Chapter 3

The national framework: laying the basis for sustainable road transport

On a national or federal transport policy level, Economic Instruments should be implemented as part of a nation-wide transport strategy. The most important examples of such national economic measures include:

- **vehicle taxation** (section 3.1),
- **fuel taxation** (section 3.2),
- **national road pricing schemes** (section 3.3).

These instruments are implemented in many developed and developing countries. Fuel taxes and vehicle taxation are among the most important sources of state revenues in many countries. They should be seen as an integral part of modern transport policies as they allow for flexible transport demand management and sound revenue generation.

The subsequent chapters outline the basic approach on how to use these instruments, and provide some case studies to see how these measures are implemented internationally. Many developing countries have been hesitant to implement Economic Instruments, though. International experience, thus, still often can be found in OECD countries only. Nevertheless, the (best practice) cases chosen also carry important insights and lessons for developing countries, too.

Vehicle Taxation

Vehicle taxation as a policy instrument

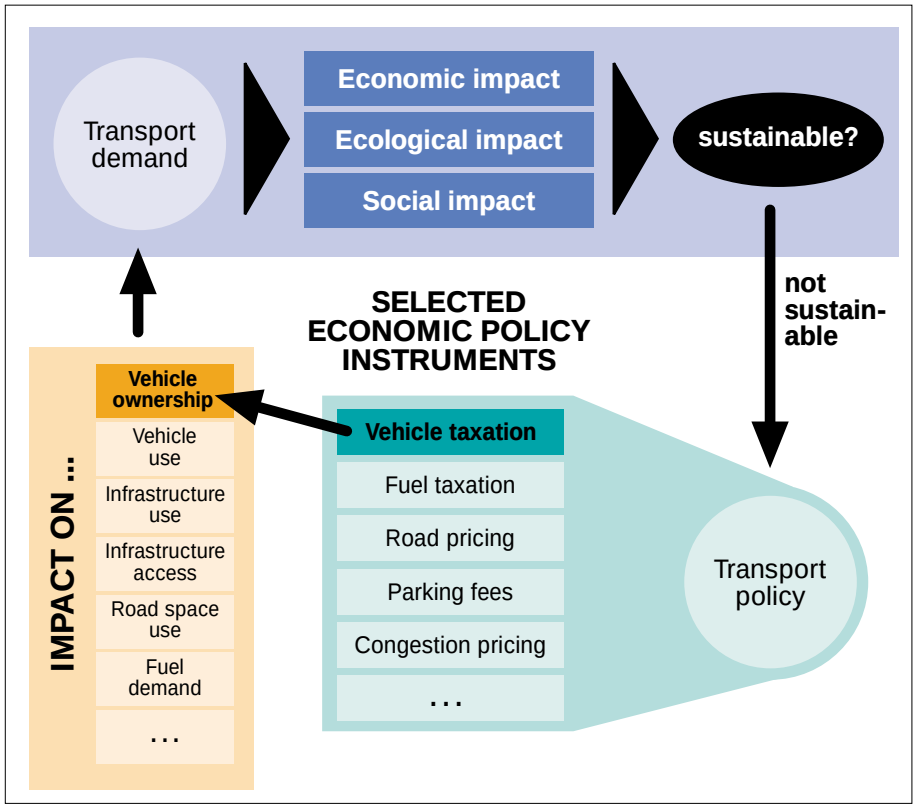
The basic idea

A major part of transport costs consists of fixed costs. These should be recovered via vehicle taxation.

Recovering fixed costs. It is estimated that more than 50 per cent of all infrastructure costs in transport are fixed – that is, they are not dependent on the actual road use. Therefore, it is argued, the actual road use of an individual road user should not be the basis for charges. Instead, every user should be charged more or less the same, as everyone who wants to drive a vehicle needs roads. This reasoning gives way to vehicle taxation: Once you have a vehicle, you will use roads – and once you want to use roads, you should make an equal contribution to finance the necessary infrastructure by paying a vehicle tax. In this respect, a vehicle tax can be seen as an entrance fee – as a ticket to enter the road network.

Other, less sophisticated justifications of vehicle taxes directly aim at reducing the number of vehicles, and/or restricting car ownership. As vehicles increasingly congest cities world-wide, restrictive measures on vehicle ownership combined with promoting and improving public transport are increasingly seen as an option to reduce traffic and its external effects, such as congestion, pollution, and accidents (Allport 1996, Gilbert 2000).

Figure 3.1: **Vehicle taxation as part of transport demand management**



Sales tax versus annual tax. Vehicle taxation can take two forms: as a sales tax, or as an annual vehicle tax / registration fee. The sales tax adds a tax element to the purchasing price and may significantly increase the price of a vehicle, thus discouraging the purchasing of a new vehicle. An annual vehicle tax may have a similar effect. However, by spreading the tax amount over many years the perceived burden for the potential buyer can be reduced. It also does not put a particular burden on new cars but rather treats all cars, both new and used ones, alike. In addition, an annual tax offers more flexibility as tax rates can be changed over time. If, for example, additional infrastructure improvements are to be financed through an increase in vehicle taxation, all vehicle users are affected equally with an annual vehicle taxation scheme (whereas a sales tax increase would only affect those buying a new car).

Vehicle taxation can take the form of a sales tax or of an annual tax. In general, the latter is more favourable as it offers more flexibility.

Optional features

Differentiating by vehicle type. It is true that a large part of infrastructure costs is independent of the actual road use once the infrastructure is in place. However, the initial design and quality of infrastructure is not at all independent of vehicle type. For motorbikes, for example, small roads would be sufficient, whereas for motorcars, for 7.5 t vans and even more so for 40 t trucks the requirements for infrastructure (and the costs involved) become increasingly demanding. It is thus obvious that charges should be graded according to vehicle type – and this is done in many countries where vehicle charges increase with the type, size or engine performance of a vehicle.

Vehicle taxation should be differentiated by vehicle type.

Differentiating by vehicle price. Differentiation by vehicle prices can serve to pursue social goals. Car ownership and the type of vehicle depend on household incomes. Levying higher vehicle taxes on new and/or expensive cars (used by rich households) while reducing levies for old, used and/or cheap cars (used by the poor) allows for differentiating the tax burden. Rich transport users will contribute more to infrastructure financing. This approach has been successfully implemented in Indonesia and Kyrgyzstan, for instance.

Differentiating by emission and noise levels. Often differentiation is also based on the external cost argument that vehicles causing higher external costs (in particular costs of environmental damage) should be charged more than vehicles which cause less external costs. For example, in many European countries vehicle taxation is differentiated according to specific emission standards – with the higher tax on the more polluting vehicles. This is supposed to be an incentive for vehicle-owners to switch to more environmentally-friendly cars or to refrain from buying polluting cars in the first place (see case study for Germany and the Netherlands). In addition, this tax differentiation also offers an incentive

The differentiation of vehicle taxation may also account for individual levels of air pollution and other external costs.

for car manufacturers to develop more environmentally-friendly vehicles as, due to the possible tax savings, consumers tend to favour such cars.

Shortcomings

Vehicle taxation relies on a comprehensive vehicle registration system.

Vehicle registries are a prerequisite. In order to administratively implement vehicle taxation, vehicle registries have to be kept by an administrative body. These, however, do not always exist in developing countries. Thus, in order to introduce vehicle taxation, a comprehensive system to centrally register each car and to make the car database accessible to the charging authority would have to be build up first – but this can only be done in the long-run. In addition, for effective car registries suitable mechanisms for the de-registration of vehicles (in case of scrapping, sale, etc.) have to be included as well.

A similar problem applies to the optional feature of differentiation by vehicle type or emissions. Here, in addition to the mere registration of vehicles, information about engine power, emission levels, etc. would have to be available first.

Vehicle taxation does not depend on actual road use ...

Limited scope of economic incentives. Following the ”user pays principle”, every motorist should bear the costs that he or she causes. As a large share of these costs consist of variable costs (maintenance, traffic management, etc.), charges should vary with road use. This, however, is not the case with vehicle taxation which is completely independent of road use and should thus only cater for fixed cost recovery.

But even fixed costs are not completely independent of road use: Every road has a maximum capacity. As soon as this limit is reached, additional lanes (or even new roads) will have to be built – which does of course increase the fixed costs of transport infrastructure. Hence, not even fixed costs in transport are really fixed. In fact, all infrastructure costs do increase with increasing traffic.

... and thus does offer no incentives for an efficient use of transport infrastructure.

