Trends and challenges in passenger mobility

Current demand for mobility encourages people to seek fast, individual means of transport. The automobile accounts for the bulk of passenger travel worldwide. This mode of transport is a source of annoying and harmful effects including noise, accidents, deteriorating infrastructure, traffic congestion and pollution (local and atmospheric). Some of these issues are now under regulation and have become less acute, but traffic congestion and greenhouse gas emissions are still major problems. Before assessing any policy undertaken to curb nuisance levels and harmful effects, one must be familiar with global mobility trends and the challenges involved.

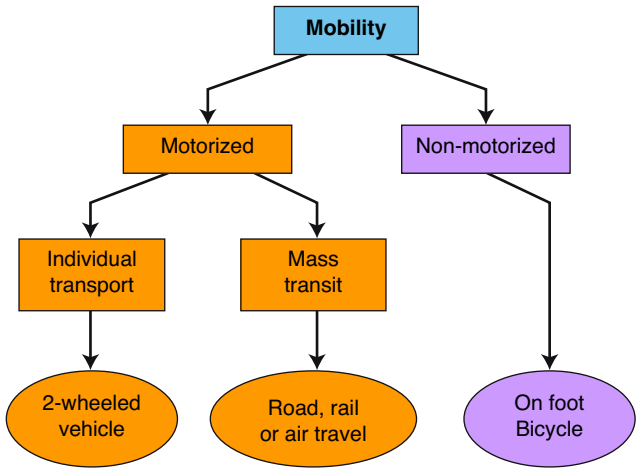
Passenger mobility corresponds to the total volume of individual trips, whose characteristics have a direct impact on it. Mobility is the "demand" and the chosen mode of transport is the "service".

Many factors are involved in choosing a mode of transport: the type of mobility involved (work or pleasure, short or long trip), demographics, national income, the extent of urbanization, population density, the cost of transport (procurement, maintenance and fuel) and infrastructure (e.g. kilometers of road or rail, bus lanes or subway system). A distinction is made between motorized and non-motorized mobility. Rarely included in travel statistics, the latter has very few adverse effects compared to motorized mobility. In fact, it represents the Number One mode of travel in the world. The Figure1 indicates the different modes.

The nature of mobility has changed over time, as travel modes have changed and individuals are traveling longer distances. Motorized means are replacing the non-motorized, with a preference for individual means of transport such as the automobile. The use of motorized means (cars, two-wheeled vehicles and buses) has pushed energy demand, especially for fossil fuels, to very high levels. Today, petroleum-based motor fuels account for more than 95% of transport-related energy consumption.

There are three main types of passenger travel: road, rail and air transport. This article examines the challenges facing the road sector, whose weight in the global transport market exceeds that of air or rail

Fig. 1: Types of mobility



transport. By one estimate[1], it accounted for 80% of the market in 1997 and will still be at 73% in 2020.

The road transport sector has seen fast growth in the number of vehicles and the consumption of transport-related energy. This has led to many problems including noise, pollution, congestion, accidents and deteriorating infrastructure. Traffic congestion gives most cause for concern because it affects all big international cities, but the main focus today is on greenhouse gas emissions,

(1) *Schafer, 1997, The global demand for motorized mobility. Transportation Research Part A, Vol. 32 (6).*

especially CO_2. A number of technologies (e.g. new motor fuels and engine technologies) geared to reducing nuisance levels are now under development or study, but they alone will not solve these problems. In addition, it takes time for new technologies to penetrate the fleet. Public authorities need to implement economic policies that will modify the behavior of industry and consumers. In other words, they need to regulate unit consumption, CO_2 emissions and travel, or else levy taxes or grant subsidies designed to impact the vehicles, fuels or congestion.

Characteristics of global mobility

Three elements characterize passenger mobility: the mode of transport used, the travel budget and the distances traveled by individuals.

Several observations can be made about global mobility. First of all, the average travel time is relatively consistent: 1.1 hour a day per capita (Schafer, Victor, 2000[2]). Secondly, the budget depends on the mode of transport. Some people spend between 3 and 5% of the household budget on non-motorized transport or using mass transit, others between 10 and 15% to use the car (Schafer, 2006[3]). Finally, people are traveling longer distances. As a result, rapid modes of transport are prevailing. As we can see, the modes of travel used and the number of kilometers traveled have changed a great deal.

