

Energy Consumption in Transport Sector and its Impact on Nepalese Economy

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INTRODUCTION

Nepal's first few development plans absorbed a major share of the development budget and gave high priority to the construction of a basic transport network that would integrate the various regions. Such an endeavour made it possible for a country whose topography is complex to increase the transport network fifteen folds within a period of thirty years. Similarly, effected population and area per km. of road length have decreased by 8 and 14 times during the same period, respectively. At present, the country has about 5700 kms. road length, of which 46 percent is black-topped, 14 percent is gravelled, and 40 percent is fair weather road. Effected population and area per km. of road length is about 1900 persons and 26 sq.kms., respectively.

Nepal's average annual per capita consumption of energy is about 249 kg. of oil equivalent (KgOE) excluding the human and animal sources of energy, of which 14 KgOE is in the form of commercial energy. 37 percent of commercial energy is being consumed in the transport sector.

Further, in the development of the modern sector of the economy the consumption of commercial energy will increase day by day, resulting in a negative impact on the balance of payment.

MODES OF TRANSPORTATION

In general, there are two main modes of transportation in Nepal; traditional and mechanized. Traditional modes of transportation basically means the use of animal and manpower without the use of sophisticated mechanism which consumes commercial energy. In Nepal, it is believed that 90 percent of goods overhauled is by traditional modes. The mechanized modes of transportation include motor vehicles, aeroplanes, railways, trolley buses and ropeways. This paper focuses on the utilization of mechanized modes of transportation.

Motor Vehicles

The completion of several highways linking east with west and north with south has provided momentum for the growth of motor vehicles during the past few years. The overall annual growth rate of registered motor vehicles during the last fifteen years was 11 percent, with the truck fleet growing at a much higher rate than the passenger car fleet (12.5

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vs 9.5 percent). The total number of registered motor vehicles are about 38,000 of which light vehicles accounted for 55 percent and heavy vehicles accounted for 45 percent. The highest traffic flow recorded was about 450 ADT (Average Daily Traffic) in the Birgunj-Kathmandu corridor (186 km.). This is mainly due to the fact that 80 percent of the import of goods passes through this corridor. Further, the import-export volume transferred through Birgunj custom point is the highest as compared to the other custom points. The passenger traffic growth in motor vehicles in different corridors of Nepal has increased at an annual average growth rate of 9 percent, while the volume of goods traffic has increased by about 2.8 percent. The low level of the economy is reflected in the ownership of one motor vehicle per 420 persons.

Aeroplanes

Presently, there is only one Nepalese airlines called Royal Nepalese Airlines Corporation (RNAC), whose passenger fleet strength includes 2 Boeing 727, 3 Avro HS-748, 8 Twin-otter DHC-6, and 2 Pilatus Porter PC-6 with carrying capacity of 125, 44, 18, and 5 persons per carrier, respectively. The Avros, Twin-otters and Pilatus Porters are operating in the domestic sector. The number of passenger-km. flown in the domestic sector has doubled in the last decade, equivalent to an average annual growth rate of 7 percent. The RNAC has expanded its services to 38 points within the country and 10 major cities in 9 countries of Asia. Sometimes, due to lack of carriers, RNAC has to hire planes from other airlines to operate in international routes. The number of passenger-km. flown in the international market has increased four-folds during the last decade, equivalent to an average annual growth rate of 15 percent. The cargo traffic in the domestic market has been decreasing for a decade. This is due to the increase in roadways which is a cheaper mode of transportation compared to the airways. The cargo traffic in the international sector, on the other hand, has been steadily increasing with an average growth rate of 14 percent per annum. At present, the total tonnage hauled by RNAC is about 2,500.

Railway System

There are two railway systems of narrow gauge under Nepal Transport Company (NTC). The Raxaul-Amlekhgunj System (47 kms.) originally constructed in 1932, which was in operation from 1934 to 1968, is now operating between Raxaul and Birgunj (8 kms.) for cargo only. This is mainly due to the following facts: development of new roadways linking Birgunj and Kathmandu, difficulty in haulage, mismanagement, repair and maintenance problems. The Jayanagar-Janakpur-Bijalpura railway line is passenger cum cargo and 53 kms. long. The line originally constructed in 1935 to run the distance between Jayanagar and Janakpur was later extended to Bijalpura. Although very old and nearing the end of its useful life, it still carried over 1 million passengers and 25,000 tons of goods per year.

