

# REVOLVE



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## MOBILITY SOLUTIONS



- Good Data p.18
- Green Hydrogen p.26
- Climate Finance p.52

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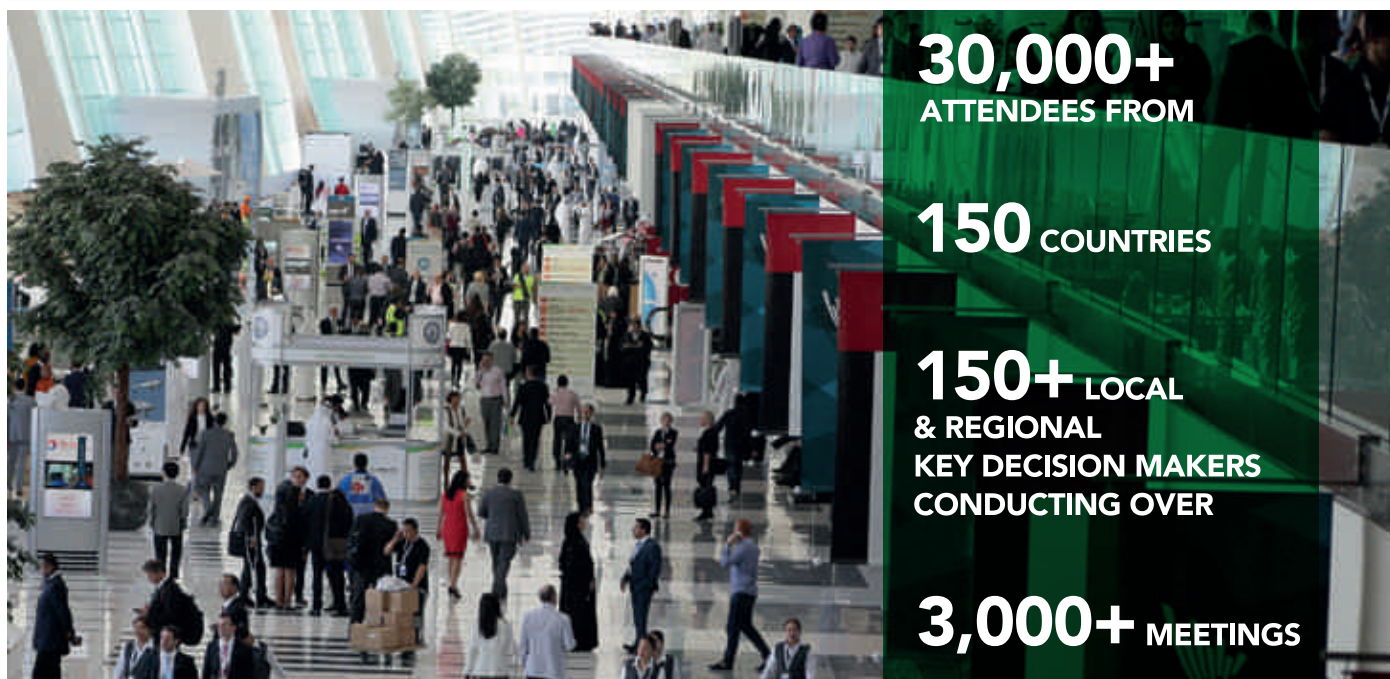
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Source: SSB-AG

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# Mobility goes digital, connected and electric

Writer: Mohamed Mezghani

For several months now, not a week has gone by without news on autonomous vehicles or innovations in ride-selling or ride-sharing apps and other so-called 'new mobility' services.

Digitalization has come to the transport sector and is paving the way for services that are breaking new ground – a development that would have been unimaginable just a decade ago. With the help of a smartphone and an internet connection, users/customers/passengers/people in many cities around the world are now within just a few clicks of finding out which mobility option best suits them at any given moment, together with journey times and prices.

Digitalization is clearly a major driving force behind the recent emergence of new services, new players, and new business models. The surge in car- and ride-sharing is challenging the market dynamics. At the same time, other services will expand the scope and role of the sector, namely:

- App-based on-demand transport – imagine a bus without any stops, routes, or timetables. Relying heavily on IT and data for service operation. The rise in app-

based, on-demand transport is opening new perspectives and leads to rethinking of service definition and network design. Local/regional transport authorities could, for example, procure such on-demand mobility services, which in certain cases might enable the provision of more efficient and/or less costly services than what currently exists.

- 'Mobility-as-a-service' (MaaS) platforms – bringing together multiple modes, together with routing, booking, and payment options, in a single app or interface. A model of urban mobility combining public transport and shared modes, MaaS, or 'integrated mobility platforms', potentially offer citizens the travel flexibility and convenience of the private car without the negative externalities of congestion, emissions, and space wasteful parking.

- Autonomous vehicles offer the potential to provide public transport 'last mile' services. The technology is here and is being tested on the roads now. The challenge is to anticipate the future role and impact of this new transport mode in the wider urban mobility picture. Uber's announcement of the launch of its first commercial service of driverless cars in Pittsburgh and the testing of autonomous

taxis in Singapore perfectly illustrate the innovation race ongoing in this field.

These tech-driven developments are also intrinsically linked to urban trends at large – namely traffic congestion, urban population growth and rapidly shrinking public space, concerns over air pollution and its impacts on health.

The transport sector accounts for 19% of global energy use and 23% of energy-related CO2 emissions. It is the sector with the fastest growing levels of energy consumption and related CO2 emissions. Transferring car-based trips to public transport will consume less energy and avoid carbon emissions. As will the adoption of cleaner propulsion systems

digitalization and electrification are disrupting mobility, redefining the role of the car, and impacting the way public transport is operated

– electric and hybrid drives, renewables, and hydrogen – a direction public transport has already been following for some years now.

This move away from fossil fuels has been further boosted by COP21 and the wider sustainable development agenda. The climate summit served to establish future political direction, with all national governments having since agreed to decarbonize their economies. This will require a strong focus on establishing solutions for decarbonizing the transport sector as a whole, with public transport playing a key role.

Public transport has been a pioneer in using alternative fuels: metros, tramways, and trolleybuses have been serving millions of people daily on all continents for decades. Today, electric and hybrid buses are developing rapidly. Zero emission declarations and visions are being announced and debated, and strategies implemented. Such visions across the regions, including America, Europe, and East Asia, are the push behind trials on the ground to assess the different technologies in real-life operations.

The EU-funded project ZeEUS (Zero Emission Urban Bus System), led by UITP, has identified five challenges as key for the uptake of electric buses in the years to come:

1. Cost: an electric bus costs twice the price of a standard (diesel) vehicle, with its batteries representing up to 45% of this cost, not to mention the investment needed for the charging infrastructure and its installation

2. Operation: operational range, or autonomy, without opportunity of charging) and the flexibility of operations with dedicated



infrastructure

3. Tenders and contracts with regards to the higher cost of electric buses, financial risk sharing between operators and their transport authorities, and consequences on the service contract

4. Interoperability and flexibility in terms of charging infrastructure and methods, for example standardization, fast- versus slow-charging, safeguarding the versatility and flexibility of the bus (one of its key strengths)

5. Energy provision in terms of availability, distribution, regulation, pricing, location of charging points, safety, and so forth

The trends touched upon above – digitalization and electrification – are disrupting mobility, redefining the role of the car, and impacting the way public transport is operated. This will lead to significant changes in our cities in the coming years, indeed some of them are already noticeable. The main challenge will be to ensure these trends benefit the citizen who wants to travel door-to-door, at an affordable price, in comfortable and safe

Alexander Dennis Enviro400 VE  
Virtual Electric Hybrid Bus on  
London Buses route No.69 at  
Stratford bus station

Source: Wikimedia

conditions. It will be up to the numerous mobility actors to find the right ways – institutional, operational and technical – to meet these expectations.

These trends and others will be described and analyzed in the upcoming edition of the Public Transport Trends Report to be published by UITP in January 2017. Enjoy reading! 🌟



**Mohamed Mezghani** has been working for 25 years in public transport and urban mobility related fields. Since 2014, he is Deputy Secretary General of the International Association of Public Transport (UITP) .

# Public transport at the heart of the new mobility world

Change is afoot in the world of transport. Cities around the world are experiencing rapid urbanization, which is in turn leading to greater demand for urban mobility. Daily trips made in urban areas worldwide are predicted to rise from 7.5 billion in 2005 to 11.5 billion in 2025.

Writer: Andrew Canning

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A central role for public transport in Berlin





Our decades-long over-reliance on the private car is leading to congestion, poor air quality and a lack of urban space. This car dependency is choking our cities, threatening our quality of urban life and holding back cities' economic potential.

Despite this, there are parallel trends developing. Younger generations are less interested in owning a car or even obtaining a driving licence than their parents while the emergence of new mobility solutions is helping to make car-free urban living a reality.

In addition, a digital tsunami is hitting the transport sector: mobile broadband, location detection, the insatiable rise of the smartphone and social media are all allowing for new and innovative services to develop that would have been unimaginable

just a decade ago. With the help of a smartphone and an internet connection, users in many cities around the world are now within just a few clicks of finding out which mobility option is best suited to them at that moment, in journey time and

Daily trips made  
in urban areas  
worldwide are  
predicted to rise  
from 7.5 billion in  
2005 to 11.5 billion  
in 2025

in terms of price. Equally, though still in its nascent stages, the autonomous car is set to play a key role in urban mobility in the years to come.

A whole host of new mobility players, many of whom we more readily associate with consumer technologies, are muscling in to the market and causing us to reconsider our mobility options. Political winds are also evolving and beginning to reflect citizens' concerns about air quality, health and wellbeing, meaning that we are gradually shifting away from car-focused urban development to policies that favor active modes of transport.

London's policies on active  
transport have reaped dividends  
Source: UITP





Sharing precious urban space in Edinburgh  
Source: UITP

## Reducing urban car dependency

For cities with long-established infrastructure, increasing road space to accommodate for more cars is simply not an option. On average, private cars are parked 95% of their lifetime and during the 5% of the time they are driven, are much less space-efficient compared to public transport, walking and cycling. Optimizing and increasing the efficiency of the existing space is therefore key to satisfying the needs of different travellers.

International Association of Public Transport (UITP) studies have shown that a broader mix of mobility services is the answer to ever more complex and intense mobility needs. In cities with high-performing public transport, complemented with services such as car-sharing, bike-sharing, cycling infrastructure (eg. clearly designated paths and parking facilities), shared taxi ser-

vices and ride-sharing options people can move around more easily.

This model of urban mobility offers citizens the flexibility and convenience of a private car, without its negative externalities, such as congestion, emissions and wasteful use of space. Indeed, it is this integrated offer of a combination of sustainable urban mobility services that most effectively challenges the flexibility and convenience of private car ownership, providing an answer as it does to ever more complex mobility needs.

Nevertheless, there will still be situations where car usage is not only necessary but also justified. In these situations, car-based services and particularly car-sharing are the obvious solutions to complement 'traditional' public transport as they offer the benefits linked to car usage without the expense or hassle associated with owning the vehicle.

In a fast-moving world when passengers need and indeed expect access to travel information that is instant, easy to use, attractive and authoritative is vital. One-stop mobility shops, such as the SMILE multi-modal app in Vienna, act as personal mobility assistants and are key to offering viable alternatives that users can depend on.

On average, private cars are parked 95% of their lifetime and during the 5% of the time they are driven

# Public transport: a vital role in tomorrow's cities

New mobility services such as ride selling apps (Uber, Lyft), free-floating car-sharing (car2go) or ridesharing apps (Blablacar) have been attracting a great deal of attention and publicity in recent months and are often seen as a panacea for all of our urban mobility woes.

They do indeed play a significant role in cutting car dependency providing door-to-door solutions: according to studies by the University of California, Berkley's Transportation Sustainability Research Center, one shared car replaces 9-13 cars in North America as users either sold a vehicle or postponed a purchase since joining a car-sharing scheme. In Germany, a recent study from Bundesverband CarSharing demonstrated that in German city centers, the percentage of car-free households among car-sharers was 78%. Alone, however, these solutions do not have the capacity or capability to meet every journey need or to solve the issue of traffic congestion.

These services thus depend on an efficient public transport system in order to function well. In San Francisco, the well-established home market of Uber and Lyft, it may be surprising to learn that combined they represent just 1-2%

of all trips made in the city. They need public transport to work well, particularly where mass transit is required between locations across densely utilised urban spaces.

To facilitate the use of carpooling or ride-sharing services, especially dynamic ride-sharing, public transport hubs not only offer the critical mass of potential customers but are also convenient and easily accessible meeting points. In addition, whenever customers use ridesharing to travel to another city, they often rely on public transport upon arrival.

In Paris, 65% of Uber trips start or end within 200m of a metro station. In Berlin, considered as the 'capital of free-floating car-sharing,' the service represents just 0.1% of total trips. This is precisely the point, though: car usage decreases because car-sharing users walk, cycle and use and depend on public transport for the majority of their trips and use a car only when it is necessary. The free-floating car-sharing hotspots in the German capital are all located within the city's rail rapid transit ring (S-Bahn), meaning that the highest vehicle use is made in an area that is also very well served by public transport.

Another important element to consider is affordability. The pricing structure of car- and ride-sharing services offers users the opportunity to access a car when required, but it is not an affordable alternative for all of a citizen's mobility needs, hence affordable public transport is a necessary complement to such bespoke service provision.

The same principle applies to walking and cycling. Access to public transport helps cyclists and pedestrians make

longer, more complex trips and can also provide convenient alternatives when people encounter bad weather, difficult topography, gaps in cycling infrastructure or mechanical problems. Investing in active travel modes not only supports public transport but also contributes to health agendas that seek to increase citizens' levels of physical activity.

With space at such a premium in modern cities, public transport is easily the most efficient in terms of capacity and space capacity, particularly on major corridors and in peak hours, to keep city economies functioning properly. Studies explor-

public transport  
accounts for 1.2  
billion trips across  
the globe each day

ing future urban mobility with shared and autonomous vehicles undertaken by the International Transport Forum show that the most effective combination of modes – with respect to the number of cars removed from the road or kilometres driven – always include high capacity at their core. Public transport will continue to outperform all other modes in the efficiency of the use of space for moving a maximum number of people.

