



Reconciling transport and the environment- a dilemma that is here to stay

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► To cite this version:

Yves Crozet. Reconciling transport and the environment- a dilemma that is here to stay. European Court of Auditors Journal, 2019, Mobility & Transport, 1, pp.6-14. halshs-03153626

HAL Id: halshs-03153626

<https://shs.hal.science/halshs-03153626>

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N° 1 | 2019

Journal



EUROPEAN COURT
OF AUDITORS

THEME **Mobility & Transport**



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activities and places together**



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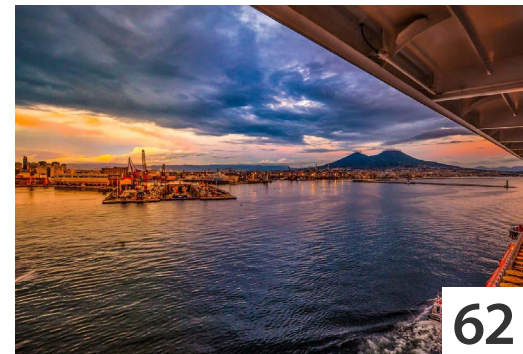


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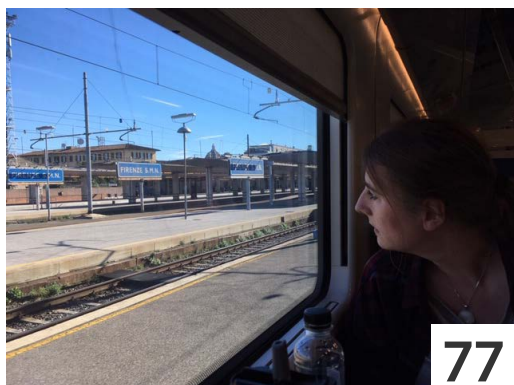
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Past editions of the Journal
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Transport – freedom of movement, but not for free

Freedom of movement is a fundamental right. And — this may surprise you — it is not something specific to the European Union. It is right there in the first paragraph of Article 13 of the Universal Declaration of Human Rights adopted by the United Nations back in 1948. And, as paragraph 2 of the same article stipulates, this right is not limited to your country, but applies worldwide.

Having rights is one thing, being able to exercise them is another issue. And here the European Union's Single Market comes into play. Article 26 of the Treaty (TFEU) stipulates an internal market, without internal frontiers, in which the free movement of goods, persons, services and capital — also called the 'four freedoms' — is assured. The Treaty also devotes a whole section (Title VI) to transport. The setting up of the Single Market and the increasing involvement of the EU in legislating, financing and organising various aspects of transport and mobility are undoubtedly intertwined. But the economic success of the Single Market, the enlargement of the Union since 2004 and changes in citizen's lifestyle have also meant different traffic flows, more traffic and new problems to be addressed.



One of my favourite slogans is 'The EU works best if the citizen does not notice it.' And to a large extent this also applies to transport and mobility issues. Because traffic has increased substantially. This is not only my feeling: it is also pointed out in the ECA landscape review on transport published in December 2018, which motivated us to select transport as the theme for this Journal. From an economic point of view, as you can read in our Long Read, transport means bringing activities and places together, be it by road, rail, air or on water. Moreover, both the time and costs needed to move goods and persons around have decreased. In most, but not in all cases, and also depending on how you define costs. Looking at the significant changes that have taken place in the area of transport in Europe since the 1990s, many of them can be traced back to EU legislation or, at least for major infrastructure works, financing. In that sense transport is an area where citizens meet the EU almost on a daily basis. And not only when they are crossing borders.

However, my slogan also applies the other way around. When something does not work well, certainly when travelling between Member States, citizens will notice and would like to see action to address the problem. And as soon as this concerns cross-border transport or transnational issues, the EU comes into the picture: 'Do something!' And in today's global village, what is not cross-border? As the EU's external auditor, the ECA often reports on where the EU can do better. The objective is to get everything running so smoothly ... that the EU citizen does not even notice it. The ECA's reports might not always fully reflect the tremendous progress the EU and its Member States have achieved in providing better ways to put freedom of movement into practice. Sometimes only a major disruption, like for example 'Brexit', can make this progress really visible, because it is then that people realise what they will lose.

