Economic and Regulatory Instruments for Road Traffic

Annex A of the Handbook 'Navigating Transport NAMAs'

TRANSfer Project – Towards climate-friendly transport technologies and measures

The concept

High quality public transport services and adequate cycling and walking infrastructure are often not sufficient to induce a shift towards alternative modes among the majority of motorists. Social norms as well as individual habits keep people that can afford a car from using public transport or non-motorised modes (NMT) (Böhler, 2010). Measures seeking to regulate car use or increase its costs can introduce the necessary driving forces to achieve a desirable modal shift.

Economic and regulatory instruments for road traffic:

- Implement road pricing
- Establish environmental zones
- Strengthen speed limits

For more details on the elements' characteristics see Box 1.

Table 1: GHG mitigation matrix of road traffic regulation

	Avoid	Shift	Improve
Direct effects	☑ Road tolls can reduce unnecessary travel activity and driving distances	☑ Makes the use of motorised vehicles less attractive and induces a shift towards alternative modes	
Indirect effects		☑ Favours the use of NMT by increasing road safety	☑ Environmental zones incentivise motorists to use low-emission vehicles
Rebound effect	☒ Road tolls can redirect traffic to other routes/zones that are not tolled. ☒ Environmental zones can lead to longer driving distances as banned vehicles try to bypass these zones		
Complementary measures *(to achieve full mitigation potential)*		☑ Parking management (see Factsheet '*Sustainable Parking Management*') ☑ 'Public Transport First' strategy (see Factsheet "'*Public Transport First' Strategy*") ☑ High quality cycling and walking infrastructure (see Factsheet '*High Quality Walking Infrastructure*') ☑ Urban logistics	☑ Promotion of energy-efficient vehicles (in particular vehicle emission standards)

On behalf of

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Federal Ministry for the Environment, Nature Conservation and Nuclear Safety

of the Federal Republic of Germany

Box 1: Possible economic and regulatory instruments for road traffic

Implement road pricing

Road pricing (*e.g.* road tolls) increase the costs of car use within a specific area, or on specific stretches of road. Its design varies depending on the main purpose of the instrument. Some urban road charging schemes impose higher charges on motorists at peak times when road systems are congested (congestion charges); others differentiate road charges according to the vehicles' emissions (IEA, 2009).

City-wide road tolls are usually implemented via toll rings around the city centre. Vehicles that cross the toll ring to enter the city have to pay a charge. Often, electronic systems including automatic vehicle detection (*e.g.* Automatic Number Plate Recognition (ANPR) systems) are used to electronically collect the charges (IEA, 2001). In some cases, electric vehicles are exempted from paying road charges.

How it works and intended effects:

- Increase the direct costs of car use;
  - ➔ Induce a shift towards alternative modes;
  - ➔ Reduce incentives for unnecessary trips.
- Emission-based tolls impose higher charges on heavily polluting vehicles;
  - ➔ Push motorised transport towards low-emission and potentially low carbon vehicles.

To be considered for implementation:

- May require a legislative framework of a higher level political authority (*e.g.* concerning privacy policies).
- Impose investment and operational costs upon local authorities as well as costs for improvements in public transport.
- Typically, generate a significant amount of revenue, which exceed the annual operating cost considerably (Timilisina and Dulal, 2008).
- Existing schemes successfully reduced average vehicle travel (Timilisina and Dulal, 2008).

Responsible actors: Local transport planning departments and financial departments

Establish environmental zones

Environmental zones or Low-emission Zones (LEZ) are areas where only vehicles or classes of vehicles meeting a prescribed emission standard are permitted. The scheme can be implemented via windscreen stickers displaying the vehicle's emission category that are manually checked by the police. Alternatively, automated systems can scan the vehicle plate number and the emission factors are obtained from the national vehicle registration body.

Sometimes the restrictions are only applied to goods vehicles above a certain weight limit (*e.g.* in Prague).

Usually, such zones are designed to improve the local air quality by limiting vehicle emissions of particulate matter, nitrogen oxide and ground-level ozone. By restricting high pollution vehicles and by inducing a switch to cleaner vehicles, the instrument can also lower CO_2 emissions (McKinnon *et al.,* 2010).

How it works and intended effects:

- Force owners of heavily polluting vehicles to use alternative modes or to replace their vehicle with a less polluting (and more efficient one);
  - ➔ Induce a shift towards alternative modes;
  - ➔ Incentivise the use of advanced, low-emission vehicles.

To be considered for implementation:

- Ideally, environmental zones are based on nationwide vehicle emission standards.
- May require a legal framework set by higher level political authorities.

Responsible actor: Local transport planning departments

Strengthen speed limits

Strengthened speed limits for road traffic can have multiple benefits: *e.g.* increased road safety or less noise. An increase in travel time for private motorised vehicles makes car use less attractive. On urban highways, speed reductions can lead to improved vehicle fuel economy, since at high speed fuel consumption is an increasing function of speed (IEA, 2001). On the remaining urban road network, where speed limits are often around 50 km/h, speed reductions have a negligible effect on vehicle fuel economy (Panis *et al.,* 2011), but speed limits improve safety and can reduce the number of severe accidents especially with cyclists and pedestrians.

How it works and intended effects:

- Reduced attractiveness of car travel;
  ➔ Shift to alternative modes.
- Increase in fuel economy on high speed roads;
  ➔ Reduced emissions per vehicle kilometre.
- Increased road safety;
  ➔ Favours a shift to non-motorised modes.

To be considered for implementation:

- Speed limits can be implemented rapidly and at low costs.

