Box 6.3

Sustainable Transport Fuels for Urban Transport

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Fuel demand for sustaining urban transport has grown several folds in last decade and this rate is escalating further and putting additional pressure on the foreign exchequer. By 2050, world population will be approximately 8–10 billion with 80 per cent people living in urban areas. Their average income will be in the range of US$15–US$25,000 per annum. The per capita energy demand in 2050 will be 2–3 times that of the present level. The relationship between per capita income and energy requirement is shown in the figure given below.

The challenge for us in India is to follow a flat trajectory of growth in fuel demand. Alternatives have to be considered in order to undertake import substitution for diesel and petrol fuels. No single fuel can sustain urban transport in foreseeable future.

CNG (compressed natural gas)

City of Delhi has successfully converted its mass transport from diesel driven vehicles to this clean fuel, CNG. CNG is an underutilized resource available in abundance in India. It can be tapped for sustaining urban transport in several mega-cities of the country. CNG needs a separate distribution network involving pipelines and filling stations, which is a capital-intensive proposition. The fuel becomes economically viable only when a large number of vehicles use it for a given transport system. If this distribution network also takes CNG to domestic kitchens, it starts to make even greater economic sense.

However concerns related to emission of fine-particulates with the burning of CNG have been raised. Their adverse health effects need to be investigated thoroughly owing to the large number of vehicles and their density in a given transport system.

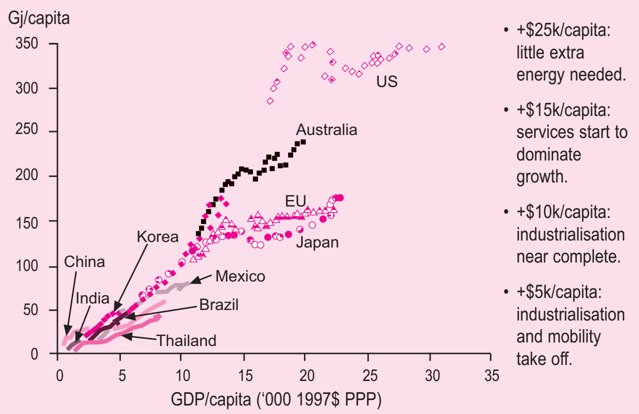

Fig. B6.3.1 Climbing The Energy Ladder: A Continuously Changing Relationship

Source: IMF, BP

LPG

LPG is a very successful transport fuel in several countries in the world. In India, the use of LPG in the transport sector has been legalized now. This fuel is quite popular and is widely used as a transport fuel especially in small urban centres and semi-urban areas. The distribution network for kitchen fuel is being used for the purpose but there is a need for spreading awareness about safety norms related to its usage. Apart from this, the subsidy targeted for domestic users finally ends up in transport sector defeating the very purpose of subsidizing a cleaner kitchen fuel.

Biodiesel

This is a green, carbon neutral fuel produced in farms and has the potential of partially substituting mineral diesel if the biodiesel programme is implemented wisely in India. India is a country blessed with agro-climatic diversity. There are a host of vegetable oils (edible and non-edible) such as Linseed, Castor, Jatropha, Karanja, Neem, Kusum, Mahua, Honge etc., which may be used for localized production of biodiesel. The biodiesel programme in India should be based on the vegetable oils available in excess in particular agro-climatic regions rather than importing a foreign plant species, like Jatropha, which may potentially disturb the flora and fauna.

The existing distribution network of diesel can be used for this fuel and in fact biodiesel can be blended at the fuel storage depot. Localized production of biodiesel will also eliminate the fuel transportation costs and strengthen the agriculture-based economy. The technology for converting vegetable oils to biodiesel is available in the country and numerous studies on engine performance and emissions have been carried out by several institutions and the results are favourable. Biodiesel usage leads to reduction in CO_2 and other emissions.

GTL

Gas to Liquid (GTL) technology can be used for production of liquid fuels (such as gasoline and diesel) from stranded natural gas. Use of this technology makes sense in the current environment if there is 'stranded' gas. This technology can also be used for production of liquid fuels from biogas but there are significant challenges. Extremely high quality diesel with 75–80 cetane number, zero sulphur and aromatics, odourless, colourless, non-toxic, biodegradable can be produced using this technology. There are emission benefits, from pure and blended products, and its performance is well established for existing engine technology. GTL fuel has clear benefits over conventional diesel in NO_x and SO_2, and is neutral on CO_2.

