

# Transport Demand Management -Part1 (excl. Road Pricing and Congestion Charging)

Manfred Breithaupt - GTZ  
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# Transport Demand Management

## 125 A.D.

Rome saw in 125 A.D. a serious traffic problem.

As a result a regulation has been imposed that restricted the number of ox carts, food delivery transport, and chariots in the center of Rome.



Mosaic from a bathroom in Ostia/Rome

## Today

TDM emphasises on the movement of people and goods, not just on motor vehicles, and gives priority to public transit and non-motorized modes, especially under congested urban conditions.



Karl Fjellstrom

Singapore has implemented a range of mobility management measures in the Chinatown area, including pedestrianised streets, evening road closures, widened and attractive newly-paved walkways, tree-planting for shade, more parking restrictions, transit improvements (including bus and MRT expansion in the area), an ERP-System, and an innovative 'smart bike' program providing free bicycle use.

# The challenges in urban transport and TDM

- **Urban areas require proper road networks**
- **New roads attract more traffic and reduce the viability of public transport**
- **Transport benefits will be offset by future congestion**

## Transport Demand Management shall

- **reduce the total volume of traffic**
- **promote shifts towards more sustainable modes of transport**

## with the objectives to

- **reduce traffic congestion**
- **reduce adverse effects on the environment or public health**
- **generate additional revenue to improve public transport and NMT by pricing mechanisms**

# Transport Demand Management measures

Transport demand management measures (including fiscal policies)

- Land use development controls
- Public transport integration
- Parking controls and management
- Regulatory controls such as odd/even systems
- Physical measures such as bus and pedestrian priority
- Pricing & charges through fuels, annual taxes
- Congestion charging

**Fiscal policies cannot be implemented as isolated instruments, but – for being successful – have always to be embedded in a comprehensive framework of Transport Demand Management measures.**

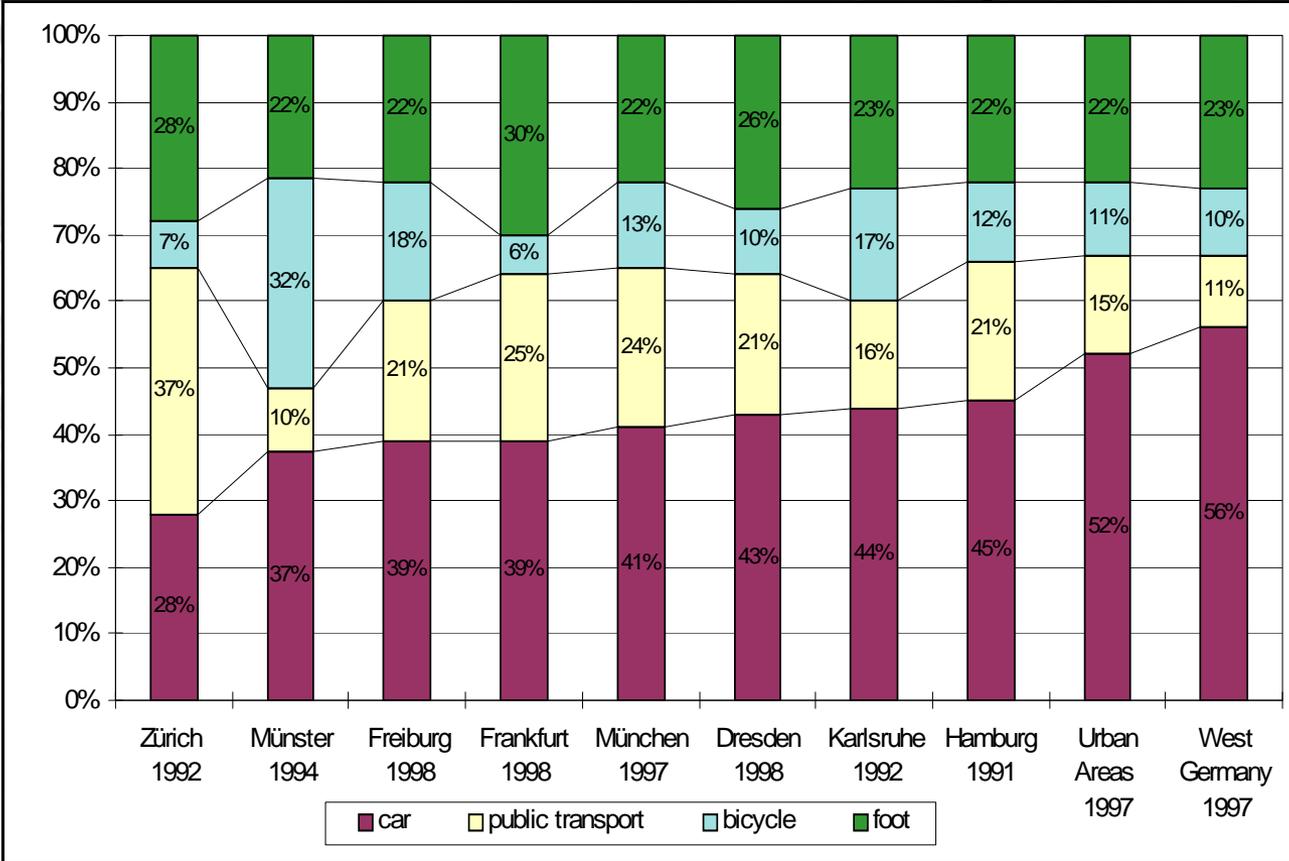
# Transit-oriented development and efficient use of urban space (just as an example for supporting TDM measures)



# Approaches for developing cities

- Focus on **measures open to rapid implementation** by the local govt., with limited reliance on foreign help. ‘Win-win’ measures provide incentives for implementation
- ‘**Least cost principle**’ considering how to maximise mobility at the lowest cost, including demand management options
- Work with a range of stakeholders & partners
- Find the key interested stakeholders and work with them. With a modest financial outlay it is possible to generate awareness
- Work with the city level: Government, NGOs, universities, civil society,
- Cooperate with other organisations, national, international levels
- Consultative workshops, seminars, focus groups, meetings
- Public awareness campaigns

# Land use development controls: Modal split in various European cities



## Münster

54% of all trips are by non-motorized means of transport (walking, bicycle).

## Zurich

private car use is smaller than 30% whereas public transport covers nearly 40% of all trips.

## Major shifts in the modal split

Major shifts in the modal split proved possible (e.g. in Zurich, Freiburg, Münster) when the local authorities implemented a **comprehensive and integrated urban policy**.