It is thus an important disadvantage that vehicle taxation offers no economic incentives for motorists to make efficient use of transport infrastructure. Furthermore, rural areas may be systematically disadvantaged through vehicle taxation. As in rural areas access to public transport and the quality of services usually is much lower compared to inner cities, shifts from individual car use to public transportation is much more difficult and the rural population more heavily depends on car use. With this car dependence, any vehicle taxation scheme may put an extra-burden on the rural population (Farrington et al. 1997).

Conclusions

Vehicle taxation is important for revenue generation ...

Vehicle taxation is a stable source of revenue. Vehicle taxes are in place in most OECD countries. The taxation of vehicle ownership is in line with the classical argument for taxing ”luxury goods”, i.e. putting a levy on those who can afford more expensive goods. Since the vehicle population is relatively easy to determine, and in many countries vehicle registration and licensing are well-established, a vehicle tax scheme should be easy to apply using the existing bodies of vehicle registry and administration.

... but it should never be the only instrument in transport pricing.

The role of vehicle taxation in a transport pricing policy. A general vehicle tax should never be used as the only instrument in charging for the provision of transport infrastructure. Hence, a pricing policy should not exclusively rely on the rather static instrument of vehicle taxation. It should rather make significant use of use-related charges as well in order to promote efficient use of transport infrastructure. This leads to the issue of fuel taxation.

International experience: Vehicle taxation in the world

Throughout the world, vehicle taxation is used as a stable source of state revenues. It is fairly easy to collect once a comprehensive system of car registration is in place. Many developing countries, too, have vehicle taxation schemes in force, or they are planning to introduce them. Often, there are historical experiences with charges on horses, carriages and other types of vehicles to build on. However, vehicle tax schemes vary significantly from country to country.

In 2000, GTZ carried out a world-wide survey of fuel and vehicles taxation. For this survey, data for tax rates for an average passenger car of 1,400 cc (such as a Toyota Corolla) were collected. A summary of the results can be found in Figure 3.2.[1]

Potential for revenue generation. The national potential for revenues from vehicle taxation may be roughly estimated by analysing national vehicles fleets. As an example, in Table 3.1 potential revenues of an increase of an annual US$ 10 per vehicle are calculated for selected countries. These rough estimates are based on vehicle fleets as stated in the ”IRF World Road Statistics 2000”.

Table 3.1: **Potential revenues of an annual vehicle tax of US$ 10 per vehicle for selected countries** Vehicle data source: IRF World Road Statistics 1999, calculations by authors

Country	Number of vehicles (both passenger cars and trucks) [vehicles in use, 1996]	Potential revenues of an annual vehicle tax of US$ 10 [Mio. US$ p.a]
Bolivia	362,000	3.6
Burkina Faso	58,600	0.6
China	10,549,000	105.5
Indonesia	3,250,925	32.5
Kenya	387,620	3.9
Malaysia	3,734,753	37.3
Mexico	13,033,000	130.3
Philippines	953,611	9.5
Thailand	4,515,721	45.2

1 Further details of the survey can be found in the GTZ publication ”Fuel Prices and Vehicle Taxation, Second Edition, September 2001”.

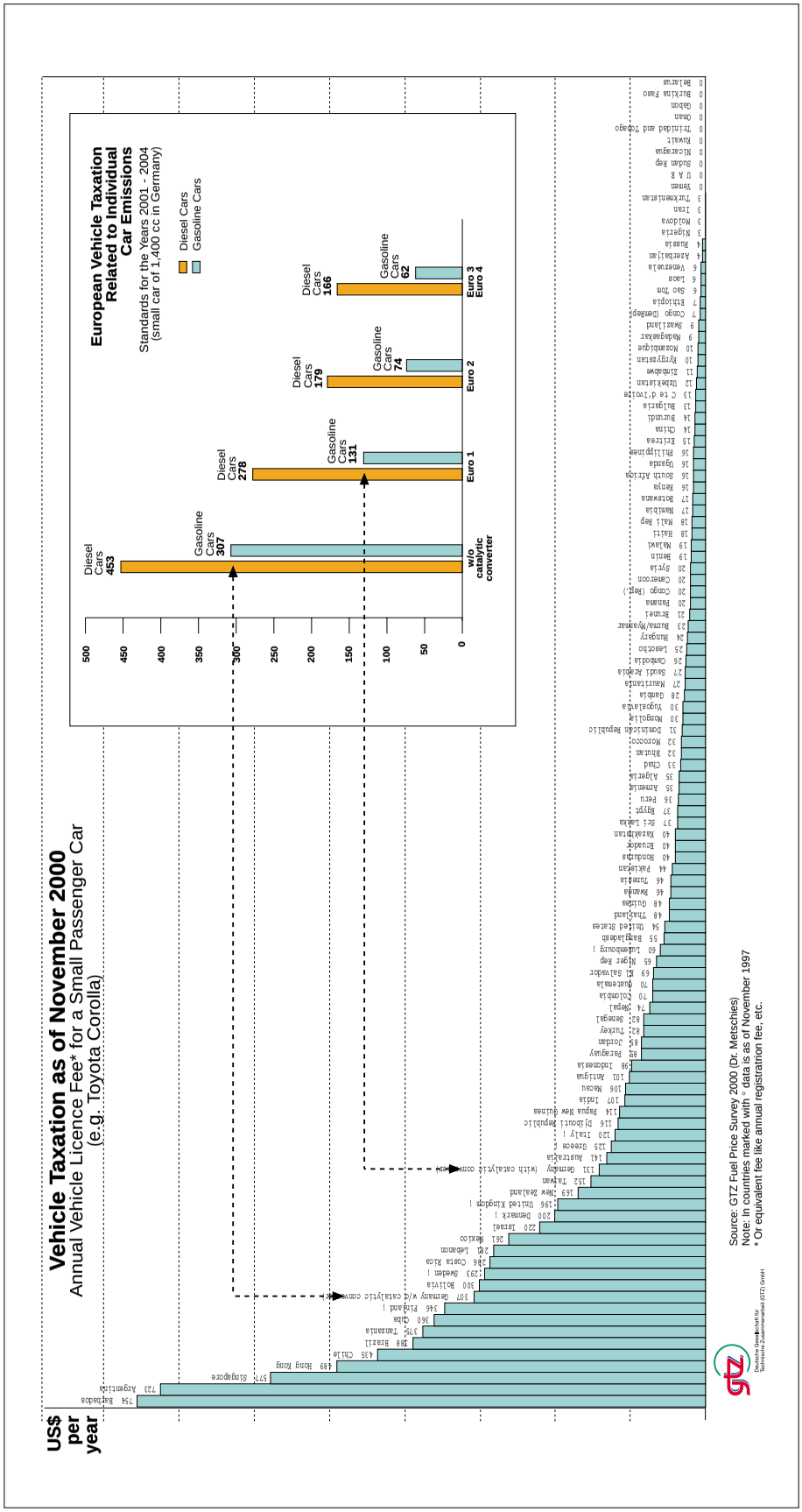


Figure 3.2:
Vehicle taxation for an average passenger car as of November 2000
Source: GTZ, Fuel Price Survey 2000

Best practice case: Vehicle taxation in Germany

Policy background and objectives

Vehicle taxation has always closely followed technical and political developments in transport.

Vehicle ownership has been taxed in Germany since the 17th century. The modern system of vehicle taxation that places a special tax on motorised vehicles was already in place as a state tax in the late 19th century. It has been modified several times in order to meet developments in vehicle technology, transport patterns, revenue and ecological objectives. Today, in Germany, a differentiated system of vehicle taxation offers incentives for drivers to switch to low emission vehicles. This system is applied to both passenger cars and trucks.

Specifications of vehicle taxation

German vehicle tax is differentiated by fuel type and emission level.

Passenger Cars. For passenger cars, engine volume forms the basis of the tax system. The annual tax is levied relative to engine power, i.e. per 100 cc of engine power. The tax is differentiated by both emission levels and fuel types. Diesel engines are generally taxed at higher rates to compensate the lower fuel tax rate on Diesel.

Table 3.2 presents the annual tax levied for a 1,400 cc vehicle per year:

Table 3.2: **Vehicle tax differentiations in Germany** Source: German Federal Ministry of Transport, Building and Housing

Note:
*) The term "3 litre car" refers to a car with an average fuel consumption of less than 90 g CO_2 emission per 100 km.

	Annual vehicle taxaton in Germany Example: 1,400 cc vehicle (e.g. VW Golf, Toyota Corolla, etc.)	
Emission level	Petrol engine	Diesel engine
Euro 4, Euro 3, "3 litre car" *)	65 US$	174 US$
Euro 2	77 US$	187 US$
Euro 1	137 US$	291 US$
reduced emission vehicles (low emission level)	191 US$	345 US$
reduced emission vehicles (medium emission level)	266 US$	419 US$
others	320 US$	473 US$

A tax bonus aims at stimulating the purchase of fuel-efficient and low-emission vehicles.