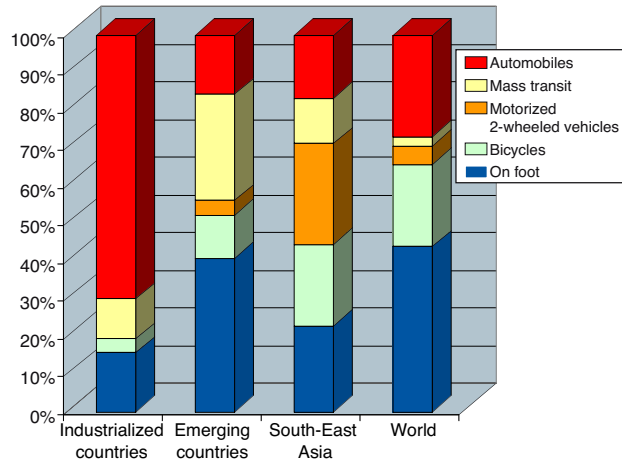
Motorized versus non-motorized

It is very difficult to make a complete mobility survey, because there is a lack of statistics, especially with respect to non-motorized transport. Nevertheless, one can make the following breakdown.

Figure 2 shows that, for short distances, walking is the most common mode of transport (36% of the world total). Next comes the automobile (22%), with mass transit close behind (20%). But the choice of transport mode depends heavily on the distance to be covered. Walking is dominant for short distances, driving preferred for longer trips. It is true that traveling by car has many advantages compared to other transport modes, among them speed and flexibility.

It is easier to account for the evolution of motorized than non-motorized mobility. In a "business as usual" scenario (2006), Schafer predicts that the number of passenger-kilometers-traveled for automobiles will come to approximately 47 billion in 2050, up from about 18 billion in 2000.

Fig. 2 - Types of global mobility (travel per day per capita)



Source : Papon, 1997[4]

In the developed countries, mobility is well documented in official statistics, but data is much harder to find for emerging countries. The distinction between these two types of mobility must be made, because of the characteristics inherent to each category of countries.

Developed countries:

- high average income,
- heavily urbanized,
- highly developed motorized mobility,
- stable but aging population,
- heavily dependent on the automobile.

Emerging countries:

- low average income,
- rapid urbanization (emergence of megalopolises),
- most travel is done still on foot,
- fast-growing, young population,
- fast-growing automobile fleet.

According to Figure 2, the automobile is the most commonly used means of transport in the industrialized countries (70% of all travel), whereas travel in emerging regions is done mostly on foot or using mass transit. South-East Asia presents a few particularities, such as the importance of motorized two-wheeled vehicles ("mopeds"). For example, 80% of the fleet in India consists of two-wheelers. In Africa, walking is clearly the dominant mode.

The travel budget

Mobility is also characterized by the travel budget, which depends on the modes of transport used and

(2) Schafer, Victor, 2000, The future mobility of the world population. Transportation Research Part A, Vol. 34.

(3) Schafer, 2006, Long-Term trends in global passenger mobility. The Bridge 36 (4).

(4) Papon, 1997, Panorama de la mobilité non motorisée au niveau mondial, mimeo, INRETS.

therefore on the level of income and development of the given country. Two types of budget must be considered: the travel-time budget and travel money budget[5]. The travel-time budget is stable, on average, but it can vary according to the type of country or city under scrutiny. In cities that are highly congested or very spread out, it takes longer to go from place to place. Travel expenditure depends to a large extent on the transport mode and therefore on the characteristics of the country. The budget increases when people gain access to the automobile. Travel accounts for about 5% of total expenditure in a country with a small percentage of household vehicle ownership and 12% in countries with a high percentage.

Trip distances

The distances traveled are increasing worldwide. In 1960, each individual traveled 1,820 km per year (taking all types of motorized transport into consideration). Today, the average has reached 5,500 (Schafer, 2006). Trip distances have increased the most in the developing and transition countries, but the trend is also very pronounced in the developed countries.

Key factors that determine demand

The following factors play a large part in shaping transport demand.

Demographics

Transport systems develop in step with population growth. The more people there are in a country, the greater transport demand will be there.

Economic activity

Increases demand for transport (both passenger and freight), then the increase in demand generates more economic growth. The higher the national income of a country, the more its inhabitants will opt for motorized, individual means of transport. As for private cars, a country in the initial stages of development will report very high economic growth with an even higher rate of increase in household vehicle ownership. When the country reaches a certain level of income, the rate of increase in vehicle ownership decreases with the rate of economic growth. When national income is very high, the automobile fleet becomes mature and the rate of increase in vehicle acquisition is low.