Putting things in perspective, public transport accounts for 1.2 billion trips across the globe each day – compared to Uber's 1 billion rides in five years – and it is this vital 'backbone' role that it plays – in combination with new mobility services – that will ultimately offer more flexible and convenient travel options that will help our cities to become less car dependent.

Public transport  
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of space for moving  
a maximum number  
of people.

# Regulatory questions for cities

The rapidly evolving world of urban mobility is raising interesting questions for cities in terms of how to organize or even regulate the market. Since the offer of an integrated combination of sustainable urban mobility services is the most effective alternative to private car ownership, cities are starting to raise questions about what can be done to encourage combined mobility such as car-sharing or ride-sharing and under what framework.

Cities are beginning to look at different aspects including network and city planning, data and travel information, fares and ticketing and service quality to encourage the take-up of these services and to ensure their complementarity and integration with existing public transport networks.

The German city of Munich, which is expecting its population to increase by 13% by 2030, has already taken forward steps on the issue with its Münchner Freiheit interchange. The hub, which is currently in the test stage, offers a glimpse at what might await users upon arriving at transport stops or stations in the years to come. Here, users have access to all urban mobility services and more, providing: metro/bus/tram connections, car-sharing, electric car-sharing, bike-sharing and taxi services all in one location. Munich's 'MVG more' app provides users with real-time information about their journeys and is the key for multimodal mobility usage.

Or take the example of the Kansas City Area Transit Authority, which took the

pioneering decision to launch a one-year pilot in partnership with (instead of competition against) the ride-hailing service, Bridj. Powered by billions of data points, Bridj's platform determines where riders want to go and how to get them there more efficiently. Using the app, riders can request on-demand shuttle services that they can access via pop-up shuttle stations. It is certainly an interesting precedent and one that other cities will be sure to follow closely.

Public transport at the heart of urban planning in Nottingham  
Source: UITP

## Mobility fit for the future

With burgeoning urbanization and the rise in demand for mobility, cities will need to plan carefully in the future to maximize the use of finite urban space and to develop high quality and high capacity public transport solutions that present a viable and attractive alternative to low capacity private car journeys. No one single solution exists, but the cities that outperform the rest of the pack in the years to come in terms of quality of life and economic growth will be those that place public transport at the core of their planning, complemented by a host of new mobility services and accompanied by a regulatory framework adapted to the local conditions. 





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ELIPTIC project  
Brussels, Belgium, 2015  
Source: STIB/ MIVB



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[www.ebsf2.eu](http://www.ebsf2.eu)

London, UK, 2015  
Source: Transport for London





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# Q&A: Pascal Smet

## Minister of Mobility, Brussels Capital Region



Pascal Smet  
Source: Valentine Courier

Brussels needs a new balance: to go from a city for cars to a city for people.

**You have been in charge of Mobility for Brussels Capital Region in 2004-2009 and now for 2014-2019. What has changed in Brussels during these 15 years?**

Brussels has many mobility challenges: for starters, there are more and more cars. There are some basic factors that are at play: subsidizing 250,000 daily commuters, federal support for company vehicles, tax incentives for living in the countryside rather than in the city (income is more expensive in the city) and savings in public transport outside Brussels. In its drive for modernity in the 1960s, our city attracted too many cars and gave them free passage everywhere. That dominance of car has had a very large impact on the quality of life in Brussels.

There have been, however, quite a few changes: more and more people ride bicycles around the city. Many Brussels residents (37%) move on foot. Investments in public transport take more and more people by tram, metro and bus. This year marks the sixteenth edition of the car-free Sunday. The car-

free Sunday in Brussels contributed greatly to changing the attitudes and mentalities about how we move among citizens and politicians. This initiative has led to the permanent establishment of car-free areas in our capital, such as Flagey, some central avenues and soon Place Dumon and Mirror Square.

In my first term as a minister, we laid the foundation for more sustainable urban development. This term, we are working more on the complexities of implementation.

**What is the best combination for improving sustainable mobility in Brussels? What are the main 'green' elements of your policy?**

Brussels needs a new balance: to go from a city for cars to a city for people. Brussels has 400,000 commuters each day of which 250,000 come in and out of the city with their own car. The result is endless traffic jams – this needs to stop.

The defunct Reyers Viaduct and the opening of central boulevards are just the beginning of a broad movement

where we return the city to the people and invest in renovating public spaces. A meeting place for visitors and locals alike between Louise and Porte de Namur and a car-free zone on the Schuman roundabout and around the European institutions are the following projects.

And we must go beyond these steps: in the next 10 years, we will invest over €5 billion for upgraded subways, more trams and cleaner buses that will better serve and connect neighbourhoods. Families will also benefit from discounts on school passes, so that more children can take the bus. We are also creating 80km of new bike paths around the small ring where parked cars will be moved to make room for trees, cyclists and walkers.

There will be new transit parking areas near Metro and RER stations on the edge of the region, so that commuters and visitors can more easily park their car and more efficiently take public transport. At the national level, we now charge trucks per kilometer in 2016. We will also implement a low emission zone starting in 2018 to support the city-friendly goods distribution with the aim of having fewer cars and less truck traffic in the downtown area, thus decreasing congestion and air pollution.

**What 3 mobility projects stand out most for you?**

I particularly like the renovation of Place Flagey for pedestrians with a bicycle infrastructure, fountains, lighting, new bus stops, a large glass canopy that

covers the tram, new street furniture and trees. This created a new meeting place for young and old in Ixelles.

The Mirror Square in Jette will be completely car-free in October 2018. Under the square, an underground car park with 199 places will be built. The north of Brussels gets so at an important meeting place. Tram 9 will connect Mirror Square with Heysel and Simonis. The quality of life and attractiveness of the district will be enhanced most certainly.

Villo! is the public bike rental service of Brussels. There are 360 stations with five thousand bikes in use. In December 2015, 8 million journeys had been registered since the beginning of the Villo! service in 2009.

In 2030, almost everyone will be moving with an electric bike.

How do you see mobility developing more sustainably in Brussels by 2030?

I hope that Brussels 2030 is truly a city for people; a city that thinks for the people; a city that invites you to walk, cycle, play and live more freely. People will no longer be interested in having an own car. In 15 years, all these cars will be replaced by automatic shared vehicles that you can book through applications. No stationary vehicles but optimum utilization of the vehicles and space. For many inhabitants, the hills of Brussels are still a barrier to take the bike. In 2030, almost everyone will be moving with an electric bike. 🌀



Place Flagey, Brussels  
Source: Hylke Grysseels



Mirror Square in Jette, Brussels.



Pascal Smet on a Villo!  
Source: Les Mecs

# Reinventing Urban Mobility

## Making the best of two worlds

The biggest challenge when tackling urban mobility problems is not to invent or reinvent mobility options, as most are already well-known and have proved to be highly efficient. The true challenge is to optimize and accelerate good practices in this field. And this can only take place if private partners and public bodies talk more often and better to one another to find common solutions and accelerate their adoption.

Writer: Xavier Tackoen

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Rail stations are huge transport interchanges that must progressively evolve to welcome innovative mobility services and new travel patterns. This visual was created within the Rail4Brussels project and aims to synthesize how the Brussels railway system could move forward to better address current mobility challenges.





The transport industry has undergone structural changes throughout its history. Besides resulting in major changes in the way we move, they have also had a significant impact on our territories and the manner in which we organize our lives and society. The train killed off the horse-and-carriage; the car forced local trams into retirement; and the plane practically ended passenger ships. Over the last decade, all indicators have shown that we are gradually entering a new transport era. Digital services – which first conquered the immaterial world (music, cinema, press, etc.) – are now rapidly developing and making inroads into the material world. This is especially evident

in the expansion of privately-owned mobility services, the use of big data and the automation of vehicles.

Given these developments, now is a good time to assess the ways we produce and organize our transportation systems. Some segments have always been managed, and largely organized, by the private sector (airlines, airports, ports, taxis, etc.). Others were launched or taken over by the public sector in order to provide a service accessible to the entire population (railways, public transport). The private and public sectors unfortunately struggle to collaborate efficiently, as their ways of working, risk management and working

timeframes are diametrically opposed. Transportation is however clearly an area where collaboration is essential, because it is operated for the benefit of all citizens and businesses.

Developments in the digital economy offer a unique opportunity to take advantage of the respective strengths of both the public and private sectors. To that end, we need a cultural change on the part of all transport sector stakeholders. The goal should be an era of openness and cooperation, in line with the emergence of the collaborative economy.

## Open innovation

Innovation cannot be commanded from above, but it can be supported or facilitated. Recent experiments with open innovation have demonstrated the value of opening the thinking process to a wider range of contributors, so as to bring in new ideas and break down barriers between established structures. This openness can be tapped into by the authorities and public enterprises, as well as by private companies.

Tesla Motors is a good yet unusual example of an innovation-focused company, yet it is probably a forerunner in this field. Elon Musk has decided to offer 'open' access to the patents on his electric cars. In his view, if a company depends solely on its patents, it is not innovating or at least not innovating fast enough. He believes that patents hold back innovation and block competitors, adding that patents are mostly used to "stifle progress and consolidate the positions of giant corporations."



Elon Musk at the Tesla Factory in Fremont, California.  
Source: Wikimedia

The French National Railway Company (SNCF) is now aware that it cannot do everything alone, despite all its internal skills. As a result, the company decided to start an open innovation process by seeking out external expertise. It set up digital challenges on two themes: 'data' and 'sensors'. SNCF wanted to identify innovative and sufficiently mature companies that would enable it to concretely address specific issues. Its role here is to support these companies in their development, focusing on what benefits the SNCF and travellers.

## Good data

Open Data has demonstrated its relevance by creating many high-value applications (multimodal route planners, parking optimization, better integration of persons with reduced mobility, etc.). This opening trend is well underway and further significant benefits can be expected from it in the transport sector. Data will effectively enhance services to users, strive for more rational travel behaviour, and optimize existing infrastructure.

Many cities have  
lacked in-depth  
knowledge of their  
mobility patterns

However, the opening of data remains incomplete. The private sector, particularly digital actors, increasingly owns a significant amount of transport-related data, thanks to its tracking of individuals through mobile terminals. The big challenge for the coming years is to optimize existing services and make clever investment decisions, in order to generate the best cost-efficiency ratio for society as a whole.



Checking the train network infrastructure.  
Source: Yann Audic / SNCF

Many cities have lacked in-depth knowledge of their mobility patterns. This has prevented them from making coherent choices and above all from making accurate assessments of the impact of their mobility policies. Historically, travel surveys gave an insight into the mobility of citizens by calling on statistical methods that required extrapolation of sources of inaccuracies. These surveys focused mainly on work-related travel, which is now an increasingly small share of overall mobility. Today, people typically have different travel patterns from one week to another and even on a daily basis. This reinforces the need for better contextualization, in order to understand people's travel needs and choices. Digital tools can integrate multiple sensors to characterize the context, trace movements and to process large amounts of data in real time. None of this data or work could be processed/done with traditional methods.

A project in the Belgian Province of Walloon Brabant demonstrated the relevance of such data (by analysing the data from mobile phones and GPS). For the first

time in Belgium, true mobility could be seen, in terms of trips made by the entire population and regardless of travel patterns. These tools have the great advantage of working in 'feedback loops': once the policies have been implemented, the effects can be seen and quantified by these tools. To achieve this however the public and private sectors should engage in a process of active cooperation. This means that cooperation should not be limited only to the collection of data, but should include a real co-construction of assessment tools while maintaining the highest degrees of people's privacy.

The big challenge for  
the coming years is  
to optimize existing  
services and make  
clever investment  
decisions

## Foresight legislation

New legislation on mobility must be developed with care and efficiency, because of the emergence of many start-ups in the field of transport and the gradual establishment of giants such as Google, Apple, Facebook, Amazon (GAFA) or Netflix, AirBNB, Tesla, Uber (NATU). Changes in the transport field are happening too fast and most new mobility entrepreneurship concepts do not comply with the existing legislation, which was established before the advent of the digital age. This means that more flexible rules need to be adopted in this field, in order to encourage experimentation. Indeed, the impact of new mobility services can only be measured if they have reached a critical mass, which is not the case in a pilot project with just a limited sample of users. This situation obviously risks destabilizing markets or introducing unfair competition. To define flexible and scalable legislation, there needs to be better dialogue between public authorities and businesses. It will also be important to set up a co-development approach, one that respects the right to competition and allows the authorities to avoid a permanent loss of control over mobility services.



Protest against UBER in Budapest, Hungary.  
Source: Wikimedia

New legislation on mobility must be developed with care and efficiency

## Cooperative funding

The transport sector needs huge investments to be implemented over many years. Most cities are facing budget cuts, which limits the investments made in transport networks. Furthermore, over the past decade, the operational costs of public transport services have generally grown faster than ridership. This has reduced cost coverage ratios. It is therefore illusory to think that public spending

alone can meet the transport challenges of our cities.

New forms of funding are required to accelerate the development of alternatives to the private car. Companies have a clear interest in contributing directly to the improvement of transport networks and the development of new services. Not in the form of a tax, as happens today

in France with a transport tax (versement transport), but by taking a financial interest in the form of a 'tax shelter', a financial mechanism used for example by Belgium's film sector. Any company that wants to invest in and support an audiovisual production in the country can, via this mechanism, benefit from exemption of any retained taxable profits worth up to 150% of the amounts actually paid. As

a result, the legislator ensures that investors in this sector are only exposed to limited financial risk, while greatly boosting investment.

Businesses can also support the transport sector by making available resources that are underutilized, such as their car parks. For instance, in order to support car-pooling, a non-financial public-private partnership project has started in Wallonia to pool the large car parks of supermarkets. In just one year, over 500 parking places across the region were made available, at a very much lower cost than the construction of new car parks while avoiding the loss of agricultural lands. But the greatest benefit of this scheme lies mainly in private partners' ability to communicate the benefits of car-pooling and ultimately to reduce congestion on the roads of Wallonia. Unfortunately, the region's current transport minister has not grasped the importance of this partnership, which has led to the expansion of car parks through new partnerships being interrupted.

