SMART MOBILITY

Multimodal and connected mobility solutions for the cities of today and tomorrow
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Making decisions about the future mobility today

Belgium has ground to a halt. Congestion records are shattered year after year. Not only is this a nuisance, it also has a disastrous impact on our economy and health. But if we act today then we can turn the tide. Even faster than you might think.

Many users dream of smooth and personalised transport options. Smart mobility solutions can help us make this dream a reality. Digitalisation and technological evolutions create the right framework in which to develop efficient solutions and services. These will improve traffic flow, limit the impact on the environment, curb the risk of accidents and increase travel comfort.

This whitepaper reflects our global vision of mobility. Our main focus is passenger transport. A conscious choice as the transport of passengers and goods each come with their own set of challenges. That is why it is better initially to consider them separately.

Our horizon is 2040. We indicate the options available with today's technology and discuss how we think mobility will evolve in the mid and long term. We also outline how local governments and authorities can prepare for the future mobility today.

Enjoy your read!

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Mobility and transport are indispensable in our modern society. They are not only the backbone of the economy, we also need them for social activities – contact with friends and family, sports, education and recreation. On the other hand mobility also has a negative impact on our society, the environment and our health. This document examines the main trends and challenges involving mobility.

1 Mobility in Belgium: trends and challenges

Mobility and transport are indispensable in our modern society. They are not only the backbone of the economy, we also need them for social activities – contact with friends and family, sports, education and recreation. On the other hand mobility also has a negative impact on our society, the environment and our health. This document examines the main trends and challenges involving mobility.

01 Urbanisation
Belgium is one of the most urbanised areas in the world. People are flocking to the cities and peripheral urbanisation is also on the rise. By 2030 the number of people living in city centres will increase by a further 10 to 30%. Not only does this create socio-economic and ecological problems for cities but increasing urban density also puts pressure on mobility.

02 Growing passenger transport
If we don’t change our policy, the Federal Planning Bureau has calculated that the demand for passenger transport will rise by 11% by 2030. The car is still the primary mode of people transport – accounting for 82% of all passenger kilometres – whereas their average occupancy rate is dropping. With the exception of the bus, the total number of passenger kilometres for other modes of transport will also increase.

03 Growing goods transport
What goes for people also applies to goods. The Federal Planning Bureau expects the number of tonne kilometres to take a 44% leap by 2030. Despite the partial shift of tonne kilometres to inland waterways and rail, delivery vans and trucks continue to dominate the goods transport scene with 70% of all tonne kilometres.

04 Smoother traffic
Last year we spent more time queueing up in rush hour traffic than the year before. The congestion barometer of Belgian national traffic information provider Touring Mobilis showed that tailbacks are not only getting longer; more and more often they also stretch beyond traditional rush hours. Because our motorways are saturated, traffic intensity on secondary roads is also on the rise. Needless to say this has a huge economic impact on our businesses.

05 Improved air quality
More traffic means more air pollution and, unfortunately, higher premature mortality. The main problems in Flanders are the high concentrations of ozone and fine dust but also nitrogen and sulphur dioxide in many places. In the Brussels-Capital Region the exposure to black carbon (soot) in traffic is the biggest problem. As yet, no norms are being exceeded in Wallonia.

06 Improved road safety
Although the number of injured road accident victims is dropping, the numbers are still high in absolute terms: more than 100 victims per day. The number of road fatalities is also diminishing but with 620 casualties in 2017 the 2020 goal of 420 fatalities per year is still a long way off. Cyclists and pedestrians are particularly vulnerable: in 2017 road accidents claimed the lives of 105 cyclists and pedestrians.
Our mobility challenges: some striking figures

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<tr>
<th>Year</th>
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<th>2017</th>
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| Hours of tailbacks | 854 | 1400 | 15 | 0.3 | 80% more traffic jams of 100 km¹
| Hours of tailbacks | 800% more traffic jams of 400 km¹

- €100 million: Tailbacks are costing businesses some €100 million per year²

- +11%: The number of passenger kilometres in Belgium will increase by 11% by 2030¹
- +44%: The number of tonne kilometres in Belgium will increase by 44% by 2030¹
- -24%: The average speed on Belgian roads will drop by 24% by 2030 during rush hour periods and by 10% during off-peak hours²

Premature mortality in Belgium due to air pollution (in 2017)⁴

- 8,340 caused by fine dust exposure
- 1,870 caused by exposure to nitrogen dioxide
- 190 caused by exposure to ozone

Number of road fatalities per million inhabitants (in 2017)⁵

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<td>European average</td>
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The drivers of our future smart mobility

Technology is the cornerstone of a successful mobility transformation. Smart infrastructure and smart vehicles further reduce the number of road accident victims, clean and energy-efficient technologies improve air quality and new mobility services reduce traffic congestions. But non-technological factors are also important: users and governments need to get on board.