For environmental reason, the vehicle tax includes an additional incentive to buy low-emission and fuel-efficient cars. For the period of 2000 to 2004 low-emission passenger cars that are registered for the first time get a tax bonus of up to US$ 1,012. The structure of the tax bonus is summarised in Table 3.3.

	Tax Bonus for environmentally friendly cars	
	Petrol engine	Diesel engine
Euro 4, Euro 3, "3 litre car" *)	276 US$	553 US$
"3 litre car"	460 US$	460 US$
Euro 4 and "3 litre car"	736 US$	1,012 US$

Table 3.3:
Tax bonus scheme
Source: German Federal Ministry of Transport, Building and Housing

Note:
*) The term "3 litre car" refers to a car with an average fuel consumption of less than 90 g CO_2 emission per 100 km.

Trucks are taxed under a differentiated vehicle taxation scheme as well.

Trucks. The system of differentiated vehicle taxation is also applied to trucks where, again, vehicle classification according to emission and noise levels forms an integral part. All trucks are grouped into one of four categories, and within each category the tax rate is calculated by applying a progressive tax rate to the weight of a truck. Thus the vehicle tax for trucks progressively increases with vehicle weight. This approach is justified as infrastructure requirements are highly dependent on vehicles weight, and the heavier trucks are, the more frequent maintenance will be necessary. However, for each category there is a ceiling which puts an upper limit to vehicle taxation.

The taxation of trucks (3.5 tonnes and more) is presented in Table 3.4.

	Annual vehicle taxation of trucks in Germany	
Emission and noise classification	minimum tax (for vehicles of 3.5 tonnes)	maximum tax (upper ceiling)
- very low levels	108 US$	600 US$
- low levels	108 US$	921 US$
- medium levels	162 US$	1,381 US$
- high levels	189 US$	1,611 US$

Table 3.4:
Vehicle tax differentiations for trucks in Germany
Source: German Federal Ministry of Transport, Building and Housing

Outcomes and results

Revenues. Vehicle taxation in Germany represents a stable source of national revenues. In 2000, revenues from this tax amounted to roughly US$ 6.4 billion. This represents 1.5 per cent of the national budget.

Conclusions

The German case exhibits important insights:

- It is both technically and economically feasible to raise important contributions to the state budget using fiscal transport measures without compromising the mobility of the population.

- It is possible to implement a vehicle tax system based on ecological considerations and differentiations thereby influencing transport demand shifts to more environmentally friendly transport technologies.

Best practice case: Transition to "Clean Cars" in the Netherlands

Policy background and objectives

The Netherlands used vehicle taxation in order to promote low-emission cars.

European background. Between 1984 and 1993 the European Community gradually introduced more stringent regulations for car exhaust emissions. By 1993 every new car sold in a member state had to comply with standards equivalent to the U.S., including the requirement to use closed-loop catalytic converters. The Dutch government chose to use economic incentive measures in order to implement the EC-directives. Following the different phases of EC regulations, there have been three different stages of incentive measures. These measures often voluntarily exceeded rather lax European minimum requirements.

Specifications of vehicle taxation schemes

The first "Incentive Measure" (1986-88). The first phase of EC discussion was marked by lax regulation. In order to accelerate the introduction of "clean cars" the Dutch government, in 1986, introduced a tax incentive that aimed at approaching U.S. 1983 standards by putting special levies on new cars, only exempting "clean cars", i.e. those cars that complied with EC emission regulation. Differentiated tax reductions were granted to large, medium-sized and small cars whereby different emission standards applied. Due to relatively weak EC emission standards the tax exemptions turned out to be rather generous. Standards could easily be met by many cars – often open-loop converters or slight technical adaptations sufficed – thus the goal of a transition to a closed-loop converters car fleet could not be achieved.

The second "Incentive Measure" (1988-1989). The lenient standards for small cars provided by the EC legislation were only temporary. In 1988 European emission standards were raised. In order to stimulate the sale of cars complying with EC standards the Dutch government revised its incentive measure. Standards for small cars were raised to the level of those for medium-sized ones. For cars complying with the (higher) U.S. standards the maximum tax reduction was granted. For large cars, which already had to conform with these standards under the 1986 provision, this was the only option.

The third "Incentive Measure" (1992-1993). After extensive debate in the EC, a directive was issued stipulating that all new cars were to comply with U.S. standards from 1993 on. The revised Dutch incentive measure came into force in 1992. Revisions were budget-neutral, without changes to the incentive structure.

Outcomes and lessons learned

The examples show that the use of economic instruments in transport policy can effectively induce shifts towards more efficient and environmentally friendly technology.

Lessons learned. The Dutch experience can be summarised in the following remarks:

- It is possible to induce major changes in car technology through economic incentive measures. The share of cars complying with U.S. 1983 norms in the active automobile fleet rose spectacularly from 0.6 per cent in 1989 to 17 per cent in 1991. In 1992 94 per cent of all new cars complied with these standards (see Figure 3.3).

- If measures are designed too lax, or standards too lenient, incentives will have no effect. If designed appropriately, transition processes can be fast (the Dutch phase-in of closed-loop converters was accomplished within only 3 years).

- Incentive measures are most effectively introduced when they can be tied to recent or upcoming global technological developments.

- It is feasible to implement incentive measures in a budget-neutral way. Additional cost of converters could be (more than) compensated by tax reductions.

Figure 3.3: **Transition to Clean Cars in the Netherlands: Fleet Composition in the Netherlands**
Data source: Schrama/Klok 1995

Fuel taxation

Fuel taxation as a policy instrument

The basic idea

Recovering variable costs. Fuel consumption can be regarded as a good approximation of road use as it is roughly – though not exactly – related to individual road use. Taxing fuel consumption is the most common form of use charges in road transport. Fuel taxation can effectively be applied to recover variable infrastructure costs. It offers a simple and reliable way of charging the users of transport infrastructure relative to their individual use, and implementation and enforcement is rather easy as the tax can be levied at a few fuel distribution centres.

The variable costs of transport infrastructure should be recovered by fuel taxation.

Improving efficiency. At the level of the individual driver, fuel taxation increases vehicle operation costs. This encourages drivers to make efficient use of their vehicles, and offers a strong incentive to economically use vehicles (and thus infrastructure). In this regard, efficient use of transport goes hand in hand with the efficient provision of transport infrastructure.

Fuel taxation helps make efficient use of transport infrastructure.