Citizens can also contribute more to the overall revenues of mobility systems by making greater use of the concept of Mobility as a Service (MaaS). This is a field in which Finland is without doubt a pioneer. MaaS represents a shift away from personally-owned modes of transportation, towards mobility solutions that are consumed as a service. This is enabled by combining transportation services from public and private transportation providers through a unified gateway that creates and manages the trip, which users can pay for with a single account. Users can pay per trip or a monthly fee for a limited distance.

A large-scale development of the monthly or annual subscription concept for a household would transfer a huge and unprecedented sums of money to the



Pooled car park in Wallonia, Belgium.



Whim, a mobile app launched by MaaS.  
Source: MaaS

## Insights from Xavier Tackoen, CEO of Espaces-Mobilités



### Q. What is Espaces-Mobilités?

A. Espaces-Mobilités is a consultancy that has been active for more than 20 years in strategic transport projects and landscape design, with the goal of improving mobility in urban and rural areas. It has always been a pioneer in new mobility services such as car-sharing, dynamic ride-sharing, pool taxis or urban cable cars.

“We have become an intermediary between the private and public sectors”

### Q. Do you see a difference in your mobility-related activities?

A. Definitely. For many years, we've been working for public bodies such as regions or municipalities, in order to define mobility plans that only engage public actors. Over the last five years and with the very rapid development of start-ups and digital giants, we have become an intermediary between the private and public sectors. This role is vital, because both these sectors need a neutral coordinator to guarantee their individual interests and to help them understand the constraints faced by each side.

### Q. Why is Espaces-Mobilités using 3D visuals in its projects?

Espaces-Mobilités is convinced that high-resolution 3D footage can help citizens and officials to visualize mobility solutions for a more sustainable future. Many mobility projects involve changing the urban landscape and adapting public space. People are often afraid of change because they don't know how things will be. 3D visuals offer a more comprehensive view of the new environment and facilitate the adoption of new infrastructure.

Citizens can contribute to the overall revenues of mobility systems by making greater use of the concept of Mobility as a Service (MaaS)

shared mobility sector (public transport, car- and bike-sharing, taxis, etc.). Today household expenditure on transport, at least in Belgium, accounts for more than 90% acquisition, use and maintenance of motor vehicles. If these individual budgets were better shared through a global system of mobility, the vehicles would be used more efficiently and the investment capacity in the system would be significantly increased

We can say that the biggest challenge when tackling urban mobility problems is not to invent or reinvent mobility options, as most are already well-known and have proved to be highly efficient. The true challenge is to ensure that urban mobility is one of the highest priorities for citizens, companies

and governments. Urban mobility needs real and transparent cooperation in order to optimize and accelerate good practices in this field. Often when you are struggling with a problem, rather than reinventing the wheel, you should call a friend or colleague to see if they have faced a similar problem. The same should systematically happen in our cities, with private partners and public bodies talking to one another to find common solutions.

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# HYDROGEN

## A credible answer to global energy and mobility challenges

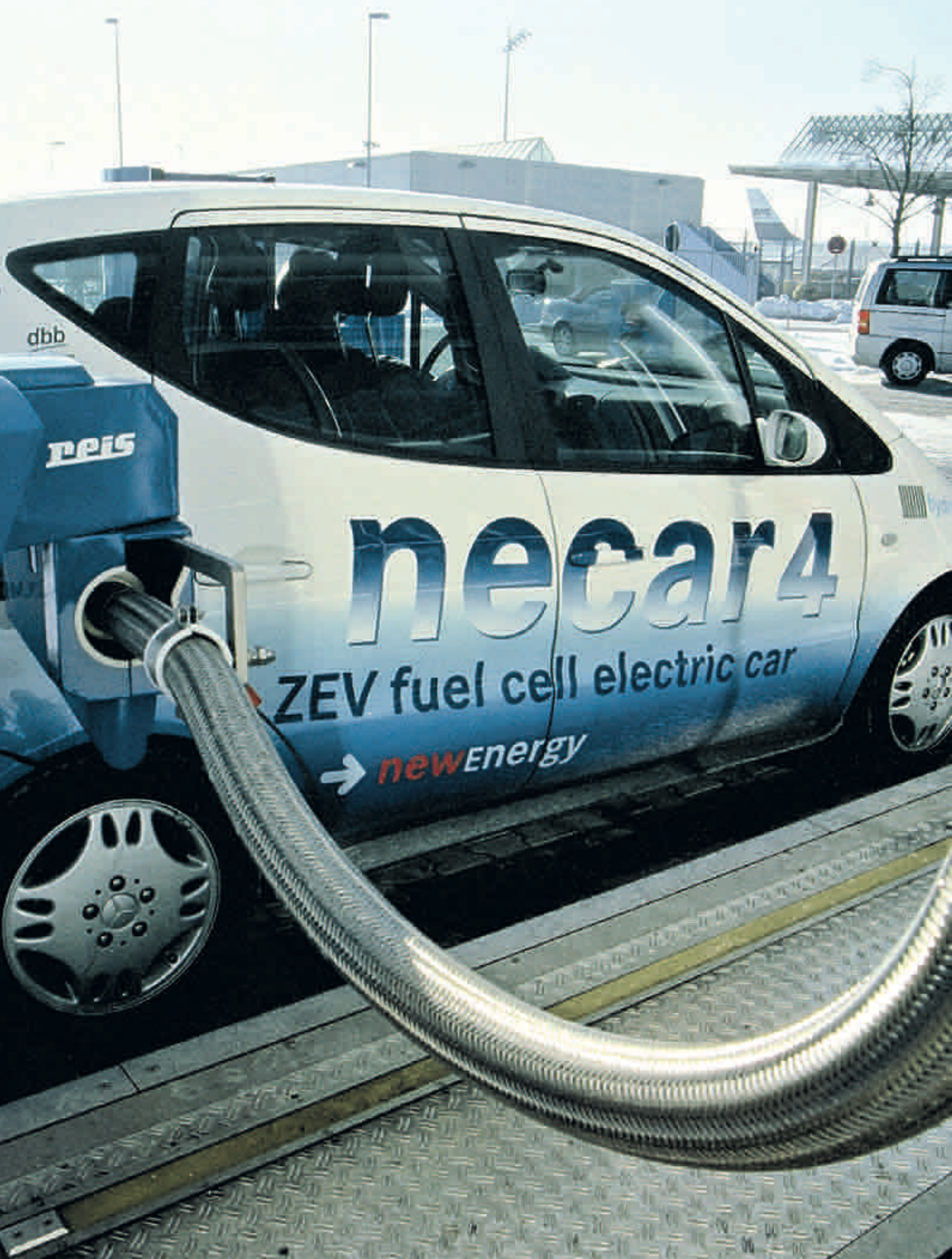
The Paris COP21 climate summit placed climate change at the top of the international political and economic agenda. Hydrogen and fuel cells are part of the solution to the climate crisis and may become a cornerstone of tomorrow's energy and transport systems. Find out why.

Writers: Jean-Christophe Lanoix and Vanessa Vivian Wabitsch

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Fuel cell vehicle at a hydrogen refuelling station.  
Source: Daimler





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For decades, key industries, such as oil refining, ammonia production, food processing, glass manufacturing, metal production and electronics, have been using hydrogen. The market for hydrogen is well established and growing. According to Markets and Markets, the current market for industry applications is expected to grow from \$118 billion now to \$152 billion by 2021.

Over the past decades, hydrogen's economic and environment benefits have led many to promote the development of hydrogen as an energy carrier. Combined with oxygen, in fuel cells (electrochemical energy conversion devices) hydrogen can produce zero-emission electricity and heat and no by-product other than water. Hydrogen is a clean, abundant and efficient alternative to conventional fossil fuels.

Hydrogen can be used to store energy from intermittent renewable energy sources, through water electrolysis —

The market for hydrogen is well established and growing.

the decomposition of water into hydrogen and oxygen through electricity. If the electricity consumed to produce hydrogen is decarbonized, hydrogen becomes a fully-decarbonized energy carrier. Fuel cells are a highly efficient power production technology. Fuel cells' applications are wide-ranging and cover many different fields, from stationary power and heat production to automotive power trains, as well as a power supply for mobile electronic devices.

The passenger car remains one of the most attractive fuel cell applications although it is the most challenging from a technological and economic standpoint. Hydrogen and fuel cells-vehicles

provide inherent value as they directly address the limitations of battery-powered electric vehicles (BEVs) such as their relatively limited driving ranges, and long recharging times. The performance and user experience of fuel cell vehicles (FCVs) is comparable to conventional vehicles. FCVs offer driving ranges beyond 700 km, 3 minutes refuelling times, high efficiency and zero emissions. FCVs are therefore an attractive sustainable transport alternative, especially for passenger cars, public transport and heavy duty vehicles.

Hydrogen is a clean, abundant and efficient alternative to conventional fossil fuels.

Hydrogen storage facilities.  
Source: DLR



# Integrating renewables into power systems

The use of hydrogen as a fuel for power generation or mobility has faced a number of challenges. Hydrogen is not a primary energy source naturally available. It is an energy carrier, like electricity, and needs an external source of energy to separate the hydrogen atoms from other atoms in complex hydrogen-rich molecules, such as water, hydrocarbons or biomass.

Today, over 95% of all hydrogen is generated from fossil fuels, in CO<sub>2</sub>-intensive processes. Due to the low cost and easy availability of natural gas, Steam Methane Reforming (SMR) is globally the dominant production method, ahead of partial oxidation of petroleum oil and coal steam gasification. However, current SMR technology generates around 10 tons of CO<sub>2</sub> per ton of hydrogen. . If hydrogen is to become one day part of the low-carbon energy system, CO<sub>2</sub> emissions will have to be drastically cut at the production level.

HINICIO's research shows that drastic emission reductions are clearly achievable, and that alternative production technologies are already starting to emerge. Water electrolysis offers a very promising path for producing green hydrogen – hydrogen produced by renewable energy with low carbon emissions – while facilitating the integration of renewables in the power system. Today's systems were not designed to cope with high levels of variable power generation. The system integration of wind and solar power will therefore become increasingly challenging. No one wants a flickering TV set because of wind speed variation...

Producing hydrogen by water electroly-



Fuel cell vehicles for public transport.  
Source: Daimler

sis is one solution to this challenge. Intermittent electricity can be converted into hydrogen and used for instance, at another location and point in time – for instance in the transport sector. HINICIO's study commissioned by the TUCK Foundation and co-financed by Total and ENGIE has shown that while both the technology and economics still need to be optimized, water electrolysis may become one of the preferred technological options for managing renewables within the next 10 years. Key to enabling such a development, the creation of a certification scheme for green and low carbon hydrogen. HINICIO is coordinating an innovative European project called CertifHy which specifically aims at developing such a scheme at European level, in collabo-

ration with leading European energy players, issuing bodies, certifiers and regulators. Such initiatives are key to develop a green hydrogen market in Europe.



# Overcoming the chicken-and-egg dilemma

Once produced, hydrogen has to be delivered to the point of use, especially to fuel cell vehicles. As conventional vehicles rely on a network of gas stations, so the deployment of hydrogen mobility will require the coordinated deployment of a sufficient number of hydrogen refuelling stations for drivers to be able to fill their tank whenever and wherever needed. Hydrogen for the supply of services stations, can either be produced on-site (for instance with an electrolyser installed next to the refuelling station) or in more centralized production facilities.

The hydrogen sector has been confronted with a chicken-and-egg dilemma for many years. On the one hand, car manufacturers are reluctant to invest in the manufacturing of fuel cell vehicles without existing hydrogen refuelling infrastructure. Clearly, no consumers would purchase such a car without the ability to refuel it. On the other hand, energy and industrial gas companies are not prepared to roll-out the necessary hydrogen infrastructure before hydrogen cars hit the road as they would face a “death valley” of several years before seeing any profit.

Costs are indeed significant but not out of reach. An EU coalition report published a few years ago estimates that a 2 billion Euro annual investment is needed in Europe to build the infrastructure required for 25% market share of fuel cell vehicles. While, at first glance, such an amount may appear daunting, this sum has to be compared with annual investments in other infrastructure sectors (oil and gas, electricity, telecommunications, transport...) which equal much bigger numbers, to the tune of several tens of billions of euros.

The solution lies in a concerted and coordinated investment approach between infrastructure players, car manufacturers and public authorities at global and local levels to ensure that hydrogen production, delivery and distribution capabilities are deployed in a synchronized manner with sales of fuel cell vehicles, and risks taken by early adopters are properly managed and rewarded. The H2Mobility initiative in Germany, as well as similar developments in Japan and California are good examples of how government and private sector cooperation

can come together to overcome such chicken-and-egg challenges. Several hundreds of hydrogen refuelling stations are currently operating worldwide and major car makers are stepping up to the plate one after another (Toyota, Honda, Hyundai, Daimler, BMW...). Current developments in Germany, Japan and California demonstrate that the infrastructural barrier is slowly but surely being overcome by the industry. However, a clearer and ambitious strategy from leading European car manufacturers is required for the market to take off.



World's first hydrogen-powered tramcar rolled off the assembly line in Qingdao, Shandong province.