Responsible actor: Local transport departments

GHG mitigation effect and co-benefits

The effects of a road toll system depend largely on local circumstances and the design of the charge. Rich and Nielsen (2007) compare the projected effects of different congestion charge schemes for the city of Copenhagen. Depending on the design of the charge, the estimated reductions in annual CO_2 emissions in Copenhagen can range between 11 500 and 154 000 tonnes. A toll ring system resulted in the smallest effects on car mileage and CO_2 emissions. Medium effects are estimated for a cordon charge, which divides the city into several zones and charges vehicles each time they cross a zone's boundary. The largest emission reduction effects are projected for a distance based charge, which could lead to 7 % reductions in car mileage.

Strengthening speed limits on urban motorways can lead to direct emission reductions, since at a speed above 50 km/h vehicle fuel consumption increases with rising tempo (see Box 1). In Rotterdam, the speed limit on a suburban motorway was reduced from 120 km/h to 80 km/h on a length of 3.5 kilometres. It was estimated that the measure resulted in CO_2 emission reductions of 15 % (EEA, 2008).

An environmental zone that restricts the access of heavy goods vehicles to the city of Prague reduced the annual CO_2 emission within the zone by 1 650 tonnes. However, heavy vehicle traffic increased at ring roads outside the zone so that the net emission reduction effect was less (EEA, 2008).

Besides emission reductions, road traffic regulations can lead to multiple benefits:

- Improved road safety (especially for non-motorised modes) and particularly a reduction in severe accidents;
- Reduction in local air pollution and noise;
- Reduced congestion;
- Decrease in road wear and tear;
- Revenue generation from road tolls, which can potentially be earmarked for improvements in more environmentally-friendly modes of transport;
- Less requirements for road capacity (and associated savings to the city budget).

Towards implementation

The instrument targets freight and passenger vehicles within the inner city. Private as well as commercial vehicle operators are induced to change their travel behaviour and to improve their vehicle fleet. Furthermore, a toll ring around the city addresses especially commuters, who travel by car. This increases the attractiveness of 'Park & Ride' (P+R) for commuting trips.

Key stakeholders

- Local transport planning departments:
  Responsible for speed limits in the road network and for access restrictions. Also responsible for the planning and running of road toll schemes.
- Local financial department:
  Responsible for the administration of road toll revenues and can be involved in the toll collection.

Table 2: Potential barriers to implementation and countermeasures

Barriers	Options to overcome
Lack of institutional capacity to run a road toll scheme or to enforce environmental zones	■ Enforcement of environmental zones by patrolling police is less expensive than automatic enforcement (*e.g.* via cameras). ■ Public-private partnerships (PPP) in which private actors provide technology and run the scheme can be an option.
Strong public and commercial opposition against road use regulations	■ Seek support from NGOs (*e.g.* cycling organisations, parents' associations). ■ Make use of the media to communicate the scheme and highlight the benefits of car use regulations (*e.g.* increased liveability in the city, improved safety). ■ Commit to earmark the revenues from road toll for improvements in public transport and non-motorised modes, and/or reduction in other taxes.
Lack of a vehicle emission classification scheme	■ Cooperate with other cities and NGOs to prompt the national government to implement mandatory national emission classification schemes.

- **Success factors**
- Strong political will and leadership;
- Proper alternatives to the private car (investments in public transport, P+R facilities and non-motorised modes might be necessary);
- Strict enforcement of road tolls and speed limits (sufficient institutional capacity, *e.g.* cooperation from the police needed) and sufficient penalties on non-compliance;
- The amount of the road toll has to be high enough to discourage commuters to travel by car;
- Strict emission limits for environmental zones;
- Information and campaigns to promote alternative modes.

Practical example: Road pricing in Singapore

The oldest congestion charging scheme is Singapore's congestion pricing scheme, which was implemented to reduce the adverse effects of car travel within the city. This began with the Area Licensing Scheme (ALS), introduced in 1975. An imaginary cordon was placed around the most congested parts of the city, termed the Restricted Zone (RZ), an area of 720 hectares. To enter this area during specific times of the day, cars needed to purchase an area license (USD 2.20 daily or USD 43 monthly). In 1998, the paper based system was substituted by an electronic road pricing scheme with automatic vehicle detection (via in-vehicle units) and payment systems. During most of the day, charges are imposed on road use in the central business district (CBD) and on expressways. The charges are raised in 5 or 30 minutes increments. The electronic road pricing scheme costs USD 5 million in operating costs, which are easily outweighed by its annual revenue generation of USD 46 million. On controlled roads, traffic was reduced by more than 40 % and the public transport speed was increased by 16 %. Since Singapore's congestion charge is area-based, evasion traffic is limited (Broaddus *et al.,* 2010, Timilisina and Dulal, 2008).

It was estimated that the urban road pricing scheme together with a vehicle quota system and the implementation of an efficient mass transit system led to fuel savings of 43 % compared to the projected fuel consumption in the absence of these measures (Poudenx, 2008).

Singapore – Photo from GIZ Photo Collection 2011

Further reading

- **Böhler, S. (2010)** *Nachhaltig mobil – Eine Untersuchung von Mobilitätsdienstleistungen in deutschen Großstädten*, Dortmunder Beiträge zur Raumplanung V8, Institut für Raumplanung TU Dortmund, Dortmund, Germany.
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- **IEA – International Energy Agency (2001)** *Saving oil and reducing CO_2 emissions in transport – Options and Strategies*, IEA/OECD, Paris.
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- **McKinnon, A., Cullinane, S., Browne, M. and Whiteing, A. (eds)** (2010) *Green Logistics – Improving the environmental sustainability of logistics*, Kogan Page, London.
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- **Rich, J. and Nielsen, O. A. (2007)** '*A socio-economic assessment of proposed road user charging schemes in Copenhagen*'. Transport Policy, vol. 14, no. 4, pp. 330–345.
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