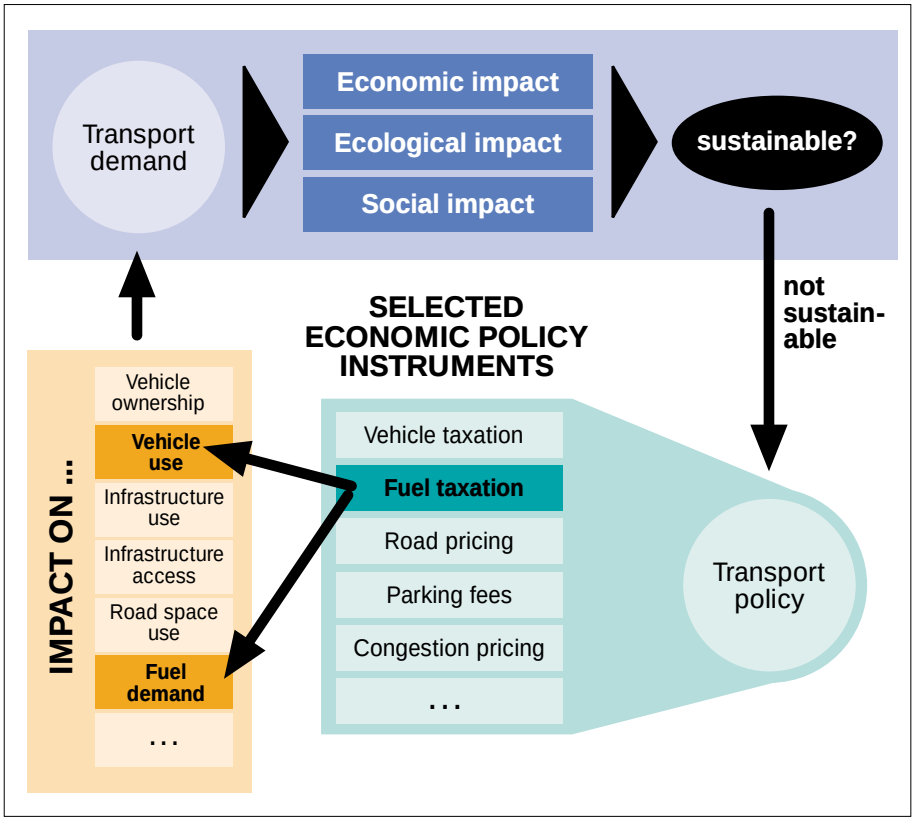


Figure 3.4:
Fuel taxes as part of transport demand management

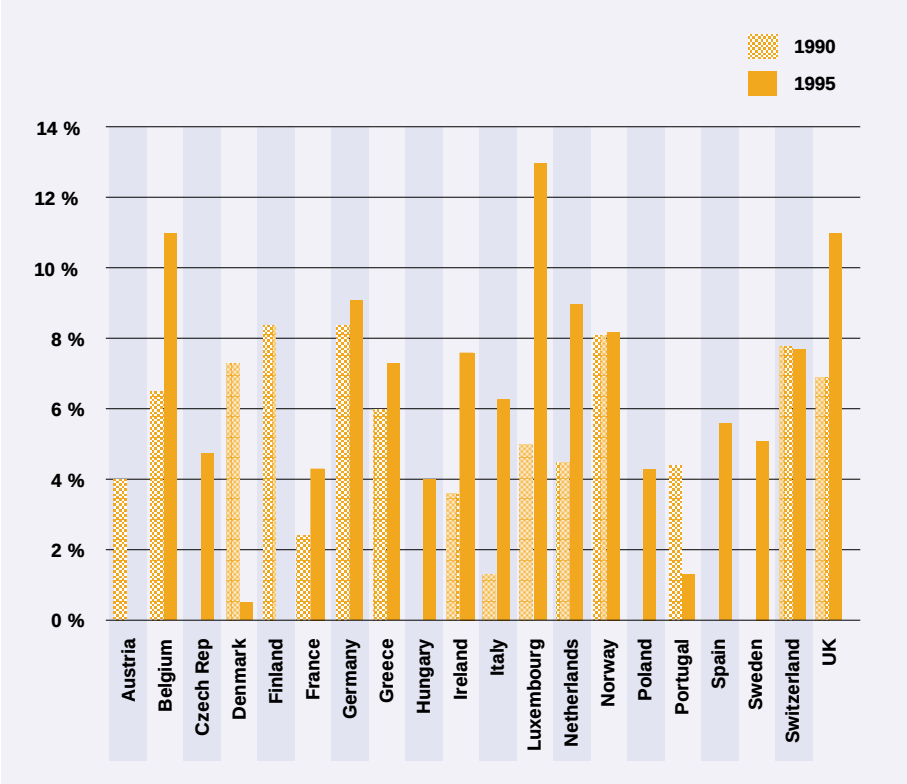
Both the global and the local environment benefits from fuel taxation.

Protecting the environment. Efficiency in the use of transport also serves environmental purposes. With present technology, transport contributes considerably to environmental degradation – both at the local and at the global level. At global level, the burning of fossil fuels like gasoline and Diesel releases high amounts of carbon dioxide which is a major source of global warming. Increasing the price of fossil fuel reduces their use and offers incentives to introduce more fuel-efficient engines or new types of fuels. At local level, emissions of sulphur oxides, nitrogen oxides, hydrocarbons, carbon monoxide, volatile organic compounds (VOCs) and particulates are largely responsible for health impacts like respiratory diseases or even cancer. Imposing a tax on fossil fuels will help shift transport to more environmentally friendly modes like public transport or fuel-efficient vehicles. However, the extent of these shifts is rather uncertain as the reactions of consumers to price increases may be small (so-called small demand elasticities)

Fuel taxation is widely used throughout the world. Regarding the contribution to the state budget, the case of Germany shows that the fuel tax can become one of the three most important sources of revenues.

Figure 3.5:
The price of leaded fuel exceeds the price of unleaded fuel by ... per cent
Sources: OECD

Note:
Germany phased out leaded fuel in 1996.



Optional features

Differentiating by fuel type. In most countries, different tax rates are applied to gasoline as compared to Diesel fuel. In some countries, like Germany, Diesel carries a lower tax burden. The aim is to reduce the burden on commercial vehicles which often run on Diesel fuel.

A differentiation of tax rates may cater for various aspects.

Differentiating by emissions. A differentiated system of fuel taxation, with higher tax rates on high-emission fuels, may induce shifts towards less polluting fuels. In all European countries, for instance, the higher tax levied on leaded fuel significantly contributed to the phase-in of unleaded petrol into the market. Also, in Eastern European countries a mix of tax differentials between leaded and unleaded gasoline and discounted road tax charges for cars equipped with catalytic converters have been successfully applied to phase out leaded gasoline (e.g. in Slovakia). Figure 3.5 gives some examples of price differentials between unleaded and leaded fuels in some European countries. A higher levy may also be applied to fuels with high sulphur content in order to stimulate the use of low-sulphur fuels.

Shortcomings

But there are limitations as well ...

Fuel taxation is only an approximation for road use. Fuel taxation will never exactly relate to the actual variable costs of the use of transport infrastructure. For the time being however, it is the best approximation that can be achieved at reasonable implementation costs. An electronic system to monitor the mileage of each individual car, for example, would provide a much more precise measure for road use – but would also entail significant costs.

... fuel taxation is not exactly related to variable costs.

Fuel taxation cannot be differentiated by location or time of road use. The fuel tax is rather general in its scope as it charges transport in general, i.e. irrespective of where and when transport activities take place. As long as the resulting traffic on roads is evenly distributed, this is no problem at all. But as soon as traffic is concentrated on certain routes (e.g. in urban centres or on express motorways) or at certain peak-times, a general fuel tax is no longer sufficient to efficiently allocate costs to users. On such congested routes the requirements for infrastructure are more demanding and expensive (e.g. more solid roads, additional lanes, etc. are needed) and external costs (such as pollution or time losses due to congestion) are significantly higher. But this is not reflected in the charges resulting from fuel taxation. To cater for the higher costs in congested areas, additional instruments may have to be applied. These issues will be discussed in the subsequent chapters.

... fuel taxation does not address the issue of congestion.

... fuel taxation does not specifically address urban transport issues.

... fuel taxation may face fierce public opposition.

Public opposition on social grounds is possible. It is often argued that low fuel prices are particularly important for low-income groups and that any increase in fuel prices will have unacceptable impacts on the poor. This argument, however, is only partly true. First, in many countries it is the rich that drive cars whereas the poor tend to use public transport. Second, if revenues from fuel taxation are used to improve transport infrastructure, the poor will benefit from this. Third, social concerns are more effectively addressed by separate instruments such as social benefits or family allowances. However, it is true that such instruments are not in place in many developing countries.

... tax revenues do not necessarily go to the country where the driving is done.

Tax evasion is possible. There is one aspect that may be particularly important for small countries and countries with long border lines. If fuel taxation is introduced (or increased) by one country alone, this step will normally result in a price differential between neighbouring countries. This provides incentives for ”refilling abroad” or smuggling of fuels – with the consequence that a significant part of revenues will not go to the country where the driving is done but rather to the neighbouring country. This makes obvious the need for regional co-ordination of transport policy as the incentive for tax evasion can be reduced when a fuel taxation is well co-ordinated with neighbouring countries.

Conclusions

Fuel taxation should be the most important instrument in transport pricing...

The role of fuel taxation in a transport pricing policy. Fuel taxation should be regarded as the predominant economic instrument in the transport sector. It creates revenues, shares the burden among the road users relative to their use, promotes efficiency in both the use of vehicles and transport infrastructure, and contributes to environmental protection.

... but it should never be the only instrument.

On these grounds, there have been discussions in many countries to only levy fuel taxes, and to completely substitute all other transport levies such as vehicle tax by fuel taxation. The reasoning is that such an approach would represent a strong incentive to firmly restrict vehicle use. Empirical studies, however, show that the mere car ownership has large influence on car use. Once a person owns a car, that person is very likely to also use the car. Therefore, the instrument of vehicle taxation plays an important role in discouraging car ownership – with the secondary effect of reducing car use as well.

There should always be a well-balanced mix of instruments that is adequate to the local conditions.

To conclude, fuel taxation is the most important instrument in transport policy. It should form the basis of a comprehensive pricing system aiming at both recovering costs and effectively channelling transport

demand. But depending on the individual national and local conditions it should always be supplemented by other instruments as well. Transport issues are just too complex to be comprehensively addressed by one instrument alone.

