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JAPAN

TRANSPORT

At the cutting edge of technology and of the modal shift

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JAPAN

At the cutting edge of technology and of the modal shift

Author • **Ghislain Favé** • *Consultant*

Japan aspires to reduce its greenhouse emissions (GHG) by 26 % in 2030 compared to 2013 levels and by 25.4 % compared to 2005 levels (Japan Ministry of the Environment, 2015). Japan is the only G20 member to have defined a quantified target for the transport sector, namely 27 % by 2030 compared to 2013 levels (Vieweg et al., 2018). Recently, in June 2019, Japan adopted a long-term low-carbon strategy aiming to reach carbon neutrality by the second half of the century. The strategy counts partly on the support of car manufacturers for national objectives on clean vehicle development. On the other hand, the strategy relies on car manufacturers' ability to achieve national targets of clean vehicle deployment, on the performance of the rail network – the modal share of which is increasing –, and on strategies to revitalise urban centres, giving a large share to low-impact and public transport.

Key takeaways

GHG emissions from the transport sector decreased by 3.6% in Japan between 2013 and 2018, mainly due to the 3.97% reduction in land transport emissions. This fall in emissions can be explained by the decrease in global volume in road transport, a unique situation compared to other developed countries caused by a weak economy, advanced demographics, and an increasing modal shift to rail. (Enerdata, 2019) ;

Innovation from car manufacturers and the national expansion strategy for new-generation vehicles, have helped catapult Japan into a world leader in the transport sector. However, these vehicles continue to represent just 1.2% of the market and the impact of taxes on private vehicle ownership appears to be greater than the impact of exemptions on the purchase of electric vehicles;

Japan is committing to hydrogen with an ambitious programme involving governmental and industrial actors on multiple multi-sectoral projects. For now, technical and economic uncertainties have not yet been resolved and the hydrogen production method does not generate significant CO_2 gains;

High performance and constantly growing rail networks have a modal share of 33%, the highest in the world, and are at the heart of the regional revitalisation strategy that gives financial and judicial resources to local authorities to rehabilitate them;

Cycling has also become more popular in cities as it is being encouraged by an urban planning with a high commercial density. Long neglected by local and national public policies, it is once again at the heart of local authorities' mobility strategies.

CONTENTS

1 - A slow decrease in emissions due to the reduction of the volume of land transport

Japan, the world's fifth largest emitter of carbon dioxide, saw its emissions increase sharply after the 2011 earthquake and the Fukushima nuclear accident, which led to the closure of nuclear reactors and an increase in the share of coal in electricity generation. After reaching a peak in greenhouse gas (GHG) emissions of 1,409 $MtCO_2e$ in 2013, national emissions began to decline in 2014. In 2017, consolidated emission by the Japanese government reached 1,294 $MtCO_2eq$, their lowest level since 2009. Compared to their level in 2013, the base year of Japan's NDCs, this represents a decrease of 8.2 % (Ministry of Environment of Japan, 2018).

Emissions from the transport sector contribute to this decline over this period but at a slower pace. Between 2013 and 2018, emissions fell from 217.45 to 209.63 $MtCO_2eq$, a decrease of 3.6% (Figure 1). **This trend is driven by the reduction in land transport emissions, which represent 89% of the sector's emissions and have fallen by 3.97% over this period**. Other modes show more stable paths, almost stagnating rail and maritime transport in recent years, and with a slight increase in air travel.

