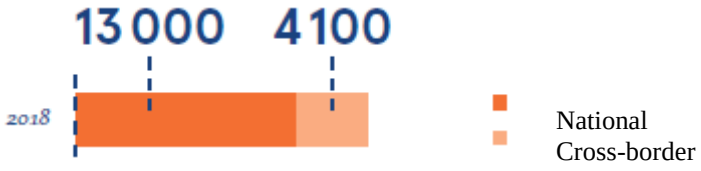
P&R lots combine the advantages of using cars, which are useful in rural areas, with those of public transport, which save space in urban areas.

Reserve P&R lots for commuters
The most popular P&R lots are in cross-border areas and those on the outskirts of Luxembourg City. However, some P&R lots are currently used for purposes for which they were not designed, i.e. as parking spaces for business areas close by. In future, a parking fee system will help promote the usage of P&R spaces for their intended purpose.

Cross-border P&R lots
Bi-lateral discussions with the authorities of neighbouring countries have led to the establishment of new P&R lots in the cross-border areas. Projects such as the new P&R lot in Stockem, Roussy-le-Village and Longwy have increased the supply of available spaces in Belgium and France. In Germany, the launch of the new "Weststrecke Trier" train line will be implemented in combination with new P&R spaces in Ehrang, Trier-West and Euren.

Cross-border bus lines that stop at P&R lots in the cross-border areas surrounding Luxembourg will be subsidised by the Luxembourgish State. In 2017, an agreement was reached with the Belgian State, according to which free P&R spaces close to the train stations of Arlon, Aubange, Gouvy, Habay, Halanzy, Libramont, Marbehan, Neufchâteau, Stockem, Trois-Ponts, Vielsalm and Virton will be provided in exchange for substantial discounts for commuters' train passes to get to Luxembourg.

P&R supply

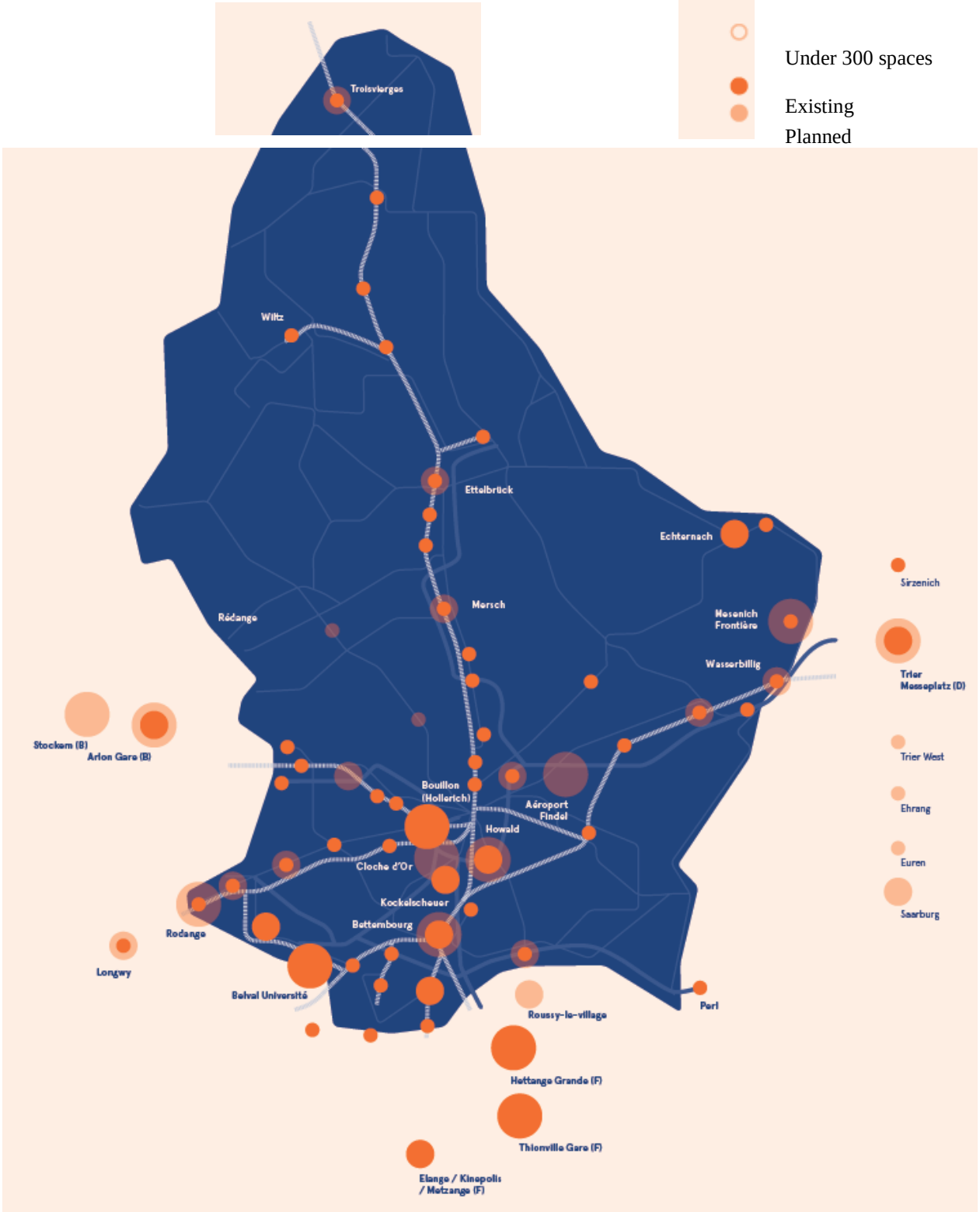


"THE SUPPLY OF P&R SPACES WILL BE DOUBLED BY 2025."

P&R Rodange, 1,600 parking spaces

As to France, the Luxembourgish Government has declared its willingness to co-finance some P&R lots in the Lorraine region along the motorway and the expansion of P&R lots at the Thionville and Longwy train stations.

Existing and planned P&R lots
(MDDI, 2018)



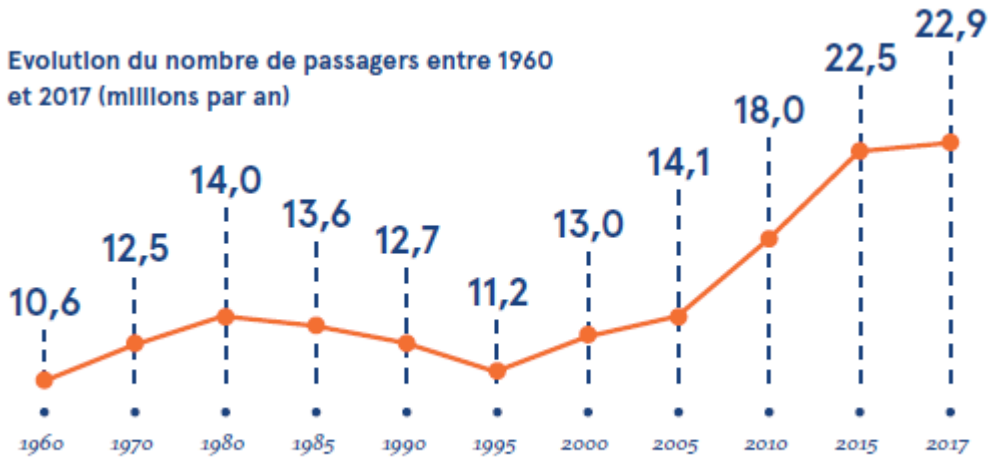
RAILWAY PROJECTS

The national railway company, CFL, transports approx. 90,000 passengers every workday. It is therefore a crucial player in both the Luxembourgish economy and the economy of the Greater Region. The multi-modal site of Bettembourg is a strategic asset in the logistics sector.

Spectacular growth

The number of passengers between 2005 and 2015 rose by 60% on the railway lines in the region (a growth rate greater than any in Europe). The current supply has come to the limits of its capacity, with a consequent increase in delays. Travellers are often confronted with delayed trains and even cancellations, and the lack of information provided to them is a source of frustration. Investments totalling 4 billion euro will be injected into the system between 2013 to 2025 to meet the requirements of this increased demand, aiming to raise the capacity of the network, meet travellers' expectations and catch up with digital change.