Gradual implementation needed. It should be noted that there is always some strong public resistance to fuel taxation. In many cases cheap fuels are regarded by public opinion as a basic right. Opposition to fuel taxation, however, should not be seen as an insurmountable obstacle to the introduction or increase of fuel taxes. It should rather be a reminder that increases should take place gradually (e.g. with no more than 10% increase at a time) and that the building-up of public awareness is very important. In many European countries fuel tax increases follow a foreseeable schedule with small but continuous tax increases. These are announced well in advance in order to reduce public resistance and to allow consumers to take foreseeable medium-term fuel price increases into account when buying a new (and hopefully fuel-efficient) car.

Increases in fuel taxation should be implemented gradually and in a foreseeable manner.

International experience: Fuel taxation in the world

Fuel taxation is one of the Economic Instruments with the highest potential for revenue generation. World-wide comparisons of fuel prices show that fuel price levels vary significantly.

The GTZ Fuel Price Survey 2000 compiled data of fuel prices for Diesel and premium gasoline. The results are summarised in Figure 3.6 for Diesel and in Figure 3.7 for premium gasoline.

According to the these figures it is possible to distinguish four types of fuel price regimes that can be found in developed and developing countries.

Table 3.5: **Fuel price regimes** Source: GTZ Fuel Prices and Taxation, 2001

Fuel price regime	Examples from developed countries	Examples from developing countries	Gasoline prices per liter in 2000 [US cents]
High taxation	EU countries, Hong Kong	Côte d'Ivoire, Bolivia, Burundi	**> 72**
Medium taxation	South Africa, Austalia, Canada	Chile, Cameroon, Malawi	**48 - 72**
Low taxation	USA	Ethiopia, Vietnam, China	**33 - 47**
Subsidised fuel prices	Saudi Arabia	Turkmenistan, Indonesia, Iran	**2 - 32**

Potential for revenue generation. To assess the potential for national revenues from fuel taxation, national fuel consumption has to be multiplied by the envisaged tax rates. As an example, in Table 3.6 potential revenues of an increase of 1 US cent per litre are calculated for selected countries.

Country	Annual fuel consumption 1996 (both Diesel and gasoline [Mio litre]	Potential revenues of an increase of fuel tax of 1 US cents [Mio. US$ p.a]
Burkina Faso	152.1	1.5 Mio US$ p.a.
Kenya	1,092.5	10.9 Mio US$ p.a.
Bolivia	1,013.5	10.1 Mio US$ p.a.
Mexico	40,423.5	404.2 Mio US$ p.a.
Thailand	15,793.7	157.9 Mio US$ p.a.

Table 3.6:
Potential revenues of a 1 US cent fuel tax increase for selected countries
Source: GTZ Fuel Prices and Taxation, 2001

These rough estimates are based on fuel consumption levels as stated in the ”IRF World Road Statistics 2000”.

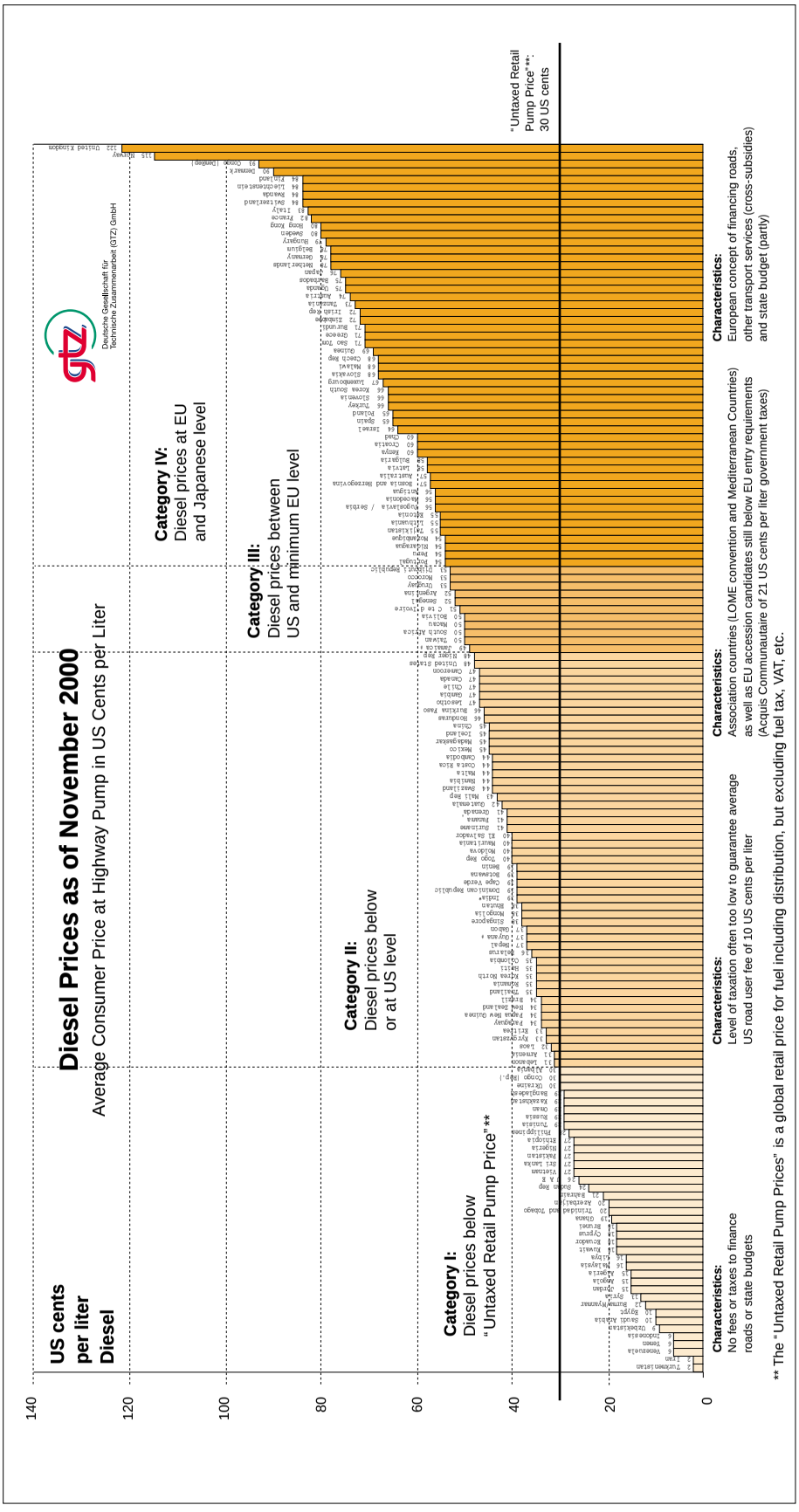


Figure 3.6:
Diesel prices as of November 2000
Source: GTZ, Fuel Prices and Taxation, 2001

