ANNEXES

ANNEX 1

ENERGY CONSUMPTION IN THE NON-DOMESTIC SECTOR

The Industrial Sector

The industrial sector uses about 1.9 per cent of the total energy requirement and approximately 8.0 per cent of the imported petroleum products. Nepal initiated planned industrial development, in the mid-fifties, with the first of its five year plans. Encouragement has been given to the industrial sector in an effort to move the national economy away from total dependency on agriculture, thereby increasing job opportunities, reducing import requirements, and providing export earning opportunities. While Nepal's industrial base remains small, the continuing efforts to build an industrial infrastructure have led to a growth rate of 18.7 per cent in 1985/86 and 29.2 per cent in 1986/87.

With the increasing use of modern processing and technology, however, the industrial demand for energy increased by 41 per cent between 1974/75 and 1984/85, or faster than the output growth rate. Demand by fuel type for industrial needs has also been changing and will continue to do so as fuels are substituted to meet changing end use requirements. Among all categories of industry, fuelwood still provides the highest share of the total energy requirement, being about 51 per cent of the total, coal/coke has the second highest share, being about 20 per cent, followed by furnace oil (9%), electricity (7%), charcoal (6%), agricultural residue (3%), diesel (3%), biogas (about 1%), and kerosene (about 0.7%).

Investment rates in modern industrial infrastructure, capacity utilisation rates, energy supply constraints, changes in the energy efficiency of production processes, and the energy pricing environment are some of the factors that will have an impact on future end use energy requirements in this sector.

The Transport Sector

The transport sector uses about 2.0 per cent of the total energy requirement and 53 per cent of the imported petroleum energy. Under WECS's BNP scenario, transportation energy requirements are projected to increase to 5.2 per cent of the total energy requirement by the year 2000. Most transportation in the informal sector is on foot or by cart or bicycle. The modern transportation infrastructure consists of one international airport, 41 domestic airports, 6,306 km of roads of all types, 42km of electric ropeway, a 13km electric trolley bus network, gas/diesel buses and cargo carriers; taxies and vehicles serving the tourist industry, private vehicles and bicycles, a railway connection, and some unmotorised river traffic.

The energy requirement for the transport sector was approximately 131,000 tons of oil equivalent (toe) in 1988/89, virtually all of which was for petroleum products. Indeed, the transport sector uses 53 per cent of all petroleum imports which is equivalent to 13 per cent of the total export earnings, in Nepal, at 1988 prices. By end use, trucks use 36 per cent of the transport sector's fuel requirements, followed by aviation (32%), buses (17%), and cars (11%). However, if current

trends continue, the share of trucks in the total requirement will increase to 44 per cent by the year 2000 with the annual requirement for trucks growing at nearly 6 per cent. Excluding aviation, diesel fuel accounts for 75 per cent of the transport sector's energy requirement and this is expected to grow at the rate of over 6 per cent during the next decade. Finally, if current trends persist, the overall demand in the transport sector will grow at the rate of over 4.2 per cent during the next decade.

The Agricultural Sector

Commercial energy use in the agricultural sector accounts for about 0.1 per cent of the total energy requirement and 4.0 per cent of the imported petroleum products.

Energy consumption in the agricultural sector can be classified as either direct or indirect. The major end uses of direct energy include draft power for tilling and threshing and pumping for irrigation. Indirect energy consumption includes human and animal labour, and imbedded energy in manure and chemical fertiliser inputs. A detailed presentation of both direct and indirect energy consumption in the agricultural sector is included in the WECS Report "Energy Demand Analysis for the Transport and Agricultural Sectors of Nepal".

The Commercial Sector

The commercial sector accounts for about 1.1 per cent of the total energy requirement and 9.0 per cent of the imported petroleum products. The commercial sector refers to commercial activities or services undertaken by private, public, or government institutions, excluding transportation services.