# Why is Zurich so successful?

## Context

Two major projects for underground transportation systems were rejected by voters in referendums in 1962 and 1973

The town council saw this as a mandate to continue working with the existing transport system based on trams and buses and to develop these into a modern, efficient and attractive transport system

## Reasons for the success of today's public transport

### Visible predominance in the streets

- Frequent bus and tram circulation

### High quality of services

- Comprehensive network
- High frequency
- Clear timetables at each stop

### Telematics system

- Priority for buses and trams at intersections

### Integrated Networks and Timetables

- Complete integration of the suburban railway lines into the city's network
- Integrated fare system, coordinated timetables

### Investment and operating costs

- **In comparison to underground transportation investment costs are only a fraction**  
(e.g. the whole telematics system costs only as much as half a kilometer of a metro tunnel)

# Managing transport demand, not just supply

Traffic management must address not just supply aspects, such as the provisioning of extra and/or wider roads, but demand.



Karl Fjellstrom

Nanjing



Especially in fairly dense cities, but equally as car-dependent cities have found, **it is not possible to build or buy your way out of congestion.**

# Transport demand management measures



*Successful TDM measures in Hong Kong have ensured the bus industry remains viable, with buses dominating city traffic.*



*TDM measures in Curitiba, combined with integrated transport and land use planning, ensure buses continue to retain market share.*

# Transport demand management: Regulatory controls

The most well known regulatory controls are odd/even schemes and their variants. Some well-known schemes includes:



**Mexico City** uses a scheme which prohibits car use throughout the federal district with number plates ending in “1” and “5” on Mondays, “2” and “6” on Tuesday etc for the 5-day working week (“Hoy No Circula” scheme);

**Bogota** uses a scheme in which 40% of private vehicles cannot operate in the city between 7 - 9AM and between 5.30 - 7.30PM in accordance with number plates;

**Sao Paulo** uses a scheme over a wide central area (within the Inner Ring) in which 20% of vehicles are prohibited from 07:00-08:00 and 17:00-20:00 for weekdays;

**Manila** uses a scheme which prohibits certain vehicles, gain identified by number plates, from operating on the main traffic arteries during peak periods.

# Making number plate restrictions work

**Mechanisms to avoid purchases of second cars  
(otherwise, number plate restrictions can encourage used car purchases)**

- 1. Apply restriction to peak periods only**
- 2. Ban four numbers each day (instead of two)**
- 3. Change number combinations quarterly or bi-annually**
- 4. Vehicle registrations at the same address receive same ending plate number**
- 5. Require new number plates for used car purchases**





© Theo Heirmann/DDP

# Particulate matter emission - Emission zones in Germany

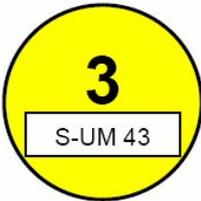


# Introduction of emission zones in Germany

- An emission zone:
  - is an area from which highly polluting motor vehicles are banned
  - these will be excluded from the city centre in three stages
  - to enter the Zone, vehicles must display a permit disc ('Vignette')
- As of 1st of January 2008: Berlin, Hannover, Cologne



# Toxic element groups



- Old diesel and petrol vehicles without a controlled catalytic converter → no vignette!
- Diesel
- Euro 2
- Euro II
- Diesel
- Euro 3
- Euro III
- Diesel Euro 4,
- Euro IV und V,
- petrol with approved catalytic converter

# German Cities with Emission Zones



## Deutsche Städte mit Umweltzonen (rechtskräftig beschlossen)



geplant eingerichtet



Stand: 2. Februar 2008  
Quelle: Umweltbundesamt

# Emission Zone: Berlin

## Stage 1 from 1.1.2008:

Vehicles (lorries and passenger cars) must at least meet the requirements of Pollutant Class 2 of the recently adopted national vehicle marking scheme. Therefore, vehicles with red, yellow and green stickers are allowed.



## Stage 2 from 1.1.2010:

Only vehicles in Pollutant Class 4—thus, only vehicles with green stickers—can drive in the zone.



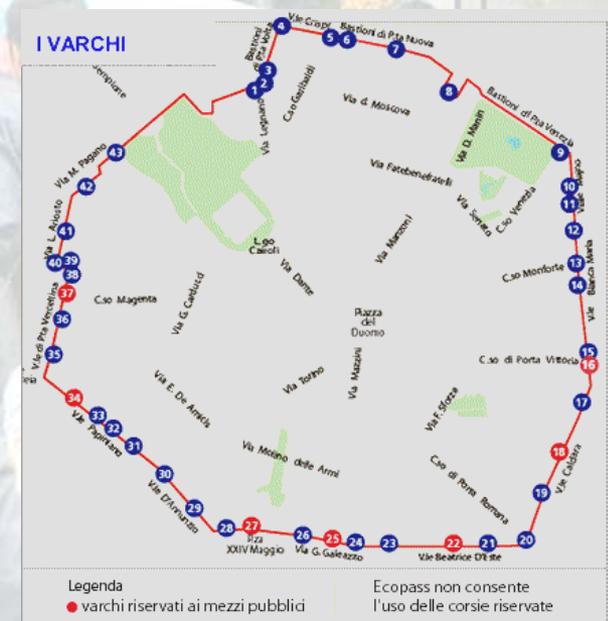
# Not only in Germany: 70 European cities ban cars from downtown

70 towns and cities in eight European countries introduced or are planning to introduce low emission zones in order to improve the air quality in the cities.

This to improve the air quality in the city centres and to protect the health of residents. Road traffic is the main source of noxious substances, like fine dust (PM 10) and nitrogen dioxide (NO<sub>2</sub>). Emissions of particulate matters increase the danger of asthmatic and pulmonary diseases, as well as cardiovascular disturbances and lung cancer. In many city centres the limit values are exceeded regularly.

# Low-Emission Zone Charging in Milan

- One-year trial of EcoPass
- Scheme of graduated emissions-based charges for entry into Milan's Limited Traffic Zone (ZTL) → controlled by 43 gates
- Electronic cameras record the passage of the vehicles, and debit the card holder's account
- Tollage up to US\$14.70 (EUR 10) per day
- Charges based on the Euro emissions class of the vehicle, the fuel type, the availability of approved filters, and if cargo or passenger
- Additionally offer of a multiple access card (50 days of access, not consecutive, with a reduced price)
- Subscription card for residents of the ZTL



# Transport demand management: Physical measures (1)

Transport demand can be reduced through physical measures which make private car use less attractive. Measures may reduce speed, increase travel distances, or prevent entry to certain areas. Road space may be re-allocated to more efficient and environmentally-friendly modes.



A narrowed intersection in Bonn providing preference to bicycles (above). In Copenhagen, road space is given to bicycles (right).



# Transport demand management: Physical measures (2)



Central Copenhagen (top) has a network of pedestrianised streets. Frankfurt's historical centre (above) is typically pedestrianised.