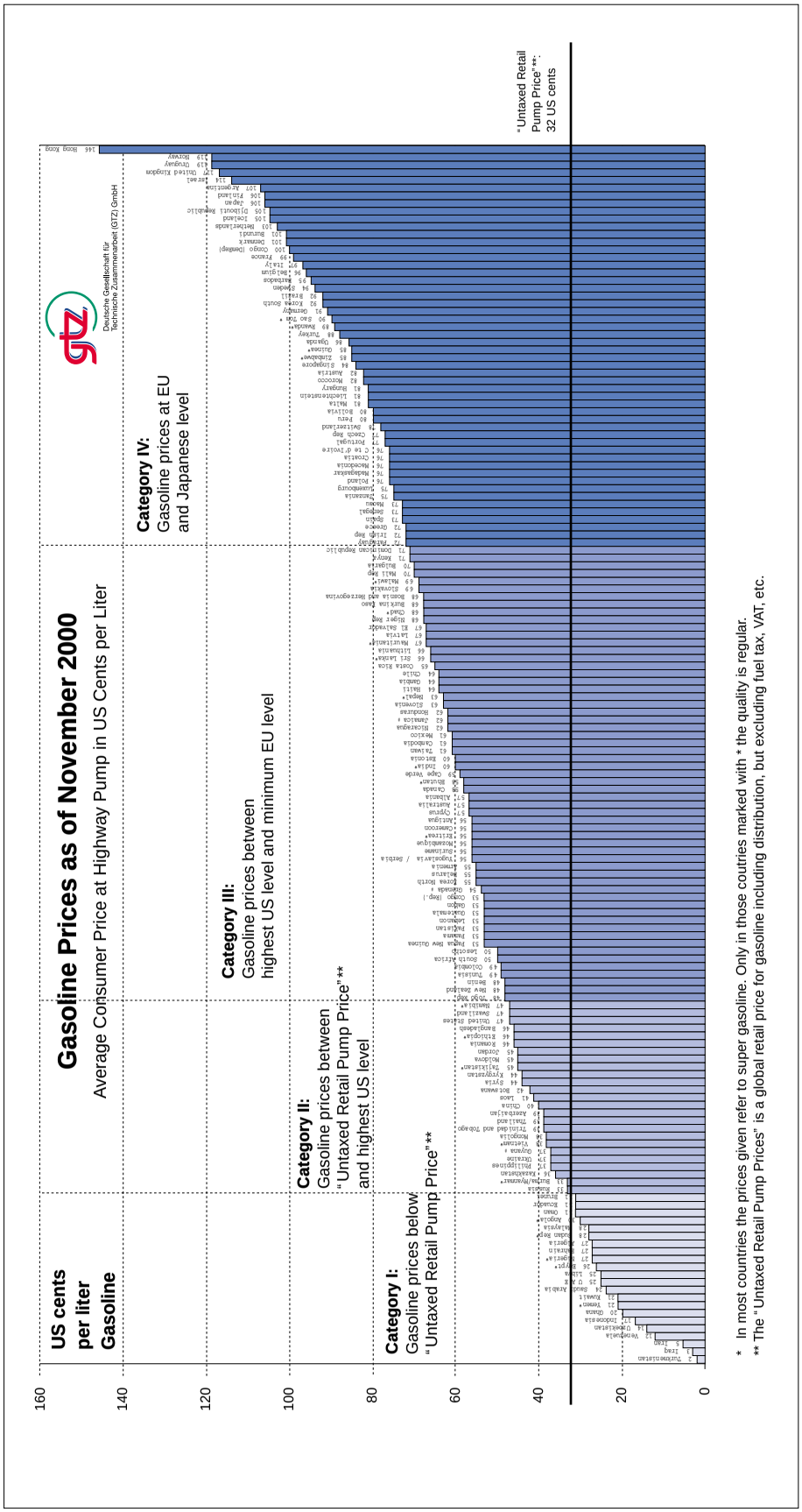


Figure 3.7:
Gasoline prices as of November 2000
Source: GTZ, Fuel Prices and Taxation, 2001

Best practice case: High fuel taxation in Germany

Policy background and objectives

Fuel taxation serves both fiscal and environmental purposes.

Petroleum taxation in Germany dates back to the 19th century. Since then, taxation has been expanded in a step by step manner from petroleum to Diesel, and to several petro-chemical and oil products. As in all other European countries, fuel taxation plays a major role in generating revenues which can be used for the financing of the transport infrastructure. In addition to the mere fiscal aspect, fuel taxation is increasingly used for environmental and energy political objectives. Therefore, in Germany the fuel tax system also includes an environmentally-oriented element, the so-called "Ökosteuer" (eco-tax). The eco-tax element is intended to specifically increase fuel prices in order to create incentives for higher fuel efficiency.

Specifications of the German fuel tax system

The German fuel tax is levied on producers of fuel and oil products. Tax incidence, however, is shared by supply and demand. The tax rates are differentiated by fuel type and, starting in autumn 2001, also by the criterion of sulphur content. As of January 2002, the tax rates on fuels in Germany are as follows:

Table 3.7: **Fuel tax differentiations in Germany**
Source: German Federal Ministry of Transport, Building and Housing

	Fuel taxation in Germany (tax per litre)	
	Gasoline	Diesel
high sulphur content (> 50 mg per kg)	**0.58 US$** (of which 0.11 US$ as eco tax)	**0.42 US$** (of which 0.11 US$ as eco tax)
low sulphur content (≤ 50 mg per kg)	**0.56 US$** (of which 0.09 US$ as eco tax)	**0.40 US$** (of which 0.09 US$ as eco tax)

As fuel should be regarded as any other commercial good, VAT has to be levied on all fuels.

Fuel taxation and VAT. These tax rates amount to more than 50 per cent of the respective retail prices. Fuel is treated as any other good, therefore, an additional value added tax (VAT) of currently 16 per cent is levied as well. This lifts the overall tax element of fuel retail prices to a total of almost 70 per cent of the final pump price.

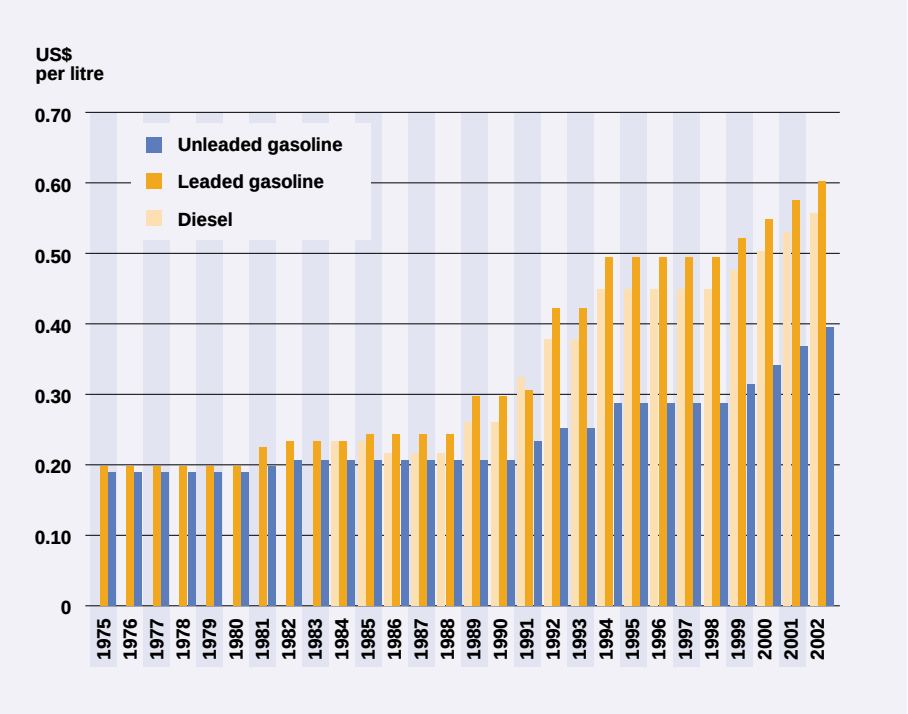


Figure 3.8:
Fuel tax rates in Germany
Sources: German Federal Ministry of Transport, Building and Housing

The eco-tax component of German fuel taxation. The environmentally oriented tax element (”Ökosteuer”, eco-tax) was introduced in 1999. The aim was to steadily increase fuel taxation over a period of six years by 0.03 US$ per year. The eco-tax is not only applied to fuels but to energy-use in general, e.g. it is also levied on electricity etc. The intention is to make the use of energy more expensive in order to stimulate fuel efficiency. This direct effect is called the ”first dividend” of an eco-tax.

The eco-tax was introduced in a gradual and foreseeable manner.

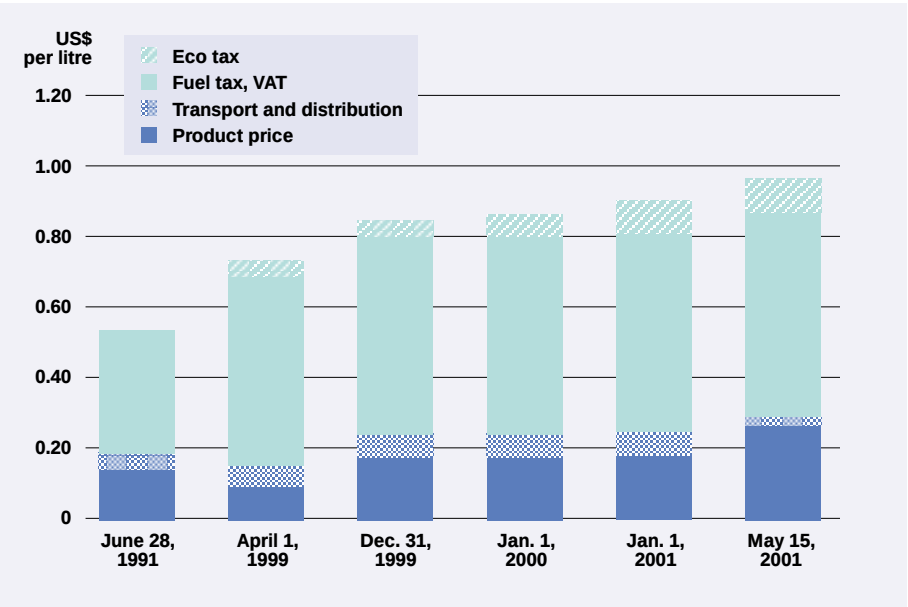


Figure 3.9:
Price of regular gasoline in Germany
Source: Shell

The revenues of the eco-tax are earmarked for the national pension scheme; they directly reduce pension premiums and thus labour costs. This effect makes labour cheaper (relative to energy prices) and offers an incentive to increase labour-intensity (relative to energy intensity). This effect is called the "second dividend" of an eco-tax.