Urbanization and population density

Urban concentrations are growing ever larger, both in the industrialized and the emerging countries. Two models of urbanization have developed in the industrialized countries. The first is the dense city, like the cities of Europe or Japan, where the dominant modes of transport are non-motorized means or mass transit. The second urban model is the spread-out city, like those in the United States or Australia, in which passenger cars account for the bulk of travel. Today, these two models are tending to merge into a city with a dense downtown area and spread-out suburbs. This is happening in France, for instance, such as in the Paris metropolitan area. The megalopolises of the emerging countries have major traffic congestion problems because city-dwellers own and use their vehicles. A high population density is generally a determining factor in individual vehicle ownership. On the other hand, suburban areas on the outskirts of cities present a density of inhabitants and housing that is too low for mass transit service, which means that people need to drive. The density derives from the urban planning model used.

In the industrialized countries, two mobility trends may be observed. People travel to meet their daily obligations: they need to go to work, do the shopping, take the children to school, and so forth. The other trend, which emerged late in the 20th century, pertains to leisure travel on weekends. In the emerging countries, travel to the workplace continues to predominate. But it is easier to commute in a car and some families save up for several years to buy one.

Motorized mobility

Although walking is still the world's dominant mode of transport, the passenger car comes in second. If one only considers longer trip distances (more than 100 km from the home), it is the most common.

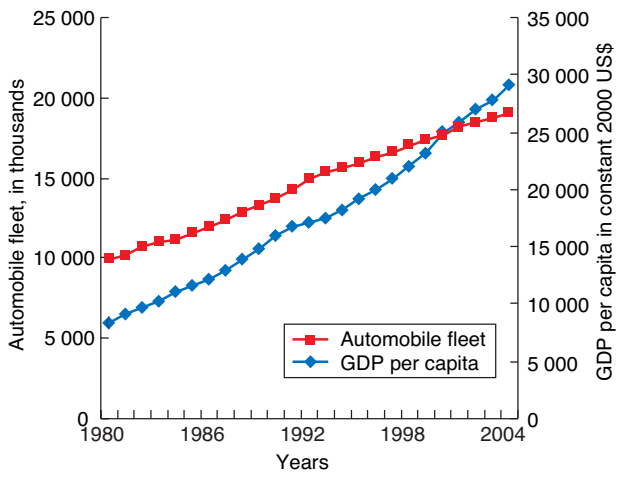
It did not take long for the automobile, the big innovation of the early 20th century, to go into mass production in the United States. In Europe, however, the private car remained a luxury until the 1960s and the advent of consumer society, vehicle ownership was reserved for well-to-do households (Orfeuil, 2004[6]). After World War II, the acquisition of a family car became a mass phenomenon. This marked the apogee of the automobile in the industrialized regions of the world. After the 'Sixties, the motor industry soon started to grow in step with the economy. Today, the size of the automobile fleet is growing more slowly than the economy in Europe, for instance (Figure 3).

Starting in the 1990s, the emerging countries began to develop their own fleets of motor vehicles. Whether in

(5) *Zahavi, 1976, Travel characteristics in cities of developing and developed countries, Working Paper 230, The Worldbank, Washington, DC.*

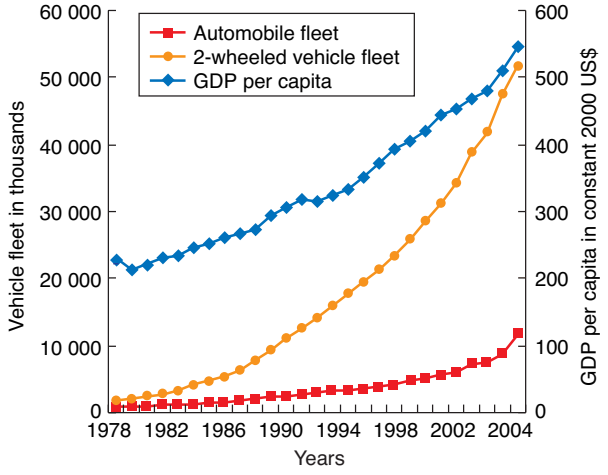
(6) *Orfeuil, 2004, La mobilité et sa dynamique sur longue période, du Moyen-Âge à la société hypermoderne. IUP/ Paris 12, CRETEIL*