Digital technology is the main driver behind the transformation of the mobility landscape. Today mobility data are available from various sources: cameras, sensors embedded in the road infrastructure, drones, smartphones, social media and vehicles. Collating these data creates new opportunities: thanks to real-time data we can improve the flow of traffic and better gear the different modes of transport to each other. The exchange of data allows for the creation of a full-fledged, seamless and multimodal transport system that groups all modes of transport and makes efficient passenger transport possible from door to door.

Artificial intelligence (AI) will be at the core of smart mobility. AI is the driving force behind self-propelled vehicles. It eliminates the risk of human failure and makes for smoother traffic. Artificial intelligence is also used to operate smart traffic lights and smart street lighting in city centres based on traffic volume and/or transport type.

Road transport still accounts for the lion’s share of CO₂ emissions in the transport industry (72.8% in 2017). The European climate agreement stipulates that transport must be decarbonised i.e. abandoning modes of transport that utilise fossil fuels and replacing them with means of transport based on renewable energy. In the years to come, stricter emission standards, a lower battery cost, more charging stations and a growing popularity among users will force a breakthrough for (plug-in) hybrids and fully electric vehicles. This electrification, which today is mainly situated in an urban context, promotes two main goals: zero emission and zero energy waste.

Source: European Energy Agency
The electric car: waiting for the final breakthrough

In 2017 fully electric vehicles (battery electric vehicles or BEVs) accounted for a negligible share of the total sales volume in Belgium (0.49%). This percentage is significantly lower than in our neighbouring countries. For instance, last year the Netherlands witnessed a shift from plug-in hybrids to BEVs. In 2017 Norway was the European leader in terms of the sale of BEVs (58.47%). In 2017, a total of 135,369 fully electric vehicles were registered across Europe, or 0.9% of the total European vehicle fleet.

Many cars sit unused 95% of the time. As a result, the principle of sharing modes of transport is gradually becoming more widespread. It avoids empty and stationary vehicles and transport costs are kept to a minimum – users only pay when they actually use a car. Moreover, digital technology is making the sharing of cars, bicycles and other modes of transport progressively easier. The rise of electric and connected vehicles will revolutionise the sharing economy. Research with Lisbon as a model shows that traffic congestions dissipate, emissions are reduced by 1/3 and just 3% of the vehicle fleet is necessary to fulfill the city’s transport needs.

Still, technology alone isn’t enough: we also need a change in mentality. In concrete terms, we must avoid unnecessary travel and select the right mode of transport when we do need to go somewhere. Trends such as the New Way of Working also illustrate that things are changing in this regard as well. We work from home, we organise video conferences instead of driving halfway across the country for a meeting or we use a co-working space nearby. The flexible mobility budget provides added motivation to adapt our behaviour in terms of mobility.

Sources: European Automobile Manufacturers’ Association (ACEA), European Alternative Fuels Observatory (EAFO), Eurostat, Rijksdienst voor Ondernemend Nederland, Statistics Norway, Agoria

<table>
<thead>
<tr>
<th>Country</th>
<th>Number of BEVs</th>
<th>Percentage</th>
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<tr>
<td>Norway</td>
<td>33,025</td>
<td>58.47%</td>
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<tr>
<td>Belgium</td>
<td>2,709</td>
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<td>The Netherlands</td>
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</tr>
<tr>
<td>Germany</td>
<td>25,056</td>
<td>0.73%</td>
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</table>

Number of battery electric vehicles (BEVs) registered in 2017 (percentages in relation to the total no. of vehicles)
Smart mobility requires an overall long-term vision

Smart mobility is all about facilitating the optimal mode of transport in relation to the need and the context – both in time and in space. In order to create such a comfortable and user-friendly mobility landscape, a long-term vision and continuous investment are indispensable. Below we have detailed our vision from today until 2040.

Towards the mobility of the future in three steps

Urban accessibility can often be improved dramatically through smart mobility. Still, the true impact on mobility will only become clear when various trends merge. Digitalising the existing road infrastructure, investing in new infrastructure, promoting alternative modes of transport, facilitating sharing systems, offering a platform where users can put together a custom-tailored itinerary, the use of connected vehicles... These are all steps on the way to the ideal mobility landscape in which we are no longer vehicle owners but users of a mobility concept. Mobility-as-a-Service (MaaS) is constantly evolving and is gaining in complexity as the smart infrastructure and data become available.

Since this process takes time, our vision targets the year 2040. Although this may seem a long way off the transformation of cities and municipalities is already underway. Together with regional and federal governments they must invest in smart infrastructure and take part in data platforms today.
The three objectives of smart mobility
The true impact on mobility will only become clear when the various solutions meet. Our vision encompasses three main objectives.

