CHAPTER-I

INTRODUCTION

1.1 Background

Nepal is geographically located along the Himalayas between longitudes $80^0$4' to $88^0$12' east and latitudes $26^0$22' to $30^0$27' North. it is bordered by the two most populous counties of the world, India in the east, south and west and by China in the north. The kingdom is roughly rectangular in shape.

Nepal is mostly mountainous country having 1,47,181 sq km of area and population about 23.4 millions. Geographically it can be divided in three regions. The mountain region, the hill region and the terai region.

Nepal is rich country in water resource. Together with this resource the steep topography endow this country with a great potential for the hydropower development. The theoretical hydro electricity potential of Nepal is 8300 MW. From the point of view of hydro electric power resource, the kingdom Nepal can be broadly divided into four river basins, Sapta Koshi in the west, Sapta Gandaki in the center, Karnali and Mahakali in the far western. Which all together comprise about 80 percent of the total run off ($170,19^9m^3$) in the country (Shrestha 1969).

We get hydro electricity from water resources. The electricity is produced from generators that are driven by hydraulic turbines. To ensure the requisite head of water, the turbine are replaced at power house which may be at some distance from the water resources. Thus creating reservoir that can be used for recreation of water supply purpose (Benton 1943).

Hydro electricity is first originated from water resources at Roghbury in Northumberland in 1879. Lord Armstrong lit his house with

electric lamp using currents from a dynamo driven by a water turbine (Benton, 1994). In Nepal "Shree Chandra Jyoti Prakash Bijuli Adda" that commissioned and established the Pharping hydro plant of 500 kw capacities. But the initiations were taken place only after the first five years plan in 1956. (NEA 2001).

The Nepalese economy is broadly characterized by traditional agricultural sector. The energy sources of Nepal are in experimental stage. The traditional sources are main sources in Energy supply in Nepal. It is a well known fact that energy development drives the helms of civilization. Water resources have been occupying a very important phase from the beginning of human civilization because of the ancient cultures had developed near the banks of rivers, seas, lakes etc. Power in the form of hydro electricity is basic energy input for industrialization of the country which is in developing stage in Nepal.

Energy in Nepal is derived from biomass resources, imported fossil fuel resources, hydropower and renewable energy resources (solar, micro-hydro and biogas). Ministry of water resources is primarily responsible for the hydropower development. Ministry of industry, commerce and supplies, through public corporation like the Nepal oil corporation is responsible for the supply of fossil fuels. The ministry of science and technology is taking leading role in the promotion of alternate energy primarily the renewable energy sources through alternative energy promotion center. Ministry of forestry and soil conservation looks after the forest sector, which is the major source of energy in Nepal. (Energy Sector Synopsis Report, June 2006.)

For the proper development of power through strong institution, NEA was established in August 1985 (B.S. 2042) as the largest public enterprises responsible for the generation, transportation and distribution

of power with proper management under the NEA act 2041 merging the fragmented institutions fragmented institution, primarily the electricity development (ED) and the Nepal Electricity Corporation. Its establishment and consolidation has provided an appropriate institution framework for the substantial development programme expansion of envisaged for power sub-sector (Shrestha 1991).

1.2 Statement of the Problem

Energy consumption pays a vital role in economic development of the country. Nepal depends upon mostly on traditional fuel resources. A well known fact is that the modern economic development can't accelerate without develop electric energy. The electric energy can be achieved also from alternative resources. But the alternative resources are limited in scale in their commercial use. So increasing demand of electricity cannot be achieved without develop hydroelectric projects. Nepal has spending large amount of foreign exchange importing petroleum fuel. It causes unfavourable BOP. So considering available water resources and geological feature energy consumption pattern could change in the form of hydro energy.

Although here are alternative resources for traditional fuel resources but only one prospect is development of hydro plants, which can be defined as sustainable energy source. Using large volume of traditional resources has been brought serious environmental problems. Hydro electricity development in Nepal is in developing stage. Power has a great significance for the overall development of a country. From household sector works to industrialization process.

Nepal has a vast water resources in the form of surface and underground water. Water sector development is affected due to lack of technology and skilled manpower. Prospect of hydro energy development

could solve the energy consumption crisis in Nepal and improve macro indicators in the economy.

So to utilize the water resource for economic development of the country for strong economic state, it is necessary to invest in hydro energy sector. How energy requirement is fulfilled by hydro electric energy and investment pattern in hydro electric energy generation is going on are to be studied in Nepal.

1.3 Objectives of the Study

The objectives of the study are:

1. To access the history of hydro electricity in Nepal.
2. To access the situation of hydro electric energy consumption pattern among over all energy source in Nepal.
3. To analyse the investment pattern on hydro electricity development in Nepal.

1.4 Research Methodology

a. Reach design: The research objectives and data sources create specific situation to apply research methodology. Current research is stood for over all situation of hydroelectricity in Nepal.

b. Data Collection: The collected data are qualitative as well as quantitative. The required data collected wholly through secondary sources. The secondary data are collected through various published and unpublished sources. NEA is one of the major producer and distributor of electricity in Nepal and WEC has played a vital role to promote energy sector of Nepal. Necessary data and information are collected from Nepal electricity authority (NEA), Water and Energy Commission

Secretariat (WECS), Independent Power Producer Association Nepal (IPPAN) Department of Electricity Development (DOED), Ministry of Finance and Central Bureau of Statistics.

c. Analytical tools and presentation: The quantitative data are presented in tabular form. Different statistical tools ratio percentage are used for analyze the presented data in tabular form. Other data presenting techniques like pie-chart, bar-diagram and flow chart are used as required in analysis. The qualitative data are analyzed widely as required and relevance.

1.5 Significance of the Study

Hydro electricity development in Nepal is in developing stage due to lack of capital and technological factor. The socio-economic and political backgrounds are not favourable for developing this sector. The supply of hydro energy is always less than it's demand. The state has been facing the energy crisis and environmental degradation.

Biomass, Hydropower and solar power are he three major indigenous energy resource base in the country. Also there exist some sporadic deposits of natural gases and coal reserves, which are very small in quantity and sill not exploited commercially. Though Nepal has a huge potential of hydropower production has been to a very minimal and therefore, it is the biomass sector which dominates the overall energy and consumption (energy synopsis report 2006).

Huge amount of traditional type of fuel are used in rural areas of the country. Petroleum fuels are difficult to import. Most of the imported petroleum fuels are consumed in urban centers.

The energy consumption pattern is not same in the country. Kathmandu valley consume the total of 50% hydro energy and its

increasing demand is 20% in Kathmandu valley. Outside the valley demand of power is increasing about 10 percent. So to fulfill this situation it's necessary to study the investment situation so as to ease generation, transmission and distribution of power with cheap and minimum loss as well as institutional expansion and developmental works of energy sector.

1.6 Limitation of the Study

The study has been carried out in macro level and its is an academic research. The main limitation of the study is based that it is on secondary data and information. According to the objectives and nature of study primary data are not collected by carrying out survey. On the other hand, study does not reflect the hydropower development beside Nepal.

1.7 Organization of the Study

The study is divided into six chapters. The first chapter is introduction part. This consists of problem, objectives and limitation. The second chapter integrates the review of literature. The third chapter deals with history of hydro power development in different plan period. The fourth chapter covers hydro energy consumption scenario of Nepal. The fifth chapter deals investment pattern in hydro power development in Nepal. The last chapter is for summary, conclusion and recommendation of the study.

CHAPTER - II

REVIEW OF RELATED LITERATURE

Many important and useful literatures are available for Nepalese water resource and hydropower sector. National and international expertise has been interested for their expertise in this sector. Some notable literatures on water resource and hydropower sector are reviewed here.

Shrestha (1996) "Financing power development in Nepal" is reviewed here. He has emphasized in his study about problem of financing on power development. Some of his major findings are:

- Energy is a vital necessity which is directly linked with economic development. Though, Nepal is endowed with rich energy resources, but it lies among the least develop groups in terms of energy consumption.
- Still all the commercial sources of energy e.g. oil, coal gas etc expect electricity have to be imparted. They are affecting a great pressure on the balance of payment situation.
- Power is a capital intensive sector. For a country like Nepal, it is impossible to shoulder all the cost of investment. Therefore, she has been mobilizing foreign resources since the first five year plan.
- The trend of financing in power development shows that share of foreign loan is greater than the grant.

Pandey (2004) " Hydroelectricity development in Nepal is the useful article for review. She has shown in her research about the status of hydroelectricity in Nepal, Problem and prospects in development and its contribution to Nepalese economy. Some of her findings are:

- Hydroelectricity Project bring many environmental problem. It also affect the social and cultural condition of adjoing area of project. But actually it serve the human society by modern life style.
- Small scale Hydroelectricity project seems advantages with the view that if natural disasters occur in project run by huge investment mainly dependent in foreign loans there will be uncountable loss of property where as we do not need foreign aid to run small-scale project.
- It is necessary to improve management aspect in concern agencies to provide the quality service to people and proper operation of generating hydro energy. Use of electric energy has been unavoidable in every sector of economy.

Shrestha (2000), In his research "Role of Hydroelectricity in Economic Development" has analyzed that the development of the hydroelectricity is possible due to the enormous water resources as well as favourable topographic and climatic condition. Hydroelectricity has tremendous advantages for the people and it helps to develop energy sector of economy. Electricity is one of the infrastructure of upgrading the socio economic condition of nation. The proper utilization of electric power accelerates the motion of national development. Our experience shows that the developed countries like Japan, UK, USA, China, France etc achieved advancement in time thought electric power. At preset the stock of non-renewable resources like petroleum products, coal, natural gas, fuel wood etc is decreasing. The hydro electricity has become economically attractive because it is renewable and environment friendly. He has discussed the role of hydroelectricity in various economic as well as non economic sectors. Industries, agriculture, transportation, social services and other sectors can be promoted by the utilization of

electricity. He has also discussed about the development during the plan periods.

Shresthacharya (2002), published a book entitled in "Energy Economic in Nepal". Summarizes his idea the over all energy in Nepal and economics concerns such as energy problems, issues and prospects of options, socio-economics and environmental issues, prices and policies, and status and strategy of energy types: Commercial, biomass and alternative energy.

The main objective of his study is to present an interrelationship between energy and economic development. He concludes that Nepal's indigenous energy source consists of commercial hydro-electricity and traditional fuel wood, agricultural residue and animal waste.

Gurung (2003) in his research "Water Resource In Nepal: An investment in energy prospects" focused into the conditions of Nepalese water resources regarding to the energy sector expenditures with respect to time in the past, at present and future some of his recommendations based on this study are:

a. We should utilize the water resources at first : water and energy are most obvious factor to be developed in proper resources case. Civilization, industrialization and development are only possible when these is sufficient energy and water. By developing the energy we can maintain the income generating industries so far which in turn provide funds for investment in other resources so that all resources are supported to act as cycle.
b. Establishment of research institutions,

Research institutions on this type of water resources based issues is prime need. Environment friendly projects in this pollution suffered world are hot cake for investors. They are waiting for favourable environment for their investment. International leading institutions are

eager to provide their influences by following their funds in water resources sector in Nepal.

Holding billions dollar in investment they can set up a sole research body where young enthusiastic researchers can get research aid to study the various sectors of water, energy environment, potential etc.

3. Energy use in mining exploration and construction: Mining exploration process has needed deep drilling activities in the possible regions. Deep drilling can be easily done through electricity surplus utilization which accounts the exploration cost cheap for mining activities.

Like wise construction activities to be performed in the established of various infrastructures in the countries regular and continuous development activities excess surplus of hydroelectricity may be the best suited energy input so as to proportionate the cost of projects and resources optimization.

Paudel (1996) In his research "Hydro electricity development Nepal is the another useful document of review. :He devoted in his study the status of hydro electricity in Nepal at present and in future. He pointed on financial problem on Hydro electricity development in Nepal.

The cost of development of hydropower is significant high due to it's remoteness difficult terrain and geological condition poor communication and transportation. One of the predominant resources for the high cost of developing hydropower is mainly due to the in sufficient capability of power plants has also increased significantly due to the grant assistance projects where international competitive bidders can not participate in the project due to the condition imposed by the donor countries.

Baral (2004) did his research is 'Financing of hydropower projects in Nepal. He analyzed the problems of financing institutions and hydropower developers and government agencies in financing

hydropower projects in the context of Nepal. His research conclude that majority of the local financing institutions were interested to finance hydropower project but due to lack of experience in this new sector they want to go with small exposure. Many local financing institutions want to wait and see or learn little more before they expose themselves to hydropower. Minority who have good clientele and quite successful in the currant market has not shown to explore now avenue and are not invested to invest in hydropower now.

He recommended to financial institutions, it is necessary to Establish of power development fund to finance hydropower projects long term lenders like power development fund (PDF) and clean energy Banks (CEB) for the power project should established. The need to long term funding agencies like PDF and CEBS have been increase day by day. If we are seriously thinking of power project financing, the concept is already started but it should be expedited and the capital base and lending procedure requirement must be learnt from experienced nations.

Bhadra (2004) "Hydropower Development in Nepal" a article entitled in "Nepalese economy, towards Building a strong Economic Nation-State" is other useful material of review.

Writer has analyzed the problem and prospects of hydropower developed in Nepal. He says the possibility exists to manufacture and export energy intensive goods such as alloy steels, aluminum , calcium carbonate. The value additions from Hydroelectricity in these industries for exceed f the cost of electricity so that these industries and highly profitable. More importantly, that allows Nepal to fully capture the potential comparative advantages of cheap hydro-electricity through value addition in industrial activities with in the country. Needles to say, the multiplier effects will promote industrial growth as well as growth of other sectors such as service sectors. This allows Nepal to more away

from the singular dependence to India for exports of hydropower. It should clear that export of "row electricity" means that Nepal's is exporting her ' comparative advantages " to India; the multiplier effects also go to her.

The major hurdles to the promotion of electricity used (supply plus demand promotion) are, however, likely to crop up from the institutional side. The promotion of private sector participation in the development of hydropower requires provisioning of a "Safety net" for the private and community investors, primarily because of the long-terms nature of the project. For example, lack of an effective and operational, legal and legislative framework for the generation, transmission and distribution of hydropower and establishment of water rights can drastically reduce the rate of private sector investments in Hydro-projects.

WECS (2005) National water plan - 2005 is the useful document reviewed here. This plan has set the objectives to generate hydropower to meet national energy requirement and to allow for export of surplus energy in hydro power sector. The pan has taken the target that per capital electricity consumption of 160 Kwh by 2017 and 400 Kwh By 2027. The estimated budget of over all plan is Rs 1218938 million for water sector and Rs 511362 million is allocated in hydropower structural and non structural development.