Energy demand in the commercial sector was approximately 72,000 toe in 1988/89. Power consumption accounted for over a quarter of this demand and the commercial sector accounted for approximately 21 per cent of all power consumption and 25 per cent of the demand for petroleum products. Hotels/lodges and restaurants account for over 80 per cent of the sector's energy requirements, with cooking accounting for approximately 69 per cent and lighting 14 per cent. Thus, to the extent that improved cooking-stoves in urban areas can also be used in restaurants, the scope for energy savings in this sector could be significant. With respect to power demand, lighting in hotels accounts for 22 per cent of the commercial sector's power requirements, and contributes significantly to peak-load requirements. Energy demand in the commercial sector will grow at the rate of 4 to 5 per cent per year over the next decade, and growth rates by fuel type are not expected to vary significantly.

EXISTING POLICIES AND PLANNING ACTIVITIES

The Energy Pricing Policy

Energy pricing is an important government policy tool. Pricing structures can have a significant influence on the mix and pattern of energy use that will occur over time in all those sectors of the economy where energy consumption is monetised. Indirectly, pricing policies help to shape future government investment requirements for energy supply development, including the level of future recurrent costs for energy imports.

Decisions on the absolute and relative prices of energy forms have direct impacts on concerns such as:

- promoting or reducing the use of selected fuels by influencing the consumer's selection of competing fuels where substitution is possible;
- ensuring the profitability and financial viability of energy suppliers;
- meeting government revenue requirements and achieving government social welfare objectives such as minimising the adverse impacts of price increases through cross-subsidy, especially on lower income households.

The overwhelming dependence of rural families and the rural economy on fuelwood, agricultural waste, and animal wastes in meeting household energy requirements, relying on free collection where the cost is the individual's time, means that there is little short-term direct scope for using pricing policy as a tool for influencing the pattern of energy use in the rural sector. For rural requirements, emphasis on conservation/efficiency measures and the development of new energy supplies to meet growing demands is required.

All energy sources which are bought and sold to end users are controlled by government agencies and corporations. The Nepal Oil Corporation (NOC) handles import, distribution, and pricing of petroleum products. The Nepal Electricity Authority (NEA) is responsible for electricity generation, transmission, and distribution. The Ministry of Water Resources, in conjunction with NEA, is responsible for electricity tariffs. The Nepal Coal Corporation is responsible for the importation, distribution, and pricing of coal. The distribution and pricing of commercial fuelwood sources is carried out by both private dealers and the Fuelwood Corporation.

While the various implementing agencies prepare their own pricing schedules, largely based on financial costs and profit requirements, the proposals must be approved by the Cabinet to ensure that public welfare and all other concerns are addressed. The factors and trade-offs considered in pricing decisions include the following.

- Economic supply costs faced by the country.
- Financial costs faced by suppliers and licence dealers to obtain and market the energy form, either indigenous or imported.

- Government revenue requirements in the form of central and local taxes.

- The impact of absolute energy prices on the end users and consumers and, in the case of domestic energy sources, the impact on lower income families especially .

- Adjustment mechanisms to reflect changes in exchange rates and to minimise exchange rate losses for imported fuels.

The energy pricing environment thus, typically, has both market and socioeconomic aspects.

Energy Pricing Issues in Selected Sectors

Domestic - Urban

Energy consumption by urban households accounts for approximately 5 per cent of the total consumption in the domestic sector, reflecting mainly the national split between urban and rural population. Domestic cooking requirements are met by an assortment of fuels, depending upon the household income bracket. Cooking requirements generally account for 70 to 90 per cent of the household's energy budget, and on average about 11 per cent of urban household income. Higher income households have the ability to use the more convenient, cleaner fuel forms such as electricity and gas.

Table 2.1 illustrates the financial costs of cooking by different fuels, including the cost of the cooking device. Observations made regarding the pricing of urban cooking fuels are as follows.

- Fuelwood supplied from private depots and electricity are priced at about half the long-run marginal supply cost or the true economic cost of supply (LRMC), thereby encouraging greater use of wood and electricity than would otherwise be justified under strict economic efficiency objectives.

- Clearly, there is greater justification for continuing to encourage the use of electricity rather than encouraging greater wood consumption, in view of the diminishing forest stock.

- The Timber Corporation's prices are about one-third of the LRMC cost of wood. This assumes that transport costs involved in bringing wood to Kathmandu represent on an average 65 per cent of the market price of wood.