Brisbane (top) is intensively re-allocating road space in favour of cyclists and buses. The wide footpaths in London's Oxford St. (above) are inviting to pedestrians, and restrict vehicles.

# Other restrictions: Shanghai to ban heavy polluting vehicles

- Effective Oct 1, 2006 Shanghai has banned heavy polluting vehicles (below Euro 1 Standard) from entering downtown.
- Cars, trucks and buses entering downtown between 7 a.m. and 8 p.m. have to comply with above Euro I standard.
- Currently, aprox. 350,000 vehicles are not meeting the emission criteria.
- The restricted zone will be a 110-square-kilometer area within the Inner Ring road.
- Motorists have to apply for stickers (free of charge) certifying that their vehicles are environmentally friendly.
- Violators will be fined up to 200 Yuan (US\$ 25) and two points will be added to their driving safety records (motorists with 12 points face licence suspension)

Source: China Daily, 30.12.2005

# Parking pricing and management

- Parking is a key issue in the push-and-pull approach towards better urban transport with fewer cars and more cycling, walking, and transit. Parking policies are supposed to support the change from car trips to the more city-compatible means of transport, and to relieve the open space of driven and parked cars for other uses.
- Parking control and pricing is the most commonly applied demand management measure.  
(full presentation on parking management be presented on Wednesday at the TDM TC)



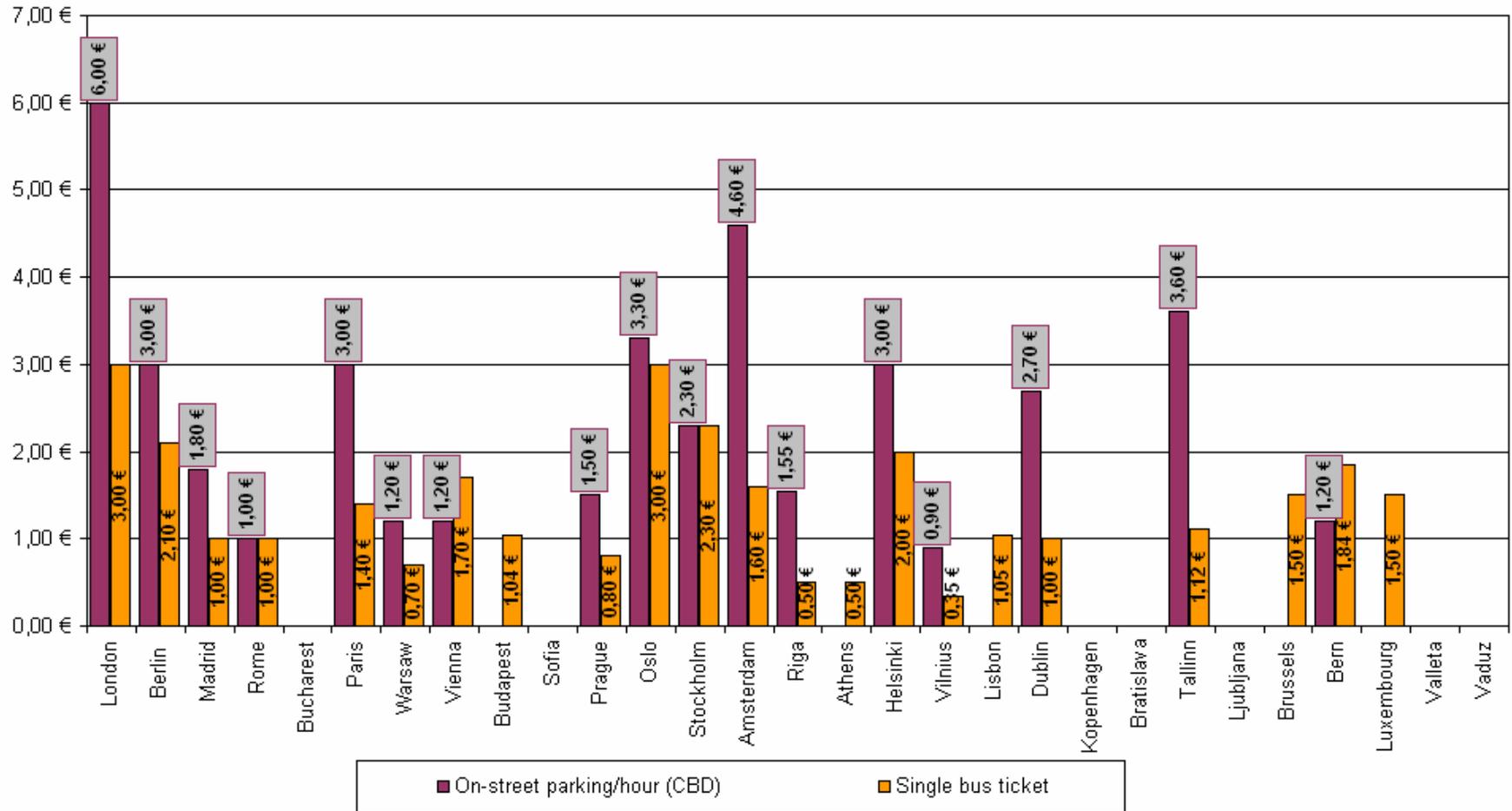
Singapore parking prices (Jan. 2002)

# Elimination of on-street parking



# Parking fees in European cities

Comparison of parking fees in European cities (On-street per hour, CBD) with costs of single bus fare



# Parking management: the example of Germany

## Restrictions

- Strict reductions in the number of parking lots in the city centres
- Closing of particular streets or areas for passenger cars (except deliveries and taxis, and sometimes buses)
- Restricted parking areas (“Residents only“)
- Parking guidance systems

## Pricing

- Regulation of all parking areas via meters and ticket vending machines
- Parking fees at least 1 Euro per hour in most cities
- Munich: parking fee of around 3 Euro per hour
- Bremen and increasingly other cities: Parking tickets may be used by two persons as public transport tickets for trips within city center during the parking time
- All mega events (concerts, sports events): the entrance ticket includes public transport ticket



Muenster, Germany



Karl Fjellstrom

*Parking restrictions are strictly enforced in Copenhagen, to leave room for other modes.*

# Economic instruments: Fuel taxation, vehicle taxes, environmental taxation

- In the absence of other measures which more accurately target peak period road use fuel taxation is a reasonable replacement measure.
- Fuel prices may be an element of a national demand management policy and may discourage some vehicle use.
- As fuel prices do not address vehicle use at specific congested (city) locations nor specific congested times, they are not a responsive measure for reducing city traffic congestion.
- Urban fuel surcharges can provide local revenue which can be used to improve the transport system (Mexico City, Bogotá).
- In Germany and other countries fuel taxation has been important in promoting more environmentally friendly fuels. Most EU countries, for example, applied fuel taxation to make (at that time) unleaded fuel cheaper than leaded fuel. This as well regarding CNG, LPG and Biodiesel (much lower fuel taxes).
- The vehicle tax in Germany and now France is strictly environmental related (factor 1:6 regarding environmental standard of vehicle). That means, the owner of a vehicle that does not meet the environmental standard as of today (Euro 4) has to pay a tax up to 6 times higher than an owner of a car which meets those standards. New for Germany is, that diesel vehicles without particulate filter are more heavily taxed.