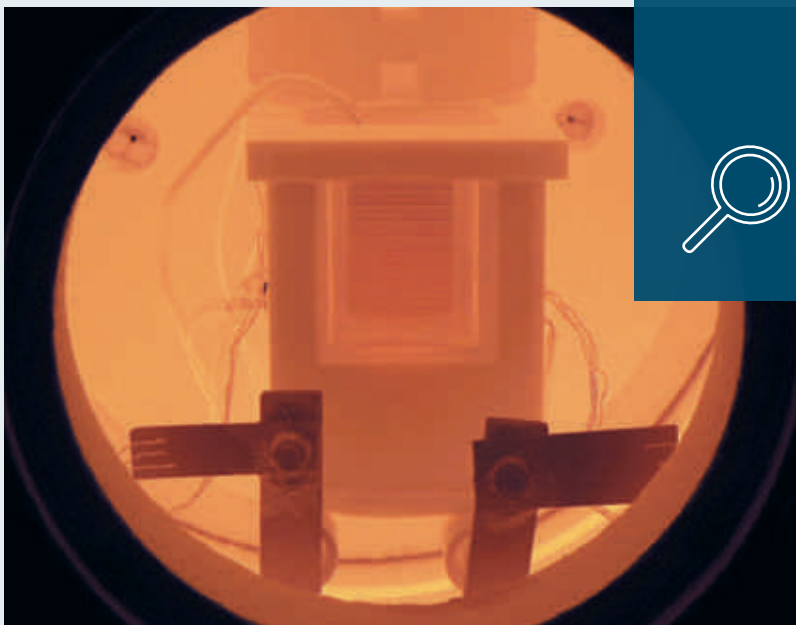
Source: Xinhua

## Reducing costs, increasing production

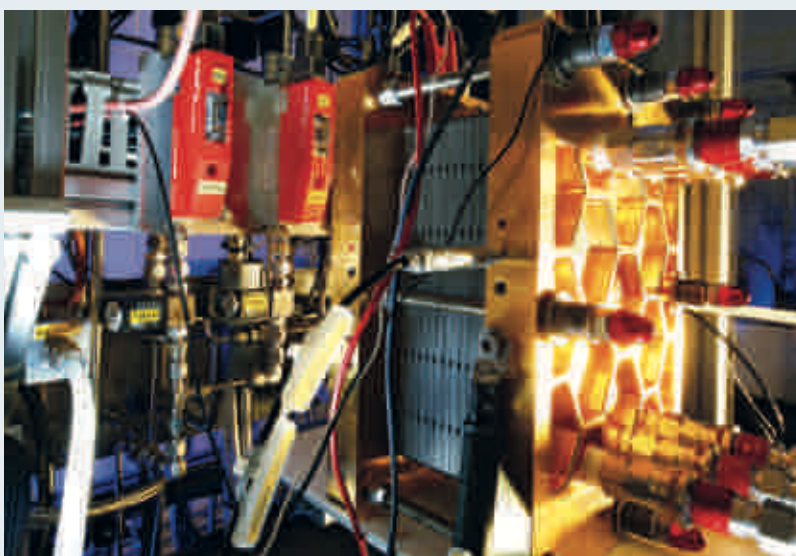
While costs have been reduced significantly and technological performance has improved in the last decade, it is also fair to say that certain technical and economic hurdles still remain along the hydrogen value chain, from hydrogen production down to end-use applications.

For instance, at the production level, the costs of electrolyzers still need to come down by a factor of 2-3 and their durability and tolerance vis-à-vis input variability must improve. This will be necessary to achieve a reasonable target price for the hydrogen at the pump, usually set around 10 euros per kilogram, which is the benchmark value to be on par with gasoline on a per kilometre basis (one kilogram of hydrogen allows users to drive around 100 kilometres).

At the fuel cell vehicle level, various barriers are worth mentioning including reducing the use of expensive precious metals such as platinum, lifetime and reliability improvements, resistance to corrosion, better integration, heat management and overall system simplification. Unsurprisingly, fuel cell costs are also still high mostly due to low production volumes. However, HINICIO's study for a world-leading electricity utility has shown that fuel cell vehicles will achieve cost parity with conventional vehicles as soon as mass production begins. For the time being, car manufacturers appear to be targeting high-end segments with high customer expectations, for which superior performance, range and refuelling experience could offset some of the price differential.



Detail of a fuel cell with measurement windows.  
Source: DLR



Fuel cell research at the DLR institute in Stuttgart is essential for future sustainable mobility and decentralized energy supply of tomorrow.  
Source: DLR

## Interview with Patrick Maio, Founder & CEO of HINICIO



### What are the biggest challenges for the hydrogen industry?

The hydrogen industry's major challenge is to align 3 planets. It is essential to bring economy, technology

and policy on the same trajectory. For hydrogen to become an even wider reality in our everyday lives, we need technological solutions and value propositions which are economically attractive and supported by the right regulatory frameworks and incentives.

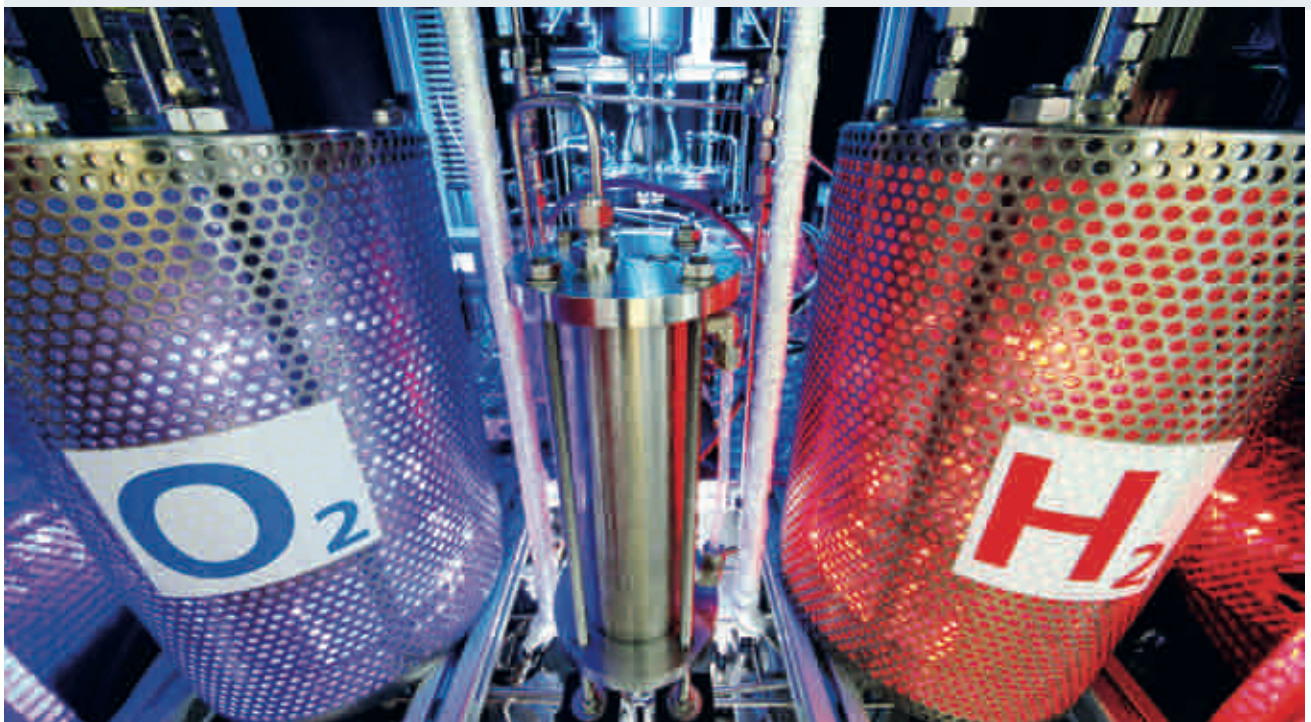
### What are the steps to align these 3 planets?

From an economic and technical standpoint, we are close to market-ready solutions. Some are already market ready. However, policies and regulations have, as yet, insufficiently encouraged hydrogen and fuel cell technologies. For example, there are no attractive subsidy schemes incentivizing people to acquire fuel cell vehicles or to use hydrogen

as an alternative to store renewable energies. Also, adequate financing instruments which would mitigate and reward the financial risks taken by early adopters investing in hydrogen refueling infrastructure have yet to be developed.

### How does hydrogen contribute to climate solutions?

Hydrogen-related technologies have a lot to offer in terms of emissions reduction, greenhouse gases at the global level, as well as local urban emissions which can be very harmful for public health. Hydrogen fuel cell vehicles perform very well on both aspects, beyond offering superior customer functionality (very fast refueling time and longer distance



Hydrogen production from renewable energy resources through water electrolysis with Proton Exchange Membrane electrolyzers.

Source: DLR

autonomy). Rapidly increasing the penetration of renewable energy by mitigating intermittency with hydrogen storage is already an option and would further leverage its greenhouse gas emission reduction potential. Beyond fighting climate change, solutions such as hydrogen are essential to produce and use our energy locally, to mitigate geopolitical risk exposures, ensure our energy security and help rethink our global growth agenda.

#### **How will hydrogen be part of climate solutions in the mid- and long-term?**

The greener the hydrogen we use – whether for traditional industrial uses, mobility or stationary uses – the more sustainable the hydrogen pathway will be. Green hydrogen is essential for mobility and energy applications.

Hydrogen will further help these sectors to fight climate change in the future. We are currently working on a European green hydrogen certification scheme, which will be a key market-enabler in the near future. I am confident that this will happen very soon.

#### **What has to be done now to enable a future with sustainably-produced hydrogen?**

Limited quantities of green and low carbon hydrogen are produced now and only in a few locations, thus lacking economic and market attractiveness. Therefore, it is important to be able to sell green hydrogen everywhere in Europe independently from its production site. Similar to having renewable electricity certificates, we need green hydrogen certificates to boost production

and trading of green hydrogen between producers and consumers which are not necessarily located near one another.

#### **How will a future of sustainably-produced hydrogen look like?**

It will be a future I would like to live in today: greener, peaceful and interconnected.

“Green hydrogen is essential for mobility and energy applications.”

## Confronting climate change

Although many challenges remain to be addressed, the opportunities offered by hydrogen and fuel cells technologies to decarbonize the transport sector while facilitating the integration of renewables are in line with the high level policy goals set during COP21 to curb global greenhouse gas emissions.

Energy utilities, gas companies, automotive OEMs, technology providers, entrepreneurs, cleantech investors, large energy users and policy makers, stakeholders around the world should thoroughly analyze the potential impacts of hydrogen on their activities, business models and product portfolios

in order to cease the upcoming opportunities and embrace this substantial technology disruption.

The emergence of hydrogen as an energy carrier is a growth opportunity and a game changer for the energy industry with potentially massive economic and environmental impact. From an environmental standpoint, hydrogen can be a cornerstone of tomorrow's low carbon energy system. Economically speaking, we are looking at a multi-billion euro sector in years and decades to come. Hydrogen is just too big to miss! 

Hydrogen can be a cornerstone of tomorrow's low carbon energy system

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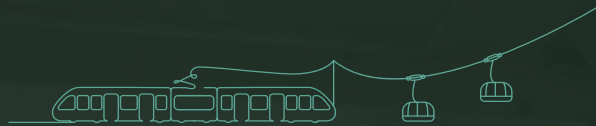
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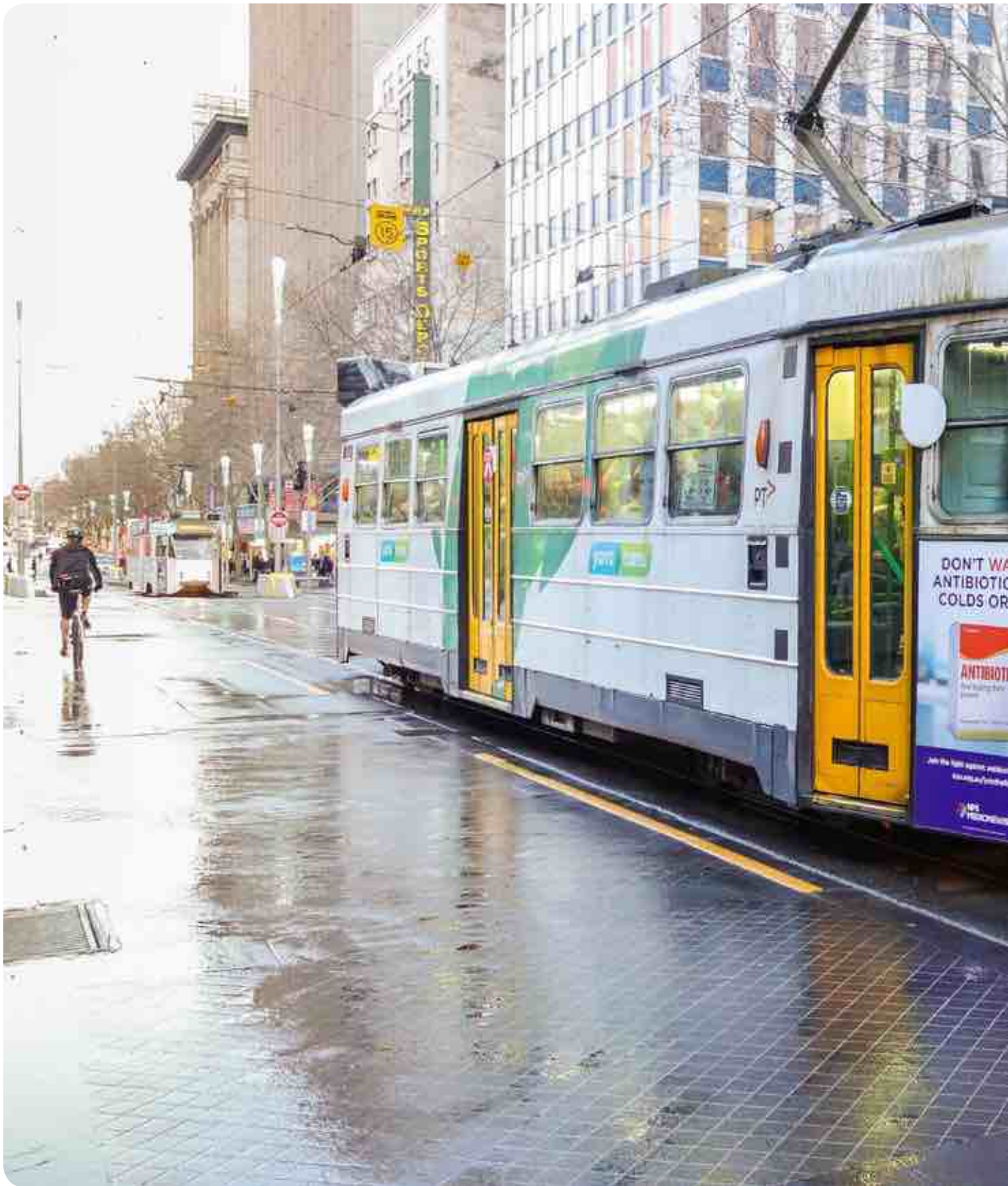
# VIEWS



## SUSTAINABLE MOBILITY



Heathrow airport T5 Business Carpark Pod, England.  
Source: JCDecaux Creative Solutions



The Melbourne tramway network with its 250 kilometres of track, 493 trams, 25 routes, and 1,763 tram stops, is the largest urban tramway network in the world.