FIGURE 1

GHG EMISSIONS BY MADE OF TRANSPORT IN JAPAN - *Source : enerdata - 2019*

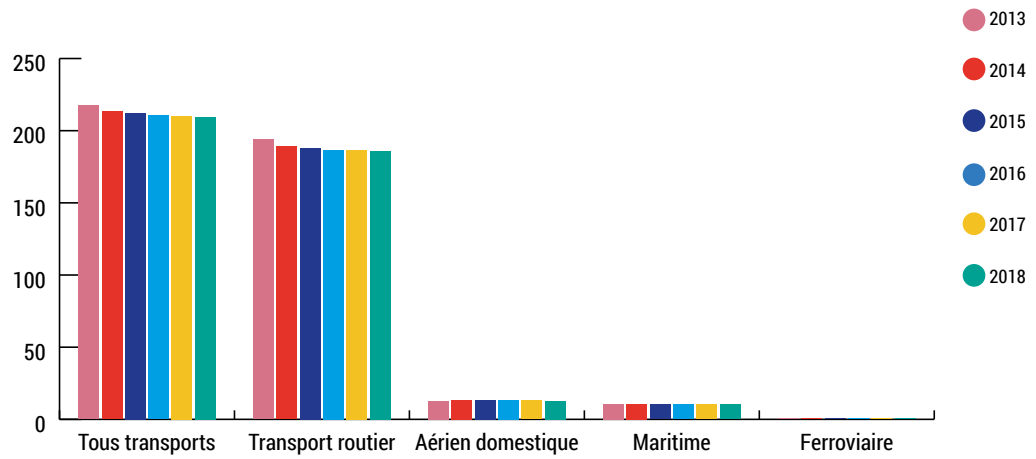


TABLEAU 1

ÉVOLUTION DES ÉMISSIONS DE GES DANS LE SECTEUR DU TRANSPORT. SOURCE - *Source : Enerdata, 2019*

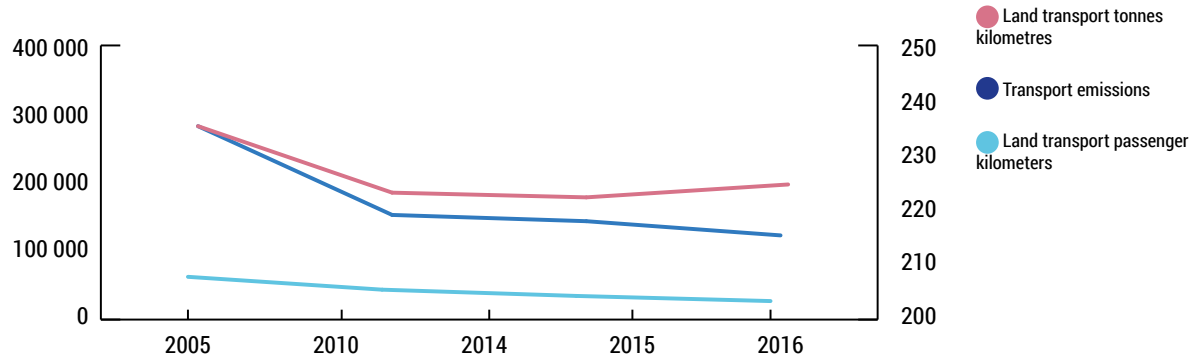
		2013	2017	Estimations 2018	Evolution (2013-2018)	Modal share of transport passengers (2014)
GHG Emissions ($MtCO_2eq$)	All transport	217,45	210,24	209,63	-3,6 %	100 %
	Land transport	193,86	186,42	186,17	-3,97 %	58,9 %
	Domestic air travel	12,60	12,99	12,66	0,48 %	7,1 %
	Rail transport	0,55	0,53	0,53	-3,64 %	33,8 %
	Navigation	10,44	10,43	10,27	-1,63 %	0,2 %

The structural economic and demographic trends at work seem to be the main factor behind the decline in road transport emissions. After several decades of economic dynamism, Japan's economy has been growing at a slower pace since the 1990s, with an average GDP growth of only 0.9% since 1991, compared to 4.5% in previous decades (Turner, 2018). This trend could worsen as the population declines: the archipelago has lost 1.6 million inhabitants over the past ten years, going from 128.1 million in 2008 to 126.5 million in 2018 (The World Bank, 2019).

In Japan, these transformations are extremely profound in all sectors. **In the transport sector, one consequence is the decrease in the volume of land transport, a unique situation among developed countries. Between 2010 and 2016, the number of passenger-kilometres of land transport fell by 10%.** The situation is similar with freight: all modes of transport combined, tonne-kilometres fell by 7% between 2010 and 2016 (Statistics Japan, 2019), with a 13% decrease for road freight alone.

FIGURE 2

EVOLUTION OF GHG EMISSIONS FROM TRANSPORT AND THE VOLUME OF ROAD TRANSPORT. - *Source : enerdata - 2019 ; Statistics Japan, 2019.*



To rectify this unique situation as well as urban sprawl and car ownership, the government is attempting to present an action framework for private and local actors in order to speed up the decarbonation of the vehicle fleet, the modal shift to rail, and the revitalisation of regional urban transport networks. The number of passenger-kilometre by train however has risen by 10%. The current national policy for 2014-2020 Basic Act on Transport Policy highlights the modal shift (freight and passengers) to train or boat, and the revitalisation of urban and regional networks via the renovation of infrastructure (light trains, tramways) and of logistics. It also mentions new generation vehicles (hybrid, electric, and fuel cell) reaching 50% of the market share by 2020.

2 - The decarbonation of the vehicle fleet led by dynamic manufacturers

• A FLAGGING ELECTRIC VEHICLE MARKET • Japan is one if the leading countries in terms of electric vehicles. In 2018, one out of three vehicles sold in Japan was either electric, hybrid, or fuel cell (Japan Long Term Strategy, 2019**) and the national electric fleet accounted for 225,000 vehicles: one of the largest markets in terms of volume.** The government aims to reach a market share of "alternative vehicles" between 50% and 70% by 2030, with electric vehicles representing 20 to 30% of the share (Japan Ministry of the Environment, 2016). As for the Ministry of Economy, Trade and industry (METI) and its roadmap "for a new era of automobiles", it aims to reduce GHG emissions from new vehicles by 90% by 2050 compared to 2010 levels (METI, 2018).

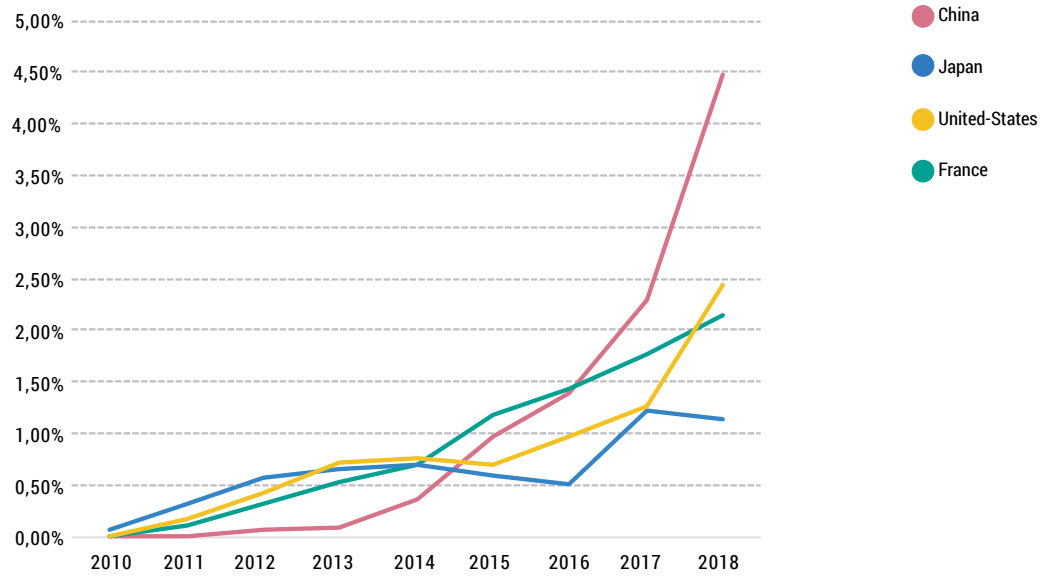
Japanese car manufacturers' role is essential in this technological shift as they remain at the forefront of innovation. In 1997, Toyota launched the Prius, the first hybrid vehicle in Japan to combine an internal combustion engine and an electric motor. Its energy recuperator, which converts kinetic

energy into electricity when braking, halved consumption compared to the gasoline-powered models of the time (Toyota, s.d.a). With over 3.5 million models sold since, the Prius is by far the best-selling hybrid modem on the world (Fleet Carma, 2018). **Nissan, for its part, is the pioneer in the electric vehicle market with the launch of the Leaf in 2010, the first electric model to exceed 400,000 sales worldwide in 2019.**

As for the batteries, the one fitted to the Leaf model has increased in 9 years from a capacity of 24 kWh to 62 kWh, considerably increasing its autonomy. Toyota has adopted the "Toyota Environmental Challenge 2050" strategy that aspires to reduce by 90% by 2050 compared to 2010 and sell more than 1 million zero emission vehicles annually by 2030 (Toyota, s.d.b). To achieve these results, Toyota recently created a joint venture with electronics giant Panasonic to develop higher energy density batteries (Reuters, 2019).

