PULSE

EXPLORE

HYDROGEN, THE FUEL OF THE FUTURE?

P.32

Pulse is intended for all stakeholders, decision makers and opinion leaders engaged in everyday mobility. A Keolis-led initiative, this biannual magazine aims to fuel debate and generate discussion about the trends and challenges that are shaping our industry.

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A s a wheelchair user, travel can often be difficult. My dream is that, one day, I'll have the freedom to go wherever I want in my own self-driving car. Unfortunately, manufacturers have yet to design an autonomous car that is wheelchair accessible. The future of mobility will be green and connected but, despite some cosmetic attempts to improve things, innovation and inclusion don't necessarily go hand in hand.

Every day, new alternative micromobility solutions hit the market – and the pavements! But almost all of them are designed for hyper-connected, able-bodied urbanites. And yet, today's mobility issues aren't just about improving accessibility for people with reduced mobility (who number two million in France alone). They also concern people with sensory or cognitive impairments, as well as the 13 million people in France who are technologically illiterate and face growing obstacles as Mobility as a Service (MaaS) gains traction.

Mobility innovation must not leave anyone by the wayside, as Éric Chareyron highlights in an opinion piece on the right to mobility and invisible vulnerabilities in this issue of *Pulse*. We also bring you a deep dive into the future of private cars, introduce a new mobility coach, and much more besides.

Enjoy your magazine!

CHARLOTTE DE VILMORIN
Founder of Wheeliz

CONTRIBUTORS

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Éric Chareyron

Director of the Keoscopie Observatory of Mobility Trends

In 2007, Éric Chareyron launched Keoscopie, an observatory of lifestyles and mobility trends. Through his studies in the field, he has developed an innovative approach that enables local authorities to better understand people's actual needs and, in turn, develop bespoke mobility strategies. He talks to *Pulse* about how the mobility solutions offered can leave some people feeling 'invisible' and shares his thoughts on 'silent' vulnerabilities. An advocate and promoter of inclusive mobility, he believes in the power of listening and empathy to help overcome the risk of exclusion. ●

NVS Reddy

Managing Director of Hyderabad Metro Rail Limited

An expert in project management in the urban road and rail sector, NVS Reddy has held several high-level positions within the Indian government. During his career, he has coordinated the construction of numerous infrastructure assets, including four viaducts in Hyderabad. In this busy city, overrun by cars and motorcycles, NVS has initiated a bold project to create an elevated metro, designed to reduce road traffic and deliver smooth, efficient and sustainable mobility for all. NVS takes *Pulse* behind the scenes on this megaproject, which is also one of the largest public-private partnership (PPP) metro construction projects in the world. ●

Xavier Corouge

Managing Director of Europcar Mobility Group's Urban Mobility Business Unit

A graduate of Grenoble Business School, Xavier is passionate about digital transformation, customer experience and brand engagement. Having gained international experience in the travel and mobility sectors, he joined Europcar Mobility Group, the European leader in vehicle rental services. Since May 2019, he has headed up the Urban Mobility Business Unit, which operates the GoCar, E-Car, Brunel and Scooty mobility offerings, as well as Paris' new carsharing service Ubeeqo. Xavier talks to *Pulse* about the future of private cars in our cities, as well as our lifestyles and his vision for a more widely shared and inclusive mobility mix. ●

Carole Martinez

French novelist

After starting out as a stage actress, Carole Martinez worked as a journalist, an assistant director, a semiologist and finally a French teacher in Paris. Drawing inspiration from the Spanish legends told by her grandmother, she began writing literature for teenagers and adults in the 2000s. In 2007, her first novel *Le Cœur Cousu (The Threads of the Heart)* was a success: it won 15 literary awards and has been translated into 20 languages. This was followed by *Du Domaine des Murmures (The Castle of Whispers)* in 2011, which won the 2011 Prix Goncourt des Lycéens, selected by high school students. In a short story specially written for *Pulse,* she follows the movements and thoughts of a passenger in a hurry. ●

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SUSTAINABILITY IS AT THE HEART OF THE INITIATIVES SHAPING THE FUTURE OF SHARED MOBILITY – DELIVERING

GREEN IS THE

by Ariane Dubois

🇸🇪 STOCKHOLM BUSES RUNNING ON WASTEWATER

Many of the buses in Sweden's capital are powered by municipal solid waste using a process introduced in the 1940s to heat homes. Wastewater, waste oil and grease from restaurants are also recovered and separated. It is all then sent to huge digester tanks at a processing plant, where it breaks down to produce biomethane to be used as vehicle fuel. **Some 50% of the city's bus fleet, Keolis operated, runs on biogas.** That's the equivalent of 850,000 cubic metres (30 million cu. ft) of wastewater recycled every year! ●

🇺🇸 FLYING CARS PREPARING FOR TAKEOFF

It's not a scene out of the next Bond movie – it's a reality! Flying cars, also known as roadable aircraft, will soon be a regular feature of the skyscape. A prime example is the AeroMobil, with its retractable wings and wheels. AeroMobil will be on sale next year – setting you back a trifling €1.2 million! Another key contender, helicopter maker Bell unveiled its Vertical takeoff and landing (VTOL) flying taxi concept at the 2019 Consumer Electronics Show in Las Vegas. "As space at ground level becomes limited, we must solve transportation challenges in the vertical dimension," says Mitch Snyder, Bell's President and CEO. **Currently, around 20 VTOL prototypes, most of them electric, are being developed by various manufacturers.** Getting about freely while caring for the environment – what's not to like?! ●

🇫🇮 LAHTI INTRODUCES PERSONAL CARBON TRADING

How do you change people's transport behaviours and promote sustainable mobility? That's the question the city of Lahti in Finland is seeking to answer with CitiCAP – the world's first personal traffic emissions trading scheme. **A mobile app automatically detects which forms of transport people are using and calculates their CO_2 emissions.** Each participant is given a weekly carbon allowance. If they use less than their allowance by making better mobility choices, they receive a reward. Capturing data on usage patterns could also help Lahti design new, more needs-responsive mobility services. CitiCAP won the Smart Mobility Award at the 2019 GITEX Technology Week in Dubai – one of the world's largest tech shows. ●

🇩🇰 DENMARK LAUNCHES E-FERRY

Denmark's e-Ferry Ellen, the world's most powerful electric ferry, made its maiden voyage in August. Powered by an unprecedented 4.3 MWh battery system – four times larger than the powerpacks on any similar vessel – **Ellen can carry 200 passengers and 30 cars, over a 40 km distance.** Over a year, it will avoid the emission of 2,000 tonnes of CO_2, 42 tonnes of NOx, 1.4 tonnes of SO_2 and 2.5 tonnes of particles into the atmosphere. Partly funded by the European Union, Ellen shows that on water like on land, fossil fuels can be intelligently replaced by eco-friendly alternatives. ●

🇳🇱 ROTTERDAM: BEST IN CLASS FOR TACKLING POLLUTION

To reduce air pollution, **the Dutch city of Rotterdam is running a highly original scheme, paying motorists to leave their cars at home.** This pilot project is aimed at drivers regularly using the most congested sections of road. For each journey they make by bus, metro or bicycle, car share with others, walk, or do with their own car but outside busy periods, they're given €3.00 in cash, or €3.50 is credited to their travel card.
The experiment is already making a difference, **with traffic volumes down 5 to 10% at peak times since it was launched in 2010.** The City of Rotterdam says 85% of the 10,000 participants who've completed the one-year scheme have changed their habits and stopped using their cars at the busiest times. ●

🇫🇷 KEROSTIN MOBILITY INVENTS THE STAIR-CLIMBING WHEELCHAIR

This Brittany-based startup arose from an observation by founder Hervé Le Saux: despite improvements, **streets and pavements can be hard to navigate for people with reduced mobility, and access to many buildings is a challenge.** So, he developed a wheelchair that can climb up or down a staircase. Its conventional wheels transform as needed into wheels with recessed notches, enabling it to negotiate stairs. **Since it was founded, the company has filed four patent applications and offers manual and motorised wheelchairs.** ●

🇫🇷 THESE BOOTS ARE MADE FOR WALKIN'!

In October, 40 people in the French city of Lille took part in the 'I month without my car' challenge organised by the local authorities. Inspired by previous challenges in Bordeaux (2017) and Dijon (2018) and with the help of staff from the ilévia network, participants were granted free use of the city's public mobility services: metros, trams, buses, bicycles, carpooling and on-demand transport. **The objective? Prove it's possible to get through a whole week without a car!** ●

🇮🇳 TOMORROW'S TRAIN EN ROUTE FOR INDIA

Elon Musk's exhilarating vision of supersonic tube travel is about to become a reality in India.
Keen to build the world's first hyperloop public transport system, **his company is working on a proposed 120 km (75 mi) route between Mumbai and Pune. It will cut the current travel time of 3.5 hours by car to just 35 minutes.**
A real boost for the state of Maharashtra where 75 million people already travel on this route every year **and forecasts predict 130 million by 2026.** Virgin says the service will have a capacity of 200 million passengers a year. ●

NEW BLACK!

CLEANER, MORE EFFICIENT SOLUTIONS THAT BETTER MEET THE NEEDS AND ASPIRATIONS OF ALL!

Illustration: Laño.

(1) Disorders that require an absence from work or continuous treatment for a period of at least six months, as defined by the French Social Security Code.

SHINING A LIGHT ON INVISIBLE VULNERABILITIES

Eighty to ninety percent of the vulnerabilities that hamper mobility among French people are invisible. Difficulties with technology, language barriers, long-term disorders[1], anxiety and convalescence are all factors that affect the way people get around without necessarily fitting the description of what we generally think of as a disability. Éric Chareyron, who heads up the Keolis Mobility Trends Observatory Keoscopie, tells us more about these vulnerabilities and their possible solutions. His message is clear: urgent action is required to ensure that mobility solutions truly meet everyone's needs.
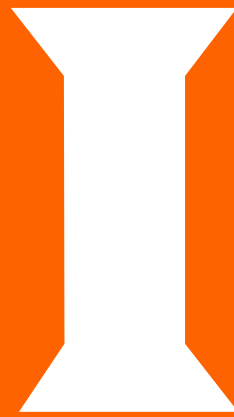
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ÉRIC CHAREYRON

Head of the Keoscopie lifestyles and mobility practices observatory created in 2007 to help local authorities prepare for the future. He is also Director of the Keoscopie Mobility Trends Observatory.

In 2016, well before the "gilets jaunes" (yellow- vest) movement began, I was particularly struck by a Crédoc (Centre for Research on the Conditions of Life, Paris) study on **French 'invisibles',** which highlighted how widespread the feeling of social invisibility is among many French people. Half of those surveyed said they were "quite or very often" faced with difficulties that were not taken into consideration by the public authorities. I was also surprised by the reasons cited to justify this feeling of being **"forgotten"**, or **"misunderstood"**, which included a lack of attention to their needs, a distorted view of their difficulties and a misalignment in the measures taken to address them. This Crédoc study and the social crisis that erupted in France a year ago lend credence to the attention I've been paying to **"vulnerable people"** for some years via the Keoscopie Mobility Observatory.

But first, what are these vulnerabilities we're referring to? Well, they don't fit the legal definition of a disability. And they certainly don't correspond to the visual representation many people have of a disability, which generally includes a wheelchair or a white cane. In the vast majority of cases, these vulnerabilities are poorly understood because they are **unseen by others** – and sometimes even **hidden** or **ignored by the sufferers themselves.**

Back in 2007, the Keoscopie Observatory focused on the problems that illiteracy poses in accessing information. Later, it turned its focus to difficulties faced by the elderly, people with limited orientation skills and low-income earners. Starting in 2017, we adopted a structured approach to conduct an exhaustive study of physical and sensory vulnerabilities, which in turn enabled us to follow up with a detailed review of the needs of people suffering from the effects of ageing[2] in 2018 and later those with long-term disorders, via a survey currently under way.

These and numerous other studies clearly show that invisible mobility-related vulnerabilities are both varied and extremely widespread. Certain temporary states of discomfort – such as tiredness, headaches and the side effects of medical treatment – are difficult to quantify. However, other vulnerabilities can be mapped more clearly. We know, for example, that more than 10 million people in France[3] suffer from **osteoarthritis. Long-term disorders** also affect 10 million French people[4], half of whom are under 65. **The digital divide** is another example, with many people – 35% of those surveyed[5] – declaring they are **"not comfortable"** with digital technology.