The plan has clearly stated about investment situation of different sector in hydropower development in Nepal. A present the government through re-Lending to NEA, is the major source of finance in the investment of hydropower project. Private sector investment are and increasing. But at present, they contribute to only about 21 percent of total installed capacity. Most of the government sources are external (77 percent). The present resending of soft loans by Government to NEA is at 10.25%. The rate applied does not follow valuable rate lending and ,

because of this also NEA has been financially stressed due to the high invest rate.

Shrestha (1995) analyzed about the hydropower development through the private sector involvement. According to him there should be the great hand of private sector in the development of Nepalese hydropower, it may be the more efficient in terms of the cost, capital allocation and technical matter. From this research he concluded that some have the following recommendation and necessary point for the policy makers

- Following the success of energy related privatization and private power development efforts in the United States and United Kingdom in 1980's similar movement towards private ownership of power projects is now taking place through out the world.
- Nepal is its initial stage of privatizing power sector.
- For many developing countries the issue is not whether to privatize. But to find out an appropriate approach to privatization and to access the effects of privatization.
- Private sector initiatives and market-oriented behavior are expected to improve the power sector's performance and efficiency .The private sector can be an important source financing for power sector development.
- In a matured power sector, private sector could be interested in investing on it's own or jointly with public sector, or in making equity in investment in power sector entities that have been successfully structured into corporation and listed on the stock exchange

- The development of private sector can proceed successfully only with an appropriate allocation if risk of surplus hydro energy and export market size of private generation project and the role of government etc.
- Private sector development of power sector does not guarantee the development of indigenous manpower.
- There are some negative impacts of privatization of power sector subjected to the high electricity tariff compared to NEA, that lead to rural electrification expensive. Rural people cannot afford it unless subsidies given by the government.
- Beside this significant portion of cash flow goes out the country as debt service and dividend payment compared to the one developed by public utility. When a project is develop on private basis that creates a problem in balance of payment. Further more private electricity generation will give less attention towards environmental inputs.

WESC (1995) "Social-economic issue in Energy Development" analyzed that energy is basic necessary for survival. It is necessary for development activities to promote education, health care, transportation and infrastructure for attaining a reasonable standard of living and it is also a critical factor for economic development and employment. Shortage of biomass fuels has forced urban households and industries to switch from biomass fuel to imported fossil fuels and other commercial form of energy. Deforestation and desertification are threatening to traditional energy supplies and agro base rural economy. These shortage of biomass fuel in rural sector have energy scarce are needed to promote rapid growth of rural economy. The aim of achieving rapid rural economic growth to meet the basic need of rural families is also plagued

by the lack of energy and other resources e.g. Farmland, technology and capital for investment.

Gyawali (2001) in his book “Water in Nepal” has studied the Nepalese water resources from both technical and the socio-economic viewpoint and discuss on it. He explained about the potentiality of available water resources for the economic development of Nepal. According to him the Nepalese socio-economic prosperity geared by the development of the vast water resources. According to him instead of the high capital cost oriented mega hydro power the small and the community – managed level of the micro hydro is preferable for the small developing country like Nepal. At last he suggested some very importance points that are necessary for the policy formation and implication, these are as follows:

1. Nepali hydroelectric energy must be cheap.
2. New (but cheap) hydropower generation must come on line at first.
3. Hydropower must be reliable in quantity and quality.
4. Regional balance must be maintained in developing generation capacity for both socio-political and techno-economic reasons.
5. Large-scale export potential should not be entertained without first achieving a strong domestic base.

Dhungel (2002), in his article “Trends and patterns of energy consumption in Nepal” has mentioned that main sources of energies are biomass (traditional), which constitutes coal, petroleum products, hydro-electricity etc. energy consumption in Nepal is dominated by biomass, which accounted for 95%, 94.9%, 91.7%, 86.4% and remained shares if commercial energy in total energy consumption in FY 1984/85, FY 1995/96 and FY 2000/01. Either share if fuel wood, in traditional or in

total energy consumption is very high and adverse in the case if electricity. Use of electricity is high in domestic sector, as well as commercial sector. High GDP cannot be accomplished without technological progress, which requires increasing se of commercial energy. Use of energy is essential for industrialization and transformation of agriculture to the other sector. More time and labor are required to collect fuel wood. As a result, there remains very little time for productive works. The use of hydropower helps to reduce deforestation that will grow agricultural production through conserving the soil, pumping, irrigation water, f drying crops, grinding grains, using tractors, threshing machine. The demand of commercial energy is positively linked with increased income of household. He emphasized that micro and small hydropower should be developed to meet rural demand for energy but medium and large-scale projects are essential to meet the demand for industrial and commercial sector.

Bhattari (2004) has done his research on "Financial Resources for the Development of Hydro-power in Nepal : a Projection upto 2030". He focus in his study is that Status of Hydro-power Development and its consumption pattern in Nepal. Among these he has shown how investment is going on to develop this sector. Further more he has analyzed the role of foreign assistance to develop this sector. Based on secondary data some of his findings are as follows:

- Nepalese Hydro-electricity has passed long time since 1911, but in FY 1990/00 the total achievement was 432.26 MW and the GDP was about 1.53 for this year.
- The share of foreign loan and grand in financing investment in electricity in 37% and 22% respectively.

- Upto 2000/01, Nepal has gained 438.13 MW capacity in Hydro-power development. Among them generated capacity was 82.50% from medium, 3.71 from small and 0.90% from micro hydro projects. Rest of the power 13.01 % is produced by thermal and solar power.
- Agricultural GDP, non-agricultural GDP and tariff are found as the major determinants of electricity consumption.
- Due to debt service and lack of internal resources about 80% of hydro-electricity has been made by foreign aid.
- In terms of size, the average construction cost/MW is lowest for micro hydro-power projects Rs. 74.67 million/MW followed by Butwal Power Company (medium) Rs. 80.56 million/MW, medium hydro project (Gvt) Rs. 144.76 million/MW, medium hydro project (Pvt.) Rs. 193.13 million/MW and highest for small hydro project (Gvt) Rs. 481.41 million/MW.

Kandel (2006) in his research "Status of hydropower in Nepalese Economy" is a another useful material for review.

He has devoted in his research in consumption pattern of energy in Nepal, development of hydro-power in Nepal and contribution of hydropower to national economy. Some of his major findings are:

- Energy consumption in Nepal is basically limited in domestic sector, among them electricity is heavily use in domestic purpose.
- Present hydropower development strategy has been accelerating formally participation of private and public sector. Government should reduce per MW generation cost of, medium hydropower, where existing cost is US$ 2800/kw.

- Nepal can develop hydro electricity sector with mobilizing domestic resources. But for this attempt we should have national consensus and priority in policy making.
- In spite of high possibility of hydro power in Nepal, its contribution to GNP is very lower form 1994/95 to 2004/05 its contribution has increased only 1.1 percentage i.e. 1.36 to 2.37.
- Nepal cannot develop this vast endowment without practice of endogeneous technology and research practices with in the country.

CHAPTER – III

HISTORY OF HYDRO ELECTRICITY DEVELOPMENT IN NEPAL

3.1 Electricity and Hydropower in Nepal

Hydropower is derived form generators turned by the force of falling water most other electric energy is obtained form generators droven by steam produced either by a nuclear reactor or by burning fashil fuel namely coal, gas and oil. In the initial stage, hydropower plants played a vital role in world, yet hydropower plants are estimated to provide only about 2 percent of the world energy requirement (Encyclopedia Britannica, 4,328-338)

Electricity is a commercial source of energy. Among the indigenous sources of non-commercial energy; hydro, solar power, solar house system and micro hydro power plants are generating electricity. The thermal plants including multi-fuel plants I and II of conventional type also generate a small amount of electricity. The generation of thermal power will be closed down when hydro-electricity can meet the demand of electricity in the country. The thermal plants have been established to meet the peak demand for power, so hydropower is the dominant source of electricity in Nepal (Bhattarai, 2004).

3.1.1 Theoretical, Technical and Economical Potentiality of Major River's in Nepal

The theoretical, technical and economical potentiality of main river system has been estimated 83.28, 49.61 and 42.133million kw. respectively. Table 3.1 has presented potentiality of major rivers.

Table 3.1: Major River and Hydro Potentiality

In million KW

River basin	Theoretical potential	Technical potential	Economic potential
Saptakoshi	22.35	11.40	10.860
Sapta Gandaki	20.65	6.66	5.270
Karnali Mahakali	36.17	25.57	25.125
Southern rivers	4.11	0.98	0.878
Country's total potentiality	83.29	49.61	42.133

Source: Energy synopsis report WECS, (1992/93).

3.2 History of Hydropower Development in Nepal

The first power plant in Nepal was established at Pherping (500kw) by Prime Minister Chandra Shamsher in 1911 A.D. to fulfill the energy need of ruling class. Second power plant was developed at Sundarijal (900 kw) by Judha Shamsher Rana in 1939 A.D.

Nepal has processed more than 6,000 rivers and rivulets. Because of her geographic characters the prospect of hydropower development is very high. But due to lack of socioeconomic and technological factor a negligible portion has been harnessed yet.

3.2.1 Power Development Prior to Plan Period

After initiation of Pherping HP in 1911 and before implementation of first five year plan in 1956, total achievement of electric sector is given below in table 3.2.

Table 3.2: Power Development in Nepal Prior to Plan

S.N.	Power plant	Capacity (KW)
1	Pherping Hydel Plnat	500
2	Sundarijal Hydel Plnat	640
3	Morang Hydro Electric Co.	677
4	Birgunj Electric Supply Co.	225
Total		2,042

Source: Acharya (1983).

Table 3.2 has shown total achievement in hydro electric generation was 2042 kw prior to plant.

3.2.2 Power Development after Plan Period

3.2.2.1 Hydro electricity generation in different plan period

Nepal has got specific direction on power development after planned economic development since 1956. It was proposed to increase the generating capacity of hydro-power in different plan period. Following table 3.2 reveals the target of total plan periods power generation and achievement in different plan period.

Table: 3.3:Target and Achievement in Power Generation in Different Plan Period

Plan Period	Target in KW	Achievement KW	Resource Allocation (Rs in Million)
Before planning	-	2,043	-
First plan (1956-61)	20,000	-	30
Second Plan (1962-	12,250	2,400	91

65)			
Third plan (1965-1970)	60,000	13,000	260
Fourth Plan (1970-75)	36,300	26,040	255
Fifth plan (1975-1980)	59,954	16,220	230
Sixth plan (1980-90)	1,29,923	75,371	3800
Seventh plan (1985-90)	1,06,629	1,03,055	4757.100
Eight plan	29,700	2,52,418	32034
Ninth plan	5,38,000	5,27,500	23385

Source: Various plan document form 1st plan to tenth plan

3.2.2.2 Major Hydro projects installed in different plan period and installed capacity

The major hydro electric project installed after plan period, since 1956 and their installed capacity are presented in the table 3.4 below:

Table 3.4 : Major Hydro projects installed din different plan period and installed capacity

Plan	Project installed	Installed capacity MW	Installed year
First plan	-	-	-
Second plan	Panauti	2.4	1965
Third plan	Trisuli Pokhara	21 1	1967 1967
Fourth plan	Sunkoshi	10	1972
Fifth plan	Gandaki	15	1979
Sixth plan	Kulekhani-I	60	1982

	Devghat	14	1983
	Pokhara Seti	1.5	1985
Seventh plan	Kulekhani-II	32	1986
	Marsyangdi	69	1989
Interim plan	Adhikhola	5.1	1991
Eighth plan	Jhimruk	12.3	1995
Ninth plan	Puwa khola	6.2	2000
	Khimti khola	60	2000
	Modi	14.8	2001
	Bhotekosi	36	2002
Tenth plan	Indrabati	7.5	2003
	Chilime	20	2003
	Kaligandaki-A	114	2003

Source: Study shows

3.2.2.3 Power Development in Tenth Plan (2002-2007)

i. Target and Objectives of Tenth Plan:

Resources allocation of public sector is Rs. 30394.2 million in normal growth rate in which share of government sector is accounted Rs. 23795.6 million and NEA's Rs. 6598.6 million in tenth plan.

a. Targets of Tenth Plan: The long-term targets of this sector will be as follows:

a. To raise the consumption of electricity to 3.5 percent form the existing 1.4 percent of the total power consumption of the country.
b. Initiatives will be taken to export 22,000 mw electricity generated from the development of Pancheshower, Karnali and Saptgandaki multi-purpose projects.

c. Hydroelectricity projects will be constructed to generate 2,230 mw electricity, out of which 400 mw could be exported.
d. Electricity will be supplied to 63 percent people through national grid and 17 percent will be covered form alternative sources of energy.
e. Per capita electricity consumption will be raised to 180 kilowatt-hour.

b. Objectives of Tenth Plan

The following objectives have been set for the electricity sector to reduce poverty in a sustainable manner in the tenth plan.

a. To produce electricity at low cost harnessing the existing water resources.
b. To supply reliable and high quality electricity at reasonable price through the kingdom by integrating economic activity.
c. To expedite rural electrification so that it could contribute to the rural economy.
d. To develop hydroelectricity as an exportable item:

c. Quantitative Targets:

The following targets have taken for achieving the objectives of the tenth plan.

a. Hydropower projects will be constructed to supply 842 mw electricity, out of which 70 mw could be exported.
b. Additional 10 percent people will be supplied electricity through the national grid for which power will be supplied to 2,600 village development committees through the national grid and additional 5 percent people will be supplied power through alternative source of energy.

ii. Programmes of Power Sector in the Tenth Plan

a. Electricity Production and Supply:

A total of 315 mw electricity will be generated and supplied from both the public and private sector during the tenth plan to meet the domestic demand. The public sector will produce 101 megawatt and the private sector 214 megawatt. The contribution of 70 mw Marsyangdi hydropower project and another 74 mw power generated form small hydropower project (less than 10 mw capacity) during the plan period will be remarkable.

It shall be required to begin construction of some hydropower projects during the tenth plan in order to export and meet the demand of power after the completion of the tenth plan. Construction of hydropower projects with a total capacity of 1,938 mw will be begun during the tenth plan. Arun with 402 mw, upper Karnali with 300 mw and upper Tamakoshi (Rolwaling) with 250 megawatt capacity are among the major projects.

The construction of western Seti hydropower project of 750 mw capacity will also be commenced during the tenth plan. This apart, construction of a reservoir hydropower project suitable to the existing electricity system will be started during the plan period.

b. Electricity Transmission and Consolidation

Construction of a total of 430 kw long transmission lines of various kilovolts will be completed during the tenth plan in order to transmit power form the hydroelectricity projects to the completed during the plan period to electricity consumption center, to export more electricity and to consolidate the system.

Of the total, 301 km transmission line will be constructed by the public sector of which the 127 km long Chameliya - Attariya 132 kv

transmission line is worth mentioning. In addition to it, the construction of 140 kw Hetauda- Berdaghat, 75 km Khimti- Dhalkebar and 40 km Hetauda – Thankot 220 kv and 14 km Dumre – Damauli 132 kv transmission line will be commenced during the plan period. This apart, 129 km. transmission line will be constructed by private sector.

