



### III. ENERGY SAVINGS IN TRANSPORT

#### A. Energy Use in Transport

The transport sector is the second largest area of energy use in society, accounting for more than 25% of total final energy use as shown in Figure 1.1.

In *Energy after Rio: Prospects and Challenges* (1997) it is stated that “Fossil fuel use for transport has increased dramatically over the past three decades. There has been a 3% annual growth rate in the world vehicle fleet leading in 1996 to some 800 million vehicles on the world’s roads. This growth rate is faster than that of either the world population or economy.”

Modes of transport in cities vary considerably between nations with a large proportion devoted to road transport in industrialised countries and a higher proportion devoted to rail and bus in developing countries.

The transport sector uses predominantly liquid fuels derived from petroleum. This is an imported item in many countries and a major drain on domestic capital. Hence there is a real incentive to replace imported liquid fuel with other options or to minimise the use of transport fuel. The use of liquid fuels for transport often causes serious air pollution in urban areas and this is another reason why efforts are being made to find alternative transport fuels. Some advances have been made in the use of Liquid Petroleum Gas (LPG) and Compressed Natural Gas (CNG) in road transport in recent years and research efforts are under way to use hydrogen as a transport fuel in the future.

While historically many cities of developing countries have been based on cycling and walking modes, in the last few decades car usage has started to grow as countries aspire to copy so-called ‘modern cities’ in the developed world. At the same time in recent years many modern cities are trying to reverse the stranglehold of the car. However, as A. Rahman Paul Barter and Tamim Raad in their publication *Taking Steps* (2000) point out “Many rich cities in Asia and elsewhere have successfully nurtured cycling and public transport. Some of the most modern and economically successful cities in Asia, such as Singapore, Tokyo, Hong Kong and Seoul, have placed public transport planning and development ahead of planning for cars.”

In cities where public transport is a major user of energy there may still be problems with reliance on fossil fuels. The use of electric powered transport in cities is one option for reducing the reliance of cities on imported oil and for saving energy through greater efficiency. However, electricity derived from coal can lead to serious air quality problems. Alternatively biofuels and solar-hydrogen systems may well be the favoured options in the future.

#### B. Strategies for Energy Savings in Transport

There are three major approaches to energy savings in transport:

- encouraging more people to use public transport
- purchasing more efficient vehicles
- educating people to use their vehicles more efficiently

Reducing automobile travel generates numerous benefits for local governments, and reduces air pollution, greenhouse gas emissions and traffic congestion, while improving economic development, public health and safety, and community livability (for further details see the ICLEI web site).

Local governments have significant powers to influence transportation sector energy use through land use, infrastructure, transit, parking, transportation demand management and other areas which essentially encourage people to use low-energy forms of transport such as walking, cycling and public transport

rather than the use a car. There are new cleaner transportation technologies such as fuel cells and electric vehicles. However, unless linked with solar technologies they do not reduce the overall consumption of fossil fuels.

Considerable savings can be made by using fuel efficient vehicles in cities and by fuel substitution to use cheaper, more efficient alternatives such as natural gas where possible. In all cases, further savings may be made by educating or requiring drivers to drive efficiently and to maintain their vehicles in good condition.

### 1. Technical Approaches

Technical approaches for saving energy in the transport sector range from fuel-efficient vehicles to the use of communications technologies to avoid the need for transportation altogether. Across the globe some innovative approaches have been developed.



#### Innovation in Non-Motorised Transportation

Many cities in developing nations have been embracing cars and other motorised forms of transport because they are seen as representing affluence and status. However, a key to sustainability is finding solutions that suit local conditions and sometimes appropriate technologies may not necessarily be the most high tech options.

Case Study 14 looks at the use of a range of different bicycle designs for the transport of freight and goods in Penang and illustrates the innovation that is possible in non-motorised transport technologies. The case study is taken from *Bicycle Reference Manual for Developing Countries* (1991). It explains the great diversity of intermediate freight and goods transport modes as partly a reflection of the lack of emphasis on status in freight transport with cost alone being the deciding factor.