Invisible vulnerabilities therefore affect a huge portion of the French population. **In fact, they undoubtedly affect all of us at some point in our lives, if we include temporary vulnerabilities,** such as injuries, the early months of pregnancy and short-term illnesses, and **circumstantial vulnerabilities.** We've all been in situations where we were confused by the transport network in an unfamiliar city, unsure about which way to go in a poorly lit neighbourhood at night, or overloaded with luggage on an overcrowded bus.

Many vulnerabilities are still poorly understood in our industry because mobility solutions are designed by a community of people – of which I'm a member – **who live primarily in cities and own a car.** Most of us are **educated, middle-aged men.** And we live in a very **homogeneous environment,** because of our jobs but also because of our social and family circles. How, then, can we truly grasp the **difficulties that we rarely experience** and easily forget because they're not part of our daily lives? And if we don't understand the problems, how can we possibly come up with effective solutions?

The current debate about making public transport free is a perfect example of this inability **to grasp the real issues.** Free public transport is presented as the obvious solution to the difficulties experienced by people who are economically vulnerable. But what do they actually say when asked about their expectations? They talk about a network that runs early in the morning and late at night to meet their commuting needs and about inter-community services so they can go shopping, see the doctor or take their children to the swimming pool on a Sunday. The demand for free transport is clearly outweighed by the desire for a service offering adapted to their needs – ideally accompanied by an income-based pricing system.

Our slowness to adopt a more inclusive view of mobility is also due to a tendency among sufferers to stay silent about their vulnerabilities. Because they lack self-esteem, feel ashamed or are afraid of being labelled as "different". Because they don't have the language skills to express their needs. Or simply because they think **it would do no good.** Our 2018 study on ageing perfectly illustrates this point. The majority of those surveyed – aged between **55** and **85** – declared they had no mobility problems and were "very satisfied" with the public transport network. But when we dug a little deeper, the same respondents admitted that many issues **caused them difficulties.** In particular, they mentioned the lack of toilet facilities and adequate seating, the digital divide and the frightening prospect of being jostled by a crowd.

Public statistics often present an inaccurate picture of the extent to which the population is affected by invisible vulnerabilities. Illiteracy is a textbook case in this regard. In France, 2.4 million people between the ages of 15 and 64 are officially counted as 'illiterate' in the strict sense of the term. However, when we add in people over 65 and anyone who hasn't studied in French for at least five years, whether in France or abroad, we can see that, in reality, **15% to 20% of the people who live in France have difficulty with our language.** Statistics can also have a distorting effect. When we focus on megacities, for example, it's easy to forget that 15% of the French population lives in suburban areas and **45% in small and medium-sized cities, towns and villages.**

The first prerequisite to gaining a better understanding of invisible vulnerabilities is therefore a change of attitude and method. And I believe that the key to this change is the ability we all have to put ourselves in someone else's shoes – **our capacity for empathy.** If we don't design mobility solutions that meet the needs of all members of society, we will have failed in our duty to provide universal access to a public

service. One of the key levers will be training and awareness sessions for everyone involved in mobility solutions, whether they deal directly with passengers or not. In terms of method, we also need to provide a forum where these invisible vulnerabilities can be expressed. Our experience at Keoscopie has shown that qualitative surveys with a sociologist are crucial if we want to break the silence surrounding these issues.

To come up with genuinely effective solutions, we need to listen carefully and avoid jumping to simplistic conclusions. We need to break away from a service offering organised solely on the basis of passenger flow analyses and shift to a more holistic approach that includes the adjustments, equipment and consideration needed to address passengers' vulnerabilities. Many of the solutions required have yet to be invented. But certain **common-sense practices** being used in other parts of the world could easily be replicated. In Melbourne 🇦🇺, for example, every tram stop has a number as well as a name, making life easier for tourists, the visually impaired and people who have difficulties with the local language. And for over 30 years, the city of Curitiba 🇧🇷 in southern Brazil has had buses with low level floors to facilitate access for wheelchair users.

When designed well, digital technology can also be an invaluable tool for **enhancing autonomy.** Examples include transport hub video terminals, which passengers can use to talk to a network employee, digital maps with local information and route planning functions, highly personalised navigation apps and voice assistance.

Failing to design a more inclusive offering means failing to achieve the mobility transition and the changes that need to be made over the next decade. In a society where longevity and medical advances are driving up **the number of people living with long-term disorders (+25% between 2008 and 2016[6]),** demographic trends must be given priority alongside environmental issues. We have already managed to develop more inclusive solutions for people with reduced mobility and for those affected by economic vulnerabilities (income-based pricing, attractive offers, etc.) and cognitive vulnerabilities (a simpler, more user-friendly service). We now need to broaden this expertise to include all the other invisible vulnerabilities that affect people's mobility. ●

" **How can we truly grasp the difficulties that we rarely experience and easily forget because they're not part of our daily lives? How can we possibly come up with effective solutions?** "

LEARN MORE ABOUT KEOSCOPIE AT: **keoscopie.keolis.com**

(2) Deterioration of physical and mental capacities linked to aging.
(3) www.credoc.fr/publications/la-france-des-invisibles.
(4) Inserm.
(5) 2018 study on digital technology carried out by Keoscopie, in partnership with Kantar.
(6) French national health insurance, 2016.

THE FIVE MAIN TYPES OF INVISIBLE VULNERABILITIES

Cognitive:	Digital:	Physical:	Circumstantial:	Economic/regional:
illiteracy, language barriers, anxiety, lack of regional knowledge and orientation skills.	the digital divide, particularly between generations; lack of access to a smartphone.	natural ageing of the human body, chronic or long-term disorders, accidents.	early months of pregnancy, temporary illness or injury (fracture, flu, etc.), lack of local knowledge (tourist, unfamiliar environment, etc.).	lack of a vehicle for financial reasons, unequal access to mobility solutions depending on population size (large cities vs. small and medium-sized cities, towns, villages).

BRT

SIZING UP TO THE MOBILITY CHALLENGES AHEAD!

◈

*by **Julien Thèves***

**A VITAL PART OF THE MOBILITY MIX ALL AROUND THE WORLD, THE HUMBLE BUS IS EVOLVING TO DELIVER AN EVEN BETTER SERVICE. FROM PAU TO MEXICO CITY, AMIENS TO BANGKOK, BUS RAPID TRANSIT (BRT) IS PROVING POPULAR. MORE MODERN, MORE COMFORTABLE AND WITH MORE CAPACITY THAN CONVENTIONAL BUSES, BUT CHEAPER THAN A TRAM OR METRO NETWORK, IT'S WINNING OVER A LOT OF TRANSPORT AUTHORITIES AND PASSENGERS ALIKE.**

It all started in the Americas! **Ottawa**, introduced the world's first Bus Rapid Transit system in 1973. Today, it carries 220,000 passengers a day. Heading south, **Curitiba** in Brazil has operated a high-performance BRT network since the 1980s to help manage mobility for its 3.2 million population. High-capacity buses – some over 28 metres (92 ft) long and carrying up to 250 people – operate on 340 routes across the city. No need for a metro or trams. Today, 70% of people in Curitiba regularly use public transport: quite an achievement in a country where the car remains king! Over the years, these extremely efficient bus networks have inspired other cities, especially in Europe. In France, the Nantes Busway entered service in 2006, operating alongside the existing tram service. In the new town of **Évry**, the Trans-Val-de-Marne BRT network makes it easier to travel between suburbs, which aren't well served by the metro or RER suburban rail network. **Utrecht**, **Las Palmas** and **Belfast**, all have BRT networks. Midway between a conventional bus and heavier modes of transport like trams or metros, they're an ideal solution for cities seeking efficient mobility.

A QUALITY BREED OF BUS

So, what exactly is BRT? Bus Rapid Transit, also called a busway or transitway, delivers a faster service, averaging up to 25 km/h (15.5 mph), compared to 15 km/h (9.5 mph) for a conventional bus. Its high frequency of service is also attractive – typically every 5 to 10 minutes during peak hours and every 15 minutes offpeak – and they usually operate from very early morning to midnight, meaning passengers don't have to check a timetable and get to their destinations faster. BRTs such as the Bulles network in **Lens** 🇫🇷, can carry up to 60,000 people a day. In **Istanbul** 🇹🇷, the Metröbus comprises a single 52 km (32 mi) line and has a daily ridership of 700,000 – the same as the RER commuter rail service in **Paris** 🇫🇷. BRT buses have a unique look and are usually well designed, with quality materials, bright coloured livery, large windows and sleek lines. Some even have covered wheels, more like a tram. To make them even more attractive to passengers, they often have a nickname:

Aixpress in **Aix-en-Provence** 🇫🇷, Möbius in **Angoulême** 🇫🇷 (after French cartoonist Moebius, but also the Möbius strip, which only has one side) and Nemo in **Amiens** 🇫🇷, the city where Jules Verne (creator of the fictional character Captain Nemo) died. On most services, a voice announces the name of each stop, and the bus stops at all of them, like a train, metro or tram. The doors open level with the curb or platform, and passengers board in the middle or at the rear, since tickets are no longer sold by the driver. Inside, better distribution of heating, ventilation and air conditioning systems makes for a more comfortable ride. Increasingly, passengers also have free Wi-Fi and USB charging points. Almost all BRT networks have dedicated bus lanes, as in **Lorient** 🇫🇷, **Mexico City** 🇲🇽 and **Tehran** 🇮🇷. What's more, they often have signal priority: traffic lights communicate with the vehicle and stay on green so it doesn't have to slow down. On some routes, BRT buses can even cut across roundabouts in a straight line, like a tram, which is faster and means passengers don't get thrown about in the bends.

AN URBAN EVOLUTION

When a new BRT is built, the city around it also changes for the better. Bus Rapid Transit means improved stations, not just simple bus stops, with a lot more seats, effective weather protection, passenger information such as time to next bus, ticket sales and more. The space along the route is often redesigned across its entire width between buildings, with wider pavements, cycle lanes, greenery and new lighting. To encourage more people to use buses and help drive the modal shift to public transport, car parking is available near stations. In some locations, the broader public transport plan also evolves, with some conventional bus routes terminating at BRT stations to further improve overall traffic flows.

TICKING ALL THE BOXES?

For a city, BRT is much less expensive than a tram system. No rails need to be laid, and rolling stock is cheaper *(see box)*. In France, the 'versement transport' – a payroll tax paid by companies to local authorities –

BRT: THE RIGHT ENERGY!

Engine or fuel type isn't a defining criterion of BRT. Yet, a growing number of networks are opting for greener alternatives. In Metz 🇫🇷, the Mettis BRTs have a hybrid diesel-electric powertrain, while the BRT network in Karlstad 🇸🇪, uses all-electric vehicles. In Sophia Antipolis 🇫🇷, the new bus-trams run on natural gas. And since November 2019, the Fébus buses in Pau 🇫🇷 are powered by hydrogen.

favours Bus Rapid Transit: when planning a new network with dedicated bus lanes, the authorities can increase this tax from the usual 0.55% to 0.9% of payroll. This makes the transport system more profitable and helps the city's finances. For a transport authority, opting for BRT also means vehicles don't have to be permanently tied to a route, but can be reassigned as demand dictates. With a metro or tram network, there's obviously much less flexibility. Conceived as a complete mobility project, BRT – with all the rethinking of the urban space it entails – benefits the city as a whole. With its modern appeal and dependability of service, it makes people want to use ...

> **The pride of many a medium-sized city, BRT is also proving a compelling choice for larger urban areas. From Manchester to Stockholm, it's operating alongside the major routes and connecting with the heavier modes of transport.**

Bayonne.

Bogota.