Developments in the number of passengers between 1960 and 2017 (in millions per year)



Safety

Luxembourg was the first country to implement the European Train Control System (ETCS), which aims to automate and harmonise railway signalling across Europe. The Luxembourgish network has been equipped with the ETCS since 2014 and it was implemented for CFL passenger trains in 2017. Freight trains will be integrating this system in 2019. As from 1 January 2020, trains that are not equipped with the ETCS will no longer be allowed on the Luxembourgish network.

ETCS (CFL)

Reliability

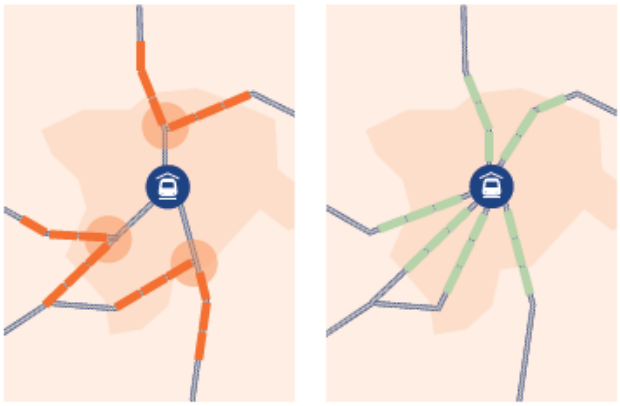
In 2017, approximately 18% of train delays were due to the railway equipment and infrastructures and 14% of delays were the result of problems on neighbouring networks. 40% of delays were caused by the ripple effect of these various causes. This can be mainly explained by the fact that various tracks cross each other when approaching Luxembourg Central Station, meaning that if one train is late, it will automatically have an impact on the punctuality of other trains, because they will have to wait for the tracks to be free. If such delays accumulate, trains must be cancelled in order to stabilise the system.

The network of railway tracks will be gradually expanded thanks to the launch of services on the second Pulvermühle viaduct (2019), on platforms 5 and 6 at Luxembourg Central Station (2019-2022) and the second line between Bettembourg and Luxembourg (2024). Every line will then have its own tracks and platforms, thus considerably reducing the risk of ripple-effect delays.

Did you know…?

Since 2005, all CFL passenger trains have been electric. The CFL has exclusively purchased electric trains fuelled by renewables since 2009.

The public service contract between the State and the CFL sets forth objectives relating to punctuality (a target for the percentage of trains that are maximum six minutes late) and to the continuity of the service (a target for the percentage of trains that are not cancelled).



Unbundling the lines entering the Central Station. On the left, the situation in 2018 is displayed; on the right, the situation in 2024 is depicted. Line 10 (Troisvierges) will be connected to line 60 (Esch-sur-Alzette). (MDDI, 2018)

Traveller information

Whether in normal situations or in a situation in which there are problems (e.g. construction sites, delays, etc.), travellers require full information concerning their planned and ongoing trips. In addition to the CFL website and app, the visual and audible AURIS information system will be progressively implemented in all stations, starting with Pétange, Luxembourg and Bettembourg. Thanks to the RAILTAB system, as from 2018, personnel working on trains will have the data required to inform passengers in real time. In the case of a disturbance on the network, the new Operations Centre ("Betriebsleitzentrale") will be responsible for finding quick solutions and communicating them to the personnel and passengers on trains.

AURIS screen (CFL)

Capacity

The key to increasing the capacity of the network is the expansion of the Central Station. Instead of nine platforms, it will have thirteen. Three other large-scale projects are underway to increase the supply:

- The construction of two new tracks for the Thionville-Luxembourg line on the most congested section of the network, i.e., the seven kilometres between Bettembourg and Luxembourg. The two existing tracks will then be exclusively used by the lines linking Esch-sur-Alzette or Dudelange (or Volmerange-les-Mines) and the Central Station.

- The fitting of double tracks on the Wasserbillig-Luxembourg line between Sandweiler-Contern and the Central Station.

- The purchase of 36 additional trains, increasing the total number of seats in CFL trains from 26,500 to 38,000 between 2014 and 2024 (i.e. 43% more). These new trains will be designed with persons with reduced mobility in mind, will have a traveller information system on board, wi-fi, USB and electric sockets, GSM repeaters, CCTV, an automatic traveller counting system, and a space for bicycles with charging sockets for electric bicycles.

Overpass north of Bettembourg for the new line to Luxembourg (CFL)

Train station modernisation

2017 Pfaffenthal-Kirchberg and Howald
2018 Lorentzweiler and Kleinbettingen
2019 Cents-Hamm, Sandweiler-Contern and Schifflange
2020 Bettembourg
2022 Luxembourg, Ettelbruck, Differdange and Walferdange
2023 Mersch, Rodange and Capellen
2024 Wasserbillig
2025 Wiltz

Ettelbruck interchange (CFL)

Removal of level crossings

Level crossings with barriers represent a risk. Since the 1970s, the number of level crossings with barriers has been reduced from 252 to 122. Between 2018 and 2024, 14 more such crossings will be removed:
Schifflange (3), Cents, Merkholtz, Walferdange, Lorentzweiler, Dommeldange, Rodange, Capellen, Dippach-Reckange, Pettingen (2) and Heisdorf.

Expansion of the Central Station (CFL)

Freight transport: inter-modal terminal of Bettembourg

The inter-modal terminal of Luxembourg has been in operation since 2017. It is located on the Rail Freight Corridor 2 (North Sea-Mediterranean) and on the North-South and East-West transport axes, making it an ideal international hub to consolidate multi-modal transport flows in Europe and beyond (including China). Combined transport flows connect the inter-modal terminal of Luxembourg with the main industrial regions and main ports of the North Sea, the Baltic Sea and Southern Europe. Right next to the main transnational motorway network, the inter-modal terminal is also close to the cargo airport and the river port. As an example, the transport of a semi-trailer by rail from Bettembourg to Boulou (South-West France) generates 245 kg of CO_2 compared to 1,843 kg of CO_2 by road.

(CFL Terminals)

Target scenario 2028

The plan on the next page shows the maximum possible exploitation of the network in 2028 if, in addition to the ongoing projects, all the measures listed below are implemented. A line on the plan represents one train per hour at peak times. To make the plan easier to understand, not all stops are depicted.

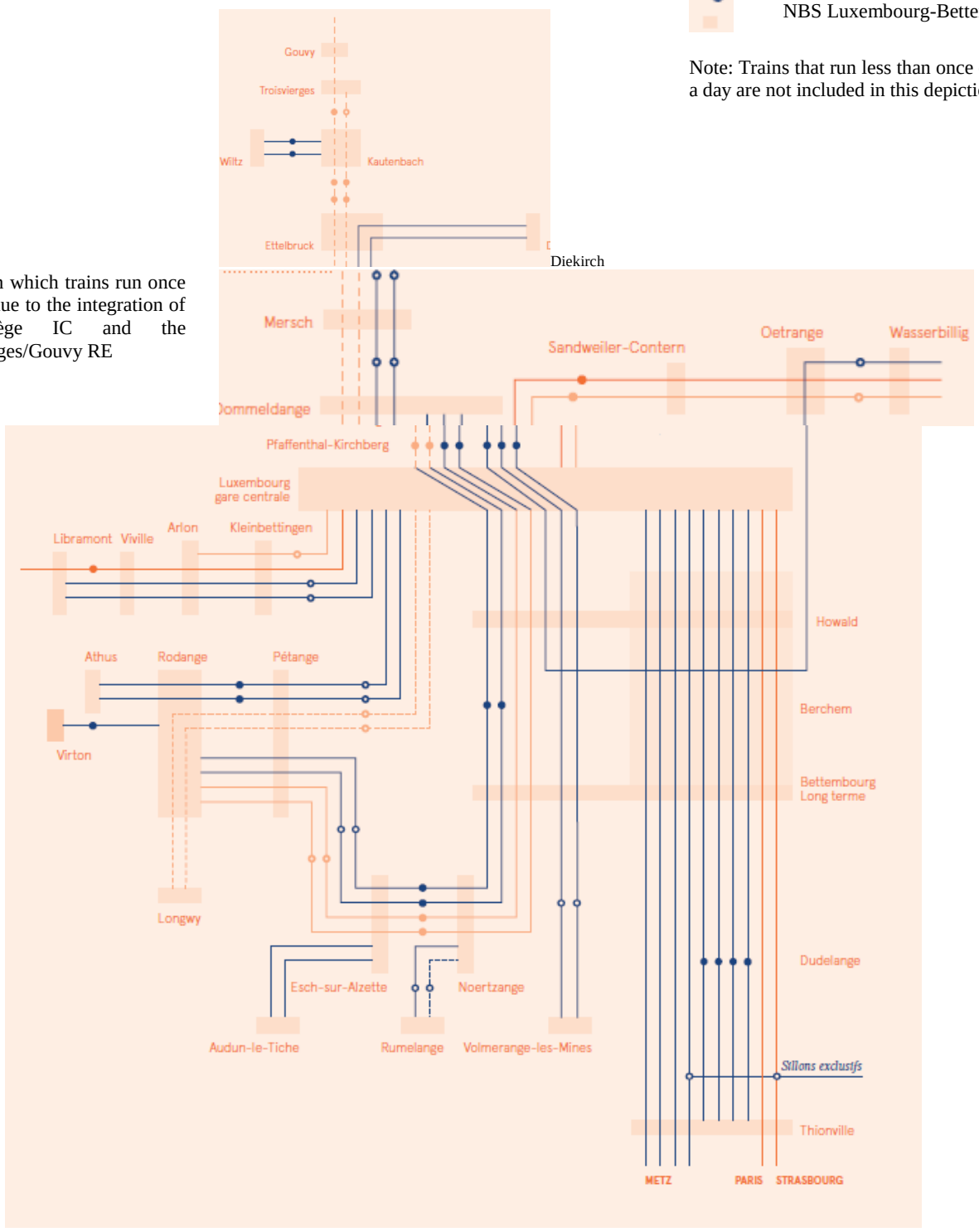
Based on the CFL's projections, this 2028 plan would offer sufficient capacity for all these lines. A later capacity increase for specific stations or stops would require 250 metre platforms allowing nine-wagon trains to stop there, compared to the current six-wagon trains.