Outcomes and results

The fuel tax is the third most important tax.

Revenues from fuel taxation. The revenues are part of the general budget, representing the third most important tax in Germany. In 2000 revenues from the fuel tax in the transport sector amounted to about 64 billion DM (US-$ 28 billion) which represents about 7 per cent of the national budget.

Demand and supply side react to incentives to switch to low emission vehicles.

Effects of the eco-tax element. The eco-tax induced fuel tax increase was implemented in a foreseeable manner as the schedule for increases was announced early on. This provided incentives to switch to more fuel-efficient driving patterns in the short-term – and to buy more fuel-efficient cars in the medium- to long-term. Both drivers and the automobile industry have started to react accordingly, and fuel consumption has decreased a little. (However, this effect was also intensified by the significant increases in retail prices due to exploding world market prices for petroleum products.)

Public opinion and public support are crucial.

Nevertheless, it has to be added that the introduction of the eco-tax in Germany led to fierce public opposition that was reinforced by emotionalising media coverage. This, however, was a rather temporary effect that waned after a while. Nevertheless it proved the necessity to create public awareness for environmental issues early on as public support is crucial.

Lessons learned

The German experience with fuel taxation contains a number of useful lessons. These can be summarised as follows:

- The timing of strategies, and long-term implementation and adjustment periods is important. Every fuel tax increase causes intense public discussions and resistance. In order to reduce friction over an adjustment, public acceptance should be built through awareness campaigns and the planning of long and foreseeable adjustment periods.

- It is possible to introduce Economic Instruments that allow both for revenue generation, and for internalisation of external costs.

- It is technically feasible to enforce a fuel tax regime. There are few enforcement problems and low administrative difficulties because fuel tax is collected centrally from a few oil companies.

- Transparent prices can contribute to achieving long-term changes in transport use.

- Fuel taxes can be implemented with significant differentiation.

- It is possible to include economic incentives to promote changes in the use of transport and to foster the technological development of cleaner cars.

- Public acceptance can be raised using taxation schemes based on social and ecological differentiations. In Germany, revenues from the eco-tax were earmarked in order to lower social security contributions. This increased public acceptance as all revenues were redistributed.

Experiences with the Environmental Trust Fund in Mexico

Policy background and objectives

Mexico City has experienced serious environmental problems and health risks from traffic pollution. Continuing increases in population and car ownership magnify these threats. As part of an environmentally oriented response, a combined city-state approach was introduced in 1992. The strategy involves a number of measures aimed at improvement and implementation of alternative energy sources for vehicles. It offers ample and efficient public transportation, the integration of

Mexico City (view of Popocatepetl Volcano) on a day without and with high pollution
Source: http://www.sima.com.mx/sima/df/volcang.html

metropolitan development policies (urban development, transportation and environment), the introduction of economic incentives in transport demand management, the inspection and oversight of fixed and mobile sources, and environmental information, education and public participation.

As part of the strategy focusing on mobile emission sources, two major steps were taken. On a national level fuel taxes were (sur-) charged in order to internalise (part of) the external costs of transport. In addition, the revenue raised until 1998 was dedicated to a so-called "Environmental Trust Fund". Its only purpose was to finance environmental projects in Mexico City.

Specifications of the ETF system

The Mexican ETF system consists of two core elements:

- **Fuel tax increase by 1 US-Cent per litre gasoline** which is levied and received by the central government (Ministry of Finance);

- **Earmarked reallocation of revenues** to ETF-financed projects such as credit schemes for vapour recovery systems at gas stations, rehabilitation of nature to increase absorption capacities for pollutants and particles (e.g. Texcoco lake), purchase of CNG vehicles[1] for police, the financing of environmental public awareness campaigns, etc.

Dedication of ETF resources is decided by the environmental commission of Mexico City, the State of Mexico and the central government.

1 CNG = Compressed Natural Gas

Outcomes and results

Between 1992 and 1998 the ETF received roughly 70 Mio. US$. These funds have been dedicated to the aforementioned projects. Since 1998 however, after a shift in political power, the Mexican Ministry of Finance has stopped payments to the ETF. Despite several initiatives the payment scheme has not been reactivated in its initial form yet.

The initiation of the ETF programmes has contributed to an amelioration of the pollution situation in Mexico City. However, in the last years, due to increasing traffic and a modal change in favour of private car use Mexico City faces again deteriorating health and pollution levels.

Lessons learned

The Mexican experience can be summarised by the following core theses:

- It is possible to design and implement simple mechanisms that will have a large impact in the recovery of external costs and the alleviation of environmental problems.
- Fuel taxation is an administratively easy means to generate revenues for environmental projects, and fuel taxes provide a broad and secure basis for long-term financing of earmarking schemes.
- Fragmented institutional powers pose a risk to a comprehensive and continuously working system. In particular, dependency on political factors increase the risk of failure of programmes.

Further information: A similar fund (”Air Quality Management Fund”) has recently been established in the Philippines. For further information please check http://www.hangin.org/legal/irr/index.html.

Road pricing

Road pricing as a policy instrument

The basic idea

The rationality behind road pricing. Road pricing is an exact and efficient way to charge road users their actual road use. It can be differentiated by vehicle type or time of the day. Road pricing may be applied to the overall road network or to particular roads or bridges. As the implementation of a general road pricing scheme is considered as technically too ambitious, road pricing is normally applied to selected routes only. It is then either implemented in order to recover investment costs for expensive infrastructure such as express motorways and bridges or to impose an extra charge on the use of congested roads. In the latter respect, road pricing is often referred to as congestion pricing: it represents an incentive for drivers to refrain from using these roads.

Road pricing creates revenues for transport infrastructure investment and contributes to congestion management.

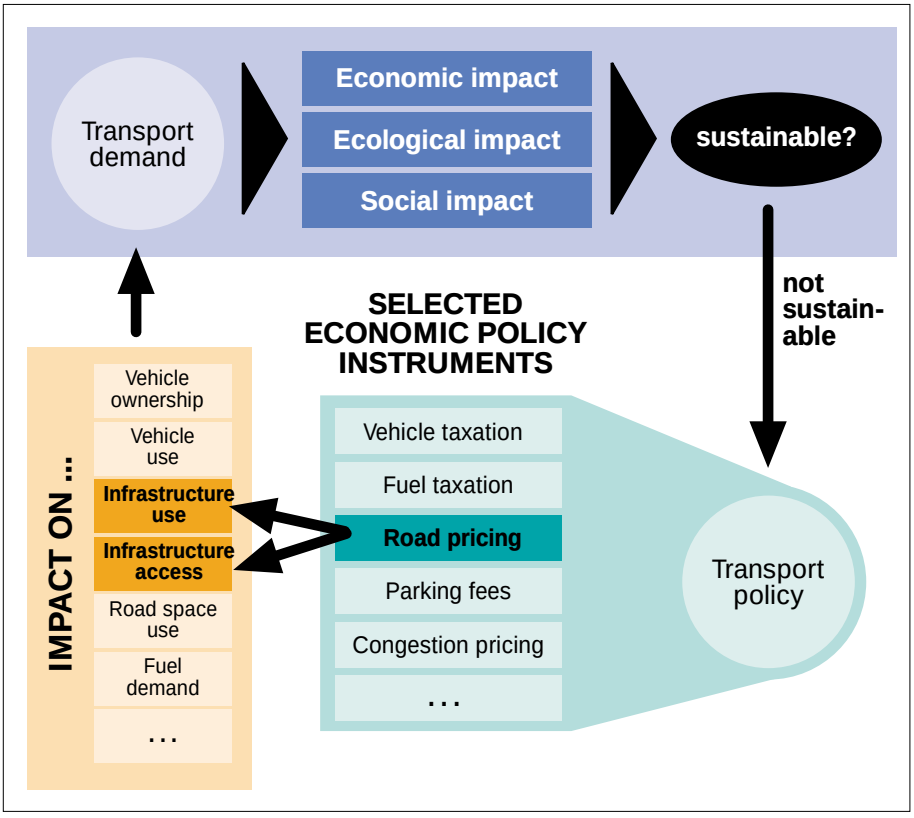
Optional features

Road pricing can take many forms.