In this Journal on transport — offered in a new format to be more user-friendly for mobile devices — we try to cover a wide array of perspectives as far as transport and mobility is concerned. Quite often from an auditor's point of view, but also offering other perspectives: ranging from academics to decision-makers at the European Parliament, in a Member State government or at the European Commission. And also from a user's perspective, either taking that role as auditor when assessing a project or giving the floor to citizens using certain transport modes. In many contributions some concerns shine through: EU transport being a patchwork instead of a network; no level playing field between different transport modes; untransparent pricing and service practices; transport being far from meeting environmental targets; maintenance issues and safety concerns, to name just a few.

Reading all these contributions it becomes clear that everybody, without exception, seems to need some form of transport. We are more and more addicted to mobility. The questions are: which type of transport and who pays for it? In Luxembourg, citizens will enjoy free public transportation from 2020 onwards. But even here mobility does not come for free. There is certainly an environmental price to pay. Article 13 of the UN Declaration speaks about a right. But rights often come with duties. In this case environmental duties. As they are reflected in the UN's Sustainable Development Goals 7 and 13, to be met in 2030. That is only 11 years from now... ! So how environmentally friendly was your 'movement' today?

Reconciling transport and the environment - a dilemma that is here to stay

By Professor Yves Crozet, Transport Urban Planning Economics Laboratory
of the University of Lyon



Source: Pixabay

Electrification of the European car fleet

Transport is for many people a rather straightforward concept: getting people and/or goods from A to B. But looking a bit closer many things come into play, like technology, geography, safety, etc. And of course the means to realise transportation ambitions. On the latter, on the economic aspects, Professor Yves Crozet is a specialist. He has built up a research reputation in Europe, providing advice to decision-makers regarding societal impact of transport and mobility choices. In this Journal's Long Read article he focuses on the environmental costs of transport and whether EU objectives set for transportation and actions to counter climate change can still be reconciled.

Transport as a driver for growth... but at which cost?

Mobility of people and goods is at the heart of Europe's economic dynamic. For decades now, the growth of transport flows has gone hand in hand with economic growth. For this reason, annual public spending on mobility accounts for more than 1% of GDP; but transport also generates multiple external costs, such as insecurity, noise, pollution, climate change and energy dependency. As a result, public policies – in particular those that are implemented or promoted by the European Union – aim to reduce these negative externalities. However, they also seek to preserve the positive externalities of mobility for the economy and society that are linked to economic growth. Reconciling these two objectives is at the heart of the White Papers on Transport (2001 and 2011). As the European Parliament and the Commission will be renewed in 2019, it is now time to take stock of the situation. Is it not contradictory to encourage mobility while at the same time trying to reduce its external costs? If economic and ecological interests cannot be reconciled, we will be faced with a real dilemma.

Transport: striking a balance between profits and external costs

Transport has a positive macroeconomic impact. Jobs that are directly or indirectly linked to transport account for more than 10% of assets and GDP. The specific impact on individuals' daily lives is no less significant because, as a component of mobility, transport helps to bring places and activities together. Journeys by motorists who drive to work or by tourists who fly to their holiday destinations only make sense by bringing locations and activities together. When transport entails lower costs, faster travel or greater comfort, it encourages diversification and more intense activity. It is thus responsible for what economists call positive externalities or external benefits. This leads in all developed countries to an increase in the distances travelled each year by passengers and goods¹.

However, transport has a considerable negative impact not only on public health but also on biodiversity and climate change. Accidents, pollution, noise, severance effects and greenhouse gases – to name but a few – are part of a long list of the external costs of transport which account for tens of billions of euros at EU level. Reducing these external costs has therefore been a priority of European policies for several decades. They have a well-equipped toolbox to help them achieve this goal, as there are many ways of internalising external costs.

ECA Journal Short Read

Transport and economic development – transport brings economic activities and places together, encouraging economic growth. But it entails also external costs related to public health and climate.

Reducing external costs – decision makers have overall four means to internalise external costs: regulations, subvention, taxation and tradable permits, each of them applied with different success rates.

Reducing Green House Gas (GHG) emissions – for this main climate objective there are four key elements relevant: 1) reducing traffic; 2) lowering unit vehicle emissions; 3) increasing occupancy rates; 4) changing modes of transport used.