Additional infrastructure requirements for the 2028 objectives

The current objectives are: eight TER regional express trains, one TGV and one freight train between Thionville and Luxembourg at peak times. To reach these targets, the following infrastructures will be required:

- On the Luxembourgish side: improvements to the Belval to Esch and the Dommeldange to Ettelbruck sections, the separation of station-level lines at Pétange Station, the expansion of the Diekirch Station by one additional platform, an appropriate strategy and the required storage installations and maintenance. In the longer term, a freight train track between Hettange-Grande and Bettembourg will be needed (bi-national project).
- On the French side: the interconnection of signalling installations at the border, the increase of electrical supply, the recovery of the plan for a track at Thionville Station, the adaptation of stations to permit the entry of longer trains and other modifications. These measures are part of the bilateral agreement dated 20 March 2018.

Plan for the train supply by 2028: one line represents one train at peak time
(MDDI, 2018)



Tracks on which trains run once an hour due to the integration of the Liège IC and the Troisvierges/Gouvy RE

Note: Trains that run less than once or twice a day are not included in this depiction.

CARPOOLING AND CAR-SHARING

Every morning, 250,000 empty car seats enter the Luxembourg City region and the cost of second cars for occasional trips is high for households, hence why innovative projects were launched in 2008.

CoPilote carpooling portal

The Ministry of Sustainable Development and Infrastructure launched the CoPilote carpooling app in 2018 for Luxembourg and the surrounding region. This portal aims to connect people taking similar trips, namely home to workplace trips.

The CoPilote website and app allows users to manage their carpooling trips easily. The advantages of this portal are:

- The location of the carpoolers is provided in **real time**.
- Companies can create their own **"communities"** to promote carpooling among their employees.
- User-friendly **cost-sharing** (if required).
- Additional **incentives** for CoPilote users.

CoPilote carpooling app (MDDI)

Car-sharing in 2018

- **CFL Flex**: Station-based system, with approximately 80 cars, distributed across 20 P&R lots close to stations and stops.
  www.cfl-mobility.lu

- **Carloh**: Station-based system with 17 vehicles, distributed across 9 stations around Luxembourg City.
  www.carloh.lu

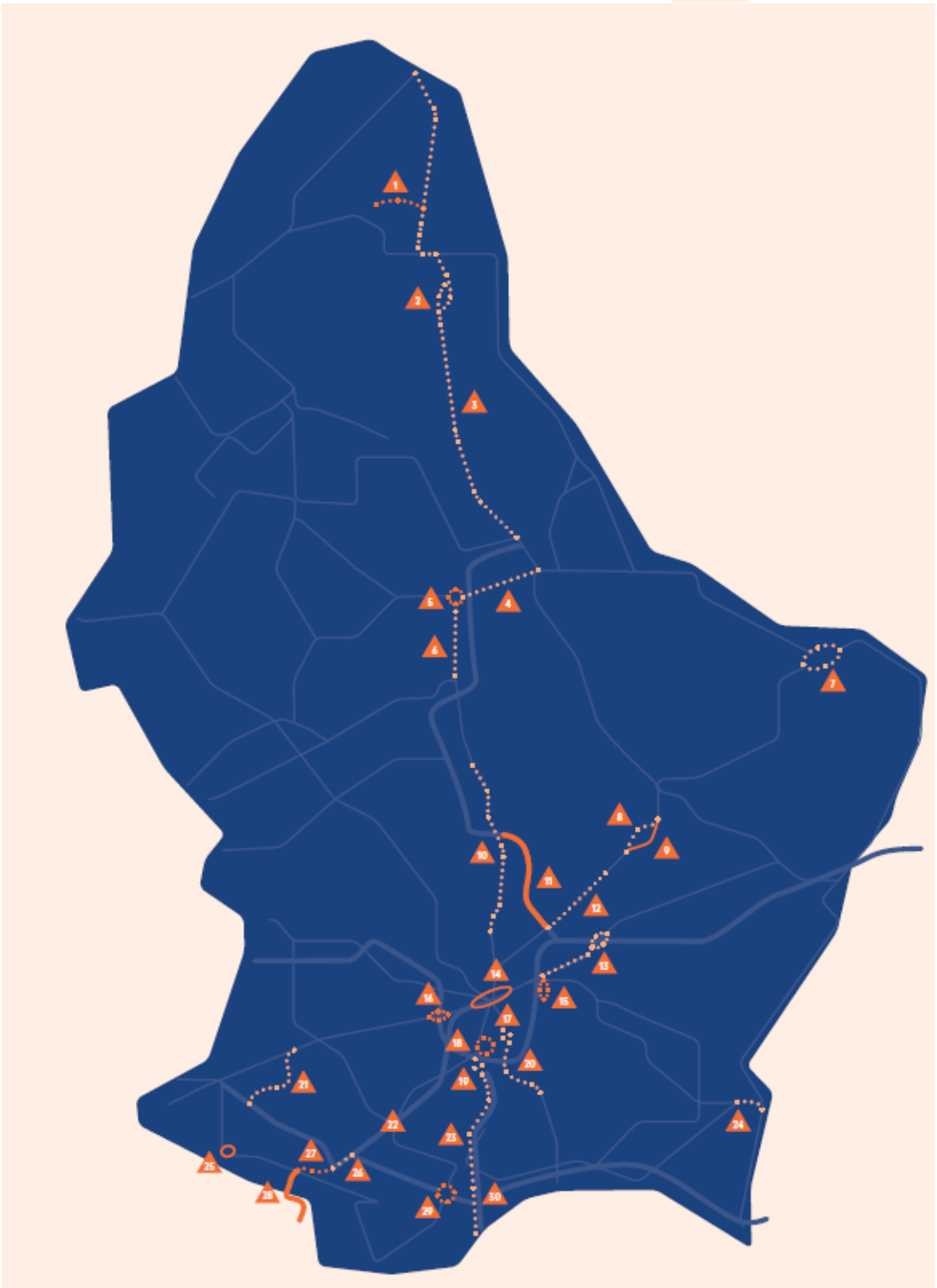
Carloh car-sharing station (MDDI photo)

ROAD PROJECTS

Even if the saturation of the roads at peak times due to an excessive number of cars that are three-quarters empty demonstrates both the need and potential for change, cars will remain an important means of transport. The present chapter provides an overview of the status quo of road projects established in MoDu 2012 and new ones. As examples, five projects will be presented in more detail.