Beside constructing new transmission lines, some new substations will also be built and the capacity of some existing substations will be enhanced. Construction of a total of 426 MVA capacity substations of various kilovolts will be completed during the tenth plan.

b. Electricity Distribution, Extensions and Electrification

Special emphasis will be given on expanding electricity to the rural areas in the tenth plan considering the unavailability of the facility. During the plan period, 965 km long transmission and distribution lines of 33 kv, 4,977 km of 11 kv and 9,940 km of 400/230 MVA and 33/11 kv distribution substations of a total capacity of 143.5 will be constructed for this purpose.

This will facilitate additional 1,000 village development committees and 705,600 consumers. Electricity will be extended to additional 14 districts during this plan period through the national grid. It is targeted to involve cooperatives or users groups in rural electrification.

d. Surveys, Studies and Promotional Activities

Surveys and studies will be made on the hydropower projects to be completed or begun during the tenth plan and on selecting appropriate projects to supply power in the future and on exporting electricity. During the plan period emphasis will be given on the studies of reservoir projects. Surveys and studies will be commissioned on various projects

with a total capacity of 13,376 mw of which 12,239 mw will be produced form the public sector and 1,137 from the private sector.

ii. Studies being Commissioned with Bilateral

Cooperation on Paneheshwor multi-purpose project (6,480 mw), Sunkoshi-Kamala Diversion (1,300 mw) and Saptakoshi multi-purpose project (3,400 mw) will be completed during this plan period. Other studies on water resources and power development and on promotiong the private sector in the development of electricity will continue during the tenth plan.

3.3 Acts, Regulations and Policies on Hydropower Sector in Nepal

Recent acts, regulations and policies related to the promotion of hydroelectricity are as follows:

3.3.1 Water Resources Act 1992

This act has been enacted to address the need to make arrangements for national utilization, conservation, management of water resources in Nepal and to make timely legal arrangements for determining beneficial uses of water resources, preventing environmental and other hazardous effects there of and also for keeping water resources free form pollution.

This act prioritizes the water use as drinking water, irrigation, other agricultural use, hydropower, industrial uses, navigation, recreational uses and other uses. This act introduces the concepts of licensing, water use associations and water quality.

3.3.2 Hydropower Development Policy 1992

This policy has been issued to attract individuals and corporate body for the development of hydropower to meet interim and long-term electricity demand in the country. The other objective of the policy is to motivate national and foreign private sector investment for hydropower.

A separate electricity tariff commission has been constituted to fix the selling price of electricity to the consumers.

3.3.3 Electricity Regulations 1993

These regulations are developed to enforce the activities in pursuance to the electricity act, 1992. It deals with the provisions relating to license, matters to followed by the distributor and consumers, voltage, frequency and power factor of electricity, safety measures regarding electric devices, safety provisions relating to the electrical works and provision relating to inspection and investigations.

3.3.4 Water Resources Regulations 1993

These regulations are developed to exercise the power conferred by the water resources act, 1992. These regulations provide detailed guidelines as to the formation of consumers' association for water use, provisions relating to the use of water resources inquiry relating to the dispute regarding water resources, provision relating to service charges, and provisions relating to acquisition of house and land compensation.

3.3.5 Hydropower Development Policy 2001

This policy has been developed to meet the energy need of country as well as to export the hydro energy and make an investment friendly, clear, simple and transparent policy to develop hydropower sector. The objectives of this policy are to generate electricity at low cost, expand reliable and qualitative electric service in country, accelerate economic

development of electrification in the country, emphasizes on rural electrification and export electric energy.

3.4 Institutions for Hydropower Development in Nepal

3.4.1 Leading Institutions

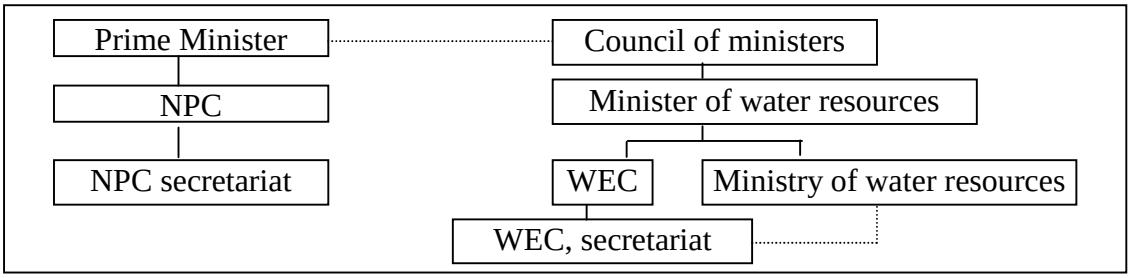
a. **WECS:** The secretariat gives suggestions to the concerned agencies of the government on formulation of policies and project implementation for appropriate use, control, protection, management and development of water resources and energy.
b. **Department of Electricity Development:** The department of electricity development will be basically developed as a study and promoter institution for carrying out studies on hydropower projects including multipurpose projects and attracting to and encouraging the private sector in the development of hydropower.

3.4.2 Present Situation

NPC works as a line agency of the government. NPC is responsible for the national planning and coordination of all sectors. For the water sector the WEC and its secretariat were established as a coordination and advisory body. Its ability to coordinate the numerous agencies involved in the water sector has not been effective because it doesn't have explicit authority. The highest authority for decision making on water related issue is the National Water Resource Development Council (NWRDC).

The following chart 3.1 presents the coordination/policy level institution for the water sector.

Figure 3.1: Policy Level Institution for the Water Sector

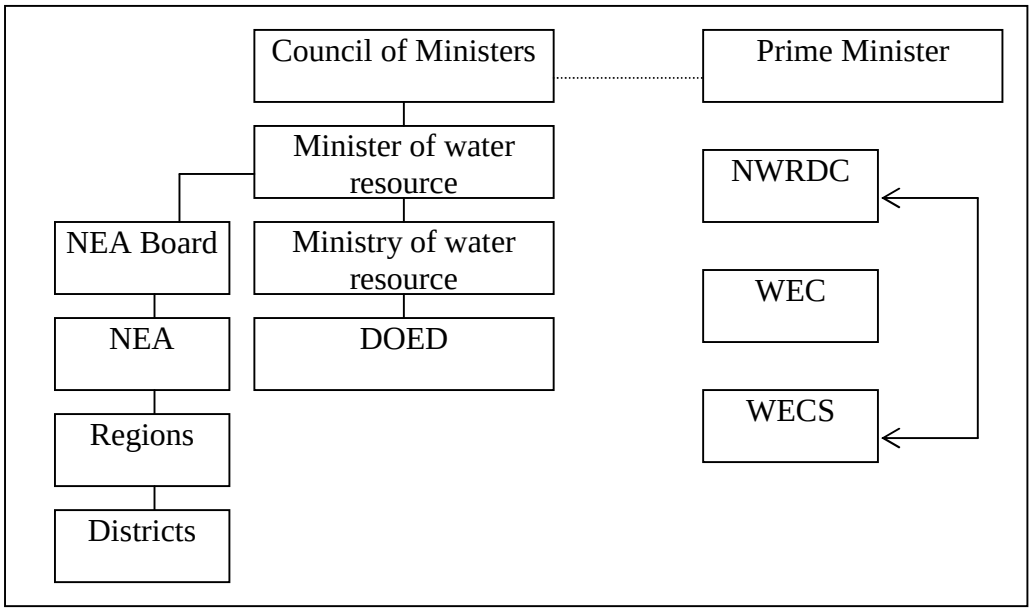


_____ line of direct authority

.....line of cooperation and advice

Following chart 3.2 shows the existing organizational setup of water resources.

Figure 3.2: The Existing Organizational Setup of Water Resource



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Source: Water resource strategy, 2002.

CHAPTER -IV

HYDRO ENERGY CONSUMPTION PATTERN IN NEPAL

4.1 Energy Consuming Sectors of Nepal

Major energy consuming sectors of Nepal are listed below:

4.1.1 Residential Sector

The residential sector consumes about 90 percent of total energy of Nepal in 2004/05. This sector consumes about 331 million GJ in 2004/05. Biomass resources are the major fuels used in this sector, namely the fuel wood agricultural residue and the animal waste. Recently renewable resources like biogas and electricity form micro-hydropower and solar home systems are substitutes of the conventional fuels used mainly for cooking and lighting. The commercial sources of fuel is used in nominal in amount and is mainly used in the urban centers. The trend of residential sector energy consumption is presented in Annex-1. In the residential sector the energy used in mainly for different end use, mainly cooking, heating, animal feed, preparation, lighting, etc. The electric energy used in residential sector is 2729 GJ in 2004/05.

4.1.2 Industrial Sector

The industrial sector energy consumption is about 3.47 percent of the total energy consumption in 2004/05. The energy consumption has been increasing marginally during the last few years since 1995. The industrial energy consumption has increased at the rate of 1 percent only. It is estimated that about 12.7 million GJ of energy is consumed in the industrial sector in 2004/05. The electric energy consumption of industrial sector is 2750 GJ in the year 2004/05 (Annex-2).

The main end-use of energy in the industrial sector are process, motive power, water boiling in the boilers and lighting.

4.1.3 Commercial Sector

Total energy consumption in commercial sector, which includes schools, hotels, restaurant government and non-government institutions etc. has increased from 2-4 million GJ in 1995 to 4.3 million GJ 2000/05 which shows an increase in 8 percent per annum. The main fuel use in commercial sector are fuel wood, kerosene and electricity. The main end use of the commercial sector are quite similar of residential sector such as cooking, heating, lighting, cooling etc.

4.1.4 Transport Sector Energy Consumption

The total energy consumption in the transport sector has been in the increasing trend. It has been seen that for the past few years the energy consumption growth rate in this sector is about 4 percent annually. The total energy consumption of this sector in the year 2004/05 is about 13.8 million GJ. The high speed diesel takes the highest share with 63 percent. The contribution of LPG and electricity is nominal to this sector.

4.1.5 Agricultural Sector

The total energy consumption in the agricultural sector is about 3 million GJ in the year 2004/05. It is about 0.84 percent of the total energy consumption of the country in the same year. The main fuel used in this sector are high speed diesel and electricity. Diesel is used for water pumping (irrigation) as well as for land preparation, harvesting etc. and electricity is used for lift irrigation.

4.2 Energy and Economy

Capital, labour and energy are three primary factors that contribute to and influence economic growth in any country in the world. Capital is the equipment, machinery, manufacturing plants and office buildings that

are necessary to produce goods and services. Labour is the viability of the workforce to participate in the production of goods and services. Energy is the power necessary to produce good and services and transport to their destinations. These three components are used to produce a country's gross domestic product (GDP), the total of all output produced in the country. Without these three inputs to production, business and industry would not be able to transform raw materials into goods and services. Energy is the power that derives the country's economy. In the industrialized nations, most of the equipment, machinery, manufacturing plants and office building could not operate without an available supply of energy resources such as oil, natural gas, coal or electricity. In fact energy is such an important component to manufacturing and production that it's availability can have a direct impact on GDP and the overall economic health. (WECS, 2006)

4.3 Sectoral Electricity Consumption Pattern

The residential, industrial, commercial, transport and agriculture sectors are the major sectors consuming electricity in Nepal. Sectoral hydro energy consumption pattern from 2001/02 to 2005/06 is presented in table 4.1.

Table 4.1: Sectoral Hydro Electric Energy Consumption Pattern in Nepal (000 GJ)

Year / Sector	2001/02	2002/03	2003/04	2004/05
Residential	2009	2222	2435	2729
Industrial	2152	2266	2483	2750
Commercial	326	334	389	394
Transport	20	20	20	21
Agriculture	105	108	114	180
Total	5612.5	5617.33	5941.75	6474.8

Source: Annex, a, b, c, d and e.

Table 4.1 has shown that industrial sector consumes highest electricity 27,50,000 GJ and transport sector consumes lowest electric energy then other sector. It is accounted 2,00,000 GJ in the year 2004/05.

4.4 Hydro Electricity Consumption Pattern in Different Year

The position of energy consumption pattern in different years is shown in table 4.2.

Table 4.2: Total Energy Consumption Situation in Nepal

Fuel type	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Share % in 1995	Share % in 2005
Traditional	258212	263634	267138	272893	278748	284735	290859	302085	308606	315269	322105	91.14%	87.71%
Fuel wood	230651	235495	237555	242687	247884	253199	258636	269158	274960	280888	286960	81 41%	78 14%
Agricultural residue	10354	10571	11645	11893	12166	12446	12732	13026	13327	13635	13964	3,65%	3.80%
Animal dung	17207	17568	17937	18314	18698	19091	19492	19901	20319	20746	21181	6.07%	5 77%
Commercial	24784	27759	29440	32741	34851	44956	43344	43852	43271	44863	43195	8.75%	11.76%
Coal	2839	3085	2540	2579	2893	10504	7446	6481	5721	7292	6459	1.00%	1.76%
Electricity	2826	3059	3278	3542	3778	4227	4612	5066	5434	5974	6673	1.00%	1.82%
Renewable	319	435	561	705	856	1015	1217	1432	1665	1779	1955	0.11%	0.53%
Grand Total	283315	291827	297139	306339	314454	330706	335421	347369	353542	361910	367255	100.00%	100.00%

Source: Annex 6.

The table presented the energy consumption pattern of Nepal from 1995-2005. The overall energy consumption of Nepal is largely dominated by the use of traditional forms of energy. The share of traditional fuels of energy to the energy consumption is estimated 87.71% in 2005. Remaining 12.31% of energy is consumed through commercial sources and renewable. The share of commercial and renewable (Alternative sources) energy consumption is accounted 11.76% and 0.53% respectively.

The share of fuelwood, agricultural residue and animal dung to the energy consumption is accounted 78.14%, 3.80% and 5.77% respectively

in 2005. This is estimated (1.41%), 3.65%, 6.07% in 1995. The figures shows the increasing trend of agricultural residue since 1995.

Share of petroleum fuel consumption in Nepal is estimated 8.19% in 2005 when the share of coal and electricity is about same. Their share in energy consumption is accounted 1.76% and 1.82% respectively in 2005. The share of alternative sources in energy consumption is in increasing trend, but increasing portion is negligible till 2005. Its share in energy consumption is extended 0.11% in 1995 and 0.53% in 2005. The share of micro hydro has not increase more than 0.01% since 1995.

Trend of electricity consumption pattern is very negligible. The figure has shown the share of hydro electricity is only 1.82 percent. In total energy consumption in the year 2005 (Annex 6). Table 3.1 has presented the increasing trend of hydro electricity consumption but it is nominal growth rate of consumption pattern since 1995.

4.5 Electricity Import and Export

The agreement between Nepal and India indicates both the countries exchange electricity as per the need. The exchange points are located at various places in the border line. Though there is a provision in the agreement to exchange to about 190 mw of electric power between the two neighborus, but due to lack of transmission facility, it is limited below 100 mw.