FIGURE 3

PERCENTAGE OF ELECTRIC VEHICLES MARKET SHARE (BEV AND PHEV). - *Source : IEA Global Electric Vehicle Outlook, 2019.*



Despite these advances, their high cost explains the difficulties for electric vehicles to enter the market despite the various tax advantages. Sales of BEV (Battery Electric Vehicle) and PHEV (Plug-in Hybrid Electric Vehicle) in 2018 are down compared to many countries. While between 2016 and 2017 these sales more than doubled in Japan, they then fell by 8% in 2018 (IEA Global Electric Vehicle Outlook, 2019). The market share of BEVs and PHEVs thus reached only 1.13% in 2018, a lower rate than that of countries such as France, China or the United States which have all caught up with Japan (Figure 3).

Taxes imposed on vehicle owners seem to discourage the purchase of new vehicles, which fell by 1.7% overall in 2018 (Japan Automobile Dealers Association, 2019) **rather than encourage fleet renewal through the purchase of alternative vehicles. Tax exemptions on vehicle purchase and tonnage (Table 2) are available for "new generation" vehicles and vehicles that exceed the 2020 fuel efficiency targets of 20.3 km/L on average for passenger cars by 30%** (Transport Policy, 2019).

TABLE 2

VEHICLE TAX IN JAPAN. SOURCE - *Source :* ENERDATA, *2019*

Tax (Governance)	Rate	Revenue (billions of euros)	Allocations
Tax on vehicle weight (State)	By 0.5 tonnes: • Private : 34 € /year • Professional : 22 €/year (Permanent for two 21 €)	5,3	General budget 407/1000 distributed to all local authorities, and a part to victims of pollution).
Car tax (Prefecture)	Voiture privée (entre 1500 et 2000 cc) 332 €/an	13	General budget
Tax on light vehicles (Municipalities)	Private light vehicle 91 €/year	1,7	General budget
Tax on vehicle acquisition (Prefecture)	3 % of retail price for private car (2 % for company vehicles Permanent 3 % for each)	0,92	General budget

A carbon tax has also been applied since 2012 and improves competitiveness of electric vehicles: €6.39 /kL for oil and petroleum products, €6.56/t for hydrocarbons, and €5.63/t for coal (Ministry of Environment, 2017).

Another obstacle to the development of electric vehicles is the great difficulty of access to charging stations. Most of the population lives in buildings and often lacks access to a private charging station. **In Tokyo, 90% of electric vehicle owners live in private homes. It is therefore necessary to develop fast charging stations in public areas as 60 of Tokyoites live in commonhold** (Auverlot et al., 2018). TEPCO, Japan's largest electricity supplier, will adapt its power poles to recharge terminals: this low-cost approach will cut the costs of a recharge station in half and TEPCO plans to initially install 100 devices in the metropolis (Kurimoto, 2019).

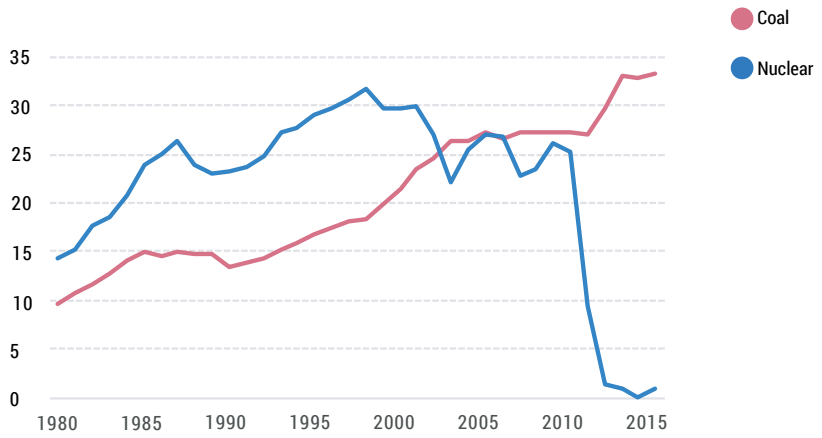
FOR A BETTER UNDERSTANDING

THE IMPACT OF THE NATIONAL ENERGY MIX ON ELECTRIC VEHICLES' GHG EMISSIONS

To measure the electrification of the vehicle fleet in terms of climate and energy relevance, it is necessary to consider the emissions generated by electricity production. However, since the accident at the Fukushima Daiichi nuclear power plant in 2011 and the shutdown of the park, the country has had no alternative but to rely heavily on fossil fuels (Figure 4). With 210 million tonnes in 2018, Japan is the third largest coal importer in the world. The national energy mix was thus composed in 2016 at 83 % of fossil fuels (42 % gas, 32 % coal and 9 % oil), 15 % renewable and 2 % nuclear energy. Emissions related to energy production rose from 2010 to 2016 from 453 $MtCO_2eq$ to 507 $MtCO_2eq$ despite a fall since 2013 (METI, 2017a). With an emission factor of 543.8 gCO_2eq/kWh in 2016, Japan is one of the only G20 countries to witness the carbon intensity of its energy mix grow compared to 1990 (Vieweg, et al., 2018).

FIGURE 4

COAL AND NUCLEAR SHARES IN THE JAPANESE ENERGY MIX (% OF TOTAL). - *Source : Based on World Bank data.*



In its recent long-term low-carbon strategy, Japan does not foresee how coal will be phased out to reduce the carbon footprint of electric vehicles and relies mainly on CO_2 capture and storage technologies in its power plants (Governement of Japan, 2019). Even today, 30 coal-fired power plants are either in the planning stage or under construction (Climate Home News, 2019) ; Japan is the only G7 country in this situation.

