CONTRIBUTION OF HYDRO-ELECTRICITY IN ECONOMIC DEVELOPMENT OF NEAPL

A Thesis

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By

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RECOMMENDATION LETTER

This thesis entitled "Contribution of Hydro-Electricity in Economic Development of Nepal" has been prepared by Mr. Khim Raj Paudel under my Supervision. I hereby recommended this thesis for examination by the Thesis committee as a partial fulfillment of the requirements for the Degree of MASTER OF ARTS in Economics.

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APPROVAL SHEET

We certify that this entitle "Contribution of Hydro-Electricity In Economic Development of Nepal" Submitted by Mr. Khim Raj Paudel to Central Department of Economics, Faculty of Humanities and Social Sciences, Tribhuvan University in Partial fulfillment of the requirements for the Degree of MASTER OF ARTS in Economics has been found satisfactory in scope and quality. Therefore, we accept this thesis as a part of the said degree.

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ABBREVIATION

ADB -	Asian Development Bank
BOOT-	Build Own Operate Transfer
BOT -	Build Own Transfer
CBS -	Central Bureau of Statistics
FDI -	Foreign Direct Investment
GDP -	Gross Domestic Product
GOVN -	Government of Nepal
GWH -	Giga Watt Hour
INPS -	Integrated Nepal Power System
IPPs -	Independent Power Producers System
KW -	Kilowatt
LP -	Liquid Petroleum
MHPP -	Micro Hydro Power Plant
MW -	Megawatt
NA -	Not Available
NEA -	Nepal Electricity Authority
NEC -	Nepal Electricity Corporation
NPC -	National Planning Commission
NRB -	Nepal Rastra Bank
OPEC -	Organization of Petroleum Exporting Countries
ROR -	Run of River
SLA -	Subsidiary Lon Agreements.
UNDP -	United Nations Development Program
US$ -	United States Dollar
VDCs -	Village Development Committees
WECS -	Water and Energy Commission Secretaria

CHAPTER-I

INTRODUCTION

1.1 Background

Situated in south Asia, Nepal is a landlocked country bordered by the Tibetan Region of china in the north and India in the east, west and south. It is roughly rectangular in shape with a total land areas of 1, 47, 181 square KM. Stretching 885 KM from east to west and between 145 to 241 KM from north to south. Topographically, the country can be divided into three district region from north to south: the mountains, the hills and flat plains known as the Terai. Administratively, Nepal is divided in five development regions, fourteen zone and seventy five districts. Each district is further subdivided into municipalities and village development committees (VDCs) according to the level of infrastructural development. These are together 3992 VDCs and 58 municipalities in the country. Of the total population of 2.32 million in Nepal, almost 31% is below poverty line. The per-capita income as has been reported by CBS (2006) sands at US$ 314 in the fiscal year 2005/06. According to the latest information the growth rate of GDP in an average is 2.7 percent (NRB, 2006).

Nepal is a small hilly country which has a huge potential of hydro-power. All the large rivers flow speedily form the Himalayan region which are fed by snow and glaciers and are thus perennial. In fact, the perennial rivers and the sleep gradient of the country's topography provide ideal conditions for the development of some of the world's largest hydro-electric projects in Nepal. Nepal's electricity generation is dominated by hydro-power. In the highly industrialized countries, electric power is the life blood on which the whole society and economy

depends. Without electric power economy development of any country is hardly possible.

The use of water to produce hydro-electricity has advantage of absence of carbon-dioxide, sulpher-dioxide, nitrous-oxide and solid or liquid waste production. Thus the hydro-electricity should contribute to a substantial reduction emission of carbon-dioxide and other harmful gases are responsible for the green house effect. According to the national environmental policy Act of the united America (1969), "The incorporation of environmental consideration in the planning of water resources, development schemes and more specially hydro-electric power generation schemes, although generally agreed to beneficial and desired has to carefully implement."

Hydro-power is a cheap, renewable source of energy in Nepalese context. Capital, labor and energy are three primary factors that contribute to and influence economic growth and development in any country in the world. These three components are used to produce a county's gross domestic product (GDP), the total of all output produced in the country. Energy is the power that derives the country's economy. In the industrialized nation most of the equipment machinery, manufacturing plants and office buildings couldn't operate without energy. Hydro-power provides reliable, efficient, safe and economic sources of energy for increasing effectiveness of the decentralized industries system.

Hydro-electricity was originated from water resources at Rough Broug in Northumberland in 1978. Loard Armstrong lit his house with electric lamps taking current from a dynamo driven by a water turbine. Electricity is the main sources of energy in the world as modern world can't be imagined without electricity. The first hydropower station in

Europe for supplying electricity to the public was built at Zurich, Switzerland in 1882. It was based on thermal plants for to thirds of the total production. USA, Russia and many western countries as well as Japan in Asia used hydro-power for early development and industrialization.

According to Encyclopedia Britannica, "Electricity is the phenomenon associated with positively and negatively charged particles of matter at rest in motion individually or in great." (Encyclopedia Britannica Vol. 615the Edition).

According to Encyclopedia Britannica, "Hydro-electric power is electricity produced from generators that are driven by hydraulic turbines to insure the requisite head of water and consistency the stream flow. Thus creating reservoir that can be used for recreation of water supply purposes." (Encyclopedia Britannica Vol. 30, 15th Edition).

Many invention and researches are proved that Hydro-electricity is renewable, none polluting and sustainable sources of energy and it is generated in low social and economic cost. Most of the developing countries are suffering from energy crisis. Nepal has not been an exception from it. Demand and consumption of energy is gradually increasing along with population growth and economic development. Large amount of foreign exchange is required from petroleum fuel. Because of absence of production of petroleum products with in country, electricity production is justified. In Nepal, Solar and wind energy are comparatively costly then hydro-electricity. Hydro-electricity is known, renewable, non-polluting and available energy resource with in the country.

Nepal has possessed first position in Asia and second in the world after Brizil in hydro-electricity potentially. Out of the total hydro-power

generation capacity of about 83,000 Mega Watt (M.W.) in the country, about 42,000 MW of power generation appears feasible to date from financial-technical perspective. According to Energy Synopsis Report (2006), "Hydro-power utilization currently about 1.5% of proven potential. The total installed electricity generation is about 613.5 M.W. out of which hydro-electric generation capacity is around 557 MW of this total generation of electricity, 603 M.W. are hooked to the national grid and the remaining are in isolated serving system comprising 40 small/mini hydro plants, about 2000 micro-hydro and about, 1200 peltry sets serving remote areas of the country."

In Nepal first hydro-power plant was established at Pharping (500 KW) in 1911 A.D. It was followed by Sundarijai (640 K.W) in 1935. Gradually, further projects on established making agreements with the government so as to contribute for domestic supply that meet very limited load.

According to Prof. Dr. M.K. Dahal "It is often argued that water resource is in backbone of the Nepalese economy which could be instrument to provide a new lease of life to sinking economy of the total 83,00 MW theoretical hydro power potential in Nepal. Commercial potential is projected to be 40, 000 MW unfortunately efforts harnessing water resources and developing hydro-power have sluggish with inordinately low production of electricity (549 MW) in Nepal, which is 0.6 percent of total theoretical hydro-power potential. The poor level of hydro-power utilization is due to primary to financial resources constraints and inherent delays in project implementation. Nepal's electricity tariff rate is considered to be one of the highest in the region and the domestic charge one of the cost items in the household expenditure."

Water is a major source of renewable energy in Nepal. The country is rich in water resources, with a total capacity of 83, 000 MW. Of the total hydroelectric potential, Nepal has presently untapped hydroelectric potential amounting 43,000 MW. The availability of abundant water resources and favorable geo-political features has provided ample opportunities for development of hydropower. Nepal could prove itself as one richest country in the region if water and human resources are simultaneously developed. The construction of hydroelectric projects contributes to the economical regional, environmental and social development of a region; such projects often result in increased investment and economic growth.
(http://www.kanitpurline.com/kolnews.php? and mid=42443).

The hydro-electricity is one of the most essential requisites of social, economic development. Modern life is associated with it. Its invention and production has greatly changed the nation. Since it can be converted to any from of energy that is light heat, mechanical power etc., it can be used now-a-ways from cooking to run big-big factories so it can be said that the supply of power is one of the basic factors from bringing changes about economic development. By providing electricity to large extent, the nation can be industrialized at the fast rate. According to Binayak. Bhadra, "Nepal can therefore, become rich if she is able to use electricity in industry and water in agriculture. Furthermore cheap electricity can be an attraction for foreign private investors to locate their industries in Nepal so it is indeed troublesome not to find policies and strategies grad towards integration of hydro-electricity with the economy." So we can say that "electric power means progress." So power can be said to be the backbone of all the modern developments. All developing countries are trying to harness, their possible resource of

power, in every corner of their country thus they are progressing rapidly in all fields by raising the living standard of their people.

The generation of hydro-electric power has opened up a new horizon for industrial development in Nepal. Electric power is an important overhead in the country engaged in the economic development at any economy. Hydro-electricity is one of the vital factors which is playing dominant rate in economic development in Nepal.

1.2 Statement of the Problem

"Hydro-electricity" means not only development of energy resources but also protection of environment. It is well realized fact that these sources of energy could greatly help national development. In fact there is close relationship between power and economic development of nation. The more power could be produced, the faster will be the rate of development.

The electricity is produced by the movement of fresh water from rivers and it is a renewable energy, "Energy" plays vital role in sustainable economic growth. In spite of fact that our country still depends upon other sources like fuel, would, petroleum, etc. for power, the annual energy consumption growth rate is greater than the population growth rate. Its impacts on the forest are very serve and dangerous. So that degradation of environment is due to excessive exploitation of forest product. If the rate increases independent countries, there will be serious problem in Nepal Like soil-erosion, landslide, pollution etc, which are negative effects on economic growth and human life as well. One the other hand, day by day petroleum price is going up. So our country is facing negative impact on production of economic growth and development.

Nepal's huge potential in hydro-power is still untapped As Nepal

has just been able to tap one percent of its potential electricity capacity, and 60 percent of Nepal's population is still deprived of electricity. In Nepal it is the fact that hydro- electricity provides a great, comparative advantage in terms of cheap energy. Now a- days, the electricity tariff regime respects the more critical aspect of development policy at present, thus the income and employment multiplier associated with hydro-energy are significantly reduced, on the other hand, people suffer from regular load shedding even at present.

At the present situation, low finance, management blunder high tariff regime, poor infrastructure, geographical condition etc. are main problem of hydro-electricity development in Nepal. The development of hydro-electricity is still at it's infancy in Nepal. According to Dr. Narayan Prasad Bhattrai, "In the context of Nepal, it is said that 1 present growth in non agriculture GDP requires 1.3 percent growth in the electricity energy consumption." This shows that the growth in electric energy consumption brings sustainable growth in non GDP agricultural.

Acceleration of Economic growth requires the development of agriculture and industry. Agricultural and industrial growth needs to be paralleled by the expansion of transport sector, which is again energy intensive. Hydro-electricity is most versatile from of energy and provide infrastructure for economic development and growth of a country due to it's advantages over other sources of energy.

The study shows the contribution of Hydro-electricity in economic development of Nepal. I hope that this study will provide recommendation and policy formulation for the future development of the hydro- electricity.

1.3 Objective of the Study

The main objective of this study is to examine the contribution of hydro-electricity in economic development of Nepal. In accomplishing this objectives the study has include,

→ To trace out the historical development of hydro-electricity under the different plan period.

→ To access the present status of hydro-electricity in Nepal.

→ To establish the relationship between hydroelectricity contribution and economic growth.

1.4 Limitation of the Study

→ Limitation of data: The study is based on the investigation of the secondary sources of data.

→ Limitation of coverage: This study is limited only to the contribution of hydro-electricity in economic development of Nepal.
So alternative sources of energy won't be study.

→ The main constraints such as time and financial factor are the main.

CHAPTER- II

METHODOLOGY

2.1 Sources of Data

Research methodology is a way to systematically solve the research problem. The data used in the study are mainly limited to macro economic indicators and other variables to relate to electricity. Qualitative (Primary) data are not available in short period, so mostly quantitative (Secondary) data are used in this study. The secondary sources include the previous studies carried out on the issue of hydro -power various institution, organization books and thesis.

2.2 Research Design

A research design is a logical and systematic plan prepared for directing a research study. A research design is the program that guides the investigator in the process of collection analyzing and interpretation observation (Nachmaias and Nachmaias, 1987: 29)

This research is mainly exploratory and descriptive in it's nature. In this research, the researchers has systematically tried to explain" The contribution of hydro-electricity in economic development of Nepal" and shown the relationship between hydro electricity and economic development by some statistical tools.

2.3 Data Analysis

The collected data from various relevant sources is processed according to need of the chapter. The available data from various document are collected, classified and tabulated to meet the needs study. Simple statistical tools like regression, D-W test, percentage are used for analyzing the data when they are necessary.

2.3.1 Log linear regression equation

It establishes the relationship between dependent and independent variables. It used to show the degree and direction of the relationship between variable and it also provide a mechanism for prediction and forecasting. Here, to show the percentage share of hydro-electricity in GDP and price, a log linear regression model has been used. The theoretical statement of this model is that electricity contribution depends upon the GDP and current price. Mathematically, this can be written as:

$Y = b_0 + b_1 \log x_1 + b_2 \log x_2$ eq^n ……(1)

Where, Y = Electricity Contribution

x_1= GDP

x_2 = Current price

b_o, b_1 and b_2 are the parameters.

Log indicates the share of electricity contribution in GDP in percentage terms.

2.3.2 Graphical tools

In this study, simple table and cross table with appropriate variable, bar diagram, pie chart and map are used for presentation of information.

CHAPTER- III

REVIEW OF LITERATURE

The review of literature is important aspect of the study of contribution of hydro-electricity in economic development of Nepal. The main purpose of review of literature is to find out what works have been done in the area of research problem under the study and what has not be done in the field of research study.

There are some of notable and remarkable studies previously conducted in the area of hydro-electricity development in Nepal and its role is to overall development of Nepalese economy. The available significant and relevant literature to this research is reviewed to identify the pros and cons of the water resource for the contribution of hydro-electricity in economic development of Nepal. Both national and international experts have shown their keen interest and have increased their expertise in this sector.

Adhikari (2006), in his article "Hydro-power development of Nepal" Concludes that the hydro-power potential of Nepal is huge and sustainable hydro-power development become the key to make Nepal's economics growth scenario brighter gaining deep inroads into national goals and priority of poverty reduction. Hydro-power has a number of benefits:

- It is a continuously renewable electrical energy source.
- It is non-polluting i.e. no heat or noxious gases are released.
- It has no fuel cost and with low operating and maintenance cost, is essentially inflation proof.
- Hydro-power technology is a proven technology that offers reliable and flexible operation.

- Hydro-power stations have a long life and many existing stations have been in operation for more than half century and are still operating efficiently.
- Hydro-power station efficiencies of over 90 percent have been achieved making it the most efficient of the energy conversion technologies.

Bhadras (2004), the article, "Hydro-power development of Nepal" is also found relevant for the review. Some of the conclusions of this article are:

- More electricity and more fossil fuels are going to be need to produce next unit of output. The investment in hydro-power sector will have to be increased not only to cope with the rising trend in electricity demand but also for the extra demand resulting from the substitution of fossil fuels that may be deemed necessary.
- Nepal has relative abundance of fresh water which gives rise to it's comparative advantage in hydro-electricity generation and year-round irrigation. This means that irrigation and hydro. Electricity can plat a leading role in the development and modernization of Nepal.
- Nepal can, therefore, become rich if she able to use electricity in industry and water in agriculture. Furthermore, cheap electricity can be an attraction for foreign private investors to locate their industries in Nepal; So, it is indeed troublesome not to find policies and strategies geared towards integration of hydro-electricity with the economy.

Rai (2004, Delhi) analyzed on the "Non-conventional Energy Sources." Some of the major conclusions of the author are:

- Energy is an important input in all sector of any country's economy. The standard of living of a given country can be directly related to per-captia energy consumption. Energy crisis is due to the two reasons; firstly that the population of the world has increased rapidly and secondly the standard of living of human beings has increased.
- Hydro power on a large scale become possible around the beginning of the twentieth century only with development of electrical power transmission but the development rate of hydro-power is still low due to she following problems:

1. In developing a project it will take about 6-10 years times for planning, investigation and construction.
2. High capital investment is needed, and some parts of the investment have to be derived from foreign sources.
3. There are growing problems on reallocation of villages involved, compensation, for damage, selecting the suitable resettlement area and environmental impact.