**Figure 3.1:** Bicycles have long been used for the transportation of small items.

#### Telework or Telecommuting

Telework (also called telecommuting or teleaccess) is working at home, in a satellite office, or at a telework centre near home one or more days a week - rather than commuting to the main workplace. It involves use of a personal computer and possibly other telecommunication technologies and usually Internet access.

In a paper on *The Socio-Economic Impact of Telework on Developing Countries* (UNDP, 1998) the following examples are given of the types of telework:

- Home-based telework: an employee or contractor works at home instead of travelling to an employer's or a customer's premises
- Mobile telework: executives, professionals or service staff use ICTs (information and communications technologies) to continue their work while travelling
- Work in telecentres: employees work in local office facilities equipped with ICTs to avoid distant commuting to work
- Work in telecottages: provide local communities with access to skills development, high performance ICTs, and the networking and socialisation aspects of work that may be missed by a home-based worker

- Outsourcing: work in some sectors such as information-intensive services and software development can be done anywhere in the world and delivered across national borders, i.e. 'outsourced'

Businesses too can offer their customers services via the internet such as electronic banking and e-commerce, which reduces the need for customers to travel to an outlet of the business.

Teleworking raises many social and economic questions which need to be addressed to ensure that poor people are not further marginalised or labour standards further eroded.

The article also points out that "Teleworking may also help curb rural migration as the cities lose their exclusivity as centres of employment due to the growing opportunities for income-generation locally through remote channels. In addition to the retention of rural population there is a likelihood of migration of previously urban teleworkers to rural areas. This reverse migration is already occurring in Western countries triggering eventual growth of employment in the local services sector."

Additional references and case studies can be found in Section D.

#### Improving Facilities for Walkers and Cyclists

By adopting measures such as traffic calming, car-free zones, dedicated walking/cycling paths, facilities such as bike racks, showers and lockers, even undercover cycling and walking paths, the walking/cycling experience becomes much safer and more appealing.

Many cities have adopted or are preparing Bicycle Plans to promote cycling through improvements to facilities and also education initiatives. The City of Portland in Oregon, USA adopted a Bicycle Master Plan in 1996 and many of the goals have been realised.

Additional references and case studies can be found in Section D.

#### Purchase More Efficient Vehicles

Firms and agencies may make considerable savings in purchase costs and operational costs by buying fuel efficient vehicles. There are many modern vehicles that have high fuel efficiency and they often cost less to purchase than the larger less efficient vehicles.

#### Alternative Fuels

While petroleum is the main fuel used in vehicles, alternative fuels are gaining popularity. Alternative fuels include Liquefied Petroleum Gas (LPG) or Compressed Natural Gas (CNG), biofuels, methanol, ethanol, electric fuel, hydrogen and solar fuel which are cheaper and less polluting than gasoline or diesel fuel. Biofuels and hydrogen and solar fuels have the added benefit of being renewable. For more information on alternative fuels see the websites listed in Section D.

New vehicles may be purchased that are designed to run on alternative fuels or existing vehicles may be converted. The cost of conversion is often justified for taxis, delivery vehicles and buses. See Case Study 15 for An Electric Transit Vehicle programme in Chattanooga, USA.

It was reported in a Reuters article *Asia makes big push into clean, alternative fuels* (2001) that Asian countries are looking for fuel alternatives primarily because crude oil imports are very expensive but also because toxic emissions from vehicles were found to be the leading cause of air pollution in Asia. The article gives examples of the alternative fuels that are being taken up in various Asian countries.

Pakistan and Australia have turned to natural gas, in compressed or liquefied form, because of its relative abundance in those countries.

Resource-poor countries such as Singapore are pursuing fuel-cell technology. A fuel cell is an electrochemical device that combines hydrogen fuel and oxygen from the air to produce electricity, which can power a car.