TEXT BOX 1

• BETTING ON THE "HYDROGEN SOCIETY" • The closure of nuclear power plants has also reduced the rate of energy independence (ratio of domestic production to consumption) to only 7% in 2015, the second lowest among OECD countries (55.9% in France and 38.8% in Germany) (METI, 2017a). To meet this energy challenge and its climate commitments, the government, in collaboration with Japanese manufacturers, is favouring the hydrogen solution. As Japan is a mountainous and densely populated country, renewable energies are not suitable.

In 2014, METI launched the foundations of the "Hydrogen Society" (METI, 2014) and published a strategic roadmap taking into account the entire supply chain and its application in the fields of energy and mobility. Applied to transport, hydrogen is an energy carrier that generates electricity by reacting in a fuel cell with oxygen from the air. This reaction only produces heat and water and hydrogen cars – or – FCEVs (Fuel Cell Electric Vehicles) – emit no emissions. **Japanese car manufacturers were the first to commercialise FCEVs: Toyota launched the Mirai at the end of 2014, just a few months after the METI roadmap; Honda followed suit and launched Clarity in 2016**. These vehicles have a longer range than traditional electric cars (more than 500 km) and have the advantage of being able to be recharged in just a few minutes.

The METI roadmap has since been reviewed and the objectives in terms of developing hydrogen vehicles and charging stations have been defined. It is expected that the vehicle fleet will have 40,000 FCEVs by 2020, 200,000 by 2025 and 800,000 by 2040. A minimum of 160 charging stations by 2020 and 320 by 2025 must be developed (METI, 2017b).

EXPERIENCE FEEDBACK

THE 2020 OLYMPIC GAMES IN TOKYO, OPENING THE PATHWAY TOWARDS THE "HYDROGEN SOCIETY"

Japan wants to use the 2020 Olympic Games in Tokyo to demonstrate the viability of a hydrogen society. A hydrogen production plant from renewable sources is currently under construction in Fukushima. It will be capable of producing and storing 900 tonnes of hydrogen per year via the electrolysis of water, the energy being supplied by a 10 MW solar plant. The hydrogen produced this way will be decarbonated and the hydrogen vehicles deployed during the Olympic Games will be clean, considering the entire cycle from "well to wheel".
It is also expected that the hydrogen produced will supply the Olympic Village, which will accommodate more than 17,000 people. Electricity and water heating will be guaranteed by stationary fuel cells (The Tokyo Organising Committee, 2019).

TEXT BOX 2

With only 2,300 vehicles at the end of 2017 (IEA EV Outlook, 2018), Japan now has the second largest hydrogen fleet in the world, behind the United States, with around 3,219 vehicles as of June 1st, 2019 (California Fuel Cell Partnership, s.d.). Market penetration remains timid and the pace of sales makes the METI target of 40,000 CFECs in 2020 difficult to achieve.

For both hybrid and electric vehicles, one of the reasons for this delay in relation to the roadmap is the small amount of recharge infrastructure. Due to Japanese regulatory specificities, the cost of building and operating a charging station is higher than in Europe or in United States and can reach 4 million euros (Ministry of Economy and finance, 2017). These specific regulations mainly target safety conditions to avoid leaks of hydrogen, a colourless, odourless and highly flammable gas, especially since Japan is highly exposed to natural disasters.

EXPERIENCE FEEDBACK

THE JAPAN H2 MOBILITY CONSORTIUM, DRIVING THE DEVELOPMENT OF HYDROGEN

The first phase of FCEV dissemination requires a sufficiently large network of hydrogen refilling stations to support the demand for FCEV. In order to accelerate the deployment of these stations, a consortium was created in March 2018, on the initiative of METI. Bringing together 11 groups of car manufacturers, infrastructure suppliers and investors, the Japan H2 Mobility consortium's primary objective is to pool efforts to build 80 stations by 2022 and 300 stations within 10 years. This synergy of forces should reduce construction costs by attracting funding.

TEXT BOX 3

The success of the "hydrogen society" also depends on controlling the production of decarbonated hydrogen at a competitive price, and **the parity of clean hydrogen with alternative fuels must be achieved. The current price is about 100 yen (0.9 €) per Nm3 and should be reduced to 30 yen (0.25€) in 2030 and 20 yen in the long term.**

At present, METI favours the production of hydrogen by coal gasification over the hydrolysis of water from renewable energy. A pilot gasification plant is being built in Victoria, Australia by the Australian power generation company AGL energy and the Japanese company Kawasaki Heavy Industries. This plant will produce 3 tonnes of hydrogen from 160 tonnes of lignite and generate 100 tonnes of CO_2 (Nagashima, 2018). **With carbon capture and storage currently absent from the project's plan, the carbon footprint is similar to one of a coal power plant.** Vehicles running on

hydrogen produced in this way would only shift GHG emissions to hydrogen production, and the overall balance in a "well to wheel" approach, would be worse than that of an internal combustion engine vehicle. The plant under construction in Fukushima that will produce hydrogen from renewable sources must demonstrate the viability of a truly clean hydrogen.

Car manufacturers are also committing to hydrogen production. **Toyota launched in 2019 a project in partnership with the Dutch Institute for Fundamental Energy Research in order to develop a photoelectrochemical cell capable of producing hydrogen from solar energy and air humidity** (Hornyak, 2019).

• ENERGY EFFICIENCY OF COMPANY FLEETS • Multiple national business programmes and initiatives aim to reduce the energy intensity of their activities and notably, of transport. Since 2009, the Excellent Eco-Commuting Business Site Certification System certifies volunteer Japanese companies that help their employees replace their car with public transport. In 2017, 665 businesses were registered (Ecomo Foundation, 2018).

The METI created a certification system called Green Management Certification that was certified by the Foundation Eco-Mo (Foundation for Promoting Personal Mobility and Ecological Transportation) and is based on the ISO14031 environmental performances. In 2003, it concerned land transport companies, as well as maritime and rail ones too in 2005. At the end of 2017, 3,559 companies were certified including almost 7,000 different sites representing 12% lorries, 16% buses and 17% taxis. Within the voluntary commitments, Japan Federation of Hire-Taxi Associations has committed to reducing its emissions by 25% by 2030 compared to 2010 via the development of new generation vehicles, taxi sharing, reduction of under-used taxis on the road and eco-driving. On the other hand, the logistics company, Tomijima Unyu $o., Ltd., banned stopped cars with engines still running, and now uses barges instead of trailers to transport goods (Ecomo Foundation, 2018).