SoelCat 12, a energy autonomous solar electric catamaran. Source: Soelyachts



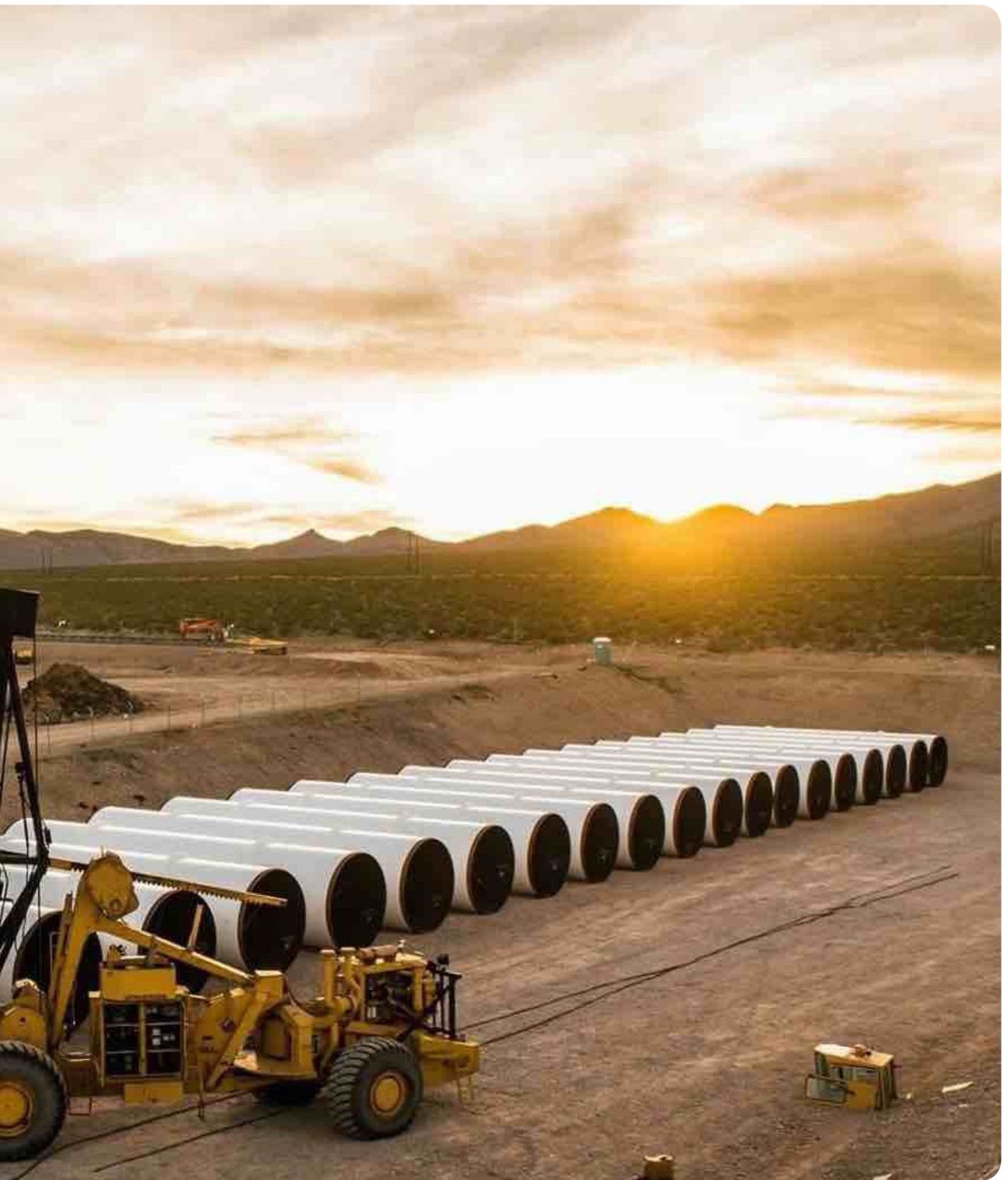
Funicular connecting Beatenbucht by Lake Thun with the village of Beatenberg, Switzerland.



Ngong Ping 360, Cable car on Lantau Island in Hong-Kong.



Construction site of a short 3 km test track in the Nevada desert to test lightweight prototype Hyperloop pods.  
Source: Neil Wood / Hyperloop One



Hyperloop is a high speed, intercity transportation system which uses passenger and cargo capsules inside a reduced-pressure tube system that would reach a top speed of 1,300 km/h.



Solar Impulse 2 flying over the Torresol Energy's Gemasolar Thermosolar Plant after taking off from Seville.  
Source: Jean Revillard / Rezo



Solar Impulse 2 landed in Abu Dhabi on 26 July 2016, completing the around-the-world trip in a total of 17 stages and 16-1/2 months; it was the first circumnavigation of the Earth by a piloted fixed-wing aircraft using only solar power.



The first eHighway system on a public road opened in June 2016. For the coming two years, a Siemens catenary system for trucks will be tested on a highway north of Stockholm. Source: Scania / CV AB





Photovoltaic sunshade 'SUDI', an autonomous and mobile station that replenishes energy for electric vehicles using solar energy, France. Source: Tatmouss

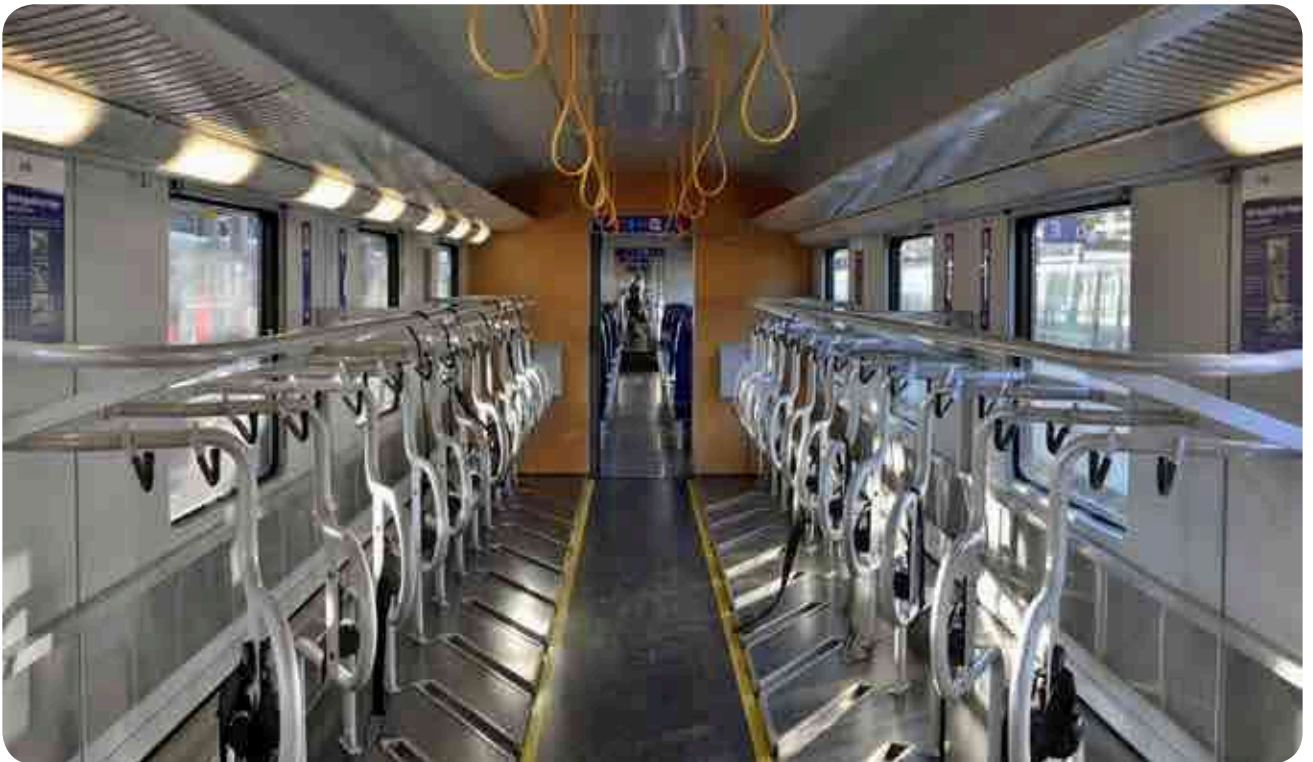




KCM 4602 (Proterra) charging at the layover area at Eastgate Transit Center, King County. The fast-charge option can be fully charged in ten minutes, while the extended range option can be fully charged in approximately one hour. Source: Atomic Taco



Bike parking in Amsterdam, Netherlands.



Bike racks in an ÖBB RegioBiking wagon, Austria.



Tram running between Wimbledon and New Addington, England. Source: Gary Knight



Slow Roll in Malmö, Sweden. Source: Anders Lejczak

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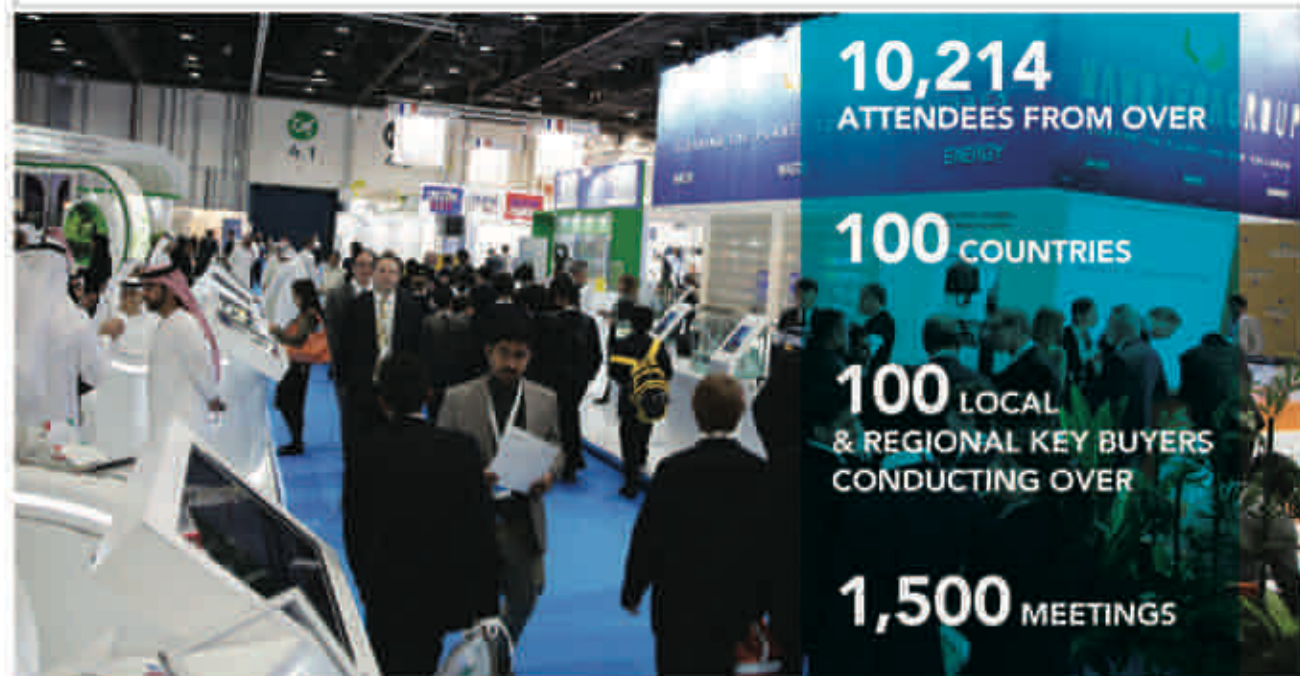


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# An Introduction to Climate Finance

Routinely referred to as the greatest challenge of our time, climate change mitigation and adaptation require the allocation of appropriate amounts of financial resources. The response, so far, has been mixed. In this article, we look at the current state of “climate finance”, as well as what hope there can be about its future.

Writer: Bruno Rauis

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Woman with solar panel, India.  
Source: Abbie Traylor-Smith / Overseas Development Institute



## Defining climate finance

“Climate finance” is an elusive term. At its narrowest, climate finance is understood to refer to those public financial resources that are allocated by developed countries to developing countries for the purposes of climate change mitigation and adaptation. In a broader designation, climate finance is meant to encompass all financial flows aimed at climate change mitigation and adaptation, whether those flows are from public or private sources, and regardless of the degree of development of their origin or destination.

With no internationally agreed upon definition, the measurement and monitoring of climate finance is unsurprisingly elusive, too. A methodological

discussion of the aggregate size of climate finance is beyond the scope of this article, but it is worth mentioning a few numbers to set the context: through the United Nations Framework Convention on Climate Change (UNFCCC), developed countries have pledged to contribute US\$100 billion per year of climate finance by 2020, from public and private sources. According to the OECD, such flows amounted to US\$62 billion in 2014<sup>1</sup>. This may sound like a lot, but it is not: the International Energy Agency (IEA) estimates that approximately US\$1 trillion a year is required between now and 2030 to fund the energy transition – and yet more than that is required for us to limit the temperature increase to 2°C.

As a result, climate finance is hotly debated. Not only do we not have enough climate finance, the climate finance we do have is often not the right kind: the vast majority of existing climate finance goes into mitigation projects, which tend to have reasonable returns on investment, while very little is left for adaptation projects that are less obviously profitable, but arguably more pressing for developing nations. Undeniably, blind profit maximization and excessive bureaucracy are legitimate plagues. At the same time, increasing the scale of climate finance is not as straightforward a task as it seems. Climate finance, as indeed all of development finance, suffers from a capacity-allocation issue.