1 Clervaux side road with bicycle path
2 Hosingen bypass
3 Safety measures on the N7 between Fridhaff and Wemperhardt with a cycling route
4 Ettelbruck-Diekirch multi-modal corridor with a cycling path
5 Ettelbruck interchange, N7 tunnel and Patton bridge with cycling infrastructure
6 Safety measures on the B7 between Colmar-Berg and Ettelbruck
7 Alternative routes in Echternach
8 Remodelling of the road through Junglinster with cycling infrastructure
9 Junglinster bypass
10 Remodelling of the N7 between Bereldange and Rollingen with cycling infrastructure
11 Route du Nord A7 between Lorentzweiler and Waldhaff
12 Bus lane between Gonderange and Waldhaff
13 Hoehenhof interchange and remodelling of the N1 with cycling paths
14 Renovation of the Pont Adolphe bridge and the Grande-Duchesse Charlotte bridge for the tram and cycling lane
15 A1: remodelling of the Hamm interchange and the Schaeffer roundabout, known as the "Irrgarten"
16 A6: remodelling of the Helfent interchange
17 New N3, rue des Scillas and Howald interchange for the tram with a cycling path
18 Ban de Gasperich and Cloche d'Or
19 Cloche d'Or interchange with cycling paths
20 Bypass south of Alzingen
21 Bascharage bypass with cycling path
22 A4 Pontpierre interchange
23 Expansion to three lanes on the A3 for carpoolers and buses
24 Bus lane on the N2 in Remich
25 Differdange bypass
26 Improvements to the A4 between Lankelz and Foetz with a bus lane
27 Micheville Phase II connection
28 Micheville Phase I connection
29 A13 interchange at Burange with a cycling path and connection to the multi-modal platform
30 N13-A13 Hellange interchange

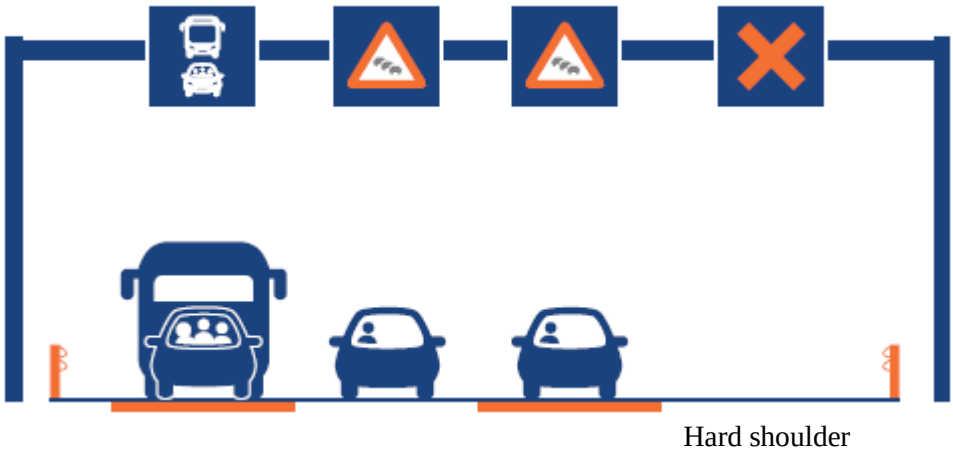
Most important road construction projects since 2012.
(MDDI, 2018)



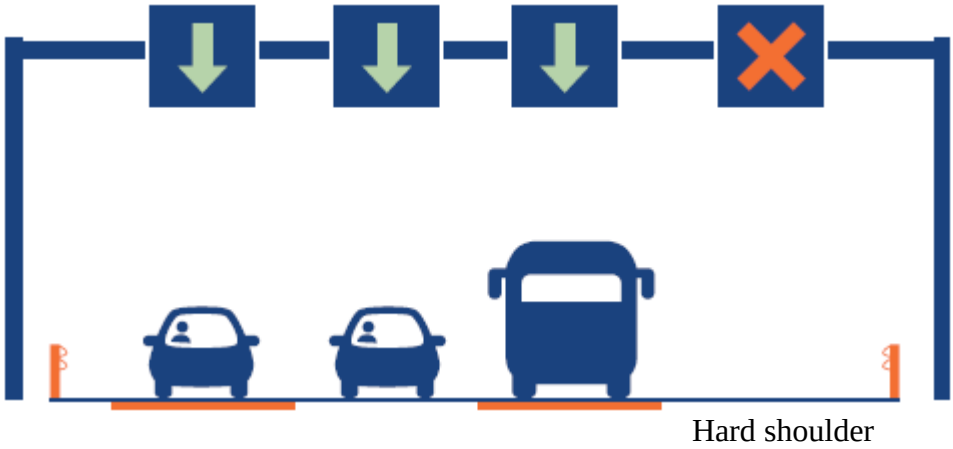
A3 MOTORWAY: EXPANSION TO THREE LANES TO GIVE RIGHT OF WAY TO BUSES AND CARPOOLERS

The Law of 15 December 2017 sets forth the expansion of the A3 motorway in both directions between the Gasperich crossing and the French border to three lanes. This artery is used by over 90,000 cars a day and is the most congested of the country. The Chamber of Deputies unanimously called for the Government to:

- Analyse the extension of noise-reducing systems in the direction of the Bettembourg crossing;
- Study the positive impact of lowering the maximum speed limit on noise pollution;
- Reserve the third lane for buses, coaches, taxis and carpoolers at peak times;
- Perform a feasibility study on the usage of the hard shoulder for public transport in the case of traffic jams.



Scenario: The left lane is reserved for vehicles occupied by at least three people (MDDI)



Scenario: Dynamic signage to allocate lane usage depending on the congestion on the motorway (MDDI)

Why should the third lane be reserved for public transport and carpoolers?

- Vehicles with at least three passengers on board in total is a powerful incentive for carpooling and considerably increases the appeal of bus lines. The traffic flow will be improved, because the same number of individuals will be transported in a lower number of vehicles. A third lane will increase the capacity of the motorway by at least 125% in terms of the number of transported individuals: 1.2 people per vehicle on average in each of the two non-priority lanes, plus at least three persons per vehicle in the priority lane (i.e. 5.4 persons compared to 2.4 persons).

- If the third lane were used for individual motorised traffic, it would only increase the capacity of the motorway by 50% in terms of the number of people truly transported. It would not give any incentive to carpoolers and would not improve the appeal of bus lines. The modal shares would therefore stay the same as they currently are, and traffic jams would simply take up the three available lanes, because some bottlenecks at the entrance to Luxembourg City would not be eliminated due to the existing built-up areas.

Constant priority, priority at fixed peak times, or depending on the traffic flow?

- The simplest and most understandable solution for users would be to permanently reserve the third lane for carpoolers and authorise buses to use it depending on the speed of the remaining two lanes.
- If the third lane were to be reserved exclusively to pre-defined groups at peak times only (e.g. between 6.30 a.m. and 9.30 a.m. and 3.30 p.m. and 6.30 p.m.), it would reduce the appeal of carpooling and buses, because carpoolers and bus passengers would lose their guarantee to a priority lane, e.g. in the case of a traffic jam outside the assigned peak times.
- The most flexible option would be to regulate the priority lane depending on the flow of traffic. This would require the installation of a "smart" dynamic control and information system.

Left or right lane?

- Overall, it would be preferable to reserve the left lane for carpoolers and buses. Overtaking on the left is a rule set forth in the Highway Code. Moreover, the left lane is not directly connected to the access ramps at interchanges.

What if the priority lane is also congested?

- If there should be regular congestion on the priority lane, the solution would be to increase the compulsory number of passengers per vehicle. In North America, there are so-called "high-occupancy lanes" that require the number of transported individuals per vehicle to be four, five or sometimes even six (e.g. minibuses).

What about the usage of the hard shoulder as a normal lane?

- The hard shoulder should be designed so it can deal with the amount of traffic on the road, for reasons related to flexibility (e.g. construction sites), but especially to deal with accidents or other incidents.
- If the hard shoulder is used as a normal lane for buses and possibly even for carpoolers, the following must be considered: crossings at interchanges, the need for additional emergency refuge areas and speed limits on the hard shoulder. As to overtaking on the right, there is a difference between professional bus drivers who can receive special training and private car drivers, a fact that must be taken into account.

How can carpooling be controlled to prevent abuse?

- As an alternative to mobile police patrols, technical solutions such as infrared radars to check the number of passengers per vehicle have been the object of studies in neighbouring countries.

What is the regulation in Luxembourg?