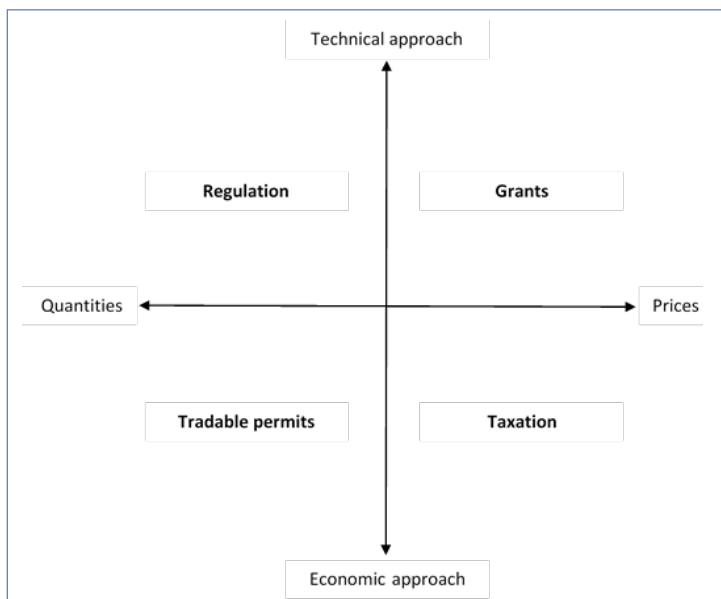
Income increase and substitution effects – these are the key elements that have offset most efforts in the EU to reduce GHG emissions.

Reducing unit emissions or activities, i.e. economic growth – these are the two variables that remain to achieve GHG emission goals. Considering the setbacks linked to each one of them – historically and politically – the EU faces a difficult dilemma.

Reducing external costs: the toolbox

Once an external cost is recognised, the means of internalising it vary. There are four such means, and, as Figure 1 shows, they combine technical or economic approaches on the one hand, and price or quantity measures on the other. These are presented clockwise, from the most basic to the most sophisticated.

Figure 1 - Means of internalisation



¹ Y. Crozet, 2016, *Hyper-mobilité et politiques publiques: changer d'époque?* Economica, 192 p.

The simplest and most obvious form of internalisation is **regulation**, which can go as far as prohibition, e.g. of dangerous goods, vehicles or behaviour. This means intervening upstream of economic stakeholders, e.g. by making seatbelts compulsory for manufacturers and drivers/passengers, or by introducing regular roadworthiness tests for vehicles. Transport is thus highly regulated in terms of driving licences, the Highway Code, vehicle weight and length, speed, drink-driving, parking, engine noise etc.

A second, widely endorsed, method is to **subsidise** an activity that is supposed to reduce the external costs of transport. This is the case of public transport in urban areas, which is regarded as more environmentally friendly than cars. However, the relevance of public transport is confined to densely populated areas: bus, tram or metro systems cannot be extended *ad infinitum*. Similarly, in order to replace the internal combustion engine with its electric equivalent, the price to pay in the form of grants for car buyers would be very high if sales were to become significant.

The third method – **taxation** – also affects prices, but aims to be profitable for society. However, although very effective, this method is less popular, as it entails environmental taxes (also known as Pigouvian taxes, after the English economist A.C. Pigou [1877-1959] who first proposed the idea almost 100 years ago). Although not explicitly included, fuel taxes can be classified under this category, as they are a major source of fiscal revenue and encourage motorists to reduce their fuel consumption and the resulting pollution.

The fourth form of internalisation – **tradable permits** – affects prices only indirectly because it mainly affects quantities. If it is possible accurately to measure and monitor the quantity of pollution emitted by a given source, why not assign a maximum emissions quota to each polluter? This ensures total emissions remain below a tolerable threshold, while allowing polluters to trade their emissions quotas on a market like the EU Emissions Trading System (EU ETS).

The European Union has used the four means available in the internalisation toolbox, but the first two have been more successful than the last two, which are more difficult for people to accept.