## The development finance paradox

No one knows exactly how much development finance the UN’s Sustainable Development Goals (SDGs) will require, but on one point everybody agrees: it will be trillions of US dollars. The current ambitions are such that only a minority of the required finance can come from the public sector. The reason is capacity: there is nowhere near enough public finance for the SDGs. There is, on the other hand, enough private finance.<sup>2</sup>

The paradox at play is that while development and climate finance has traditionally been a public agenda, it is the private sector that must step up to represent the brunt of it. Because development and climate finance is not always good business by private sector standards, the way forward requires a new kind of cooperation between the public sector, international institutions, the private sector and even the civil society.



# The public sector

To say that the public sector does not have the financial muscle necessary to finance all climate change mitigation and adaptation efforts is not to say that the public sector is powerless – quite the contrary. The public sector has a privileged position and commanding tools at its disposal. Laws, regulations, tax incentives and subsidies all have profound impacts on how private money flows. In practice then, the public sector's role is one of a catalyst, and the focus is on finding the best use for limited public resources (financial or otherwise) in order to crowd in the private sector.

The UK's Green Investment Bank (GIB) is a good example of how this can work. The GIB was created in 2012 by Her

Majesty's Government, with funding of GBP3 billion and expecting to leverage an additional GBP15 billion in private investments in green infrastructure in the UK. The GIB's mission is not to finance all of the UK's green infrastructure requirements, but rather to “invest in a way which demonstrates the attractiveness of the opportunity to others. [...] We must show that it is possible to invest in projects which are green and profitable – this is our double bottom line.”<sup>3</sup> In the GIB case, it worked so well in fact that they are currently in the middle of a privatization process, freeing up public funds to be reused somewhere else.<sup>4</sup> The Green Bank phenomenon is

recent, but growing. The Green Bank Network, an organization aimed at sharing data and best practices between the green banks in the US, the UK, Australia, Malaysia and Japan, was created at the twenty-first Conference of Parties to the UNFCCC (COP21) in Paris last year.

In practice, the public sector's role is that of a catalyst, to crowd in the private sector.

## International Institutions

Windmills, Copenhagen.  
Source: Thomas Rousing / Creative Commons



International institutions have long had climate finance as part of their development agenda. In fact, there are so many initiatives that it is exceedingly difficult to keep track of them, or indeed understand how they differ from one another. At the center of the efforts lies the United Nation Framework Convention on Climate Change (UNFCCC), the financial mechanism of which are the Global Environmental Facility (set up as an independent body at the Rio Earth Summit in 1992) and the Green Climate Fund (set up at COP15 in Copenhagen in 2009). The UN's Adaptation Fund (COP7 in Marrakech in 2001) focuses solely on adaptation projects in developing countries that are Parties to the Kyoto Protocol. The Climate Investment Funds are multilateral funds not directly under the UNFCCC, but seemingly working to achieve similar objectives. The World Bank serves as trustee to all of these funds, and is also an agency through which monies are disbursed. And if this

is not complicated enough, those entities have further sub-funds and there are yet other side projects both in the UN (the UN Environment Programme Finance Initiative) and in the World Bank Group and other multilateral development banks.

Hopefuls and cynics alike have, legitimately, decried the unnecessarily complicated and bureaucratic nature of the institutions. The fact remains though, that billions in climate finance are being channelled through them. In addition, they bring political and technical expertise which private sector operators do not always possess in-house. By encouraging the private sector to invest alongside them in projects they have rubber-stamped, they are ideally situated to play a role of “honest broker” between the public and the private sector. As a result, they are instrumental in the quest of going “from billions to trillions”, as the World Bank Group famously put it.

## The private sector

Traditional banking operates a model of risk/reward optimization. In this model, risk is bad and financial reward is good. Green infrastructures do not do well under this model: they typically carry higher uncertainty (risk) than traditional infrastructures do, and their environmental benefits are not always directly quantifiable in financial terms. Tragically, the banking regulations that emerged after the recent global financial crisis have made this problem worse: aimed at reining in the banking sector's excessive risk taking practices, the regulations also compel banks to reduce their exposures to borrowers in developing nations and infrastructure projects.

With banks genuinely hamstrung, it has become clear that the surge in private climate finance has to come from other sources. Capital markets, where trillions of dollars can be accessed from a diverse institutional investor base (asset managers, mutual funds, pension funds, sovereign wealth funds, etc) are the obvious alternative. The shift is not happening painlessly, but there are interesting developments.

"Green Bonds" are debt securities issued to finance projects with environmental benefits. What started about a decade ago as isolated bond issuances by supranational agencies to finance climate change related policy goals, has more recently morphed into a market-wide initiative, with

an increasing number of private sector borrowers issuing Green Bonds to fund various kinds of projects and assets. A catalyst in the development of the Green Bond market was the establishment by the International Capital Market Association (ICMA) of the Green Bond Principles,<sup>5</sup> industry-wide standards which issuers voluntarily follow to earn the right to call their bonds "green". The benefits for issuers include access to new pockets of investors. For the environmentally conscious investors, Green Bonds increase their investment universe. The Green Bond market is grow-

ing rapidly, with 2016 year to date issuances (US\$43 billion) already higher than last year's total issuances (US\$42 billion), and multiples of what it was just three years ago in 2013 (US\$11 billion).<sup>6</sup>

Socially Responsible Investing (SRI) is another phenomenon on the rise, with an interesting history. Seemingly for centuries investors of various religious traditions have been known to avoid investing in companies active in what they saw as "sin industries", such as alcohol, tobacco, firearms or gambling. Such was the

With banks genuinely hamstrung, it is clear that the surge in private climate finance has to come from capital markets



preaching of Methodism's John Wesley in the 18th Century, and such are the rules still applicable today to Shariah compliant finance. But SRI is evolving beyond "negative screening" and emerging today as a significantly more complete discipline. It includes, among others: investing according to environmental, social and governance considerations ("ESG Integration"), using shareholder rights to compel companies to behave sustainably ("Shareholder Engagement"), and channelling investments towards traditionally underserved individuals or communities or in a manner

The Global Sustainable Investment Alliance estimates in their latest report that Social Responsible Investing has grown 61% between 2012 and 2014

that solves environmental or social issues ("Community / Impact Investing" – micro-finance is, in this classification, a form of Community / Impact Investing). The Global Sustainable Investment Alliance estimates in their latest report that SRI has grown 61% between 2012 and 2014, and that at US\$21.4 trillion it currently represents 30.2% of all professionally managed investments in the developed world. The SRI definition used by the report is debatably wide, but the rise of SRI is real and it is good news for climate finance.

One of the most inspiring examples of climate-related SRI is the Breakthrough Energy Coalition.<sup>7</sup> Ironically, the Coalition comprises industrialists and businessmen mostly from outside the finance industry: Bill Gates, Mark Zuckerberg, Richard Branson, Jack Ma, Mukesh Ambani – and twenty odd other business household names. The project was born out of the view that technology is the answer to the world's energy issues, and that the world cannot afford to wait for the normal cycles of research and investment to transform the energy landscape. Current government-backed research is insufficient, and in today's business environment transformative energy projects are unlikely to attract early-stage financing from traditional private investors. What is required is scaled up government-backed research together with a different kind of private investor, one with a long-term commitment and who is willing to put truly patient flexible risk capital to work. The Coalition wants to fill the shoes of this different kind of private investor and is committing capital in those countries that have agreed to increase government-backed research on clean energy innovation.

Windmill in the Black Forest,  
Brandkopf, Germany





Solar panels in a village, Lesotho.

## More participation

Climate change mitigation and adaptation is a colossal task. Colossal too, is the financing required for it. But for those of us who believe that climate change is real and who want to leave a planet behind for the next generations, there is no choice but to try and mobilize the necessary resources. “Too little, too late” is a valid criticism, one that we need to collectively take on board and address. The funds exist – the challenge is to get them to where we want them. The roles of public and private sectors are complementary, and public-private partnerships can form unique combinations to address unique problems. Initiatives to date by the public and private sectors are encouraging.

What is perhaps still missing from the picture is a more active involvement of the civil society. True, individuals do not directly command trillions of dollars, and it is easy for an individual to feel powerless in the international finance sphere dominated by big business and government. But individu-

What is perhaps still missing from the picture is a more active involvement of the civil society.

als do have power. For one, individuals have investment power. Crowd-funding initiatives and peer-to-peer platforms allow anyone with an internet connection to contribute small amounts of funding to climate change related projects. Perhaps more importantly though, we individuals are consumers and constituents, and as such have power over the private and public sectors. Individually we may be negligible, but our collective action is meaningful. With other initiatives gaining ground, the time seems ripe for our civil societies to realize this potential. ☀

### Notes:

1. Estimates vary greatly depending on the scope of the study concerned. For instance, under an obviously wider definition, Climate Policy Initiative estimated a total amount of climate finance in 2014 at US\$391 billion. For other studies see, among others, Heinrich Böll Stiftung or the Overseas Development Institute.
2. OECD estimates that total Official Development Assistance from OECD countries is at approximately US\$130 billion per year; by contrast, total assets held by institutional investors in the OECD amount to approximately US\$70 trillion.
3. [www.greeninvestmentbank.com](http://www.greeninvestmentbank.com)
4. To ensure that the green purpose is not lost when the GIB is shipped off to private investors, the government introduced a clever “special share” mechanism.
5. See <http://www.icmagroup.org/Regulatory-Policy-and-Market-Practice/green-bonds>. The Green Bonds Principles were first established in 2014 then reviewed in 2015 and again in 2016
6. [www.climatebonds.net](http://www.climatebonds.net)
7. [www.breakthroughenergycoalition.com](http://www.breakthroughenergycoalition.com)



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### AMONG THE SPEAKERS:



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Member of the National Commission for State Energy and Public Utilities Regulation (NERC)



**SEVKI ACUNER**

Country Director EBRD in Ukraine



**MIKHAIL STRATAN**

Chairman of the State Energy Efficiency Agency of Moldova



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# The other side of the road

## Electric vehicles in the developing world

Electric vehicles (EVs) are one of the innovations shaping the future of mobility and could offer many improvements to the transport sector in the developing world, but the road to the adoption of the EVs in developing countries is still very bumpy...

Writers: Elisa Asmelash

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Traffic in India.  
Source: Alex Graves



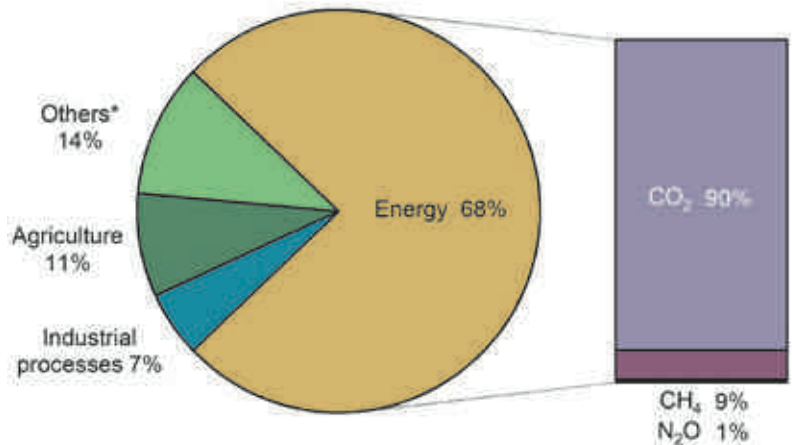


## Setting the scene

The transport sector is a key component of economic development and welfare and its pervasiveness and high energy intensity make it the most energy consuming sector of the global economy. It is the second largest sector in terms of global emissions. It predominantly depends on fossil-derived fuels, with 95% of transport energy coming from petroleum-based fuels, largely gasoline and diesel<sup>1</sup>.

Transport is facing one of the most challenging evolutions when compared to other sectors of the economy. This will require a holistic sectorial transformation. Firstly, through urbanization policies, which will have an impact on

Figure1: World CO2 emissions by sector in 2013



Transport contributes to approximately 23% of total greenhouse gas (GHG) emissions, which are expected to grow up to 50% by 2030

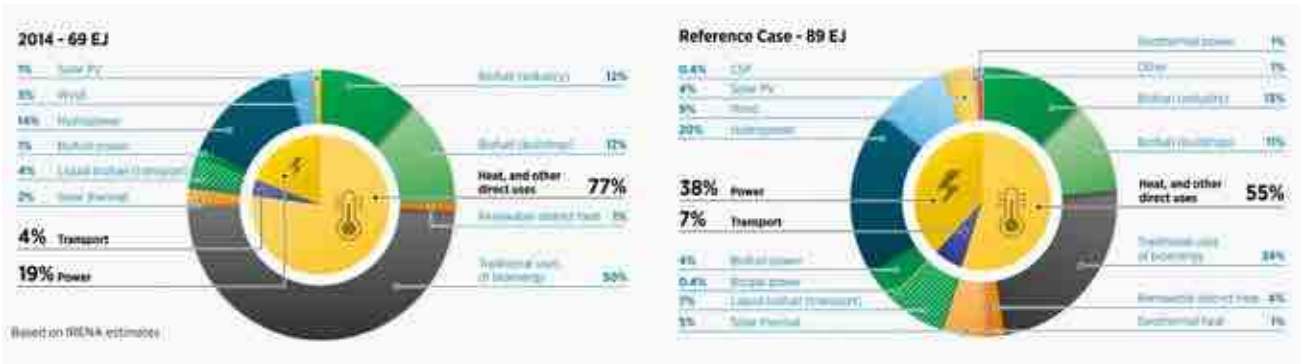
Source: IEA, CO2 Emissions From Fuel Combustion, Highlights, 2015

Night Traffic in Bangladesh.

Source: Sam Nasim



Figure 2: Renewable energy use in 2014 and 2030 (Reference Case)



Transport has the lowest renewable energy share of any sector, with little expected growth by 2030

Source: IRENA, Roadmap for a Renewable Energy Future, 2016

transport needs and infrastructure. Secondly, through the introduction of clean energy fuels policies promoting use of electricity (electric vehicles), hydrogen (fuel cell vehicles) and biofuels (blended with diesel).