Other countries such as China, India and Thailand are looking at biofuels. The two most common are ethanol and biodiesel, a diesel-engine fuel that can be made from vegetable oils, animal fat or algae.

In India, CNG is being used for original equipment and in converted buses, taxis, and three-wheelers. A biofuel LPG two-wheeler has been developed by an Indian company, TVS-Suzuki Ltd.

Estimates available in India and from experience worldwide show that an alternative fuels strategy is more cost effective in meeting tighter emission standards than improved conventional fuel technologies. New Delhi-based National Institute of Public Finance and Policy has confirmed in its study that the cost per weighted tonne of emission reduction with particulate trap on diesel vehicles is 60 times higher than the cost of a CNG retrofit.

A US General Accounting Office report on *Alternative Fuels Experiences of Brazil, Canada, and New Zealand in Using Alternative Motor Fuels* (1992) states that “Worldwide, ethanol, LPG (also known as propane), and CNG are the most commonly used alternative fuels. Ethanol and LPG are each currently used in about 4 million vehicles, and CNG in more than 400,000 vehicles.

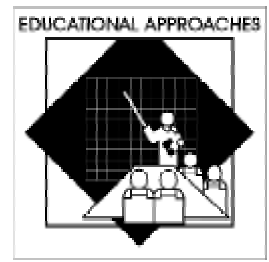
Our study focused on the alternative fuel programmes of Brazil, Canada, and New Zealand - countries that energy experts identified as leaders in encouraging the use of alternative fuels. In Brazil, ethanol is used in vehicles that are built to run only on that fuel. Brazil currently has about 4 million ethanol-powered vehicles, about 30 percent of its total number of vehicles. Also, almost all gasoline-powered vehicles in Brazil use a blend of gasoline and ethanol. In Canada and New Zealand, gasoline-powered vehicles are converted to run on CNG or on propane, and many of these vehicles can continue to use gasoline as well. Currently Canada has a total of 170,000 CNG and propane vehicles, or about 1 percent of its total number of vehicles, while New Zealand has a total of 105,000 CNG and propane vehicles, or about 6 percent of its total number of vehicles.”



**Figure 3.2:** Biofuels, including biodiesel, ethanol and methanol produced from agricultural sources are able to replace conventional fuel sources in many transport applications

## 1. Educational Approaches

Educational approaches involve informing people of the impact of using cars and encouraging people to use other modes of transport. Many different and creative approaches have been used to reduce people's dependence on the car and thus their travel costs, including:



### Car-Free Days

The first Car-Free Day was organised in Bogotá, Colombia and its success has spawned many similar events around the world. The day provides a focal point for highlighting the impact of car usage and the other options which are available. By making the event entertaining and appealing people are encouraged to become more imaginative about their transportation options. See Case Study 16 Car-Free Day.

### Information and Marketing Campaigns

Many cities have adopted campaigns to inform and motivate people to consider alternative transport modes to the private car. Western Australia has started the TravelSmart initiative which is featured in Case Study 17.



**Figure 3.3:** Car free days encourage the utilisation of non motorised transport, such as walking and cycling, but also public transport options including buses.

Boulder in the US has a GO Boulder campaign to encourage people to use alternative modes of transport using:

- Marketing brochures, pamphlets, posters, maps and lists
- A searchable database of businesses that home deliver
- Ads for events such as No Drive Days which are held monthly

### Driver Training

Where the use of cars cannot be avoided, energy and cost savings can be achieved by providing driver training and information like that provided in *Global Warming Cool It!: A home guide to reducing energy costs and greenhouse gases (2000)*, including:

- Information about the fuel efficiency of various motor vehicles to encourage people to purchase efficient vehicles
- Discouraging the use of four wheel drive vehicles in the city as they consume much more fuel than conventional vehicles
- The advantages of using LPG or CNG as a fuel
- Guidelines for sensible driving practices to reduce fuel use and pollution, such as smooth driving, driving at moderate speeds, avoiding short trips (walk or ride instead) and car pooling
- Discouraging the use of car air conditioning as much as possible as it can increase fuel bills by more than 10%

Encouraging car owners to keep their vehicles well-maintained, including keeping tyres at their optimal pressure to reduce rolling friction, in order to achieve much greater fuel efficiency and reduce pollution. Roof racks, sun visors and signs can increase air drag and waste fuel.