Regulation and grants: simple solutions

Regulation has been the most successful tool for implementing European and national policies. The best example of this is improved road safety. For example, France has seen a fivefold reduction in road deaths since 1972, even though traffic has increased fourfold over the same period. The risk of dying in a road accident has therefore fallen by a factor of 20. This is due to proactive policies regulating not only vehicles themselves but also the way they are used: maximum speeds have been reduced on all categories of road, and measures have been taken to combat drink-driving and various forms of road crime. However, the number of people killed and injured on Europe's roads remains high, and this explains why new regulations – such as points-based systems with stricter penalties – are being introduced on a regular basis.

In terms of pollution, regulation has also been effective in reducing unit emissions from new vehicles. Between the Euro 0 (1990) and Euro VI (2013) standards, unit engine pollutant emissions from heavy vehicles were drastically reduced: by factors of 36 for nitrogen monoxide (NO_x), 7.5 for carbon monoxide (CO), 18.5 for hydrocarbons (HC) and 36 for particulates (see Table 1). This led to a significant reduction in total pollutant emissions. In France, emissions from the transport sector fell between 1990 and 2015 by the following proportions: NO_x -60%, CO -90%; sulphur dioxide -88%, lead -99%, and particulates between -51% and -66%, depending on size². However, these results do not compensate for the so-called 'Dieselgate' scandal. The sophisticated software that car manufacturers used to approve vehicles enabled several of them to falsify their real engine emissions. And in many countries, including France, pollution in urban areas often remains above acceptable levels for the public health.

Thus, in February 2017 the European Commission sent a final warning – the last step before referral to the European Court of Justice – to several EU Member States including France, Germany, Spain, Italy and the United Kingdom. All were accused of exceeding maximum pollution thresholds too often in big cities, in particular for NO_x and particulate matter. The Commission drew attention to the fact that '400 000 citizens die prematurely each year in the EU because of poor air quality.'

2 Source: CITEPA <https://www.citepa.org/fr/activites/inventaires-des-emissions/secten#Evolution>

In France, for instance, an estimated 48 000 premature deaths are attributed each year to fine particulate matter. The EU has singled out 19 urban areas in France – including Paris, Grenoble, Lyon and Marseille – that exceed authorised pollution levels. The cities concerned will be required to reduce traffic volumes, which they could do by means of road charges and urban tolls. However, they are more likely to resort to legislation to ban the vehicles that pollute the most. At the same time, governments have developed systems of grants for purchasing electric or hybrid vehicles, and have continued to subsidise public transport in the hope of promoting a shift towards cleaner modes of transport.

Table 1 - Changes in emission standards for heavy vehicles in the EU

Standard	Reference text (directives)	Data of application (all types)	NOx (g/kWh)	CO (g/kWh)	HC (g/kWh)	Particulate matter
Euro 0	88/77	01-10-1990	14,4	11,2	2,4	-
Euro I	91/542 (A)	01-10-1993	9	4,9	1,23	0,36
Euro II	91/542 (B)	01-10-1996	7	4	1,1	0,15
Euro III	1999/96	01-10-2001	5	2,1	0,66	0,13
Euro IV	1999/96	01-10-2006	3,5	1,5	0,46	0,02
Euro V	1999/96	01-10-2009	2	1,5	0,46	0,02
Euro VI	Regulation (EC) No 595/2009	31-12-2013	0,4	1,5	0,13	0,01

One question that arises is how effective regulatory measures and grants actually are. In order to achieve the desired results, would it be better to ban the oldest vehicles from the road, or to replace them more quickly with the aid of grants? Has the time not now come to combine taxation with the usual tools of regulation and grants?

The fact is that, as far as environmental pollution is concerned, public policies appear to be inconsistent. On the one hand, politicians talk in alarmist terms about the costs of pollution and climate change; on the other hand, however, the measures taken to deal with such issues are extremely conservative, being largely confined to technical aspects even though economic tools would be much more powerful. This is illustrated by the experience of Stockholm's urban toll: since urban road pricing was introduced there in 2006, the city of Stockholm has seen a 25% reduction in both traffic and pollutant emissions. Why has this system not been replicated in Europe more often?

The limited success of charging and tradable permits

Since the 1990s, the European Union has funded considerable research into mobility pricing with a view to internalising external costs. Urban tolls have thus been presented as a relevant solution (see Box 1), as have road-use charges for heavy goods vehicles (the *Eurovignette* Directive). Indeed, the European Parliament plans to amend the Directive so that such charges are no longer fixed, but depend on the distance travelled by vehicles and thus on the actual level of greenhouse gas emissions.