The electricity imported form India along the points of exchange for the year 2005 is about 241 gwh whereas export to India is about 110 gwh. The table 4.3 below shows the quantity exchanged between the two countries since 1997. It can be seen that except for the year 2003, Nepal is the net importer of electricity.

Table 4.3: Exchange of Electricity between Nepal and India

Category	1997	1998	1999	2000	2001	2002	2003	2004	2005*
Export to India	100.22	67.41	64.16	95.00	126.00	133.86	192.25	141.24	110.70
Import from India	153.98	210.29	232.39	232.20	226.54	238.29	149.88	186.68	241.39
Net import/export	53.76	142.88	168.23	137.20	100.54	104.43	-42.37	45.44	130.69

Note: * Provisional figure.

Source: Energy synopsis report, 2006.

The table 4.4 has presented revenue from electricity and revenue from export to India.

Table 4.4: Total Revenue from Electricity

Category	1997	1998	1999	2000	2001	2002	2003	2004	2005
Domestic	1769.84	1895.85	2056.05	2622.03	3161.38	3641.43	4249.81	4578.99	4987.04
Non-Commercial	386.36	405.14	419.58	527.40	835.78	722.12	783.99	816.01	862.37
Commercial	446.96	477.04	515.72	661.58	555.62	818.75	894.91	986.07	1012.66
Industrial	1801.58	1973.37	2093.88	2599.34	3086.10	3608.13	4039.65	4380.22	4799.74
Water Supply & Irrigation	95.70	100.28	78.14	95.65	120.90	138.68	148.53	154.80	211.57
Street tight	80.11	101.98	111.37	149.95	176,05	200.74	246.79	329.52	314.11
Temporary Supply	7.99	7.17	7.06	13.39	6.77	3.63	4.74	3.46	5.06
Transport	6.09	6.51	9.46	18.31	27.73	27.90	29.29	28.94	30.72
Temple	6.21	6.71	7.42	9.70	11.45	12.16	14.24	20.80	29.17
Community Sales	-	-	-	-	-	-	16,59	20.09	2404
Total (Internal Sales)	4600.84	4974.05	5298.67	6697.35	7981.78	9173.53	10428.53	11318.92	12276.46
Bulk Supply (India)	249.29	199.92	198.15	327,80	396.06	514.12	808.96	673.69	609.51
Gross Revenue	4850.13	5173.96	5496.82	7025.16	8377.83	9687.65	11237.49	11992.61	12885.97
Rebate									280.78
Net Income from Other Services									659.16
Total Revenue	4850.13	5173.96	5496.82	7025.16	8377.83	9687.65	11237.49	11992.61	13264.36

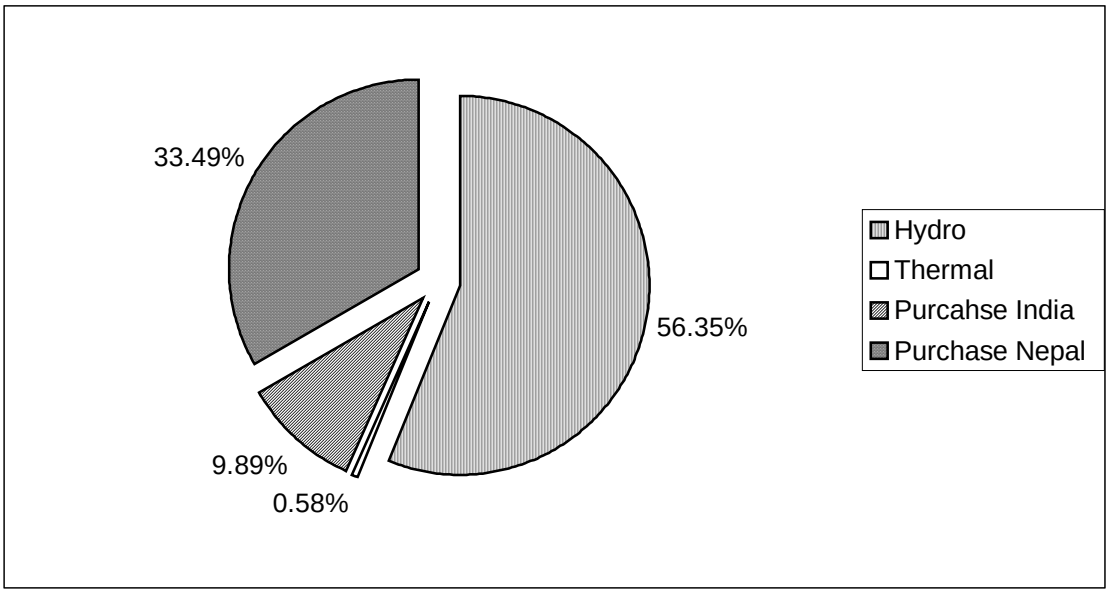
Source: Annex 12 (a)

The figure in table has shown the revenue received form electricity supply to India. It is accounted Rs. 808.96 million revenue received form power supply in 2003. That is highest revenue received compare to 1997

to 2005. Revenue received in 2005 is less in amount Rs. 199.45 million compare to 2003.

Following figure 4.1 shows the hydro electricity generation and trade of power with India.

Figure 4.1: Power Generation and Trade of Power with India



Source: NEA, A Year in Review, 2005/06.

4.6 Total Transmission Line Expanded in Nepal

The length of total transmission line distributed in Nepal is presented in the table 4.5 below.

Table 4.5: Total Transmission Line

S.N.	Transmission line	Length (km)
1	132 kv	2076
2	66kv	586
3	66kv (under ground cable)	7
4	33 kv (single circuit)	2485 (km)

Source: Annex-8.

4.7 Urban and Rural Areas in Hydro Energy Consumption in Nepal

Currently the urban population is consuming most of the electricity. But majority of people live in the rural areas and most of the agro-industries, irrigation and cottage industries are also concentrated on the rural areas. As the overall development of the nation premises on the development of the rural areas, balanced development can be achieved only through creating opportunity for equal consumption of power in the villages and the urban areas (NPC, 2002).

4.8 Environmental Aspect of Hydro Energy Use

Hydropower development activities affect the environment (degradation, exhaustion of natural resources and pollution), human (displacement, cultural issues, and natural hazards/risks) and their institutions (sharing benefits among diverse interest groups). Since most of the economically feasible power project sites in Nepal are located in sensitive natural areas, a great deal of environmental consideration is needed to minimize the adverse environmental effects (Rijal 1999).

4.9 Electricity Supply, Distribution and Prices

Overall electricity use in the total energy consumption is about 1.5 percent. Electricity is generally supplied through the grid extension by Nepal Electricity Authority. Also there is isolated grids which provides electricity to certain isolated areas which are out of reach of national grid. Electricity is also provided through micro hydro schemes and solar home systems.

Nepal electricity authority is primarily responsible for planning, construction and operation for electricity supply. Presently there are various independent power producer's (IPPS), who generate electricity and under the power purchases agreement with NEA, sell the bulk power

to NEA. There are two different price structures for the electricity produces for the residential customers depending upon the type of transmission. The price structure of the electricity transmitted by national grid and distributed is regulated by the electricity Tariff fixation commission, while the isolated system along with the micro hydro generated electricity fixes the prices according to the generator.

The tariff for different sector of the economy is also different. Also for the residential sector the tariff depends upon the amount of the unit consumed. For domestic consumer NEA has fixed minimum monthly charge Rs. 80 upto 5 AM meter holder Rs. 4.00 per unit is charged upto 20 units. Total 20 kwh energy is exempted for 3 AM meter holder. It is charged Rs. 7.30 per unit in consumption of 21.250 units and Rs. 9.90 per unit over 250 unit consumption. In the industrial sector the price of electricity is less compared to other sectors of the economy. The tariff rate is charged Rs. 5.90 for small industry and Rs. 4.60 for high voltage (60kv and above) per unit consumption. NEA has fixed the lowest price Rs. 3.60 per unit of low voltage (400/230 volt) for irrigation. Also, NEA has introduced time of day meter's for effective utilization of the energy generated (Annex 7).

4.10 Per Capita Electricity Consumption in Nepal

Electricity consumption is an indicator of economic development of a country. Lower level of consumption of electricity as commercial energy indicates lower level of economic development of the country and vice-versa. Generally, per capita electricity consumption is used to measure living standard of the people of a country. Nepal's per capita electricity consumption is one of lowest in the world. A recent study shows that 14 percent of the total population has access to electricity and most of the electricity facility is concentrated in the urban areas. The per capita electricity consumption of Nepal was 47 kwh in 1998, the lowest

among selected developing Asian countries (Bhutan 600 kwh, Bangladesh 81 kwh, Myanmar 60 kwh, Pakistan 237 kwh, China 934 kwh, Maldives 220kwh, and India 443 kwh). (Dungel; 2004)

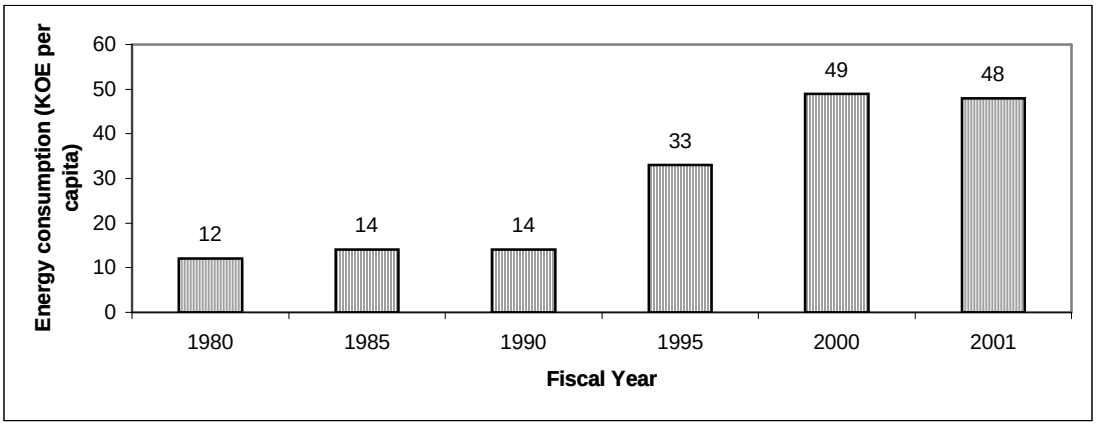
The Un data base shows the situation of per capita energy consumption from 1980 to 2001. It is presented in the table 4.7.

Table 4.6: Per Capita Energy Consumption of Nepal

Year	1980	1985	1990	1995	2000	2001
Energy consumption per capita (KOE per capita)	12.0	14.0	14.0	33.0	49.0	48.0

Source: UN Data base.

Figure 4.2: Per Capita Energy Consumption of Nepal



The data base has shown the situation of highest per capita energy consumption 49.0 KOE in 1995 compare to other years.

Data base has indicated 131st energy consuming position of Nepal in the world.

4.11 Growth of Electricity Consumer

Following table 4.7 reveals the situation of electricity consumer form 1997-2005.

Table 4.8: Electricity Consumer in Different Year

Particulars	1997	1998	1999	2000	2001	2002	2003	2004	2005
Domestic	503330	548110	593468	643314	713307	848540	930554	1010719	1113740
Non-Commercial	6338	7192	7654	7815	7643	8629	9722	9865	9950
Commercial	2441	2637	2948	3096	3386	3898	5317	5454	6000
Industrial	12928	14062	14996	16179	17701	18789	19833	21374	22500
Water Supply	190	205	215	232	236	251	305	352	370
Irrigation	713	776	876	967	1083	1353	1721	2557	3400
Street Light	482	683	842	932	1012	1048	1229	1437	1500
Transport	8	12	21	47	37	49	48	48	50
Community Sales	_	-	_	-	_	1	1	15	35
Total (Internal Sales)	527452	574844	622358	673974	745987	884530	970606	1053930	1159850
Bulk Supply (India)	5	5	5	5	5	5	5	5	5
Grand Total	527457	574849	622363	673979	745992	884535	970611	1053935	1159855

Source: Annex 13.

Table shows number 4.8 of consumer is greater in domestic sector compare to other sector. It's consumer are increasing continuously form 1997. Number of consumer in domestic sector is accounted 1113,740 consumer in the year 2005. Electricity consumer in transport sector is lower compare to other sector. It is accounted just 50 consumer in 2005.

CHAPTER -V

INVESTMENT IN HYDROPOWER DEVELOPMENT IN NEPAL

5.1 Electric Power System in Nepal

There are two sub-systems under the electric supply system in Nepal. First is the largest "interconnected Nepal power system" (INPS) i.e. central grid system, which accounts for about 98 percent in terms of capacity and energy supplied and is managed by NEA, as a public utility. Most of the power plants are connected to the INPS. Second is isolated supply system. In this system there are 40 small hydro plants under public sector. Another system is the "independent power producers system" (IPPS). Under this system, Butwal Power Company (Public utility)operates two hydro plants namely the Adhikhola (5 mw) and Jhimruk (12.30 mw). The entire production is sold to NEA. Khimiti khola hydropower project (64 mw) is the first private sector project in Nepal based on build-own-operate-transfer system. The power plant is owned and operated by Himal Power Limited Norwegian Company interkraft. In addition, two more IPPS, the Slaleri, Chialsa and Khumbu Bijuli company (Namche) operate small hydro plants of 400 kw. and 600 kw capacity in remote areas. Likewise, at the individual level micro hydropower plants and solar house system plants are also under IPPS. Bhotekoshi power company of 36 mw capacity is a joint venture project promoted by Himalayan International Power Company and two other firms, Harsa engineering incorporated and Panda energy international from USA. The company made a feasibility study of the Bhotekoshi project of 36 mw with the grant assistance of US government (Bhattarai, 2004).

5.2 Cost of Hydropower Projects by Size

The estimated construction cost of different type of hydro-projects are given in table 5.1.

Table 5.1: Cost of Different Hydro Projects by Size

S.N.	Category	Average construction cost MW (Rs. in million)	Average generation unit cost/kw in Rs.
1	Medium hydro-project (govt.)	144.76	4.91
2	Small hydro-project (govt.)	481.41	16.32
3	Butwal power company (medium)	83.56	2.73
4	Micro-hydro projects (private)	79.56	2.53

Source: Bhattarai, 2004.

Small hydropower are costly to generate per unit power. It is Rs. 16.32 per unit cost and average construction cost is Rs. 481.41 million. Micro hydro project of private sector can generate per unit in Rs. 2.53 and its average construction cost is Rs. 74.56.