**Improved accessibility**
We travel efficiently and waste less time (or gain time) in transit.

**Lower environmental impact**
Our noxious emissions (CO₂, NOx, fine dust) are reduced and air quality improves which, in turn, benefits our health.

**Improved road safety**
The number of traffic fatalities is reduced to zero by 2050 in accordance with the EU’s ‘Vision Zero’ objective.

Want to know more about data?
Download our whitepaper ‘Data, the cornerstone for cities and municipalities of tomorrow’ at www.agoria.be

Smart mobility: some points of concern

**Need for open and real-time data**
Traffic cameras, GPS systems, transport companies... Relevant mobility data comes from everywhere, both from public and private players as well as from civilians. To be able to use them to maximum advantage, these data must be open and available in real time – both for governments and users. For example:

- **Governments** can improve traffic flow: smart traffic lights, dynamic speed limits, etc.
- **Travellers** can optimise their trip: mode of transport, route, departure time, etc.

**Protection of personal data**
The GDPR (General Data Protection Regulation) requires organisations to establish an inventory of their data – including camera images – and protect them through appropriate technical and organisational measures. They must also develop procedures enabling them to track down data leaks and report them to the Privacy Commission.

**Cyber security, more than ever a priority**
The more connected systems are part of the mobility infrastructure, the greater the importance of cyber security. It is important that local governments include ‘security by design’ in the specifications of public tenders.
Urban and regional areas benefit from an improved traffic flow. Modern information and communication technologies, both on the side of the road and in vehicles, help to achieve this goal. We have used several concrete examples to illustrate what smart infrastructure cities and municipalities can implement today.

**The basis: Intelligent Transport Systems (ITS)**

The implementation of information and communication technologies in vehicles and road infrastructure to make traffic safer, more efficient, more reliable, more comfortable and more environmentally friendly is indicated through the collective term Intelligent Transport Systems (ITS). Today quite a few ITS are available that are geared to improving mobility, both within and outside the city. These systems are constantly evolving and becoming more intelligent.

**What Intelligent Transport Systems are available today?**

**Smart traffic management systems for all modes of transport**
- Smart traffic lights
- Smart parking systems
- Sharing system infrastructure
- Dynamic speed limits
- Dynamic route selection
- Smart toll collection system

**Other smart infrastructure with a significant impact on efficient and safe transport**
- Cycle superhighways
- Smart charging infrastructure: electric charging stations with real-time information on availability
- Smart lighting: smart public lighting infrastructure with cameras and sensors that direct the flow of traffic

Want to know more about smart lighting?
Download our whitepaper ‘Smart public exterior lighting for the city of tomorrow’ at [www.agoria.be](http://www.agoria.be)
Smart traffic lights

Smart traffic lights direct traffic based on the actual traffic situation: in the city centre, at busy intersections and on arterial roads. These intelligent traffic control systems have a positive effect on travel time, safety and emissions. The evolution in available technology is resulting in ever more intelligent control systems.

Rigid control
- Fixed green light times, possibly geared to the time of day or specific day
- No detection of current traffic
- Most commonly used with traffic lights in Belgium

Mini dynamic control
- Green light times based on the traffic present at the intersection
- Detection based on inductive loops in the road surface
- Detection of a limited number of modes of transport: only vehicles, no cyclists or pedestrians

Dynamic control
- Green light times based on the traffic present at the intersection
- Detection based on multiple systems: loops, cameras, etc.
- Detection of all modes of transport: cars, public transport, cyclists, pedestrians, etc.
- The system takes account of priority traffic via a transmitter in emergency and public transport vehicles

Completely dynamic traffic management or ‘Talking Traffic’
- Green light times are adjusted entirely automatically based on oncoming traffic, current traffic density, etc.
- Traffic is directed from a central location through the use of artificial intelligence that factors in oncoming traffic (all modes of transport), current traffic density, current speeds, real-time data and historical data
- The system also takes account of priority traffic: emergency services, public transport, cyclists and pedestrians

New generation of traffic lights in Apeldoorn and Deventer

The cities of Apeldoorn and Deventer are testing traffic lights that ‘recognise’ which cars, cyclists and public transport is/are heading towards them. Based on the oncoming traffic, the intelligent traffic control systems adjust the traffic controls. For instance, cyclists get more frequent and longer green light times in bad weather and motorists are advised to maintain a certain speed to make the green light. Curbing emissions and limiting unnecessary stop & go alleviates the pressure on cities.