... public transport! The work can create some disruption at the start, but it's soon forgotten once the sleek new vehicles enter service. The pride of many a medium-sized city, BRT is also proving a compelling choice for larger urban areas. From **Manchester** 🇬🇧 to **Stockholm** 🇸🇪, it's operating alongside the major routes and connecting with the heavier modes of transport. Running on diesel,

Mexico city.

but also increasingly on gas, electricity or hydrogen *(see box)*, it's gradually gaining popularity: BRT vehicles operate in **Rouen** 🇫🇷 (TEOR), **Pau** 🇫🇷 (Fébus) and **Barcelona** 🇪🇸 (Retbus), and will soon be entering service in **Amiens** 🇫🇷, **Bayonne-Anglet-Biarritz** 🇫🇷 and **Limoges** 🇫🇷, **Chennai** 🇮🇳, **Cebu** 🇵🇭 and **Madison (Wisconsin)** 🇺🇸. Ideally suited to urban mobility, there's also an intercity version – what we might call Coach Rapid Transit – like the Silver Streak operated by Keolis on a 61 km (38 mi) route between **Los Angeles** and **Montclair (California)** 🇺🇸, for Foothill Transit. It's a different breed of vehicle, designed for longer distances, but just as fast and comfortable and with the same capacity.

DRIVING PROGRESS IN ASIA AND AFRICA

Already widely adopted in the United States (Busway in **Miami,** HealthLine in **Cleveland,** MAX in **Las Vegas,** etc.) and Latin America (Metrobus in **Mexico City** 🇲🇽 and **Buenos Aires** 🇦🇷, BusCaracas in **Caracas** 🇻🇪, Metropolitano in **Lima** 🇵🇪, among others), these 'super buses' are entering service in the megacities of Asia and Africa. In **Seoul** 🇰🇷, BRT services have reduced the modal share of cars from 21% in 1996 to 18% in 2002[1]. In emerging countries, where public transport can be sorely lacking,

TRAM OR BRT: IS IT REALLY ONE OR THE OTHER?

For a transport authority, BRT is less expensive to deploy than a tram system. Yet these two different modes can prove highly complementary, as shown by Helsinki 🇫🇮 and Dalian 🇨🇳. Beyond the economic factors, cities also need to configure the network, and running trams measuring 30 to 42 metres (98 to 138 ft) in length along the narrow, winding streets of some historic centres is just impossible. Here, buses are the only option. Conversely, on some busy routes, trams can carry a lot more people.

BRT is an ideal remedy to urban congestion. In **Nigeria,** the Lagos Bus Rapid Transit System – Africa's first BRT – entered service in 2008. A similar scheme is being considered in **Cairo** 🇪🇬, while the **Dakar** 🇸🇳 BRT in Senegal, which is due to launch in 2022, will serve 23 stations and carry 30,000 passengers a day. All around the world, from small towns to the largest capitals, Bus Rapid Transit really is blazing a trail! ●

€5–10 MILLION
That's the cost per kilometre to build a BRT network (compared to €13–22 million for a tramway).

€400,000 –€1 MILLION
That's the price of a BRT bus (compared to €2–3 million for a tram).

**30–40 YEARS**
Although a tram costs more than a BRT vehicle, it lasts longer (vs. 10–15 years for a bus).

+25%
Was the increase in the daily ridership on the Metz public transport system in France in 2013, the year the Mettis BRT entered service.

THE CAR: A NEW SHARED MOBILITY SOLUTION?

by Adeline Tissier

A single "carshare" can replace up to 13 private 🚗 and reduce each user's greenhouse emissions by as much as 41%. The model underpinning our use of private cars is being called into question. But what if the car had a real future as part of a MaaS (Mobility as a Service) ecosystem?

➤ PERCENTAGE OF CONSUMERS THAT USE THEIR OWN VEHICLE EVERY DAY

🇺🇸 59% / 61%
🇮🇳 47% / 50%
🇩🇪 47% / 46%
🇨🇳 38% / 38%
🇯🇵 21% / 20%

■ TODAY
■ 3 YEARS FROM NOW

Source: Deloitte Global Automotive Consumer study, 2020.

➤ WORLDWIDE AUTOMOTIVE PRODUCTION

100 M
90 M
80 M
70 M
60 M
50 M
40 M
30 M
20 M
10 M
0 M

1915 · 1930 · 1975 · 1990 · 2005 · 2020

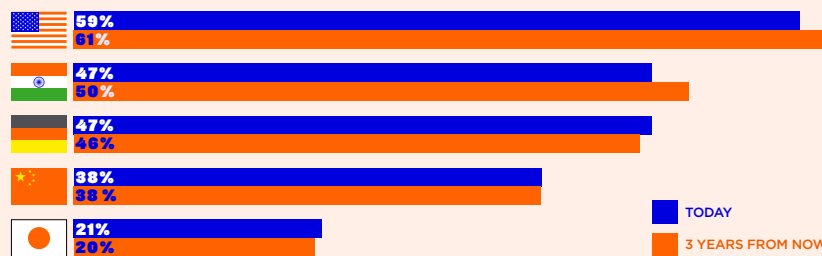## 90%
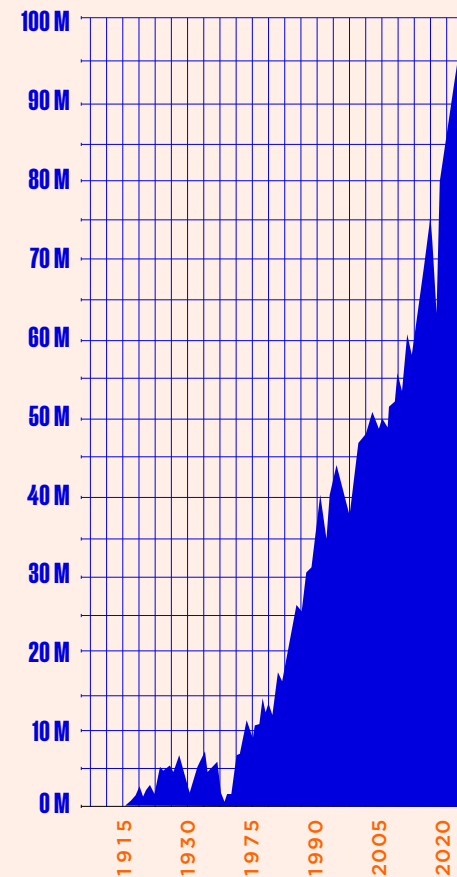
The average private car stands unused for 90% of the time.

Source: Shared Mobility: Innovation for Liveable Cities. International Transport Forum, OECD, 2016.

107hrs

The average time spent by 🚶 in traffic jams every year in Los Angeles.

72hrs

in London.

Source: The Guardian, March 2018.

Cars are a vital form of transport in rural and suburban areas, but cities are increasingly keen to restrict or ban them. The traditional social model is also changing, especially among younger people, who typically prefer 'using rather than owning' commodities, cars included. The proportion of young Americans with driving licences stood at **92%** in 1984. Today, it has plunged to **78%**.

More than anything else, what's pushing the private car towards the exit door is a combination of environmental imperatives and public health issues. The internal combustion engine is solely responsible for almost one-quarter of global CO_2 emissions. The World Health Organisation estimates that **90%** of the population is now breathing polluted air – believed to be the cause of over 7 million early deaths a year[4]. Like the roads, our lungs are choking!

Reigning supreme for over half a century

Owning a car has always been synonymous with independence and closely tied to the development of the middle class in countries around the world. Since the **1950s,** the car has charmed us as a symbol of power and freedom. And nothing has challenged its supremacy – not even the various economic crises, which only slowed its inevitable rise[1].

Today, the sheer number of cars on the road is dizzying – over **1.25** billion globally[2] – but the unquestioning adulation of the automobile seems to have waned. We no longer talk about empowerment, but dependency. What once was liberation is now more about restrictions. And the ideal of adventures across vast open spaces has given way to news stories of choking urban pollution. In short, the language of the **2000s** and today reflects a reality as grey as exhaust smoke.

The automotive sector is showing signs of weakening. After a decade of record sales, the number of new cars being registered has fallen for the second year running. In 2019, overall sales are expected to drop by **4.5%**[3] in all three main markets: China (**–9%** in 2019), the United States (**–2.5%**) and the European Union (**–3%**).

Cleaner ways of powering vehicles

Vehicle manufacturers are adapting to society's expectations and environmental concerns by developing more efficient and viable solutions. One report predicts that hybrid and electric powertrain technologies will co-exist alongside each other in a fairly even split by 2040[5].

But for now, uptake remains slow. While global sales of electric vehicles, for example, were up 68% in 2018 and **30%** in 2019, they still account for less than **3%** of total sales[6]. And while the car-buying public seem ready to make the jump, **35%** say purchase price is still a barrier, with **24%** also citing the lack of range. On the subject of self-driving cars, they'll almost certainly be a success in the

➤ BREAKDOWN OF CAR USAGE IN EUROPE

6% — BORROW OR SHARE A VEHICLE
7% — RENT A CAR ON A LONG-TERM BASIS
11% — USE A CAR ON AN AD-HOC BASIS
17% — NEVER USE A CAR
60% — OWN A CAR (FULL OWNERSHIP)

Source: Observatoire des Mobilités Emergentes, August 2018. Study of mobility trends based on a representative sample of 4,000 people in France (aged 18 to 70) and 3,000 people in Germany, Spain and the United Kingdom, who answered an online survey.

➤ HOW EUROPEANS ARE MAKING USE OF EMERGING MOBILITY PRACTICES

BICYCLE 30%
MICROMOBILITY DEVICES 10%
PRIVATE HIRE VEHICLES 21%
COACHES 27%
CARPOOLING 31%
VEHICLE HIRE 7%
CARSHARING 5%
MOTORCYCLES/SCOOTERS 2%
HIRE BICYCLES 7%

Source: Observatoire des Mobilités Emergentes, August 2018. Study of mobility trends based on a representative sample of 4,000 people in France (aged 18 to 70) and 3,000 people in Germany, Spain and the United Kingdom, who answered an online survey.

➤ PERCENTAGE OF RIDE-HAIL USERS THAT QUESTION WHETHER THEY NEED TO OWN A VEHICLE GOING FORWARD (BY GENERATION)

Source: Deloitte Global Automotive Consumer study, 2019.

■ PRE-BOOMERS
■ GEN X
□ GEN Y/Z

🇯🇵 45% / 55% / 60%
🇮🇳 34% / 44% / 51%
🇺🇸 17% / 20% / 46%
🇩🇪 17% / 31% / 35%
🇨🇳 32% / 38% / 39%

(1) Michel Freyssenet, "World automobile production by continents and main countries", 1898–2018.
(2) Statistica, 2015.
(3) Euler Hermes, September 2019.
(4) WHO, May 2018.
(5) "Global Automotive Executive Survey", KPMG, January 2019.
(6) Euler Hermes, September 2019.

longer term[7], but there are still some significant technological and ethical issues to be addressed[8].

A new form of public transport?

Beyond the technological advances making cars cleaner and safer, willingness to change our driving habits is a key factor in solving the mobility challenge. **To limit single occupancy car use,** public transport authorities and operators have introduced a host of solutions for integrating cars into their shared mobility ecosystems. Carpooling and carsharing services and on-demand services using shared vehicles are already proving viable around the world, especially for filling the first and last-mile gap in public transit systems. One American study[9] estimates that if all motorists agreed to make shared vehicle trips, the number of vehicles on the road could be reduced by almost a third[10].

MaaS (Mobility as a Service) would boost efficiency by providing **"unprecedented opportunities for integrated ticketing, real-time information and more,"** according to a report by the Centre on Regulation in Europe (Cerre) in September 2019.

But limiting the number of vehicles isn't the same as effectively deterring private car use. Convincing motorists to forego the comfort of their private vehicles requires further efforts. The same report states that the full development of MaaS and shared mobility will only become a reality and prompt a modal shift if "the rules for using the roads are oriented towards strong incentives for ride sharing"

coupled with "real disincentives for the use of individual cars", says Xavier Corouge, Managing Director of Europcar Mobility Group's Urban Mobility Business Unit. In other words, we need to regulate. "Public transport authorities are uniquely qualified to promote the clear vision of mobility needed across an entire region so that cars can be integrated into a new mobility ecosystem," adds Xavier Corouge. "They're also best placed to coordinate everyone involved in managing the operational issues".

Several major cities are already making the transition. Taking an incentive-based approach, the Montreal and Ottawa 🍁 transport authorities have opened up bus and taxi lanes to carpoolers with at least three people aboard. Another solution is urban road tolls, or congestion charging – as in Singapore 🇸🇬, London 🇬🇧 and soon New York 🇺🇸. Oslo 🇳🇴 has taken an even tougher approach, banning cars from the city centre and removing parking spaces. In the Belgian and Slovenian capitals, the authorities have closed many of the main roads to motorised vehicles.