Charging tools do exist, then, but they are rarely used. Urban tolls apply only in London, Stockholm, Oslo and Valetta, and partially in cities such as Milan. Very few local politicians cite urban tolls as one of their objectives for the years to come.

Box 1 - Urban tolls

Urban tolls are economists' preferred tool for reducing the social costs of transport in dense areas. Today, there are dozens of urban charges around the world (especially in Europe and Asia) in a wide range of situations. Urban tolls differ by:

Purpose: the objective of urban tolls may be to finance new infrastructure, cut congestion or reduce environmental pollution. While the Rome or Milan tolls are examples of measures that prioritise the environment, most tolls (Singapore, London and Stockholm) seek to cut road congestion, with lower emissions as a joint objective.

Spatial coverage: tolls may apply either to specific infrastructure (Sydney) or to a specific geographical area (London), or be payable as soon as vehicles pass through certain locations (Oslo and Stockholm). However, the zones where urban tolls apply often occupy only a very small part of the surrounding metropolitan area.

Charging structure: some tolls are fixed (Dubai), while others depend on the distance travelled (Santiago); some tolls operate 24 hours a day, while others vary during the day and/or from one day to the next, depending on traffic speed (Singapore); some tolls are the same for all vehicles (Sydney), while others vary by size and/or engine type (Milan and Rome); and some systems offer exemptions (London), while in other places (Singapore) all road users have to pay.

Technology: the two main ways of collecting and monitoring compliance with tolls are based either on a card or a chip system in vehicles (Bergen and Tokyo), or on an optical recognition system for registration plates (London and Valletta). Progress on GPS-type satellite technologies is currently being incorporated into Singapore's urban charging system.

Tolls have a significant effect on traffic levels. Whether in London (-16%), Milan (around -15%), Singapore (-45%) or Tokyo (-10%), the introduction of tolls was followed by a significant drop in traffic (and sometimes a switch to cleaner engines, as in Stockholm). Urban tolls often have a beneficial effect on air quality (in Milan, NO_x emissions fell by 11% and PM₁₀ emissions by 14%). Most cities have seen similar increases in public transport use (+4.5% in Stockholm, +5% in Rome and +5% in London), while toll receipts (80 million euros/year in Singapore and 135 million euros/year in London) have made it possible to offer better modal alternatives. However, despite these genuine successes, urban toll investment and operating costs are often a major item of expenditure (46% of revenue in London, 55% in Milan and 100% or more in Valletta), with the choice of optical recognition technologies having a potentially detrimental effect on the socio-economic situation.

An increasingly frequent topic of discussion, not only in Luxembourg, but also in Brussels, Paris and Germany, is the possibility of free public transport. However, this type of measure has very little impact on the modal shift³. In those cities where public transport is free, neither road congestion nor pollutant emissions are falling. This type of measure therefore mainly shows public policymakers' aversion to road charges and their preference for awarding grants. Thus, in Rotterdam, a 'negative toll' is being tested in the form of grants for those who agree not to use their cars. The question which then arises is where the public funds allocated to this policy will originate.

As regards road and motorway charges for heavy goods vehicles, the results are also mixed. In 2014, France abandoned its eco-road tax project, which was modelled on Germany's. However, even in Germany, despite the 'toll collect' (LKW Maut) bringing in 5 billion euros a year, Heavy Goods Vehicle (HGV) traffic has not fallen. Charging policies are therefore subject to two types of limitation: not only are they rarely implemented, but when they are, their impact is limited because demand remains strong despite the higher charges. I explain why further below.

This type of remark also applies to air transport, which is growing very rapidly in all European countries. One explanation for this veritable boom is the downward trend in ticket prices. Lower fuel consumption and higher seat-occupancy ratios have made it possible to pass on major productivity gains to customers. The fact that aviation fuel is not taxed has, of course, facilitated this transfer. This is why the EU proposed that a global emissions trading system (ETS) be set up at a global level, although opposition from countries such as China, the United States and Russia has prevented this from happening. However, the fact remains that even an increase in the cost of aviation fuel would have had only a modest impact on air traffic. At current prices per tonne of CO₂, a carbon tax (about €30 per tonne) on air transport would entail only a slight increase (barely 10%) in ticket prices.