5.3 Compare of per unit construction cost of different power projects of Nepal

Table 5.2 presents the project unit cost of different power station:

Table 5.2: Construction Unit Cost of Different Power Station

S.N.	Project	Capacity (kw)	Unit cost US$/kw
1	Chilime HP	20	1583
2	Piluwa	3	1527
3	Indrawati	7.5	3027
4	Chaku	1.5	2200
5	Kudi	3.4	185
6	Sunkoshi	2.5	1700
7	Kulekhani-I	60	3466
8	Kulekhani-II	32	2693
9	Kaliganda-A	144	2530
10	Middle Marsyangdi H.P.	70	4866
11	Marsyangdi H.P.	69	4766

Source: Kendel (2006).

Comparing the per unit construction cost of medium size hydro project as MMHP and MHP are higher than compare to other small size projects. The unit cost of the Kulekhani-I and Kulekhani-II HPS are also higher than compare to small size project. The lowest per unit construction cost of Piluwa HP is US $ 1527 compare to other project. The largest HP is Kaligandaki-A, has unit construction cost of US $2530. It shows that private sector projects has less per unit cost of construction.

5.4 Investment in Hydro Projects in Different Period

The “Aadi power house”, the first hydropower station of Nepal, it’s construction cost was Rs. 71327500 (NEA, 2006). Until 1989/90, investment in the electricity sector was entirely with in the domain of public sector. But with the initiation of economic liberalization policies

and private sector led growth since 1990/91, private sector investment started to increase in the electricity sector.

In the earlier year (1956/57-1974/75) investment in electricity was only 414.34 million (RATC, 1982) which significantly increased to Rs. 3734.56 million during the period.

5.5 National Capital Expenditure in Hydropower Sector

Table 5.3 below shows the national capital expenditure in hydropower sector.

Table 5.3: National Capital Expenditure in the Water Sector (Electricity)

Rs. in million (Cost and price 1999)

Year	Cost	Year	Cost
1979/80	3040.26	1989/90	4472.39
1980/81	3722.20	1990/91	2679.40
1981/82	1991.65	1991/92	2324.86
1982/83	2047.53	1992/93	3320.49
1983/84	2848.73	1993/94	3206.31
1984/85	1925.39	1994/95	2297.02
1985/86	3463.50	1995/96	3873.98
1986/87	3663.23	1996/97	4994.50
1987/88	5096.98	1997/98	5121.00
1988/89	4774.85	1998/99	4811.30

Source: Annex-10.

5.6 Major Hydro Station under Operation and Total Investment

Major hydro station under operation and total investment is shown in below table No. 5.4.

Table 5.4: Major Hydro Station under Operation and Total Investment

S.N.	Hydro station	Installed capacity	Commissioning year	Project cost
1	Kaligandaki 'A'	144mw	Aug. 2002	296.6 million US$
2	Marsyangdi	69mw	Nov. 1989	221.51 million US$
3	Kulekhani-I	60mw	May 1982	117.84 million US$
4	Trisuli	24mw	1967	IC 19 crores (T/L)
5	Gandaki	15mw	1979	NRs. 17 crores
6	Madi Khola	14.8mw	Dec. 2000	30,000.00 US$
7	Devighat	14.10mw	Dec. 1984	NRs. 75 crores
8	Sunkoshi	10.05mw	Jan. 1972	NRs. 109.37 million
9	Puwa Khola	6.2mw	Apr. 2000	15.7 million US$
10	Chatara	3.2mw	July 1996	NRs. 162585000.00
11	Panauti	2.4mw	2012 B.S.	NRs. 2.7 crores
12	Seti	1.5mw	Jul. 1985	NA
13	Fewa	1.0mw	2025 B.S.	NA
14	Sundarijal	0.6mw	1991 B.S.	NA
15	Pharping	0.5mw	1991	NA
16	Kulekhani II	32mw	1986	NRs. 1240 million

Source: NEA, Generation (2006), Baral (2004)

5.7 Major Hydro Projects on Government Sector and Donors

Major hydro projects on government sector and donors are presented in the table 5.5.

Table 5.5: Major Hydro Projects on Government Sector and Donors

S.N.	Project name	Installed capacity	Donor's name
1	Kaligandaki 'A'	144mw	ADB, FINIDA
2	Sundarijal HPS	0.64mw	British Gov.
3	Phewa HPS	1mw	India
4	Panauti HPS	2mw	Russia
5	Trisuli HPS	21mw	India
6	Sunkoshi HPS	10mw	China
7	Kulekhani I	6mw	WB/Other
8	Devighat	14mw	India
9	Kulekhani II	32mw	Japan
10	Marsyangdi HPS	75mw	WB/other
11	Madi Khola	14.80mw	Korean
12	Puwa Khola	6.20mw	Japan
13	Gandak	15mw	India
14	Seti	1.5mw	China
15	Chatara	3.2mw	IDA

Source: Bhattarai (2004), NEA (2006).

5.8 Some Notable Aspect of Loan and Aid

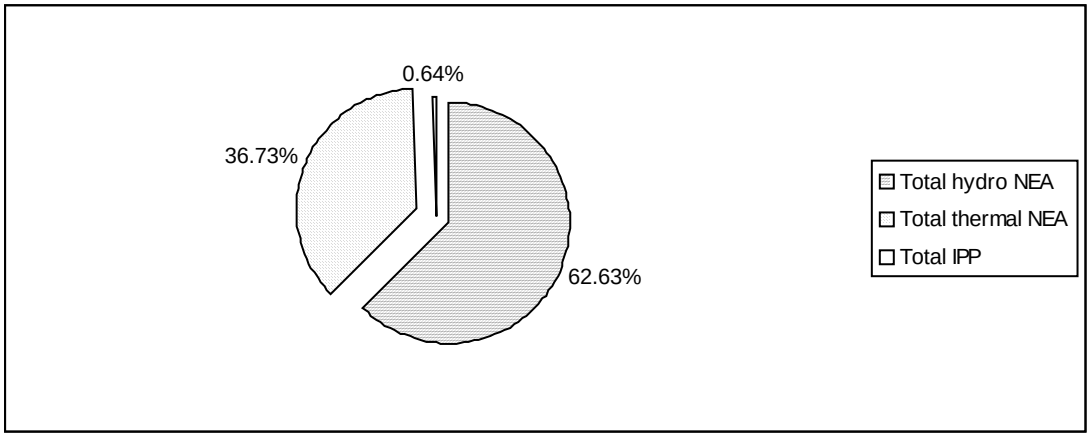
The investment in hydropower is made by NEA/GOVN, multilateral and bilateral donor agencies and private entrepreneurs. About 80.0 percent of power development is funded by external financing. The fund is allocated to GOVN, which lend to NEA through subsidiary loan agreement (SLA). The government receives the loan at 0.75 percent to 1.25 percent interest rate with a 30-40 years repayment period. The lending rate is 10.25 percent. Some funds are grant money. The total cost estimate may vary depending on the project. In some projects the cost of

road construction and environmental impact have also been included as part of the project cost. Thus, the cost of hydropower project is site specific. Cost effective process needs an in-depth analysis to identify the areas where cost can be reduced by technical administrative and legislative approaches. (CEDEOCON, 2004)

5.9 Total Power Generation by Different Electric Generating Sectors in the Year 2006

Following figure shows the total power generation by different sectors.

Figure 5.1: Generation (MWH)



Source: NEA, Generation (2006).

The figure has shown the heighest contribution of NEA in power generation. The NEA's contribution is highest in power generation. It is accounted 62.63 percentage. Thermal generation of NEA is 36.72 percentage and IPP's generation is listed 0.64 percent.

5.10 Major Hydro Station's Contributing for INPS

5.10.1 The Kaligandaki 'A'

This project is located at Krishna Gandaki VDC in Syanjga district in Kaligandaki river. It commercially produced electricity from Aug. 16, 2002. Since that period to the end of F/y 2062/063 the total energy

generated is 2345.41 gwh. Compared to the design average annual generation of 842 gwh, the plant has generated 621.34 gwh in the fiscal year 2062/063 which is 26.2% less than design value. 621.34 gwh energy generation in F/y 2062/063 is 12.63% higher than energy generated in previous year 2061/062. The power station's generation contributes 39.22% to INPS.

5.10.2 Marsyangdi HPS

The commercial operation of Marsyangdi HP was started in 5 Nov. 1989. It is located at Tanahu district on Marsyangdi river near Prithvi highway. Its generation occupies 23.32% to INPS. The average annual generation of power house is 462.5gwh.

5.10.3 Trisuli HPS

The power station is located 70 km north west of Kathmandu at Trisuli, Nuwakot and constructed on Trisuli river. The first stage which was completed in 1966 consisted of civil works and installation of three turbo sets. In first stage 900 kw of power was made available to the capital.

The installation of remaining four turbo sets were completed during the second stage of development in 1970. Then total power generation become 21,000 kw.

The power house has generated 134.46 gwh in fiscal year 2062/063. It contributes 8.49% in INPS.

5.10.4 Kulekhani -I

Kulekhani-I is the only reservoir type hydro electric station in Nepal. It's installed capacity is 60 mw having two units each of 30 mw. The power project was commissioned on 14th May 1980. It has generated 114.7 gwh of energy in the fiscal year 2062/063, an decrease of –34% compared to the previous year's generation. The generation form Kulekhani-I contribute 7.24% in the INPS.

5.10.5 Devighat HPS

Devighat hydropower stations comes in operation since year 1984 with an installed capacity 14.1 mw (3 x 4.7mw). It is located near Batter Nuwakot 70km north-west of Kathmandu.

The average designed annual generation of power station is 144gwh. The generation of this power station for the fiscal year 2062/063 Is 95.07 gwh which is 13.17% increment as compared to the generation in the previous fiscal year 2061/062. The power station contributed 6% of total energy to INPS.

5.10.6 Sunkoshi HPS

The Sunkoshi HPS, located at 81 km east from Kathmandu, Sunkoshi river in Sindhupalchowk district. The plant come in service since January 1972. The average annual generation of this power station is 70 gwh and its generation contributes 3.24% in INPS.

5.10.7 Kulekhani-II

The Kulekhani-II hydropower station is cascade power station to Kulekhani-I, installed capacity of 32mw. The operation of powerhouse is completely dependent on the operation of Kulekhani-I.

The power house was commissioned in the year 1986. Kulekhani-II hydropower station has generated 47.33 Gwh of energy in the fiscal year 2062/063. The generation form Kulekhani-II contributed 2.99% of the total energy in INPS.

5.11 Project Under Construction

5.11.1 Middle Marsyangdi

Middle Marsyangdi hydro electric project is a run of river type scheme. The plant has designed for the installed capacity 70 mw. The estimated cost of the project is about 13.65 billion rupees. The government of Germany had initially provided a grant for the financial

resources of the project. The balanced amount was agreed to be managed jointly by government of Nepal and NEA.

5.11.2 Kulekhani III hydro power project

The Kulekhani-III hydro power project is proposed as cascade connection with Kulekhani-II, hydro station. It's installed capacity is 14 mw. This project is being financed jointly by government of Nepal and Nepal Electricity Authority.

The project cost is estimated at US$ 27.60 million. It will be commissioned to meet the peak demand of day season by 2009. The annual energy output of the project will be 40.28 GWH.

5.11.3 Chameliya Hydro Electric Project

The estimated cost (January 2006) of the project of 30 mw installed capacity is US $ 78.853 million including 131 km transmission line of 132 kv. As per the assurance received from the government of republic of Korea to provide soft loan of US $ 25 million and is waiting for positive response. Similarly, GOVN has also requested the organization of Petroleum Exporting Countries (OPEC) fond for providing soft loan of US $ 15 million. Thus the project is envisaged to be implemented with co-financing of GOVN/NEA and some donor agencies.

5.12 IPP's Investment in Power Generation

Following table 5.6 shows the IPP's investment in power generation.

Table 5.6: IPP's Investment in Power Projects

S.N.	Project name	Capacity	Cost of project	Completion year
1	Syangja	183kw	2.4 million	2058
2	Rairang	500kw	NA	Nov. 2004
3	Chakukhola	1500kw	NA	2062
4	Sunkoshi II	2.5mw	330 million Rs.	2062
5	Piluwa Khola	3.0mw	NRs. 328.4 million	2003
6	Indrawati	7.5mw		2059
7	Jhimruk	12mw	19.3 million US$	1994
8	Chilime	12mw	NRs. 36 million	2060
9	Bhotekoshi	45mw	US $ NRs. 447,78,94,521	-
10	Khimti Khola	60mw	-	-

Source: NEA, Generation, 2006, Fourth Issue.

5.13 Energy and International Cooperation

Nepal has been supported by donor's agencies for its economic development since it initiated five years development plan. In the energy sector too, there is no exception. The major share of energy investment comes form donors and international NGO's. Nepal has been receiving international assistance for a long time in hydro resources development. Also since early nineties there has been huge assistance in the alternative energy sector through various donors, namely SNV, NORAD, DNNIDA, GTZ, KFW, World Bank etc. also there has been various technical assistance through UN organization like UNSCAP, FAO, UNDP and SAARC (SARI-E) in the software part. Recently, BIMSTEC like

organization has been established in the South Asia for the energy security of the region for effective condition and cooperation Nepal is the member of various committees like world energy council, ICOLD etc. and WECS has been acting as a secretariat of the Nepal chapter of these organization: WESC has been the focal point of various organizations like UNESCAP, FAO and BIMSTEC (WESC, 2006).

5.14 Investment in Electricity Sector and Source of Financing

Table 5.7 has shown the investment in electricity sector and source of source of financing in different period.

Table 5.7: Investment in Electricity Sector and Source of Financing

Rs. in million

Year / Sources	1984/85		1985/86 – 1989-90		1990/91-1994-95		1995/96- 1999-2000	
	Amount	Share %	Amount	Share %	Amount	Share %	Amount	Share %
Internal	176.90	35	11079.01	61.18	28666.62	78.96	10492.51	63.48
Government	176.27	34.87	1258.86	6.95	1782.60	4.91	1633.70	2.56
NEA	-	-	9798.36	54.11	21052.39	57.99	33091.90	51.88
Private *	0.63	0.12	21.79	0.12	5831.36	16.06	5766.91	9.04
External	328.60	65	7031.30	38.82	7637.85	21.04	23296.39	36.52
Loan	286.80	56.74	5385.10	29.73	6112.10	16.84	17366.40	27.22
Grant	41.80	8.21	1646.20	9.09	1188.50	3.27	3711.30	5.82
FDI	-	-	-	-	396.75	0.93	2218.69	3.48
Total	505.50	100	18110.31	100	36304.47	100	63788.90	100

Note: * Private includes joint venture investment in micro-hydro projects

Sources: Bhattarai, 2005.

The table 5.6 has shown share of external loan decreasing in the time 1995/96 – 1999/2000 in total investment in hydro sector. It is about

25.48 percent less than the year 1894/95. Mobilization of internal source was less than external sources in the early year 1984/85. The share of private inventor's in this sector is increased after only year 1995/96. Its share is accounted 9.04 percent for the period 1995/96 – 1999/2000 in total investment Rs. 63788.70 million. NEA has invested more than 50 percent share in the total invesment in hydro sector in 1995/96 – 1999/2000.