The City of Tokyo went even further by adopting an energy efficiency indicator for lorries by connecting data from around one million lorries every month to evaluate their efforts in terms of reducing emissions. Companies that make the biggest efforts are favoured by shippers and their efforts are made visible via a rating system on the lorry itself (C40, 2017).

3 - A dense rail network representing a growing modal share

In Japan, urban planning, which is dense and mainly located on the coastlines, has been strongly oriented by rail, with cities structured around high-capacity public transport networks. Urban densification located across the transport axes facilitated train travel which appeared in the early 1910s and that grew considerably in the 1950s and 1960s. In 1964, the first high-speed train "Shinkansen" began its service with the operation of the Tokaido line between Tokyo and Osaka.

FOR A BETTER UNDERSTANDING

THE HIGH COST OF CAR OWNERSHIP ENCOURAGES TRAIN TRAVEL

The cost of buying and owning a car has historically been high in Japan. On top of purchase taxes, car owners must regularly get their cars inspected via the shaken, a compulsory vehicle inspection programme. Car owners are also required to pay a tax on the weight of the vehicle. Additionally, all highways have tolls whose prices are among the highest of the world. Though the revenue generated from these tolls was initially supposed to reimburse loans due to the

construction of the highways, tolls have not budged, and prices have progressively increased. This means that a 510 km journey between Tokyo and Osaka costs USD 180 (Lipscy et Schipper, 2013). Another obstacle for buying a car in Japan includes having to register for a private parking space outside public roads before even buying a car. Most of the Japanese population does not have access to a private garage and renting a private parking space is expensive.

TEXT BOX 4

The Japanese rail network accounts for 27,000 km of rail including 20,000 km of electric rail (Thomas, 2016). **Japan's largest rail operator, East Japan Railway, annually carries over 6.4 billion passengers, more than the SNCF and Deutsche Bahn combined** (International Union of Railways, 2018). **The modal share of rail transport is the largest in the world at 33% in passenger volume.** Although Japan's population is ageing and declining, the network is increasingly being used and the passenger-kilometre index increased by 10% between 2010 and 2016 (Statistics Japan, 2019) and by 1.3% between 2016 and 2017 (ITF transport Outlook, 2019). This increase is due large cities' attractiveness, where populations are growing, but the surge in international tourists also contributes to this increase. The archipelago attracted over 28.7 million tourists in 2017 and the *East Japan Railway* with the *Tokyo Metro Co.* both recorded an increase in the number of foreign travellers (Martin, 2018).

FIGURE 5

TRANSPORT MODAL SHARE IN 2015. - *Source :* UIC *Railway Handbook, 2017.*

	Passenger PKM	Freight TKM	Total TU
ROAD	62.9%	50.9%	60.2%
AVIATION	6.7%	0.2%	5.2%
NAVIGATION	0.2%	43.7%	10.6%
RAIL	30.2%	5.2%	24.2%

Contrary to passenger transport, the volume of freight transport by train remains marginal and is even slightly dipping. In 2015, rail represented 5% of the modal share compared to 50% for land transport and 43% navigation (Figure 5).

However, the modal share of rail (passengers and goods) is on the rise, reaching 25% in 2015 compared to 20% in 2007 (Figure 6).

This relative increase also seems to be due to the economic situation with a 36% decrease in tonne-kilometres travelled by road and 16% in the volume of goods transported between 2005 and 2016: from 52 million tonnes to 44 (Statistics Japan, 2019).

FIGURE 6

PASSENGER AND FREIGHT TRANSPORT INCLUDING ALL MODES 2000-2015 (BILLION PASSENGER-KILOMETRES AND TONNES-KILOMETRES – LEFT, PERCENTAGE OF TRAIN – RIGHT. - *Source : UIC Railway Handbook, 2017.*

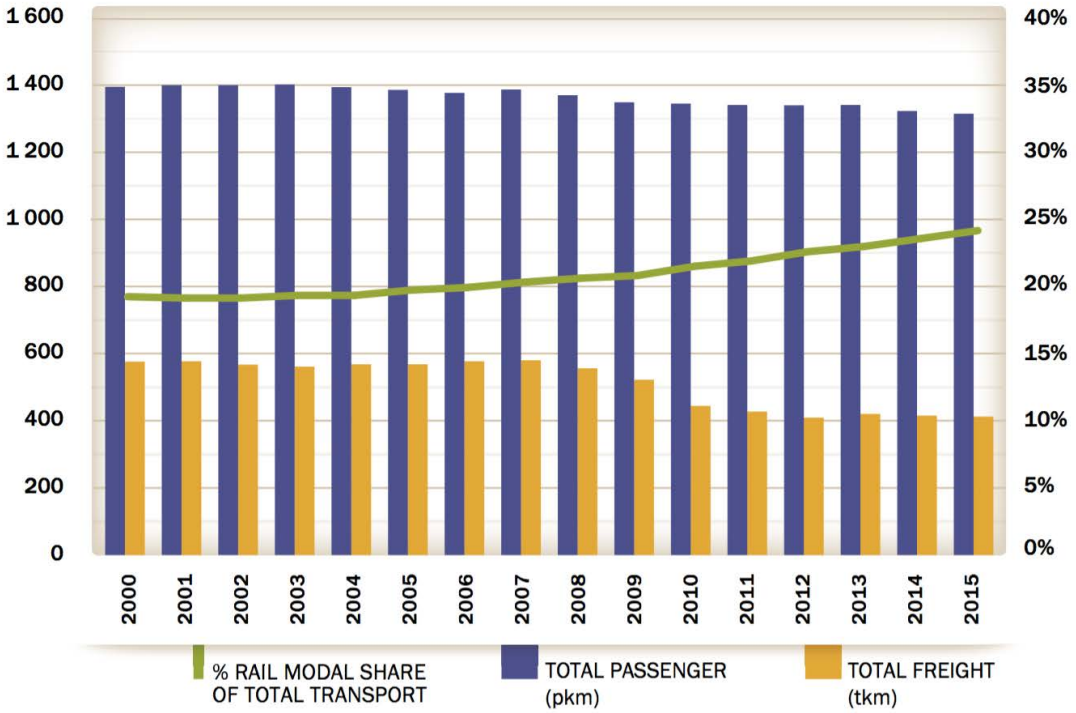
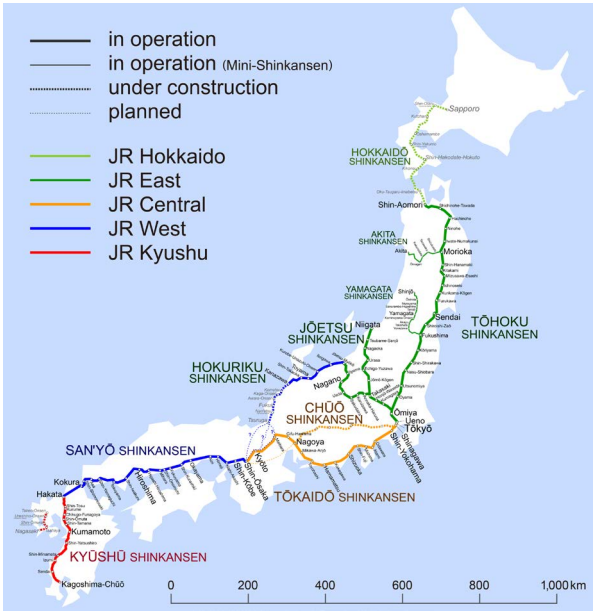