Source: city of Apeldoorn
Traffic lights in Copenhagen give right of way to buses and cyclists

Copenhagen has taken things a step further than Brussels. The city installed 380 smart traffic lights equipped with artificial intelligence. The system automatically favours public transport and cyclists. The aim is to cut the travel time of buses by 20% and that of cyclists by 10%. Buses that are running behind schedule get 30 additional seconds of green light whereas cyclists benefit from ‘green waves’. The traffic lights along certain cycle paths are set in such a way that cyclists who maintain a speed of 19 km/h are never stopped by a red light.

Improved traffic flow on 17 Brussels traffic axes

In Brussels the traffic lights along the inner ring road (Kleine Ring) have been geared to each other. Based on scenarios they are directed via a central traffic computer: the settings in the morning are different from those during the day and in the evening, and they are different on weekdays as opposed to over weekends. Every scenario can be adjusted in real time and specific scenarios are also included e.g. for European summits. All data is available via opendatastore.brussels.
Smart parking systems

Smart parking systems detect whether or not a particular parking space is available. This can be done via a sensor in the ground but also with cameras mounted on poles, buildings or vehicles. The collected data is applied in real time. A dedicated app or digital info screens along the road point motorists towards free parking spaces. They can head straight for them, thereby easing congestion in the city centre.

30% of city traffic is generated by looking for a parking space
10 min is the average time needed to find a parking space in a city
4.5 km is the average distance motorists cover before finding a parking space in a city

Smart parking technologies also open the door for new applications:

- Motorists can be notified when their purchased time is about to expire
- Cities can act faster in case of parking violations that endanger public safety
- Shop owners can pay for their customers’ parking space as an extra service

Shop & Drive parking spaces in Liège

Since 2018 the centre of Liège boasts 223 Shop & Drive parking spaces. Motorists and suppliers can park there free of charge for 30 minutes. They don’t have to buy a parking ticket, send a text or place a parking disc behind the windshield: sensors keep the time. If the parking space is not vacated on time then a parking attendant is notified. Violations are sanctioned. The system was adopted following the example of Kortrijk, where it was introduced in 2014 as ‘Shop & Go’. Other cities have also adopted this innovative parking system.

Scan scooter with ANPR cameras in Bruges

In Bruges there’s a scan scooter that goes around registering the license plates of parked vehicles. Every license plate is compared to a database containing the license plates of local residents and cars with a valid parking ticket. When a scanned license plate isn’t found in the database, a parking attendant is notified and he/she can check whether the vehicle is parked legally. Other cities and municipalities use similar vehicles e.g. Schaarbeek, Charleroi and La Louvière.

Sources: city of Liège and city of Bruges
Cycling infrastructure

The bicycle plays a prominent role in the mobility of the future. This calls for an attractive, safe and efficient cycling infrastructure – not just in city centres but also between cities. And precisely this aspect is often a concern: 58% of cycle paths in Flanders, for instance, no longer meet the requirements in terms of width, coating, comfort and safety as stipulated in the official cycling handbook.

Policy makers in Utrecht are of the opinion that walking and cycling are the city’s main modes of transport. The action plan ‘We All Cycle’ sums up the city’s ambition to become a world-class bicycle city. People of all ages must be able to cycle safely there. The ultimate goal is to double the number of cycling commuters between 2011 and 2030.

If we want the bicycle to be seen as a valid alternative to cars then the infrastructure should be treated accordingly.

This is already possible today:

- **Bicycle guidance**, such as digital message signs showing cyclists the way
- **Cycle streets** where cyclists have right of way over cars
- **Cycle superhighways** to cover longer distances at a constant speed
- **Secure bicycle parkings**, possibly with an app to book a slot
- **Secure neighbourhood bicycle parkings**

In addition, several innovative applications are also available:

- **Heated cycle paths** that no longer need to be cleared of snow
- **Green waves** with LED lighting indicating whether cyclists have to accelerate or slow down to avoid a red light
- **A cycling app** that turns the light to green as the cyclist approaches the traffic lights

Sources: 1. Agentschap Wegen & Verkeer (Agency for Roads and Traffic) 2. Fietsberaad Vlaanderen

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Utrecht, a biker’s Walhalla

Policy makers in Utrecht are of the opinion that walking and cycling are the city’s main modes of transport. The action plan ‘We All Cycle’ sums up the city’s ambition to become a world-class bicycle city. People of all ages must be able to cycle safely there. The ultimate goal is to double the number of cycling commuters between 2011 and 2030.

**Bicycle guidance**

Bicycle guidance systems indicate how many spaces are available in any given bicycle parking lot.

**Cycle superhighways**

Cycle superhighways make it easy for cyclists to cover longer distances.

**Parking spaces**

Every minute, a single optical sensor per sixty parking spaces registers which parking spaces are free.