# TDM - Environmental Trust Fund Mexico (1)

## The Environmental Trust Fund (ETF)

The ETF was created in 1992 with the main purpose to finance environmental projects in Mexico City.

## Specification of the ETF-System

- **Fuel tax increase by 1 US-Cent per litre gasoline** which is levied and received by the general government (Ministry of Finance)
- **Earmarked reallocation by revenues** to ETF-financed projects such as credit schemes for vapor recovery equipment at gas stations, rehabilitation of nature to increase absorption capacities for pollutants and particles, purchase of CNG vehicles for police, 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.

# TDM - Environmental Trust Fund Mexico (2)

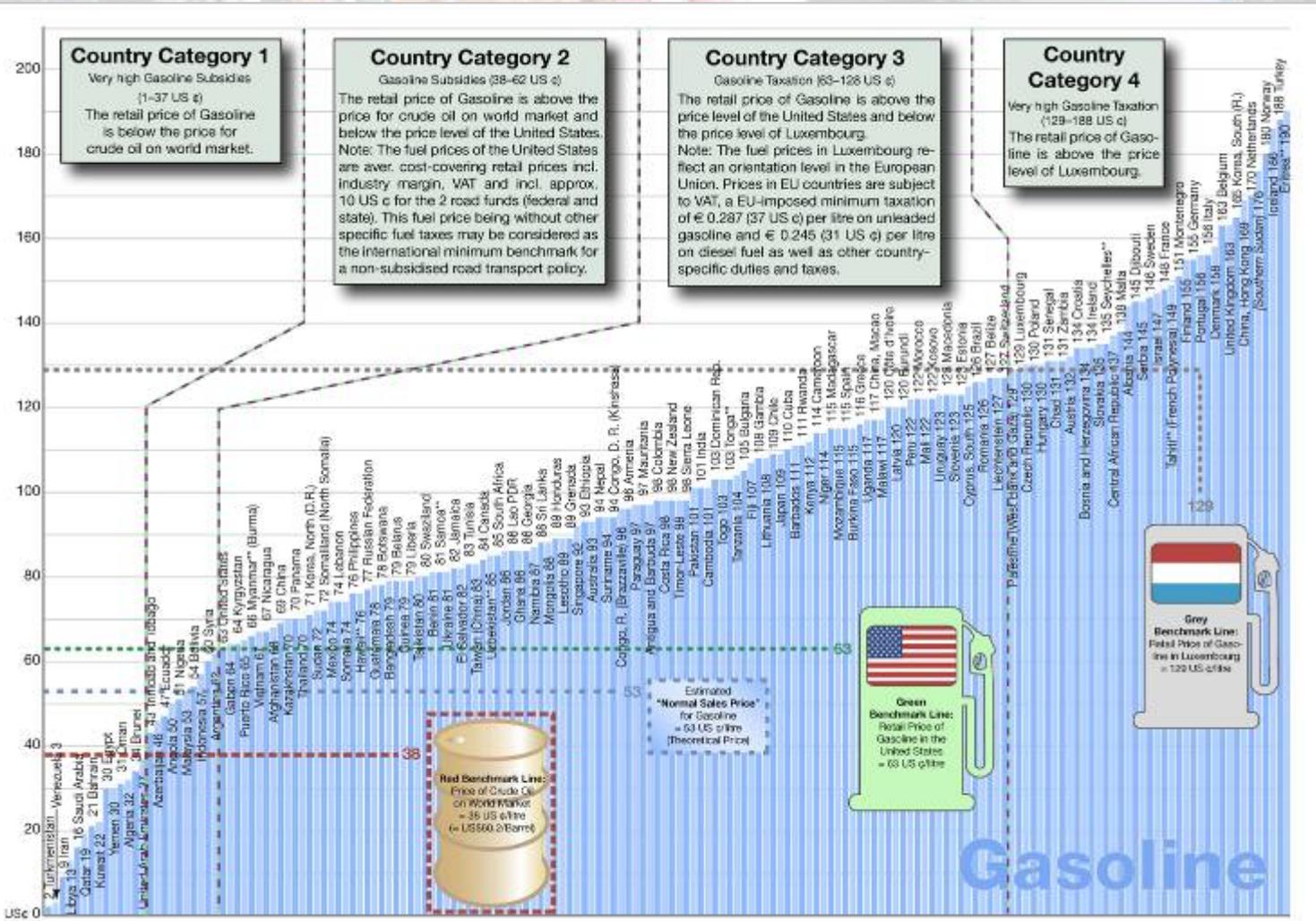
## Outcomes

Between 1991 and 1998 the ETF received roughly 70 Mio. US-\$.

## Lessons learnt

- It is possible to design and implement simple mechanisms for recovering external costs and alleviation of environmental problems with a large impact.
- **Fuel taxation is an administrative 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.**