But none of these measures on its own is enough. They need to be part of a holistic approach to shared mobility, with a combination of suitably adapted municipal infrastructure, incentives for eco-friendly forms of mobility, introduction of restricted zones and development of high-performance digital platforms to promote MaaS as an efficient and sustainable mobility ecosystem.

Pending Elon Musk's dream of underground tunnels carrying passengers in autonomous, ecologically friendly vehicles, we must start thinking about cars differently and change people's behaviours through a combination of incentives and regulation. ●

▶ DIFFERENCE IN ENVIRONMENTAL IMPACT OVER THE LIFECYCLE OF AN ELECTRIC OR PETROL CAR (x 10⁴ kg equiv. of CO_2)
Source: CIRAIG, 2016.

- **END-OF-LIFE**
- **USE**
- **SHIPPING**
- **MANUFACTURE**
- **RAW MATERIALS**

▶ SPLIT OF DRIVETRAIN TECHNOLOGIES BY 2040, ACCORDING TO AUTOMOTIVE INDUSTRY LEADERS
Source: Global Automotive Executive Survey, KPMG, January 2019.

- Internal combustion engines
- Electric batteries
- Fuel cells
- Hybrid

▶ CARSHARING VEHICLES
Source: Roland Berger Strategy Consultants.

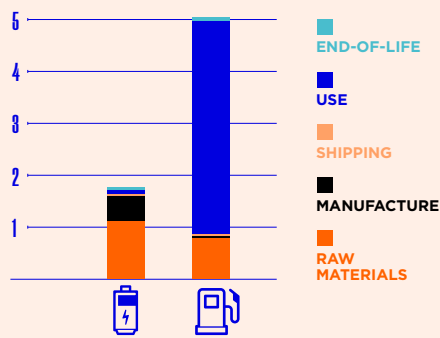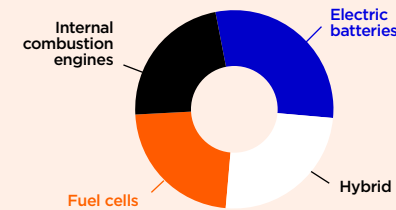**10%** **ONLY 10% OF THE CURRENT NUMBER OF VEHICLES ARE NEEDED TO MAINTAIN THE SAME LEVEL OF MOBILITY.**

GLOSSARY

Roundtrip carsharing: residential service with allocated parking space/charging point for each vehicle.

Free floating: carsharing with no allocated parking space. Rental for short distances and durations.

Ubeeqo: roundtrip electric or hybrid carsharing solution, launched in 2018 by Europcar Mobility Group, with operations in Paris, Berlin, Milan, Madrid, Barcelona, London.

80% of Ubeeqo users don't own a car.

60% of Ubeeqo users also use other modes of transport.

50% would buy a car if there was no carsharing service.

▶ FREQUENCY THAT CONSUMERS USE MULTIPLE MODES OF TRANSPORTATION IN THE SAME TRIP

- **NEVER**
- **RARELY**
- **1 x A WEEK**

Country	NEVER	RARELY	1 x A WEEK
🇰🇷	7%	55%	38%
🇯🇵	10%	58%	32%
🇨🇳	8%	64%	28%
🇮🇳	8%	66%	26%
🇩🇪	25%	55%	20%
🇺🇸	39%	48%	13%
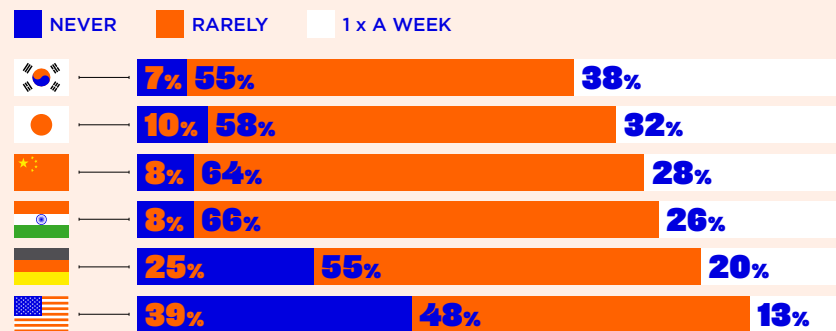
Source: Deloitte Global Automotive Consumer Study, 2019.

(7) "La voiture individuelle, un nouveau mode de transport collectif ?", Annales des Mines, Réalités Industrielles, CAIRN Info, May 2018.
(8) "Global Automotive Executive Survey", KPMG, January 2019, and "MIT Moral Machine", MIT study, 2016.
(9) "Three Revolutions in Urban transportation", UC Davis, May 2017.
(10) Opinion piece, Le Monde, July 2017.

"Unless transport authorities are involved, no long-term change will happen"

INTERVIEW WITH XAVIER COROUGE, MANAGING DIRECTOR OF EUROPCAR'S URBAN MOBILITY BUSINESS UNIT

HOW WILL PRIVATE CAR USE CHANGE IN THE NEXT 10 TO 20 YEARS?

For almost a century, the car has given us freedom and a great way to get where we want to go. But today – for obvious ecological, economic and health reasons – it has effectively led urban mobility up a dead-end street. Congestion is getting worse everywhere. Public health is deteriorating. And targets for cutting greenhouse gas emissions are more ambitious than ever. We absolutely must reduce the number of cars on the world's roads. To do this, we urgently need to adopt and embed new behaviours that no longer involve individual use of private cars, but shared use instead.

HOW CAN CARS BE INTEGRATED INTO THE SHARED MOBILITY OF THE FUTURE?

If you buy a car, you obviously want to get your money's worth out of it, so you end up using it for all your journeys. Conversely, if you opt for carsharing, you only use a vehicle when you really need it, while continuing to take advantage of public transport and micromobility services for your other trips. The first carsharing schemes emerged in the 1980s. Digital has now taken it to a whole new level, with carsharing solutions that are ideally suited to shorter journeys, especially in urban areas. Today, cars are part of the landscape in our major cities, but how they're used

can take different forms. Free-floating carsharing is much like micromobility, where you use a car for very short journeys, and it competes directly with other shared mobility solutions and public transport. Roundtrip carsharing, on the other hand – where users pick up and drop off the car at the same station – is clearly intended to replace private vehicles. However, the success of these solutions is still

relative. Compared to the billions of journeys made every day, it's still a marginal trend. In Switzerland, for example, only 1% of the population makes use of this kind of mobility. And in Paris 🇫🇷, it's just 0.1%. There's a huge development potential. We're only at the start and we need to go much further, so that the car finds its rightful place in the shared mobility value chain.

WHAT ROLE CAN MAAS PLAY?

Like healthcare or education, mobility is a shared asset. And like any shared asset, it can only develop in a cohesive and needs-responsive way if the public authorities are closely involved. MaaS has huge potential to reduce individual use of private vehicles – not just cars, but scooters and so on – by making it easier to adopt shared services as an integral part of a broader multimodal mobility offering.

"We urgently need to adopt and embed new behaviours that no longer involve individual use of private cars, but shared use instead."

But as well as incentive-based solutions, reducing single occupancy car use will also depend on measures such as road tolls, restricted zones and removal of parking spaces. The scope for transport authorities to introduce incentives coupled with their regulatory powers is crucial, especially in megacities where urban sprawl is an issue. Without their involvement, no long-term change will happen. In Singapore 🇸🇬, the ratio of land used for parking and roads has been reduced to an impressive 12%, whereas in Los Angeles 🇺🇸 it's still 50%! ●

— "Mobility coach, can you hear me?"

In our homes, at the office and in the car on the daily commute, voice assistants are already with us throughout our lives. For the shared transport sector, this technology is a great opportunity to offer passengers an even smoother travel experience while letting them make last-minute changes to their plans. Augmented with AI and smart data, voice assistants act as a "coach", delivering a "conversational experience" that helps make mobility more inclusive for all passengers... technophiles and technophobes alike!

— "Tell me more about yourself, coach"

— "Send a message", "play some music", "switch off the light" – this sort of simple voice command is run-of-the-mill stuff for my cousins, voice-based assistants.

— You probably use them almost every day with your digital assistant speakers (like Alexa from Amazon), your smartphone (like Apple's Siri personal digital assistant), or other connected devices such as your TV, watch or car. These applications can understand and respond to voice requests either in text or by taking action.

— But I'm a bit different: I'm a "voice coach". I can do everything those assistants can, but I'm also able to interpret your requests and give you a voice response. In fact, thanks to my built-in artificial intelligence and deep learning capabilities, I can even chat with you!

— "How smart are you, really?"

— Let's just say I learn as we go: the more I'm used, the better I get. That's a form of intelligence, isn't it?

— So, to improve the way I recognise linguistic patterns and respond to them properly, I need to be used – a lot!

— And the more (and the better) you ask me things, the better I'll understand you.

— "So, what's my commute going to be like this morning?"

— That's exactly the kind of question I'm designed to answer! My whole purpose is to guide you to your end destination.

— And unlike my cousins, the voice assistants, I can guide you vocally, learn what your habits are, take account of traffic conditions in real time and adapt to fit your preferences.

— This makes me easier to use and, most of all, more relevant! I respond to your needs instantly as they change – which happens when your trip gets a bit stressful!

— "Where can I find you?"

— Coaches like me are starting to gain popularity in cities. Dijon (France) rolled out a mobility coach in 2019 combining AI, smart data and voice recognition. A world first!

— Dijon's mobility coach is directly accessible via the DiviaMobilités network app. It was co-built with users and partners through open innovation.

— The result is a unique conversational experience. It tells passengers when the next bus or tram will arrive, gives them traffic updates and looks for the best route depending on their preferences. It can even make unprompted suggestions!

— "Are you listening to everything I say?"

— I wouldn't dream of it! The Dijon coach only works when you switch on your smartphone's mic. Privacy-by-design is one of my best features: your private life stays private!

— But it's true, some people are concerned about "passive listening" – and that's not all. They can also be embarrassed to call on me in public. Then there's the need to speak really clearly so I understand. And I could be seen to be intruding into your privacy. But don't worry – the technology's improving all the time.

— "Are you really that useful?"

— To start with, you can access me instantly without having to tap on your screen. It's called hands free, surely you've heard of it! According to 41% of people who already use me, I'm faster than any website. Not bad, hey?

— As for transport authorities, I'm their ideal partner, helping them maximize the value of their transport offer, as well as making it easier to understand, throughout their region.

— In addition, thanks to me, mobility becomes more inclusive, because I'm easy to use and accessible to all passengers – especially those who have trouble using digital devices and little touchscreens or reading written instructions.

— I even take the stress out of your trip thanks to my cool features!

1 in 4 US households has at least one voice-enabled speaker.

80% of the population have already embraced voice technology, in China and India.

50% of smartphone owners (some 16 to 20 million people) in France use their voice assistant[1].

45% of voice interactions take place in the home, but it's becoming increasingly mobile: 36% of voice requests are made when travelling by car and 19% in the street.

FROM 150 TO 180: that's the number of words we pronounce in 60 seconds[2], whereas we only type about 40 on a keyboard. The time saved is colossal.

(1) Viseo technology analysis – Roland Berger, "La voix monte le son – La révolution naissante des assistants vocaux", 2019.

(2) Le Journal de Montréal, 31 October 2019.

HYDERABAD

- Over ten million inhabitants.

- The sixth most populous city in India after Mumbai, Delhi, Kolkatta, Chennai and Bangalore.

- "City of Pearls": historically known for its diamond and pearl trade.

- Main industries: pharmaceuticals, IT, biotechnology, finance.

- HITEC City district: home to multinational giants such as Google, Facebook, CISCO and IBM.

- Elevated Metro with 3 lines (phase 1 opened in 2017, to be completed early 2020), 57 stations and a daily ridership of around 400,000 (October 2019).

NVS Reddy is at the helm of the Hyderabad Metro Rail in India 🇮🇳, a project which he developed using a public-private partnership (PPP). Reddy has 36 years' experience working in managerial roles in government sectors. His mandates over the years have been wide-ranging, and he has worked on various public developments from railway to road, including the major railway infrastructure project, Konkan Railway, as well as the implementation of four flyovers in Hyderabad city.
Inspired by: the land value capture systems of Tokyo, Hong Kong and Singapore metro, and the BRTS in South America.