Road pricing may take the form of:

- **A general road pricing scheme** for the complete road network (which is often considered as too expensive to implement);
- **Tolls** (which are often used to recover investment and maintenance costs of motorways or bridges);
- **Urban road pricing** can take different forms: **congestion pricing** restricts the use of congested urban roads and reduce the need for network extensions; **area licensing** imposes a charge on the actual road use in cities; and **cordon pricing** is equivalent to an entrance fee into a city.
- **Vignettes schemes** (which can be seen as a fee for temporarily accessing certain road networks, e.g. express motorways);
- **An electronic mileage-tax for Heavy Goods Vehicles** as introduced in Switzerland or under preparation in Germany (in order to effectively tax transit cargo transport).

Figure 3.10:
Road pricing as part of transport demand management



Generating revenues. In an increasing number of cases, toll schemes are implemented to finance infrastructure investment. In many instances private investors are involved on the basis of BOO/BOT models (build, own, operate / build, own, transfer) where the private sector invests in infrastructure and is allowed to recover investment costs by collecting tolls for a certain period of time.

Road pricing is a way to finance the upgrading of expensive infrastructure such as motorways and bridges.

Pricing congestion. In urban areas, tolls (referred to as urban road pricing or congestion pricing) are not necessarily raised for financing purposes but rather as an incentive not to use congested areas. In many densely populated urban areas it is virtually impossible to provide sufficient road capacity to meet peak time demand. Urban road pricing then tries to restrict that demand by increasing travel costs. Urban road pricing may refer to single roads (toll roads), to cordon boundaries (cordon pricing), or to complete areas of a city (e.g. the central business district). Urban road pricing will be discussed in Chapter 4.

Road pricing can reduce congestion and the external costs that are induced by congestion.

Shortcomings

Unwanted traffic diversion is possible. Whenever road pricing is introduced, transport authorities may expect drivers to evade priced roads. If this contributes to levelling off peak travel, it represents the desired effect. In many cases, however, this may be an unwelcome effect when, for example, large shares of traffic divert from motorways to secondary roads going through populated rural areas and villages. In order to keep such diversions within acceptable limits, the actual level of road pricing should not be too high. As long as the price differential between priced and unpriced roads is small, traffic diversion will not be a major problem, as any diversion is always counter-balanced by the burden of additional travel time. The other option in order to avoid traffic diversion is to subject all alternative routes to road pricing as well.

Road pricing may induce unwanted changes of travel routes.

Equity and acceptability issues may cause problems. As any road pricing scheme puts an additional financial burden on car users there are ”winners” and ”losers”. The group of ”winners” clearly includes those who use (improved) public transport. The effects of car users is less straight forward. Some will definitely benefit from reduced congestion, shorter journey time and improved road quality. For other, however, the increased costs of individual car use may make it impossible for them to use their car. They may have to change mode to public transport, if available, and thus benefit from improved public transport. However, if public transport is not available for them, high transport costs may be regarded as an ”isolation tax”.

Road pricing may require additional redistributional measures.

Equity deficits have the potential to reduce public acceptance for road pricing schemes. To resolve these problems it might be necessary to introduce supporting measures for a road pricing strategy such as:

- **direct rebates to low-income groups**, and "isolation reimbursements",
- **public transport subsidies** for low-income users (direct transfers),
- **increased supply of public transport**, subsidised public transport fees.

Road pricing requires adequate technical infrastructure.

Implementation is technically demanding. The availability of technical infrastructure for the charging process is a prerequisite for road pricing. It may be done by manual fee collection at tolling stations. This, however, can be a time-consuming process that hinders traffic flows. Automatic electronic pricing may be more convenient but a considerable amount of investment is necessary for such installations.

Conclusions

Road pricing can be a sensible element in a comprehensive pricing policy.

Road pricing can only be a part of a transport pricing policy. As long as road pricing cannot be applied to the overall road network it should never be the paramount instrument to generate revenues for the financing of transport infrastructure. One major reason is that pricing levels would necessarily have to be high and unwanted traffic diversion would thus be considerable. Only when other sources for revenues are available, road pricing can be at moderate levels and diversion effects will be moderate. Therefore, as long as comprehensive road pricing is not feasible, it should mainly be seen as a pricing instrument to finance particularly expensive parts of the road network (e.g. bridges or motorways) or to specifically address road congestion in urban areas (see urban road pricing as discussed in Chapter 4).

Road pricing should be integrated into broader land-use and transport development concepts. There are plenty of cautionary tales that highlight the danger of the isolated and uncoordinated application of road pricing. Even promising project such as the M1 motorway in Hungary ended up in severe financial situations when they were not embedded into comprehensive network concepts. Another example is the second

Tagus bridge in Lisbon/Portugal, where the independently developed pricing scheme for the project failed, upon which an integrated system that also included the first bridge had to be developed.

Public awareness needed. As with all other economic instruments, road pricing will most likely face public criticism. Again it is important to take that resistance seriously and to openly address it. Public awareness of the negative effects of congested roads (such as increase in travel times, noise, pollution, accidents, etc.) should be created early on.

If road pricing is introduced in a predictable and gradual manner, opposition is less severe.

Keep it simple. Whenever road pricing schemes are to be implemented for the first time, the technical design should be kept simple at first. Tolling plazas with manual fee collection will be sufficient in the initial phase (and will even create jobs). Only later on, when road pricing has proven successful, more sophisticated tolling technology may be introduced.

Best practice case: Road pricing of highways, and toll roads in France

Specifications of the French road pricing system

Toll roads are operated by private companies...

Network elements. In France more than 42 per cent of all expressways are tolled roads. A network of more than 7,300 km is operated by a total of 10 motorway companies, covering specific sections of the network (see figure 3.11). Most companies were established in the 1960s. The biggest company is ”Autoroutes du Sud de la France” (ASF), operating a network of about 2,000 km of mostly 2x2- but also 2x3- and 2x4-lane motorways.

...which work on a concession basis...

All companies work on a concession basis: They are responsible for the construction and financing of motorways, as well as for the efficient operation, with particular attention being given to optimal traffic flows and

Figure 3.11:
The toll road system in France
Source:
www.autoroute.fr

road safety. To recover costs, the concessionaires are allowed to charge motorists for the use of motorways. To this end, they operate a large number of tolling plazas throughout their networks.

...under government control.

All companies are set up as private companies, but with capital being held by public entities, either directly or via the governmental agency ”Autoroute de France”. Both the national government, regional bodies (départments) and local authorities (cities and towns) hold shares of the companies. This is also reflected in the composition of the company boards. Sometimes local or regional Chambers of Commerce and Industry hold shares as well.

The only exception from the prevailing public ownership is the concessionaire ”Compagnie financière et industrielle des autoroutes” (Cofiroute). This company is run by private investors with private capital only. It operates a total of about 800 km of motorway in the region south-west of Paris. Major shareholders of Cofiroute are construction companies, a major French bank and a large French insurance company.

Toll differentiations. Tolls are differentiated by both vehicle type and route. On average a toll of 7 US cents per km is charged. An example of tolls for the 770 km route between Paris and Marseille is given in Table 3.8.

Table 3.8:
Toll rates in France
Source:
www.autoroutes.fr

Vehicle categories	Toll for a single trip between Paris and Marseille (approx. 770 km)	
	Total toll for that route	Toll per kilometer for that route
Class 1: Passenger car	39.1 US$	5.0 US cents
Class 2: Passenger car including trailer	51.45 US$	6.7 US cents
Class 3: Truck, up to 3.5 tonnes	82.87 US$	10.8 US cents
Class 4: Truck, more than 3.5 tonnes	114.56 US$	14.9 US cents
Class 5: Motorbike	23.46 US$	3.1 US cents

Outcomes and results

Revenues. In 2000, all companies together had total revenues of approximately 4.86 billion US$ out of which investment of about 1.71 billion US$ was financed. In the late 1990s revenues were mainly allocated to road construction (49 %), tax payments and VAT (31 %), salaries (19 %), and inspection and maintenance of the existing road network (4 %).

Lessons learned

1. It is technically feasible to implement a nation-wide road pricing system.

2. It is institutionally feasible to commercialise implementation and operation of a national road pricing system.

3. It is possible to charge full internal costs of transport according to road use, and it is possible to raise enough revenue for network extension and improvement.

Further Information. English-language information about French toll roads can be found at the website of the ”Association des Sociétés Francaises d’Autoroutes” at http://www.autoroutes.fr. On this website links to all concessionaire companies can be found as well.