Bhattrai (2005), in his book "Hydro-power development of Nepal". From his research he concluded that some of the following recommendation and necessary points for the policy makers:

- If Nepal can develop and export hydro-electricity (white gold of Nepal), it can earn billions of foreign currency. The example of OPEC countries shows the potential of earning huge amount of foreign exchange by exporting petroleum products to the rest of the world. Government should develop a perspective plan for the development of hydro power sector.
- The pattern of energy consumption in domestic sector should be shifted to other highly important sector, particularly electricity

based industries and transportation she accessibility of electricity should be extended to rural area of the country.

- Priority should be given to develop medium sized hydro-electricity project in general and micro power projects in particular in hill and remote areas.
- Preference should be given to mobilize domestic financial resources by encouraging private sector investment in hydro-power projects.
- Foreign direct investment could also be one of the potential sources of finance for hydropower development. So, the existing legal as well as institutional problems hindering FDI in hydropower sector should be resolved.
- There is a need for national consensus among major political parties on the issues of utilization of Nepal's water resources. A clear national policy on hydro. Power needs to be enunciated to be abode by any party that cause to power.
- NEA should be given authority and autonomy to work more efficiently. On it parts, NEA should strengthen its finical condition are reduce electricity loss, which is 25 percent at present with distribution system.
- Foreign loan should be accepted and invested in such hydro projects where adequate return would be generated to replay back the loan.

Dhital (2004), in his article "Hydro-power development in Nepal" states that:

- Nepal is water rich country, but with little efforts are towards harnessing water resources and developing hydro-power. In recent years, economic growth rate is confined fairly below the normal

target 4.3 percent during the tenth plan (2002-07). Growth has been inadequate to make crucial impact on poverty. Unless water resource is effectively utilized, it would be difficult to attain the millennium development Goals set by Nepal (UNDP, 2003).

- Hydro-power is a non-consumptive category of water use. In Nepal the underdevelopment of this resource can be attributed to financial constraint and inefficient management.
- Hydro-power is an exportable commodity. India is the potential market for the electricity that Nepal produces. India's willingness to pay for Nepal's hydro-power is one of the key factors for sustainable hydro-power development. Both the countries receive power from each other. Hydro-power is one of the potential areas of co-operation between Nepal and India.
- The access to electricity is to be taken as the key indicator to the progress of living standard. It enhances the capabilities of the people to reduced poverty. Thus hydro power development should be considered as one of the most important facts of economic development.

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 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, drying corps, 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.

Bastoal (1994) in his book "water resources development" analyzed on the Nepalese hydro-electricity development. Some of the major conclusions of the author are:

- Nepal is endowed with various renewable sources of energy among them hydro-power is one of the richest and most useful recourses of energy in Nepal.
- Rivers are not only the ornaments of the country but can be like demands it they are rightly utilized by evolving a long term plan for its development.
- Hydro-power though requires initially big investment for construction yet the running cost in low. But in Nepal hydropower projects can be quite comparative to any economical hydro-power project in the world.
- American experience shows that it is economical to contract hydro-power projects in hilly regions so also in our case. Hence location of hydro-projects in hills and regulation the flood water in the plain

areas where we can utilizes the regulated water for irrigations purpose. In general, it is better to locate our hydro projects in the hills, whose the river over flow she plain areas we should develop fishers in such reservoirs and they to develop navigation in the plain areas.

- In this period Nepal definitely set to ad more emphasis on hydro power potentiality which is can be good sources of revenue of the government and backbone to future industries.

Asymposium (1979), published by untied nations "Hydro-electricity Prospects in the New Energy Situation" is also found relevant for review. Some of the conclusions of this symposium are:

- The expected growth of the economically exploitable hydro potential must be considered in the framework of the expected future demand of electric power which in its turn, is to large extent dependent on economic growth.
- In general, most of the industrialized counties have developed their hydro-electric potential to a high degree.
- Hydro-electric energy is presently extremely valuable as the price of its replacement energy (fuel oil) is very high.
- The value of energy storage capacity should be carefully considered with a view to study the feasibility therefore.
- The development of standardization and automation may play an important role in economic feasibility studies on small power stations.
- The development of hydro-electric potential had to contend not only with economic and financial problems but also with the constraints of environmental protection.
- Multi purpose hydroelectric schemes, and their impact or the

environment should be considered in reaction to energy and water conservation as well as in a broader sense to the healthy development of society.

W.B. (2004), published by world bank "Nepal and the world bank" has found the relevant review, which includes some major points are described as follows :

- Nepal two principle sources of energy are forest and rivers. But deforestation is challenges, and using trees for is not sustainable process.
- Only 15 percent of Nepalese people having assessed to electricity.
- Hydro-power provides a reliable efficient safe and economic source of power for increasing effectiveness of the decentralized industries system.
- The World Bank has supported several hydro-power projects, with an emphasis on expanding generation and distribution, as well as improving technical and operational efficiency of the NEA.

Acharya (1983), analyzed the Nepalese hydro-power exploration development speed during the various planning period. According to her Nepal has not still got success to explore the available water resources, even in maintaining the domestic need of the electricity for the lighting purpose. She analyzed the various alternatives for the hydro power exploration in Nepal, along this she found some important point as follows:

- Hydro-electricity is the most useful natural resources for economic development in Nepal. It is back bone industry, agriculture, transportation, and it is the most useful thing for social service purpose also.
- The present level of hydro electricity development in Nepal being

abundant resources, very insignificant portion has been harnessed yet which is adequate.

- Power distribution in different development region is unbalanced.
- The water power potential of Nepal is it's great asset. Developments of these resources will not only increase foreign exchange but also will be turned as Arabian oil wealth in the future with efficient management.
- Nepal facing many problems in the hydro-electricity development, they are lack of capital, manpower, technical knows, how and sufficient market, with in the country. Beside this the most important problem in poor power plans of Nepal.

The report Hydro-power development policy (1992) has found the relevant review, which includes the objectives are:

- To supply electricity as per the demands of the people in urban and rural areas through the development of the high potentiality of the water resources that exists in the country.
- To enhance the development of hydro-power to meet the energy need required for the industrial development in the country.
- To motive the national and foreign private sector investment for the development of hydro-electric power.
- To render assistance in the conservation of environment by supplying clean energy through the development of hydroelectric power.

The journal (June, 2003) published by ADB (Philippines) is also found relevant for review which includes one major point is described as follows:

- Nepali estimated potential for hydro-power generation is 83, 000 megawatts (MW) of which about 42, 000 MW are technically and economically viable.

- The recent agreement between Nepal and India to increase the amount of power exchanges from 50 MW to 150 M.W. further facilities exchanges of power to need the demand border areas.
- Nepali faces complex changes in developing large scale hydro-power projects, including lack of capital resources poor health of electricity boards in India, and the difficulty in setting agree able tariffs.

Shrestha (2000), in his thesis entitled, "Hydro-electricity in Nepal" has found the relevant review, which includes some important point as follows:

- Nepal is known as the second richest county in water resources after Brazil. If fact that hydro-electric power plays a vital role in over all development of developing country like Nepal.
- Perennial rivers and steep topography have been proved to be the divine gifts of Nepal to generate hydro-electricity among 8300 M.W.
- In Nepal hydro-electricity is comparably chapter more affordable and permanent sources of energy that the energy we obtain from coal petroleum and oil gas.
- Adequate development of it promotes economic condition of the nation as well as human civilization.

Mahat (2007), Budget speech "fiscal year 2007-2008" has found the same important conclusion described follows:

- Despite accessive reserve of water resources the country is unfortunately facing the problem of load shedding every day and Nepal has to spend billions of rupees from India. In order to solve this situation quickly, it is essential to attract domestic and foreign investment. Due to the growing domestic and external demand for

energy, investors are attracted towards it. If this opportunity is properly utilized, the national gain will be high. Therefore, domestic resources to be mobilized for small and medium scale hydro power projects and foreign investment and resources to be mobilized for large scale hydro projects. Nepal has planned to produce 5000 MW hydro- electricity within next 10 years period. Nepal's government has allocated Rs. 7.65 billions in the hydro-electricity sector next year.

- Middle marsyagdi hydro- electricity project is going to be completed next year Chamelia hydro-electricity (30MW) project is planning to be accomplished by 2011. Similarly, Kabeli 'A' (30 MW) and Riddi Khola (2.4 MW), Trisuli- 3A (60MW), Upper Trisuli-B (40MW), Kulekhani-III hydro- electricity project are in under constructions and some project are planning to be started this fiscal year by mobilizing national and foreign resources. The large hydro-power projects like West Seti, Arun-III and Upper Karnali will be implemented shortly with foreign investments.
- Rural level electricity distribution system will be managed to serve additional 35 areas next year through community electricity distributing agencies under the community rural electrification and distribution management programme. For rural electrification program, if any private, electricity generating company wants to run the program, arrangement of cost sharing will be provisioned on the basic of the proposal. Next year, some 185 thousand households will be benefited from entire program of the rural electrification. Besides this unfinished rural electrification project will get one billion rupees immediately to generated electricity to the people. By this additional investment the entire districts of

Terai ad Ilam, Panchathar, Bhojpur, sindhuli, Dolakha, Kavre, Sindhupalchock, Nowakot, Dhading, Arghakhanchi, Gulmi, Palpa, Syangja, Kaski, Tanahun, Gorkha, Myagdi, Bageung, Dailekh, Surkhet, Dadeldhura, and other nearly 600 VDCs (including 49 districts)unfinished electrification program will be completed. By this program additional 5 Lakh people will directly be served by electricity.

In order to attract private sector in the electricity generating business, the following points will be simplified made security for the capital of the hydro-electricity project.

I. Survey license, power generation and power purchase agreement will be simplified.
II. Work permission will be made with in a short period of time.
III. Holding the project for long time should be minimized.
IV. The individual or companies who do not start their work in the time he's annual renewal fees should be increased.
V. The license should be cancelled if the works are not carried out with in specific period.

Jha and Devkota (2007), in their article, "Hydro-power and environment" from the half yearly journal 'Vidyut' have found the main two consequences of not development hydro-power in Nepal, these are:

- Environment consequences

In Nepal traditional sources of energy which includes the fuel-wood, agriculture residue and animal dung corers almost 86.24 percent of the total energy demand, in the year 2001 are 13.76 percent was covered by commercial sources including petroleum, coal and electricity. In the same year of the total energy demand, fuel-wood, agriculture residue,

animal dung, petroleum, coal and electricity supplied 76.7 percent, 3.38 percent, 5.77 percent, 9.27 percent, 3.2 percent and 1.36 percent respectively (economic survey, 2003/04

This high percentage (76.7%) of fuel-wood supply as the sources of energy increases deforestation, which again causes fuel-wood crises. With fuel-wood crises, the consumption of agriculture residues for the energy purpose has also increased resulting in falling production, exposure to the risk of soil erosion and further degradation in croup productivity and biomass supply. This further led to deforestation and creates the severe environmental consequences and the rate of desertification may increase. In addition, the lost of forest area and its density has also resulted in an ecologically fragile agricultural system.

Specially, in urban area of Nepal major sources of energy consumption are: petroleum, coal and LP gas and kerosene. These all creates the air pollution and health hazard. Comparatively the hydro-power is "clean", i.e. It does not create the kind of pollution that is incidental to use of coal, LP gas petroleum etc.

- Economic consequences

Poverty is deeply rooted in Nepal, where per capita income is US$ 240 according to NPC report 2006. To make a developed country, Nepal in trying to formulated policies and initiate activities to fulfill basic needs. Nepal has to flourish its agriculture, industry, hydro-power, trade tourism etc, despite its different policies.

Nepal has been facing trade deficit from history to yet. Considering this fact, hydro-power generation, tourism and agriculture and agro-processing is better and should be major priority areas for development in

Nepal which have the comparative advantage. So, it is wise to develop our natural and cultural resources basically the hydro-power by using the cost effective which help to reduce the high trade deficit with India and rest of the of the countries, reduce unemployment increase per-capita GDP and promote economic growth. In this scenario these is high consequence of not developing hydro-power. Therefore for the all faced development of the country, development of cost effective and environment friendly hydro- power is one of the best which is persistent and urgent in Nepal.

A report (2005), published by Water and Energy Commission "National water plan" has presented the following action programmes on hydro electricity are:-

- The focus of the hydro-electric power programme during the first five years on identifying and developing cost-effective small and medium hydro- power projects that are capable of meeting domestic needs, including ground water pumping for irrigation at affordable prices.

- In the ten years, substantial benefit will be realized by maximizing hydro-power development for different markets, including energy-intensive industries, transport sector and power exports.

- By the end of twenty-five years, the country will have a total hydro -power capacity of about 4000 MW excluding exports, and more than 75% of all house hold will be provided with Integrated Nepal Power System (INPS) electricity.

- Large projects will be developed for export where small and medium hydro-power projects will cater to the domestic needs.

However, multipurpose projects will be developed for both export and domestic purpose. Five action programmes have been identified and their key activities are enumerated below:

1. Programme to develop cost effective micro, small and medium hydro-power. The key activities are:

(a) Introducing necessary steps to utilize and maximize local professional, financial, material, equipment and labor resources in hydro-power projects;

(b) Developing programmes to identify cost-effective small and medium hydro-power plants;

(c) Introducing and practicing the "value engineering" concept in hydro-power projects as far as possible.

(d) Developing small and medium size projects by mobilizing local resources;

(e) Reviewing the re-leading rate as appropriate for public sector projects; and

(f) Encouraging the development of projects to utilize the existing infrastructure such as transmission lines, access road etc.

2. Programme to enhance rural electrification. The key activities are:

(a) Expediting the integrated Nepal power system (INPS) grid extension activities in peri-urban and terai rural areas;

(b) Supporting development and maintenance of isolated micro and small hydro-power projects and alternative energy source to extend

hill an mountain rural electrification;

(c) Encouraging and supporting CBOs including women's groups, to participate in electricity distribution programmes;

(d) Integrating cottage and agro-industry programmes with rural electrification;

(e) Supporting micro-hydro programmes and local initiatives;

(f) Establishing Rural Electrification Agency to expedite extension of rural electrification programmes;

(g) Mobilizing public participation and also establish rural electrification fund; and

(h) Investing 1% royalty obtained from the hydro-power projects in the hydro-power infrastructure-affected VDCs for the sole purpose of expanding electrification to such VDCs.

3. Programme to improve power system planning. The key activities are:

(a) Carrying out power system planning and prepare hydro-power expansion plans in a transparent manner;

(b) Encouraging suitable types of hydro-power projects to address the present seasonal imbalances in supply and demand;

(c) Identifying and developing hydro-power projects with due attention to regional balance; and

(d) Continuing demand-side management exercises and incorporates captive plants.

4. Programme to encourage private investments in hydropower development and electric power distribution. The key activities are:

(a) Establish an independent Electricity Regulatory Commission to create a conducive atmosphere to raise the confidence and attract private sector to invest in hydro-power development;

(b) Create an effective ‘one-window’ entity to support private sector participation;

(c) Introduce levy on electricity consumption to generate more resources to the power development fund, which has been created to encourage private investments; and

(d) Make appropriate arrangements to avail of the national transmission gird to wheel electric power as well as distribution of power direct to consumers by private producers.

5. Programme for power sector reform and development. The key activities are:

(a) Reconstructing the NEA through appropriate corporation and ultimately privatizing it before 2027;

(b) Establishing Rural Electrification Agency at the centre to develop and support rural electrification programmes;

(c) Establishing hydro-power Research Centre and coordinate with other existing academic and research institution;

(d) Implementing both technical and non-technical loss reduction programmes in power sector through effective institutional mechanisms and community participation; and

(e) Developing Electricity Tariff Fixation Commission as an independent regulatory body (electricity regulatory commission).

Pradhan (2007), in his article “Challenges and issues on the domestic hydro power projects and perspective on export oriented hydro-power projects” from the Half yearly journal ‘Vidyut' have found two basic markets for power generated under Nepal hydro-power development programme, these are:

- Challenge and issue on the domestic Hydro-power projects:

In the steep terrain country like Nepal with dispersed villages in the hill and mountains, electrification is very costly. This situation poses challenges in managing the financial resources to expand the electrification network. The electric tariff in Nepal is high, the high tariff represent most critical aspect of the development policy at present. The challenges lie in developing cheap and reliable hydro-power projects so as to keep the tariff within reach of everyone. Nepal government is, therefore, under taking power sector reform measures with a view to bring about improvements to remedy the situation. Following the some ideas need to be effective the domestic hydro-power projects, they are:

(a) There is need for increased use of local financial resources in project development.