FIGURE 7

MAP OF SHINKANSEN NETWORK. SOURCE : HISAGI, 2016



Japanese rail networks also have a lower energy intensity per passenger-kilometre compared to the average in Europe (Global Status Report, 2018). Rail freight in Japan is on average three times higher than in Europe (300 passengers in high-speed trains for example). Over 90 % of passenger-kilometres and tonnes-kilometres were electric in 2018, the highest rate in the world (The Future of Rail, 2019). The high-speed train Shinkansen is without a doubt the jewel of the Japanese rail system. Capable of going up to 320 km/h, this train circulates on a dedicated railway of around 2,800 km (Thomas, 2016) and serves the majority of Japanese towns (Figure 3). Praised for its punctuality (the average delay is less than a minute) and safety, the Shinkansen network is gradually being extended: the Shinkansen Hokkaido line that will connect the cities of Aomori and Hokkaido is currently under construction. This expansion is part of a logic of major projects encouraging rail and construction industries, despite the absence of the climate component in the decision-making process, this line will contribute to the reduction of GHG emissions (Lipscy et Schipper, 2013).

EXPERIENCE FEEDBACK

JAPANESE RAIL COMPANIES COMMITTED TO THE FIGHT AGAINST CLIMATE CHANGE

East Japan Railway, the main rail operator in Japan has adopted emission reduction targets. The company hopes to reduce by 40 % in 2031 compared to 2014 levels. The strategies adopted by the company to reach the target include improving energy efficiency of lighting and air conditioning, deploying new modern trains and renewable energy production (JR East Group, 2018). In 2014, the company reduced its energy consumption by 10 % since 1990 including transport itself but also energy consumed by stations (Hayashiya, 2017).

The *Central Japan Railway* is developing the next generation Shinkansen, the N700S train. The latter will operate on the Tokaido line at the same speed as the current trains but with greater energy efficiency. The new design reduces the train weight by 13 tonnes and energy consumption by 7 % (Hosozawa, 2018).

Furthermore, the company launched the construction of the "Chuo Chinkansen" which will connect Tokyo to Nagoya from 2027. This line is dedicated to the Maglev train, an electromagnetic lift train. This technology allows very high speeds to be reached and a prototype went up to the record speed of 603 km/h on April 21st, 2015 (McCurry, 2015). On this next line, travel time will be halved, making rail transport more attractive.

TEXT BOX 5

Even though passenger volume is increasing nationally, gaps still exist between different areas of the country. Rural regions are particularly affected by demographic decline and their share of aging population is growing faster than in cities (Koike, 2014). In rural areas, public transport is progressively declining because of this. In various regions, railway lines are operating at a loss, which means lines will certainly close in the next few years (Rail Delivery Group, 2018), sparking a peak in car ownership and GHG emissions.

However, dependence on private cars is more complicated for older people: fatal accidents involving people over 65 account for more than half of all accidents in Japan. To address this issue, some cities are setting up bus services on demand. **The city of Chigasaki where 30% of the population is aged over 65 is establishing a bus service operating from 7am to 8pm. Reservations can be made by telephone or via a mobile application. The system is progressively extending with 8 rail lines now served** (Chigasaki City, s.d.). Since 2014, one out of six Japanese cities are offering this type of service. The Japanese government wishes to double the number of cities offering this on-demand service (Weng Kin, 2014).

4 - "Revitalising" Japanese cities with public and low-impact transport

• REVITALISING TOWN CENTRES WITH PUBLIC TRANSPORT • Facing the demographic and economic decline in certain cities and regions, a series of laws are intended to equip these areas to revitalise their local economies and city centres through the rehabilitation of public transport networks. First, the "Low Carbon City Promotion Act" of 2006 requires local authorities to develop low-carbon development plans that include the use of public transport, energy efficiency, or the development of green areas. By 2017, 23 cities had developed their plans. The "Act on Revitalisation and Rehabilitation of Local Public Transport Systems" adopted in 2007 and revised in 2014, is an example of cooperation between the State and the community by allowing cities and provinces to