- Prices for imported LPG and kerosene are set for cost recovery and reflect the import costs to government. Prices, nevertheless, do remain susceptible to any future change in world oil price and to supply constraints.

- Relative to kerosene and wood tax structures, taxes and duties on LPG cooking gas are low. It is assumed that LPG is mainly used in higher income households.

Table 2.1 RELATIVE FINANCIAL ATTRACTIVENESS OF COOKING OPTIONS

ENERGY SOURCE	COOKING DEVICE					ENERGY COST					TOTAL	RANKING
	Type of Cooker	Unit Cost	Expect-ed Life	Annual Main-tenance	Simple Annualise Cost	End-use Demand	Effici-ency of Device	Energy Required	Energy Price	Annual Energy Cost	Total Annual Cost	
		(Rs)	(Yrs)	(Rs)	(Rs)	(GJ/HH/ yr)		(GJ/yr)	(Rs/GJ)	(Rs)	(Rs)	
Fuelwood-Kathmandu												
- TCN	Traditional	0	2	0	0	5.9	0.12	49	33.5	1,646	1,646	1
- Private Depots	Traditional	0	2	0	0	5.9	0.12	49	69.5	3,416	3,416	6
- Private Depo with ICS	Improved Stove	200	2	10	100	5.9	0.25	24	93.5	2,201	2,311	2
Kerosene	Wick Stove	150	2	10	85	5.9	0.40	15	198.9	2,934	3,019	4
	Pressure	200	5	25	65	5.9	0.50	12	198.9	2,347	2,412	3
LPG	Stove	3,000	10	50	350	5.9	0.65	9	470.6	4,272	4,622	8
Electricity (400 V Supply)	Modern Stove	1,500	10	10	160	5.9	0.60	7	444.8	3,280	3,440	5
	Clay Stove	75	2	25	63	5.9	0.50	12	333.5	3,935	3,998	7
Ag. Waste	Traditional	Non-Monitized										
Animal Waste	Traditional	Non-Monitized										

Source: WECS. Energy Options and Issues and the Eighth Five Year Plan. 1989.

The greatest scope for pricing adjustments from strict economic efficiency objectives appear to be with wood followed by electricity. Consumption of electricity for cooking needs, nevertheless, is relatively minor and largely restricted to higher income families except under circumstances of kerosene supply interruptions. Electricity is mainly for lighting. About 60 per cent of the urban households rely on wood for cooking and any major revision of pricing structure would have to be developed in stages while ensuring adequate supplies of substitute fuels; it is kerosene that is mainly available and households can afford the replacement of cooking stoves.

The most significant factor to assess, in energy pricing strategy, is the relative pricing of kerosene and wood, and in the case of electricity, if the policy objective is to gradually reduce kerosene use, to overcome vulnerability to supply shocks. At present, kerosene and wood together represent over 80 per cent of the urban domestic cooking requirements and can be substituted. Kerosene, under the current pricing structure, is slightly less economical than wood. Before the supply shock, kerosene prices were slightly more economical than wood prices for cooking needs. The previous pricing structure, combined with convenience of use, would have gradually reduced the share of wood use in relation to kerosene for urban needs, assuming that there are no supply constraints in the case of either fuel.

Domestic - Rural

Energy consumption in the rural domestic sector on a GJ basis accounts roughly for 89 per cent of the total energy consumption in the Kingdom. The bulk of consumption is for cooking and is based on non-monetised use of traditional fuels, including wood, agricultural waste, and animal waste. Electricity is available in only a few former *Panchayats* and kerosene is mainly used to supplement lighting requirements to the extent that households can afford the fuel and that the supply is available. Pricing policy will thus have little direct influence in the short-term, on patterns of rural energy use, apart from in the case of kerosene.

Overwhelmingly, this means that rural energy policy has to focus on the options which are:

a) development and management of new supplies and
b) conservation/efficiency improvements.