Note: Views expressed here are of the author of the box.

Box 6.4
Vehicular Pollution Issues in India

Avinash Kumar Agarwal

The dominant reasons for higher air pollution in Indian cities are high vehicular density in urban areas, poor and unregulated fuel quality, predominance of two-stroke vehicles, lack of efficient mass rapid transportation systems, uncontrolled growth of vehicular population, improper traffic planning, inadequate maintenance of vehicles, inadequate pollution prevention and control systems and lack of enforcement of pollution standards. A large number of two-stroke vehicles (up to 70 per cent of total vehicle population) run on the roads of NCR Delhi. Rampant adulteration of petrol/diesel makes the situation worse. Numerous small diesel run generator sets (in excess of 150 thousand in Delhi alone) spoil the urban air quality because of frequent power failures. Further, many small-scale industries use furnace oil with more than 3.5 per cent sulphur content.

A number of measures have been adopted by the government to control the vehicular pollution, which include introduction of stricter emission norms (Euro/Bharat norms). Fuels quality has been improved significantly and since 2000 metro cities are supplied with unleaded petrol instead of leaded petrol and 0.05 per cent sulphur content diesel (since 2003) in place of 0.5 per cent sulphur content diesel. All diesel-operated buses have been converted to operate on CNG in Delhi.

These two changes, namely: low sulphur diesel and introduction of CNG in Delhi have improved the urban air quality in the capital significantly. While the introduction of CNG has led to a significant reduction in particulate emission (on mass basis), the size of the particulates has also reduced. Smaller particles emitted by CNG vehicles are invisible and they absorb more poly-aromatic hydrocarbons (PAHs) on their surfaces, since smaller particles have larger surface to volume ratio. PAHs have been recognized as 'probable carcinogens' worldwide. Hence it is not yet clear whether the introduction of CNG on a large scale has reduced the health hazards associated with the vehicular pollution or not. A detailed epidemiological study should be undertaken.

Note: Views expressed here are of the author of the box.

requires commercial vehicles to undergo stringent testing at specified periodicity. There is no requirement for any similar stringent testing of personal vehicles, except for a periodic requirement of undergoing an exhaust emissions test, and this appears to be necessary.

Improve Urban Public Transport

Several measures are necessary to bring about the required improvements in public transport. To begin with a public transport system design, which can be developed within city constraints given the city's topography, time taken to develop the systems and improve accessibility to people would be an ideal system.

System design

The design of an efficient and cost-effective public transport system is a complex task and several system design parameters need to be kept in mind. A well-designed system is one that meets the demand in a cost effective manner, without too much spare capacity or without too much crowding. The following indicators can summarize optimality of a system:

- Least space consumption per passenger-km
- Least energy consumption per passenger-km
- Least emission per passenger-km
- Least accidents per passenger-km

The critical design parameters that need to be taken into account are:

- Line capacity, which is the number of people who can be transported per hour
- Speed, that is, the average speed of the system
- Cost, both capital and annual
- Construction time
- Ease of access
- Load factor, which is defined as the ratio of the number of actual users to available capacity. For achieving low cost per passenger, the load factor should be close to one. Similarly for lower fuel consumption and emissions per passenger, the actual number of users should be close to capacity.

There is also a range of public transport technologies with different cost–capacity–route flexibility characteristics. While bus systems on a shared right of way are the least expensive and the most flexible, they offer the lowest carrying capacity. Dedicating lanes for such buses and using longer, articulated buses can increase the capacity of the system. However, this increases costs and limits route flexibility. At the other end are underground rail-based systems that offer very high capacity but are very expensive and offer virtually no route flexibility. Thus, the choice of technology involves trade-offs in terms of cost and capacity that should be carefully taken into account in designing the public transport system. Any laxity in this can easily lead to a system that is either inadequate or has used up resources in providing capacity that is not required.