Making the transport sector more energy efficient

Expected increase in vehicle ownership due to economic growth and continued shift from rail to road has been found responsible for the rapid increase of energy consumption in the transport sector. How can matters be changed around?

Transport consumes nearly half of the country's oil, a substantial portion of which is diesel. This consumption increased by more than two-and-a-half times between 1980 and 2000 – from roughly 17 to 45 million tones of oil equivalent (Mtoe).[1] Energy consumption in the transport sector increased at the rate of 3.1 per cent a year in the 1970s, 4.9 per cent in the 1980s, and 5.4 per cent in the 1990s.

Higher incomes drive the growth of motor vehicle sales. By 1998, India had 40 million motor vehicles in use – 40 per 1,000 people. The majority (about 70%) is two-wheelers such as scooters, motorcycles and mopeds. There are approximately 5 million cars, 4.5 million three-wheelers such as auto rickshaws, 2 million goods vehicles and 0.5 million buses. Incidentally, the absence of a good mass public transport system has caused an explosion in the number of these smaller private vehicles. Rising passenger-vehicle ownership will contribute significantly to energy consumption projections.

Table 1: Energy Intensity by Mode of Transport.

Mode of Transport	Occupancy (persons/vehicle)	Fuel Type			
		Petrol	Diesel	CNG	Electricity
Passenger modes: BTU/passenger-km					
Scooter/ motorcycle: 2 - stroke	1.5	527	-	-	-
Scooter/motorcycle: 4-stroke	1.5	426	-	-	-
Auto rickshaw: 2-stroke	1.75	938	-	-	-
Auto rickshaw: 4-stroke	1.75	738	-	666	-
Car	2.5	1,206	1,302	971	-
Urban bus	50	-	197	311	-
Suburban electric rail	800	-	-	-	27
Main line rail	900	-	135	-	46
Freight modes: BTU/ tonne-km					
Truck	-	-	1,587	-	-
Main line rail	-		256	-	85

Source: TERI study, May 2002 and Planning Commission, May 1980.

The Railways' share of transport energy consumption fell to only 6 per cent in the 1997 from almost 60 per cent in 1971.[2] Road vehicles now account for 80 per cent of all passenger kilometers and 60 per cent of freight transport.

Energy has a special significance in transportation not only because it is one of the major users of energy but also because different modes of transport use different forms of energy with varying intensities. In other words, some modes move people and goods far more efficiently than others. For instance, a petrol-powered car consumes 1,206 BTUs to move one person over one kilometer whereas a CNG-powered bus does the same for only 311 BTUs and main-line railway under electric traction does it for only 46 BTUs (table 1).

Impact of Mode of Transport on Energy Consumption

Owing to increase in travel demand (both passengers and freight traffic) and inefficient means of travel, fuel consumption in the road transport sector has grown over the years. Passenger kilometers tripled from 118 billion in 1970 to 380 billion in 1997 and freight tonne kilometers increased from 127 billion to 287

billion.[3] Nevertheless, railway energy consumption plunged dramatically to 2.5 Mtoe in 1997 from 8.7 Mote in 1971. This was due to a major reduction in energy intensity, mostly resulting from a shift from coal to diesel and electricity. Road transport being considerably more energy intensive than rail – the continued shift will add significantly to the increase in energy consumption. It is therefore suggested that the use of personal vehicles and trucks should be discouraged and railways encouraged for energy conservation.

The growth of the transport sector in urban areas spawns other problems too. In the absence of an integrated urban transport policy and the inability of the public transport system to keep pace with the growing travel demand, use of personal modes of transport would continue to rise leading to energy-inefficient means of travel. The share of private vehicles (two-wheelers and cars) in the total number of registered vehicles increased from 65 per cent in 1971 to 82 per cent in 1997. The occupancy rate of personalised vehicles further increases energy intensity in terms of fuel consumption per passenger-kilometre. For instance, energy consumed per passenger-kilometre by a car can be as high as six times that of a bus (Table 1). Poor road quality and poor maintenance of roads in urban areas hinder the smooth movement of traffic, leading to congestion, which also increases energy consumption.

Technology Alone is Not Enough

The task of the government is to help and encourage innovation and market deployment of new transportation technologies including those based on alternative forms of energy such as CNG, LPG, ethanol, bio-fuels, and, in the longer term, hydrogen.

Technology offers enormous potential for improving fuel efficiency and reducing environmental problems associated with transport. But pricing is also central to both developing and deploying technology. Reforming existing taxation may improve the effectiveness of any new subsidies for introducing improved vehicle and fuel technologies. More importantly, air quality strategies, which count on advancements in automotive technology alone, such as in vehicle emission control devices or fuel efficient engines, are bound to be limited in their impact on motor vehicle air pollution. This is because they neither address the rise in vehicle ownership caused by economic growth nor do they consider the increased vehicle use that is induced by improved automotive technology itself, such as the reduced cost of traveling associated with more fuel-efficient vehicles.

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Thus technology alone is not enough. Demand management measures are required to restrain road traffic growth by better directed land use planning, stricter demand management, and greater use of public transport. These objectives can be achieved by regulatory or market instruments; both of which require improved administrative capabilities. Such a focus for effective government action needs to recognise the different potentials for influencing mobility demand, energy intensity and fuel mix.

For more information, see:
Urban transport and the environment <www.teriin.org/urban/urban.htm> Clearing the air: better vehicles, better fuels. Pp 345
<www.teriin.org/pub/books/clearing.htm>
Cleaner air and better transport: making informed choices. Pp 40
<www.teriin.org/pub/books/cleanair.htm>

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Route electrification under the Indian Railways

Electric traction, owing to its capability of using indigenously available alternative sources of energy such as coal, hydel power, LPG and nuclear power, reduces the nation's dependence on largely imported diesel oil. This makes transportation pollution-free and energy efficient.

Electrification was first introduced in the Indian Railways (IR) in 1925 with 1,500 V DC and subsequently enhanced to 3,000 V DC. By 1936, 388 route kilometers was electrified. At present, five out of the seven major trunk routes connection to Mumbai, Kolkata, New Delhi and Chennai, are fully electrified. On the other two routes, Kolkata-Chennai and Mumbai-Chennai, works is in progress. In 1995, a 2x25 kV auto transformer system of traction was introduced on the Bina-Katni-Anuppur-Bishrampur/Chirimiri sections of Central and South Eastern Railways as an advanced technological innovation.

About 25 per cent of the total route kilometers under IR is electrified (see table). Out of 15,398 electrified route kilometers, 1,379 route kilometers are on the suburban sections. The remaining 14,019 route kilometers is on heavy density freight routes. During 2000 – 01, 44 per cent of passenger train kilometers and 60.4 kilometres of the BG freight gross tonne kilometers were operated on electric traction.

Route electrification under IR

Period	Route km Electrified
Up to 7th Five-year Plan	9,252
Annual Plans (1990-92)	1,557
8th Five-year plan (1992-97)	2,708
9th Five-year Plan (up to 2000-01)	1,881
Total (as on March 31, 2001)	**15,398**

Reference book:
The Bulletin on Energy Efficiency
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