Fig. 3 - The automobile fleet and income in Europe



Source: The United Nations, The World Bank

Fig. 4 - The private car fleet and income in India



Source: The United Nations, The World Bank and national statistics

Fig. 5 - World automobile fleet in 1960, according to the UN: About 86 million

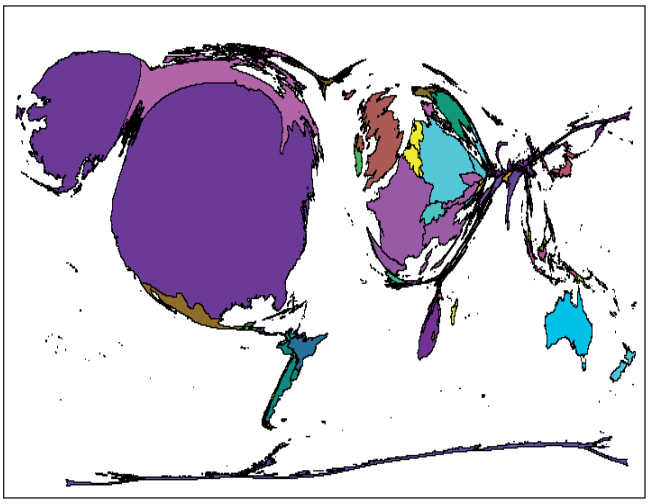
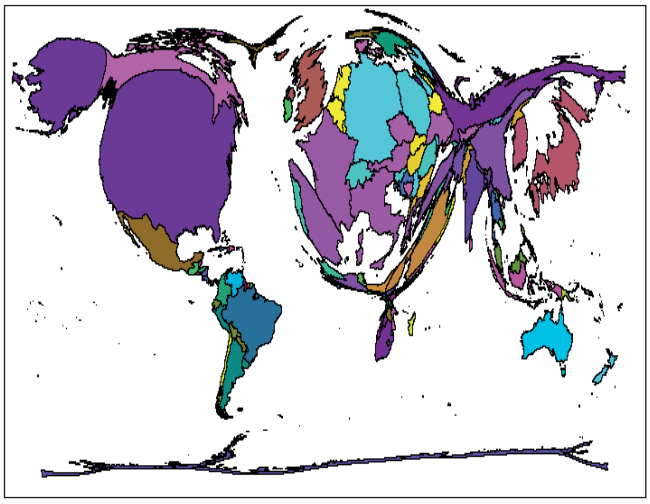


Fig. 6 - World automobile fleet in 2004, according to the UN: About 620 million



Asia or South America, the private car fleet grew quickly during this period, which boosted growth of the world fleet. While Latin America, for instance, saw the automobile win out over other types of privately owned vehicles, two-wheeled vehicles accounted for the bulk of the fleet in Asia. Figure 4 shows the situation in India, where the two-wheeled fleet has been growing faster than the economy since the 1990s. The automobile fleet has been increasing at about the same rate as the economy, but with fast growth in recent years.

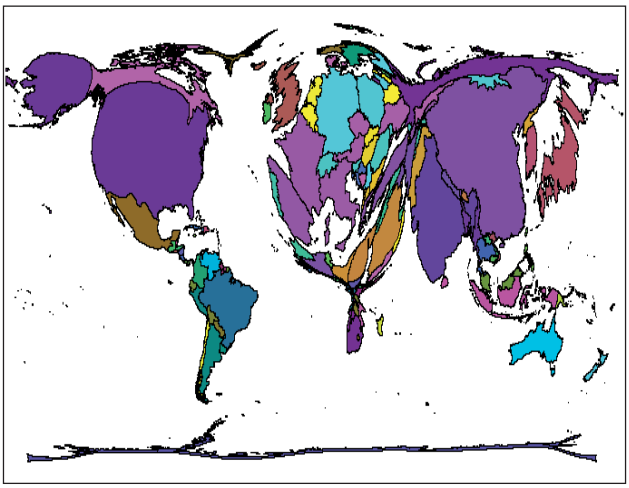
Evolution of the world automobile fleet

The world maps (Figures 5, 6 and 7) show the status of the global automobile fleet in 1960, 2004 and 2030 (data concerning two-wheeled vehicles are harder to find). The "surface area" of each country changes in proportion to the percentage of vehicle ownership (number of cars divided by the population).