3 T. Mucanu, Ch. Winkler, T. Kuhnimhof, 2018, The travel demand impacts of fare-free regional transport in Germany, International Transport (70).

Can economic growth be reconciled with climate change?

Under the COP 21 UN Framework Convention on Climate Change, the European Union has committed itself to significantly reducing CO₂ emissions, in particular from transport. By 2030, transport, which accounted for 60% of the EU's emissions in 2014, is expected to reduce its emissions by 30% when compared with 2005 levels. However, this objective seems very ambitious in the light of recent developments. Although emissions fell in 2009-2011 due to the economic downturn, they subsequently picked up again as economic growth resumed. Thus, in 2017, France's transport emissions were only slightly lower than in 2000. This means that even if emissions growth can be avoided, any reduction is much more difficult. We will demonstrate this by highlighting the failure of the modal shift that has been a central objective of public policy for the last 20 years. As the limitations not only of the modal shift but also of pricing have become clear, what other options are available (see Box 2)? Will lower unit vehicle emissions and higher occupancy rates suffice? Or will mobility and thus economic growth also have to be curbed?

Box 2 - Four key ways to reduce greenhouse gas emissions

The overall objective of reducing greenhouse gas (GHG) emissions in the transport sector can be broken down into a few key variables. For each type of transport (passengers or goods) and for each mode of transport (road, rail, water, air, etc.), total emissions depend on a share of traffic – in passenger-kilometres (pkm) or tonne-kilometres (tkm) – multiplied by unit emissions per pkm or per tkm. These unit emissions are calculated by taking into account the unit emissions of the various vehicles and the occupancy rate. This gives the following formula:

$$GHG\ emissions = \frac{Traffic \times Unit\ vehicle\ emissions}{Occupancy\ rate}$$

With the formula provided in **Box 2**, the reduction in total emissions is easy to calculate. For each mode of transport, the solution entails:

- 1) **reducing traffic** (passenger-kilometres or tonne-kilometres);
- 2) **lowering unit vehicle emissions; or**
- 3) **increasing occupancy rates;**
- 4) In terms of overall mobility one can also **organise a vast modal shift**, i.e. a progressive reduction in the traffic generated by modes of transport that structurally emit the most pollutants towards those that emit the fewest because they consume the smallest quantities of fossil fuels.

This fourth way – the modal shift – has been prioritised by the EU since the 1990.

The limitations of the modal shift

The modal shift was central to the EU's 2001 and 2011 White Papers on Transport. This was particularly the case for goods, which were supposed to switch from road to rail and water on a massive scale. To this end, the European Union identified corridors along which transport infrastructure – mainly rail – needed to be built or improved so as to create a genuine trans-European transport network (TEN-T). For passengers, high-speed rail projects had the same objective, i.e. to offer an alternative to intra-European air travel. With its emphasis on the development of public transport, the modal shift also concerned passengers in urban areas.

As the end of the decade approaches, the results of the modal shift are far removed from the original objectives, as a report recently submitted to the European Parliament makes clear⁴. The introduction to the report stresses that:

'the **modal share** of road, rail and inland waterway transport remained **substantially unchanged** between 1996 and 2016, both for passenger and freight transport, with road transport showing a slight increase. Looking at future projections, road transport is expected to keep its predominant position both for the passenger and freight sectors.'

⁴ Research for the TRAN Committee - Modal shift in European transport: a way forward, Study requested by the TRAN Committee, Policy Department for Structural and Cohesion Policies, Directorate-General for Internal Policies, PE 629.182 - November 2018, 174 p.

The results are not entirely negative, though. In city centres in particular, vehicle traffic and pollutant emissions have fallen, at the same time as public transport and soft mobility (walking and cycling) have developed. However, the further one moves away from densely populated areas, the more difficult it is for rail to compete with road or air. This is illustrated by two examples: road freight transport and long-distance passenger transport.