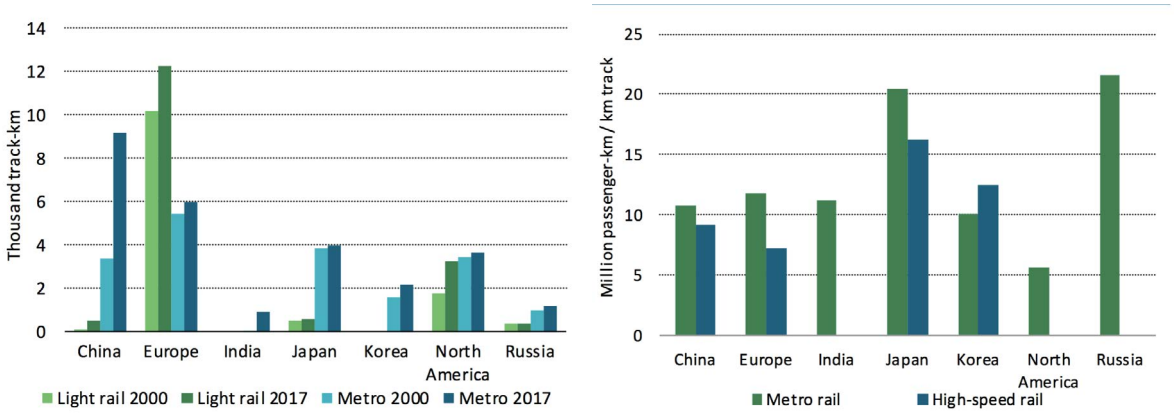
separate the ownership of railways and operations (vertical separation). Thus, regional governments can use this law to support train lines that are no longer profitable and reclaim infrastructure to renovate and revitalise a region-wide transport network, with financial support from the State.

The vertical separation mechanism has enabled many cities (Fukui, Sapporo, Kyoto, Yokkaichi, Hitachinaka) to rehabilitate their urban train networks and many trends have come to light: tourist trains to encourage other train uses, restaurants, reintroduction of tramways, etc. The city of Toyama (420,000 inhabitants) is often considered an example for the reintroduction of a light rail system since 2006 through the vertical integration mechanism. The city has set up the semi-public Toyama Light Rail Company in public-private partnership with *Hokuriku Electric Power Company* (Japan Local Government Centre (JLGC), 2017) to convert a line threatened by closure into a light rail system (LRT) and to finance its 2009 link up with existing tramway lines. As a result, the city has facilitated the installation of new residents in the city centre (shopping facilities, subsidies for the elderly). By 2015, weekday ridership had doubled and more than tripled on weekends. Pedestrian trips also increased by 32% in 6 years and there are fewer vacant shops (EJRCF, 2016).

Japanese cities are among the most developed in terms of urban train infrastructure with 4,000 km of metro and more than 20 million passenger-kilometre per kilometre of metro rail (Figure 8). The metropolitan network of Tokyo remains the busiest in the world still in 2018 with nearly 3.5 billion trips per year (UITP, 2018).

FIGURE 8

DEVELOPMENT OF URBAN TRAINS (METRO AND LIGHT RAIL) 2000 - 2017 (LEFT) AND METRO AND HIGH-SPEED TRAIN USE IN 2017 (RIGHT). - *Source : The Future of Rail, UIC, 2019.*



The modal shift towards public and low-impact transport displayed by cities responds to a dual ecological and socio-economic imperative. **According to the economist from Kansai University, Kiyohito Utsunomiya, this tendency to take charge of the redesign of transport networks comes from the consideration of social benefits in supporting local transport systems and the importance of the inhabitants' social capital, multiplying opportunities for inhabitants to meet each other. These local social ties have been revived among residents since the Fukushima disaster (Utsunomiya, 2016).**

EXPERIENCE FEEDBACK

TRAMWAY AND BICYCLE TRANSFORMING THE CITY OF UTSUNOMIYA

The city of Utsunomiya, an important industrial centre, has the 2nd highest motorisation rate in the country with 1.2 cars per household and the highest fuel consumption per capita. In an effort to promote a lifestyle less dependent on private cars, the city has launched several projects, the most emblematic of which is the creation of a tramway line. This line will be integrated into the rail networks, its stations will be connected to bus lines, and it will have a parking lot to encourage motorists to use public transport to get to the city centre. It is 15 km long, due to be complete by December 2019 and will be the first tramway line built (and not renovated) in Japan since 1948.

The city also wishes to combat the phenomenon of urban sprawl and has launched the "Networked Compact City" programme that aims to revitalise the business district and central areas of the city. Pedestrian and bicycle spaces are planned, and these neighbourhoods will be better connected to mass transit networks. In 2003, Utsunomiya adopted the Basic Plan to Utilize Bicycles. This plan included the implementation of a bicycle network that enabled a reduction of 40 % of cycling accidents. It also includes the creation of bicycle garages near train stations and bus stops as well as cycling parking spaces for short periods of time (Koike, 2014).

TEXT BOX 6

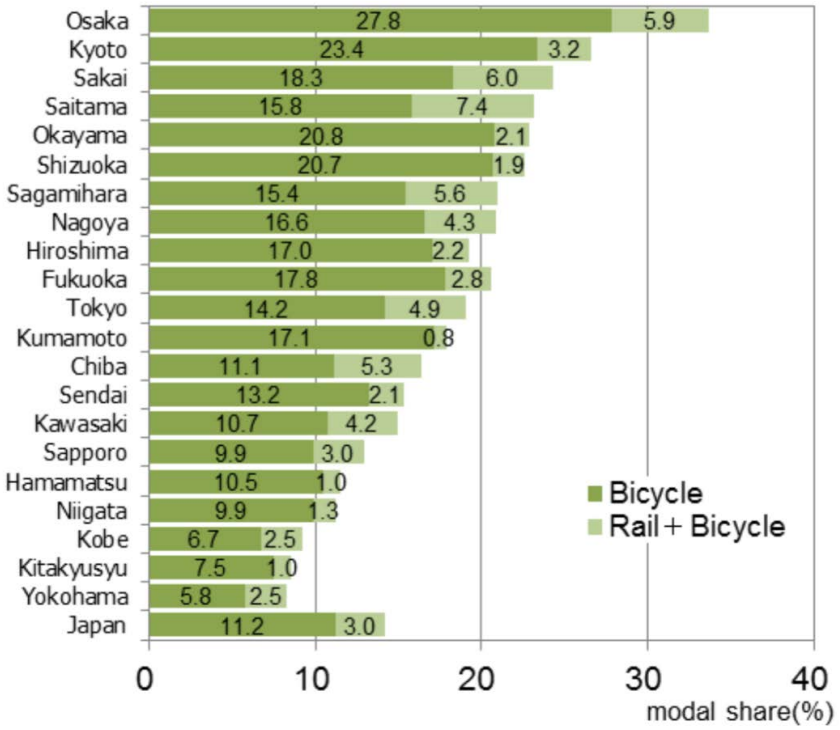
• AN INCREASINGLY COMMON CULTURAL PRACTICE DESPITE THE LACK OF ATTENTION FROM PUBLIC AUTHORITIES • Bicycles have a significant place in Japanese cities: their modal share represents over 25% in Osaka and 14% in the megapolis Tokyo. Their average is 15%, much higher than most European countries (Figure 9). The rate of bicycle equipment is high with a ratio of about 1 bicycle for 1.5 people and the cycling culture is well rooted in Japanese society (Suzuki et Nakamura, 2017). Bicycles are used for daily shopping but also for taking children to school or even between public transport journeys (18% of railway network users in Tokyo get to stations by cycling). This practice concerns the majority of the population and is notably higher for the elderly and for women who cycle more than men. The proportion of bicycle users is 60/40, while in France it is 35/65 (Villes cyclables, s.d.).