CHAPTER -VI

SUMMARY, CONCLUSION AND RECOMMENDATIONS

6.1 Summary

Nepal is located between two populous countries China and India. Every energy consumption process in Nepal is dominated by traditional fuel resources and, position of hydro energy consumption is nominal in every consuming sectors.

First Hydro plant in Nepal was installed in 1911 at Phering (500 kw). The journey of power development has passed about 9 decades. In this time period Trisuli, Sunkosi, Gandak, Kulekhani-1, Devghat, Kulekhani-II, Marsyangdi Puwa Khola, Modi Khola and Kaligandaki 'A' HPP were installed whose aggregate generation is 389.15 mw. Except that there major HPP are commissioning namely middle Marshandgi, Chameliya and Kulekhani-III of aggregate capacity 140 mw. One of the large scale project upper Tamakoshi (309mw) is being planned and proposed. Contribution of thermal power generation is accounted 55.028 kw. Isolated and interconnected system of small hydro power existing in the country are generating 18.968 kw power. The major HPP under private sector are Andhikhola, Jhimouk, Kimti, Bhotekoshi, Sange Khola, Indrawati, Chilime, Pliuwa Khola, Sunkosi small and Rairang, whose power generation comprises 148.283 kw. The development of power generation was on progression only after plan period since 1956. The long term vision on this sector has released only after 2000.

Share of hydroelectricity consumption in overall energy consumption is 1.5 percent. It is the total of 6673000 GJ of all energy consumption in the year 2005. The energy consumption pattern of Nepal is dominated by traditional sources. It is accounted 88 percentage in the

year 2005. The major energy consuming sector are residential sector, industrial sector, commercial sector and transport sector. Residential sector consume highest amount of energy compare to other sector. It is 289800 GJ in the year 2005/06. To increase the consumption of electricity NEA has fixed different tariff rates and exempt to certain consuming sectors. The lowest charge per unit is fixed in irrigation i.e. about Rs. 3.50.

India is only one country of electricity trading to Nepal. Electricity trading situation is not satisfactory now. Only in the year 2003 net power export is in favor of the Nepal.

There is different electricity supply system existing in the country. There are two sub-system under the electric supply system in Nepal. They are INPS and IPPS. There are also some isolated systems supplying electricity independently in the remote areas.

Investment pattern in hydro project is either public land private or joint venture. Prior to 1990 only public sector was in financing in power development. But after the initiation of liberalization policy private sector started to invest in this sector. Before investing in hydro projects it is necessary to observe the viability of fund and construction cost of project. Later it affects the per unit generation cost. Average construction cost and average generation unit cost of small hydro power plant is higher than other plant. But in usual the medium HPP are cost effective both in average construction cost and average generation cost. In the year 1998/99 Rs. 4811.30 million national capital is invested in hydro energy sector. The major share of investment in energy sectors comes from donor's and international NGO's. Nepal has receiving international assistance from a long time in hydro resource development. Recently

middle Marsyangdi hydro project (70 mw) is in construction. The estimated cost of the project is about 13.65 million Rs.

6.2 Conclusion

Nepal has got long experience in hydro generation and its utilization. But even after completion of 10^{th} plan development of power in Nepal is still in infancy stage. A single large scale hydro plant has not been installed in the country. So crisis of hydro energy occurs time to time uncertainly and consumer are facing load-seeding problem. Its contribution in over all energy consumption is only 1.5 percentage. On the other hand pattern of fuel consumption is dominated by traditional resources basically fuel-wood, which has created a serious environmental problem, deforestation and land erosion. Nation has not got sufficient hydro energy supply system in rural remote areas. There are not developed any alternative way of energy supply, rather based on traditional resources. Some alternative energy technologies are operated in these areas but they are not available everywhere in country. Except certain urban centers life standard and development pace has not been achieved according to 21^{st} century. Urban areas are also facing great energy crisis. So only the way to cope with this problem is development of hydro energy and its balanced distribution in rural areas, as well as remote area's of the country. The today's national interest should be in investment in hydro energy development using mostly internal resources and reducing foreign aid and loan, in energy sector. If we could mobilize the internal resources it could accelerate the speed of hydro energy development. This will help to create the indigenous technologies in hydropower development sector. Alternative resources like micro hydro and IPP production should be highly encouraged for increase INPS capacity. This is the only one way which uses the local resources and

sustainable development of the hydro energy sector in Nepal. Lastly we can conclude that, macro indicators are affected by agro-based activities in the Nepalese economy. Nepal could not achieve modern agro-based industrialization without harnessing available water resource in the form of hydro energy. Present agro-based economy could not give any sign of rise up beyond this development path. The stagnancy of agro-based economy could not be restructured with out use of modern energy form.

6.3 Recommendations

Recommendations are as following:

a. **Natural Gift and Development Strategy:** In the present situation economic activities cannot accelerate without electric fuel. The sources of other fuels are decreasing day by day. But in the context of renewable energy, hydro power could be a sustainable energy source in Nepal. Because the water resource is well known for hydro capacity and its generation in Nepal. So all the development strategy should be followed by water resources development. If hydro projects will be strategically proposed with the view of down stream effects there will be equal chance of agro-development, in the country, which is still the backbone of country's livelihood.

b. **Conventional Fuel Consumption Structure should Substitute Gradually by Hydro-Energy:** Modern development cannot formulated with out use of non-conventional fuel structure in grass root level of society. This is the age of globalization and e-governance, but a bitter reality is that, Nepal has heavily depended in conventional type fuels sources. On the other hand advanced technologies for electric generation are far form present situation and imported fuels are costly for government to subsidies. So hydro energy could substitute for the conventional type fuel, which are consuming largely

through out the country. After that high life standard of people with modernization and industrialization will achieve among strong economic activities. In this situation per capita energy consumption will measure the status of people and improve their present life standard in Nepal.

c. Internal Sources for Hydro-Projects Development: Now investment situation in hydro projects in Nepal is depended on foreign assistance. Even most of the technologies and manpower are imported to construct medium type projects. It's serious effects reflects the high per unit cost for customer. So nation should take maximum efforts for mobilization of indigenous sources for investment and produce own technology and manpower. At least one or two large scale hydro project could be installed to address domestic need at present. It is contradict situation of energy export by such projects which will be built by foreign loan and grant. Government should guarantee consumption of hydro-power for all people and all part of the country. After that export oriented projects could be invited wholly depended on foreign investor in power sector. Government should facilitate private sector financing in rural energy, like small hydro and micro hydro plants. Which can be collected small sources of investment in hydro energy sector and fulfill the energy demand of isolated area.

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TERMS AND DEFINITION

MW and KWH:

If 5 megawatt (MW) power is generated for 24 hours then the KWH will be 5 x 24 = 120 MWH and 120 x 1000 KWH = 120,000 kwh.

Categories of power projects:

Hydropower projects have been categorized as large, medium, small and micro scale projects on the basis of the capacity above 500 mw, 10mw to 300 mw, 1 mw to 10 mw and up to 1 mw respectively.

Electric current and hydro electricity:

Hydro electricity is derived from generators turned by the force of falling water. Most other electric energy is obtained from generators driven by steam produced either by a nuclear sector or by burning fosil fuel namely coal, gas and oil (Bhattarai 2004). Alternative energy sources solar and wind power also produce electric current.

Annex-1

Residential Sector Energy Consumption in Nepal

in 000 GJ

Fuel type	2001./02	2002/03	2003/04	2004/05	2005/06*
Traditional	298349	304611	311186	317798	324516
Fuelwood	266724	272323	278220	284138	290149
Agricultural residue	11723	11970	12221	12478	12742
Animal dung	19901	20319	20746	21181	21626
Commercial	14874	13993	13356	11815	12045
Petroleum	12839	11748	10892	9061	9108
LPG	1301	1451	1711	2008	2217
Motor Spirit	0	0	0	0	0
Air Turbine Fuel	0	0	0	0	0
Kerosene	11537	10297	9181	7053	6891
High Speed Diesel	0	0	0	0	0
Light Diesel Oil	0	0	0	0	0
Fuel-Oil	0	0	0	0	0
Others	0	0	0	0	0
Coal	27	23	29	25	39
Electricity	2009	2222	2435	2729	2898
Renewablcs	1432	1665	1779	1955	2134
Biogas	1392	1620	1731	1903	2078
Micro Hydro	40	44	47	50	53
Solar	0	1	1	2	3
Others	0	0	0	0	0
Total	314655	320269	326321	331567	338696

Source: Energy Synopsis Report, 2006.

Note: * Provisional figures, subject to final audit.

Annex-2

Industrial sector energy consumption in Nepal

in 000 GJ

Fueltvpc	2001/02	2002/03	2003/04	2004/05	2005/06*
Traditional	1986	2069	2157	2245	2338
Fuelwood	684	712	743	773	804
Agricultural residue	1302	1357	1414	1473	1533
Animal dung	0	0	0	0	0
Commercial	10551	9900	11559	10516	14647
Petroleum	1945	1936	1812	1331	1469
LPG	0	d	0	0	0
Motor Spirit	0	0	0	0	0
Air Turbine Fuel	0	0	0	0	0
Kerosene	662	603	538	413	404
High Speed Diesel	182	190	190	199	197
Light Diesel Oil	1	0	0	0	0
Fuel Oil	578	554	421	-28	27
Others	522	588	663	747	841
Coal	6454	5698	7263	6434	10248
Electricity	2152	2266	2483	2750	2930
Renewable	0	0	0	0	0
Biogas	0	0	0	0	0
Micro Hydro	0	0	0	0	0
Solar	0	0	0	0	0
Others	0	0	0	0	0
Total	12537	11969	13716	12761	16985

Source: Energy Synopsis Report, 2006.

Note: * Provisional figures, subject to final audit.

Annex-3

Commercial sector energy consumption in Nepal

in 000 GJ

Fueltype	2001/02	2002/03	2003/04	2004/05	2005/06*
Traditional	1750	1925	1926	2049	2214
Fuelwood	1750	1925	1926	2049	2214
Agricultural residue	0	0	0	0	0
Animal dung	0	0	0	0	0
Commercial	3172	3303	3391	3286	3621
Petroleum	2846	2970	3001	2893	3205
LPG	1028	1229	1449	1700	2040
Motor Spirit	'0	0	0	0	0
Air Turbine Fuel	0	0	0	0	0
Kerosene	1818	1741	1552	1192	1165
High Speed Diesel	0	0	0	0	0
Light Diesel Oil	0	0	0	0	0
Fuel Oil	0	0	0	0	0
Others	0	0	0	0	0
Coal	0	0	0	0	0
Electricity	326	334	389	394	417
Renewables	0	0	0	0	0
Biogas	0	0	0	0	0
Micro Hydro	0	0	0	0	0
Solar	0	0	0	0	0
Others	0	0	0	0	0
Total	4921	5228	5316	5335	5836

Source: Energy Synopsis Report, 2006.

Note: * Provisional figures, subject to final audit.

Annex-4

Agriculture sector energy consumption in Nepal

in 000 GJ

Fuel type	2001/02	2002/03	2003/04	2004/05	2005/06*
Traditional	0	0	0	0	0
Fuel wood	0	0	0	0	0
Agricultural residue	0	0	0	0	0
animal dung	0	0	0	0	0
Commercial	2776	2888	2892	3085	3100
Petroleum	2671	2780	2778	2905	2873
LPG	0	0	0	0	0
Motor Spirit	0	0	0	0	0
Air Turbine Fuel	0	0	0	0	0
Kerosene	0	0	0	0	0
High Speed Diesel	2647	2774	2772	2904	2872
Light Diesel Oil	24	6	6	1	1
Fuel Oil	0	0	0	0	0
Others	0	0	0	0	0
Coal	0	0	0	0	0
Electricity	105	108	114	180	228
Renewable	0	0	0	0	0
Biogas	0	0	0	0	0
Micro Hydro	0	0	0	0	0
Solar	0	0	0	0	0
Others	0	0	0	0	0
Total	2776	2888	2892	3055	3100

Source: Energy Synopsis Report, 2006.

Note: * Provisional figures, subject to final audit.

Annex-5

Transport sector energy consumption in Nepal

in 000 GJ

Fuel type	2001/02	2002/03	2003/04	2004/05	2005/06*
Traditional	0	0	0	0	0
Fuel wood	0	0	0	0	0
Agricultural residue	0	0	0	0	0
animal dung	0	0	0	0	0
Commercial	12025	12703	13132	13894	14209
Petroleum	12004	12683	13112	13873	14189
LPG	72	81	96	113	128
Motor Spirit	119	2259	2276	2534	2628
Air Turbine Fuel	1716	1911	2316	2417	2721
Kerosene	0	0	0	0	0
High Speed Diesel	8028	8414	8407	8807	8710
Light Diesel Oil	69	18	17	3	3
Fuel Oil	0	0	0	0	0
Others	0	0	0	0	0
Coal	0	0	0	0	0
Electricity	20	20	20	21	20
Renewable	0	0	0	0	0
Biogas	0	0	0	0	0
Micro Hydro	0	0	0	0	0
Solar	0	0	0	0	0
Others	0	0	0	0	0
Total	12025	12703	13132	13894	14209

Source: Energy synopsis report, 2006.

Note: * Provisional figures, subject to final audit.