Sources: city of Utrecht and municipality of Ede
Smart and frost-free cycle path in Ede

The frost-free, smart cycle path in Ede keeps itself from icing over, eliminating slippery conditions and the environmental damage caused by road salt. The system communicates with the weather prediction to be able to function autonomously. Moreover, it is energy efficient because it uses residual heat from the return pipe of the green heat network of Warmtebedrijf Ede.

Cykelslangen, an architectural masterpiece for cyclists in Copenhagen

In 2014 Copenhagen inaugurated one of the most memorable cycling infrastructures in the world. ‘Cykelslangen’, Danish for inner tube, is a cycle superhighway over four metres wide and 200 metres long. Part of this two-lane cycle path curves up and over the water – in places floating more than five metres in the air – as it bridges a shopping area in the port of Copenhagen. Rising satisfaction scores (from 82% in 2006 to 98% in 2014) with regard to the cycling infrastructure in Copenhagen illustrate that continuous investments in cycling infrastructure pay off.

Source: city of Copenhagen
Vehicles are getting smarter and smarter. They contain more and more technology that enables us to monitor our environment: a central computer, cameras, sensors, laser scanners and connectivity.

**From smart to connected vehicles**

A distinction is made between smart and connected vehicles. Today we have smart vehicles: the vehicle makes a decision based on the input of its own cameras or sensors. For instance, a self-parking car uses sensors and cameras to park automatically, sensors enable a car with adaptive cruise control to maintain a safe distance to the car in front and a city shuttle brakes automatically when a child unexpectedly pops up in front of the vehicle.

These are the first steps toward connected and autonomous vehicles. A connected vehicle communicates and exchanges real-time information with another vehicle (Vehicle-to-Vehicle or V2V), the road infrastructure (Vehicle-to-Infrastructure or V2I) and individuals (Vehicle-to-Person or V2P). The eCall functionality is a simple example of V2P; a car that can communicate with traffic lights is a fine example of V2I.

**Toward the Vehicle-to-Everything world (V2X)**

Intelligent Transport Systems (ITS) will evolve into Cooperative Intelligent Transport Systems (C-ITS). ITS supply the digital technology for the car and the road infrastructure whereas C-ITS provides the communication between the systems: a vehicle with another vehicle, the infrastructure, a person or with another C-ITS system. This cooperative aspect will greatly enhance traffic safety, traffic efficiency and travel comfort.

These applications will continue to develop in the years to come. We estimate that by 2030 vehicles will be able to take account of everything and everyone along the road (Vehicle-to-Everything or V2X) and drive autonomously. This is only possible if the road infrastructure evolves in tandem: accurate digital maps, completely dynamic traffic management, connectivity (5G and others), mobility data platforms with accurate and real-time information, etc.
**Autonomous cars**

When smart vehicles are coupled with smart infrastructure the door towards autonomous driving swings wide open. Although vehicles can already drive autonomously today – on specific roads and along routes calculated in advance – it will take another ten to fifteen years before we can fully benefit from the advantages offered by completely autonomous vehicles. The evolution takes place on several levels.

- **Not autonomous**
  The car can issue warnings but autonomy is out of the question. The driver drives the car.

- **Driver assistance**
  The car can perform partial tasks, such as steering, braking or accelerating. The driver is still the main factor.

- **Partially autonomous (2018)**
  The car can steer, brake and accelerate autonomously. The driver still has to keep an eye on things and intervene when necessary.

- **Conditionally autonomous (2021)**
  The car drives autonomously in every situation with the exception of particularly bad weather. The driver can even take a nap.

- **Largely autonomous (2025)**
  The car drives autonomously in every situation with the exception of particularly bad weather. The driver can even take a nap.

- **Fully autonomous (2030)**
  The ultimate self-driving vehicle: it drives fully autonomously and adjusts to every situation, even emergency situations.
Self-driving city shuttles

A trend that is emerging in metropolitan areas worldwide are self-driving shuttle buses. Projects involving autonomous city shuttles are currently being rolled out in a number of countries including Australia, the US, China, Japan, France, Germany, Sweden and Switzerland. Initially they stuck to low-risk routes but meantime they have ventured into everyday city traffic.

Autonomous public transport

The idea to automate public transport is not new: self-driving underground trains have been around for over 30 years. However, the advent of new technologies is increasing the degree of automation in public transport. Just think of autonomous city shuttles but also buses and trains. In Brussels, for instance, tests are being carried out to automate train traffic along the North-South connection, which would make it possible to increase the frequency on these saturated lines.

Autonomous driving is not the answer to everything

If everyone leaves the office at the same time we’ll still be queueing up in our self-driving cars. That is why we have to keep investing in other forms of mobility (such as public transport, bicycles and sharing systems) and in the shift of an owner mentality to a user mentality.