Considering the high commercial density in the outskirts of cities in Japan, urban planning is encouraging cycling to make up for the lack of public transport to cover short distances. On another note, the dense cities have made car parking spaces expensive and hard to find, which explains why users choose their bicycle over their car for short distances.

Cycling's modal share is growing in urban areas but has generally decreased on a national scale (Yoshida, 2015). Yet, public policies are barely encouraging inhabitants to cycle: there are few cycling networks in Japan and cyclists must cycle on the pavement, often near roads, which means pedestrians and cyclists do not get in the way of each other (Villes cyclables, n.d.). In 2013, only 52 cities, meaning 3% of all Japanese cities had a Cycling Plan (MLIT, 2012). Institutions lack interest in the cycling sector, which is also visible in the Japan's long-term-low-carbon strategy adopted in June 2019. Indeed, there is no mention of cycling in the chapter dedicated to transport GHG emissions mitigation.

FIGURE 9

CYCLING MODAL SHARE FOR DAILY JOURNEYS IN LARGE JAPANESE CITIES (2010). - *Source : Yoshida, 2015 ; Population Census, 2010.*



Cycling is currently being re-recognised as a credible sustainable alternative to car driving. Both national and local governments have implemented new measures to control and strengthen its use. The Ministry of Land, Infrastructure, Transport and Tourism published in 2012 a methodological guide entitled "Bicycle Usage Environment Creation Guideline for Comfort and Safety". The guide to cycling facilities addresses the planning and design of cycling spaces and the application of traffic rules for cyclists.

EXPERIENCE FEEDBACK

KYOTO, A SUSTAINABLE MOBILITY MODEL

Following the launch of the "Walkable City: Kyoto" in 2010, containing 94 projects, the city of Kyoto kicked off its transition toward a city model where cars lost their importance. Since then, cars' modal share has dropped year after year and city GHG emissions linked to transport have fallen by 20 % in 2015 compared to 1990 levels. The local government's next target is to increase cycling in the city. In 2015, the city adopted a brand-new Cycling Plan recognising all bicycle benefits for society, the local economy and the environment. This plan included the expanding of the cycling network as well as educational campaigns for car owners and cyclists. Because it is a very dense and almost completely flat city, Kyoto is a perfect city for cyclists. Today, the city accounts for over 45 km of cycle lanes, dedicated parking spaces have increased by 65 % and there are over one hundred self-service 'Pippa' bicycles all over the city. The number of 20 to 34 year old as well as 65 to 69 year old cyclists has increased (Barrett et Hjorth, 2018).

TEXT BOX 7

Within the development of their sustainable mobility policies, Japanese cities also benefit from support of city networks. The Japan Climate Initiative boosts the collaboration and enables cities to share their good practices. Created in 2018, this initiative was inspired by the American "We are Still

In" group. It brings together 105 companies, 30 cities with populations of over 40 million inhabitants, as well as many NGOs to lead climate action in Japan. Cities participating in the initiative include Tokyo, Yokohama and Kyoto and all notably share the same target of becoming carbon neutral by 2050. Japanese cities are also part of many international initiatives. The city of Yokohama is a member of the Carbon Neutral City Alliance initiative. It equipped its city vehicle fleet with clean vehicles and was the first Japanese city to have launched self-service bicycles in 2011. Tokyo is part of the 20 cities that signed the C40 declaration of intent on clean buses and commits to replacing all of its buses and its municipal fleet with hydrogen vehicles.

EXPERIENCE FEEDBACK

IN TOKYO URBAN MOBILITY DRIVING A REDUCTION IN EMISSIONS

From 2000 to 2015, Tokyo has reduced its GHG emissions by 36.1 % in the transport sector. Mass transport, low-carbon vehicle and eco-driving are the main strategies that have been implemented. The Tokyo metro is the busiest in the world with over 3.5 billion journeys in 2018. An energy efficiency indicator applied to 264 companies from the land transport and over 10,000 vehicles has also enabled a reduction of 20 % of their overall emissions. Since 2003, CO_2 emission norms and particles notably for diesel vehicles, as well as energy efficiency standards of vehicles in use and quotas for low-carbon vehicles for companies have been imposed (Climate Chance, 2018).

The Japanese capital is also developing cycling and has launched a Cycling Plan including the implementation of 400 km of appropriate cycle areas. But progress remained timid as the network accounts for 13 km of cycle lanes. In its 2019 classification of cycling cities, the Copenhagenize Index 2019 shows that if cycling culture is very strong in Tokyo, policies supporting its practice are needed (Copenhagenize index, s.d.).

TEXT BOX 8

Conclusion

Japan's strategy for reducing its emissions in the transport sector rely on the modal shift of land transport to low-impact and public transport. Even though technological innovation is a significant national strategy and is a particular feature of Japanese manufacturers, the market for "new generation" vehicles and the current fleet do not allow, as of now, a significant reduction in road transport emissions, which is more likely to be achieved by reducing the demand for road transport. In addition, the electricity mix is too carbon-intensive for electric cars to be considered clean.

The national strategy offers an efficient framework for action to cities and regions to revitalise their local economies via urban development making urban centres and regional railway networks denser.

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