Ropeway System

In 1927 a mono cable ropeway system with a capacity of 8 tons per hour started service between Dhorsing and Matatirtha (22.5 kms.). It was abandoned in 1964 when a bi-cable ropeway with a capacity of 25 tons per hour was introduced from Kathmandu to Hetauda (42 kms.). The present bi-cable ropeway system is being operated by NTC. The total transit time is about 4 hrs. It consists of 360 carriers with an average speed of 9 km/hr. Earlier, the system was not running on a regular basis due to frequent power failure, inadequate repair and maintenance programme, lack of trained and experienced operators and mismanagement. However, after the maintenance and repair of carriers, rollers, track ropes, etc. and the commissioning of Kulekhani hydro-electric project, the system has been running satisfactorily for the last three years. The major advantage of the system lies in its cheapness. The freight rate for ropeway transport of bulk goods from Hetauda to Kathmandu is almost half that of truck transport. Although the ropeway is the cheapest mode of transport along this corridor, its use is less popular than the truck transport. This is mainly due to the absence of a ropeway system between Raxaul (custom point) and Hetauda, which results in additional transshipment cost. Furthermore, unsatisfactory operating conditions of the ropeway are liable to cause delivery delays, damages, pilferages and other direct and indirect costs to the customers. At present, the ropeway system carries about 10,000 tons of goods (3 percent of the total goods along this corridor), while during 1960s and 70s it carried about 35,000 tons.

Trolley Bus System

The present trolley bus system is 13 kms. long, running from Tripureswor to Bhaktapur and being operated by NTC since 1975. The system is powered from two AC/DC substations at 600 volts. At present, 14 trolley buses are in operation. Each bus makes about ten trips per day. The trolley bus passengers range from 2 to 3 million per year. It has been operating quite satisfactorily. Various studies reveal that the trolley bus system will be a more economically feasible proposition compared to motor vehicle transport.

TRENDS IN ENERGY CONSUMPTION

There are mainly three types of commercial energy being used by the mechanized modes of transportation: Petroleum fuels, coal, and electricity. Petroleum fuels are being consumed mainly by the motor vehicles and aeroplanes. Coal is being consumed by one of the railway systems, while electricity is being consumed by a ropeway and trolley bus system. In 1983/84, over 98 percent of the energy consumed in the transport sector was met by the petroleum fuels, out of which High Speed Diesel Oil (HSDO) amounted to 45 percent, Aviation Turbine Fuel (ATF) to 37 percent, and Motor Spirit to (MS) 16 percent; while in 1970-71 petroleum fuels amounted to about 95 percent of the total energy consumed in this sector, out of which HSDO amounted to 43 percent, ATF to 13 percent, and MS to 39 percent. A comparatively negligible amount of electricity is

used by a trolley bus and a ropeway system, while coal is used by the Nepalese Railway system (Fig. 1). Petroleum fuels and coal have to be imported, while electricity can be thought of as an indigenous source of energy even though it is being imported from India because of Nepal's inability to exploit its tremendous technically feasible hydro-power potential (27 GW). The total energy consumption in the transport sector grew at an average annual growth rate of 8.6 percent during the period 1970-71 to 1983-84. It is forecasted that energy consumption in this sector will increase at an average annual growth rate of 5.5 percent till 1995-96 (Fig. 2). It is envisaged that dependency on petroleum fuels will further increase if the present pattern of supply and demand continues.

Petroleum Fuels

The petroleum fuels used in the transport sector are high speed diesel oil (HSDO), motor spirit (MS), and aviation turbine fuel (ATF). Almost 49 percent of the total import of petroleum fuels was consumed in the transport sector in 1983/84, while about 46 percent was consumed in 1970/71 (Fig. 3). Nepal Oil Corporation (NOC) is responsible for the supply of this fuel within the country. It imported 57,766 TOE of HSDO, 13,466 TOE of MS, and 19,478 TOE of ATF in 1983/84 (Fig. 2). At present, NOC has the storage capacity of 24,600 Klt. of petroleum fuels at 6 different places of Nepal. It is estimated that 65 percent of HSDO import and 100 percent each of MS and ATF is consumed by the transport sector, at present. If the present situation is not checked or improved the percentage share of petroleum fuels consumed in this sector will further increase to 99 percent by 1995/96. The overall growth rate of the consumption of petroleum fuels in this sector was 9 percent during period 1970/71 to 1983/84. It is estimated that it will increase with an average annual growth rate of 5.5 percent for the period 1984/85 - 1995/96 (Fig. 2).