In districts where there are already acute pressures on the the available supply of traditional energy sources through the felling of trees or land clearanes, the most immediate option is the introduction of improved cooking-stoves. Improved cooking-stoves have the potential to double the conversion efficiency of traditional fuel use and thus, theoretically, offer the opportunity to reduce half the requirement of fuelwood and agricultural waste. The development of new energy supplies is expected to occur over a longer time-frame. It should include community-based forest management and plantation schemes and, where appropriate, extension of the hydroelectricity grid, micro and small hydro-based energy plants, biogas, and other options.

In terms of the extent to which pricing policies have an impact on rural energy uses, areas of ongoing or further consideration include:

- updating the policies on cost-recovery, life-line rates, and cross-subsidy requirements for rural electrification, small hydro-schemes, and other commercial energy supply projects;

- examination of the role that locally-derived energy pricing structures can play as an

incentive to encourage community-based forest management and afforestation schemes;

- examination of opportunities for extending credit schemes, to communities having lower income-generating and landholding households, for implementing biogas schemes where technically feasible (i.e., dung availability and climate);
- examination of the extent to which pricing policy in urban centres can reduce depletion of forest stocks in adjacent rural areas; and
- examination of the extent to which kerosene is required as a rural domestic fuel if forestry programmes are not fully implemented, the extent of subsidy required, and the pricing and rationing options.

The Transport Sector

The transport sector accounts for about 53 per cent of the imported petroleum products. Regarding the scope for adjusting the pricing policy for transportation fuels, the main considerations are as follows.

- Current petroleum product, pricing policies reflect cost recovery objectives and economic efficiency. Retail prices primarily reflect the border costs and government revenue requirements.
- Adjustments in relative prices of petroleum fuels used in transportation offer limited scope in the short-term for changing the transportation fuel mix, for example, towards more economical use of diesel, given the vehicle types in the existing transportation fleet. Fuel costs are a minor component in the purchase decision for the impact of new vehicles.
- The establishment of absolute price levels for transportation fuels remains a trade-off between government revenue requirements and the socioeconomic impact of increased transportation costs. It is significant to note that private vehicle ownership represents about 50 per cent of all light vehicle registrations.
- Apart from private vehicle use, the technical and non-technical measures to improve energy efficiency in the transportation system are discussed in Section 6. These offer greater opportunities for cost reduction and energy savings than the use of pricing mechanisms.

Industrial Energy Sector

Industry accounts for about 25 per cent of the monetised energy consumption and about 8 per cent of the imported energy requirements. The share of industries in energy consumption is growing. Electricity is required for motors and lights. Process heating and boilers account for approximately 60 per cent of energy requirements in modern industry. Fuelwood, coal, and oil are the main fuels used for process-heating (WECS 1990).

The relative prices of fuelwood, coal, and oil will have an impact on an industry's choice of fuel. This assumes that over the longer term the capital is available to make the necessary equipment

conversions to facilitate a switch over from fuels currently used in industry and assumes that both capital costs and annual fuel costs will be accounted for the choice of fuel for a new plant.

Considering energy prices alone, the relative costs of using different fuels for process-heating requirements in industry are shown in Table 2.2. An average conversion efficiency for each energy type is taken into account. The pricing structure in Table 2.2 is for Kathmandu. Absolute prices of these energy sources vary slightly in different regions reflecting the difference in cost of the transportation of supplies.

Regarding energy pricing for industrial process-heating requirements, for both air-heating and water-heating applications, the following observations are made from Table 2.2.

- Wood supplied from the FCN is currently the cheapest energy source for industry, on an efficiency-corrected basis. This is reflected in the fact that wood still meets over 40 per cent of the process-heating energy used in industries.
- Coal and wood supplied from private depots are roughly competitive at current prices.
- Coal is less expensive to use than oil by a factor of 65 per cent. However, this does not include the cost of storage and the handling of coal on the plant site or the relative cost of coal-burning equipment.
- LPG and electricity are considerably more expensive for the low temperature process-heating that is most common in industry and their use is limited to special process applications, motors, and lighting.

The main considerations for energy pricing in the industrial sector should be based on the basic policy of reducing reliance on imported fuels. There is added scope for using coal to displace wood in industry through a relative adjustment in the pricing of wood, although the trade-off is for imported coal. This will require examination of the conversion costs faced by industries and of whether it is technically feasible for small cottage type industries to convert to coal. Wood used by the industrial sector represents approximately 21 per cent of the current wood use for all domestic requirements in urban centres and under 2 per cent of the total national wood consumption.