As far as the transport of goods is concerned, the star pupil in the European class is Germany. In the case of rail, the success of German freight operators (with a 40% increase in traffic between 2000 and 2017) is indeed impressive (at the same time in France, rail traffic fell by 40%). However, this performance is not all that it seems to be, as road transport's share of the market has not fallen. If a modal shift has taken place, it has not been from road to rail, but from water to rail, as the table below shows. This is worrying in view of the ambitions which the European Union set for itself in the 2011 White Paper. The fact is that roads seem likely to retain their dominance in the foreseeable future, for the simple reason that they are the only mode of transport that offers a door-to-door solution for goods – which cannot transport themselves – without the need for offloading. Furthermore, the road network provides access to the country's entire territory, which is not true of the railways.

Table 2 - Change in market share for freight transport in Germany

	2000	2005	2010	2015	2016
Water	15%	12%	10.8%	9.2%	8.8%
Rail	18%	18.1%	18.7%	19.5%	18.8%
Road	67%	69.9%	70.5%	71.3%	72.4%

Source: Eurostat

Another structural limitation of rail freight is the development of supply chains, where warehouses play a key role. The fact is that goods rarely travel directly from manufacturer to customer. Given the large volumes involved, they make several short trips of a few hundred kilometres from one warehouse to another before they reach their final destination. Rail transport is simply not competitive in such cases, not only because warehouses lack line connections but also because the distances covered are relatively small in relation to the scale at which rail is relevant (journeys of over 500 km).

All this means that the various modes of transport do not operate on a level playing field. Indeed, such are the advantages of road transport (i.e. speed, flexibility, reliability, adaptable volumes, and no offloading) that it has become the most obvious solution.

In its special report 19/2018, published in September 2018, the ECA has painted a critical picture of the state of high-speed rail. The European HSR network tripled in size between 2000 and 2016, from 2 708 km to 8 200 km. At the same time, however, traffic only doubled in size to 124 billion pkm. Given this situation, does the network really need to triple in size between 2010 and 2030, as the 2011 White Paper recommends? The question arises because the network has been extended since the beginning of the century at the same time as yields have been falling. After reaching a maximum of 21.9 million pkm per km of network in 2001, the rate of increase dropped by 50% in 2016⁵. This was the result of lines being brought into service with a potential that was lower than the HSL relevance threshold of 9 million pkm/year. The report singles out three new lines (Eje Atlántico, Madrid-León and Rhine-Rhône) whose traffic is well below this threshold. However, many planned HSLs also fall into this category.

Income and substitution effects in the area of transport

The limited progression of traffic on HSR lines contrasts with the success of air transport, where low-cost airlines have made high-speed rail less attractive, not because of direct point-to-point competition – which is relatively infrequent – but because of the incredibly wide range of destinations that customers are offered. These days, when Europeans are deciding where to spend their holidays, they no longer start by choosing their destination, but consult airline websites first to see what is on offer. Increasingly, they also choose a mode of transport before deciding on their destination. This trend is clear in France, where TGV traffic increased by 12% between 2008 and 2017, at the same time as passenger numbers between mainland France and

⁵ The figures for 2016 were 19.2 in France, 17.5 in Italy, 12.7 in Germany and 5 in Spain, a country which has over-invested in HSR.

Europe rose by 39%. The fact that more and more airports are connected to a high-speed rail line means that the TGV now serves as a complement to rather than as a substitute for air transport, as the 2011 White Paper stated.

In the area of air transport, EU policies run up against their own contradictions. For decades, transport policies in developed countries have been based on the idea that the external benefits of mobility should be extended to the entire population. Thus, road tolls disappeared in Britain and France at the beginning of the 19th century; indeed, roads are still mostly toll-free in the UK. In France, 99% of the national road network of more than one million kilometres is also still toll-free. Extending transport networks obviously acts as an incentive to increase the number and length of journeys.

At the same time, the EU is promoting the development of competition as a key factor in reducing costs and increasing demand, as was found to be the case for air transport. Deregulation of the sector has led to a significant drop in ticket prices. For intra-EU travel, passengers pay around 5 cents per kilometre, i.e. half as much as travelling by train (10 cents) and five times less than travelling by car (around 25 cents). It is therefore hardly surprising that the number of passengers in airports is increasing much faster than rail and road traffic.