(b) Project selection based on screening and ranking with sufficient alternatives would make the project more efficient.

(c) Enhanced use of domestic man power and manufacturing base for planning, design and construction of hydro-power project will not only increase manpower skills but also reduce the cost that Nepal has

currently being spending in obtaining such service from out side. This capability needs to be effectively utilized for the future project development on the winder scale.

(d) Mountain terrain often offers some of the best opportunities for small hydro-power plants. Such areas are frequently remote from national gird system. Making the use of small local resources even more attractive, so encouraging private sector involvement in domestic hydro-power development.

(e) In the changed scenario, system planning criteria for domestic power project has to be reviewed.

- Perspective on export oriented projects:

Local developers in Nepal have been involved mostly in the smaller power plants. For large projects involving huge capital and international agreement, it is beyond the national investment capacity and requires external financial support. While supply to provide domestic demand is highest priority, efforts to make advantage of opportunities for power export to india. Nepals hydro potential opportunity for Nepal to become a major power exporter to India and at the same time earn revenue power sales to help develop Neal's own domestic economy. With the development of high voltage inter-connection with Nepal and India, these will be a big prospect for development of export oriented hydro-power projects.

Shrestha (1991), in this book "hydro-power in Nepal issues and concepts of development" some of the major conclusion of the other are:

- Major achievements in the economic development of Nepal could

be realized through proper harvesting of the vast water resources but nearly 100% dependency on overseas professionals and a failure to develop our manpower gradually to prevent realization of this goal.

- The opportunities in hydro-power development are not only approving new projects but also have commitment in maintaining and optimizing the efficiency of existing hydro-power plants, such opportunities mean institutional development but this has been overlooked for obvious reasons.

- An alternative strategy for the hydro-power development in the world is to open the doors, for privatization where there would be a change for development through competition and reduction of bureaucratic control.

- To demonstrate the assessment of condition that have been made throughout the history of development of hydro-power in Nepal, fact and figures suggest that many part mistakes continue in to the present decision making process.

- Because of improper information management non-existent human resource development and myopic decision-making, we have made ourselves vulnerable to the decades of outside help where terms are drawn up to the advantage of multinational finding agencies.

- As the development of hydro-power in Nepal has always been dictated by many constraints and conditions, projects are selected by planning procedure, which is deliberately designed to produce a ‘no option’ situation in decision-making.

The report (1996, London), published by financial time energy "electricity in south Asia" has focused on Nepal's hydro-power situation. Prospects and problems. Some of the conclusions of this report are:

- The Himalayan Kingdom of Nepal nestles between India and China. It was ranked seventh poorest country in the world by US Aid in 1995. Agriculture is the main economy activity. The country's main resource is hydro-power with a theoretical potential of 83,000 MW up to 25,000 MW of is exploitable. However, its exploitation is difficult because of the terrain. So far only 1% of the potential has been tapped.

- Hydro-power, however, remains the country's greatest potential sources of both electricity and revenue. This gives Nepal, according to the some experts, the second highest per-capital hydro-power potential in the world.

- A long side the development and generating capacity to meet its own demand, Nepal harbors ambitions to build plants the will export power to India. Such schemes as have been discussed have foundered on the rock of finance and ownership. Nepal needs joint ventures, probably with India companies to develop this potential but it wants to remain in control of its asset.

- Small hydro-power also plays a key part in Nepal's power development Plans. The northern region of the country, with its small isolated rural communities, has an enormous mini and micro hydro-power potential. Because of impossible terrain, this terrain, this represent, the only source from which may of these communities will ever receive power.

- The transmission and distribution power represents one of the key challenges to the electricity industry in Nepal. The terrain is rugged and difficult that may of the northern communities may never be supplied with power from central hydro-power plants. The cost is simply too great.

- There is difficult terrain, making it costly to develop hydro-power potential. This is like to act as a discouragement to investors and project developers alike. And finally Nepal is competing with neighbors such as India, Bangladesh and Pakistan which have already made great strides along the road towards the encouragement of private sector investment in their own power industries. Many potential investors and developers are like to look there first, and turn to Nepal only when the opportunities else where have been exhausted.

- The government of Nepal, aware that change will be required has been working towards a policy for promoting privately financed hydro-power projects. This will include a verity of options such as Build-Own-Transfer (BOT) and Build-Own-Operate-Transfer (BOOT) as well as the provision of site licenses.

A report (1997, London), published by financial time energy "Investing in hydro-power" has presented, mountain terrain often offers some of the best opportunities for small hydro-power plants. Such areas are frequently remote from national grid system. Making the use of small local resources even more attractive, several countries are encouraging private sector involvement in small hydro-power development.

Hydro-power is capital intensive. Most of the investment is

required at the start to build the project. It is necessary, therefore, to take special care with costing during the feasibility study to ensure the project will be economically viable.

A Final report (2004), published by water and energy commission secretariat "Hydro-power sub-sector" has described about Nepal's Hydro-power. Hydro-power is contributing significantly to the growth of economy by helping the growth of industrial and commercial sectors. If we look at the electricity consumption data of industrial and commercial consumers for the last decade from 1991 to 2001, we find that in the industrial sector the electricity consumption has increased from 206.89 GWH to (520) 634 GWH and in the commercial sector it has increased from 36.34 GWH to 94.166 GWH .The electricity consumption has just increased by 2.5 fold. The total consumption these two sectors constitute nearly 48% of the total electricity sale. This makes clear the contribution of hydro-power to the development of industrial and commercial sector. So vital for the national economy. Some of the suggestions of this report are:

- The Nepal power system has mostly ROR plants limited capability to supply the peak load in dry season and power surplus in west season. For meeting the peaking demand of system storage’s plan are needed. To meet this unique demand pattern of Nepal power system optimum combination of RoR projects and storage projects should be developed.

- Rural electrification schemes specially in isolated areas are considered un economic. However, integration of rural electrification schemes with the socio-economic developments programmes in the districts could be proving to be economically

viable. Government should expand Rural electrification area to improve the life of the village people.

- One of the basic requirements to make hydro-power cheaper in the maximum utilization of local resources: money, manpower machineries etc. This will require infrastructure development proper legal provisions and the structuring of organization related sector.

- formulation of hydropower program is based on the following:

  - Develop cost effective small and medium hydro-power project.

  - To accelerate rural electrification government should provide increased support.

  - Social and environment concepts.

  - Encourage power based industries/ transportation.

  - Facilitate banking sector flow the fund to power sector.

  - Strengthen institutional and physical infrastructure for power export.

  - Promote research and development in hydro-power.

  - Restructure of power utility company.

Paudel (1986), unpublished thesis entitled 'hydro electricity development in Nepal' has highlight and the importance of hydro-power for all round development of any nation. Some of the conclusions of this thesis are:

- Electricity is an essential and important commodity as water and air for mankind in the modern world. Per-capita electricity consumption is considered as the yardstick for the development of a country.

- Electricity, for every person, should be the goal of development because it helps every one to live with facilities of modern lifestyle, clean and easy way of cooking, heating and cooling rooms, washing, saving and clearing are the rational ways of dayly living from man with the help of electricity. Out of the total population of the nation only 15 percent people are facilitated with electricity whereas the rest are still inside the darkness of misfortune on scarcity.

- The researcher also has developed the relation ship between agriculture and electricity, industry and electricity and transportation and electricity. He says that major sector of the nation, agriculture. Contribution 40 percent of GDP is falling to increase the trend of agro. An export implying there by that an alternative source has to by develop urgently. This possible only when electricity is applied in increasing the production process. Electricity brings about economic welfare by the development of agriculture. Regarding industrial development, he mentions that electricity is essential to set up the different types of industries. Therefore, electricity is the most important over-head for country's development by establishing small, medium and largescale industries.

- The researcher said that the high cost imported fuel could be substituted with low cost of indigenous hydro-electrical power in

the fild of transportation. Nepal's transport economy is facing a big challenge stir up by world oil crisis. The running of transportation like rail way, ropeway, trolley bus etc. is highly essential for ordinary life. This fore, rivers in Nepal are not only ornaments are utilized properly.

Gyawali (2001), in his book "water in Nepal" has made a very important study on Nepalese water resources from both technical and socio-economic viewpoint. According to him the Nepalese socio-economic prosperity geared by development of Nepal. According to him instated of the high capital cost oriented mega hydropower, the small and the community managed level of micro hydro power is preferable for the small developing country like Nepal. As last he suggested some very importance points which are necessary for the policy formulation and implication, these are as follows:

1. Nepali hydroelectric energy must be cheap.
2. New but cheap hydro-power generation must come on line at first.
3. Hydro-power 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 with first achieving strong domestic base.

The article (Sept18, 2007), published by "RSS, the Rising Nepal" has found the some opinions about hydro-power. These opinions are:

- Minister for finance Dr. Ram Shran Mahat has said country's

economy could be improved by developing the sector of hydroelectricity and reducing dependency on mineral sources of energy. Environment could be protected and People's social and economic living standard could be improved if expenditure on mineral resources of energy could be decreased by increasing electricity consumption. He urged investors from India and other countries of invest in hydroelectric projects to translate the enormous possibilities into reality. He said small and micro hydroelectric projects could be constructed in rural areas to extend electrification; medium sized projects could be development for internal consumption with domestic capital and large scale projects could be developed for export by attracting foreign investment.

- Minister for physical planning and words, Hisila Yami said Nepal could not translate its enormous hydroelectricity potentiality in to reality because of internal reasons and stressed that projects in this area could be developed in mutual understanding.

- Former Deputy Prime Minister, Bharat Mohan Adhikari said investors from other countries including India, china and Australia are interested to invest in the project of hydro-electricity in Nepal.

- Alok singh of Indian Embassy in Kathamandu expressed his belief that the summit would be able to extend relations between two countries by giving new dimension through the development of hydroelectric project.

Basnyat (Magh 12, 2059), in his article " Meeting Energy Needs, Generating More Hydro-electricity" from the daily journal "The Rising Nepal" have found following conclusions, these conclusions are:

- Development areas need more energy, which multiplies human labor, increasing productively. Among others it lights buildings, Purifies water, power various kind of machinery. Collected and disseminate information. Electricity is one of the most reliable sources of energy. It is an essential ingredient of economic envelopment and is equally necessary for non-commercial uses.

- Nepal's tremendous potential of water resource is not only renewable but also environmentally safe to be exploited. These resources can bring about progress and prosperity. For hydro-electricity generation, technical studies have been conducted by scholars, academic and research institutes. Feasibility studies indicate that relatively low-cost hydro-power could be generated from many projects in Nepal.

- Although there is an increasing participation from private sector in Nepal’s hydro-power sector, there is a need to encourage more such involvement. Actually, private sector participation and foreign investment are crucial if more hydro- power to be produced and more areas of Nepal are to be electrified in the years to come.

- The writer said that, during the past few decades, there has been a resurgence of interest in establishing waterpower plants in many countries. It is due to the increasing in the cost of other fuel together with realization that fossil fuel resources are rapidly decreasing. Nepal has also placed emphasis on the setting up such plants.

- Despite its richness in water resource, Nepal has not been able to provide access to electricity to the majority of its people. Less than

18 percent of its people have been enjoying electric facilities. It has estimated that the total demand for electricity in Nepal at present is 380MW. However, on the supply side only 340MW is available for distribution this depicts the actual situation where there is a total deficit of 40MW. Even if the hydro-project under construction is completed on schedule, there will be relief only for a short time before demand outstrips the supply.

Similarly, Basnyat (Magh 25, 2059) in his article “micro-hydro-power generation private sectors important” from the dally journal “The Rising Nepal” has found following suggestions, these suggestions are:

- Micro hydro- electric plants can be set up at low costs. Since such plans can be established in short duration, rural can be done with minimum transmission cost and loss. Such power plants not only help in meeting the increasing demand of power but also help in flood control and enhancing irrigation facilities.

- The establishments at micro hydroelectric plants wills illuminate rural horns. It will also assist the people in improving traditional technology. No doubt, power helps in operating industries. It is natural, therefore to except rural people to be interested in establishing cottage and small industries. This will help rural folks in income generation and meeting their daily needs.

- The preservation of the environment may be helped through the reduction of pressure on agriculture land and dwindling forest. This is possible through micro-hydro power. Actually, the micro hydro-technology is dependable and also suitable for hilly regions, where the majority of the people live without lights.

- Although the community based rural electrification programme started as poverty alleviation and agricultural development programme, it has now become an important civil society movement. The governments of Nepal, recognizing rural people need have given facilities for power generation. It is encouraging that the establishments of such hydro-power project by giving soft loans, subsidies and tax, exemption will help the meet the power needs of rural people to some extent.

- The writer said “since the amount allocated for hydro-power generation is by no means adequate, the participation of private entrepreneurs in micro hydro-power generation should be looked at as a necessity. However, the private entrepreneurs will be attracted to micro hydropower only when the infrastructure development programme is given top priority.

A report (2001), published by World Bank “Nepal proposed power sector development strategy” have found very important for power development strategy in Nepal. This report attempts analyze the key implementation constraints facing Nepal’s hydro-power development and proposes option for reform. The report makes the following recommendation in the four areas, which are necessary study for the policy formulation and implication these are:

- The role of policy making should rest with the Ministry of Water Resource, with the possibility of the Department of Electricity Development and Water and Energy Commission Secretariat given the role of executing bodies. The Electricity Traffic fixation committee be redefined and over time be allowed to evolve in to on independent regulatory authority.

- While there are alternative institutional restructuring options for the National Electricity Authority, certain common principles apply for private capital to be successfully mobilized. These include: eliminating conflicts of interest, improving creditworthiness; improving opportunities for attracting private capital; and providing appropriate regulatory framework for the operation of the system and technical and commercial rules for grid operation. Reconstitution of the board of directors of National Electricity Authority with a private professional board could be a useful transition arrangement.

- Nepal's comparative advantage in hydro-power lies not as much in the cost of developing hydro-project as it does in fact that it is unencumbered by the complex center state relationship and inter state water disputes that characterize the Indian situation. The government of Nepal has an opportunity to create a policy environment for independent power producers that is more favorable than in India for the development of medium size dedicated export projects by the private sector.

- To improve electricity access to rural areas. Nepal must supplement exiting institutional methods of delivering electricity services to rural areas with innovative approaches such as by developing community based systems. Rural electrification business must be financially viable for it to succeed. Efforts are needed to establish rules that allow cost recovery and possible mechanism for providing subsidies for capital costs of new connection.

Maharjhan (2004), in his article "Micro Hydro-power Plant: A new

prospect of Nepal's Electric Power Market" has found relevant for review some of the conclusions of this article are:

- Energy is the basic necessity for survival. It is necessary for development activities to promote education, health care, transportation and infrastructure for attaining reasonable standard of leaving and is also a critical factor for economic development and employment. It has been recognized that Nepal's main natural resource is its abundant hydro-powered potential. The distinct topography of Nepal's with its high hills and more than 6,000 rivers crossing the country provides many opportunities for the development of this field. Nepal is estimated to have theoretical hydro potential of 83,000 MW of which 42,000 MW is economically feasible.

- Electric power plays a significant role in the economic development and it plays a crucial role in human welfare. The writer said that, "the supply of energy is often a major constraining factor in the development of country's economy. Many developing countries spend a large proportion of their development budgets on energy, and while the developed nations debate the sustainability of the fossil fuel sources for may developing countries the sustainability of these energy sources immediately a question of funds with which to by then. This is the case in Nepal."

- The scope and prospects of the micro-hydro system in Nepal is very high. The national grid, which runs along the densely populated terrain with is higher level of economic activities, can not a solution for northern rural hilly areas at present. These areas have very few economic activities are sparsely populated. This

makes grid fed electricity for these areas economically unfeasible. Hence the importance of micro hydro-power plant (MHPP) is more stressed.

- A supply of energy is suitable form is considered to be on of the main inputs required to raise the standards of living of the people and to minimize damage to the ecosystem. Per capita consumption of energy has to increase significantly in order to develop systems and infrastructure necessary for improvement of living conditions and increase in incomes.

- At present is having a tough time sharing its financial resources in development project because of the increasing expenses in security related aspects. So big projects are remote for the time being and also they are costly and have a significantly bad effect on the environment, therefore development of small and micro hydro is increasing. Micro-hydro schemes involve local people and companies in the generation and distribution of electrical power. And the price of electricity is determined on a local basis. With the imminent appearance of electricity in these remote places, other development activities related to electricity are also attainable. So MHPP schemes are playing the dual role i.e. selling electricity by expanding the energy market to the remote place and contributing to the development of these areas.
- Nepal has huge resources of water and a major portion is still to be explored. So with the effective planning and development of this sector can change the future of nation. So, the policy making organizations of government and the private sector should work together in developing this sector and achieve maximum benefit from it.