The other aspect of energy pricing for industry is the consideration of using electricity tariffs to stimulate energy- intensive industrial development. There appears to be limited scope for this in the short-term, and its use would necessitate a separate investigation by WECS in the form of a power absorption study.

Planning Activities

In WECS, work focussing on the national-level energy planning includes detailed analyses of the energy sector, its relationship and linkages to the rest of the economy, and the main interactions within the energy sub-sectors themselves. As is the case in all planning disciplines, the energy planner is expected to provide recommendations that explicitly identify or recognise a number of planning trade-offs. As part of the orientation to policy analysis, energy planners and other concerned agency representatives must consider the relative merits, inconsistencies, and trade-offs among the various policy objectives for the energy sector.

Table 2.2 RELATIVE FINANCIAL ATTRACTIVENESS OF COOKING OPTIONS

			FINANCIAL					ECONOMIC
	1.			4.		2.		2.
Domestic Cooking	Average Market Price	Assumed End Use Efficiency	Suppliers Aquisition Cost	Transportation Cost	Others & Dealers Margins	Taxes and Duties	Final End Use Price	LRMC
Energy Type	Rs/Unit	%	%	%	%	%	Rs/GJ	Rs/GJ
Fuelwood-Urban								
- FWC	0.7/kg	15	6.4%	64.5%	21.8%	7.3%	279	650
- Private Depots	1.5/kg	15	-	-	-	7.3%	599	650
- Private Depot with ICS	1.5/kg	25	-	-	-	7.3%	359	650
Kerosene	6.9 ltr	45				4.0%	422	494
LPG	11.48/kg	65	58.0%	12.0%	26.0%	4.0%	724	847
Electricity (400 V Supply)								
- Modern Cooker	1.6/kwh	80	-	-	-	-	556	1,226
- Clay Stove	1.2/kwh	50	-	-	-	-	667	1,961

Source: WECS. Energy Options and Issues and the Eighth Five Year Plan. 1989.

Notes :
1. Based on current prices from distributors (LPG prices are pre March '89 prices).
2. Efficiency corrected values.
3. Assumes substitution of Kerosene for short term.
4. Includes overhead charges, shrinkage, temparature effects, splitting losses etc. as appropriate for fuel type
5. FKUP - Final End Use Price

HMG has conducted a number of studies and programmes intended to address water and energy development concerns. The three main thrusts of government-wide planning in the past included implementation of the Basic Needs' Programme; planning and implementation of the Decentralisation Policy, and the development of the Government's Eighth Five Year Plan.

An illustration of planning activities included within this policy framework, geared to address the main concerns in the water and energy sectors, are discussed below.

Planning Programmes

- Interim Government Guidelines. HMG issued a set of policy and planning guidelines for overall economic development after the new government was formed. This occurred after the last PSC meeting. Stress has been placed on indigenous resource development, poverty alleviation, and the maximum use of existing management and technical resources available in the country.

- The Eighth Five Year Plan. The National Planning Commission (NPC) previously established task groups consisting of officials from HMG line agencies to prepare inputs for the Eighth Five Year Plan. Multi-sector investment priorities are to be outlined. The approach NPC adopted for investment planning in the energy sector was to outline energy supply and demand management programmes for each energy type and the consuming sector. The Irrigation Master Plan formed the main input of the Eighth Plan for that sector. The Eighth Plan has been deferred until after the elections.

- The Forestry Sector Master Plan. HMG is still in the process of securing finances for the implementation of the Forestry Sector Master Plan. This overall programme includes plans for afforestation, forest management, village woodlot, and other fuelwood supply measures. It incorporates a dissemination programme for improved cooking-stoves (programmes which have met with limited success in the past). Programmes are also planned for soil conservation and stabilisation. The Irrigation Master Plan will form the major input of irrigation programmes.

- The Power Sector Efficiency Programme. Discussions are continuing between HMG and the IBRD for a 'Power Sector Efficiency' programme which incorporates further funding for equipment to support NEA's loss reduction programme as well as for hydro-plant rehabilitation and distribution system strengthening activities. An industrial energy management programme, focussing on reduction of imported energy, is also included.