ANNEX 7

Tariff Rates of NEA

(Builling Effective since September 17, 2001)

1:	Domestic consumvers				
	A	Minimum Monthly Charge: Meter Capacity		Minimum Charge (NRs)	Exempt (kWh)
		Up to 5 Ampere		80.00	20
		15 Ampere		299.00	50
		30 Ampere		664.00	100
		60 Ampere		1394.00	200
		Three phase supply		3244.00	400
	B.	Energy Charge:			
		Up to 20 units		Rs. 4.00 per unit	
		21-250 units		Rs 7.30 per unit	
		Over 250 units		Rs. 9.90 per unit	
2.	**TEMPLES**				
	Energy charge			Rs. 5.10 per unit	
3	**Street Light**				
	A.	With Energy Meter		Rs 5.10 per unit	
		Without Energy Meter		Rs 1860.0 per kVA	
4	**Temporary supply**				
		Energy charge		Rs 13.50 per unit	
5	**Community wholeseal consumer**				
		Energy charge		Rs 3.60 per unit	
6	**Industrial**			Monthly Demand Charge	Energy charge
				Rs./kVA	Rs/Unit
	A.	Low voltage (400/230 Volt)			5.45
		a) Rural and Cottage		45.00	6.60
		b) Small industry		90.00	5.90
	B.	Medium Voltage (11kv)		190.00	5.80
	C.	Medium Voltage (33 kv)		190.00	4.80
	D.	High Voltage (66 kV and above)		175.00	4.60
7.	Commercial				
	A.	Low voltage (400/230volt)		225.00	7.70
	B	Medium Voltage (11kv)		216.00	7.60
	C	MediumVoltge (33 kv)		216.00	7.40
8.	Non commercial				
	A	Low voltage (400/230volt)		160.00	8.25
	B	Medium Voltage (11kv)		180.00	7.90
	C	MediumVoltge (33 kv)		180.000	7.80
9.	**IRRIGATION**				
	A	Low voltage (400/230volt)			3.60
	B	Medium Voltage (11kv)		47.00	3.50
	C	MediumVoltage (33 kv)		47.00	3.45

10	**WATER SUPPLY**				
	A	Low voltage (400/230volt)		140.00	4.30
	B	Medium Voltage (11kv)		150.00	4.15
	C	MediumVoltage (33 kv)		150.00	4.00
11	**TRANSPORTATION**				
	A	Medium Voltage (11kv)		180.00	4.30
	B	MediumVoltge (33 kv)		180.00	4.25

Time of Day (TOD) Rariff Rates

		Consumer category &	Monthly Demand	Energy charge (Rs/unit)		
		Supply level	Charge (Rs./kVA)	Peak Time	Off peak	Normal
				18:00-23.00	23:00-6:00	6:00-18:00
A:		**High Voltage (66.kV and above)**				
	1	Industrial	175.00	5.20	3.15	4.55
B.		**Medium Voltage (33 kV)**				
	1	Industrial	190.00	6.55	4.00	5.75
	2	Commerical	216.00	8.50	5.15	7.35
	3	non commercial	180.00	8.85	5.35	7.70
	4	Irrigation	47.00	3.85	2.35	3.40
	5	Wate supply	150.00	4.55	2.75	3.95
	6	Transportaiton	180.00	4.70	2.95	4.15
	7	Street light	52.00	5.70	1.90	2.85
C.		**Medium Voltage (11 kV)**				
	1	Indusrial	190.00	6.70	4.10	5.85
	2	commercial	216.00	8.65	5.25	7.55
	3	Non-commercial	180.00	9.00	5.45	7.85
	4	Irrigation	47.00	3.95	2.40	3.45
	5	Water supply	150.00	4.60	2.80	4.10
	6	Transportaiton	180.00	4.80	3.00	4.25
	7	Street light	52.00	6.00	2.00	3.00

Source: NEA (2006) a Year in Review

Note: a. If demand meter reeads kilowatts (kW) then kVA=kW/0.8

b. 10% discount in the total bill amount will be given to the govcernment of Npeal approved indsutrial district

c. 25% discount in the totla bill amount will be given to the Nepal Governemtn hospital and health Centers (except residential complex)

Annex-8

Power Development of Nepal

MAJOR HYDRO POWER STATION			**THERMAL POWER STATIONS**		
EXISTING:			**EXISTING:**		
1	Trisuli	24,000kW	1	Biratnagar	1028kW
2	Sunkosi	10,050kW	2	Hetauda	12,750kW
3	Gandak	15,000kW	3	Marsyangdi	2,250kW
4	Kulekhani no1	60,000kW	4	Duhabi Multifuel-1	26,000kW
5	Devghat	14,100kW	5	Duhabi Multifuel-2	13,000kW
6	Kulekhani no.2	32,000kW		Total	55,028kW
7	Marsyangdi	69,000kW	**SMALL HYDROPOWER**		
8	Puwalkhola	6,200kW	**Existing (Grid Connected)**		
9	Madi Khola	14,800kW	1	Pharping***	500kW
10	Kali Gandaki 'A'	144,000kW	2	Panauti	2,400kW
	Total	389,150kW	3	Sundarijal	640kW
Under Construction (NEA)			4	Phewa (Pokhara)	1,088kW
1	Middle marsyangdi	70,000kW	5	Seti (Pokhara)	1,500kW
2	Chameliya	30,000kW	6	Tinau (Butwal)	1024kW
3	Kulekhani III	14,000kW	7	Baglung	200kW
Planned and propsoed:			8	Tatopani/ Myagdi (i+ii)	2,000kW
1	Seti (west)	750,000kW	9	Jomsom**	240kW
2	Arun 3	402,000kW	10	Chatara	3,200kW
3	buddhi Gandaki	600,000kW		Total	12,792kW
4	Kali Gandaki2	660,000kW	**Existing (Isolated):**		

5	Lower Arun	308,000kW	1	Dhankuta	240kW
6	Upper Arun	335,000kW	2	Jhupra (Surkhet)	345kW
7	Kamrnali (Chisepani)	10,800,000kW	3	Doti	200kW
8	Upper karnali	300,000kW	4	Phidim**	240kW
9	Pancheswor	6,480,000kW	5	Gorkhe (Ilam)***	64kW
10	Thulo Dhunga	25,000kW	6	Jumla**	200kW
11	Tamure/Mewa	101,000kW	7	Dhading	32kW
12	Upper Rrisuli	61,000kW	8	Syangja***	80kW
13	Dudh Kosi (Storage)	300,000kW	9	Helambu	50kW
14	budhi Ganga	20,000kW	10	Salleri* (Sceco)	400kW
15	Rahughat Khola	27,000kW	11	Darchula (i) & (ii)**	300kW
16	Likhu-4	40,000kW	12	Chame	45kW
17	Kabeli 'A'	30,000kW	13	Taplejung**	125kW
18	Upper Marsyangdi 'A'	121,000kW	14	Manang	80kW
19	Upper Trisuli 3B	44,000kW	15	Chaurjhari ** (Rukum)	150kW
20	Andhikhola (Stroage)	180,000kW	16	Syarpudaha** (Rukum)	200kW
21	Khimiti II	27,000kW	17	Khandbari**	250kW
22	Hewa khola	10,000kW	18	Terhathum**	100kW
23	Langtang Khola (Storage)	218,000kW	19	Bhojpur**	250kW
24	Madi Ishnaswor (storage)	686,000kW	20	Ramechhap	150kW
25	Upper Seti (storage)	122,000kW	21	Bajura	200kW
26	Kankai (storage)	60,000kW	22	Bajhang**	200kW
27	Upper Tama Kosi	309,000kW	23	Arughat Gorkha	150kW
28	Upper Modi 'A'	42,000kW	24	Okhaldhunga	125kW
	Total	22,458,000kW	25	Rupalgad (Dadeldhura)	100kW

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26	Surnaiyagad (Baitadi)	200kW	**SOLAR POWER**		
27	Namche*	600kW	1	Simikot	50kW
28	Achham	400kW	2	Gamgadhi	50kW
29	Dolpa	200kW		Total	100kW
30	Kalikot	500kW	**⊥ TRANSMISSION LINE LENGTH**		
	Total	6176kW	1	132 kV transmission line	2076ckt km
Under construction (NEA)			2	66kV transmission line	586ckt km
1	Gamgad	400kW	3	66kV underground cable	7ckt km
2	Heldung	500kW	4	33kV single circuit	2485 km
	Total	900kW	**⊥⊥ SUBSTATION CAPACITY**		
Private sector plants				132/11 kV	71MVA
Existing:				132/33 kV	358MVA
1	Andhi Khola (BPC)	5,100kW		132/66 kV	211MVA
2	Jhimruk (BPC)	12,000kW		66/11 kV	424MVA
3	Khimti Khola (HPL)	60,000kW		66/33 kV	25MVA
4	Bhotekoshi (BKPC)	36,000kW		Total	1089MVA
5	Sange Khola (SHP)	183kW	Note:		
6	Indrawati (NHPC)	7,500kW	* Private & others		
7	Chilime (CPC)	20,000kW	** Leased to the private sector		
8	Piluwa Khola (AVHP)	3,000kW	*** Not in normal operation		
9	Chaku Khola (APCo)	1,500kW	⊥ IPPs lines not included		
10	Sunkoshi Small (SHP)	2,500kW	⊥ These capacities are within the Grid substations only. Transformers within distribution substation, power houses and local distributions are not included		
11	Rairang (RHPD)	500kW			
	Total	14,8283kW			
Under Construction:			Installed capacity in Nepal Electricity Authority (including Private and Others)		
1	Khudi (KHP)	3,450kW			
2	Sisne Khola (GBHP)	750kW			
3	Bramchi (UH)	999kW			
4	Thoppal Khola (THP)	1,400kW			
5	Pheme Khola (KHP)	995kW			
6	Lower Nyadi (BHP)	4,500kW			

7	Lower Indrawati (SHP)	4,500kW	Source: *NEA (2006) Fiscal Year 2005/06 A Year I Review*
8	Salinadi (KSHPL)	232kW	
	Total	16,826kW	

Annex-6

Historical Trend of Energy Consumption by Fuel Type in Nepal

in 000GJ

Fuel type	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Share % in 1995	Share % in 2005
Traditional	258212	263634	267138	272893	278748	284735	290859	302085	308606	315269	322105	91.14%	87.71%
Fuel wood	230651	235495	237555	242687	247884	253199	258636	269158	274960	280888	286960	81 41%	78 14%
Agricultural residue	10354	10571	11645	11893	12166	12446	12732	13026	13327	13635	13964	3,65%	3.80%
Animal dung	17207	17568	17937	18314	18698	19091	19492	19901	20319	20746	21181	6.07%	5 77%
Commercial	24784	27759	29440	32741	34851	44956	43344	43852	43271	44863	43195	8.75%	11.76%
Petroleum	19119	21615	23623	26619	28180	30224	31286	32305	32116	31596	30063	6.75%	8.19%
LPG	643	916	1075	1131	1232	1508	1975	2401	2761	3257	3821	0.23%	1.04%
Motor Spirit	1172	1380	1497	1572	1674	1862	1984	2119	2259	2276	2534	041%	069%
Air Turbine Fuel	1357	1469	1731	1860	2009	2056	2283	1716	1911	2316	2417	0 48%	0.66%
Kerosene	6559	7568	8841	10226	10696	12006	11472	14018	12641	11271	8659	2 32%	2 36%
High Speed Diesel	8597	9501	9783	11402	11978	11780	12367	10857	11378	11369	11911	3.03%	3 24%
Light Diesel Oil	149	174	78	38	21	156	134	94	24	23	3	005%	0 00%
Fuel oil	406	341	320	54	189	428	588	578	554	421	-28	0 14%	-0.01%
Others	236	266	299	337	380	428	482	522	588	663	747	008%	0 20%
Coal	2839	3085	2540	2579	2893	10504	7446	6481	5721	7292	6459	1.00%	1.76%
Electricity	2826	3059	3278	3542	3778	4227	4612	5066	5434	5974	6673	1.00%	1.82%
Renewable	319	435	561	705	856	1015	1217	1432	1665	1779	1955	0.11%	0.53%
Biogas	298	412	536	678	826	981	1179	1492	1620	1731	1903	0.11%	0 52%
Micro Hydro	21	23	25	27	1 30	34	38	40	44	47	50	0.01%	001%
Solar	0	0	0	0	0	0	0	0	1	1	2	0.00%	0 00%
Others	0	0	0	0	0	0	0	0	0	0	0	0 00%	0 00%

Grand Total	283315	291827	297139	306339	314454	330706	335421	347369	353542	361910	367255	100.00%	100.00%

Source: Energy Synposis Report, 2006.

Annex-9

Structure of Energy Consumption from 1990/91 to 2005/06 in Nepal

Thousand tonne of Oil Equivalent

Energy sources	1990/91	1991/92	1992/93	1993/94	1994/95	1995/96	1996/97	1997/98	1998/99	1999/00	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06*
Traditional	5576	5691	5811	5933	6059	6185	6268	6403	6540	6681	6824	7066	7240	7397	7558	7721
Fuelwood	4980	5084	5191	5300	5412	5525	5574	5694	5816	5941	6068	6315	6451	6591	6733	6878
Agri. waste	224	228	233	238	243	248	273	279	285	292	299	305	312	319	328	336
Animal dung	372	379	387	395	404	412	421	430	439	448	457	446	477	487	497	507
Commercial	349	419	430	483	581	651	691	769	818	1054	1016	1029	1015	1059	1014	1133
Coal	42	58	26	32	67	72	60	61	68	246	174	152	134	171	152	241
Petroleum	257	306	348	391	448	507	554	625	661	709	734	758	753	747	705	724
Electricity	50	55	56	60	66	72	77	83	89	99	108	119	128	141	157	168
Others	4	5	6	6	7	10	13	16	20	24	29	33	39	45	45	50
Total	5929	6115	6247	6422	6647	6846	6972	7188	7378	7759	7869	8128	8294	8501	8617	8904

*Estimate of first eight months.

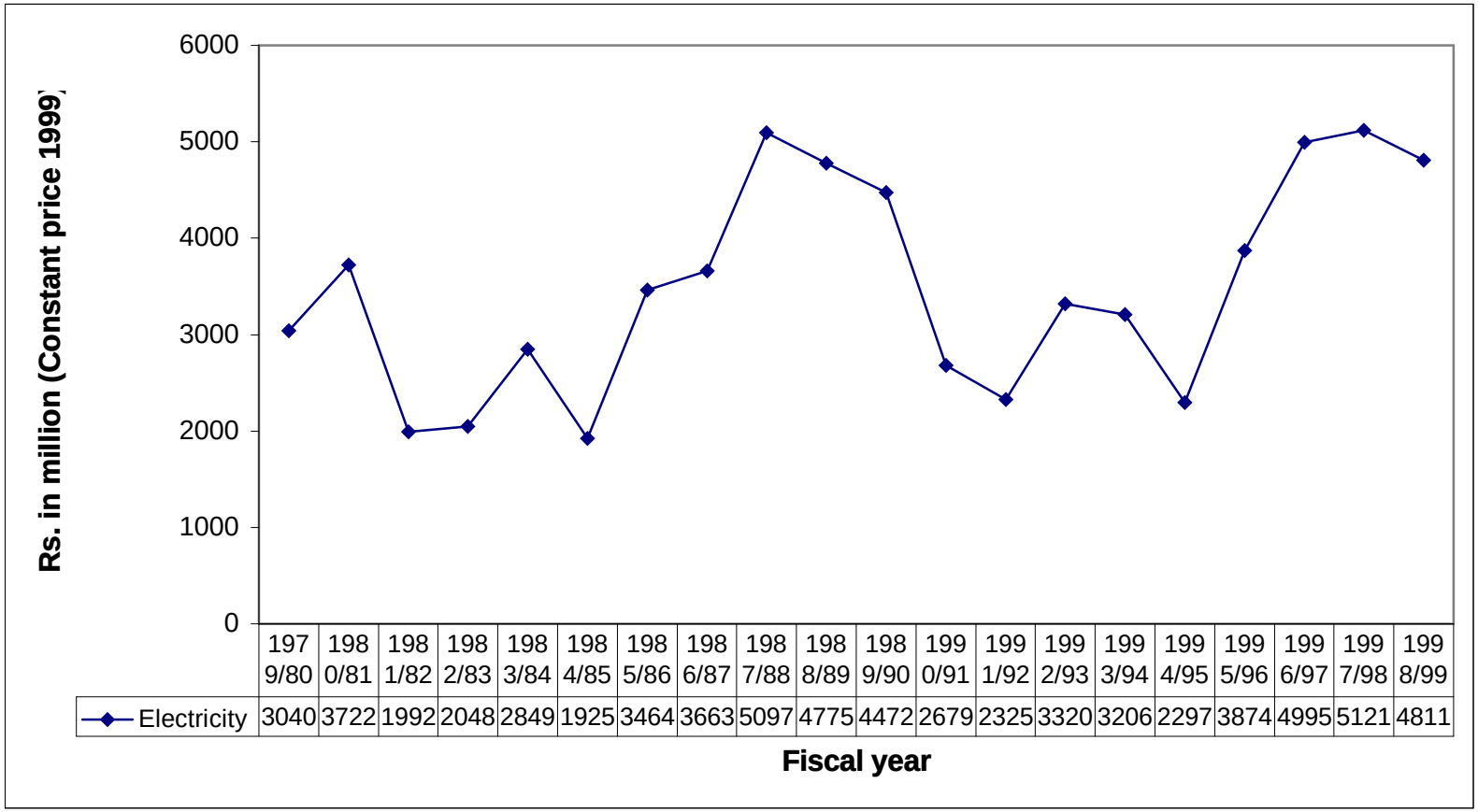
Note:

1. Since the fiscal year 1993/94 structure of energy consumption is presented in tonne of oil equivalent (TOE) instead of tonen of coal equivalent (TCE). The basis of conversion is taken as 1 TOE equivalent to. 1 454288 TCE.
2. The renewable energy has been included from FY 2004/05 in detail.
3. As data have been adjusted in accordance with the survey recently conducted by water and energy commission it may not verify with the earlier statistics.