# A global perspective on fuel prices



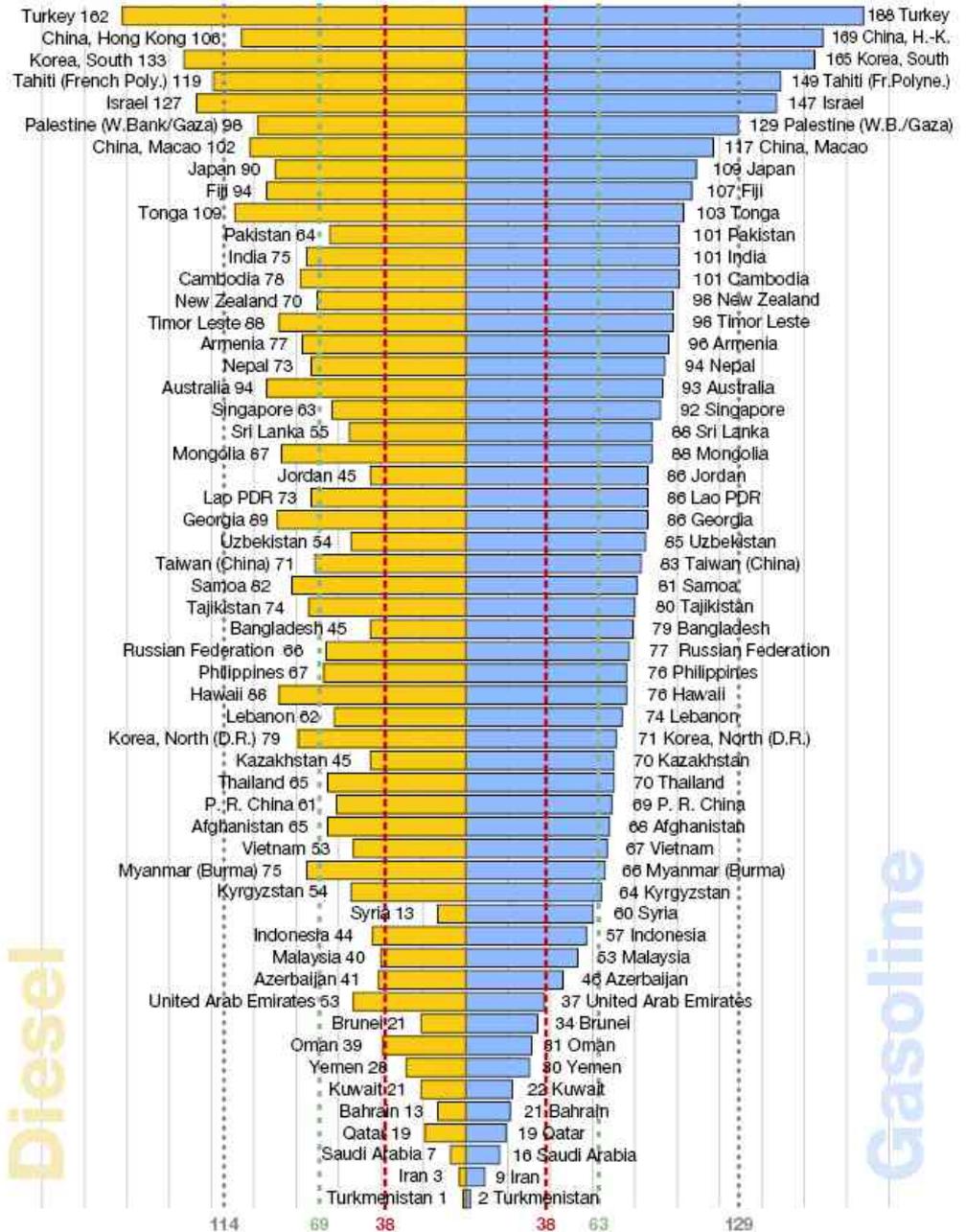
## The survey:

- 170 Countries
- Diesel and Gasoline
- Last survey in November 2006
- Next survey in November 2008
- November 2007: Flash survey Africa

# Fuel taxation in Asia

Comparison of fuel prices in Asia as of Mid-November 2006

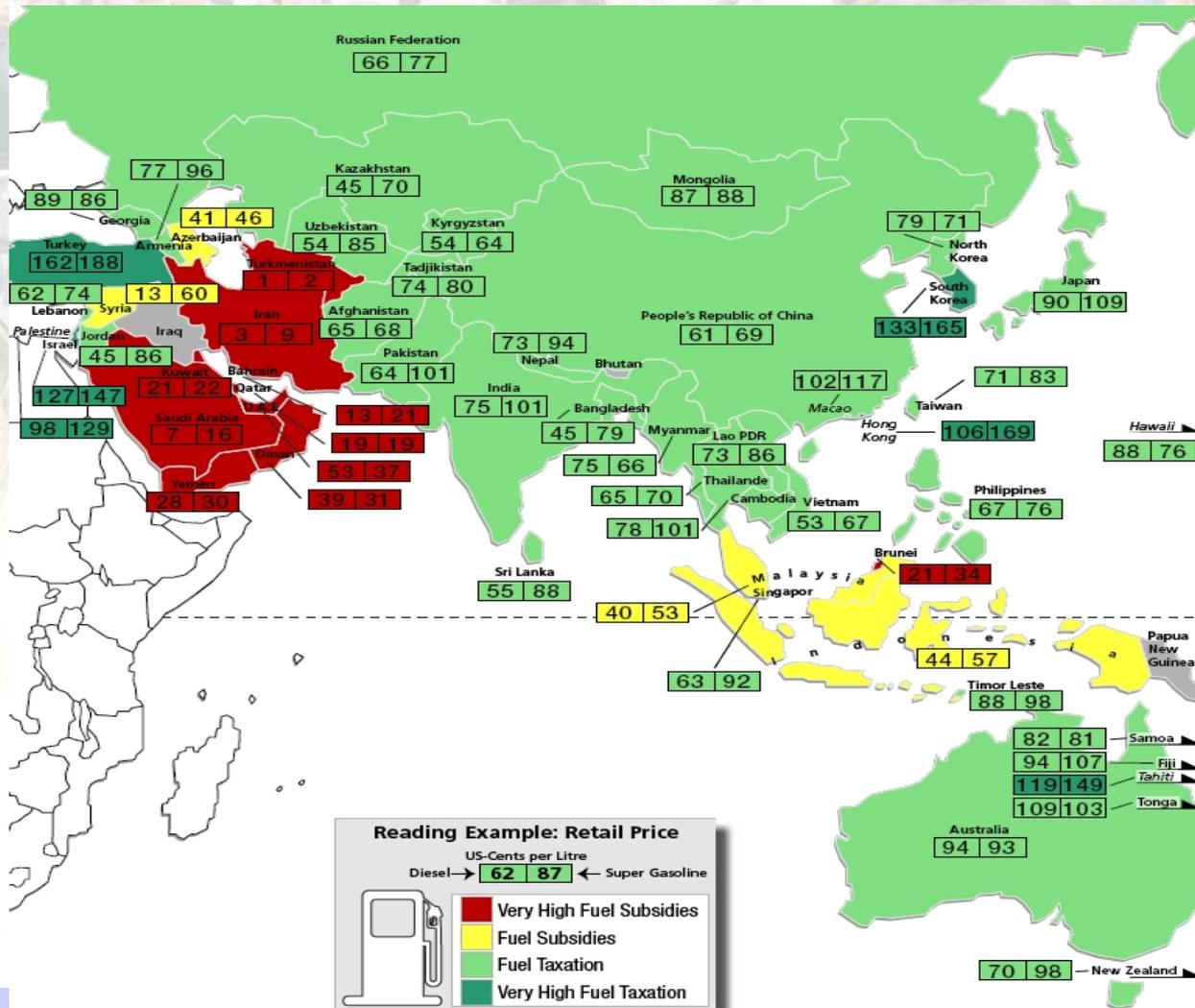
Full data set available on [www.gtz.de/fuelprices](http://www.gtz.de/fuelprices)