Malla (19 march, 2001), in his article “Nepal Electricity Authority and its Role in Regional Power Trade” have focused on. Nepal hydro resources and power exchange between India and NEA. The writer said, “Foreseeing the immense demand for electricity from the increasing population and growing economy, entering the regional power business in South Asia lies in the ability to produce mega power in a cost effective way. In this vast arena, NEA plays a key role in Nepal power sector and finds a niche that promises substantial business in the future. The immense proportions of “clean” hydro in Nepal’s territory and it's stablished link with India from the cutting edge of NEA’s business.” Some of the major findings of this article are:

- Nepal’s water resources are it's for most natural endowment. This is the means by which the country cans more out of the ranks of the underdeveloped to those of the rapidly developing countries. This also the means the use of country must plan so that harnessing of its potential brings about economic growth. This is the means which can solve the country’s chronic trade deficit.

- The key player in Nepal’s power sector is the Nepal Electricity Authority (NEA). The NEA will continually improve the quality and quantity of hydro-power developments so that it may keep expanding its power exchange and trade capacity with India.

In the end, the researchers are conducted under contribution of hydro-electricity in economic development till 1983 A.D. thus researchers are not sufficient at present because the problems are always dynamic but not static. So past status of hydro-electricity energy could not address the present status. Considering such fact the researcher in very interested to conduct his research under it.

CHAPTER- IV

HISTORICAL DEVELOPMENT OF HYDRO-ELECTRICITY IN NEPAL DURING DIFFERENT PLAN PERIODS

4.1 Hydro-electricity Development in Nepal before First Five Year Plan

In our country Nepal electricity was unknown until 1911. Chandra Shamser was first prime to initiate hydro-electricity development. Being impressed by electricity supply in England, he has technicians from there and established the first hydro-electricity center in Pharping, the construction of which has completed in 1911 AD. This was first opened formally by His Majesty King Prithivi Bir Bikrakm Shah in 1911 AD by switching on in Tundikhel administrative building. The name "Chandra Jyoti" was given the light. The installed capacity was 500KW and 12KW cable was installed to transmit 11KWof power. This power house has been closed now and water from this reservoir is now used for water supply to Lalitpur municipality and adjoining areas. The second hydro-electric center was established at Sundarijal in 1934. This had the installed capacity of 900KW, it is now working with the capacity of 640KW.Morang hydro-electricity Supply Company located at in Morang district was the third power house established in the country with capacity of 677KW, it was the first hydro-project outside the Kathmandu valley. It started distributing electricity in 1939. This power house was completely destroyed by land-slide and doesn't exist at present. Before five years plan period one diesel power station established to supply electricity in Birgunj in 1950. The total electricity production before planned economic development in 1956 was 2077KW and now only 640KW is being generated from this plant at present. Source: Aychara (1983)

4.2 First Five-Year Plan Period (1956-1961)

In the first five-year plan period, electricity was given forth priority. In addition, Rs. 3 million was allocated with the objectives of generating 20,000KWof electricity, which included both diesel and hydro-electricity. Nepal made agreement for the first time with USSR and India to get aid to construct the most important hydro electric project like Panuti and Trisuli respectively. Similarly agreement was also made with India for the construction of hydro electric project in Pokhara with the capacity of 500MW. Agreement was also made with UK for the construction of hydro electricity project in Chisapani with the capacity of 400 KW. The first five year plan enunciated a policy to study the feasibility of small and medium size hydro project in Nepal. This was only achievement of this plan.

Table 4.2.1

Program of Electricity Development of the First Plan

S.N.	Project	Year of Completion	Power Supply in KW	Donor Countries
1	Trisuli	1963-64	9000	India
2	Pokhara	1961-63	500	India
3	Thadokhala	1962-63	400	UK
4	Panauti	1962-63	2400	USSR

Source: HMG of Nepal, NPC and The First Five Year Plan.

4.3 Second Three-Year Plan Period (1962-1965)

The plan laid emphasis on the establishment and expansion of transmission lines and diesel plants on temporary basis to meet the demand, until the hydropower plants in some big towns like Kathmandu,

Birgunaj, Hetauda and Biratnager etc. were complete. In order to produce more power to meet the increasing requirement of industrial and agriculture development, and effective manage the distribution of power, a separate organization under the name of Electricity corporation was established in, 1964 as a government enterprise.

The plan had given second priority next to road construction with the objectives of predicting 30,000 of electricity both for hydro power and diesel. The total expenditure estimated for this programme was Rs. 9.1 million. However, in reality the expenditure increased to Rs. 13.75 million and 7600 KW additional electricity was produced against the target of 12, 256 KW. The included 2,4000 KW. Form Panauti hydro-electricity project constructed with the aid of USSR.

Table 4.3.1

Target of the Second Plan

S.N.	Project	Power Supply in KW
1	Trisuli Hydro project	9000
2	Panauti Hydro project	2400
3	Pokhara Hydro Project	500
4	Thadokhola Hydro Project	350
	Total	12,250

Source: HMG of Nepal, NPC and The Second Plan.

4.4 Third Five-Year Plan Period (1965-1970)

This plan gives first priority to hydro-electricity generation along with transport and communication with the objectives of providing 60.000 KW extra electricity. The budge allocated was Rs. 60 million. Only 19000 KW electricity was generated during this plan period and which included hydro-electricity and diesel. This includes Trisuil

(9000KW) and, Phewa in Pokhara (1088KW) and started generating in 1969. Both of these projects were constructed with the assistance of India. During this planning period, Trisuli and Koshi were not fully able to generate their estimated power potentiality. Simultaneous Sunkoshi project and Dhankuta small hydro electricity project were also under construction.

Table 4.4.1

Achievement of Third Five Year Plan

S.N.	Project	KW
1	Trisuli	9,000
2	Pokhara	1,088
	Total	10,088

Source: HMG of Nepal, NPC and The Third Plan

During this period, transmission line from Kahtmandu to Birgunj (66KV) was fully completed and Dhran, Dhankuta, transmission line was under construction. Locations of micro hydropower were also surveyed.

Table 4.4.2

Target of Third Five-year Plan

S.N.	Project	KW
1	Trisuli	21,000
2	Kulekhani	16,000
3	Koshi	7,500
4	Seti	5,000
5	Gandaki	1,000
	Total	50,500

Source: HMG of Nepal, NPC and The Third Plan.

4.5 Forth-Five Year Plan Period (1970-1975)

The fourth plan laid emphasis on transmission and network improvement, fixation of power tariff, power purchase from India for various project, use of foreign exchange to build diesel plants to meet the demand of Bagmati and Narayani Zones. Similarly, efforts where made to make power available at least in one place of 12 out of 14 zones of the country. A policy was also formulated for power development categorizing in into five headings, such as construction transmission lines, small hydel project, diesel installations and survey. A part from these no specific energy policy was formulated in this plan.

In this plan period, the total electricity from hydro-power was 26.040 KW and from the diesel was 5.256 KW. Transmission line of 152.2KM length was also constructed during this period.

Table 4.5.1

Target and Achievement of Fourth Plan

S.N.	Project	Target(KW)	Achievement (KW)
1	Trisuli	9,000	9,000
	Gandaki	10,000	-
3	Sunkoshi	10,050	10,000
4	Koshi	6,800	6,800
5	Small Hydel-project (Dhankuta)	240	240
	Total	36,090	26,040

Source: HMG of Nepal, NPC and The Fourth Plan.

4.6 Fifth Five Year- Plan Period (1975-1980)

In the fifth plan, policies were formulated to fulfill the short term and long term demand with in the country to export excess power to India

and to expand village electrification. To promote agriculture development village industries and production activities, it also formulated a policy to fix the tariff on the basic of actual cost of projects to limit the electricity services and activities in government sector and handover the operation and distribution of electricity gradually to other electricity entities making them capable in business activities.

Table 4.6.1

The Programme of Electricity Development in Fifth Plan

S.N.	Name of Project	Position of Project	Target (KW)
A	Small Hydel Project		
1.	Jhurpa Small hydel project	Running	345
B	Big and medium Hydel project		
1	Kanakai Hydel Project	Running	32,000
2	Devi ghat Hydel Project	Running	14,000
3	Kulekhani Hydel Project	Running	60,000
4	Sikhrbas Hydel Project	New	2,400
5	Sarbada Babai	New	49,000
	Total		1,57,745

Source: HMG of Nepal, NPC and The Fifth Plan.

4.7 Sixth Five Year Plan Period (1980-1985)

Like other previous planning periods, the sixth plan has given main emphasis on hydro- power sector to develop hydro power stations. Sixth five year plan projects surveyed and electrified in new places with the help of new transmission line and station. The plan laid emphasis on the development of small hydel projects in the mountain and remote areas. In order to find out alternative sources of cheaper energy,

search and survey activities were initiated. The plan also laid emphasis on narrowing down of regional imbalance in power distribution. Private sector was encouraged to invest in power sector including alternative energy sectors.

Table 4.7.1

Hydropower Generation in Sixth Five-Year Plan

A. Large Scale Project

S.N.	Name of Project	Target (KW)	Achievements
1	Kulekhani I (Makawanpur)	60,000	completed
2	Devighat (Nuwakot)	14,100	completed
3	Marsyangdi (Lamjung)	50,000	not completed
4	Devighat (Sapta Gandaki)	1,50,000	to start
5	Kanki	38,000	to start
6	Jhimruck (Pyuthan)	10,000	to start
	Total	3,22,100	Achievement 74,100

Source : HMG of Nepal, NPC and The Sixth Plan.

B. Small scale project

S.N.	Name of project	Target (KW)	Achievement
1	Namche (solukhumbu)	600	not completed
2	Sailleri (solukhambu)	80	not completed
3	Phidim (panchthar)	260	completed
4	Bhojpur	260	not completed
5	Khadwari (sankhuwasabha)	100	not completed
6	Taplejung	120	not completed
7	Okhaldhunga	120	not completed
8	Ramechhap	60	not completed
9	Baglung	175	completed
10	Jomsom	260	completed
11	Doti	200	completed
12	Jumla	250	completed
13	Jeeri	80	not completed
14	Chema (manang)	40	not completed
15	Gorkha	64	not completed
16	Dhading	32	completed
17	Dadeldhura	100	completed
18	sindupalchowk (Helambu)	50	not completed
19	Manang	80	not completed
20	Kusmisera	100	not completed
21	Syangja	80	completed
22	Gorkha	90	completed
23	Darchula	100	not completed
24	Other small hydro project	2,482	to completed
	Total	5,783	Achivement=3,929

Source : HMG of Nepal, NPC and The Sixth Plan.

4.8 Seventh Five Year Plan Period (1985-1990)

The seventh plan period has come with the possibilities of different hydro-electricity for power generation. The plan considered development of multipurpose projects with electricity based transportation to substitute import of petroleum. And on the other hand small hydro electricity projects were completed which were started during sixth planning period. The plan purposed also encouragement to the private sector in the establishment and operation of micro hydel plant, particularly in the rural areas. During the plan period, Nepal Electricity authority (NEA) was established margin Electricity Department and Nepal Electricity Corporation (NEC). In the plan period a total 720 km. transmission line of 132 KV capacities was completed and to the target in seventh plan was 103.05 MW.

Table 4.8.1
Hydro-Power Projects Started in Sixth Plan and to be Completed in Seventh Plan.

S.N	Name Project	Capacity (KW)
1	Taplejung	125
2	Khandbari	250
3	Terthathum	100
4	Bhojpur	260
5	Namche	484
6	Salleri	200
7	Okhaldungha	75
8	Manang	80
9	Chame	50
10	Tatopani (Myagdi)	1,000
11	Chaurajari	150
12	Syarpubha	200
13	Bajura	200
14	Bajhang	200
15	Darchula	50
16	Ramechhap	125
	Total	3,549

Source : HMG of Nepal, NPC and The Seventh Plan.

4.9 Eighth Five Year Plan Period (1992- 1997)

The eight plan emphasized on hydro-power sector to develop hydro-power station considering the inadequate government funding for electricity development. In the plan comprehensive policies for hydro-power and energy development were formulated. Indigenous labor, skill and resources as well as foreign investment and technology were utilized. Efforts were also initiated for the diversified use of electricity, control of leakage and reliable supply of electricity. Tariff rates were also changed making them more realistic. Private sectors (national and foreign) were involved in electricity generation. The NFA was made responsible for making arrangement for the purchase of hydroelectric plant, and for transmission and distribution lines where required by private sector. The agreement on "Mahakali River" integrated development between Nepal and India paved the way for foreign investment in large hydro-power project such as Pancheswar. The achievement of eighth plan was agreement on power generation and trade between has been completed with the purpose exporting electricity to India. In power generation the 'Jhimruck' hydro- electricity project of 12.5 MW has been completed and construction of 'Kali-Gandaki- A (144mw) has been initiated. By operating and strengthen of Trishuli Devighat hydro-power project it was target to add 12.2 mw of power, and after competition of this project 11mw has been added. Some micro plants which were started from seventh plan period and finished in eighth plan are Namche, Achham and Tatopani etc. The government has made its policy to electricity the 1200 villages of 21 districts of country during eighth plan.

Table 4.9.1

Hydroelectricity Achievement of Eighth Plan

S.N.	Name of project	Capacity (MW)	Sector
1	Aruns III (could not be implemented)	402	-
2	Kali Gandaki 'A'	144	Public
3	Puwa	6	Public
4	Chilime	20	private
5	Modi	14	Public
6	Khimti	60	private
7	Indrawati	5	private
8	Bhot koshi	36	private
9	west seti	750	private
	Total	1,437	

Source: HMG of Nepal, NPC and The Eighth Plan.

4.10 Ninth Five Year Plan Period (1997- 2002)

The plan enunciated a long term policy with a view to raising the share to electricity energy consumption about 1 percent to 3.5 percent in the next 20 years. The plan also laid emphasis on development of multipurpose projects like Koshi 4,700mw,Karnali 10,800mw and Mahakali 4,680mw for domestic use as well as for export. The major policies mentioned in the plan included institutional reforms to attract private sector in power generation and distribution.

In the ninth plan, in order to develop hydro-power, various programmes such as generation and supply of electricity, power transmission, system strengthening, rural electrification and feasibility study and design were to be implemented. The programmes of power generation of ninth plan in annex 14.

4.11 Tenth Five Year Plan Period (2002-2007)

The tenth plan lays emphasis on the construction of small, medium, large and reservoir type of hydro projects. The plan intends to promote integrated development of water resources involving private and public sector. The plan also lays emphasis on rural electrification, control of unauthorized leakage of electricity. Rural electrification has an important role to play in accelerating, agricultural growth and rural development. According to tenth five year plan, it requires a huge investment to provide electricity services to the rural areas from national grid system, therefore the rural areas from national grid system therefore the rural development and economy can significantly benefit from development of decentralized renewable energy.

"Nepal known as a highly potential country for generating hydro-electricity, has a theoretical potential of generating 83,000 Megawatt electricity and real production capacity of 527.5 Megawatt. The public Sector generated 412.5 mw and the private sector produces 115 mw, which comes to be 0.63 percent of total potential of electricity generation. As electricity plays a crucial role in balance development of agriculture industry and other sectors, it is necessary to supply power reasonable price and its effective consumption is also equally important. It is undisputable that electricity expenditure the process of balance development. As the development of electricity call for huge investment, it is necessary to seek investment from various sources and make best use of the existing resources.

Currently, the urban population is consuming most of electricity. But majority of people live in the rural areas and most of the agro-industries, irrigation and cottage industries are also concentrated on rural areas. As the over all development of the nation promise on the development of

rural areas, balanced development can be achieved only through creating opportunity for equal consumption of power in the villages and the urban area."

Open and liberal economic policies have been adopted in all fronts with emphasis on private sector led growth. In the power sector private sector is given full freedom for investment. As a result private join venture companies have initiated to construct some hydro-projects under the Built-Own-Operate and Transfer System (Boot) in the tenth plan. The programmes of power generation of tenth plan are in annex 15.

4.12 Eleventh Three Year Interim Plan period (2007-2010)

In three year interim plan, production of electricity will be 105 M.W. including private and public sector, which will be supplied to reduce load shedding. In which, 20 M.W. contribution will be from private sector and 85 M.W. from public sector. In this period, contribution of private micro-hydro power project is very important because 20 M.W. will be fulfilled from this sector and than 70 M.W. from middle marshyangdi and 14 M.W. from Kulekhani III.