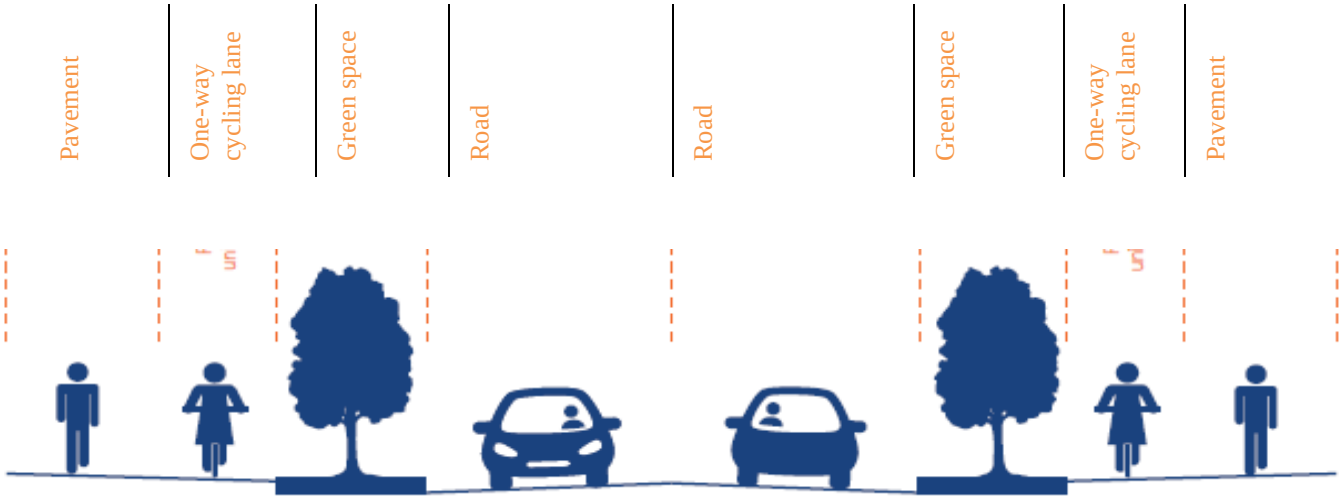
- Traffic regulations will have to be adapted in accordance with the decisions made in response to the questions above.

JUNGLINSTER N11: BYPASS AND REORGANISATION

If a bypass is built without redesigning the secondary road used by the locals and offering alternative means of transport, an increase of traffic on the bypass will gradually lead to a reoccurrence of the traffic problems encountered in the town. The Junglinster bypass was opened in September 2015. The reorganisation project to cross Junglinster aims to create a low-traffic area in the centre of the town and better pavements for pedestrians. The national PC2 cycling itinerary (Echternach-Luxembourg) will be moved away from its most dangerous section (i.e. the mixed-traffic section on the CR132 (max. 90km/h)) and a separate cycling lane will be built in the town of Junglinster.

N11 bypass, Junglinster, opening 2015 (P&Ch)

A similar project is currently being planned for the N7 between Rollingen and Bereldange. Indeed, the "Nordstrooss" A7 currently acts as a bypass for the Alzette valley. No N7 redesigning project had been planned under the A7 project.



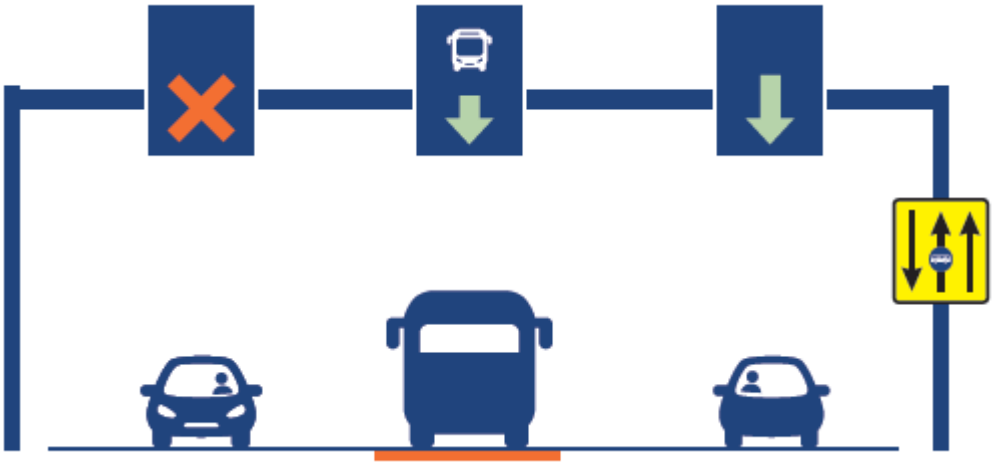
Reorganisation of the road through the town of Junglinster, with a separate PC2 cycling itinerary (P&Ch)

BUS LANE BETWEEN GONDERANGE AND KIRCHBERG

On the Echternach-Luxembourg (N11) axis, the bus is the only option for public transport. It is very important to establish measures to give right of way to buses on the most congested sections. The ongoing study on the matter is analysing the following options:

- Bus lane on the middle lane of the N11 between Gonderange and Waldhaff (if possible, in alternative directions depending on where the traffic flow is heaviest; if not, then in the direction of Luxembourg City);
- Shorter motorway ramp from the N11;
- Lateral bus lane between the Waldhaff interchange and the Serra roundabout in Kirchberg.

Study on a bus lane between Gonderange and Kirchberg (P&Ch)



Scenario: Dynamic bus lane on the middle lane of the N11 between Gonderange and Waldhaff (MDDI)

SAFETY MEASURES ON THE N7 BETWEEN FRIDHAFF AND WEMPERHARD

The N7 is used daily by 10,000 to 15,000 vehicles and is the main northern road axis in the country. Although its expansion to three lanes will not allow it to reach its capacity limit (approx. 19,000 to 24,000 vehicles a day), the lack of a physical barrier between the two directions and the left exits at some intersections (e.g. Lipperscheid) represent a safety risk.

The project for safety measures on the N7 plans the following:

- A physical division between the two directions on the N7;
- The construction of full interchanges to eliminate the left exits outside towns;
- The widening of the hard shoulder, so that it can be used as an alternative lane in exceptional situations, such as in the case of accidents or building sites;
- The construction of a national cycling itinerary using existing rural paths to link the towns on the plateau of the N7.

The removal of left exits, the bypass of the Fridhaff roundabout (ongoing construction in 2018) and the bypass around Hosingen will improve the traffic flow on the N7.

Future interchange on the N7 in Lipperscheid (P&Ch)

Why not build a motorway?

- A motorway with two lanes in both directions would be appropriate for a high increase in traffic on the N7. From a capacity viewpoint, building a motorway would not be justified in this case.
- A motorway requires considerably larger curve radii than those on the current N7. A new motorway would therefore require a new plan.
- Usually, motorway ramps are larger than the current ones on the N7. Traffic from the various towns is currently fed by means of direct access to the N7, and a new motorway would require this traffic to go through neighbouring villages to access it.
- The new layout and the motorway interchanges would occupy large areas of farmable land and natural habitat zones.
- A motorway would inevitably attract transiting traffic between the A27/E42 (Saint-Vith) and the A31/E25 (Thionvillle). In addition to noise and environmental pollution, this additional transiting traffic would cause bottlenecks on the current axis in the areas of Ettelbruck, Mersch, the Route du Nord tunnels, the Kirchberg motorway interchange, the Howald tunnel on the A1 as well as on the A3.

NEW N3 IN LUXEMBOURG AND HOWALD

Like on the Avenue John. F. Kennedy in Kirchberg, where the tram has been running alongside separate cycling lanes since 10 December 2017, a new N3 between the Rocade de Bonnevoie and the interchange in Howald would represent the type of interurban multi-modal corridor required to accommodate trams, private motorised traffic, cycling lanes and pedestrian pavements on the large axes.

New N3, Rue des Scillas (P&Ch)

Lengthened N3 by means of the Buchler bridge, south of the Central Station (P&Ch)

NEW TECHNOLOGIES

The transports sector is undergoing profound changes. Digitalisation, and options such as connected and self-driving vehicles will lead to a form of mobility in which humans are travellers more than drivers.

The promise of self-driving cars

In the future, when vehicles will be able to drive themselves even in urban settings, we can imagine self-driving taxis that will reduce the need for privately-owned cars. As a result, public spaces will be rethought, giving more space to pedestrians, cyclists and public transport.

www.nacto.org

Strategic study of the Third Industrial Revolution

The "Rifkin" study projected a new economic model for Luxembourg by 2050, including the proposal of several strategic mobility measures. Some of them have already been launched and are underway, such as limitations imposed on mobility needs, the development of a "mobility as a service" solution and the purchase of a zero-emission fleet of vehicles. Other recommendations seem futuristic at first glance, as for instance speeding up the transition towards self-driving cars and a self-driving public transport system that will be able to offer flexible and on-demand solutions.