Here, the only fleet that really stands out is the United States fleet (61.4 million). In 1960, 63% of the world's cars were in the US.

In Figure 6, the deformed surface area of the United States and Europe seems to be roughly equivalent. In 2004, the automobile fleet in Europe (Europe of 25, Norway, Russia and Romania) slightly exceeded that of the United States: 248.9 million versus 231.4 million, respectively. Apparently, the level of vehicle ownership in other regions remains marginal.

Fig. 7: World automobile fleet in 2030, IFP simulation: About 1.3 billion



Projections of the world automobile fleet in 2030 (Figure 7) show that Asia – especially China and India – will probably occupy prominent positions. In a business-as-usual scenario, India and China will have a fleet about as large as that of Europe today, about 250 million vehicles. The market may be saturated in the industrialized countries, where about 80% of households own vehicles, but the fleets in the emerging countries, especially those in Asia, are growing quickly.

Road transport as a source of annoying and harmful effects

The transport sector offers benefits but at a cost. Although it correlates positively with economic growth, since it enables people to get their workplace and to consume, it is also a source of annoying and harmful effects that are either related to the transport mode itself or to the energy consumption induced. The transport sector is responsible for six types of adverse effects:

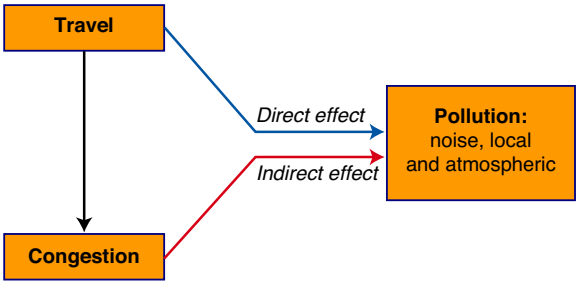
- the deterioration of infrastructure,
- accidents,
- traffic congestion,
- sound pollution,
- local pollution (air, water),
- greenhouse gas emissions (GHGs).

Deteriorating infrastructure, accidents and noise

These disadvantages are mostly due to private cars. They are subject to government scrutiny and solutions have been implemented. Projects to modify existing roads or build new ones are being implemented to solve the problem of deteriorating infrastructure. Other projects target noise pollution by resurfacing roads with sound-deadening materials, building noise barriers or improving acoustic performance for vehicles (for noise perceived externally and inside the vehicle). A number of measures have been taken to reduce accident occurrence: increasingly strict speed limits, regulations concerning the intake of alcohol or drugs, and policies to boost awareness of these issues. Inside the passenger compartment of vehicles, safety has also been improved by installing airbags and ABS systems.

Traffic congestion and local & atmospheric pollution

Fig. 8 - Direct and indirect adverse effects



The accelerated pace of urbanization in recent decades and the development of motorized mobility frequently leads to traffic congestion, especially in the densely populated cities of industrialized countries and the megapolises of emerging countries. This nuisance is caused directly by the use of means of transport. Heavy traffic produces polluting emissions in greater quantities, so it contributes indirectly to local, atmospheric and noise pollution. Traffic jams only affect vehicle users whereas pollution has an impact on the entire population. According to the European Commission, traffic congestion is the biggest nuisance caused by the current system of transport. As a result, governments have decided to concentrate on reducing congestion.

Since the 1970s, governments in the industrialized countries have been concerned about local pollution. The transport sector is responsible for several types of polluting emissions, including nitrogen oxides (NO_x), sulfur dioxide (SO_2), unburned hydrocarbons (HC and VOCs) as well as soot and particulates. This has led to regulatory action. In Europe, the Euro 5 standards will take effect in 2009 and the Euro 6 standards are set for 2012. Similar regulations have been adopted elsewhere, such as in the United States (CAFE[7]) and Japan, and the emerging countries are gradually following suit. For instance, India began to introduce the Bharat emissions standards in 2000. These policies have significantly reduced the level of aggregate fleet emissions.

(7) *CAFE: Corporate Average Fuel Economy.*

However, the passenger road transport sector emits greenhouse gases, including CO_2, which is responsible for global warming. After the Kyoto Protocol was adopted in 1997, many governments became concerned about this type of emissions.

How can negative impacts be reduced?

Several approaches may be envisaged to reduce all of these impacts, depending on the scale.