- Least Cost Generation Plan. NEA completed the updating of the generation plan for grid supply. The current load forecasts indicate shortages by the mid 1990's and a 150 MW deficit (hydro only) before the planned commissioning of Arun III.

- Proposal on Equitable and Efficient Pricing of Fuelwood and Commercial Fuels. HMG and ADB finalised the terms of reference of a study to recommend policy options for pricing and inter-fuel substitution, focussing on the rural and urban domestic sectors. The study proposes to examine local fuelwood market costs and pricing structures, to review and recommend measures to improve programmes promoting the use of efficient stoves, to assess factors that affect traditional and commercial energy inter-fuel substitution, and to recommend pricing and supply strategies in that light. HMG has designated WECS to

be the implementing agency to coordinate work done by local and expatriate consultants. The study is scheduled to start by early 1991 and is due for completion after eight months.

- NEA Marginal Cost and Tariff Study. NEA, with World Bank financing, is undertaking a marginal cost and tariff study for the electricity sector. The study will also consider, to a limited extent, inter-fuel pricing factors which affect electricity demand and substitution in all sectors. The report is due by November.

- Rural Electrification Master Plan. NEA, with World Bank financing, completed a rural electrification master plan. The work covers tariff, electrification, and inter-fuel substitution measures in the rural economy for domestic, irrigation, and cottage industry loads and examines electrification strategies and costs. The study is completed in draft form.

- Master Plan for the Karnali and Mahakali River Basins. HMG initiated a programme, with Japanese funding, to provide site investigation work for promising sites in the above basins.

- Hydrometric Network Assessment. HMG initiated a study programme to assess the DHM hydrometric capabilities in Nepal.

- Natural Resource Management for Sustainable Development: ODA funded a natural resource management study which mainly focussed on hill communities. It considers feasible policies, institutions, and investment activities to promote sustainable natural resource use. The study emphasis is on resource use interactions for agricultural development, forest development, and population growth and livestock use. Substitution and trade-offs in the use of different traditional energy forms were considered. The second phase considered policy dimensions and implementation strategies, focussing on community-based initiatives.

- Project Specific Studies. NEA and DOI (with donor support in some cases) are continuing to undertake project-specific reconnaissance, pre-feasibility, and feasibility studies for irrigation and power projects. A detailed design of Arun III is nearing completion. An updated feasibility study of the Kali Gandaki has been planned. Investigation work on the Pancheswor Site is nearing completion. The Chisapani feasibility study was also completed and work on the Upper Arun Feasibility Study was initiated. DOI is also starting studies on a number of major irrigation schemes.

The above represent a few of the main overall planning activities in the water and energy sectors, currently being undertaken by HMG independently or with donor support. In addition, there are numerous project-specific studies that are in process, associated with the ongoing management and implementation of projects. Policy measures that support the objectives of efficient water and energy resource utilisation and facilitate conditions for future development, involving private entrepreneur and local community participation, are also being studied and acted upon by HMG in a number of fields. Over the past few years these have included:

- recent study and subsequent adoption of revisions in forest use legislation and

- recent revisions and improvements in rural credit schemes such as ADB/N subsidies to assist local participation in energy schemes for biogas and micro-hydropower.

ANNEX 3

ENERGY CONSERVATION POLICIES IN THE NON-DOMESTIC SECTOR

Increasing Energy Efficiency

There is currently no comprehensive strategy in the field of energy efficiency in Nepal. There is, however, a significant amount of effort to bring about better energy efficiency in some sub-sectors, particularly in the supply side of the power sub-sector and the forestry sector, and in the use of traditional energy sources. Efforts are being made to design an appropriate energy pricing policy at WECS and to realise the appropriate pricing of electricity.

Regarding energy efficiency, it is currently envisaged that WECS will provide the framework of a comprehensive energy efficiency strategy and will provide advice to the ministries, the public and private suppliers, and users of energy. The implementation and the enforcement of policies and technical measures will be carried out by each of the relevant institutions.