Diesel

Gasoline

# Regional Comparisons



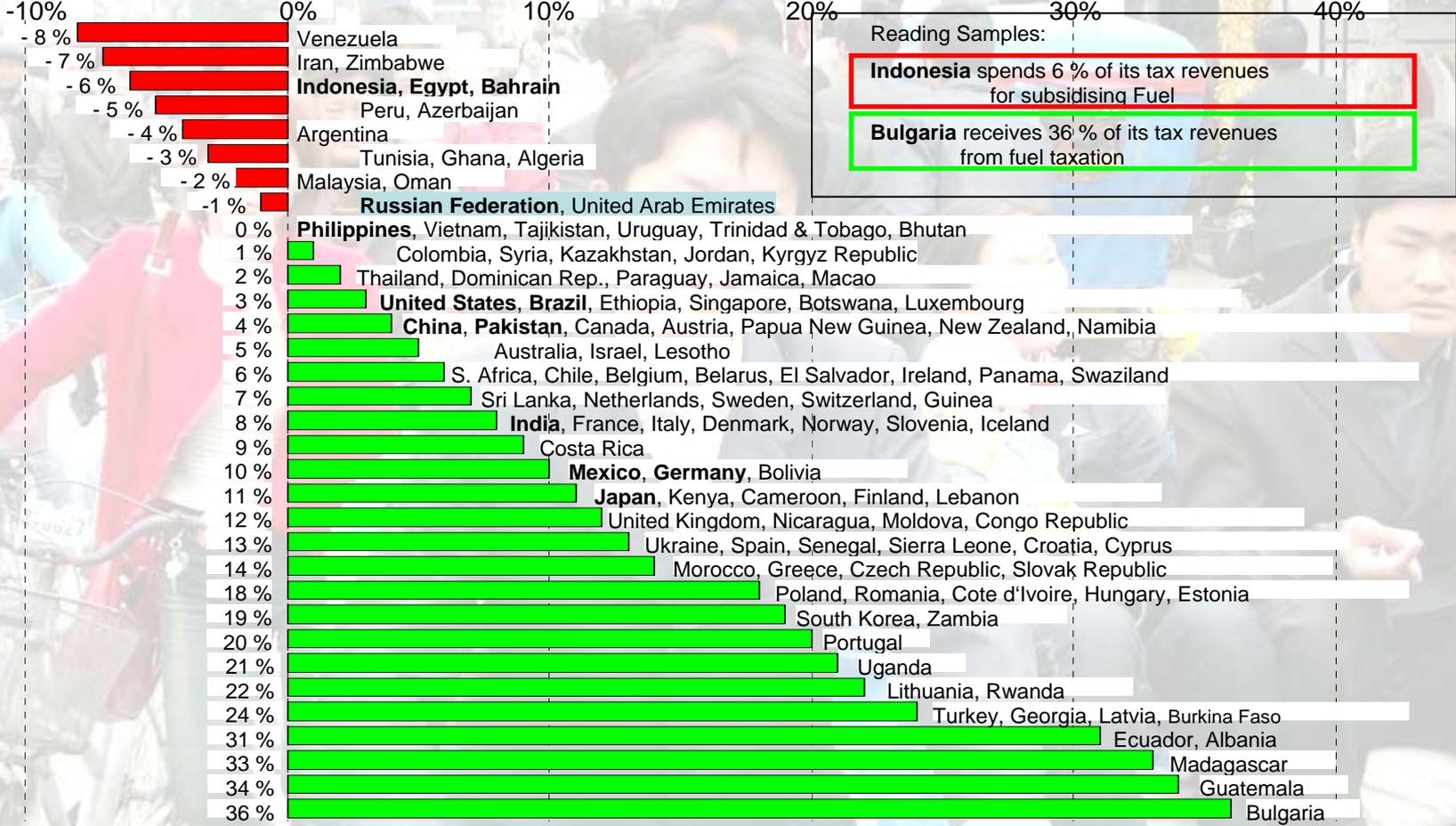
**Regional comparisons as indicators for:**

- Smuggling potential
- Good governance
- Regional Transport Sector Dialogue

# Fuel taxation in Asia

[Calculated Transport Fuel Taxation as % of Total Tax Revenues\*]

Fuel Contribution to Total Tax Revenues in 110 Countries



Reading Samples:  
**Indonesia** spends 6 % of its tax revenues for subsidising Fuel  
**Bulgaria** receives 36 % of its tax revenues from fuel taxation

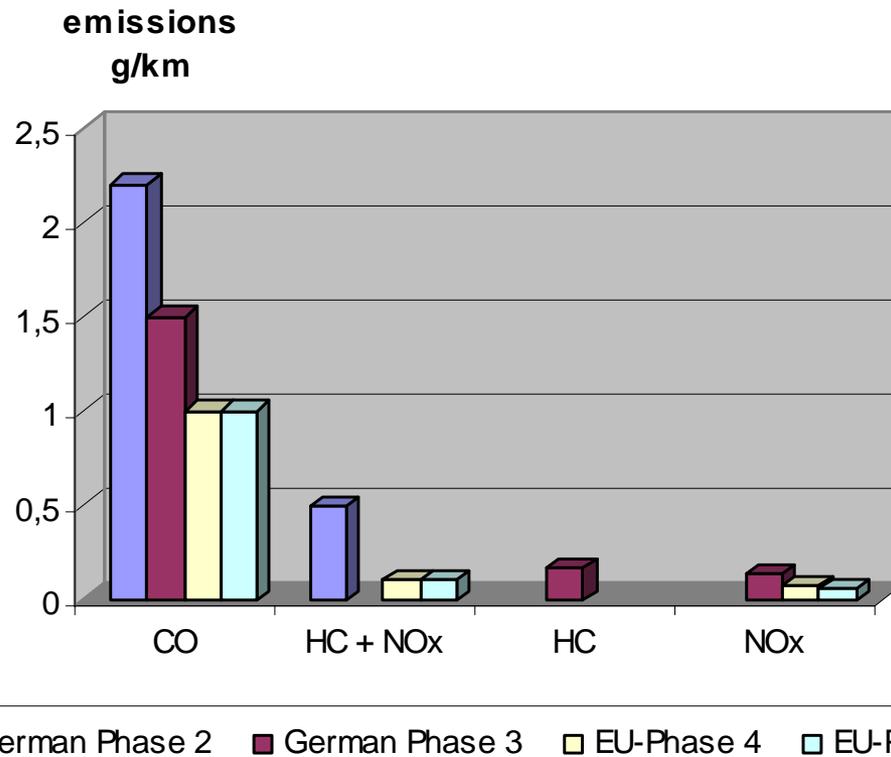
Note: Current fuel taxation revenues have been calculated with a fuel consumption of 10 litre / 100 km for a passenger car and 25 litre / 100 km for a commercial vehicle. The average annual travel distance of passenger cars has been estimated at 10.000 km per year, if exact data is not available. The average annual travel distance for commercial vehicles has been estimated at 25.000 km per year (average of pick-up, truck and public service vehicles). Fuel taxation per litre has been estimated at sales price of 10<sup>th</sup> Dec. 2002 minus „Normal Sales Price (excluding fuel taxation)“. (for details see chapter 8.1 and 8.2)