(Source: Economic survey, 2005/06).

Annex-10

National Capital Expenditures in the Hydro Energy Sector from 1979/80 to 1998/99 in Nepal



	197 9/80	198 0/81	198 1/82	198 2/83	198 3/84	198 4/85	198 5/86	198 6/87	198 7/88	198 8/89	198 9/90	199 0/91	199 1/92	199 2/93	199 3/94	199 4/95	199 5/96	199 6/97	199 7/98	199 8/99
Electricity	3040	3722	1992	2048	2849	1925	3464	3663	5097	4775	4472	2679	2325	3320	3206	2297	3874	4995	5121	4811

Source: Water resource strategy Nepal (2002), WESC Singhadurbar.

Annex-11

Percentage share of Sectoral Energy Consmption at Differetn Years in Nepal

Sector	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Residental	92.11	91.68	92.33	91.90	91.53	89.25	89.78	90.58	90.59	90.17	90.28
Industrial	3.91	4.03	2.16	2.26	2.39	4.75	3.88	3.61	3.39	3.79	3.47
Commercial	0.90	0.97	1.07	0.95	1.02	1.12	1.23	1.42	1.48	1.47	1.45
Transport	2.77	2.99	4.02	4.42	4.72	3.87	4.05	3.46	3.59	3.63	3.78
Agricultural	0.23	0.24	0.33	0.36	0.23	0.90	0.94	0.80	0.82	0.80	0.84
Others	0.09	0.09	0.10	0.10	0.11	0.11	0.12	0.13	0.14	0.15	0.17
Trand Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Source: Energy Synopsis Report 2006.

Investment in Electricity Sector and Source of Financing

Year Sources	1984/85		1985/86 – 1989/90		1990/91-1994/95		1995/96- 1999-2000		2000/01 –2005/06					
	Amount	Share %	Amount	Share %	Amount	Share %	Amount	Share %						
Internal	176.90	35	11079.01	61.18	28666.62	78.96	10492.51	63.48						
Government	176.27	34.87	1258.86	6.95	1782.60	4.91	1633.70	2.56						
NEA	-	-	9798.36	54.11	21052.39	57.99	33091.90	51.88						
Private *	0.63	0.12	21.79	0.12	5831.36	16.06	5766.91	9.04						
External	328.60	65	7031.30	38.82	7637.85	21.04	23296.39	36.52						
Loan	286.80	56.74	5385.10	29.73	6112.10	16.84	17366.40	27.22						
Grant	41.80	8.21	1646.20	9.09	1188.50	3.27	3711.30	5.82						
FDI	-	-	-	-	396.75	0.93	2218.69	3.48						
Total	505.50	100	18110.31	100	36304.47	100	63788.90	100						

Annex-12 (a)

Revenue from Electricity in different years by NEA

(Rs. in million)

Category	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006*
Domestic	1769.84	1895.85	2056.05	2622.03	3161.38	3641.43	4249.81	4578.99	4987.04	5363.46
Non-Commercial	386.36	405.14	419.58	527.40	835.78	722.12	783.99	816.01	862.37	92948
Commercial	446.96	477.04	515.72	661.58	555.62	818.75	894.91	986.07	1012.66	1138.21
Industrial	1801.58	1973.37	2093.88	2599.34	3086.10	3608.13	4039.65	4380.22	4799.74	5061.11
Water Supply & Irrigation	95.70	100.28	78.14	95.65	120.90	138.68	148.53	154.80	211.57	196.63
Street tight	80.11	101.98	111.37	149.95	176,05	200.74	246.79	329.52	314.11	373,06
Temporary Supply	7.99	7.17	7.06	13.39	6.77	3.63	4.74	3.46	5.06	9.86
Transport	6.09	6.51	9.46	18.31	27.73	27.90	29.29	28.94	30.72	30,50
Temple	6.21	6.71	7.42	9.70	11.45	12.16	14.24	20.80	29.17	25.04
Community Sales	-	-	-	-	-	-	16,59	20.09	2404	2847
Total (Internal Sales)	4600.84	4974.05	5298.67	6697.35	7981.78	9173.53	10428.53	11318.92	12276.46	13155.81
Bulk Supply (India)	249.29	199.92	198.15	327,80	396.06	514.12	808.96	673.69	609.51	565,60
Gross Revenue	4850.13	5173.96	5496.82	7025.16	8377.83	9687.65	11237.49	11992.61	12885.97	13721.41
Rebate									280.78	305.08
Net Income from Other									659.16	596.57

Services										
Total Revenue	4850.13	5173.96	5496.82	7025.16	8377.83	9687.65	11237.49	11992.61	13264.36	1401290

* Provisional figures; subject to final audit.
Source: NEA, Fiscal year 2005.

Annex-12 (b)
Electricity Sales in different years by NEA

In GWH

Category	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006*
Domestic	355.118	378.778	410.566	467.049	518.36	557.94	617.11	676.365	730.829	810.19
Non-Commercial	57.991	60,227	62931	63592	73,157	78.22	80.736	83012	91.342	101 03
Commercial	67.606	71.471	77.343	81.822	94.166	90.426	92.741	108.122	107.435	123.45
Industrial	376,742	413738	440.996	508357	520.634	596.677	629.505	689.799	763.771	803.35
Water Supply & Irrigation	27.978	29.045	22.831	15.742	28.6	29.283	29.983	31.671	36.115	42.73
Street Light	20.929	26.585	29.405	31.741	36,981	39.517	45.803	55.196	57.844	64,88
Temporary Supply	0.844	0.711	0.766	0.927	0.826	0.282	0.348	0,251	0.394	0.73
Transport	1,483	1.663	2,598	2,678	5.892	5635	5.53	5,471	5.715	5.98
Temple	1.691	1.801	1.982	2.366	2.511	2.476	2.811	4.111	4.204	4,91
Community Sales	-	-	-	-	-	5.717	4.74	5.581	8.172	802
Total (Internal Sales)	910.382	984.019	1049.418	1174.274	1281.127	1400.456	1504.567	1653.998	1805.821	1965.27
Bulk Supply (India)	100.218	67.41	64.158	95	126	133,857	192.249	141.235	112.529	101
Grand Total	1010.6	1051.429	1113.576	1269.274	1407.127	1534.313	1696.816	1795.233	1918.35	2066.27

* Provisional figures; subject to final audit.

Source: NEA, Fiscal year 2005.

Annex-13

Growth of Electricity consumer in Nepal from 1997 to 2006

Particulars	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006*
Domestic	503330	548110	593468	643314	713307	848540	930554	1010719	1113740	1229750
Non-Commercial	6338	7192	7654	7815	7643	8629	9722	9865	9950	10010
Commercial	2441	2637	2948	3096	3386	3898	5317	5454	6000	6170
Industrial	12928	14062	14996	16179	17701	18789	19833	21374	22500	23020
Water Supply	190	205	215	232	236	251	305	352	370	380
Irrigation	713	776	876	967	1083	1353	1721	2557	3400	6450
Street Light	482	683	842	932	1012	1048	1229	1437	1500	1550
Transport	8	12	21	47	37	49	48	48	50	54
Community Sales	_	-	_	-	_	1	1	15	35	58
Total (Internal Sales)	527452	574844	622358	673974	745987	884530	970606	1053930	1159850	1279897
Bulk Supply (India)	5	5	5	5	5	5	5	5	5	5
Grand Total	527457	574849	622363	673979	745992	884535	970611	1053935	1159855	1279902

* Provisional figures; subject to final audit.
Source: NEA, Fiscal year 2005.

Annex-14

Total Investment and Production in Hydro Electricity Sector in Nepal

(Rs. in Million)

FY	Gvt. Total Revenue	HMG's Investment						NEA's Investment			J.V Lo
		Local	Share % of revenue in electricity	Foreign Assistance			HMG Total	In Gvt. Projects	In its own Projects	Total	Inv
				Grant	Loan	Total					
1975/76	1115.6	25.89	2,32	14.20	8.50	22.70	48.59				
1976/77	1322.8	2330	1.76	8.60	16.80	25.40	48.70				
1977/78	1582	35.34	2.23	15.40	192.40	207.80	243.14				
1978/79	1811.9	5507	3.04	46.70	161.80	208.50	263.57				
1979/80	1880	87.81	4.67	145.10	261,30	406.40	494.21				
1980/81	2419.2	92.89	3.84	202.00	358.30	560.30	653.19				
1981/82	2679.5	65.97	2.46	186.60	129.60	316.20	382.17				
1982/83	2841.6	12958	4.56	15190	161 80	313.70	443,28				
1983/84	3409.3	190,09	5,58	119.20	343.70	462.90	652.99				
1984/85	3916.6	176.27	450	41.80	286,80	328.60	504,87				
1985/86	4644.5	143,88	3,10	188,10	703.40	891.50	1035.38	114.48		114.48	
1986/87	5975.1	307.85	5.15	99.40	831.90	931.30	1239.15	135.26	1192,34	1327.60	
1987/88	7350.4	253.16	3,44	536.40	1135.10	1671.50	1924.66	178.35	110305	1281.40	
1988/89	7776.9	267,97	3.45	296.10	1439.30	1735.40	2003,37	195.45	4744,70	4940,15	
1989/90	9287,5	286.00	308	526.20	1275.40	1801.60	2087.60	231.23	1903.50	2134.73	
1990/91	10729.9	199,50	1.86	356.70	806.90	1163.60	1363.10	276.17	7611.84	7888.01	2
1991/92	13512.7	1 171 00	1,27	300.30	943.10	1243.40	1414.40	348.65	1865.23	2213.88	
1992/93	15148.4	220.60	1.46	429.00	1579.50	2008.50	2229.10	394,45	3962.33	4356.78	576
1993/94	19580.8	679,90	3.47	50.90	1581.40	1632.30	2312.20	213.18	3321.45	3534,63	
1994/95	24575.2	511,60	2.08	51.60	1201.80	125330	1764.90	452.13	2606.96	3059.09	
1995/96	27893.1	308.10	1.10	817.40	2084.70	2902.10	3210.20	680.14	4097.63	4777.77	368
1996/97	30373.5	578.80	1.91	1303.00	2565.50	3868.50	4447.30	960.84	5449.67	6410.51	

1997/98	32937.9	58610	1.78	828.80	3289.80	4118.60	4704.70	1130.25	4984.03	6114.28	
1998/99	37251	140.20	0.38	437.00	4234.10	4671.10	4811.30	1439.06	5281.62	672068	179
1999/00	428938	2050	005	325.10	5192.30	5517.40	5537.90	1212,48	7856.18	9068.66	12

Source: Bhattarai (2005) "Hydroelectricity development in Nepal, Kathmandu.

Annex-15 : Hydropower Generating Stations by Types

Hydropower Generating Stations by Types Installed Capacity and Year of Commissioning

S.N.	Name of station	Installed capacity (kw)	Year of commissioning
1	Sundarijal	640	1935
2	Panauti	2400	1965
3	Trisuli	21000	1967
4	Pokhara	1088	1967
5	Sunkoshi	10050	1972
6	Gandaki	15000	1979
7	Kulekhani-I	60000	1982
8	Devighat	14100	1983
9	Dhankuta	240	1971
10	Tinau (Butwal)	1024	1978
11	Surkhet (Jhupra)	345	1977
12	Gajuri	25	1978
13	Thansing	20	1979
14	Baglung	175	1981
15	Doti	200	1981
16	Phidim**	240	1981
17	Gorkhe	64	1982
18	Jomsom**	2401	1983
19	Jumla**	200	1983
20	Dhading	32	1983
21	Syangja	80	1984
22	Pokhara (Seti)	1500	1985
23	Helumbu	50	1985
24	Godawri (HMG)	30	-
25	Kulekhani II	3200	1986

26	Darchula (I &II)**	300	1987
27	Salleri (SCECO)*	400	1986
28	Chame	45	1987
29	Manang	80	1988
30	Marsyangdi	69000	1989
31	Adhikhola (BPC)	5100	1991
32	Arughat (Gorkha)	150	1990
33	Bajhang	200	1989
34	Bajura	200	1990
35	Bhojpur**	250	1989
36	Chaurjhari**	150	1989
37	Khandbari**	250	1989
38	Okhaldhunga**	125	1990
39	Ramechhap	150	1989
40	Rupalgadh	100	1991
41	Syarpudaha**	200	1989
42	Taplejung	1258	1988
43	Tatopani Myagdi I	1000	1991
44	Terhathum**	100	1988
45	Surnayaoad**	200	1991
46	Tatopani Myagdi II	1000	1995
47	Achham	400	1995
48	Namche II*	600	1994
49	Pharping***	500	1911
50	Jimruk (Pyauthan)	12300	1995
51	Kalikot	500	1999
52	Dolpa	200	1999
53	Puwa Khola	6200	2000
54	Khimti Khola (HPL)	60000	2000
55	Modi Khola	14800	2001
56	Bhote Koshi (BKPC)	36000	2002

57	Indrawoti (NHPC)	7500	2003
58	SangiKhola (Sange HP)	183	2003
59	Chilime	20000	2003
60	Kali Gandaki 'A'	144000	2003
61	Chatra	3200	-

* Private, ** Leased, *** Not in normal operation

Source: Statistical Pocket Book Nepal, 2006, CBS, Ramshahpath.