EasyMile EZ10 is a marked presence on Stockholm streets

Since January 2018, two EasyMile EZ10s can be seen driving around the Swedish capital of Stockholm. These driverless shuttle buses drive around the capital fully autonomously, interacting with cars, bicycles and pedestrians. They shuttle back and forth between the Kista Galleria shopping mall and the Scandic Victoria Tower between 7 am and 6 pm.

Brussels Airport and Flemish transport company De Lijn are experimenting with a self-driving bus

Brussels Airport and De Lijn have given the go-ahead for a trial project with a self-driving electric bus on the airport grounds. Early 2020 the shuttle will conduct test drives at the airport. If all goes well, passengers and staff will be able to hitch a ride between the terminal and Brucargo air freight as of mid-2021.

Sources: city of Stockholm and Brussels Airport
Mobility hubs are a logical next step in the evolution of smart infrastructure. They are becoming true hotspots, places where work, living, shopping, recreation and, especially, mobility come together. We have to kick into gear now if we want these hubs to be a reality by 2040.

**Mobility in 2040: smart multimodal mobility hubs**

Mobility hubs are much more than that:
- They are also **energy hubs**. They house automated charging stations for electric vehicles (such as fast chargers for 6-minute top-ups), they have charging systems for e-bikes, scooters and city shuttles, they are fitted with solar panels and energy storage systems, they recover the braking energy from trains, etc.
- In addition they are also developing into true **communication hubs**, with the connectivity required to handle all digital applications (5G, WiFi, narrowband), with interactive panels and MaaS applications (Mobility as a Service) that help travellers plan, book and pay for their itinerary via a single platform.
- More even, they are turning into veritable **experience hubs**, where a critical mass of people work, live, shop and relax. These hubs breathe innovation and economy.

This means that future mobility systems demand a horizontal approach. Factoring in urban densification, the mobility strategy will be linked to the optimum use of energy, space and economy. Cities and municipalities are not stand-alone systems, rather they are linked to a broader regional, national and international mobility network.

**Mobility, energy, communication and experience come together**

Typical for mobility hubs is of course the **concentration of mobility services and the transfer possibilities**: public transport, city shuttles, bicycle sharing, scooter sharing, car sharing, the nearest electric vehicles, carpooling, inland waterway shuttles, bicycle parkings (monitored – reservations possible), electric charging systems, dynamic parking management systems, real-time travel information, real-time carpooling, microtransit services, parcel delivery, comfort and priority for cyclists and pedestrians, orientation and signposting, urban design implementations.
Different levels of mobility hubs

Depending on the space and the transit options there will be different kinds of mobility hubs:

- **Large hubs**: for long-distance travel and international transport (rail and aviation)
- **City level hubs**: for mid-distance travel e.g. between cities
- **Small hubs**: short trips from one municipality to another and to other hubs
- **District hubs or rural hubs**: for local travel

Source: Office of Walloon minister Di Antonio

En route to the first mobility hubs in Belgium

In Flanders transport company De Lijn is conducting a strategic exercise on the future organisation of depots and mobility hubs. The first pilot project will be launched in Mechelen.

The depot there will become a hub including:

- Charging infrastructure for electric buses
- A transhipment centre for last mile logistics
- Car and bicycle sharing systems
- Housing above the depot
- Solar panels with an output of 288 Mwh

A map of Walloon mobility hubs

In Wallonia a work group is currently planning the geographical distribution of mobility hubs there. This is what the mobility hub network could look like in Wallonia.

A first look at the mobility hubs of tomorrow

Source: Office of Walloon minister Di Antonio
An extra dimension for the urban mobility landscape

The pressure on our available space is constantly increasing. To be able to handle all movements of persons within the city, additional space is created via a third dimension: the air. Various new technologies are being developed which, in time, will become part of the mobility hubs and of the range of available modes of transport and MaaS applications.

1. **SkyTran** is a rapid transit system based on magnetic levitation that reaches a top speed of 150 km/h and can transport 25,000 passengers an hour in an urban context.

2. **Pop.UP Next** is a passenger vehicle that can move both on the ground and through the air.

3. **Land Airbus** is a bus two lanes wide that moves above traffic with wheels underneath and rails on the sides. It has a top speed of 60 km/h and can transport up to 1,400 passengers.

4. **Octocopter** is an autonomous passenger drone that can transport one person at 100 km/h for 23 minutes.

5. **Volocopter** is an autonomous passenger drone that can transport two people over a distance of 27 km at 50 km/h.

6. **Hyperloop** is a transport system that transports passengers in reduced-pressure tubes. One capsule propels 10 to 20 people at speeds of up to 1,200 km/h.
In the future, smooth travel will require a multimodal system. To make travel appealing to users they must have easy and straightforward access to the various modes of transport and sharing systems. That means the creation of an all-in platform is indispensable and mobility as a service (MaaS) is becoming imperative.