High Speed Diesel Oil

This middle distillate is used in road transport mainly by trucks and buses for carrying goods and passengers. The consumption of HSDO varies with the type, alignment, and condition of the road as well as the type and condition of vehicles. The hill road consumes about 10 percent more fuel compared to the terai road, even though the condition of the roads may be similar. The condition of the road in Butwal-Bhairahawa corridor is worse than that of Biratnagar-Dharan corridor: hence its fuel consumption is 10 percent higher even though the alignment of the roads are similar. Another important factor which predominates fuel consumption is the number of stops along the corridor, though this fact is not considered in the study. The percentage of maintenance cost (including the removal of tires) to that of fuel and lubricant cost in these corridors lie in the range of 0.5-0.7, but the lowest is observed in the longer routes.

The consumption of HSDO in the transport sector was about 37,550 TOE in 1983/84. It increased more than 3 times during the period 1970/71 - 1983/84 (Fig. 2), which is equivalent to an average growth rate of about 9 percent. The storage capacity of HSDO within the country was about 18 percent of its total import. The percentage of its import to that of total import of petroleum fuels had been steadily rising from 22 percent in 1970/71 to 38 percent in 1983/84 (Fig. 3), in spite of the price being raised three fold. The percentage share of HSDO in the transport sector was about 40 percent in 1970/71 and 45 percent in 1983/84 (Fig. 1).

It is estimated that the HSDO demand will increase at an average annual growth rate of 5.3 percent till 1995/96 (Fig. 2). The forecast is based on the regression analysis performed between HSDO consumption in the past, index of GDP, and population, assuming that there will be no major change in energy supply policies for a decade. The percentage share of HSDO will decrease to 44 percent by 1995/96, due to the relative percentage share increase in ATF (Fig. 1).

Motor Spirit

At present, this light distillate is exclusively used to propel the light motor vehicles. The percentage share of motor spirit consumption in the transport sector was about 39 percent in 1970/71 and 16 percent in 1983/84, with an average growth rate of about 1.6 percent per annum (Fig. 1 and 2). The percentage of its import to that of the total import of petroleum fuels has been decreasing from about 18 percent to 7 percent for the last thirteen years (Fig. 3). This was mainly due to the fact that diesel vehicles entail better fuel economy compared to the gasoline vehicles, e.g., price of MS per litre is almost double to that of HSDO, even though its initial cost is high and it causes more damage to the environment. This can also be highlighted by the fact that it took almost a decade to reach the consumption level of 1972/73, even though this was also due to the restriction of supply followed by the oil embargo of 1973 (Fig. 2). The storage capacity of this fuel was about 13 percent of its total import in 1983/84.

It is estimated that the MS demand will increase at an average annual growth rate of 4.3 percent till 1995/96 (Fig. 2). The demand forecast is based on the trend of consumption in the past eight years. Earlier fuel consumption behaviour had an erratic trend due to the 1973 oil embargo. It is also estimated that the percentage share of this fuel in the transport sector will decrease to 13 percent by 1995/96 (Fig. 1).

Aviation Turbine Fuel

The major consumer of ATF is Royal Nepal Airlines Corporation (RNAC). It consumes about 80 percent of the ATF imported by Nepal Oil Corporation (NOC), while the rest is consumed by other international airlines operating in Nepal. NOC imported about 19,500 TOE in 1983/84, while the ATF consumption of RNAC was about 30,500 TOE. The storage

capacity of ATF within the country is about 13 percent of the total import of NOC. RNAC had to purchase about 40 percent and 50 percent of its consumption of ATF from foreign countries at airports in 1970/71 and 1983/84, respectively. The ATF consumption increased almost eightfold between 1970/71 and 1983/84 (Fig. 2), equivalent to an average annual growth rate of about 18 percent, while ATF import by NOC has increased sevenfold during the same period with an average growth rate of about 16 percent per annum, which implies that RNAC has been able to expand its international market quite satisfactorily. At the same time, the percentage share of ATF in the Transport sector has risen from about 13 percent to 37 percent (Fig. 1), while the percentage of its consumption to that of the total import of petroleum fuels increased from 6 percent to 20 percent during the period 1970/71 - 1983/84 (Fig. 3), a reflection of the growing importance of aviation in a country which still lacks an extensive network of highways and railways.