In the budget speech of FY (2007/08), finance Minister determines to produce 5000 M.W. electricity in 10 year. According to this plan, construction of hydro-electricity project will be started with in three year interim plan having capacity of 2085 M.W. The programs power generation of Eleventh Plan is tabulated in annex 16.

CHAPTER-V

PRESENT STATUS OF HYDRO-ELECTRICITY IN NEPAL

5.1 Nepal's Hydro-Electricity Potentiality

The theoretical, technical and economical potentiality of main river system has been estimated 83.28, 45.61 and 42.133 million kw respectively. Following table has presented potentiality of major rivers.

Table 5.1.1

Hydro-Electricity Potential in Nepal

In Million KW

S.N.	River basin	Theoretical potential	Technical potential	Economic potential
1	Saptakoshi	22.35	11.40	10.860
2	Sapta Gandaki	20.65	6.66	5.270
3	Karnali and Mahakali	36.17	26.57	25.125
4	Southern Rivers	4.11	0.98	0.878
	Total	83.29	45.61	42.133

Source: Energy Synopsis report WECS, (1992/93)

The table shows that Nepal has 83.29 million kilowatts of hydro. Electricity potentially 50.5 percent (42.133 million kilowatts) is economically viable. The highest potential is possessed by karnali and mahakali rivers from theoretical, technical and economic perspective. Southern rivers possess low potential because they do not follow from the Himalayan region.

5.2 Physical Achievement in Hydro-Electricity Development

Since the installation Pharping hydel plant 1911 A.D. Nepal has traveled 95 years in the journey of power development. Though at the time of establishment of pharping hydel plant, it was supposed to be the largest one in the South-East Asia, but even after the completion of the ten plans, the development of power in Nepal still in infant stage. Table 5.2.1 has shown the physical achievement in hydro-electricity development n different plan period.

Table 5.2.1

Achievement in Hydro Electricity Development in different Plan Period

(in mw)

Plan	Total planned target (mw)	Total Achievement (mw)	Achievement (%)	Share of hydropower (%)	Share of there mal and other (%)
1st plan	20	0.75	3.75	-	100
2nd plan	22	7.50	34.09	73.33	26.67
3rd plan	36	19.96	55.44	100	-
4th plan	40.30	28.50	70.72	91.37	8.63
5th plan	58.85	18.71	31.79	86.75	13.31
6th plan	144.92	87.62	60.45	87.81	12.18
7th plan	106.63	103.06	96.65	99.9	0.10
8th plan	29.70	28.50	95.96	100	-
9th plan	306.66	137.66	44.89	90.56	9.44
10th plan	314	181.279	57.73	N.A.*	N.A*.
Total	1079.06	613.556	56.86		

Source: Bhattarai (2005), Tenth plan and statistical pocket Book CBS, (2006).*Not Available

The table shows the achievement was lowest is first plan (3.75 percent). The rate of achievement increased significantly in the subsequent plans, although she performance varied from plan to plan. The achievement was highest in the seventh and Eighth plan (around 96). But the achievement was lower in the Ninth and Tenth plan.

5.3 Hydro Electricity Consumption Situation in Nepal

The position of energy consumption pattern in different year is shown in following table.

Table 5.3.1

Total Energy Consumption Situation in Nepal (in 000 GJ)

Fuel type	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Traditional	258212	263634	267138	272893	278748	284735	290859	302085	308606	315269	322105
Petroleum	19119	21615	23623	26619	28180	30224	31286	32305	32116	31596	30063
Col	2839	3085	2540	2579	2893	10504	7446	6481	5721	7292	6459
Electricity	2826	3059	3278	3542	3778	4227	4612	5066	5434	5974	6673
Renewable	319	435	561	705	856	1015	1217	1432	1665	1779	1955
	283315	291827	297139	306339	314454	330706	335421	347369	353542	361910	367255

Percentage share of Total Energy consumption situation in Nepal

Fuel type	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Traditional	91.13%	90.34%	89.9%	89.1%	88.6%	86.1%	86.7%	87.0%	87.3%	87.1%	87.71%
Petroleum	6.74%	7.4%	7.9%	8.7%	9.0%	9.1%	9.3%	9.3%	9.1%	8.7%	8.19%
Col	1.0%	1.06%	0.86%	0.84%	0.92%	3.2%	2.2%	1.9%	1.6%	2.0%	1.76%
Electricity	1.0%	1.05%	1.1%	1.16%	1.2%	1.3%	1.4%	1.4%	1.5%	1.7%	1.82%
Renewable	0.13%	0.15%	0.2%	2.24%	0.3%	0.3%	0.4%	0.4%	0.5%	0.5%	0.53%
	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Source: Energy Synopsis Report, 2006.

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 in consumed through other types of sources. The share of petroleum, col, Electricity and renewable is accounted 8.19%, 1.76%, 1.82% and 0.53% respectively.

Trend of electricity consumption pattern is very negligible. The table has shown the share of hydro-electricity is only 1.82 percent. In

total energy consumption in the year 2005 (Annex 6). Table 5.3.1 has presented the increasing trend of hydro-electricity consumption but it is nominal growth rate of consumption pattern since 1995.

Figure 5.3.1.1

Energy Consumption by fuel Type FY 2004/05

Source: Energy Synopsis Report, 2006.

5.4 Growth of Electricity Consumers

Following Table shows the situation of electricity consumer from 1998-2006.

Table 5.4.1

Electricity Consumers in Different Year

Particulars	1998	1999	2000	2001	2002	2003	2004	2005	2006	share percent in 1998	share percent in 2006	growth rate
Domestic	548110	593468	643314	713307	848540	930554	1010719	1113740	1229750	95.34%	96.26%	10.62%
Non-Commercial	7192	7654	7815	7643	8629	9722	9865	9950	10010	1.25%	0.78%	4.21%
Commercial	2637	2948	3096	3386	3898	5317	5454	6000	6170	0.45%	0.48%	11.21%
Industrial	14062	14996	16179	17701	18789	19833	21374	22500	23020	2.44%	1.80%	6.35%
Water Supply	205	215	232	236	251	305	352	370	380	0.035%	0.029%	8.01%
Irrigation	776	876	967	1083	1353	1721	2557	3400	6450	0.13%	0.50%	30%
Street Light	683	842	932	1012	1048	1229	1437	1500	1550	0.11%	0.12%	10.78%
Transport	12	21	47	37	49	48	48	50	54	0.020%	0.043%	20.68%
Community sales	-	-	-	-	1	1	15	35	58	-	0.30%	-
Total (Internal sales)	574844	622358	673974	745987	884530	970506	1053930	1159850	1277442	99.99%	99.99%	10.49%
Bulk supply (India)	5	5	5	5	5	5	5	5	5	0.008%	0.0043%	0
Grand total	574849	622363	673979	745992	884535	970611	1053935	1159855	1277442	100%	100%	10.49%

Source: NEA, Fiscal year 2006.

The table 5.4.1shows number of consumer is greater in domestic sector compare to other sector. It's consumer are increasing continuously from 1998. Number of consumer in domestic sector is accounted 1229750 in the year 2006. Electricity consumer in transport sector is lower compare to other sector. It is accounted just 54 consumer in 2006.

5.5 Per-capita Electricity Consumption

Electricity consumption is an indictor of economic development of a country. Lower level of consumption of electricity as commercial energy indicates lower level economic development of the country and vice-versa. Generally, per capita electricity consumption is used to measure living standard of 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 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 220 kwh and India 443 kwh. (Dhungel 2004)

The per-capita energy consumption in different year is shown in following table.

Table 5.5.1

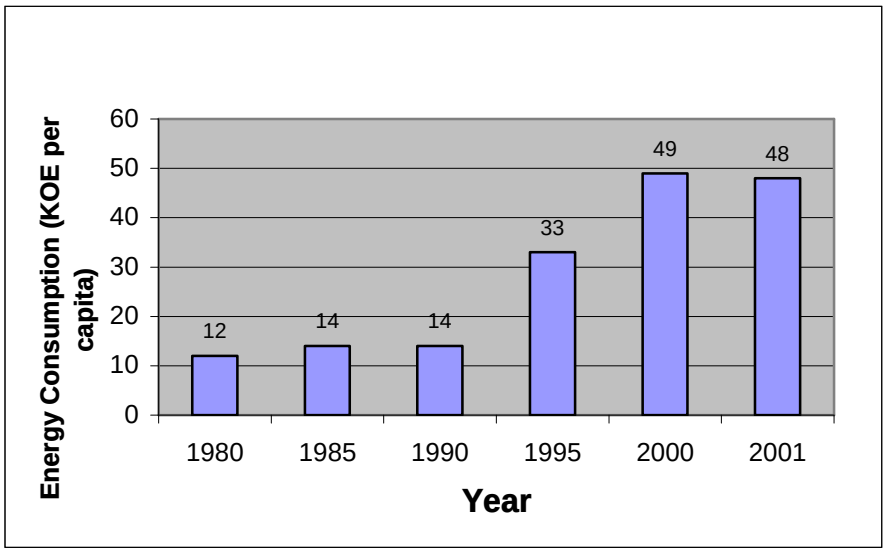
Per-capita Energy Consumption of Nepal

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

Source: UN Data-base

Figure 5.5.1.1

Per-capita Energy Consumption of Nepal



The UN data base shows the situation of per capita energy consumption from 1980 to 2001. It is presented in the above table and Figure. It has shown the situation of highest per capita energy consumption 49.0 KOE in 2000 compare to other years. The UN data base has indicated 131st energy consumption position of Nepal in the world.

5.6 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 150 MW of electrical power between the two neighbors, but due to lack of transmission facility, it is limited below 100 MW.

The electricity imported from India along the points of exchange for the year 2005 is about 241 GWh whereas export to India is about 110 GWh. The table 5.6.1 below Shows the quantity exchanged between the two countries since 1979. It can be seen that except for the year 2003, Nepal is the net importer of electricity.

Table 5.6.1

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

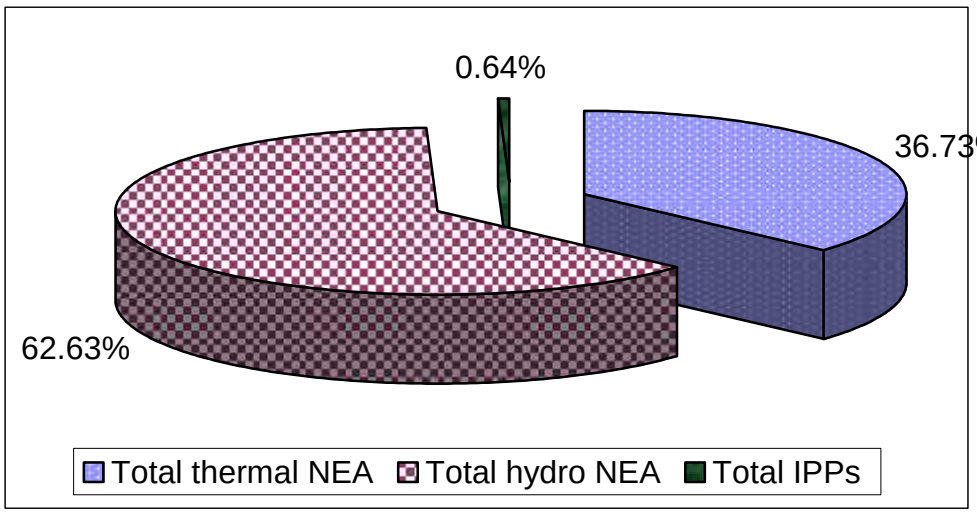
Source: Energy Synopsis Report ,2006.

5.7 Total Power Generation (2006) in Nepal

Following the figure shows the total power generation by different sectors.

Figure 5.7.1.1

Generation (MWH)



Source: NEA, Generation (2006).

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

5.8 Lon and Aid to Hydro-Electricity Development in Nepal

The investment in hydro-electricity 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 of NEA through subsidiary lone 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 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 Electricity Sales

Following the table shows the situation of electricity sales from 1998-2007.

Table 5.9.1

Electricity Sales from 1998-2006

(in GWh)

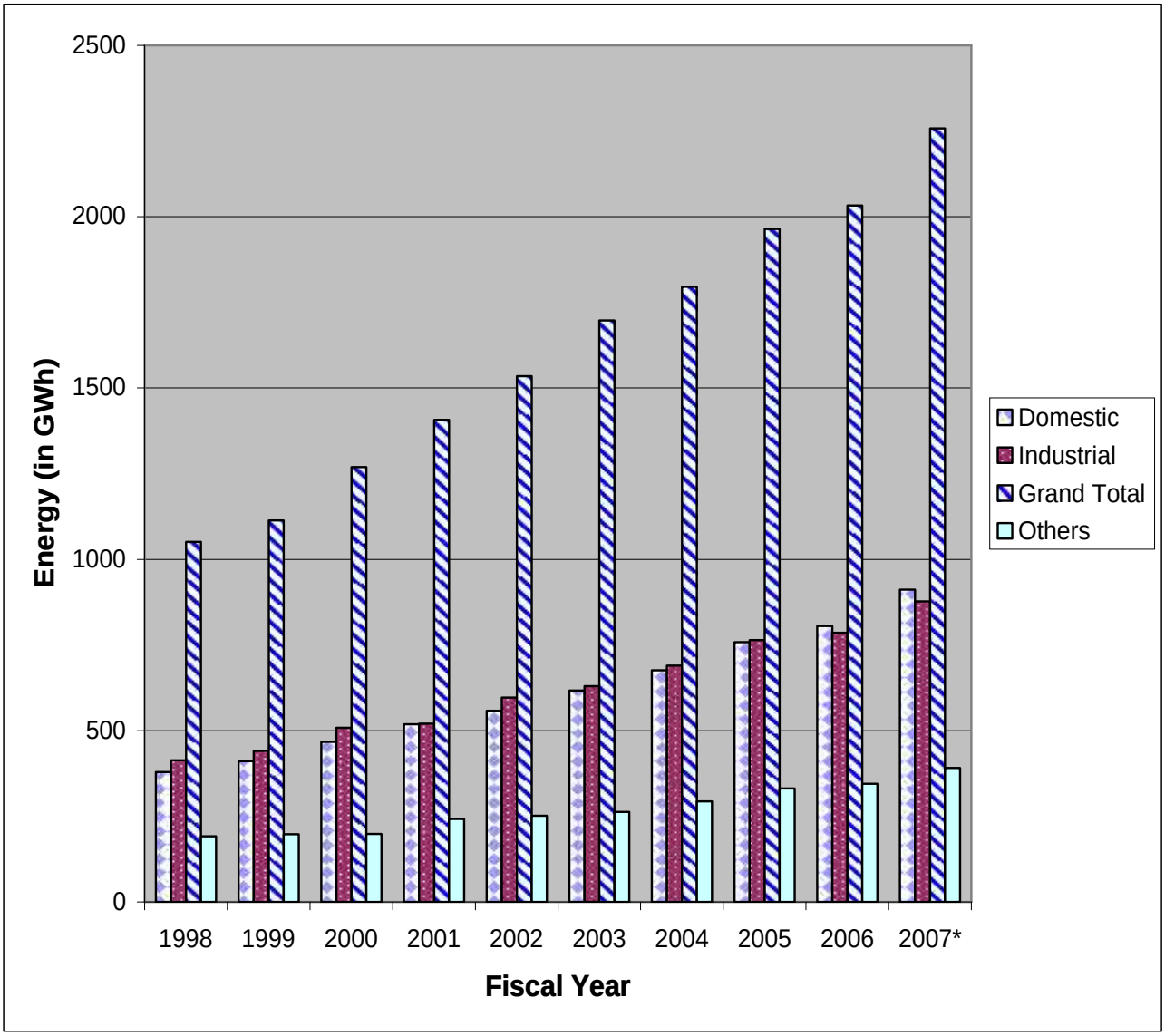
Category	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**share % in 1998**	**share % in 2006**	**growth rate**
Domestic	378.778	410.566	467.049	518.36	557.94	617.11	676.365	758.189	805.72	36.02%	39.63**%**	9.96**%**
Non-Commercial	60.227	62.931	63.592	73.157	78.22	80.736	83.012	100.543	95.29	5.72**%**	4.68**%**	5.89**%**
Commercial	71.471	77.343	81.822	94.166	90.426	92.741	108.122	109.308	120.3	6.79**%**	5.91**%**	6.72**%**
Industrial	413.738	440.996	508.357	520.34	596.677	629.,505	689.79	764	785.55	39.35**%**	38.64**%**	8.34**%**
Water Supply &	29.045	22.831	15.742	28.6	29.283	29.983	31.671	49.98	45.5	2.76**%**	2.23**%**	5.77**%**
Street Light	26.585	29.405	31.741	36.981	39.517	45.803	55.196	54.861	63.24	2.52**%**	3.11**%**	11.44**%**
Temporary Supply	0.711	0.766	0.927	0.826	0.282	0.348	0.251	0.393	0.87	0.067**%**	0.042**%**	2.55**%**
Transport	1.663	2.598	2.678	5.892	5.635	5.53	5.471	5.803	5.65	0.15**%**	0.27**%**	16.51**%**
Temple	1.801	1.982	2.366	2.511	2.476	2.811	4.111	4.58	4.77	0.17**%**	0.23**%**	12.94**%**
Community Sales	-	-	-	-	5.717	4.74	5.581	6.034	9.18	-	0.45**%**	-
Total (Internal	984.019	1049.418	1174.27	1281.12	1400.45	1504.567	1653.998	1853.69	1936.07	93.98**%**	95.28**%**	8.82**%**
Bulk Supply (India)	67.41	64.158	95	126	133.857	192.249	141.235	110.702	96.55	6.41**%**	4.75**%**	4.59**%**
Grand Total	**1051.429**	1113.576	**1269.274**	1407.127	1534.313	**1696.816**	1795.233	**1964.393**	**2032.62**	**100%**	**100%**	**8.58%**

Source: NEA, Fiscal Year 2006/2007

The table 5.9.1 shows the electricity sales from 1998-2006. Where, more electricity sales to domestic sectors compared to other sectors. Electricity sales is increasing continuously for different sectors, its clear that the calculation of growth rate and percentage share of electricity sales in 1998 and 2006.