CYBERABAD
DREAMS

TEN MILLION PEOPLE. FIVE MILLION VEHICLES. ONE OF THE LARGEST PUBLIC-PRIVATE PARTNERSHIP TRANSPORT PROJECTS IN THE WORLD. CAN THE PIONEERING NEW METRO OF HYDERABAD, IN INDIA 🇮🇳, PAVE THE WAY TOWARDS A SHARED MOBILITY CULTURE IN A CITY TEEMING WITH PRIVATE VEHICLES?

*by **Karen McHugh**, photos: **Sunil Thakkar***

All the top software companies – Apple, Amazon, Facebook, Google, Oracle, Microsoft – you name it, it's in Hyderabad," says NVS Reddy, Managing Director of Hyderabad Metro. **"In our western part of the city you'll see a different world, you'll see tall skyscrapers and world class buildings."**

It's clear that Hyderabad is a city that is going places. It's one of India's fastest growing cities and its connection to the IT industry has earned it the moniker 'Cyberabad'. But with progress comes problems including more and more people taking to the roads. The ensuring gridlock sees air pollu-tion at times reaching three times the safe level. Safety is also an ongoing issue on Hyderabad's over-crowded roads, with **1,258** road accidents recorded in the city in the first half of **2019**.

A city bridging old customs and new, Hyderabad combines a **450**-year old culture with the logistical challenges of a modern metropolis. But as the suburbs expanded, its roads became a clamour of rickshaws, two-wheelers, cars plus an often-chaotic bus system. Hyderabad was in dire need of a better way to transport its citizens.

But how do you change the commute culture in a city that adds nearly half a million new vehicles to its roads every year? A new approach was needed ▶

HYDERABAD METRO

The PPP was implemented under a design, build, finance, operate and transfer (DBFOT) basis.
Initially Keolis assisted in establishing the design of the metro and its operational strategy. It was then tasked with looking after the depots, signalling system, telecommunications, ticketing systems and ticket machines, as well as the running and maintenance of the 57 metro trains themselves. Keolis also recruited and trained staff.

that could convince the throngs of commuters that public transport was the answer.

In **2003,** Hyderabad transport officials were already considering the option of a metro. Three years later global tenders were floated and a few years thereafter, construction work began in earnest. Chosen to head the transformation effort was NVS Reddy, a public sector head with three and a half decades experience in senior government positions.

PUBLIC PRIVATE PARTNERSHIP

"We wanted to have a high-performance mass transit system which met Hyderabad's fast-growing population's needs," says Reddy. "My first challenge was implementation. The state government did not have the kind of money required for this three-billion-dollar project. The chief minister asked me to think about an alternative. That's how I hit upon the idea of a public-private partnership (PPP)," he says.

Risk allocation between government and private partners required careful attention but the PPP offered real advantages in terms of flexibility and efficiency, according to Reddy. "The combination of public and private actors meant we had the agility to progress swiftly and adapt plans and designs whenever necessary."

Indian infrastructure giant Larsen & Toubro Limited was chosen as the private sector partner, with the public sector banks serving as the lenders for the project. Keolis was awarded the Operation and Maintenance contract in **2012,** with the first segment opened to passengers in **2017,** a second in **2018** and a third in **2019.** The metro is expected to break even in its sixth or seventh year of full operations.

How is operating a public-private partnership in reality? **"I joke that it's like an Indian marriage, where divorce is not an option!"** says Reddy. "PPPs are not always easy, especially for huge mass transit projects. By simply following the concession agreement, a PPP will not become a success. Keeping dialogue open and a proactive approach from the Government side is essential."

COMBATING SINGLE VEHICLE USE

The main obstacle to the metro remains the private vehicle. **"The problem lies in the image of public transport in most Indian cities. The majority of people travel by motorbikes and scooters, with the car reserved for the better off. But with about 1,500 extra vehicles per day, congestion has become a chronic problem on the roads,"** says Reddy.

SUSTAINABILITY IN THE METRO

● Energy efficiency is inherent in the design of Hyderabad metro. The elevated metro system has an open architecture cutting out the need for tunnel ventilation and air conditioning in the stations – good for Hyderabad's carbon footprint.

● The Regenerative Braking System means that 35% of energy is generated while braking and is fed back into the electric grid and re-used.

● Electric charging points are being introduced at metro stations in anticipation of an eventual changeover from fossil fuel vehicles, with a BRT corridor the next step for Hyderabad's sustainable transport policy.
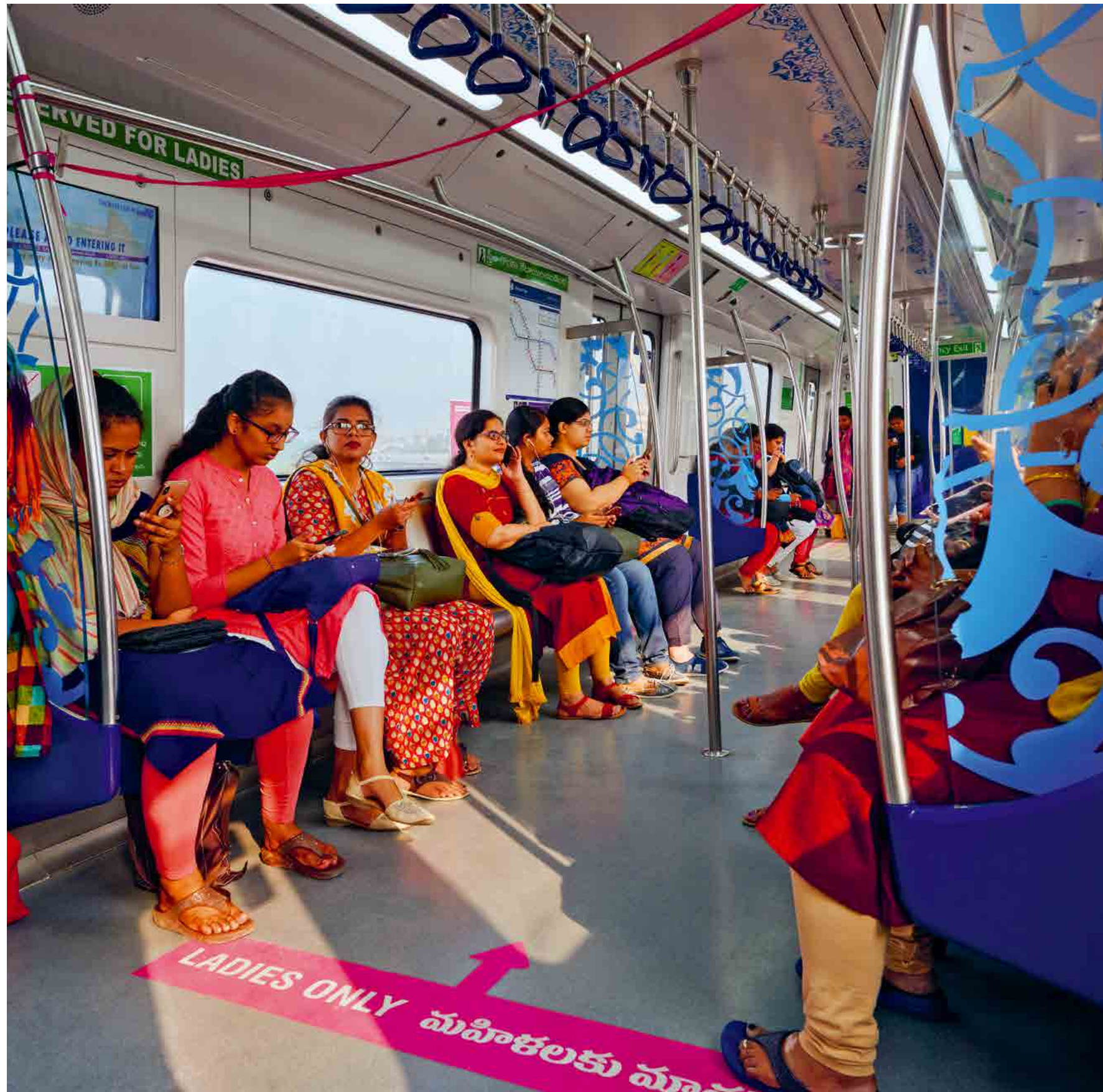
The city is making a conscious effort to encourage public transport, with the metro slashing journey times by half for commuters and being perceived as an increasingly viable option. **"With the metro, the culture is changing,"** says Reddy, who even took the unusual step of penning folk songs himself to promote it to the local people, which were then broadcast at city festivals. **"If you are driving a car or two-wheeler you're under tremendous stress, whereas the metro is much less stressful. That's why more and more people are switching over."**

With about **400,000** daily riders and figures increasing continuously, numbers are roughly in line with expectations as commuters opt to travel by metro. And the metro is proving extremely popular among passengers, as Keolis' recent survey revealed. In the few months following its opening to the public, Hyderabad Metro achieved a customer satisfaction rating of **95%,** making it the most popular public transport network among **13** cities surveyed.

DEVELOPING MULTIMODALITY

Hyderabad Metro is connected to the main rail terminals and bus depots such as Secunderabad Railway terminal and Mahatma Gandhi bus station, a skywalk connecting the metro station to the platforms of the bus station.

Areas for bikes, electric bikes and for Uber and Ola ride-sharing for first and last mile connectivity are all being developed. Parking is also available at many metro stations for two-wheelers and cars, although more dedicated car-parks are still needed. **"It has started slowly improving and it'll change substantially in the next few years to become a seamless travel facility which contributes to reducing Hyderabad's chronic congestion,"** Reddy says.

WHAT IS BRT?

Bus Rapid Transit is a system which combines the comparatively low cost and flexibility of a traditional bus operation with the speed and capacity of a tramway. A BRT has its own dedicated corridor within the road network and includes intersection priority, which reduces delays during passenger boarding (see p.12).

Hyderabad plans to construct a BRT corridor, but to make it elevated like its metro, unlike most BRT models worldwide. With average speeds of 30 km/hr and a station every 500 metres, the new route will stretch 18 kilometres from KPHB station to the Financial District in western Hyderabad. It will also link with the IT firms in HiTec City – home to half a million techies. The project is expected to be completed within three years.

Further multimodality challenges include introducing efficient feeder bus services to the metro and ensuring the timetabling works well between modes. In the meantime, private vehicle shuttle services have been introduced, with young entrepreneurs encouraged to bring in minibuses to bridge the gap.

REDESIGNING A CITY

Hyderabad Metro and its stations play a part in what Reddy hopes will bring positive change for society, from renewed economic activity to improved public safety, which in turn will attract people to the metro.

> **An elevated BRT is a new concept for an Indian city. It will hopefully become a reference for others.**

"For me Hyderabad Metro is not simply a transportation project. It's an opportunity to redesign an Indian city as a people-friendly green city," he says. Hyderabad pledged that with its metro would come

improved security, safety and a better quality of life. **"People are already feeling the change. The quality of life will change, it's just the beginning,"** says Reddy.

Following on from the success of the metro, an airport line and a Bus Rapid Transit (BRT) system connecting the financial district with the KPHB station in the west of the city are also in the works. It's set to be India's first BRT corridor featuring electric buses, which Reddy also hopes to fund through PPP. But once again this will be BRT with a twist as the BRT will run on elevated roads, which he hopes will inspire other cities facing similar challenges. **"In Indian cities, BRT is very difficult at road level. Elevated BRT is rare throughout the world and a new concept for an Indian city. It will hopefully become a reference for others."**

Yet even before the introduction of BRT, the metro is already proving very popular in Hyderabad, a city with ambitious plans looking to intelligently improve its infrastructure amid rapid expansion. **"I'm very proud of the city. Of course we need to learn a lot but I see a bright future for Hyderabad and other Indian cities thanks to mass transit. It's just a matter of time."**

From Jules Verne and Mark Twain to Agatha Christie and Paula Hawkins, mobility has proved an endless source of inspiration for writers the world over. French author *Carole Martinez* continues the tradition with a short story written especially for this issue of *Pulse.*

Transported

Work's speeding up [BREATHE] Try and save time [BREATHE] Every hour no every minute of sleep counts [BREATHE] Come on, nod off immediately so you don't lose a second Disconnect Close your eyes and shut off the screen straight away or maybe the other way round. [BREATHE] It's no good the room's pitch black but the screen's still tattooed on to my retina [BREATHE] I don't nod off as easily as I used to My age or my era?