It is estimated that ATF demand will increase at an average annual growth rate of 6 percent till 1995/96 (Fig. 2). This forecast is based on the regression analysis performed between ATF consumed in the past, index of GDP, and population. The percentage share of this fuel in the transport sector will increase to about 43 percent by 1995/96 (Fig. 1).

Electricity

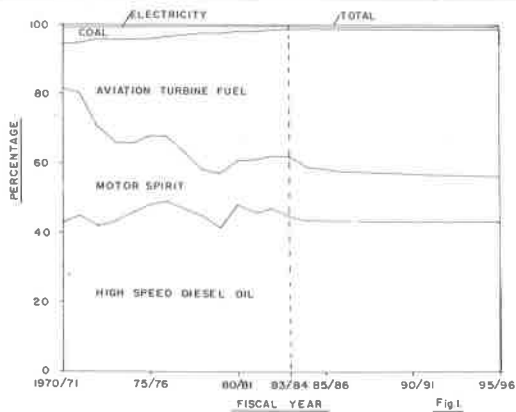
Electricity is consumed in the transport sector by a ropeway and a trolley bus system. The average consumption of electricity by the ropeway is about 600 Mwh if it runs at its rated capacity, while it is about 1000 Mwh for the trolley bus system. The use of electricity in this sector is quite nominal, in spite of hydro-energy being an indigenous source of energy available in plenty if exploited. At present, only about 0.5 percent of technically feasible hydro-energy has been exploited. This is mainly due to the fact that the initial investment required to develop the hydro-power plant is quite high. Massive use of this source of energy to replace imported hydro-carbons in the transport sector seems impossible in the foreseeable future without a committed approach.

It is estimated that the demand for electricity will increase at an average annual growth rate of 5.5 percent till 1995/96, while the percentage share of electricity will remain at the present level even in 1995/96 (Fig. 1 and 2).

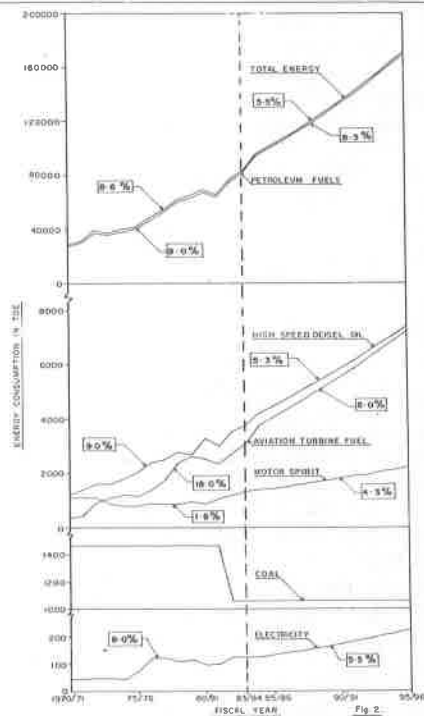
Coal

At present, 1,800 tonnes of coal is being used by Jayanagar-Janakpur railway system. The consumption of coal was about 2,500 tonnes till 1982 (Fig. 2). But due to the use of diesel in the Birgunj railway workshop it has decreased to the present level. The percentage share of coal in this sector was about 5 percent in 1970/71, while it was about 1 percent in 1983/84 (Fig. 1). This is due to the fact that while the use of coal in this sector did not increase the use of other fuels did so during the last decade.

SHARE OF DIFFERENT TYPES OF FUELS IN TRANSPORT SECTOR



TREND IN ENERGY CONSUMPTION IN TRANSPORT SECTOR, 1970/71-1995/96



SHARE OF IMPORTED PETROLEUM FUELS

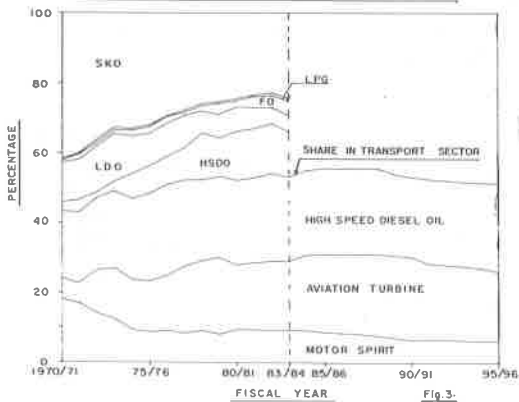


Fig. 1, 2 and 3

There seems to be no commitment for the expansion of the railway system. Even if a railway system was to be opened it would run with electricity; so it is envisaged that there will be no increase in coal consumption by this sector till 1995/96.