Figure: 5.9.1.1

Electricity Sales from 1998-2007



Source: NEA, Fiscal Year 2006/2007

5.10 Revenue from Electricity

Following the table shows the Revenue from electricity under 1998 to 2007

Table: 5.10.1

Revenue from Electricity (1998-2006)

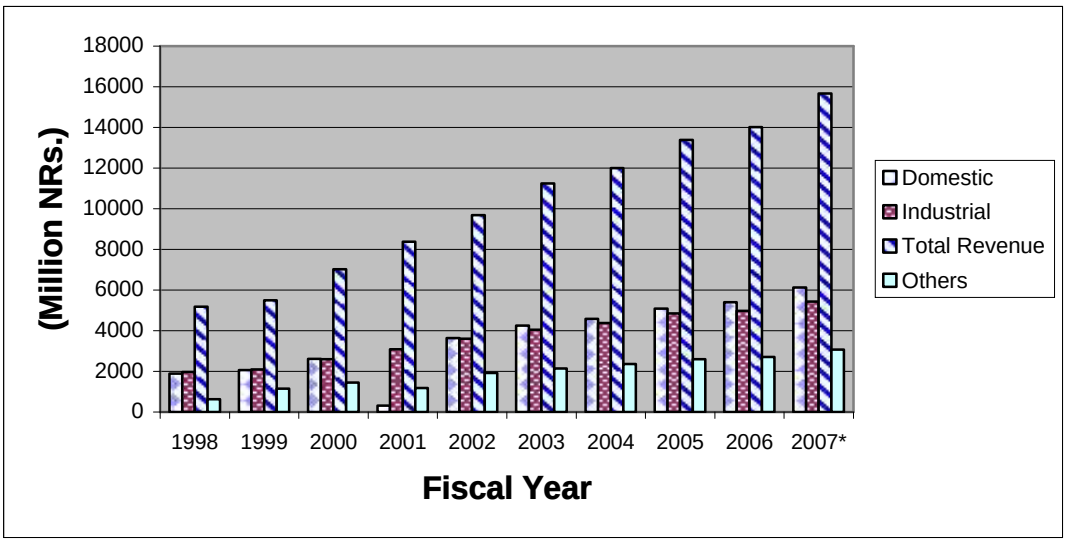
(In Millions NRs)

Category	1998	1999	2000	2001	2002	2003	2004	2005	2006	share % in 1998	share % in 2006	growth rate
Domestic	1895. 85	2056. 05	2622. 03	3161. 38	3641.43	4249.81	4578. 99	5079.87	5405.12	36.64%	38.58%	13.99%
Non-Commercial	405 14	419 58	527 40	835 78	722.12	783.99	816 01	947.12	881.73	7.83%	6.29%	10.20%
Commercial	477 04	515 72	661 58	555 62	818.75	894.91	986 07	1015.47	1118.21	9.22%	7.98%	11.23%
Industrial	1973.37	2093 88	2599 34	3086. 10	3608.13	4039.65	4380.22	4851.40	4978.69	38.14%	35.53%	12.26%
Water Supply & Irrigation	100.28	78.14	95 65	120 90	138.68	148.53	154 80	239.97	197 96	1.93%	1.41%	8.80%
Street Light	101.98	111 37	149 95	176 05	200.74	246.79	329 52	315.45	422.35	1.97%	3.01%	19.43%
Temporary Supply	7 17	7 06	13.39	6 77	3.63	4.74	3.46	5.50	11.18	0.13%	0.079%	5.70%
Transport	6 51	9 46	18 31	27 73	27.90	29.29	28.94	30.47	29.78	0.12%	0.21%	20.92%
Temple	6 71	7 42	9 70	11 45	12.16	14.24	2080	23.08	2442	0.12%	0.18%	17.2%
Community Sales	-		-	-		16.59	2009	21.42	23.94	-	0.17%	-
Total (Internal Sales)	4974 05	5298 67	6697 35	7981 78	9173.53	10428.53	11318.92	12529.75	13093.3	96.13%	93.46%	12.86%
Bulk Supply (India)	199.92	198 15	327 80	396 06	514.12	808.96	673.69	573.44	579.33	3.86%	4.1%	14.22%
Gross Revenue	5173.96	5496.82	7025.16	8377.83	9687.65	11237.49	11992.61	13103.18	13672.7	100%	97.60%	12.91%
Net Income from other services			-		-	-	-	285.86	336 09	-	2.3%	-
Total Revenue	5173.96	5496.82	7025.16	8377.83	9687.65	11237.49	11992.61	13389.04	14008.80	100%	100%	13.25%

Source: NEA, Fiscal Year 2006/2007

Table 5.10.1 shows the revenue from electricity from 1998-2006, where more revenue from domestic sector then other sector. The revenue from electricity is increasing continuously which fact is clear that percentage share of revenue and trend of growth rate.

Figure 5.10.1.1
Revenue from Electricity (1998-2007)



Source: NEA, Fiscal Year 2006/2007

5.11 Load shedding in Nepal

In the present situation, load shedding has become great problem of Nepal. Nepalese people are suffering from continuous around 42 hour load shedding per week. This situation is symbol of weakness of Nepalese government because Nepal is the second richest country in water resource. At this moment load shedding impact bad effect on every sectors like, industry, transportation, domestic, school, hospital etc. It is a obstacle to develop economic and domestic activities. The eleventh Three Year interim plan focused on to remove the problem of the load shedding.

Eleventh Three Year Interim Plan will play important role to reduce load shedding comparison to previous year. NEA will import 40-50 M.W. electricity FY 2065/66 form India to decreased the time of load shedding. Middle Marshyangdi hydro-project will minimize load shedding in FY 2065/66 which will be connected to central grid. After interim plan 600 M.W. electricity will be connected to national grid. Load shedding will be phase-out by internal production which have guessed in this period.

CHAPTER-VI

HYDRO-ELECTRICITY AND IT'S CONTRIBUTION

6.1 Positive Impact of Electricity

6.1.1 Positive Impact of Electricity on Industry

Nepal is the less developed countries in the world. In Nepal here is not adequate amount of industries without electricity, large scale industries are impossible to set up. Hydro-electricity plays a vital role in economic development of the country by providing energy to the industrial sector of any nation utilize more electricity the country will be progress fast. Nepal is rich in hydro-power if we utilize this available resource; it will give great help for the industrialization of country. Therefore, hydro-electricity is the most important over head for country's development by establishing small, medium and large scale industries with in the countries.

The industrial sector energy consumption is about 3.47 percent of the total energy consumption in 2004/5. 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 2007/05. The electric energy consumption of 2750 GJ In the year 2004/05. (Energy Synopsis Report, 2006.)

6.1.2 Positive Impact of Electricity on Agriculture

Nepal is an agricultural country. Agricultural plays important role in Nepalese economy. In agricultural sector we would no applied scientific method of production for rising productivity in agricultural

sector it became essential to increase electricity facilities. For modernizing agricultural, we make available irrigation facilities to develop agro-based industries electricity can play an important role. In agriculture sector until now we only used to energy of animal and human power. By applying electricity in production process we can increase production. By increasing productivity of agriculture we can able to increasing national income.

The total energy consumption in agriculture sector is about 3 million GJ in the year 2004/05. It is about 0.84% of the total energy consumption of country in the same year (2004/2005). The main fuels used in this sector are high speed diesel and electricity. But the electric consumption in these sector is small amount only 180 GJ in the year 2004/05. (Energy synopsis Report, 2006)

6.1.3 Positive Impact of Electricity on Transportation

Transportation is the most important overhead in the process of economic development of any nation. In the field of transportation, hydro-electricity is very essential in Nepal. It is because in Nepal with a low-cost of indigenous, hydro-electrical power may be substitutable for high cost imported fuels transportation. In Nepal that transport sector so far consumer very little amount of electric power. In the present situation the government of Nepal is trying to develop the transportation secure by providing more electricity.

The total energy consumption in the transportation sector has been in the increasing trend. The total energy consumption of this sector in the year 2004/2005 is about 13.8 million GJ. The high speed diesel takes the highest share with 63 percent. But the contribution of electricity is nominal (only 0.15%) to this sector. (Energy Synopsis Report, 2006)

6.2 Hydro-electric Contribution and Economic Growth

Hydro-electricity power is one of the basis needs for social economic upliftment of nation. If we utilize hydro-electric power in a planned way it helps to the National economic development and growth. The development of developed countries like USA, UK, France, China, Japan has through electricity. The highly industrialized countries of the world electricity has become virtually lifeblood on which the whole claborate economic depends.

Hydro-electricity is as essential and important commodity for mankind in the modern Nepal. Per capita electricity is usually considered the yardstick of economic growth and development of a country. In the context of Nepal, following table has shown the relationship between hydro-electricity contribution and economic growth.

Table 6.2.1

Contribution of Hydro- Electricity

In Economic Growth

	1	2	3	4	5	6	7	8	
F.Y.	Total GDP in million (Current price	GDP at Current price in electricity water an gas sector	GDP originated by electricity	GDP originated by hydro-electricity	Energy sold in GWH	Hydro-electricity energy sold in GWH	Price/GWH in million	Contribution of T.G.D.P Hydro electricity in	
								in million	percenta
1994/95	2,09974	2,862.00	2,718.90	2,447.01	829.52	746.568	3.27	2441.27	1.16
1995/96	2,39388	3,598.00	3,418.10	3,076.29	943.12	848.808	3.63	3081.17	1.28
1996/97	2,69570	4,457.00	4,234.15	3810.74	1,00.71	905.139	4.22	3819.68	1.41
1997/98	289.798	4,383.00	4,163.85	3747.47	11,051.81	946.629	3.95	3739.18	1.30
1988/99	3,30,.18	4,632.00	4,400.40	3,960.36	1,108.69	997.821	3.96	3960.36	1.20
1999/2000	3,66,285	5,942.00	5644.90	5,080.41	1,245.73	1,121.157	4.54	5090.05	1.39
2000/01	4,41519	7,750.00	7362.5	6,626.25	1,379.12	1,241.20	5.34	6628.008	1.50
2001/02	4,59,443	9138.00	8,68.10	7,812.99	1,557.75	1,401.975	5.58	7,823.020	1.71
2002/03	4,92231	11,447.00	10,874.65	9,787.185	1,694.27	1,524.84	6.41	9,787.185	1.99
2003/04	5,36,749	11,974.00	11375.30	10,237.77	1675.114	1,507.62	6.79	10,236.7398	1.91
2004/05	5,89,412	12782.00	12,142.9	10,928.61	1,821.391	1,639.2519	6.66	10,928.59	1.86

Source:

- Statistical year Book of Nepal (2005)
- Statistical Pocket Book, Nepal (2002,2003,2004,2005,2006)
- Economic Survey (2006/2007)
- NEA, A Year in Review (2004/2005, 2005/2006,2006/2007)
- Bhattrai, NP (December,2005) "Hydro power Development in Nepal"

Note:

Col-3 Assuming 95 percent sare of electricity from gas, water and electricity
Col-4and 6 Assuming 90 percent sare of hydro electricity
Col-7 Relationship between Col, 6 and 4
Col-8 Relationship between Col, 6 and 7 Relationship between Col, 1 and 8

The table 6.2 has shown the relationship between hydro-electricity contribution and economic growth in the time 1994/95-2004/05. The table has shown the highest contribution of hydro-electricity in GDP fiscal year 2002/03.

6.3 Empirical Analysis

Here an attempt has to be made to analyzed the relationship between Hydro-electricity contribution and GDP. Fore this purpose, collected data table 6.2 are computed from regression equation by using SPSS programmed.

The regression equation mention below represents the relationship between Hydro-electricity contribution and GDP which is given by:

Hydro-electricity contribution= $bo+b_1$ log GDP + b_2 log price

The result of this equation is,

Hydro-electricity contribution=-15638.6+697.4411 log GDP +26291.607 log price.

(-0.626)* (0.13)* (3.679)*

$R^2 = 0.968$	F = 122.21
Adj $\bar{R}^2 = 0.960$	D.W. = 1.174

As shown in the equation constant or intercept coefficient (bo) is -15638.6, which shown that average effect on Hydro-electricity contribution if independent variable i.e. GDP and price are zero or other variable exclude from the model. The result shows that the coefficient of GDD (b_1) is 697.441 which explains that one percent change in GDP canses 697.441 percent change in electricity contribution, holding price constant. And (b_2) found to be 26291.607 which explain that one percent change in price causes 26291.607 percent change in electricity

contribution holding GDP constant. It means there is positive (+ve) relationship between Electricity contribution GDP and price.

The coefficient of determinants R^2 is 0.968 which depicts that around 97 percent variation of electricity of contribution is determined by the explanatory variables (GDP and price). As such, the calculated 'F' value is grater then tabulated 'F' value, So the overall regression line is significant and it shows a better association between the variables in the equation. Similarly the number in parenthesis (*) indicates the 't' value of respective parameters. Where single star (*) indicates insignificant 't' value and double star (**) indicates the significant value of 't'. At the last the value of (D.W) is 1.174 which depicts positive auto correlation between the variable.

CHAPTER- VII

SUMMARY AND RECOMMENDATION

7.1 Summary

Nepal is a Mountainous and landlocked country of the south Asian region located between the two populations countries of the world. India to the east, south and west and China to the North. Nepal has possessed first position in Asia and Second in the world after Brizil in hydro-electricity potentially.

Hydro-electricity is the most versatile sources of energy and provides infrastructure for economic development and growth of Nepal due to it advantages over other sources of energy. Though, Nepal along history (since 1911) of development hydro-electric power, it's development is still infant stage.

Every Energy consumption process in Nepal is dominated by traditional fuel resources and position of hydro-electricity consumption is nominal in every consuming sectors. Share of hydro-electricity consumption in over all energy consumption is 1.5 percent. Electricity consumers are increasing continuously from 1998. At the present the highest number of consumers in domestic sectors and lower n transport sectors compare to other sector. Per capita consumption is used to measure living standard of people of a country. But Nepal's per capita electricity consumption is one of the lowest in the world.

India is only one country of electricity trading to Nepal. Electricity trading situation in not satisfactory now. Only in the year 2003 net power export is in favor of the Nepal. The investment in hydro-electricity is made by NEA/GOVN, multilateral and bilateral donor agencies and private entrepreneurs. About 80% power development is funded by

external financing. A the present situation, low finance, management blunder, high tariff regime poor infrastructure, geographical condition etc are main problem of hydro-electricity development of Nepal.

Energy is the basic necessity for survival. It is necessary for development activities to promote transportation, agriculture, Industry. In the context of Nepal hydro-electricity is a critical factor economic development and growth. The empirical analysis shows the positive relationship between hydro-electricity contribution and economic growth. At the end of FY 2005/06, the total achievement of hydro power was 557 MW. Its contribution in over all energy consumption is only 1.5 percent.

7.2 Recommendation

The following recommendations are made on the basis of the findings of the study.