\* Most recently available consolidated central government tax revenues from the International Monetary Fund are used. Currencies have been converted using the average exchange rate of the concerned fiscal year. (for details see chapter 8.3)

[Sources: Verkehrstaschenbuch Aral 2002/2003, World Road Statistics IRF 2002, IMF Government Finance Statistics Yearbook 2002, Consultants Calculations]

# Vehicle taxation in Germany, based on...

## European emission standards for passenger cars (petrol engine)



# Vehicle taxation in Germany

## Vehicle tax for passenger cars

Emission Group	Tax per 100 ccm in € for GASOLINE Cars	Tax per 100 ccm in € for DIESEL Cars
Euro 3, Euro 4 and „3 liter car“	6,75	15,44
Euro 2	7,36	16,05
Euro 1	15,13	27,35
Other Passenger Cars	25,36	37,58

# Fuel Taxation in Germany

Fuel	Tax (2007)	€/t CO2	€/l
Gasoline	655,00 €/1000 l	273,17	0,65
Petroleum/ Kerosene	655,00 €/1000 l	255,05	0,65
Diesel	470,40 €/1000 l	178,62	0,47
LPG	180,32 €/1000 kg	60,00	0,09
CNG	183,00 €/1000 kg	32,72	0,09

# Incentives for using alternative fuels

(only relative comparison - retail prices March 2008)

	Gasoline (premium)	Diesel	LPG	CNG
Germany	1,44 €/l	1,35 €/l	0,68 €/l	0,99 €/l
India	0,70 €	0,44 €	0,33 €/kg	0,30 €/kg
Indonesia	0,30 €	0,29 €	0,29 €/kg	0,19 €/kg
Hong Kong	1,23 €	0,81 €	0,28 €/l	tba
Singapore	0,96 €	0,73 €	1,33 €/kg	0,75 €/l
China	0,46 €	0,44 €	0,52 €/l	0,18 €/l*
Korea (South)	1,06 €	0,93 €	tba	0,30 €/ m <sup>3</sup> *
Bangladesh	0,61 €	0,37 €	tba	0,08 €/m <sup>3</sup> *
UK	1,39 €	1,38 €	0,68 €/l	0,56 €/l

\*retail prices February 2005



# New environmentally oriented taxation system for new cars in France

# New vehicle taxation system for new cars in France

- France's Environment Ministry in December unveiled a system of green taxes on gas-guzzling cars and bonuses for cleaner vehicles, as part of a nationwide strategy to slash global warming emissions.
- From January 1, any driver who buys a new car emitting more than 160 grams of carbon dioxide per kilometre (just over half a mile) will be charged a once-off penalty of up to 2,600 Euros (3,800 Dollars).

# Penalties for new cars

- Penalties will start at 200 euros, rising to 750 for emissions above 166 grams, and 1,600 euros above 200 grams.
- Penalties are expected to apply to around a quarter of all new car sales, while around 30 percent of buyers would qualify for a bonus based on current new car sales.
- Designed to steer drivers towards cleaner transport, **the scheme will pay for itself**, the ministry said, with the levy on polluters used to pay out bonuses for the rest.

# Overview

Output in grams of Co <sub>2</sub> /km	Price
< 60	+ 5000 €
< 100	+ 1000 €
121-130	+ 200 €
131 - 160	0
161 - 165	- 200 €
166 - 200	- 750 €
201 - 250	- 1600 €
> 250	- 2600 €

# Comments

- Emission limits will be toughened every two years, by five grams each time, to encourage manufacturers to keep developing cleaner cars.
- Plans for taxing higher emitting vehicles were approved by the President following a four-month forum on environment that brought together the government, industry and the green lobby.

# Singapore's new policy to enhance CNG use

- ❑ Effective October 2006, all new diesel engines are required to be either Euro 4 compliant or fuelled with CNG
- ❑ CNG taxis now enjoy an ARF (Additional Registration Fee) rebate of 20%
- ❑ CNG busses and commercial vehicles are exempted from paying ARF until end 2005
- ❑ CNG taxis and busses get a 20% road tax rebate
- ❑ Euro IV diesel taxis registered from June 1, 2004 to Dec 31, 2005 enjoy an ARF rebate of 100%, those registered from Jan 1, 2006 to Sep 30, 2006 will enjoy a 80% rebate on ARF
- ❑ Within next 2-3 years, 3000-4000 taxis should operate on CNG

# The push and pull approach

## Measures with push-effects

Area-wide parking management, parking space restrictions in zoning ordinances, car limited zones, permanent or time-of-day car bans, congestion management, speed reductions, road pricing...

## Measures with pull-effects

Priority for buses and trams, high service frequency, passenger friendly stops and surroundings, more comfort, park-and-ride, bike-and-ride..., area-wide cycle-networks, attractive pedestrian connections...



## Measures with push- and pull-effects

Redistribution of carriageway space to provide cycle lanes, broader sidewalks, planting strips, bus lanes..., redistribution of time-cycles at traffic lights in favour of public transport and non-motorized modes, public-awareness-concepts, citizens' participation and marketing, enforcement and penalizing...

Source: Müller, P., Schleicher-Jester, F., Schmidt, M.-P. & Topp, H.H. (1992): Konzepte flächenhafter Verkehrsberuhigung in 16 Städten", Grüne Reihe des Fachgebiets Verkehrswesen der Universität Kaiserslautern No. 24.

# Relevance for lower income developing cities

The so-called „push and pull strategy“ is the key for sustainable transport development, and when consequently followed may have significant influence on modal split

How much of the “push” (getting people out of their cars) and the “pull” (getting people into public transport and NMT) will be applied depends on the financial resources of a given city, but even the more on the dedication and leadership of the mayor and the city council.

With very limited financial resources, for example parking management and access restrictions (push) can be implemented, while on the other hand public bus transport can be made considerably more attractive by a bus regulation and concessioning scheme and a reallocation of public space (for example into cycle lanes and/or bus lanes/BRT systems).