### 3. Planning and Regulatory Approaches

Innovative city planning can eliminate or greatly reduce the need for private car usage. This is obviously easier to do for new developments but retrofitting existing cities is also possible. Alongside planning initiatives some cities have adopted regulations to discourage private car usage. This approach is particularly crucial in large cities with serious air pollution problems. These methods are helpful especially in the short term but they need to work hand in hand with more positive long-term approaches which support transportation alternatives.



#### Integrated Planning

In many developed nations in the last 50 years, cities have grown based around the car. These sprawling cities are energy intensive and make the use of walking/cycling and public transport modes difficult or virtually impossible. By careful planning, walking/cycling and public transport modes can be made more convenient so that people can live easily without cars or use them much less frequently. This involves creating nodes of medium-high density mixed zoning developments. Curitiba in Brazil is an inspiring example of this and a great model for participatory, environmentally sensitive planning. See Case Study 18 The Planned City.

#### Integrated Public Transit Systems

Public transit options include light rail, trams, buses, mini-buses, and taxis. Public transit systems are more energy-efficient than private car usage when well-patronised which requires careful planning to ensure that public transport options are easy, safe and convenient to use. Singapore has developed an integrated transit network which provides a very fast and convenient public transport system. This has been achieved by integrating different parts of the system, making timetable information easily accessible and providing a simple ticketing system. See Case Study 19 Integrated Public Transport Systems.

#### Growing Food in the City

Cities are notorious for sucking in huge amounts of resources from beyond their boundaries. This involves lots of energy in transportation. By growing food in the city and even other materials such as timber, transportation needs are reduced and there are added benefits of cities being more self-sufficient and people maintaining contact with basic life-supporting systems. This approach requires planning and regulatory support.

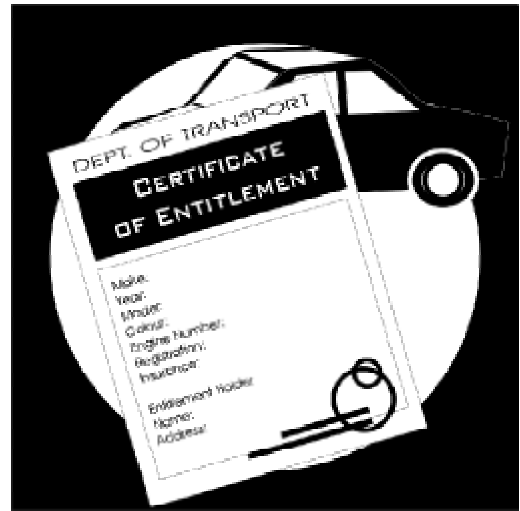
Some 800 million people are engaged in urban agriculture worldwide, with the majority in Asian cities, according to United Nations Development Programme (2000) estimates. In the International Food Policy Research Institute report *Achieving Urban Food and Nutrition Security in the Developing World* it is quoted that “Urban agriculture provides an estimated 15 percent of all food consumed in urban areas and is likely to double that share in the next couple of decades. Cities with more advanced urban agriculture sectors, particularly in Asia, have become largely self-sufficient in higher-valued, nutritious perishables”. See Case Study 20 Urban Agriculture.

## Quotas

Quotas can be used to limit the number of cars on the road and can be a fairer system than simply using pricing mechanisms. In Singapore a quota system has been introduced to control the growth of new cars on the road. See Case Study 21 Vehicle Quotas.

## Employer Trip Reduction Schemes

Portland, US has introduced an ECO Rule which requires employers to adopt measures to reduce their employees' car usage. This may involve shorter working weeks, encouraging car pooling, incentives for the use of public transport, work from home options, flexible working hours, provision of better facilities for cyclists and workplace competitions and fitness programmes. See Case Study 22 Employee Commute Options Rule.