COST OF IMPORTING PETROLEUM FUELS

The major consumers of the petroleum fuels were the transport sector (49 percent), domestic sector (29 percent), and the industry and commercial sector (16 percent) in 1983/84; a similar trend was observed with little change in the percentage share in the past, although an average annual growth rate of 7 percent was observed during the period 1970/71 - 1983/84. The consumption of petroleum fuels in the transport sector increased with an average annual growth rate of 9 percent during the same period. The expenditure on the import of petroleum fuels increased at an average annual growth rate of 16 percent during the period 1974/75 - 1983/84. This was due to the rising inflation, currency exchange rate, etc. It is obvious that the expenditure on total imports increased with an average growth rate of 15.3 percent per annum, which implies the increasing share of expenditure for the import of petroleum fuels compared to other import items. The share of petroleum fuels being used by the transport sector increased from 44 percent in 1970/71 to 47 percent and 49 percent in 1974/75 and 1983/84, respectively (Fig. 3). The expenditure on the import of petroleum fuels as a percentage of the total export earning rose from 21 percent in 1974/75 to about 41 percent in 1983/84 depicting an increasing trend with substantial intra-annual fluctuation caused mainly by the frequent change in import-export by-laws with the change of Cabinet. This implies that only about 10 percent of the total export earning was diverted to meet the demand for petroleum fuels in the transport sector alone in 1974/75, while about 22 percent was diverted in 1983/84. The expenditure on the import of petroleum fuels as a percentage of the total import ranged between 8 and 11.

It is estimated that about 20 percent of the total export earning will be diverted to meet the demand for petroleum fuels in the transport sector alone in 1984/85, while about 38 percent will be diverted in 1995/96. It should be further noted that if a similar trend exists with no major policy intervention (with regard to substitution and conservation to replace imported petroleum fuels) then by 2000 A.D. all of the export earning will be diverted to import petroleum fuels.

CONCLUSIONS

In 1970/71, imported petroleum fuels amounted to about 95 percent of the energy consumed by the transport sector, out of which HSDO amounted to 43 percent, ATF to 13 percent, and MS to 39 percent. This accounted for about 46 percent of the total import of petroleum fuels. Over 98 percent of the energy consumed in this sector is met by petroleum fuels (i.e., 46 percent of the total petroleum fuels import and 3.5 percent of the total energy consumption), out of which HSDO amounted to 45 percent, ATF to 37 percent and MS to 16 percent in 1983/84. The percentage share

of petroleum fuels consumed is expected to further increase to over 99 percent by 1995/96, out of which HSDO will amount to 44 percent, ATF to 43 percent, and MS to 13 percent. The main causes for the change in the percentage share in the transport sector, specially ATF and MS are: Firstly, the country has given more emphasis on the development of air transport due to the lack of an extensive road works in Hills, and the importance of tourism to the economy: Secondly, diesel vehicles entail better fuel economy compared to the gasoline vehicles, although they are damaging to the environment.

In 1974/75, about 10 percent of the total export earning was diverted to meet the demand for petroleum fuels in the transport sector and about 21 percent to meet the demand for all the sectors, while it was about 22 percent and 41 percent in 1983/84, and is estimated to be about 38 percent and 80 percent in 1995/96.

Further, it is also clear at this juncture, that if the present trend of energy supply remains unchanged for a decade the situation will become worse. In the development of modern sector of the economy the consumption of commercial energy will increase day by day, which will have a negative impact on the balance of payment. As the consumption of petroleum fuels in the transport sector is substantial, priority should be given to identify the possibility of the substitution of petroleum fuels with the indigenous source of commercial energy i.e. electricity, and conservation of this fuel as early as possible. Based on these identifications a committed policy intervention regarding petroleum fuels is an urgent need.

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