There are two main reasons for greater passenger mobility:

- The first is the trend towards a general increase in purchasing power: on average, the cost of motorised mobility is falling. Thus, in France, recipients of the minimum wage in 1972 needed to work for one hour in order to purchase three litres of petrol. 47 years later, they can buy six litres, and as their cars consume almost half as much fuel, they can drive four times further per hour worked. As car prices have fallen, the 'economic speed'⁶ of passenger cars has quadrupled;
- As well as this income effect, there is also a substitution effect caused by the variation in relative prices. Cheaper plane tickets have stimulated demand for air travel, whose economic speed is now five times that of the automobile. For one hour of work, a recipient of the minimum wage can now travel 200 km by air, but only 40 km by car.

The same combination of income and substitution effects has impacted the transport of goods:

- As competition in road freight transport (RFT) began to develop in the 1970s, i.e. more than 20 years earlier than for rail transport, RFT achieved significant gains not only in terms of productivity – a factor in price reductions – but also in terms of quality and reliability. Thus, although road transport remains significantly more expensive than rail, it is rail – which was still dominant in the mid-20th century – that has seen its market share steadily decline because it is less adaptable.
- The substitution effect was amplified by the equivalent of an income effect because the per-tonne value of goods increased. As a consequence, the purchasing power of goods is increasing. The cost of transport represents a declining percentage of the value of goods. It is therefore not surprising that a more economical road-based service for goods has been preferred over rail and its attendant constraints.

Reduce unit emissions... or growth

It is not just travellers but also goods that are now covering ever greater distances, primarily due to economic growth. This means that purchasing power is increasing more than transport costs. Deregulation and competition are also factors here, as they have helped to lower the relative prices of the modes of transport that rely most on fossil fuels, i.e. road and air. The equation in Box 2 leaves only two means of reducing CO₂ emissions from transport: one is technical and the other is economic.

The technical solution entails reducing unit vehicle emissions while increasing their load factor. This is exactly what air transport has achieved over the last 20 years. However, as traffic has grown significantly, CO₂ emissions from aircraft – although they have barely increased – still account for 10% of transport emissions as jet engines still consume fossil fuels. In order to reduce unit vehicle emissions, their source of energy therefore needs to change, which is why the emphasis is now on electrifying cars and – to a certain extent – lorries. In order to achieve this, the European Union

6 Crozet Y., 2017, Économie de la vitesse: Ivan Illich revisité, in *L'économie politique* n°76, pp. 24-37.

is envisaging binding standards for car manufacturers so that all new vehicles sold emit less and less CO₂ per kilometre. Several countries, including France, are envisaging banning the sale of vehicles powered by internal combustion engines from 2040, the aim being that all cars should be electric by 2050.

However, what are the chances of such an objective being achieved and – even if it can be – what will the actual impact on CO₂ emissions be? These two questions are worth asking. First, because announcing the electrification of cars is reminiscent of the announcement of the modal shift 15 or 20 years ago; and second, because electric motors use electricity that may have been generated from fossil fuels. Battery production and recycling are also sources of CO₂ emissions. It is therefore highly likely that climate commitments in the transport sector will be difficult to achieve by purely technical means.

There remains the economic solution, but this entails calling into question the very principle of economic growth. This could take the form of regulations and fiscal disincentives that are explicitly designed to reduce economic activity – and thus the flow of people and goods – by curbing income growth. However, such a scenario is not currently on the public policy agenda as it has significant adverse effects, not least in terms of public revenue.

Dilemma likely to remain very pertinent

A lucid assessment of the transport sector suggests that it will be very difficult for EU Member States to achieve their commitments to reduce CO₂ emissions. The limited results achieved over the last 20 years suggest a need for prudence in the face of optimistic pronouncements. The emphasis has now switched from the modal shift to electrification. However, even if electrification develops, it will be no panacea.

It is therefore highly likely that in a few years we will be faced with a dilemma that will force us to clarify the current ambiguity: either we commit to negative economic growth in order to reduce passenger and freight traffic, or we acknowledge our inability to reduce our reliance on fossil fuels to the extent that we had hoped. Although such an alternative is now increasingly likely, it is difficult for policymakers to accept, particularly when they ponder the well-known aphorism by Cardinal de Retz (1613-1679): 'It is to one's own detriment that one ceases to be ambiguous.'