Everything's speeding up [BREATHE] The world doesn't shut down, never shuts down anymore [BREATHE] They're awake on the other side of the world I don't know them but they're working on the same screen [BREATHE]

I live in a world that never sleeps And tomorrow I've promised to lend my car to my daughter Ana [BREATHE] How stupid saying I could easily get to work on public transport [BREATHE] Perhaps I could book a taxi instead I've got a stressful meeting at 9am [BREATHE] It's years since I took the metro Don't want the smell of other people Prefer my own smell sometimes not even that [BREATHE] I like the smell of my car Ana says we smell the same me and my car like

plastic [BREATHE] It's possible since I spend more time in it than with my two youngest who are already in bed when I get back [BREATHE] I stay at the office 'til the traffic eases so I don't spend even more time in this space that has taken my smell or that has given me its artificial smell [BREATHE] Hours glued to my steering wheel at dawn and dusk answering calls from places where the sun hasn't yet set I waste no time and the years pass

[B R E A T H E]

But tomorrow will be murder fighting for a seat and I'll have to rent a bike to get to the metro station I bet it'll break down And then I'll break down before the meeting [B R E A T H E] It's like the ends of the Earth to me The kids would have a ball if they could hear me Come on it's just this once Then I'll get my car back and never lend it out again [BREATHE] Ana's worked out the 10,000 km I drive to work and back every year produce three tonnes of CO_2 [BREATHE] She says I'm contributing to climate change

[B R E A T H E]

Soon there'll be nothing left to breathe

7.15am I've put a book in my bag A book I can't believe it Last time I read anything was years ago No time to waste 7.17am I cross the paving stones I used to love it reading diving into a story into a poem turning pages Work has consumed my reading my dreaming my days my nights 7.20am Take the bike off its stand like Ana showed me 7.21am Saddle at the right height Bag in the basket and down the slope…

The wind on my face,

The wind in my hair,

My jacket flapping against my sides,

I fly down the street through the fresh morning air…

Something surges up inside me, a powerful feeling I used to know.

Joy!

Oh! I can [B R E A T H E]!

At last, I can [B R E A T H E] !

I [B R E A T H E] in autumn, the day, the moment!

I cut straight through the little wooded area, far from the traffic jams, and the cycle path unfurls beneath my wheels. I feel the landcape in my legs, the rises and falls, the curves of the Earth. Beneath the giant trees faintly gilded by the season, I sense a new-found joy. I am at one with the world. I feel like I belong I'm in harmony realigned with Mother Earth. How the kids will laugh when I tell them their dad had an existential experience on the way to work! It will give me something to tell them, something to share with them this evening.

OK I'm here, time to say farewell to my travel companion. I dock my bike outside the metro station and tear down the steps into the bowels of the Earth 7.35am Avoid eye contact weave through the crowd [BREATHE] Stand on the platform wait for my train Stare at people's feet and my own [B R E A T H E] How strange all these feet tapping across the grey floor in their high heels and trainers… Hang on a minute! That man's wearing flip flops and pink nail varnish! I can't resist, I look up to see whose preposterous feet these are with their huge toes flourishing their fuchsia attire and immediately meet a pair of amused eyes watching me watching them, I fell into the trap. They were waiting for me.

My surprise brings a smile to the owner's kind good-natured face.

"I like to let my feet breathe," he says. *"I think they look more cheerful in pink and they make people dare to look at others, like you have. Breathe! The wonderful thing here is the variety! Make the most of it! So many faces, So many identities, thoughts, stories! Don't be afraid of these sweet, brief encounters! Don't be afraid of eyes, smiles, complicity! Enjoy this togetherness. It doesn't last, but it reconnects us. With others, and with ourselves! The metro is a source of inspiration. Have a good journey, my friend!"*

I follow the man on to the train that's just stopped at the platform, lose sight of him, find a spare seat and start to sit down, but I'm a bit clumsy and find myself on the lap of a large lady who smells of jasmine. I apologise profusely. She bursts out laughing and her mood is contagious. No I didn't hurt her, I'm not that heavy. I squeeze in beside her and take out my book. I glide through the lines, savour a few poems, then venture a look around. A bouquet of faces. Life is sweet in the bowels of my city. I feel good, surprisingly good… I savour the smiles, the conversations, the colours of people's skin, eyes and clothing… I'm travelling, transported, serene. My stop already! I say goodbye to the jasmine lady who gets off too.
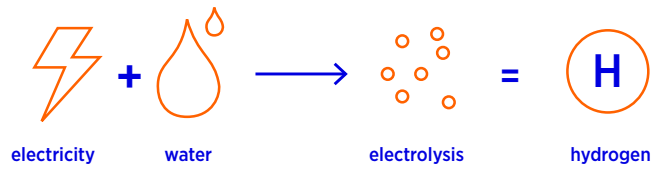
It's 8.15. I can't believe it, I'm early and I've loved my deep dive into the city. I've got my breath back.

I get to my meeting feeling zen.

There's a slight scent of jasmine.

There she is, at the other end of the table, smiling. ●

electricity + water → electrolysis = hydrogen

HYDROGEN MOBILITY IS GAINING REAL TRACTION. ALL AROUND THE WORLD, H-POWERED BUSES ARE STARTING TO APPEAR IN OUR CITIES. THE BENEFITS ARE SIGNIFICANT: THEY DON'T POLLUTE, THEY DON'T MAKE ANY NOISE, THEY'RE QUICK TO REFUEL AND THEY OFFER GREATER RANGE THAN THE EQUIVALENT BATTERY-POWERED VEHICLE. SO, DOES HYDROGEN HERALD THE FUTURE OF SHARED MOBILITY?

HYDROGEN: THE FUEL OF THE FUTURE?

by Julien Thèves

The transport sector is one of the largest CO_2 emitters in the world. In **France,** alone, cars, trucks and other vehicles release 120 million tonnes of CO_2[1] into the atmosphere every year. In cities, the level of pollutants has become critical. Internal combustion engines emit carbon dioxide, nitrous oxides and tiny particles. Thankfully, a growing proportion of these vehicles are running on gas or electricity. All these innovations are positive, but of course none of them is a fix-all solution. Natural gas is a fossil energy, which is running out. Biogas, derived from biomass, isn't yet produced in large enough amounts. And electric vehicles are heavily reliant on relatively rare metals such as lithium to make the batteries that power them. However, there's a new energy carrier on the block: hydrogen.

(1) Source: Insee, France's national office for statistics and economic studies.

1
H
Hydrogen
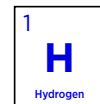
WHAT IS HYDROGEN?

Hydrogen is one of the simplest and most abundant elements in the Universe, accounting for 75% of the mass and 92% of the total number of atoms. However, it doesn't really exist in its pure state on Earth, naturally occurring instead in the form of dihydrogen (H_2). Combined with oxygen, it forms a water molecule (H_2O). In industry, hydrogen is widely used for producing ammonia for fertilisers and refining petrochemical products. The metallurgical, electronics, glass and textile industries also use a lot of it.

A BRIEF HISTORY OF HYDROGEN MOBILITY

1799

------- French engineer **Philippe Lebon** predicted that "hydrogen gas" could be used as a "force applicable to machines". However, it took almost two centuries for his vision to really become a reality.

PHILIPPE LEBON
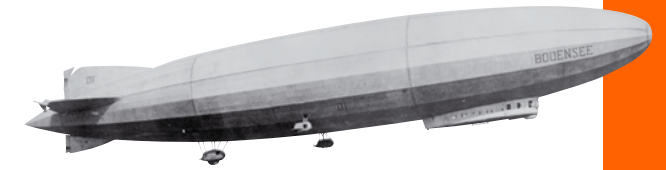
Early 20th century

------- Airships used **dihydrogen**. This lighter-than-air gas enabled them to gain height, but it wasn't used to provide forward thrust. It was the wind that naturally propelled those impressive craft. Today, dirigibles use helium, which is also lighter than air.

19th century

------- Some internal combustion engines were running on **coalbed methane**, partly composed of hydrogen.

A COALBED METHANE ENGINE
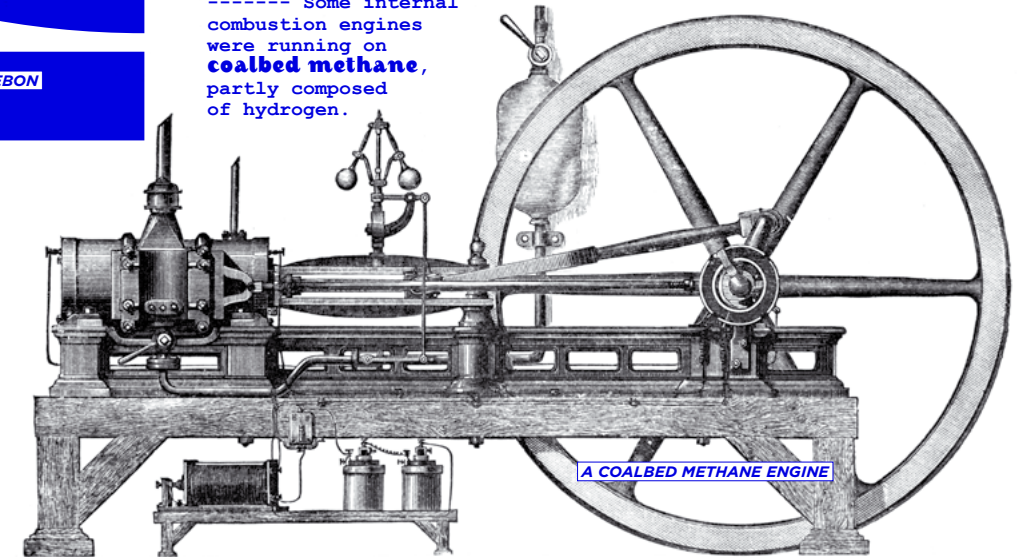
1939

------- Swiss chemist **Christian Schönbein** discovered the properties of the electrolysis of water, which would form the basis of the fuel cell: by passing an electric current through water, the H_2O molecules are split into dihydrogen (H_2) and dioxygen (O_2). Conversely, when hydrogen is fed into a fuel cell, it mixes with oxygen and generates an electric current, which can be used to power a vehicle, for example, while giving off water vapour.
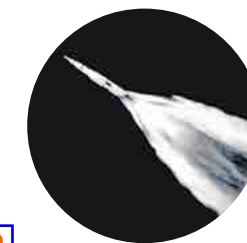
1959

------- A prototype **fuel cell** was developed. It was used as a model for the fuel cells on the Saturn rockets on the Apollo programme.

1799

1959

HYDROGEN IN ALL ITS COLOURS

When it's produced by steam reforming of methane, it's called **'grey hydrogen'** because the process generates CO$_2$. If the CO$_2$ is recovered and used by sparkling water and other drinks manufacturers, for example, it's known as **'blue hydrogen'**. And if the hydrogen is produced by the electrolysis of water using electricity from a renewable source, we say it's **'green'**.

A force applicable to machines

Two centuries after French engineer Philippe Lebon realised that "hydrogen gas" would one day be a "force applicable to machines", 🚐, 🚌, 🚚, 🚐 and even 🚲 are now running on H! So, how does it work? Hydrogen is found almost everywhere in the Universe, but rarely in its pure state. To obtain this precious gas, there are several methods.

> ❝ **A hydrogen-powered vehicle runs on electricity. But its refuelling time is shorter, its range greater and its hydrogen tanks lighter and more compact than the batteries on an all-electric vehicle.** ❞

Widely used in industry, hydrogen can be produced by steam reforming of natural gas, which is converted into H$_2$ using heat and water vapour. There's also a more ecological solution, which doesn't release any CO$_2$ into the atmosphere: electrolysis of water. By passing an electric current through water, H$_2$O molecules are split into dihydrogen (H$_2$) and dioxygen (O$_2$). The hydrogen obtained is then compressed and stored in a high-pressure tank on a vehicle. When you press the accelerator, hydrogen is fed into a fuel cell where it mixes with oxygen in the reverse reaction to the electrolysis of water. Electricity is recreated, and the only by-product is heat and water vapour. In other words, a hydrogen-powered vehicle actually runs on electricity, but with a few notable differences. Its hydrogen tanks are much lighter and more compact than the batteries on an all-electric vehicle. Refuelling time is 10 to 30 minutes, compared with several hours for an electric bus. Plus, it has greater range – over 300 kilometres (186 mi), compared to an average of just 250 kilometres (155 mi) for a conventional electric bus. And of course, it's just as quiet as its all-electric cousin (about the same sound level as a normal conversation). Even more beneficially, when the electricity is from a renewable source, such as wind or solar, the hydrogen is deemed to be 'green'. Thus, it can effectively 'store' electricity from an intermittent source for future use – as fuel for a bus, for example.