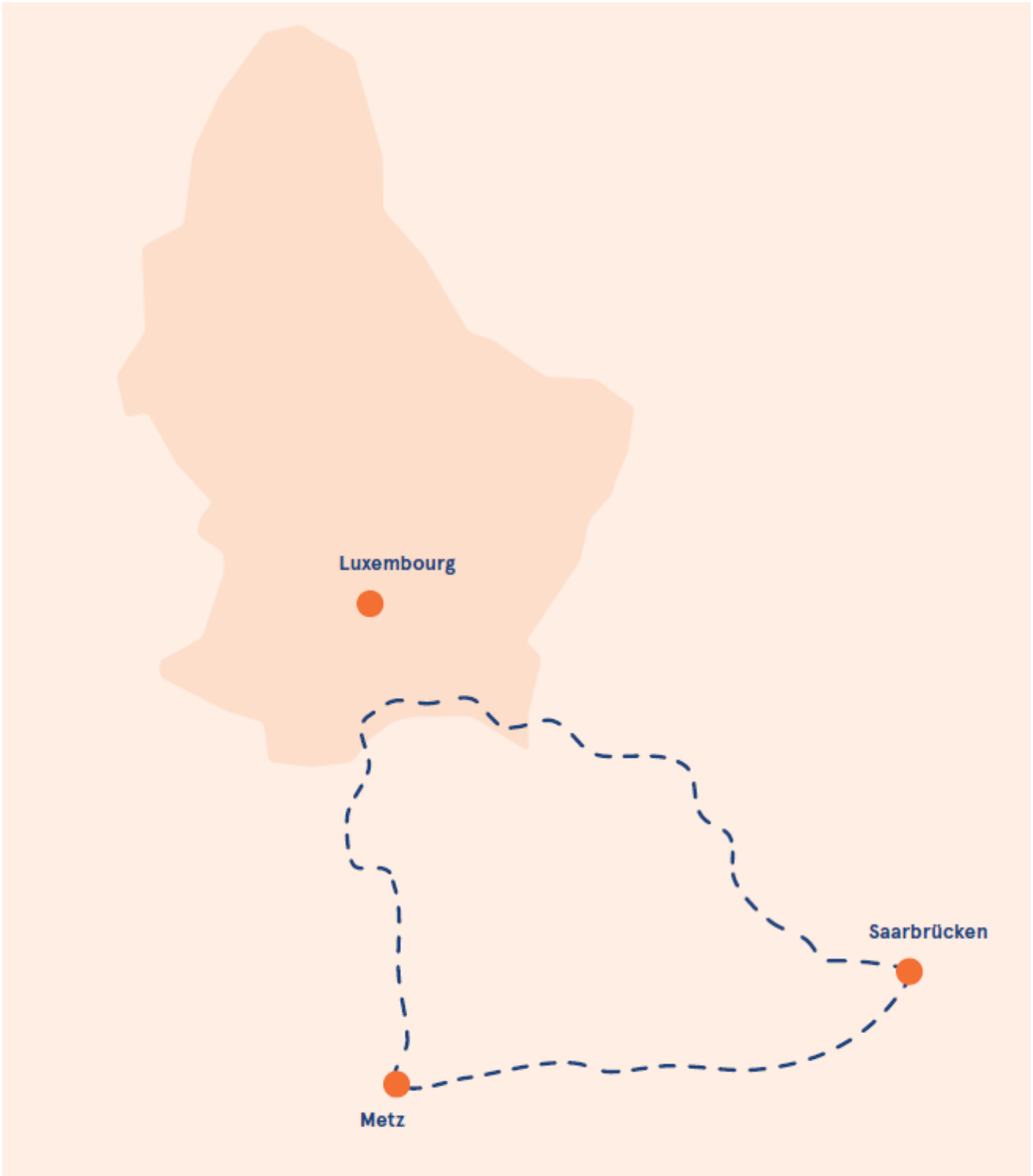
www.troisiemerevolutionindustrielle.lu

Self-driving commuter bus in Sion (Navya)

Digital pilot site in France-Germany-Luxembourg

In September 2017, the Government signed an agreement with France and Germany to test connected and self-driving vehicles in real road settings. The objective of this cross-border circuit is to promote the development and experimenting with automated driving technologies for the purpose of smart transport systems and electric mobility. The initial tests will take place in the second semester of 2018.

Digital testing site in France-Germany-Luxembourg
(MDDI, 2018)



Chapter 5

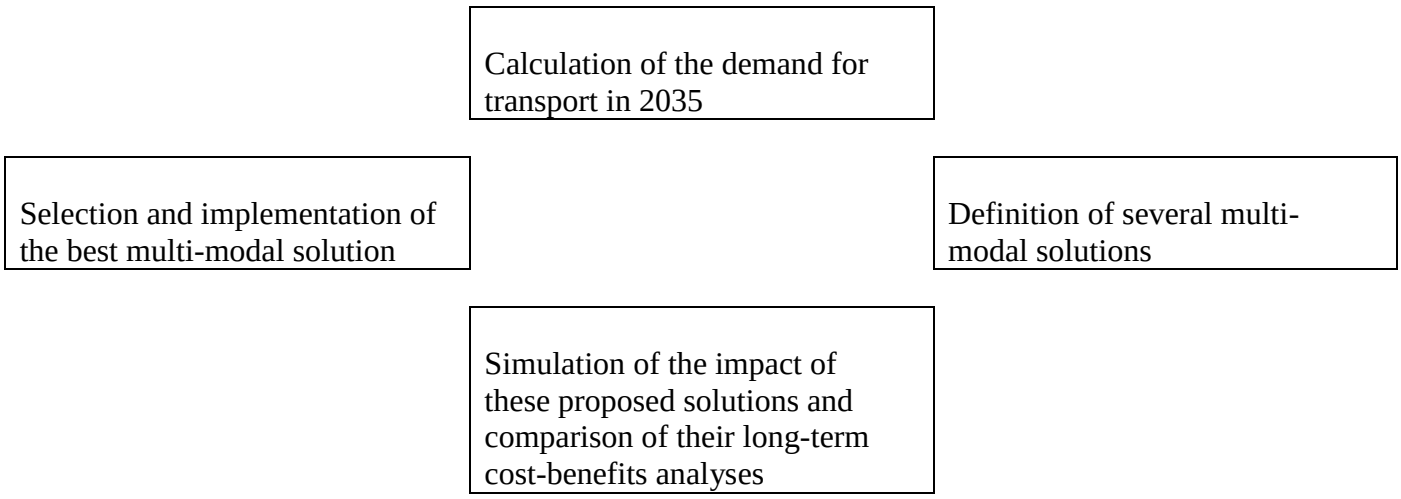
HORIZON 2035

Demographic projections and the ten to fifteen years required to implement the large-scale infrastructure projects mean that ideally, a coherent solution should be proposed as soon as 2020 for mobility in 2035. This solution will be drafted based the projected demand, spatial planning objectives, and comparisons between the various options depending on their long-term costs and benefits. A strategy for 2035 can only be sustainable if it mobilises all 4 mobility players and makes use of the entire mobility toolbox.

We want to declare:
“If all 4 mobility players join hands to implement a defined set of measures by 2035, the mobility supply in Luxembourg will include good transport networks, infrastructures, capacity, connections and trip durations at peak times.”

THE APPROACH

In order to ensure that the mobility supply in 2035 is both coherent and appealing to users, the transport and infrastructure supply must meet the predicted needs of the transported individuals.



What are the alternatives to a multi-modal approach based on the analysis of the projected demand?

The best alternative will be an iterative process that will consist of rethinking the bottlenecks. After solutions to these bottlenecks have been found, the impact on the transport networks will be examined. Following this study, construction works will begin on the next bottleneck. This approach could be described as **eliminating traffic jams by means of building sites**. This is not particularly satisfactory to users, because the mobility supply will always be one step behind the demand.

Another alternative would be to simply increase the capacity of all the existing infrastructures and finding the mobility solution for the future this way. This approach could be described as the **reproduction of current problems on a larger scale**. This would prolong the duration of the current modal shares. It would mean that the future generations will have to cover high maintenance costs.

TOOLS FOR THE STRATEGIC MOBILITY PLAN

The implementation of the approach for 2035 requires instruments that are currently being developed by the Ministry of Sustainable Development and Infrastructure.

Coordination
The team at the Directorate for Mobility Planning at the Ministry of Sustainable Development and Infrastructure has been strengthened.