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Curitiba: the unique advantage that a city development matured over more than 25 years. This influenced heavily land-use patterns. Initial spark: a dedicated and visionary mayor (Jaime Lerner)

# The case of Curitiba: land use and transport



# The case of Curitiba: land use and transport



# Singapore's comprehensive approach to TDM

- Vehicle taxation to influence travel demand.
- Vehicle taxes are imposed at various points, including import, sale, and annual registration.
- Singapore has been the major exponent of vehicle taxation as a means of reducing transport demand, with a tax structure aimed at discouraging older vehicles. Yet even with high taxes vehicle ownership continued to increase, leading in 1990 to the application of an absolute quota system limiting the number of vehicles.

## Elements

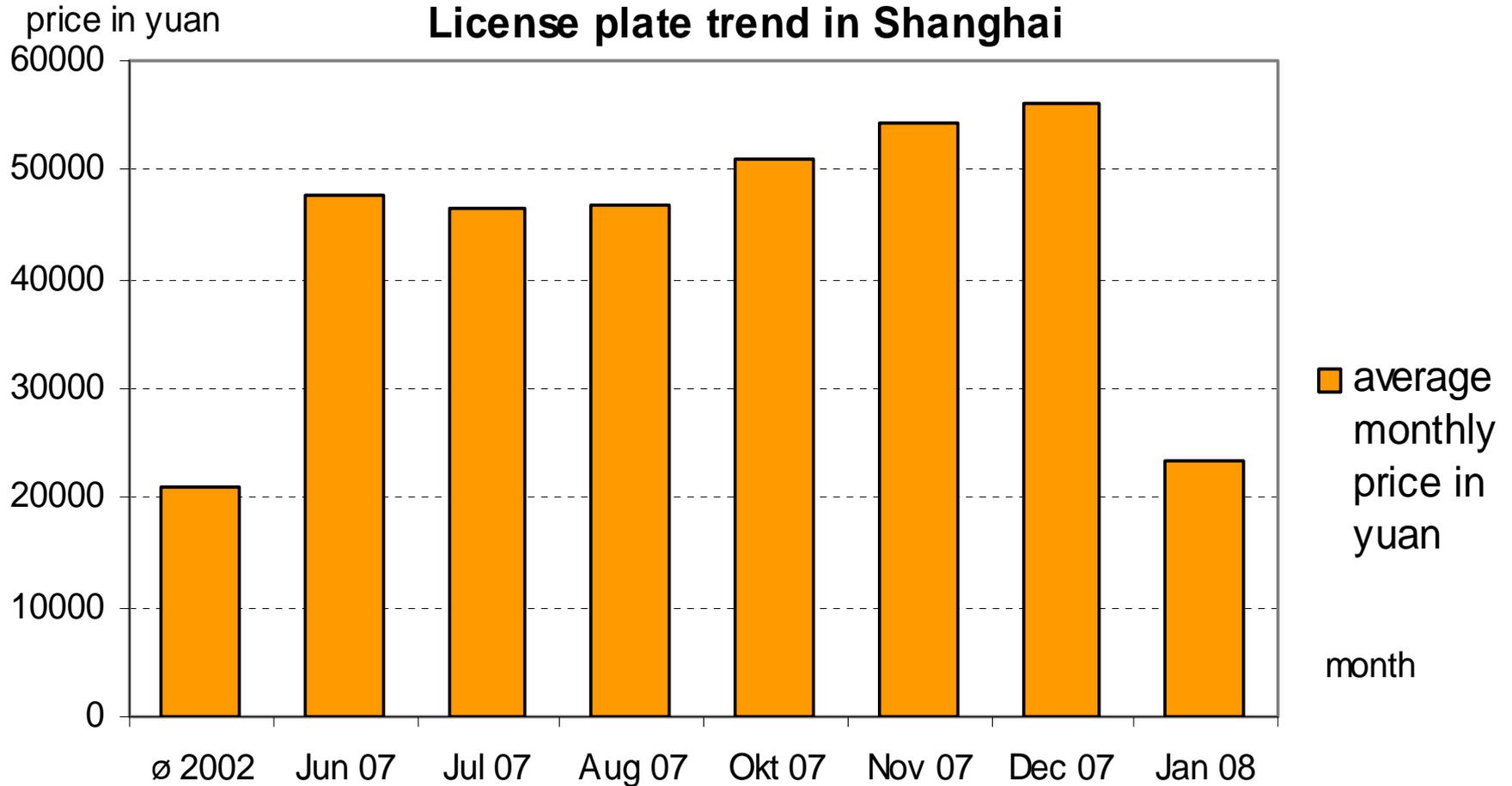
- Area Licensing Scheme (ALS)
- Electronic Road Pricing (ERP) commencing 1998
- Vehicle Quota System
- Annual Road Tax
- Park & Ride scheme
- bus improvement & priority
- mass rapid transit system
- traffic management measures

# Bidding System in Shanghai

Shanghai applies a bidding system regarding the registration for new cars

- A pre-given number of vehicles can be entitled for registration per month, there is no differentiation between the categories of vehicles

# Monthly average price



**In 11 auctions held 2007, the average bid was more than 40,000 yuan per plate.**

own compilation, Jan 2008

# Commentary on November 07 Bidding

- The average bid for private car license plates in Shanghai **hit a record high 54,000 yuan (7,267 U.S. dollars) in November**, the second consecutive month prices surpassed 50,000 yuan.
- At a monthly auction on Saturday, the average bid for the 7,500 license plates on offer was 54,317 yuan, a 6.5 percent increase from the 51,000 yuan average in October, according to an auction source.
- The lowest bid was 53,800 yuan at the auction that attracted nearly 10,600 buyers. The source declined to reveal the highest bid.
- Shanghai started imposing quotas on car ownership in 1986 in an effort to control the increasing number of private cars and traffic congestion.

# Conclusions-Fiscal Instruments (in the context of TDM) (1)

- TDM and EI are particularly appropriate in developing country cities, because of their low costs and multiple benefits.
- Simply increasing vehicle flows does not solve today's challenges in urban transport – it rather attracts more traffic. Only a combined strategy of improving public transport and restricting individual car use can lead to sustained improvements in urban transport.
- There is a wide range of specific instruments to be used both for improving public transport and for restricting individual car use.
- The institutional set-up for applying an integrated urban transport policy is of paramount importance. Major aspects include: integration of land-use planning, settlement planning and urban transport planning. A regional or urban transport authority shall be responsible for an integration of all public transport operators.

# Conclusions-Fiscal Instruments (in the context of TDM) (2)

- Mobility management measures should be developed, assessed and applied not individually, but as a package.
- The major stakeholders must be involved at all times to achieve a high level of acceptance (both at the level of planning and implementation).
- The “high-cost” and comprehensive TDM framework of Hong Kong and Singapore should be seen as “high-end” examples. Cities can use TDM and EI tailor-made and according to financial resources.

# gtz

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[sutp@sutp.org](mailto:sutp@sutp.org)

[transport@gtz.de](mailto:transport@gtz.de)