**A single integrated platform**

The MaaS platform supports all multimodal movements through user-oriented information and travel services such as navigation, route planning, localisation, accessibility, bookings and payment. By integrating everything into a single platform the user can seamlessly utilise the various modes of transport, both public and private. Based on the user’s criteria the MaaS platform will formulate a proposal for the trip. These criteria include price, speed, comfort, accessibility and tourism. If incidents or unexpected events occur en route the platform will suggest a new alternative. Smartphones will play a crucial role in the communication between the user and the various actors.

New business models are blurring the strict lines between public and private mobility. Mobility-as-a-Service will encourage the public/private co-creation and joint offering of mobility systems, as well as the shared and open use of space, data and infrastructure. The evolution in infrastructure and vehicles goes hand in hand with the evolution in MaaS, which uses real-time data made available more frequently and efficiently via different sources.

**Evolving mobility**

Two important shifts are contributing to this new outlook on transport: the ever diversifying mobility offer on the one hand and the advent of new services and actors due to the liberalisation of the market on the other. Until recently the Belgian transport landscape consisted of public transport, taxis, buses and private means of transport such as cars and bicycles. Over the last few years, however, (private and public) services that complement the traditional modes of transport have boomed: bicycle and car sharing, carpooling, shared taxis, etc. We expect the liberalisation of the market to bolster this trend even more. The development of autonomous vehicles will even take us one step further by giving rise to a system of mobility on demand (Mobility on Demand or MoD).
MaaS: important conditions

1 Integration of modes of transport and payment

The different operators must conclude partnerships allowing travellers to use multiple modes of transport with a single ticket. In Brussels and the surrounding area the MTB (Metro-Tram-Bus) season ticket was introduced in the 70s so passengers could travel with the 4 leading public transport operators (MIVB, NMBS, TEC and De Lijn) within the Brussels-Capital Region. Payments are centralised via the MOBIB card, which also supports payment for modes of transport of other partners who have joined the agreement. With MaaS, though, we have to think one step further: an integrated season ticket giving users access to all modes of transport (public transport, bike and car sharing systems, charging stations, car parks, etc.). A central payment system will have to be set up to ensure easy payment. Smartphones will play a crucial role in this regard.

Travelling across the Île-de-France with the Navigo card

With the Navigo card and the corresponding one-week, one-month or one-year pass, travellers are free to use all modes of public transport within the 5 zones of Paris Île-de-France. Some providers of, amongst others, bike and car sharing systems have meanwhile also joined the Navigo system. Currently some 80 operators support the card. In 2019 a Navigo app will be introduced for which validation will go through the NFC smartphone chip.

Source: Navigo
Integrated mobility platform and open data

The creation of an integrated mobility platform is crucial to give travellers a transparent overview of the varied and ever-changing mobility options. It is absolutely essential to centralise accurate real-time data on the various public and private transport modes and to make them available to the general public. This is because the availability of data allows the different actors to develop multimodal route planners, offer the most efficient routes and develop new services.

Route planners are becoming increasingly intelligent: they integrate a growing number of transport modes, they take account of the present traffic situation, availability and delays, and they calculate the actual costs. To do this they not only need theoretical times but also actual times and the different rates or costs of the transport. This is the only way to keep users informed in real time via their smartphone or another smart device.

Governance by a transport authority

The final condition for a successful rollout of MaaS is good governance of the various public and private actors by a managing body that not only develops the strategy but also guarantees the operation and complementarity of the various modes of transport. Preferably it should also draw up an agreement as to the allocation of revenues and take care of all operational and technical aspects, as well as the data management for the central mobility platform. In addition, it is important that the managing body be able to administrate a sufficiently large geographical area. For instance, Transport for London manages an area that is larger than the administrative territory of London and Empresa Municipal de Transportes (EMT) administers the MaaS platform in Madrid.

Whim, striving for the ‘Spotify of transport’

In 2016, MaaS Global, a Finnish company that develops mobility services, launched Whim, an app that combines a route planner with subscription plans. In return for a fixed fee users get unlimited access to different modes of transport. After Helsinki the app is also coming to Antwerp. Just like in Helsinki and to make things as simple as possible for users, Whim is looking to group as many mobility partners as possible in its platform. De Lijn, NMBS, taxi companies, car, bicycle and scooter sharing companies are just some of the mobility providers involved in the project.

Ongoing development leads to Automated Mobility on Demand (AMoD)

AMoD will become a reality once autonomous vehicles have reached level 5 (see also p. 17). With AmoD vehicles will not only take passengers from point A to B; thanks to artificial intelligence they will do so in a custom-made format. Based on, for example, our calendar and real-time traffic information this type of digital assistant will calculate the optimum departure time, pick the fastest route and make sure a car or collective taxi is waiting at the right time.