Coming soon to a city near you!

In the Yvelines area, southwest of Paris, **France's** first hydrogen-fuelled 🚌 has been operating the 9 kilometres (5.5 mi) route between **Versailles** and the town of **Jouy-en-Josas** since September 2019, without emitting any pollution. In **Pau,** southwest France, the Fébus fleet of eight vehicles, operated by Keolis, provides services using locally produced hydrogen. In the **north of France,** six hydrogen-powered 🚌 connect the towns of **Auchel** and **Bruay-la-Buissière.** Similar projects are taking shape in **Le Mans, Chaumont, Dijon** and **Lyon.** Admittedly, these non-polluting vehicles cost more than a conventional bus, but a lot less than a 🚋. Elsewhere in Europe, they're causing quite a stir. **Antwerp** 🇧🇪, **Oslo** 🇳🇴, **London** 🇬🇧, **Birmingham** 🇬🇧, **Aberdeen** ✉, **Hamburg** 🇩🇪, **Cologne** 🇩🇪, **Rome** 🇮🇹, **Milan** 🇮🇹, **Reykjavik** 🇮🇸 and **Riga** 🇱🇻 are all rolling out hydrogen 🚌, thanks to the support of European or national programmes. By 2022, almost 600 H-powered 🚌 are expected to be in

EUROPE'S COMMITMENT TO HYDROGEN MOBILITY

With **Europe on the Move,** the EU is promoting ways to reduce CO$_2$ emissions in transport. With the **Clean Hydrogen in European Cities** (CHIC) project, the **Joint Initiative for hydrogen Vehicles across Europe** (JIVE) and the **Fuel Cells and Hydrogen Joint Undertaking,** the European Union is supporting the sector by means of subsidies and recommendations for energy producers, manufacturers and authorities. Recently, the 28 member states agreed funding of €40 million for the rollout of 600 hydrogen buses in **Lithuania, Denmark** and the **United Kingdom** as part of the **H₂Bus Europe** project.

A Brief History of Hydrogen Mobility

PART 2/3

1980

DIAMOND HK-36TC SUPER DIMONA – BOEING

1980

------- Japanese carmaker Mazda launched a research programme to run its rotary piston engines on hydrogen.

2008

----- Boeing conducted its first test flight with an **aircraft** powered by a hydrogen fuel cell.

HR-X MAZDA

2015

------- Toyota launched the hydrogen-powered Mirai, with a refuelling time of just three minutes. The same year, China unveiled the first hydrogen-powered **tram,** with a capacity of 380 passengers.

2015

---- This year also saw the launch of the world's first hydrogen-powered **taxis.** Paris-based company Hype unveiled the initiative at COP21. In 2020, it aims to increase its fleet to 600 vehicles.

2015

ALPHA – PRAGMA INDUSTRIES

------- The first hydrogen-powered **bicycle** was introduced. Its extended range of 100 km (62 mi) and fast refuelling time of just 2 minutes make it a much better performer than the electric bikes that have been used in major cities since the 2000s.

2017

------- The first Coradia iLint hydrogen-powered **train** built by Alstom entered service in Lower Saxony, Germany. It has a range of 1,000 kilometres (620 mi).

CORADIA ILINT – ALSTOM

2017

service in Europe. And it's not just 🚌. In **Paris** 🇫🇷, the Hype fleet of taxis runs on hydrogen. Hydrogen 🚲 can be seen in **Chambéry** 🇫🇷 and **Laval** 🇫🇷, France, and a hydrogen 🚊 has already hit the tracks in **Germany.** The **United States** has invented the hydrogen 🚚 *(see "A brief history of hydrogen mobility" opposite)*, while a 🚢 is being tested in **Nantes** 🇫🇷. Indeed, this new energy carrier is driving a huge economic and political effort. Asian countries are especially convinced of its benefits. **China** is running 🚌 on hydrogen. The Chinese government has stopped all subsidies for electric batteries, diverting them instead to hydrogen. In **South Korea,** all 🚌 will be running on electricity within 10 years – and hydrogen will be a key part of the mix. And in **Japan,** 100 H 🚌 will be in service for the 2020 Summer Olympics. The country plans to have 900 stations and 80,000 vehicles in service by 2030.

Cutting the financial and environmental costs

Currently, electrolysers produce hydrogen at around €10 per kilogram. For a 🚌, this means a fuel cost of €80 per 100 kilometres (compared to just €20 in the case of biogas). In the longer term, as production scales up to industrial volumes, the cost of vehicle fuel cells should come down. Some are already being produced in **France** by Symbio, which was recently bought by Michelin. 🚌 manufacturers like Solaris, Van Hool, Safra and Caetano are working to offer 12-metre hydrogen 🚌 at an attractive price of around €650,000 – but joint orders of 100 vehicles or more could bring the price down

to €450,000, according to Jean-Marc Ducros, Director of Alternative Energies at Keolis. To date, if you add up all the costs, the total cost of ownership of a hydrogen 🚌 is still high – 2.5 times more than a diesel vehicle.

Creating a conducive ecosystem

Costs will only come down if all stakeholders are onboard. In **Europe,** the development of **'hydrogen valleys',** led by the Fuel Cells and Hydrogen Joint Undertaking (FCH JU), is a step in this direction. Three European regions – **Auvergne-Rhône-Alpes,** 🇫🇷 **Aragon** 🇪🇸 and **Northern Netherlands** 🇳🇱 – joined forces in 2019 to create a conducive environment for hydrogen mobility, with electrolysers, hydrogen storage facilities, networks of stations and vehicle fleets. In total, almost 250 initiatives are being supported by the EU[2]. The **Netherlands,** is planning to repurpose some of its gas pipelines to transport hydrogen produced using electricity from offshore windfarms. In **Germany,** an R&D programme with a budget of €1.4 billion over 10 years has been adopted. It's expected to attract a further €2 billion in private investment. Other countries are planning to massively scale up hydrogen production. **Chile,** for example, has huge solar energy resources and could one day export hydrogen by sea. Hydrogen has a major advantage: produced from electricity, it can be stored for future use. Intermittent renewable energies, such as solar or wind, can thus be captured for later. ●

(2) https://hydrogeneurope.eu/index.php/projects.

In **France,** the Plan for the Deployment of Hydrogen for the Energy Transition (PDHET) was announced in June 2018, with funding of €100 million. By 2028, it calls for 20,000 to 50,000 hydrogen-powered light duty vehicles, 800 to 2,000 heavy duty vehicles and 400 to 1,000 stations across the country. In the **United States,** the California Fuel Cell Partnership has deployed around 50 hydrogen stations in cities and towns around the state. By 2030, almost 1,000 are expected to be in operation. In **China,** the government is aiming to get 1 million fuel cell vehicles on the roads by 2030. In **Japan,** where hydrogen mobility originated, Toyota, Honda and Mazda have helped get the necessary ecosystem in place. And **South Korea,** home to Hyundai, is investing €2 billion to become the world leader in hydrogen cars. In the Land of the Morning Calm, the new hydrogen economy is expected to create 200,000 jobs in the next 20 years.

A Brief History of Hydrogen Mobility

2018

FÉBUS, PAU'S BRT

2019

------- Several manufacturers have a stake in the hydrogen **bus** market, including Van Hool (Belgium), Solaris (Poland), Safra (France) with its Businova vehicle and Gaetano (Portugal) with Toyota technology.

2019

------- Nikola Motors unveiled its hydrogen-powered **truck.** Available to lease – not buy – it has a range of 1,600 km (≈ 1,000 mi).

NIKOLA MOTORS

SKAI, D'ALAKA'I

2019

------- Skai, the first hydrogen-powered eVTOL **air taxi**, was launched by American company Alaka'i Technologies. It has a range of 640 km (400 mi) and a fast enough refuelling time to eventually make it a viable new form of shared mobility.

2025

------- Singapore-based company HES Energy Systems is currently developing the first hydrogen-electric **aircraft** for operation on inter-regional routes. It will be able to carry passengers and merchandise alike. The first prototype should be ready for testing in five years.

2020

------- Toyota announces the arrival of a new generation of its Mirai car, with several thousand already sold worldwide. According to Toyota, however, it will be the end of the decade before hydrogen vehicles are available at the same price as hybrids.

ELEMENT ONE, H3 DYNAMICS

FARE DODGING– EVER BEEN TEMPTED?

WHETHER IT'S OPPORTUNISTIC OR ORGANISED, FARE EVASION ON PUBLIC TRANSPORT IS NO MINOR ISSUE. AROUND THE WORLD, TRANSIT NETWORKS EVERYWHERE FACE ONE OR MORE OF MULTIPLE AND CONSTANTLY SHIFTING TYPES OF FARE EVASION. *PULSE* UNCOVERS THE ECONOMIC AND SOCIAL REALITIES BEHIND THIS GLOBAL BANE AND EXPLORES POTENTIAL SOLUTIONS TO EFFECTIVELY TACKLE IT.

by Adeline Tissier

When it comes to fare evasion in France, if there's one image that sticks in people's minds it's that of former president Jacques Chirac jumping over a ticket barrier in the Paris metro in 1980, when he was mayor of Paris. As well as making the news, the scene is symptomatic of the small liberties a lot of people take with their local transport network – be it now and again, or on a more regular basis.

Is it because they see public transport as something that belongs to everyone? Or because they can't afford the fare? Or because of an incident on their journey? Categorizing fare evaders is complicated *(see opposite)* because there are as many reasons for fare evasion as there are evaders. And many reject responsibility by pointing to a broken ticket machine or lengthy queues at the ticket office…

OUT OF SIGHT, OUT OF MIND

While some figures are available – for example 1% of commuters have committed fare evasion in Shanghai 🇨🇳, 6% in London 🇬🇧 and 20%

in Marseilles 🇫🇷 – a lack of exhaustive research makes it hard to get a clear picture of the issue.

Christophe Merlin, Director of Passenger Safety & Fare Compliance at Keolis, believes there's a simple reason for this: **"fare evasion is either a source of shame or is hushed up.** Most often, it reveals a failure of the entire process deployed to fight fare evasion – from the definition of services and pricing to punitive fare evasion enforcement, communications and dissuasion. This is compounded by the fact that operators and transport authorities adopt varying degrees of response for tackling the issue. What's more, they tend to downplay the level of evasion or issue ambiguous figures. Based on **'visible fare evasion'** (by comparing ridership with revenue), the figures mostly underestimate **'real fare evasion',** which is thought to be four times higher."

This was revealed by Cerema[1] and confirmed by France's state auditor, the Cour des comptes[2]. In Europe, the UTP[3] rail and public transport union is today addressing the issue, and the French Ministry of Transport is working on a reference system to provide common definitions for assessing fare evasion. **"Aiming for a more in-depth assessment also implies recognising the scale of the problem – and demonstrating a commitment to fight fare evasion,"** emphasises Christophe Merlin. **"This is especially true since fare dodging**

has become quite sophisticated,"** explains Xavier Arrufat, Founder & Chief Executive Officer of Barcelona-based AWAAIT Artificial Intelligence. **"Mobile apps are now available that alert passengers of upcoming ticket inspections."**

MAJOR ECONOMIC RISK

For PTAs and operators, the risks involved are substantial, with passenger and staff safety obviously one of the main ones.

However, the financial risks are the greatest. Lost revenue due to fare evasion significantly hampers investments and can potentially derail plans to upgrade networks, improve passenger service or carry out maintenance operations.

These losses are further exacerbated by the **scissor effect** currently facing networks[4] On the one hand, costs are rising, fuelled by the need to expand service offerings, while on the other hand, revenue is falling due to an increase in the range of travel passes and the drop in full-fare ridership. In France, the Cour des comptes (state auditor) puts estimated revenue losses at between €500 and €600 million a year for all operators.