Nepal has vast hydro-resources, which represent a source of potential wealth. Commercially exploitable hydro-power generating potential is estimated to be 43,000MW. In the context of renewable energy, hydro- power could be sustainable energy source in Nepal. So all development strategy should be followed by water resource development.

Hydro-electricity is the engine of growth and development of Nepal or the present situation economic activities can't accelerate without electric fuel. It is back bone of the modern developments and essential for industrialization, agricultural development, transportation and other sector. Its contribution in over all energy consumption is only 1.5 percentage. Currently in Nepal, there is big push for Nepal's water resources as the dominant National strategy not only for sect oral gain but also as a engine for countries overall economic development.

In Nepal, the private sector has indeed meet with some success implementing rural electrification projects. There is also evidence that

private sectors in Nepal has continuing interests in undertaking rural electrification projects. What is needed to implement such projects is the existence of enabling environmental that promotes private sectors involvement in rural electrification.

There is a positive relationship between hydro-electricity contribution and economic growth then hydro-electricity should be developed. Nepal should adopt two approach for development of hydro-electricity. First, It should cater to domestic (national) needs and second export power for neighboring countries. In order to meet the domestic power requirement the government should be encouraged private sector to establish of micro and small hydro-projects by internal finance and resources. In order to meet the export power requirement the government should be encouraged foreign investor to establish of medium and large scale hydro-project by foreign loan and grants.

In new Nepal, new vision, new policy and new construction should be used for national development. Due to the lack of policy for investment in hydro-electricity in Nepal, we can not invite the foreign construction company to construct the hydro-electricity project. We make good farsighted policy to invite the foreigner for construction; we will produce huge amount of electricity with in a few years. So our constituent assembly should make National policy and suitable environment to invite National as well as foreign investor.

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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
Fuel wood	266724	272323	278220	284138	290149
Agriculture 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	10279	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
Electricity	27	23	29	25	39
	2009	2222	2435	2729	2898
Renewable	1432	1665	1779	1955	2134
Biogas	1392	1620	11731	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

Fuel type	2001/02	2002/03	2003/04	2004/05	2005/06*
Traditional	1986	2069	2157	2245	2338
Fuel wood	684	712	743	773	804
Agriculture 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	0	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	6754	5698	7263	634	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

Fuel type	2001/02	2002/03	2003/04	2004/05	2005/06*
Traditional	1750	1925	1926	2049	2214
Fuel wood	1750	1925	1926	2049	2214
Agriculture residue	0	0	0	0	0
Animal dung	0	0	0	0	0
Commercial	3172	3303	3391	3286	3621
Petroleum	2846	2970	3001	2893	325
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	1992	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
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	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
Agriculture 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
Agriculture residue	0	0	0	0	0
Animal dung	0	0	0	0	0
Commercial	12025	12703	13132	13894	1409
Petroleum	12004	12683	13112	13873	17189
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-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	315261	322105	91.14%	87.71
Fuel wood	230651	235495	237555	242687	247884	233199	258636	269158	274960	2%948	2S6960	4141%	7814%
Agricultural residue	10353	1m71	11641	11891	12166	12446	12732	13026	13327	13635	13964	1 6 °0	380%
Animal dung	17207	1768	17937	14314	18698	19091	1949[1]	19901	20319	20746	21141	6 07%	5 77%
-													
Commercial	24784	27759	29440	321	34851	44956	43344	43852	43271	44863	43195	8 7·'%	11.76'/
Petroleum C~~	19119	21615	23623	26619	28180	10224	31286	32105	32116	31596	30063	6.75%	8.19
LPG	643	916	1075	1111	1232	508	1975	2401	2761	3257	3921	0 [1]3°0	104%
Motor Spirit	1 72	1380	1497	1572	1674	1862	1984	2119	2259	2276	2534	0 1°0	069%
Air Turbine Fuel	1357	1469	1731	1860	2009	2056	2243	1716	1911	2316	2417	048%	066%
Kerosene	6559	7568	4841	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	1 911	3.03%	3 24%
Light Diesel Oil	149	174	78	38	21	156	134	94	24	23	3	f 05%	000%
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	0.08%	0.20%
Coal	2839	3085	2540	2579	2893	10504 1.76Br	7446	6481	5721	7292	6459	1.00%	
Electricity	2826	3059	1278	3542	3778	4227	4612	5066	5434	5974	6673	1.00%	1.82
-													
Renewable	319	435	561	705	856	1015	1217	1432	665	1779	1955	0.11%	0.53
Biogas	298	412	536	678	826	981	1179	1392	1620	1731	1903	0 11%	052%
Micro Hydro	21	23	25	27	30	34	38	40	44	47	50	001%	001%
Solar	0	0	0	0	0	0	0	0		1	2	000%	000%
Others	0	0	0	0	0	0	0	0	0	0	0	000%	000%
Grand Total	283315	291827	297139	306339	3144,54	330706	335421	347369	353542	161910	367255	100.00%	**100.00**

Source: Energy Synopsis Report, 2006

ANNEX - 7
Tariff Rates of NEA

(Building Effective since September 17, 2001)

1:		Domestic consumers		
	A	Minimun 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**			
		Enlarge 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 (33kv)	190.00	4.80
	D.	High Voltage (66 kv and above)	175.00	4.60
7.	**Commercial**			
	A.	Low voltage (400/230 Volt)	225.00	7.70
	B.	Medium Voltage (11kv)	216.00	7.60
	C.	Medium Voltage (33kv)	216.00	7.40
8.	**Non-Commercial**			
	A.	Low voltage (400/230 Volt)	160.0	8.25
	B.	Medium Voltage (11kv)	180.00	7.90
	C.	Medium Voltage (33kv)	180.00	7.80
9.	**Irrigation**			
	A.	Low voltage (400/230 Volt)		3.60
	B.	Medium Voltage (11kv)	47.00	3.50
	C.	Medium Voltage (33kv)	47.00	3.45
10.	**Water supply**			
	A.	Low voltage (400/230 Volt)	140.00	4.30
	B.	Medium Voltage (11kv)	150.00	4.15
	C.	Medium Voltage (33kv)	150.00	4.00
11.	**Transportation**			
	A.	Medium Voltage (11kv)	180.00	4.30
	B.	Medium Voltage (33kv)	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 (66kV and above)**				
	1.	Industiral	175.00	5.20	3.15	4.55
B.		**Medium Voltage (33 kV)**				
	1.	Industrial	190.00	6.55	4.00	5.75
	2.	Commercial	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.	Water Supply	150.00	4.55	2.75	3.95
	6.	Transportation	180.00	4.70	2.95	4.15
	7.	Street light	52.00	5.70	1.90	2.85
C.		Medium Voltage (11kV)				
	1.	Industrial	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.	Transportation	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 reads kilowatts (kW) then kVA = kW/0.8

b) 10% discount in the total bill amount will be given to the government of Nepal approved industrial district.

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

ANNEX - 8
Power Development of Nepal

MAJOR HYDRO POWER			**THERMAL POWER STATIONS**			**ONLY POWER PURCFHAGE AGREEMENT (PPA) CONCLUDED**		
Existing			**Existing**					
1.	Trisuli	24,000 kw	1.	Biratnagar***	1,028 kw	1.	Mailung khola (MKHP)	5,000 kw
2.	Sunkosi	10,050 kw	2.	Hetauda	12,750 kw	2.	Daram khola(GHP)	5,000 kw
3.	Gandaki	15,000 kw	3.	Marsyangdi	2,250 kw	3.	Tadi khola (ASHP)	970 kw
4.	Kulekhani No. 1	60,000 kw	4.	Duhabi Multifuel-1	26,000 kw	4.	Upper Mai khola (ENDE)	3,100 kw
5.	Devighat	14,100 kw	5.	Huhabi Multifuel-2	13,000 kw	5.	Lower indrewati (SHP)	4,500 kw
6.	Kulekhani No. 2	32,000 kw		**Total**	**55,028**	6.	Lower Nyadi (BHP)	4,500 kw
7.	Marsyangdi	69,000 kw	**SMALL HYDRO POWER**			7.	Madi-1 (AGP)	10,000 kw
			Existing (Grid Connected)					
8.	Puwa Khola	6,200 kw	1.	Phsrping	500 kw	8.	Upper Modi khola (GITEC)	14,000 kw
1.	Modi Khola	14,800 kw	2.	Panauti	2400 kw	9.	Seti-2 (THP)	979 kw
2.	Kali Gandaki "A"	144,000 kw	3.	Sundarijal	640 kw	10.	Lower chaku (LBPN)	1,765 kw
	Total	**389,150 kw**	4.	Phewa (Pokhara)	1,088 kw	11.	Phawa khola (SHC)	2,079 kw
Under Construction		**K.W.**	5.	Seti (Pokhara)	1,500 kw	12.	Mai khola (HDHC)	2,400 kw
1.	Middle Marsyangdi	70,000 kw	6.	Tinau (Butwal)	1,024 kw	13.	Belkhu khola (MFIC)	320 kw
2.	Chamelia	30,000 kw	7.	Baglung	200 kw	14.	Upper Handi khola (CPDS)	991 kw
3.	Kulekhani III	14,000 kw	8.	Tatopani/Myagdi (i+ii)	2,000 kw	15.	Siuri khola (NGPL)	990 kw
Planned and Proposed:			9.	Jomsom**	240 kw	16.	Narayani Sankar Biomass (TMB)	500 kw
1.	Seti (West)	750,000 kw	10.	Chatara	3,200 kw		**Total**	**57,094 kw**
2.	Arun 3	402,000 kw		**Total**	**12,792 kw**	**Under Construction:**		
3.	Budhi Gandaki	600,000 kw	**Existing (Isolated):**			1.	Sinsne khola (GBHP)	750 kw
2.	Kali Gandaki	660,000 kw	1.	Dhankuta	240 kw	2	Pheme khola (KHP)	995 kw
3.	Lower Arun	308,000 kw	2.	Jhhupra (surkhet)	345 kw	3	Sali Nadi (KSHPS)	232 kw
4.	Upper Arun	335,000 kw	3.	Doti	200 kw	4	Thoppal khola (THP)	1,650 kw
5.	Karnali (Chisapani)	10,80,000 kw	4.	Phidim**	240 kw	5	Mardi khola (GHP)	3,100 kw
6.	Upper Karnali	300,000 kw	5.	Gorkhe (llam)***	64 kw	6	Pati khola (UHP)	996 kw
7.	Pancheswor	6,480,000 kw	6.	Jumla**	200 kw	7	Ridi khola (RHPD)	2,400 kw
8.	Thulo Dhunga	25,000 kw	7.	Dhading	32 kw		**Total**	**10,123 kw**
9.	Tamur/Mewa	101,000 kw	8.	Syangja***	80 kw	**SOLAR POWER**		
10.	Upper Trisuli	61,000 kw	9.	Helambu	50 kw	1	Simikot	50 kw
11.	Dudh Kosi (Storage)	300,000 kw	10.	Salleri*(sceco)	400 kw	2	Gamgadhi	50 kw
12.	Budhi Ganga	20,000 kw	11.	Darchula (i)&(ii)**	300 kw		**Total**	**100 kw**
13.	Rahughat Khola	27,000 kw	12.	Chame	45 kw	**TRANSMISSION LINE LENGTH**		
14.	Likhu -4	40,000 kw	13.	Taplejung**	125 kw	1	132 KV Transmission Line	2076 ckt km
15.	Kabeli "A"	30,000 kw	14.	Manang	80 kw	2	66 kv Transmission Line	586 ckt km
16.	Upper Marsyangdi "A"	121,000 kw	15.	Chaurjhari ** (Rukum)	150 kw	3	66 kv Underground Cable	7.0 ckt km
17.	Kulekhani No. 3	14,000 kw	16.	Syarpudaha** (Rukum)	200 kw	4	33 kv Single Circit	2485.0 km

18.	Andhi Khola (Storage)	180,000 kw	17.	Khandbari**	250 kw	**SUBSTATION CAPACITY**		
19.			18.	Terhathum**	100 kw		132/11 kv	71 MVA
20.	Khimti II	27,000 kw	19.	Bhojpur**	250 kw		132/33 kv	358 MVA
21.	Upper Modi	14,000 kw	20.	Ramechhap	150 kw		132/66 kv	211 MVA
22.	Langtang Khola (Storage)	218,000 kw	21.	Bajura	200 kw		66/11 kv	424 MVA
23.	Madi ishaneswor (Storage)	86,000 kw	22.	Bajhang**	200 kw		66/33 kv	25 MVA
24.	Upper Seti (Storage)	122,000 kw	23.	Arughat Gorkha	150 kw		**Total**	**1089 MVA**
25.	Kankai (Storage)	60,000 kw	24.	Okhaldhunga**	125 kw	NOTE		
26.	Upper Tama Kosi	309,000 kw	25.	Rupalgad (Dadeldhura)	100 kw		. Orivate & Others	
27.	Upper Modi 'A'	42,000 kw	26.	Surnaiyagad (Baitadi)	200 kw		.. Leased to the Private Sector	
28.	Hewa Khola	10,000 kw	27.	Namche	600 kw		… Not in normal Operation	
29.	Upper Trishli 3 B	44,000 kw	28.	Achham	400 kw		IPPs lines not included	
	Total	**12,76,6000 kw**	29.	Dolpa	200 kw		These capacities are within the Grid Substations only. Transformers within Distribution substation powerhouses and Local Distribution are not included.	
			30.	Kalikot	500 kw			
				Total	**6,176 kw**			
			Under Construction		400 kw		Installed Capacity in Nepal Electricity Authority (including Private and Others):	617.478 MW
			1.	Gamgad	500 kw			
			2.	Heldung				
				Total	**900 kw**			
			PRIVATE SECTOR PLANTS					
			1.	Andhi Khola (BPC)	5,100 kw			
			2.	Jhimruk (BPC)	12,000 kw			
			3.	Khimti khola (HPL)	60,000 kw			
			4.	Bhotekosi (BKPC)	36,000 kw			
			5.	Sange khola (SHP)	183 kw			
			6.	Indrawati (NHPC)	7,500 kw			
			7.	Chilime (CPC)	20,000 kw			
			8.	Piluwa khola (AVHP)	3,000 kw			
			9.	Chakukhola (APCo)	1,500 kw			
			10.	Sunkosi Small (SHP)	2,500 kw			
			11.	Rairang (RHPD)	500 kw			
			12.	Khudi khola (KHP)	3450 kw			
			13.	Baramchi (UHC)	980 kw			
			14.	**Total**	**152,713 kw**			

Source: NEA, Fiscal Year 2006/2007.

ANNEX-9
Hydro-Electricity Contribution and Economic Growth

	1	2	3	4	5	6	7	8	
F.Y.	Total GDP in million (Current price	GDP at Current price in electricity water an gas sector	GDP originated by electricity	GDP originated by hydro-electricity	Energy sold in GWH	Hydro-electricity energy sold in GWH	Price/GWH in million	Contribution of T.G.D.P Hydro electricity in	
								in million	percentage
1994/95	2,09974	2,862.00	2,718.90	2,447.01	829.52	746.568	3.27	2441.27	1.16
1995/96	2,39388	3,598.00	3,418.10	3,076.29	943.12	848.808	3.63	3081.17	1.28
1996/97	2,69570	4,457.00	4,234.15	3810.74	1,00.71	905.139	4.22	3819.68	1.41
1997/98	289.798	4,383.00	4,163.85	3747.47	11,051.81	946.629	3.95	3739.18	1.30
1988/99	3,30,.18	4,632.00	4,400.40	3,960.36	1,108.69	997.821	3.96	3960.36	1.20
1999/2000	3,66,285	5,942.00	5644.90	5,080.41	1,245.73	1,121.157	4.54	5090.05	1.39
2000/01	4,41519	7,750.00	7362.5	6,626.25	1,379.12	1,241.20	5.34	6628.008	1.50
2001/02	4,59,443	9138.00	8,68.10	7,812.99	1,557.75	1,401.975	5.58	7,823.020	1.71
2002/03	4,92231	11,447.00	10,874.65	9,787.185	1,694.27	1,524.84	6.41	9,787.185	1.99
2003/04	5,36,749	11,974.00	11375.30	10,237.77	1675.114	1,507.62	6.79	10,236.7398	1.91
2004/05	5,89,412	12782.00	12,142.9	10,928.61	1,821.391	1,639.2519	6.66	10,928.59	1.86

Source:

- Statistical year Book of Nepal (2005)
- Statistical Pocket Book, Nepal (2002,2003,2004,2005,2006)
- Economic Survey (2006/2007)
- NEA, A Year in Review (2004/2005, 2005/2006,2006/2007)
- Bhattrai, NP (December,2005) "Hydro power Development in Nepal"

Note:

Col-3 Assuming 95 percent sare of electricity from gas, water and electricity
Col-4and 6 Assuming 90 percent sare of hydro electricity
Col-7 Relationship between Col, 6 and 4
Col-8 Relationship between Col, 6 and 7 Relationship between Col, 1 and

ANNEX-10

Source: NEA, Fiscal Year, 2007.