The barriers and constraints encountered in Nepal are very similar to those encountered in other developing countries and to some extent in the developed countries. The main barriers and constraints are the following.

- o Lack of information about energy-efficient technologies and about possible savings.
- o Lack of technical expertise in those areas.
- o The relatively low priority given to the improvement of energy efficiency; importance of access to raw materials, spare parts, etc.
- o Front-end investment costs.
- o Inadequate pricing of energy, very often below the economic costs.
- o Dispersion of the energy users and therefore problems of reaching-out.

The Industrial Sector

By the end of 1990/91, industries in Nepal will have to spend about U.S. $ 12.5 million for energy inputs and future growth is likely to be substantial. Experience from Nepal and other developing countries indicates that no-cost/low-cost energy efficiency measures could provide savings of about 10 to 15 per cent, - i.e., annual savings between US$ 1.2 to 1.8 million.

While there is undoubtedly cost-effective measures that could be taken to improve the energy efficiency of the industrial plants and of the large commercial concerns of Nepal, relatively little has been done except for workshops conducted by the Ministry of Industry (MOI) and ESCAP/UNIDO in 1985 and 1986 and very limited auditing.

As in most of the developing countries, numerous barriers and constraints will have to be overcome. In Nepal, the following barriers and constraints should be addressed.

- Inadequate energy pricing and supply. As an illustration, there is no time-of-day pricing of electricity and no sanctions (no-metre) or adequate penalties to induce power factor corrections. Because of a lack of storage facilities for furnace oil, many medium and small industries are forced to use higher priced fuel.

- Lack of knowlege on energy information, on the part of the plant managers and of the technical personnel, on basic energy-management concepts.

- Lack of skilled technical personnel in the plants or as consultants to identify and implement energy-efficient measures.

- Lack of an adequate supply of energy-efficient equipment.

- Inadequate financing and incentives.

To improve the energy efficiency of the industrial and large commercial sectors, MOI and WECS have designed the Nepal Industrial Energy Management Programme (NIEMP) which includes an energy management information programme, an energy management training programme, an energy auditing programme, a financial and capital assistance programme, and an energy services and procurement programme.

Broad principles to explore energy demand management in the industrial sector include the following.

- Energy Efficiency - to reduce waste and the level of energy inputs required for given production levels, potential actions range from conducting in-plant energy audits to establishing simple no-cost and low-cost 'house-keeping' measures to the specification of modern, energy-efficient equipment for new plants.

- Energy Substitution - concerns the type of process-heating fuels used in industries (process-heating accounts for 80% of the industrial energy use) and the direction of substitution (e.g. coal and wood vs petroleum).

- Electrification - concerns defining the role of electricity in industrial development and identification of further substitution possibilities to use electricity to the maximum extent for non-process-heating industrial applications.

- Energy Pricing - concerns the role of energy pricing as a stimulus for promoting investment in efficiency and substitution measures.

- The Long-term Industrial Structure - concerns seeking ways to ensure industrial development programmes, giving priority to energy supply issues e.g. the comparative advantage of electricity-intensive industries, opportunities to create local industries which will reduce the import of products with significant imbedded electricity.

For the purpose of this paper, a few general approaches are outlined to help reduce reliance on imported energy, recognising that some measures would only be practical or feasible in the longer term and would require investment. Categories of measures to reduce the reliance of the transport sector on petroleum fuels include the following.

a. Efficiency Improvement Measures for Vehicles.

- o Technical efficiency - relating to the improvement of the fuel economy of transport vehicles which is a function of engine type, size, state of maintenance, and vehicle weight.
- o Operational Efficiency - relating to the management of vehicle fleets and usage patterns which affect total mileage and fuel consumption.

b. Substitution Measures.

- o Switching Mode of Travel - includes changing patterns of travel from vehicle to mass public transport, greater use of bicycles, etc.
- o Energy Substitution - implying greater use of electricity for transport, for example, by encouraging ropeways-trolley buses instead of diesel buses, and rail electrification to the extent feasible to replace the long-distance haulage of goods by truck on higher traffic density routes.

c. Demand Restraint Measures.