Medium-term solutions focus on improving energy efficiencies and new technologies for vehicle engines and fuels: LPG, NGV, hybrid or electric vehicles, biofuels and so forth. But several factors help prevent these new technologies from penetrating the fleet. For one thing, consumer behavior is characterized by great inertia (although the sharp fuel price hikes of summer 2008 did affect consumer behavior). Nor are people eager to replace a familiar technology with a new and unfamiliar one that usually costs more, especially if their vehicle is still in good condition. These elements explain in part why fleet turnover is so slow. Other reasons are improved vehicle life expectancy and the economic crisis. For instance, in France, it takes about fifteen years for quasi-complete fleet turnover (*Union routière française*, 2007). The penetration of new technologies is a very slow process that must be supported by economic policies that encourage individuals to consume responsibly. In Europe, favorable tax conditions were instrumental in promoting the use of diesel. Today, raising the level of environmental awareness among consumers may help accelerate fleet penetration for new technologies.

A government can use three key tools to compensate for the deficiencies of the market and its slow pace of change. It can use tax legislation and regulations bearing on vehicles, traffic congestion and motor fuels. As far as pollution is concerned, governments can issue emissions permits that give the right to emit pollutants within set limits and can be traded on an emissions trading market. But it would be difficult to apply a system like this to individual consumers, which means that government measures bearing on emissions standards and tax allowances are of key importance. To reduce the annoying and harmful effects of using motor vehicles, the government must take measures targeting the motor vehicle, the fuel or congestion.

Key policy options are presented in Table 1.

Policy choices differ from country to country. The United States prefers to impose standards (usually governing energy efficiency, like the CAFE standards implemented at the end of the 1970s) than use tax mechanisms. In Europe, the latter seem to have the preference, because motor fuels are heavily taxed. In France, following the Grenelle Environment Summit in 2008, a progressive, long-term vehicle scrapping bonus was made available to support the purchase of clean vehicles. In the City of London, the Mayor introduced toll charges on cars entering the city centre to ease congestion. One should note that the directive imposing a reduction of CO_2 emissions in new vehicles—to 130g CO_2/km in 2012 and a targeted 95g CO_2/km past 2020—marks a significant evolution in the European approach.

Table 1

Policy options for controlling the external costs of road transport

	Market-based incentives		Command-and-control regulations	
	Direct	Indirect	Direct	Indirect
Vehicle	Emissions fees	Differential vehicle taxation Tax allowances for new vehicles	Emissions standards	Vehicle inspection Mandatory use of low-polluting vehicles Compulsory scrappage
Fuel		Differential fuel taxation	Fuel composition Phasing out of high polluting fuels	Fuel economy standards Speed limits
Traffic		Congestion charges Parking charges	Physical restraint of traffic Designated routes	Restraints on vehicle use Bus lanes and other prioritie

Source : Based on a table in a report by K. Button, 1994[8], IFP

Other solutions may also be envisaged. Standards imposing the use of cleaner motor vehicles and the new motor fuel specifications may help accelerate fleet penetration for new motor fuels. The EU directive on renewable energy, known as the biofuels directive, is one illustration (see Panorama articles: "Transport Energies: Advantages and Disadvantages" and "Low-CO_2 Road Vehicle Technologies").

Whether standards or taxes, congestion relief measures help curb traffic and thus, indirectly, reduce polluting emissions.

(8) Button, 1994, Internalising the social costs of transport, ECMT.

Trends and challenges in passenger mobility

Looking to the long term, we should be thinking about how to organize passenger mobility differently and how to modify urban planning to ensure that people live and work in the same locality and that reserved paths or lanes are allocated to pedestrians, bikes and buses (this is already being done, to some extent, in France). Cities should be laid out better to minimize congestion and additional pollution.

Changes in global mobility (transport modes, trip distances) constitute the biggest challenge to the sustainability of existing transport systems. The rapid growth of road transport, especially individual passenger transport (cars), generates many annoying and harmful effects worldwide, the most problematical of which are congestion, local pollution and CO_2 emissions. Starting now, we need to rethink our approach to urban planning, land use and zoning. Short- and medium-term solutions exist, especially new engine and motor fuel technologies, but they need to support from the public authorities. The type of support is open to debate. Is it better for a government to impact prices and thus opt for tax mechanisms or to take regulatory action? That depends on the characteristics of the country concerned and the specific annoying or harmful effect to be reduced (e.g. by acting on traffic congestion and thus polluting emissions indirectly, or emissions directly). It also depends on the concept of social equity applied, which may not be compatible with existing measures.

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