ANNEX-11

Revenue from Electricity

Category	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007*
Domestic	1895. 85	2056. 05	2622. 03	3161. 38	3641.43	4249.81	4578. 99	5079.87	5405.12	6125.33
Non-Commercial	405 14	419 58	527 40	835 78	722.12	783.99	816 01	947.12	881.73	940.73
Commercial	477 04	515 72	661 58	555 62	818.75	894.91	986 07	1015.47	1118.21	1309.29
Industrial	1973.37	2093 88	2599 34	3086. 10	3608.13	4039.65	4380.22	4851.40	4978.69	5439.02
Water Supply & Irrigation	100.28	78.14	95 65	120 90	138.68	148.53	154 80	239.97	197 96	224.46
Street Light	101.98	111 37	149 95	176 05	200.74	246.79	329 52	315.45	422.35	466.19
Temporary Supply	7 17	7 06	13.39	6 77	3.63	4.74	3.46	5.50	11.18	17.32
Transport	6 51	9 46	18 31	27 73	27.90	29.29	28.94	30.47	29.78	32.61

Temple	6 71	7 42	9 70	11 45	12.16	14.24	2080	23.08	2442	24.67
Community Sales	-		-	-		16.59	2009	21.42	23.94	52
Total (Internal Sales)	4974 05	5298 67	6697 35	7981 78	9173.53	10428.53	11318.92	12529.75	13093.38	14631.62
Bulk Supply (India)	199.92	198 15	327 80	396 06	514.12	808.96	673.69	573.44	579.33	489.04
Gsmss Revenue	5173.96	5496.82	7025.16	8377.83	9687.65	11237.49	11992.61	13103.18	13672.71	15120.66
Net Income from Other			-		-	-	-	285.86	336 09	556.30
Total Revenue	5173.96	5496.82	7025.16	8377.83	9687.65	11237.49	11992.61	13389.04	14008.80	15676.96

Note:* Provisional figures, subject to final audit.
Source: NEA, Fiscal Year 2006/2007

ANNEX-12

Electricity Sales from 1998-2007

(in GWh)

Category	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007*
Domestic	378.778	410.566	467.049	518.36	557.94	617.11	676.365	758.189	805.72	911.51
Non-Commercial	60.227	62.931	63.592	73.157	78.22	80.736	83.012	100.543	95.29	101.15
Commercial	71.471	77.343	81.822	94.166	90.426	92.741	108.122	109.308	120.3	143.88
Industrial	413.738	440.996	508.357	520.34	596.677	629.,505	689.79	764	785.55	877.26
Water Supply &	29.045	22.831	15.742	28.6	29.283	29.983	31.671	49.98	45.5	49.43
Street Light	26.585	29.405	31.741	36.981	39.517	45.803	55.196	54.861	63.24	69.48
Temporary Supply	0.711	0.766	0.927	0.826	0.282	0.348	0.251	0.393	0.87	1.28
Transport	1.663	2.598	2.678	5.892	5.635	5.53	5.471	5.803	5.65	6.56
Temple	1.801	1.982	2.366	2.511	2.476	2.811	4.111	4.58	4.77	4.77
Community Sales	-	-	-	-	5.717	4.74	5.581	6.034	9.18	14.57

Total (Internal Sales)	984.019	1049.418	1174.274	1281.127	1400.456	1504.567	1653.998	1853.691	1936.07	2179.89
Bulk Supply (India)	67.41	64.158	95	126	133.857	192.249	141.235	110.702	96.55	78.25
Grand Total	1051.429	1113.576	1269.274	1407.127	1534.313	1696.816	1795.233	1964.393	2032.62	2258.14

Note : *Provisional figures; subject to final audit.

Source: NEA, Fiscal Year 2006/2007

ANNEX-13

Electricity Consumers in Different Year

Particulars	1998	1999	2000	2001	2002	2003	2004	2005	2006
Domestic	548110	593468	643314	713307	848540	930554	1010719	1113740	1229750
Non-Commercial	7192	7654	7815	7643	8629	9722	9865	9950	10010
Commercial	2637	2948	3096	3386	3898	5317	5454	6000	6170
Industrial	14062	14996	16179	17701	18789	19833	21374	22500	23020
Water Supply	205	215	232	236	251	305	352	370	380
Irrigation	776	876	967	1083	1353	1721	2557	3400	6450
Street Light	683	842	932	1012	1048	1229	1437	1500	1550
Transport	12	21	47	37	49	48	48	50	54
Community sales	-	-	-	-	1	1	15	35	58
Total (Internal sales)	574844	622358	673974	745987	884530	970506	1053930	1159850	1277442
Bulk supply (India)	5	5	5	5	5	5	5	5	5
Grand total	574849	622363	673979	745992	884535	970611	1053935	1159855	1277442

Source: NEA, Fiscal year 2006.

Annex-14

Power Generation Programme of Ninth Plan

A. Projects to be completed in Ninth plan

S.N.	Hydropower projects	capacity (MW)	Type	Completion year	Sector	Located District
1	Indrawati III	5	RoR	2000	Private	sindhupalchowk
2	Puwakhola	6	RoR	2000	Public	Ilam
3	Modikhola	14.8	RoR	2000	Public	parbat
4	Chillime	20	RoR	2000	Private	Rasuwa
5	Khimti I	60	RoR	2000	Private	Dolakha
6	Kali Gandaki 'A'	144	RoR	2002	Public	syangja
7	Tanakpur	8	RoR	2000	-	
8	Upper Bhotekoshi	36	RoR	2001	Private	sindhuplchowk
	Total	293.8				

B. Projects to be initiated in Ninth plan and to be continued.

a. Medium Projects

S.N.	Hydropower projects	capacity(MW)	year of Completion
1	Kulekhani III	14	To be continued
2	Khimti II	27	"
3	Likhu	44	"
4	Mid-Marsyangdi	61	"
5	Mid- Bhotekoshi	120	"
6	Upper Karnali	300	"
7	Arun III	402	"
8	West Seti	750	"
	Total	1,718	

b. Small Hydro- Power project

S.N.	Hydropower projects	capacity(KW)	year of Completion
1	kalikot	500	1999
2	Dolpa	160	1998
3	Dailekh	300	-
4	Lomanthang	65	-
5	Khothang	2,300	-
6	Gamgadhi	200	-
7	Heldung	250	-
	Total	3,775	

Extension of Transmission Line in Ninth Plan

S.N.	Projects	Length (km)	Year of completion
1	Kusaha-Dhalkebar	120	2058 B.S.
2	Dhalkebar-Hetauda	137	2058 B.S.
3	Dhumkebas- Butwal	43	2056 B.S.
4	Khimti –Bhaktpur –Balaju	47	2057 B.S.
5	Modi – Pokhara	40	2058 B.S.
6	Kali Gandaki 'A' –Pokhara	58	2058 B.S.
7	Kali Gandaki 'A' –Butwal	48	2058 B.S.
8	Pokhara- Marsyandi	85	2056 B.S.
9	Bhaktapur – Syuchatar	20	2058 B.S.
10	Pathliva –Parwanipur	15	2058 B.S.
11	Shalkebar- Sitamadhi –India	30	2058 B.S.
12	Butwal- Sunauli- India	30	2058 B.S.
13	Mahendranager-Tanakpur	11	2058 B.S.
14	Khimti – Dhalkabar	80	2058 B.S.
15	Mid marsyandi – Dumare	25	2058 B.S.
16	Bhotekoshi- sunkoshi	25	2057 B.S.
17	Chilime- Trisuli Devighat	39	2057 B.S.
18	Indrawati –panchkhal	31	2058 B.S.
19	Hetauda- Dumkibas	140	2059 B.S.
	Total	1,024	

Survey and Feasibility Study Programme of Ninth Plan

S.N.	Hydro power Project	capacity (MW)	Sector
1	Kulehani III	13	Public
2	Upper Modi	14	Public
3	Lower Modi khola	20	private
4	Budhiganga	22	Public
5	Rahu Ghatt khola	24	Public
6	Thulo Dhunga	25	private
7	Khimti II	25	Public
8	Chamelia	30	Public
9	Likhu IV	34	private
10	Kaweli 'A'	35	private
11	Upper Marsyangdi 'A'	43	private
12	Simbuwa khola	53	Public
13	Kankai	60	Public
14	Mid marsyangdi	61	Public
15	Tamor	72	private
16	Sharda	75	private
17	Bheri – Babai	82	private
18	Seti III	107	Public
19	Mid –Bhotekoshi	120	Public
20	Upper Marsyangdi III	121	private
21	Andhi Khola	154	Public
22	Tama Koshi II	287	Public
23	Upper Trishuli II	300	Public
24	Dudh Koshi	300	Public
25	Upper Karnali	300	Public
26	Budhi Gandaki	600	private
27	Kali Gandaki	660	private
28	West Seti	750	private
29	Sapta Koshi	470	Public
30	Pancheshwar	6,480	Public
31	Karnali	10,800	Public
	Total	26,367	

Source: HMG of Nepal, NPC and The Ninth Plan.

Annex -15

Hydro-Electricity Projects to be Completed in Tenth Plan

S.N.	Project Name	Capacity (MW)
	Under public sector	
	a) Project with licence to generate electric	
1.	Middle Marsyangdi	70
	b) The project with feasibility completed	
2.	Chemelia	30
3.	Heldung	0.5
4.	Gumgad	0.4
	Total	100.9
	Under a joint venture of private & public sector	
	a) Project with license to generate electricity	
1.	Chilime	20
	Total	20
	Under private sector	
	a) Project with license to generate electricity	
1.	Upper Modi	14
2.	Indrawati III	7.5
3.	Mailung	5
4.	Piluwa	3
	b) Project with electricity purchasing agreement	
5.	Langtang	10
6.	Dram	5
7.	Kudhi	3.5
8.	Sunkoshi Small	2.6
9.	Baramchi	1
10.	Chaku	1.5
11.	Feme	1
	C) Project with feasibility study completed	
12.	Kabeli I	30
13.	Rahughat	27
14.	Lower modi	20
15.	Madi	20

16.	Doti	8.5
17.	Hewa	5
18.	Manhari	5
19.	Lower Indrawati	4.5
20	Trisuli	4
21.	Belkhu	2.6
22.	Vijayapur – 1	2.5
23.	Thupal	1.9
24.	Ridi	1.8
25.	Rigdi	1.5
26.	Kahule	1.5
27.	Sirsegad	1
28.	Junrimba	1
29.	Lower Piluwa	1
30.	Gomagand	0.4
31.	Khoranga	0.2
32.	Tatopani	0.2
	Total	193.7
	Grand Total	314.6

Hydro- Electricity Project to be Commenced in Tenth Plan

S.N.	Name of project	Sector	Capacity
1	Kulikhani	Public	42
2	Upper Tamakoshi (Rolwaling)	Public & Private	250
3	Khimiti II	Public & Private	27
4	Thulo Dhunga	Public & Private	24.7
5	Western Seti	Private	750
6	Arun III	Private	402
7	Upper karnali	Private	300
8	Likhu -4	Private	51
9	Upper Marsyandi 'A'	Private	50
10	Myagdi	Private	22
11	Upper Madi	Private	19.2
	Total		1937.9

Distribution Line will be Completion in Tenth Plan

A. Under Public Sector

S.N.	Name of Distribution line	Length (km)	Completion year (B.S)
	a) 132 kv distribution line		
1	Butwal-sunauli (Link of Export & Import)	25	2060/61
2	Dhalkebar-vittamod (Link of Export & Import)	45	2061/62
3	Parwanipur- Birguni (Link of Export & Import)	15	2061/62
4	Mid-Marsyandi-Marsyandi Hydro electric center	41	2061/62
5	Thankot- Chapagaun-Bhaktapur	27	2061/62
6	Pathlaiya- Parwanipur	20	2063/64
7	Chameliya- Attariya	127	2063/64
	b)66kv distribution line		2063/64
8	Kulekhani III- Hetauda	1	
	Total	301	

B. Under Private Sector

S.N.	Name of Distribution line	Length (km)	Completion year (B.S)
	a) 132 kv distribution line		
1	Upper Modi-Modi Hydro-electric center	10	2060/61
2	Kabeli 'A'- Anarmani	77	2063/64

3	Rahughat-Modi Hydro-electric center	26	2063/64
4	Lower Modi- Modi Hydro-electric center	5	2063/64
5	Madi-1 – Lakhnath	7	2063/64
	b) 66 kv distribution line		
6	Mailung- Grang	3	2060/61
7	Langtang- Chilime	1	2061/62
	Total	129	

Construction of Distribution Sub-Station to be Completed in Tenth Plan

S.N.	Name of Substation	Capacity	Completition year
	a)132/33 kv substation		
1	Butwal	30	2059/60
2	Dubhai	30	2059/60
3	Aanarmani	15	2059/60
4	Dhalkebar	15	2059/60
5	Chandranigapur	30	2061/62
6	Kawasoti	30	2063/64
7	Duhabi	30	2063/64
	Total	180	
	B)132/11 kv Substation		
8	Bharatpur	15	2059/60
9	Pokhara	15	2059/60
10	Harisiddhi	22.5	2060/61
11	Naya parwanipur	40	2060/61

12	Bhaktpur	30	2060/61
13	Chapali	22.5	2061/62
14	Chandranigapur	10	2061/62
15	Bardghat	10	2063/64
	Toatal	165	
	C) 66/11 kv Chabhil		
16	Naya Chabhil	22.5	2060/61
17	Naya patan	22.5	2060/61
18	K-3	36	2062/63
	Total	81	
	Grand Total	426	

Hydroelectricity Project for Completion of Survey and Study in Tenth Plan

S.N.	**Name of project**	**Capacity (mw)**
	a) Under Public Sector	
1	Pancheswor Multipurpose project	6,480
2	Saptakoshi Multipurpose project	4,700
3	Upper Tamakoshi (Rolbaling)	250
4	Sapta Gandaki	225
5	Langtang watershed	221
6	Upper Seti watershed	122
7	Madi- isaneshwor watershed	86
8	Kanakai Multipurpose	60
9	Bheri- Babai	48
10	Kulekhani III	42
10	Inawa	2.7
11	Sarada	2.2
	Total	12,238.9

	B) Under Private Sector	
1	Lower Arun	308
2	Upper Trisuli-II	300
3	Upper Marshyangdi	121
4	Upper Marshyangdi-II	85.5
5	Likhu –IV	51
6	Upper Marshyangdi – A	50
7	Bhotekoshi – V	46
8	Khimti- II	27
9	Lower Magdi	25
10	Thulodhunga	24.7
11	Magdi	22
12	Upper Magdi	19.2
13	Roshi –IV	12
14	Roshi- I	10.5
15	Roshi – III	7.5
16	Aankhu	5
17	Sunaiya	4.8
18	Lower Roshi	4.8
19	Taadi	4.2
20	Lower Balafi	3
21	Kolfu	2.2
22	Dordi- I	2.1
23	Daraudi	1.4
	Total	1,136.9
	Grand Total	13,375.8

Source: Government of Nepal, NPC and The Tenth Plan.

Annex -16

Hydro-Electricity Projects to be Completed in Eleventh Plan

S.N.	Name of Project	Capacity (K.W.)	Completion year
1.	Chemelia	30,000	2067/68
2.	(Upper Tamakoshi)	309,000	2070/71
3.	Upper Seti watershed)	122,000	2070/71
4.	Upper Trishuli (A)	60,000	2070/71
5.	Upper Trisuli (B)	40,000	2070/71
6.	Rahu Ghatt	27,000	2070/71
7.	Kaweli 'A'	30,000	2070/71
8.	Mailung	5,000	Private Sector
9.	Lower Indrawati	4,500	Private Sector
10.	Upper Modi	14,000	Private Sector
11.	Dram Khola	5,000	Private Sector
12.	Lower Madi	4,500	Private Sector
13.	Madi -1	10,000	Private Sector
14.	Faba Khola	2,079	Private Sector
15.	Arun 'III'	402,000	Private Sector
16.	Upper Karnali	300,000	Private Sector
17.	West Seti	750,000	Private Sector
	Total	2,115,079	

Source: Government of Nepal, NPC and The Eleventh Interim Plan.