Transport is facing one of the most challenging evolutions when compared to other sectors of the economy.

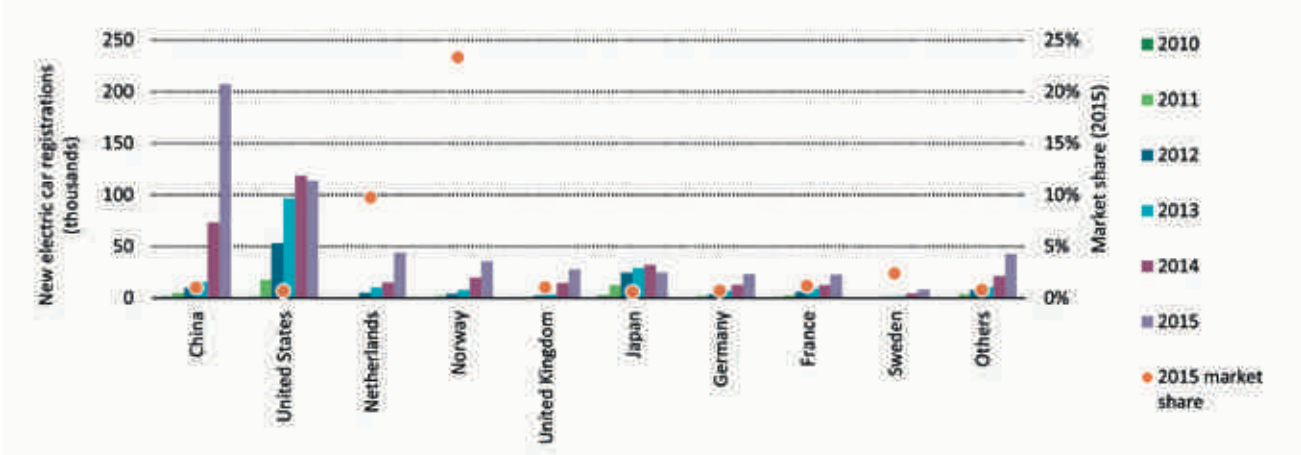
Among these options, electric vehicles (EVs) have strong and concrete potential to reduce dependence on fossil fuels by relying on a source of electricity that is mostly domestic and relatively inexpensive. EVs have the ability to trigger innovation, create new and advanced domestic manufacturing industries, which in turn boost job growth and ultimately foster economic development.

Over the past two years, markets for EVs, including two- and three-wheelers, have witnessed an impressive growth worldwide according to an IEA report<sup>2</sup>. This increase has been in terms of sales, with over 550,000 vehicles being

sold worldwide in 2015 representing a 70% growth relative to the year 2014, as well as in terms of the number of vehicle models being offered. All this has been possible thanks to policy support. However, advancements have been concentrated in a relatively limited number of EVs markets: the United States, the Netherlands, Norway, the United Kingdom, Japan, Germany, France and China<sup>3</sup>. Except for China, the rest of the countries belong to the so-called: 'developed world'.

So what about developing countries?

Figure 3: EV sales and market share in a selection of countries and regions, 2015



Source: IEA, Global EV Outlook 2016, Beyond one million electric cars, 2016

## An electric start

The challenges posed by transportation in developing countries are unprecedented. When developed countries were building their transportation infrastructure, their populations were significantly smaller compared to those in today's developing world. Similarly, vehicle ownership rates in developing nations are lower when compared to developed ones. Motorization is increasing rapidly. Limited infrastructure and institutional capacity are being stretched to their limit with populations' rates growing at a fast pace.

The problems are not uniform – each city and country faces different circumstances – but all countries seem to display the same types of barriers with different levels of intensity. These can be grouped into three main categories: Policy, Infrastructure and Grid requirements.

Firstly, developing countries still lack concrete and comprehensive support regimes, in the form of regulatory policies to frame the EVs market and boost its development. Policy interventions include introducing policy instruments to promote EVs, setting up infrastructure, incentivizing automobile manufacturers to produce EVs, and inducing consumers to switch to EVs. Having a comprehensive view of the status and potential of the regional renewable energy industries as a source of power for EVs could act as a starting point for any policy/regulatory intervention.

Secondly, EVs macroeconomic and infrastructure challenges are a major impediment to market development specifically in developing countries: EVs require a well-functioning road infrastructure, which is often lacking in the developing world, and having the possibility of installing the hardware and software charging

infrastructure, which ensures energy is transferred from the electric grid to the vehicle.

Thirdly, the adoption of EVs adds additional requirements on the grid. Charging EVs causes the grid and generating capacity to be heavily loaded during

Despite these barriers, expanding electric mobility in developing countries can offer environmental benefits.

times when domestic power consumption is traditionally rather low, and in places where such quantities of power are not currently available. Grid systems in developing countries do not have the power infrastructure to carry capacity to deal with this extra need of energy simultaneously.

Despite these barriers, expanding electric mobility in developing countries can offer environmental benefits. Most cities in developing countries have severe air pollution problems caused by a significant number of old and inefficient vehicles on the road. Electric vehicles, coupled with broader clean transport and urban development strategies, can be key in reducing emissions from the transport sector and achieving climate change goals.

EV deployment can also be seen as a key component of wider targets for developing local renewable energy technologies and clean energy solutions. Lastly, the development of EVs could be seen as a critical social opportunity and serve wider social development objectives. Local automobile manufacturers and industries can be developed, which would lower the reliance on imported EVs. Most importantly new jobs could be created boosting local economic and social development.

Customized electric rickshaws in Comilla, Bangladesh.  
Source: Tawsif Salam



# Regional realities – driving back seat or front seat?

## Asia

In Asian markets there clearly is a trend towards electric two- and three-wheelers. They are often the primary means of transportation for low income people, because they are cheap, easy to operate and can navigate crowded conditions more smoothly than a full-size car.

An emblematic example of the Asian market's development of electric two-wheelers is China, which is by far the major market for electric two-wheelers, currently representing about 40% of the Chinese two-wheeler stocks<sup>4</sup>. With the expansion of urbanization, motorization has been challenging the country through traffic jams, as well as through air and noise pollution. In this context, electric

two-wheelers serve as a high level mobility alternative. These vehicles present an affordable alternative to private car ownership, with a lower environment impact. Additionally, they are more flexible and efficient for personal use, standing in contrast to public transport systems. Two wheelers can circulate easily through congested streets and can be charged easily both outdoors, through traditional charging stations, as well as indoors, as they often have a removable battery. Finally, they have one of the lowest emissions of any type of motorized transportation.

The rise of electric two-wheelers has been stimulated since 1999 by govern-

ment policies, which were drastically banning conventional two-wheelers in urban areas. However, two-wheelers are not left without critics, and the correct implementation of regulations for their production and operation is still questionable. In particular, their increased speed, power and size creates a three-fold problem: i) confusion about how to classify (bikes or motorcycles?) and regulate them; ii) safety concerns, as they drive beyond speed limits and they are noiseless, thus less noticeable; and iii) diminished environmental benefits, related to their uncontrolled number in the roads, as well as to the lack of regulations in the recycling of the vehicles' batteries.

## Africa

Transport is a perpetual problem in Africa: bumpy and potholed roads, unhealthy transport solutions, lack of accessibility, improper planning, an increase of privately owned cars, unreliable power supplies, and poor (if not inexistent) infrastructure. These are just a few examples of the basic problems that the whole continent is facing when it comes to transportation. In this challenging context, mass transport, complemented by cycling and walking, is the best option for getting around.

It is not surprising then that there are indeed strong doubts about whether Africa is ready for EVs.

Out of all the continents, Africa has the least activity surrounding EV development, despite the potential benefits it may bring to its population. In recent years some African countries have shown signs

of development toward EV adoption, however, these isolated cases exemplify the necessity of solid policy frameworks.

In 2014, a large French investment company introduced electric busses in Cameroon. These run on renewable energy produced by solar panels connected to Lithium Metal Polymer (LMP) electric bat-

Kayoola Solar Bus Launch, Uganda.

Source: Malaika Media Uganda



teries, enabling solar energy to be stored and used 24/7. Similarly, Uganda produced its first solar-powered bus earlier this year. The bus prototype was developed by Kiira Motors Corporation, a local automobile manufacturing company, with hopes of expanding production and generating local employment.



### Islands

Electric car Nissan LEAF.  
Source: Megapower

Islands lend themselves perfectly to electric vehicle technology.

Most island regions in the world are extremely dependent on fossil-derived resources for their socio-economic development. Imported petroleum-derived fuels can represent up to 98% of the primary energy use in island nations. In this context, the development of EVs can act as

driver to increase renewable energy penetration. Electric vehicles have a range of around 70 miles per charge, which is sufficient for most transportation needs in island nations.

Barbados stands as the best case study for EVs in the Caribbean region. Barbados is a relatively small, flat island with a great abundance of solar and wind energy

throughout the entire year. Despite this, the country is 100% reliant on imported petroleum products. As such, EV development is a compelling political, environmental and economic case. Barbados' first EV enterprise began in 2013 by a local, privately-owned company called Megapower which started importing and selling EVs. Currently, there are 160 privately owned EVs on the road and 40 charging stations installed throughout the whole island.

Despite improvements and plans to expand adoption, full EV deployment faces significant barriers in public policy institutions. There is still some reluctance within the government which has yet to fully embrace EVs, seeing them as a luxury items rather than an opportunity for development. As these products are not incentivized, and the upfront costs and taxes on high weight imported cars are high, the shift towards EVs presents many obstacles.

Charging station for electric taxis in Salitre, Colombia.  
Source: Bogota.gov.co

### Latin America

The transport sector is one of the largest sources of energy-related emissions in Latin America, and while their EV market is still at an incipient stage, these vehicles are becoming a critical element in many of the countries' transportation agendas. Energy production in Latin America is generally very clean, as it relies on hydropower and limited coal-fired generation, strengthening the environmental case for the adoption of EV technologies in the region.

Colombia is a representative example of this expansion and one of the leaders in the region in widespread EV adoption. Since 2012, the country has undertaken significant efforts to develop sustainable transportation, both in creating a solid policy framework and strategy, as



well as electrifying the country's fleet of buses and taxis. Despite challenges related to infrastructure and bureaucratic hurdles, this plan is particularly promising for the reduction of GHG emissions, as Colombia's electricity is primarily generated from hydraulic energy. Private light

duty vehicles are projected to increase in Colombia's vehicle fleet from 16% in 2009 to 36% by 2040<sup>5</sup>, and the country is currently planning to go beyond public transportation and expand to private adoption of EVs.

# A Practical Guide to boosting EVs development and deployment

There are 3 critical elements that local governments must address to boost EVs adoption:

## 1. Policy & regulatory framework

Policy-makers need to show a stronger commitment to creating favourable legislative and regulatory frameworks for EVs. Fiscal measures are needed because EVs still have high up-front purchase prices compared to internal combustion vehicles (ICVs) and most of consumers cannot afford one. Even if EVs offer long-term fuel saving opportunities, most consumers do not have a long-term mind-set. They tend to focus on current-gain maximization and heavily discount future cost savings. Subsidies, upfront grants and tax exemptions can help them to afford an EV and foster a future-oriented perspective. Because the

industry is still in a state of infancy, EVs should be granted favourable treatment through reduced licensing requirements or sales tax incentives in order to be able to compete with ICVs.

## 2. Infrastructure and grid

Massive investments will be needed not only to provide developing countries with adequate infrastructure to support smooth flowing of vehicle traffic, but also to re-shape urban space and how the cities are evolving. Installing charging infrastructure should go hand in hand with grid reconstruction, as well as modernization and transformation for the inclusion of renewable energy sources into the electrical mix. This is

where governments and institutional investors can come in to back large scale and long-term investments into EV infrastructure.

## 3. Informed customers

Designing policies to target the industry at large is just one part of the story. Specialized forums such as workshops between policy-makers and industry groups can serve to fast-track effective policies. Similarly, detailed information on the life cycle costs and environmental benefits should be made available to consumers to familiarize them with the beneficial aspects of the technology. 



Electric vehicle in Agra, India.

### Notes:

1. Data from the United States Environmental Protection Agency (EPA)
2. IEA, Global EV Outlook 2016, Beyond one million electric cars, 2016.  
Available here: [https://www.iea.org/publications/freepublications/publication/Global\\_EV\\_Outlook\\_2016.pdf](https://www.iea.org/publications/freepublications/publication/Global_EV_Outlook_2016.pdf)
3. IEA, Global EV Outlook 2016, Beyond one million electric cars, 2016.  
Available here: [https://www.iea.org/publications/freepublications/publication/Global\\_EV\\_Outlook\\_2016.pdf](https://www.iea.org/publications/freepublications/publication/Global_EV_Outlook_2016.pdf)
4. IEA, Global EV Outlook 2016, Beyond one million electric cars, 2016.  
Available here: [https://www.iea.org/publications/freepublications/publication/Global\\_EV\\_Outlook\\_2016.pdf](https://www.iea.org/publications/freepublications/publication/Global_EV_Outlook_2016.pdf)
5. Ministry of the Environment and Sustainable Development "Colombia MRP Preparation phase: outline of progress," Government of Colombia, May 2013.



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# The Rhone and the Power of its Waters

## Managing and protecting a great European river

The Rhone, like all great rivers, brings risks and benefits, impacting the communities who live along it and who in turn have tried to control it. These communities are learning to achieve an optimum balance between benefit and control, and to restore and protect the natural character and ecology of the river, as encompassed in the principles of the EU Water Framework Directive.

Writer: Peter Easton

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## water management

The River Rhone is of great importance to the Mediterranean because it provides the largest inflow of any river into the sea. Its average discharge of 54 km<sup>3</sup>/year (1,720 m<sup>3</sup>/sec), represents 12% of the total of all river inflows (about 450 km<sup>3</sup>/year). The second largest inflow is from the River Po of Italy with 49 km<sup>3</sup>/year (11%). The Nile – with the largest basin of all Mediterranean rivers – supplies only 15 km<sup>3</sup>/year (3%) due to lower rainfall in North Africa compared to Europe, and the impacts of dams and irrigation. The Rhone is a major source of nutrients and particulate matter to the Mediterranean Sea (Alliot et al. 2003), and an important factor in fishery yields of the Gulf of Lion.