Long-term cost-benefits analysis of rail and road traffic projects
The first version of a tool set up specifically for Luxembourg will be ready by the summer of 2018.

Simulation of potential scenarios and solutions
The data provided by Luxmobil have permitted the update of the of the IT model at the Model Transport Department ("Cellule Modèle de Transport") and the development of a second model that will cover the entire Greater Region (MMUST).

Data on the current and predicted mobility needs
The Luxmobil survey carried out in 2017 collected representative data on the behaviour and needs of residents and cross-border workers in terms of mobility (for the first time since 1997).

Some principles for mobility planning

- At peak times and in bottlenecks, the aim is to improve the passage of a maximum number of passengers, not necessarily vehicles.
- It is important to think of the user's position when conceiving a public transport system, cycling paths, public spaces, etc.
- Express buses or trains that stop at secondary stops should not be named "express".
- The solution to a problem can sometimes be found at a different location of the transport network.
- The first transfer from one means of transport to another must represent added value to the user. The second and third transfer will take the form of car traffic.

EXAMPLE:
THE ESCH-SUR-ALZETTE TO LUXEMBOURG CITY CORRIDOR

The analysis of a first transport corridor along the A4 motorway between Esch-sur-Alzette and Luxembourg City is being analysed for 2035.

1. Status quo

- This is a corridor that connects the two largest urban areas in the country, known as Agglo LUX and Agglo SUD.
- Due to the off-centred location of stops and the detour via Bettembourg, the CFL's line 60 is no longer competitive compared to the car for a number of connections that will be important in 2035, such as the connections between the areas north of Esch and the South-West of the capital, two sectors that are likely to develop significantly.
- In 2018, at peak times, a bus circulates approximately every three minutes on the A4 for a total of 5,500 passengers a day. Every day, buses are trapped in traffic jams with cars.

2. Demand in 2035

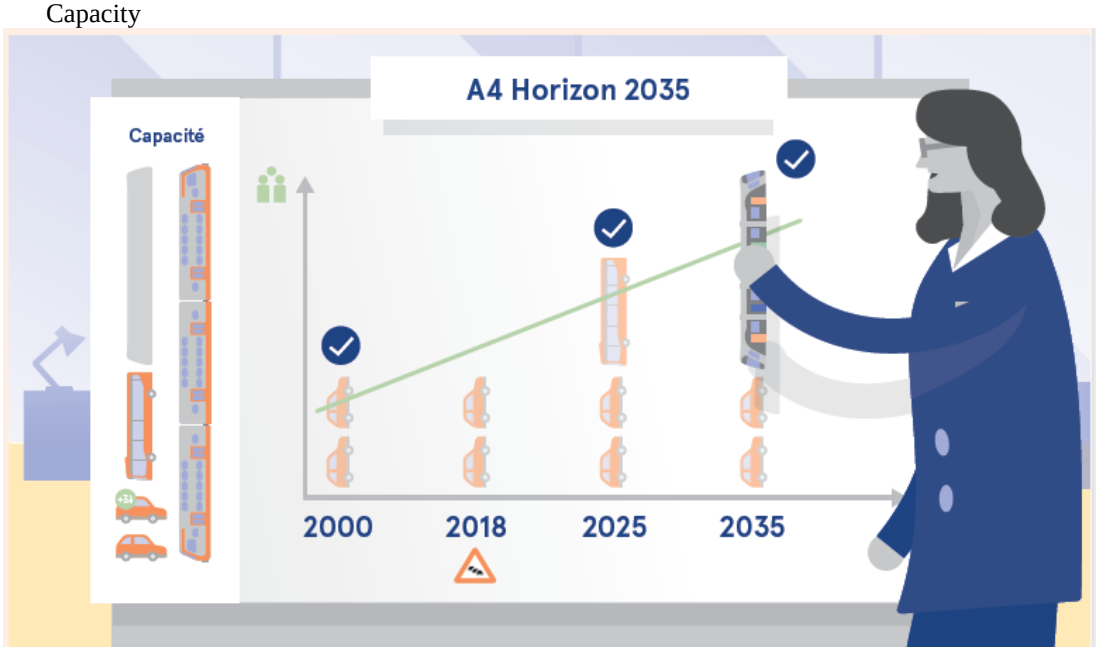
- Even if 15,000 additional passengers used the CFL's line 60 and 10,000 additional passengers carpooled on the A4, at least another 15,000 trips would have to be transferred to public transport and to the express cycling paths along the A4. (This calculation is based on Statec's scenario of average growth.)
- In order to encourage this high number of passengers to use public transport along the A4, the fastest connection possible will have to be implemented, ideally directly to Kirchberg, with the possibility to reach other popular destinations in the capital by means of one transfer only.

3. Limitations and opportunities

- The bottleneck formed by the Natura 2000 bird protection zone on the level of the plateau of Leidelengerbësch will probably have a strong impact on the chosen modes.
- In Luxembourg City, the projects for the Boulevard de Cessange and Boulevard de Merl will permit the extension of the artery on a site of its own and provide access to the new neighbourhoods.
- A separate bus lane that is already being planned for the interchanges of Lankelz and Foetz will help transfer part of the diffuse demand on a likely interchange in Foetz.
- Urban planning for the industrial areas of Esch-Schifflange could be structured by means of an effective transport mode.

The A4 until 2035

Capacity



Choice of the mode of public transport that should be added to the two lanes on the A4 to meet the population's projected demand for transport (green light) by 2035. (MDDI, 2018)

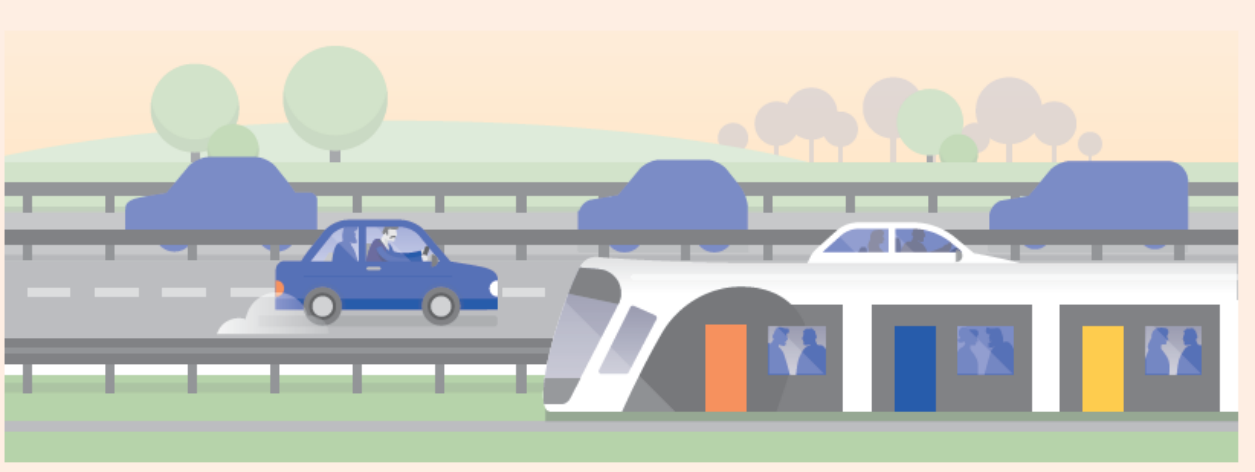
4. Choice of the main mode of transport

Three alternatives have been examined to reach the minimum target of 30,000 trips per day in both directions:

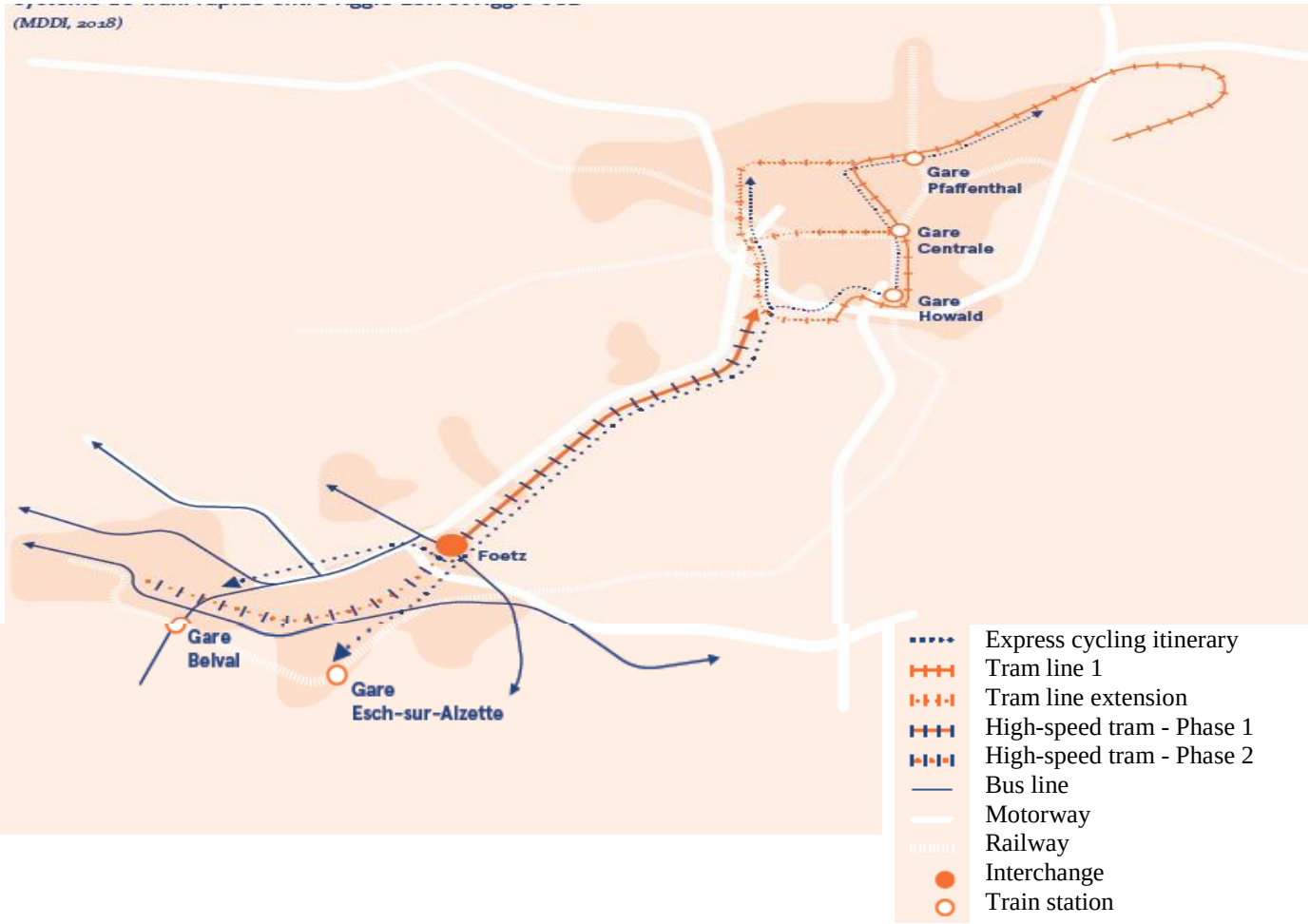
- A separate lane for buses on the A4 would not reach the required capacity by 2035 and will only appeal to users if a very high number of buses drove directly to the popular destinations of the capital, which is not in line with Luxembourg's transport policy.

- An underground line or a monorail would be excessive for the demand. Moreover, the number of passengers transported would be lower than that transported by a road system. Indeed, an underground system or a system on pillars would not be able to travel to all the popular destinations of the two urban areas.

- The construction of a high-speed tram line could provide transport to the urban areas on both ends of the corridor and its speed (approx. 100 km/h) would be high enough along the A4 corridor to be appealing to users. The exterior rolling stock could be the same as that of a purely urban tram, the only difference being the engine and the brakes. This system would provide sufficient capacity and could be integrated into the Luxembourg City tram network. On the southern end of the corridor, it would allow access to the main developing areas (industrial areas in Esch-Schifflange, Lallange, Belval, etc.), provide direct and fast links to Luxembourg City and act as a structuring axis for part of Agglo SUD, which has the highest demand for transport.



High-speed tram line between Agglo LUX and Agglo SUD
(MDDI, 2018)



5. Selection of the multi-modal concept and planning

A plan in the form of phases will provide a medium-term solution before the high-speed tram is launched (by 2035).

- **Medium-term:** Transport links will be provided by means of several higher-capacity bus lines that will connect several centres in the South of the country and the cross-border areas to two or three terminals in Luxembourg City. The possibility of transferring from one line to another in the Esch-sur-Alzette area must be offered to increase the number of links between locations of origin and destination. These lines will benefit from special infrastructures for buses planned for the sections between the interchanges of Lankelz and Foetz, along with other potential priority measures between Foetz and Leudelange. In addition, an express cycling path network will be developed, connecting Belval, Esch and Schifflange to the cycling paths in Luxembourg City, Hollerich and the Cloche d'Or. Due to the bottlenecks in the urban areas and environmental restrictions, namely between Foetz and Leudelange, the layout and size of the high-speed tram infrastructure must be taken into consideration at all stages of the medium-term plan.

- **By 2035** the high-speed tram will link Belval to the industrial zones around Esch-Schifflange as well as to Luxembourg City. Certain details and the location of the connection hub in Luxembourg City will have to be specified depending on the stages of development of the tram network and operative constraints. In order to guarantee the access of the high-speed tram to other locations, an interchange will have to be planned in the area of Foetz to allow the main bus lines to connect with slower bus lines in the urban area of Esch. This way, transport will be faster. To reach this aim, the bus lanes on the A4 between Lankelz and Foetz will still be required.

Impact

The introduction of this highly effective multi-modal concept linking the two main urban centres of the country will create a structuring transport axis.
The perspective of implementing the system will allow a more organised and harmonised form of development across the territory in the years to come. Traffic problems as those known since 2018 and that are related to the demographic and economic growth in those two areas will gradually lessen over time. According to the operation plans for the tram network, important direct connections can be set up, e.g. CHEM - CHL, Uni Belval - Uni Kirchberg, Esch-sur-Alzette - Findel, etc.

What does the future hold?

This analysis of the Esch-sur-Alzette to Luxembourg City corridor represents the first piece of the puzzle that the MDDI has been working on for the whole country. The final objective is to conceive a coherent multi-modal concept for mobility in Luxembourg and the neighbouring regions by 2035.

THE TRAM NETWORK

In the urban area of Luxembourg City, large-scale urban development over the upcoming decades will permit the interlinking of the tram network, thus offering direct links that will not have to pass through the central tram axis between the Central Station and the Hamilius road terminal. The full railway triangle at Place de l'Etoile will be key to the network.

Stages for the extension of the tram network

- The line 1 between Cloche d'Or and Findel is already being planned and construction has been launched.
- Central Station - Porte de Hollerich, for the new neighbourhoods.
- Links to the future residential area in Kirchberg (Kuebebierg).
- Extension to the office areas of Kalchesbruck (N1) from the airport.
- Place de l'Etoile - Centre Hospitalier de Luxembourg (CHL), if there is sufficient room for two tram tracks and for an extension to Kirchberg.
- Linkage of the tram network via the future Boulevards de Merl and Cessange, ensuring a connection to the high-speed tram from Esch and connections between the Cloche d'Or, the Porte de Hollerich and the CHL (Route d'Arlon).
- An effective public transport system must be designed in order to transport passengers from the CFL's line 30 (Wasserbillig) to the interchange in Héienhaff (Findel).
- In view of a very long-term development of the transport system, a corridor will be reserved for an extension between the CHL and the CFL "Mamer Lycée" stop (Campus Tossebierg). At this stage, the constraints of a one-track tram line on this section (meaning fewer trams per hour and the elimination of a bus lane) mean that there would be a considerable degradation of the public transport supply for most users. In addition, a one-track tram line would make the rest of the network more vulnerable due to restrictive scheduling.

The limitations of the tram

Like any other form of transport, trams have their limitations:

- The cost of a tram network can only be justified if several tens of thousands of passengers use it a day.
- Because its commercial speed is 20 km/h within urban areas, express buses (with fewer stops) or connections to train lines would be more effective for longer distances.
- If the creation of the tram network were to be disadvantageous to a higher number of passengers (e.g. those who had access to direct bus lines) than those who benefit from it, it will be likely to increase private motorised traffic instead of increasing the use of public transport.

Potential tram network in 2035
(MDDI, 2018)

Line 1
Extension in the medium term
Extension in the long term
Esch – Luxembourg connection
Potential future extension
Connection to public transport (to be determined)
Railway
Motorway
Interchange
Long-term development potential
Ongoing / Planned development
Current urban development
Railway triangle

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