- o Rationing Activities - involving restrictions, where appropriate, on the amount of fuel allocated for different uses with the objective of reducing unnecessary or wasteful consumption but not hindering social or economic activity.
- o Fuel Pricing - involving the restructuring of fuel prices to reduce or minimise unnecessary travel.

d. Design and Maintenance of Transportation Facilities.

- o Road Maintenance - As fuel efficiency depends on road conditions, proper and timely maintenance of roads would contribute to energy savings.
- o Urban Design - concerns long-term aspects of urban design to the extent that use of non-energy intensive transportation systems are provided for in planning; for e.g. expansion of public transit, safe use of bicycles in urban areas, etc.
- o Land Use Planning - concerns planning the location of industries and commercial enterprises to minimise transportation energy needs and costs over the long- term.

In Nepal, numerous measures can be devised to improve the energy efficiency of the transportation sector. The following have been considered.

- Extension and electrification of the railways. Studies have been conducted but funding has not been secured.

- Extension of the electric trolley system in the Kathmandu Valley. Feasibility studies have been conducted but financing has not been secured.

- Rehabilitation and improved maintenance of the major roads could contribute a lot to savings.

- Extension and improvement of the ropeways. Studies have been conducted and the Hetauda-Kathmandu ropeway may be improved. This will have only a limited impact on road transportation.

- Improvement of traffic management, particularly in the Kathmandu Valley. Financing for this activity will be provided by the ADB.

- Improved maintenance of vehicles through improved training of mechanics, law enforcement, and drivers'/owners' information services.

- Fiscal measures to induce the import of energy efficient vehicles and eliminate inefficient vehicles.

The Agricultural Sector

Since Nepal is dominated by subsistence agriculture, many of the energy-demand management options, in practical terms, are the same as discussed for the rural domestic sector and refer to traditional energy sources.

The use of commercial energy in the agricultural sector is nominal. The amount of time over which tractors and pumps are used is limited. The use of electric pumps is higher than the use of diesel. There is lack of an integrated and coordinated approach for farm mechanisation.

- It is necessary to strengthen the integrated and coordinated efforts to provide modern farm inputs, especially at farm level. It may, therefore, be necessary to devise incentive mechanisms for ensuring the timely delivery of the integrated package (optimum quantities of water, fertiliser, improved seeds, and appropriate and efficient farm machinery and tools) to reach the farmers, rather than providing such components separately.

- There is a need to provide appropriate incentives and training to manufacturers for producing efficient farm machinery.

- The creation of regional training centres for local entrepreneurs, such as blacksmiths, carpenters, etc, to facilitate the repair and maintenance of agricultural implements as required.

- An appropriate environment (proper incentives, academic atmosphere, etc) needs to be provided for researchers, conducive to the development of high yielding varieties of seeds, related farm technology, and organic manure.

The Commercial Sector

The majority of business for hotels and lodges is generated by tourism and business travellers. Hence, increased operating costs are typically passed on directly to the consumer in the form of increased rates and/or itemised costs. Since all foreigners are required by law to exchange convertible currencies into Nepalese rupees (and pay their hotel bills in convertible currency to hotels using substantial amounts of commercial energy) the majority of the commercial energy consumed is effectively being paid for directly by end users with foreign exchange. Consequently, the impact on balance of payments is minimised. Nevertheless, reduction in energy costs will improve the profitability of commercial enterprises.

Some of the measures to be evaluated for demand management in the commercial sector include the following.

o Energy Substitution.

- Consideration of means to encourage greater use of electricity for end uses currently relying on imported fuels, especially for larger establishments.
- Consideration of greater use of simple solar systems for hot water needs in hotels and associated kitchen needs; however, in many cases solar would be marginally more attractive than electricity.

o Energy Efficiency.

- Consideration of the use of improved technologies for lighting and energy management for water heating needs, especially in profitable enterprises with investment capital.

For service institutions, such as hospitals and schools, and for government buildings, energy efficiency opportunities in a practical sense may be limited but, nevertheless, can contribute to reduced operating costs. Before meaningful steps can be identified it will be necessary to establish responsibility for setting in place a group to look at energy management opportunities in these facilities and buildings.