In Singapore, a study commissioned by Stanford University showed that AmoD can reduce the number of cars to one third of the current vehicle fleet. With the exception of an electric top-up with a fast charger, cars will also be used more efficiently – up to 20 hours per day.
It is important for legislation to respond to technological evolutions in a timely fashion. Below you will find an overview of the current legislation, both on a European and Belgian level.

**Smart infrastructure**

- Directive 2010/40/EU of the European Parliament and of the Council of 7 July 2010 on the framework for the deployment of Intelligent Transport Systems in the field of road transport and for interfaces with other modes of transport
- Commission Delegated Regulation (EU) No 886/2013 of 15 May 2013 supplementing Directive 2010/40/EU of the European Parliament and of the Council with regard to data and procedures for the provision, where possible, of road safety-related minimum universal traffic information free of charge to users
- 17 August 2013 – Law for the creation of a framework for the introduction of Intelligent Transport Systems and the amendment of the law of 10 April 1990 regulating private and particular security (known as the ITS framework law)
- 15 December 2013 – Royal Decree implementing articles 5 and 6 of the law of 17 August 2013 for the creation of a framework for the introduction of Intelligent Transport Systems and the amendment of the law of 10 April 1990 regulating private and particular security (known as the ITS framework decision)

**Protection of personal data**

- Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (General Data Protection Regulation)
The mobility situation in your city or municipality can’t be improved overnight. Nevertheless, the decisions you (don’t) make today will determine your success in the mid and long term. We would like to share six recommendations with you.

**01 Work together with all levels of government**

Smart mobility requires a coherent and coordinated policy on every level of government. Cities and municipalities, regions as well as other competent authorities must be on the same page. A transparent vision and strategy must be established based on consultations between all parties involved. There’s little use in installing smart infrastructure on all municipal roads if the intersections with regional roads aren’t included.

**02 Invest in smart infrastructure**

Invest in available technologies and infrastructure that boost road safety and improve the flow of traffic: smart traffic lights, dynamic road signs, sensors and cameras, cycling infrastructure, etc. Facilitate multimodality by providing the necessary infrastructure and space. Work towards mobility hubs where various modes of transport come together in a single location. Since space in our cities is so scarce aspects such as urban planning are also key.

**03 Implement an open data policy**

Just like all transport operators and governments, cities and municipalities must implement an open data policy in all areas that involve mobility. Share all your traffic data through supralocal, centralised platforms. Only by bringing together all data and making it accessible you can create the ideal climate to implement mobility applications such as MaaS and MoD. The development of a mobility data platform and the appointment of an administrator is a task for the regional or federal level.

**04 Promote bicycle use**

In terms of infrastructure the bicycle all too often takes a back seat vis-à-vis other modes of transport. Devote time and resources to developing a high-quality cycling infrastructure to turn the bicycle into an attractive alternative for the car. Cycle superhighways are a fine example but also try to give cyclists the room they deserve in the city centre. The more cycle streets and smart, secure bicycle parkings there are and the smoother the flow of traffic, the more people will opt for the bicycle.
Promote green modes of transport

By supporting environmentally friendly modes of transport you are diminishing the impact of transport on the environment. The electrification of vehicles can be promoted by installing public and semi-public (smart) fast chargers. Another option to combat air pollution is the introduction of a low-emission zone.

Lead by example

As a city or municipality investing in infrastructure is not enough, you also have to lead by example. Promoting teleworking diminishes the need for transport. Deploying electric cars and bicycles reduces your CO₂ emissions. And self-driving shuttle buses and electric public transport in the city centre are testament to your commitment to innovative and alternative means of transport. All these measures will stimulate your local residents to do the same.

From technical to functional public tenders

The rollout of such an infrastructure naturally requires suppliers. With public tenders use functional descriptions whenever possible. In this way you can describe your requirements without curbing the freedom of your suppliers. As a result they will be quicker to propose innovative solutions. An example: instead of demanding that cycle paths be at least 2 metres wide, stipulate it must be able to handle at least 500 bicycles per hour.

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<thead>
<tr>
<th>Technical description of a cycle path</th>
<th>Functional description of a cycle path</th>
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<tbody>
<tr>
<td>Minimum width 2 metres</td>
<td>Minimum 500 bicycles per hour</td>
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“Smart infrastructure, autonomous vehicles, mobility hubs... it isn’t until all pieces of the puzzle fit together that the impact of smart mobility will become obvious: improved traffic flow, lower environmental impact, fewer accidents and a higher degree of travel comfort.”

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