AREAS FOR ACTION

So what can be done? Certain approaches have already proved effective. **"These include tapping into predictive data to focus fare**

SIX TYPES OF FARE EVASION

"CALCULATED" RISK-TAKER: believes the reward outweighs the risk of fare evasion.

"ACCIDENTAL" EVADER: ticket vending or validation machine not working, misunderstood the fare policy, "forgot" to buy a ticket, travel pass/ticket lost or stolen.

"CAN'T AFFORD IT" EVADER: does not have the means to pay for a ticket.

"EVENT" FREE-RIDER: takes advantage of a major cultural or sports event involving large crowds, when operators prioritise passenger flow.

"MILITANT" FARE DODGER: dissatisfied with service quality or disagrees with what they believe to be excessive fares.

"CAREER" EVADERS: intentional fare evasion (often involving delinquent or other anti-social behaviour like loafing) or organised fare evasion (fake travel passes, alerts via social media, tapping into system vulnerabilities, etc.).

Source: Fare evasion in ground public transport networks, French Ministry of Ecological and Inclusive Transition, 2019.
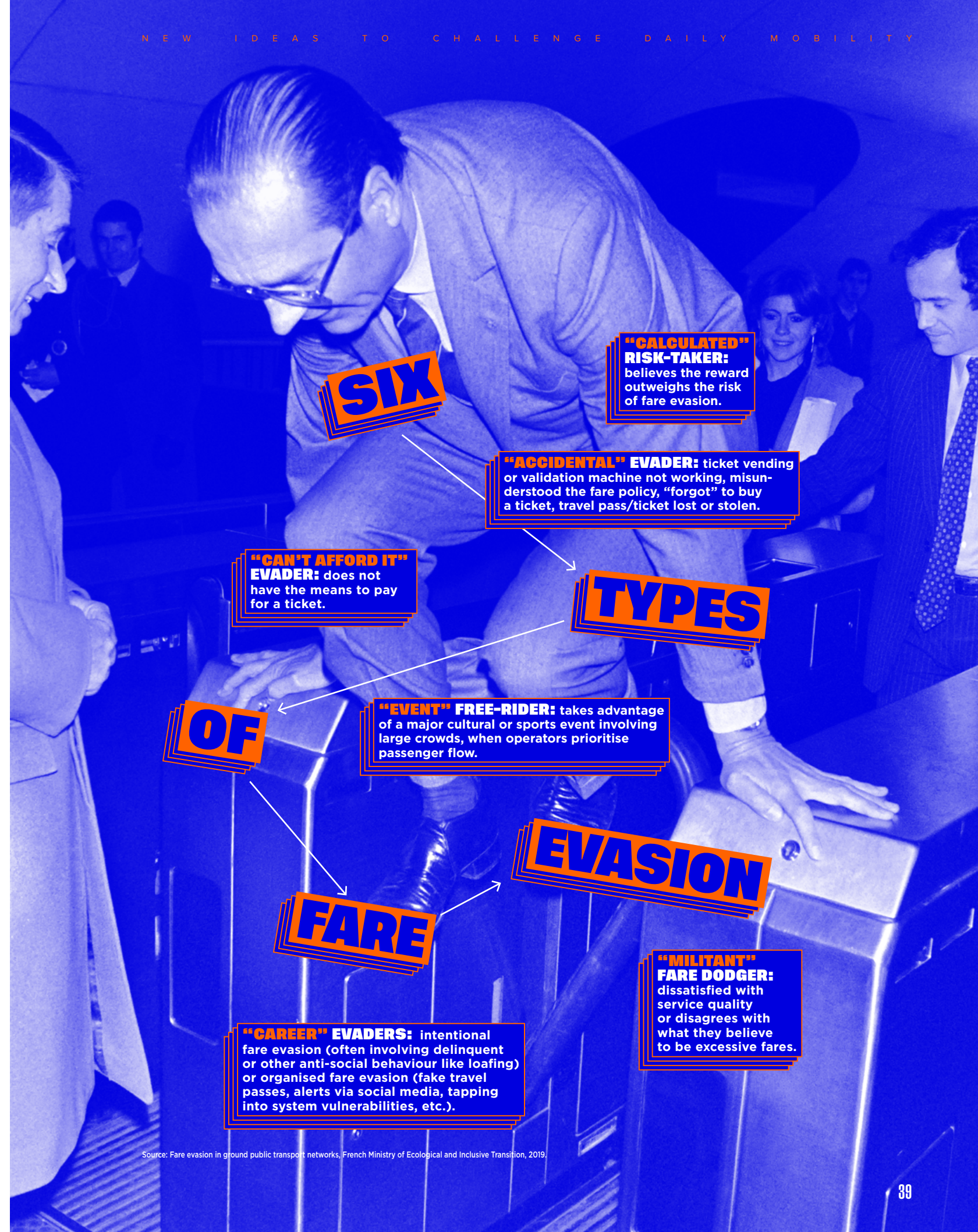
(1) French Centre for Research on Risks, Environment, Mobility and Infrastructure.

(2) Cour des comptes, 2016 annual public report.

(3) French Union of Public Transport and Rail operators (UTP).

(4) Gestion de la lutte anti-fraude dans les transports publics - comment lutter contre les voyageurs sans billets? Sia Partners, December 2015.

HOW TACKLE EVASION

CAN WE FARE ?

PRICING 1

Social (concessionary) fares. The Netherlands, Germany and France offer concessionary fares (for example for the unemployed or people on low-income).

Passenger loyalty incentives via monthly/annual passes and/or discounts. Kalsruhe (Germany) allows passengers to travel for free at certain off-peak times.

Failsafe vending/validation systems. Some network operators implement rigorous maintenance policies to ensure ticket vending and validation machines remain in perfect working order.

Electronic ticketing. In France, Dijon is the first city to allow passengers to pay for their journey directly onboard using their contactless credit card as part of an "open payment" system. Other technologies include NFC, M-tickets, SMS tickets and online purchases.

Free travel for refugees and asylum seekers. In Lille, Keolis has partnered with an NGO to provide travel passes for undocumented refugees.

PREVENTION 2

Communication campaigns. To help reduce the €8m loss in revenue incurred by the city of Bordeaux, a public awareness campaign has been rolled out spotlighting the real cost of a trip by bus or tram.

Nudge-based incentives. In Besançon, a Proof of Concept (PoC) is under development to facilitate the work of fare enforcement officers by counting fare violations in real time.

Passenger relations training for inspectors to encourage less harsh treatment. In Dijon, passengers that forget to validate their passes are given a second chance.

DISSUASION 3

Access barriers on closed networks. In Lyon, tickets are valid for a specific duration rather than journey. Tickets are time-stamped by barriers to prevent them being passed on to other passengers.

Convert fare dodgers into legitimate paying riders. In France (Rennes, Besançon and Dijon), instead of paying a fine, people caught free riding can buy a travel pass under the Keolis Trok'It scheme.

Alert passengers about upcoming fare enforcement actions. Messages are published in the press or sent to pass-holders by email in order to win their loyalty.

"Scramble" fare dodging apps. A technology that makes free riders think ticket inspectors are operating at every station, making it impossible for them to share accurate information.

Communicate on outcomes of fare enforcement actions and prosecution of repeat offenders. This widely used tactic calls on the regional daily press and social media.

FARE ENFORCEMENT 4

Smart barrier cameras. In Barcelona (Spain), a system based on clearly visible cameras had helped reduce fare evasion by 70% in a month.

Increase inspections, especially for specific times and places. In conjunction with startup Datategy, Keolis is trialling a predictive data solution across several networks to optimise inspectors' rounds.

Strengthen fare evasion fine systems. The Oscar solution developed by Keolis centrally issues and manages electronic penalty fares and fines to ensure all evaders pay. It will be rolled out on all networks in France in 2020.

Undercover transport inspectors. Leveraging behavioural sciences and targeting determined fare dodgers (travelling without a ticket), this technique unsettles culprits and avoids having to check all passengers, which hampers flow.

Community work for repeat offenders. Combining fare enforcement and education, this initiative targets fare evaders facing their sixth fine. They are required to assist with preventive actions – in full staff uniform – or accompany passengers with reduced mobility at cultural or sporting events.

EDUCATION 5

Social assistance for people caught fare dodging. In partnership with community groups and social inclusion agencies, this approach raises awareness about reduced pricing polcy.

Awareness campaigns for young people. Communications campaigns are conducted mainly in middle and high schools, as well as universities, especially at the start of the school year.

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inspections on the worst affected parts of the network at different times of day," explains Xavier Arrufat. Installing more ticket barriers is also highly dissuasive. By taking this direction, the Dutch city of Amsterdam has managed to not only reduce fare evasion (down 34% between 2015 and 2018), but also the number of violent incidents on its network (-27%)[5]. **"But we nevertheless need to think on a wider scale,"** says Christophe Merlin. **"Fighting fare evasion shouldn't amount to just slapping fines on fare dodgers or taking one-time measures. We need to consider every aspect of the passenger journey and devise targeted actions at each stage."** For Xavier Arrufat, **"The answer lies in combining different approaches: dissuasion doesn't work without fare enforcement, and vice-versa. It's all about striking the right balance."**

The first step is to assess the issue to get a clear understanding of who fare evaders are and why they choose to flout the law. Defining a clear methodology addressing network features and passenger profiles is crucial.

Secondly, fare structures must be tailored to local social and economic realities. To be accepted and complied with, the fare policy (pass options, discounts, etc.) must be simple and easy to understand. And it must be seen to be fair and appropriate. "Social" fares can be part of this mix. Another key factor is a robust ticket vending and validation system to prevent unintentional fare evasion due to faulty equipment.

Lastly, penalty fares and fines must be fully enforced. Fare compliance must look beyond ticket inspection. **"The French state auditor reported that 60% of fines issued in 2016 weren't paid. This is no longer acceptable,"** says Christophe Merlin. **"For the system to be consistent and credible, we need to ensure all fines are paid so that fare dodgers can't get off scot-free. Naturally, passengers in Doha, Lyon and Barcelona won't be subject to the same policies. But one thing is certain: dialogue is essential."**

To win the fight against fare evasion, we need everyone onboard – elected officials, regional authorities and operators, but also law enforcement agencies and community groups. We'll only succeed through a policy that benefits all stakeholders, enabling them to support investments and the necessary actions. ●

(5) How Dutch Transit Agencies Fend Off Fare Evaders, City Lab, January 2019.

"Fending off fare evasion calls for constant vigilance"

READ THE INTERVIEW WITH XAVIER ARRUFAT, FOUNDER & CHIEF EXECUTIVE OFFICER OF AWAAIT ARTIFICIAL INTELLIGENCE ON: **pulse-mag.com**

SOVIET BUS STOPS

CANADIAN PHOTOGRAPHER CHRISTOPHER HERWIG CHANCED UPON A REMARKABLE NUMBER OF STRIKING AND OFTEN FLAMBOYANT BUS STOPS FROM THE SOVIET ERA DURING A LONG-DISTANCE BIKE TRIP FROM LONDON TO ST. PETERSBURG IN 2002. HIS DISCOVERY SPARKED A FASCINATION FOR THESE FORGOTTEN GEMS DESIGNED BY LOCAL ARTISTS AND ARCHITECTS TO GLORIFY PUBLIC TRANSPORT. FOR THE NEXT 15 YEARS, HIS QUEST TO UNEARTH MORE OF THESE WEIRD AND WONDERFUL STRUCTURES TOOK HIM ACROSS 14 COUNTRIES AND 30,000 KM.

interview by **Tiphaine Clotault**

★ —— "**Each time I came across another bus stop, it drove me on to find the next one.** I was completely hooked! The most striking designs are found along the most remote roads. When you see these works of art emerge in the middle of nowhere, set against the backdrop of vast and barren landscapes, you feel a unique sense of serenity."

★ —— "**In most former USSR countries, these bus stops are considered devoid of architectural and aesthetic value.** My project has, in all humility, helped rekindle interest in these pieces of history. There are people in Russia who now share their photos of bus stops on social media."

LEARN MORE ABOUT CHRISTOPHER HERWIG'S WORK ON:
www.instagram.com/herwigphoto/

★ —— "**None of the bus stops are shown on maps.** Hunting them down involved endless online searches to find people who might know something about them. And when I'd get there, locating them was like a treasure hunt! My work became a lot easier when Google Earth was launched…"

~ SPECIAL THANKS ~

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