The Rhone basin is transnational: 92% in France, 8% in Switzerland, and a very small part in Italy. 16 million people live along its course. The source of the 813 km river is the Rhone Glacier in southern Switzerland, at an altitude of 1765 metres, from where it flows through Lake Geneva (Lac Léman) and out through the city of Geneva at its western end. Soon after Geneva (population 200,000), it crosses westwards into France, travelling southward through Lyon (population 500,000), and later through Valence, Avignon and the ancient Roman town of Arles, below which it branches to either side of the Camargue (the Rhone's original delta) as the Little and Great Rhone, eventually discharging into the Mediterranean Sea. The Camargue is an extensive wetland of international importance (recognized under the Ramsar Convention), and home to important plant and animal species, including the iconic pink flamingo. At Lyon, the Rhone is joined by its largest tributary, the 473 km long Saone, extending the river basin northwards, nearly as far as Strasbourg.



The Rhone river basin.

# Flood management and transport

Historically, since Roman times and before, the Rhone has been an economic corridor and transport route between the Alps and the Mediterranean. The north-south Saone-Rhone corridor has also served as an important link between the North Sea and the Mediterranean. Significant modifications of the Rhone started in the early 1800s, initially for flood protection. Large floods in 1840 and 1856

destroyed parts of Lyon, leading to additional flood protection schemes. However, in 1857, the importance of flood plains for absorbing flood flows was recognized, and a ban on embankments upstream of large cities was applied – an important lesson for modern river management. The river is now significantly canalised between Lyon and the sea to aid navigation, characterised by widening and

deepening of the main channel or cutting of straighter side channels. Flood management can be a significant source of conflict at local level. France imposes strong restrictions on land development on flood plains, which may conflict with landowners' plans for development or dikes for local flood protection (Pigeon, 2013).

## Supporting renewable and nuclear energy sources

The Rhone provides an important source of hydro-electric power, in the Alpine reaches in Switzerland, and upstream of Lyon in France, with most developments between the late 19th century up to the 1980s. There are now 24 schemes (Olivier et al 2009): four in Switzerland, one shared on the French-Swiss border (Chancy-Pougny) and 19 in France. They have a total capacity of 2.8 GW, and produce an average total of 15,000 GWh/yr.

For France, the Rhone hydropower represents approximately 13% of its renewable energy, and about 4.5% of all electricity supply.



For France, the Rhone hydropower represents approximately 13% of its renewable energy, and about 4.5% of all electricity supply. The Rhone also supports a number of nuclear power plants on its banks through supply of cooling water.

Donzère-Mondragon dam and hydropower station, the most productive on the Rhone.  
Source: Wikimedia

## The river's influence on culture

Around the world, cultures living along major rivers depend on them for water supply and irrigation, for transport, for carrying away waste (in the modern world, hopefully with proper treatment). Some major rivers, such as the Ganges in India, have religious significance. The flooding of flood plains and deltas brings vital nutrients for agriculture. Some benefits are more subtle. The lower Rhone is famous for the Cotes du Rhone wine region. The torrents from melting ice following the last ice age left, in addition to thick layers of silt and clay (raw material for soils), a high concentration of large rounded flattened pebbles (les galets), up to several centimeters in size, across the landscape. The role these pebbles play in the 'terroir' is to absorb the sun's heat during the day and radiate it back onto the grapes at night, thus helping with the ripening and intensity of flavor.



Cote du Rhone grapes and 'galets' pebbles laid down when the river was much wider.  
Source: jean-louis Zimmermann

## Implementing the River Basin Management Plan

The Rhone is fairly typical of a major European river. It was created by natural geological and climatic processes over millions of years but has been heavily modified over recent centuries to be moulded to man's needs and to pacify its more powerful and damaging characteristics. The challenge today is to maintain the positive achievements and benefits, while restoring more natural characteristics and quality where possible. Many of the natural characteristics are also now recognized as being essential to man's interests. For example, natural flood plains and meanders are often better than engineering works for flood protection. A healthy river supports the natural capital of biodiversity and healthy ecosystems.

The challenge today is to maintain the positive achievements and benefits, while restoring more natural characteristics and quality where possible.

Prior to the EU Water Framework Directive (WFD), France was already advanced in catchment-based water resources management. The Water Act 1992 initiated the creation of Water Management Master Plans for six hydrographic basins, including the Rhone-Mediterranean-Corsica (RMC) plan (1996). These already contained many of the characteristics of the WFD.

The WFD is applied through the River Basin Management Plan (RBMP) of the Rhone-Mediterranean. The main part of the RBMP applies to the Rhone river basin, but also includes the whole of the French Mediterranean coast (excluding Corsica). It is common to include smaller

river basins (such as those along the Mediterranean coast) in a larger RBMP, as they are too small to justify their own.

The complete Rhone RBMP is over 500 pages in the main document, and 260 in the Programme of Measures. In French, the RBMP is called SDAGE (Schéma Directeur D'Aménagement et de Gestion des Eaux). The principal sections are, typical of most RBMPs:

- General context
- Current status
- Environmental objectives
- Exemptions from objectives
- Development of the RBMP through stakeholder engagement and consultation
- Programme of Measures.

The following are summaries of some of the key aspects of the RBMP.

## River basin characteristics

The Rhone-Mediterranean basin consists of the Rhone river basin and a collection of smaller sub-basins covering a total of 127,000 km<sup>2</sup>, representing 25% of French mainland territory. Its water resources are relatively abundant, including a variety of watercourses, many lakes, wetlands, Alpine glaciers, and aquifers. However, there are large differences in the availability of resources locally, according to geology and climate. Geographically, the basin extends from the Champagne and Lorraine departments in the north (along the Saone tributary), to the Mediterranean coast in the south, as far as the border with Spain. The population is 15 million.

## River compared to a human life

Like any great river, the evolution of the Rhone as it flows from source to sea can be compared to a human life. From its source, it first cascades rapidly through rocky streams, like an excited child. As it flows, it grows and matures, gradually slowing, but still vibrant, picking up the 'experience' and influence of its many tributaries along the way. Occasionally, it experiences a 'big event', such as rapids or waterfall. In its mid-section, it has slowed further and gained more size, but is also at its most useful and productive. Providing water supplies, moving transport, a source of food, and an acceptor of wastewater (hopefully well treated). Eventually, as it approaches its end, it slows and broadens out considerably, gliding majestically and peacefully along slow shifting meanders. This is also where it gives back much of what it has collected during its long life. It

deposits sediments and nutrients on its flood plains, supporting productive agriculture, and provides a quiet nutrient-rich haven in its marshes and mudflats for diverse wildlife, including migrating birds. Eventually it flows into the sea, replenishing it with water and nutrients to support sealife. This is also where a renewal occurs, whereby water is evaporated from the sea and carried by clouds back inland to fall as rain and snow in the hills and high mountains, to replenish the river sources again.

This is perhaps an idyllic view of a truly natural river, long before it has been interfered with by man. However, it's an ideal we want to retain and restore as much as reasonably possible. This is where the WFD plays a critical role for rivers across Europe.

The river's source, the Rhone glacier at 1765 metres.





Pont de l'Université bridging the Rhone at Lyon.

## Mapping of important features

The mix of land surface is as follows: 51% forest and woodland, 27% agriculture, 14% grassland, 6% urbanised, 2% aquatic. The basin contains nearly 2,800 surface water bodies, of which about 230 are 'heavily modified' and 22 are artificial (such as reservoirs). The definition "heavily modified" covers water bodies with essential artificial modifications for such things as navigation, flood defence, water supply and hydro-power, and allows for exemption from the prin-

ciples of restoration to a natural condition and quality.

There are 238 identified ground-water bodies or aquifers. Of these, 68 are alluvial, meaning they consist of shallow layers of sand and gravel, and often exchange water with surface water bodies such as lakes and wetlands. Alluvial aquifers are easily accessible for abundant water supply, but also vulnerable to pollution. The rest of the aquifers are in porous hard

rock, often with depths of 10s or 100s of meters. These are generally less vulnerable to surface pollution, except where large fractures or caves are present, which can transport pollution rapidly.

The RBMP maps many other important types of information, such as water quality, land use, pollution incidents, flood risk and projected impacts of climate change.

# Environmental objectives

The Objectives and the 'Programme of Measures' are characterized according to 9 key principles:

- Adapt to climate change
- Prevent or address problems at their source (instead of at point of impact)
- Prevent further degradation of aquatic environments
- Take account of economic and social issues while ensuring sustainable provision of public water and wastewater services
- Reinforce the principals of river basin management to ensure a balance between land and water
- Combat pollution giving priority to hazardous substances and human health including domestic and industrial pollution, eutrophication and pesticides.
- Preserve and restore the natural function of water bodies and wetlands and their biodiversity
- Achieve balanced sharing of water resources now and into the future
- Improve the protection of populations from flooding, taking into account the natural functioning of water bodies

Flamingos on the Camargue, the internationally important wetland of the Rhone's natural delta.

Source: Peter Easton

In the 2010 RBMP, the key objective was for 66% of water bodies to achieve good ecological status by 2015. This was achieved for 52%. On chemical status, 93% of surface water bodies achieved the target compared to an objective of 94%. For groundwater bodies, the result was 85% achieved compared to an

Data are the foundation of knowledge, critical to understanding the status of the water environment.

objective of 87%. Also for groundwater, 91% of aquifers achieved a good status for water availability compared to an objective of 100%.

Does the failure to achieve all or most objectives mean the WFD and RBMP are failures? The reality is that most RBMPs across Europe did not achieve their objectives. A valid view is that it is bet-

ter to set a high bar of achievement, with the result that more is achieved than with a lower bar. The most important result is that good progress is being made, and expected to continue. The programme also drives the collection of comprehensive data. Good data are the foundation of knowledge, critical to understanding the status of the water environment and measuring changes (good or bad).

The general result is that the status of surface water and groundwater bodies in terms of both quality and quantity has made significant and continuing progress. This is a key objective of the WFD. The renewed RBMP objectives remain ambitious, as shown in Table 1.

## Programme of Measures (POM)

The POM sets out the actions to achieve the RBMP objectives. The POM for the Rhone is comprehensive, covered in a dedicated 260-page document. In



addition to the detailed technical activities, implementation of the POM, will be achieved through a combination of regulation, financial incentives and communication.

Stakeholder engagement is recognized as an important requirement for successful implementation. Around 150 consultation meetings were held across the river basin at all community levels including public and private sectors, regulators, local business representatives, land owners and community organizations. Technical design followed policy agreements and financial assessments.

The POM lists thousands of actions under each sub-basin, and for individual water bodies, such as the following examples:

- Restore ecological continuity (free movement of species and sediments)
- Restore natural river flow and natural features
- Restrict the dispersal of fertilizers and of erosion
- Discourage the use of pesticides and promote alternative practices
- Promote sustainable farming practices, such as organic, crop rotation, improved land management
- Ensure wastewater treatment facilities are in good order and achieving regulatory quality standards
- Promote water efficiency in the agricultural sector

Les Pâquis lighthouse on Lake Geneva / Lac Léman.

Table 1:

| Water body type                     | Good status category to be achieved | 2015 (achieved to date) |      | 2021 |      | 2027 |     |
|-------------------------------------|-------------------------------------|-------------------------|------|------|------|------|-----|
|                                     |                                     | No.                     | %    | No.  | %    | No.  | %   |
| Groundwater bodies (total 238)      | Chemical                            | 195                     | 81.9 | 202  | 84.8 | 238  | 100 |
|                                     | Quantitative                        | 212                     | 89.1 | 235  | 98.8 | 238  | 100 |
| Surface water bodies* (total 2,786) | Ecological                          | 1462                    | 52.5 | 1845 | 66.2 | 2786 | 100 |
|                                     | Chemical                            | 2590                    | 93.0 | 2591 | 93.0 | 2786 | 100 |

\*sub-divided into watercourses, lakes, coastal waters and transition waters  
Source: Rhone-Mediterranean RBMP 2016 - 2021





Top: Quays of the Rhone in Lyon.  
Below: Nyon on the Swiss shore of  
Lake Geneva / Lac Léman.

## International cooperation

Unlike the Rhine and Danube, there is no formal international commission for the Rhone. Switzerland does not implement the WFD, but does cooperate on international river basins (Nilsson et al 2004). In the Rhone basin, it cooperates with France on Lake Geneva (Léman), through the Commission Internationale pour la Protection des Eaux du Léman (CIPEL, founded 1963, [www.cipel.org](http://www.cipel.org)), whose main focus is protection of water quality for drinking water (for 800,000 people) and for the natural environment. CIPEL territory covers

the upper Rhone catchment to the point where it crosses to France, which includes the whole Lake Geneva/Léman catchment and the Arve tributary (mostly in France). In addition, the RBMP states that the French authorities formally consult the Swiss dur-

ing RBMP development. Detailed historical reviews of transboundary governance of the Rhone and its challenges are given in Bréthaut & Pflieger (2013) and Bréthaut & Clarvis (2014).

Unlike the Rhine  
and Danube,  
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The historic Pont d'Avignon (Saint Bénézet) eventually abandoned due to regular flood damage.

In summary, the Rhone is a major European river of great significance to the Mediterranean. Like many large rivers, it has undergone many man-made influences over the centuries, historically for human benefit and protection with little consideration for environmental impacts. River management has been complicated by competing priorities between different interests, such as energy, water supply, navigation and flood protection, and more recently, a greater demand to restore and protect the natural environment. Modern sustainable river management requires that the right road is followed between protecting human interests (water supply, economical, transport, flood protection, energy) while also achieving as much as possible to restore the natural quality and condition of the river and its associated landscape. Effective multi-stakeholder governance, including transboundary cooperation are critical to success. This is what the Water Framework Directive sets out to achieve for all rivers across the European Union. The results remain imperfect, but important progress is being made. 🌀

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