**Figure 3.4:** Quota systems can be very effective in limiting car ownership and use.

## Parking

By regulating the number of parking spaces available and their usage, car usage can be discouraged especially for trips that could be serviced adequately by public transport.

## Speed Limits

Speed limits should be enforced on urban streets for reasons of road safety and fuel efficiency. Fines can help to enforce this measure and they also generate funding for other road safety measures.

## Vehicle Inspections

Compulsory annual vehicle inspections are used in many countries as road safety and efficiency measures. Well maintained vehicles use less fuel and are safer to drive. These programmes are self funding through inspection fees.

## Alternative Fuel Regulations

Some State or local governments have introduced regulations to support the use of alternative fuels such as requiring their vehicle fleets to use alternative fuels.

## 4. Economic Approaches

Economic approaches encourage people to use alternative modes of transport by providing monetary incentives and disincentives for the use of the private car.



## Car-Sharing

In many European cities car-sharing businesses have been established to enable residents in car-free communities to use neighbourhood car hire schemes instead of owning their own car. This initiative is gaining popularity in other countries around the world. See Case Study 23 Car Sharing.

## Transportation Fee

Cars require significant amounts of infrastructure in the form of roads and parking. Often these costs are subsidised by the government. One way to encourage people to use their cars less or not at all is to adopt a user pays system where people who use this infrastructure more are charged more and so are aware of the true cost of car usage. See Case Study 24 Transportation User Fee.



### Shop and Ride

A good example of corporate involvement is a novel scheme in the US which has been adopted by supermarkets whereby they offer their customers free public transport passes. See Case Study 25.

### Parking Fees

Fee structures that encourage car pooling and use of parking only for short trips which may be hard to do by public transport, can act as powerful disincentives for single occupancy car use. See Case Study 26 on the Los Angeles Rideshare Trust Fund.

### Fuel Levies

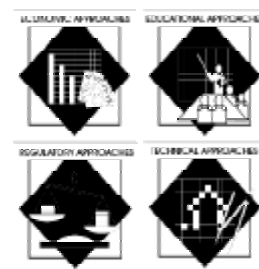
Many countries impose levies or taxes on fuel sales to finance road construction or road safety programmes. Such levies can also be applied selectively to influence consumer choice against leaded fuel or fuels that cause excessive pollution.



Figure 3.5: Case Study 12 details a successful Shop and Ride Scheme operating in the USA.

## 5. Integrated Strategies

Many developing cities are already experiencing serious air pollution problems from increased motorised transport use and this has prompted cities like Surabaya in Indonesia to embark on innovative integrated transportation programs to address these issues.

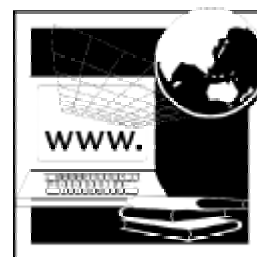


The Surabaya City Planning Board presented a paper titled *Efforts Toward Sustainable Urban Transport and Clean Air in Surabaya: An Integrated Approach*. The strategies that have been proposed or already undertaken cover improvements to public transport, measures to support non-motorised transport, technical measures, economic measures and reforms and education and public participation initiatives. This integrated approach is outlined in Surabaya's Strategic Plan which was developed through a long series of participatory meetings and incorporated input from a wide range of interested parties.

## D. References and Resources

A. Rahman Paul Barter and Tamim Raad (2000). *Taking Steps: A Community Action Guide to People-Centred, Equitable and Sustainable Urban Transport* <http://www.geocities.com/sustranet/actionguide/Outline.htm>

Barbara Gruehl Kipke (1991). *Bicycle Reference Manual for Developing Countries*. [http://www.mobility-consultant.com/brm/toc/brm\\_shut.htm](http://www.mobility-consultant.com/brm/toc/brm_shut.htm)



Jaime Lerner (1999) *Change Comes from the Cities*. <http://www.ourplanet.com/imgversn/81/lerner.html>

Rueters (20 June 2001) *Asia makes big push into clean, alternative fuels*. [http://www.enn.com/news/wire-stories/2001/06/06202001/reu\\_asia\\_44048.asp](http://www.enn.com/news/wire-stories/2001/06/06202001/reu_asia_44048.asp)

Surabaya City Planning Board *Efforts Toward Sustainable Urban Transport and Clean Air in Surabaya: An Integrated Approach*.

<http://www.worldbank.org/cleanair/Asia/bngkwshp/presentations/pdf/number15.pdf>

UNDP (1997). *Energy After Rio: Prospects and Challenges*.

<http://www.undp.org/seed/energy/contents.html#A>

UNDP (1998) *The Socio-Economic Impact of Telework on Developing Countries*.

<http://www.undp.org/info21/bg/b-dary.html>

UNDP (2000) *Achieving Urban Food and Nutrition Security in the Developing World*.

<http://www.ifpri.cgiar.org/2020/focus/focus03.htm>

US General Accounting Office (1992) *Alternative Fuels Experiences of Brazil, Canada, and New Zealand in Using Alternative Motor Fuels*. Abstract available through <http://catf.bcresearch.com/CATF/CATF.nsf/CatalogByTitle/F63918A3F0AF585C88256976006BEDB2!OpenDocument>

### **Telework**

Oregon Office of Energy. <http://www.energy.state.or.us/telework/telegas.htm>

You Can Work Anywhere <http://www.youcanworkfromanywhere.com/infocenter/casestudy.htm>

Washington State University Energy Programme Transportation and Telework Services

<http://www.energy.wsu.edu/index/telework.cfm>.

### **Facilities for Non Motorised Transport**

Institute for Transportation and Development Policy. [http://www.itdp.org/programs/programs\\_3.html](http://www.itdp.org/programs/programs_3.html).

### **Alternative Fuels**

US Alternative Fuels Data Center <http://www.afdc.nrel.gov/>

Alternative-fuel Vehicle Directory <http://www.vwc.edu/~gnoe/avd.htm>

Clean Vehicles <http://www.clean-vehicles.com/>

*Alternative Fuels for Fleet Vehicles*, May 1999 US Report with numerous links

<http://www.pprc.org/pprc/pubs/topics/altfuels.html/#general>

### **Urban Agriculture**

*Feeding the City from the Back Forty: Case Studies in Regional and Urban Food Production*.

<http://www.greenestcity.org/rap/>

James L. Garrett and Marie T. Ruel (eds) *Achieving Urban Food and Nutrition Security in the Developing World*. <http://www.ifpri.org/2020/focus/focus03.htm>

*Final Report: Urban and Peri-urban Agriculture on the Policy Agenda from the FAO/ETC joint Electronic Conference August 21 - September 30, 2000*.

<http://www.fao.org/DOCREP/MEETING/003/X6091E.HTM>

## **Sustainable Transportation**

The City of Toronto

[http://stratus.city.toronto.on.ca/inter/mte/mte.nsf/\\$defaultview?OpenView &Count=5](http://stratus.city.toronto.on.ca/inter/mte/mte.nsf/$defaultview?OpenView&Count=5)

Dr Paul Barter (1999). *An International Comparative Perspective on Urban Transport and Urban Form in Pacific Asia: The Challenge of Rapid Motorisation in Dense Cities*. PhD thesis.

<http://www.wistp.murdoch.edu.au/publications/projects/pbarter/pbarter.html>

Jeff Kenworthy, Felix Laube and others (1999). *An International Sourcebook of Automobile Dependence in Cities, 1960 - 1990*. University Press of Colorado

Peter Newman & Jeff Kenworthy (1999). *Sustainability and Cities: Overcoming Automobile Dependence*. Island Press, Washington.