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Scenario Analysis of Integrated Nepal Power System for Energy Banking between Nepal & India from Nepalese Perspective for Projected Ten Years

by

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A THESIS

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ABSTRACT

The surplus – deficit energy analysis for projected ten years of Integrated Nepal Power System (INPS) gives ideas about the monthly energy status in different scenarios and helps in better planning for Energy Banking between Nepal and India from Nepalese perspective and also in increasing the opportunities of internal consumption within the country. Energy banking between power systems of Nepal and India will enhance the power system security and reliability of Nepal power system. The real problems created by delays in commissioning of upcoming generation projects due to different delaying factors such as delays in commissioning of projects from their PPA concluded date and delays in completion of transmission projects will change the pattern and amount of generations in upcoming periods which results into difficulty in planning purpose. Similarly, the increase in both the generations and expected energy consumption also impacts the INPS in future as well.

This thesis presents the scenario analysis of surplus – deficit energy for projected ten years period with the consideration of different scenarios in both the generation and consumption sector and simulates the load flow analysis of planned INPS after the saturation of new generation projects for fiscal year 084/85 in most likely generation scenario i.e. Shift IPP and NEA Plants scenario. Three scenarios viz. commissioning of upcoming projects in accordance with the Power Purchase Agreement (PPA) concluded date, with one year delay for projects coming under Independent Power Producers (IPPs) & additional three years delay in projects coming under Nepal Electricity Authority (NEA) and its sister organization are considered in generation sectors. The consumption sector is introduced with five scenarios viz. Normal, Growth with Categorization of Consumption, Intervention with Induction Chulo, Intervention with Electric Vehicle and Combined Intervention of Induction Chulo and Electric Vehicle.

Surplus – Deficit (S – D) ratio has been used for studying the relative dominance of surplus or deficit energy over a year. For the projected ten years period, the surplus – deficit energy of each month of those fiscal years are determined. This study clearly decides for monthly energy banking scenario between two countries in both the normal load consumption growth in Nepal and also with opportunities of increasing use of electrical energy. This study also models and simulates the planned INPS after generation saturation in "Shift NEA and IPP Plants" scenario for five scenarios to predict the import export options in five energy consumption scenarios as well.

When the energy demand is expected to grow at the rate of 8% per annum, the maximum export of energy has been observed for months of Ashoj. The study shows the Dhalkebar – Muzzafarupur 400 kV line has been fully used upto its capacity and around 2094 MW power export has been observed through 400 kV Butwal – Gorakhpur cross border transmission link.

When the energy demand is expected to grow as per growth rate with categorization of consumption, the maximum import (in the month of Falgun) is achieved with four import lines viz. Dhalkebar – Muzzafarpur 400 kV line, Tanakpur – Mahendranagar 132 kV transmission line, Butwal – Gorakhpur 400 kV line and Kusaha – Katiya 132 kV line. Similarly, when the energy consumption policy is implemented as intervention with induction chulo or combined intervention of both induction chulo and electric vehicle for maximum import in these scenarios with monthly peak demands of about 5803MW and 6139 MW respectively for fiscal year 084/85, six import lines in accordance with cross – border planning have been neede to accommodate the total import peak demand within their loading capacity. These lines are Tanakpur – Mahendranagar 132 kV line, Butwal – Gorakhpur 400 kV line, Dhalkebar – Muzzafarpur 400 kV line, Kusaha – Kataiya 132 kV, Parwanipur – Raxaul 132 kV line and Duhabi – Purnea 400 kV lines. However, Amlekhgunj – Kamane – Pathlaiya – Parwanipur – Birgunj – Simara – Amlekhgunj loop is provided with additional capacitor banks to compensate for convergence problem cause by reactive power need in latter two import scenarios.

When the export scenario is analyzed with electric vehicle integration policy in the months of Ashoj, only Dhalkebar – Muzzafarpur 400 kV line is needed to accommodate the export demand which is in the range of capacity of this line (i.e.1200 MW).

The transformers of Balaju, Bhaktapur, Chapali, Dhalkebar, Hetauda, Suichatar, Khimti and Parwanipur grids is found critically overloaded in all scenarios and should be upgraded once the upcoming generation projects saturates in INPS. The 66 kV and 132 kV transmission lines of Kathmandu sub – system and Amlekhgunj – Kamane – Pathlaiya – Parwanipur – Birgunj – Simara – Amlekhgunj sub – sytem is found critically overloaded in all scenarios. Similarly, all the 66 kV and 132 kV in buses in INPS have been found to operate with critical bus voltages in all scenarios after generation saturation in planned INPS indicating vulnerability of our INPS as well.

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LIST OF ACRONYMS AND ABBREVIATION

AEG	Actual Energy Generations
AMEC	Average Monthly Energy Consumption
AMIE	Actual Monthly Imoprt Energy
AMPCF	Average Monthly Plant Capacity Factor
CMIE	Calculated Monthly Import Energy
DoED	Department of Electricity Development
EMEG	Expected Monthly Energy Generations
E2Ws	Electric Two – Wheelers
E4Ws	Electric Four – Wheelers
FY	Fiscal Year
GDP	Gross Domestic Product
GWh	Gigawatt hours
HEVs	Hybrid Electric Vehicles
INPS	Integrated Nepal Power System
IPPs	Independent Power Producers
KL	Kilo Litres
kV	Kilovolt
kWh	Kilowatt hours
LDC	Load Dispatch Centre
LPG	Liquified Petroleum Gas
MAED	Model for Analysis of Energy Demand
MEC	Monthly Energy Consumption
MJ	Mega Joule
MW	Mega watt
MWh	Megawatt hours

NEA	Nepal Electricity Authority
PCF	Plant Capacity Factor
PIC	Plant Installed Capacity
PPA	Power Purchase Agreement
PVMI	Percentage Variartion in Monthly Import
RCOD	Required Commercial Date of Operation
ROR	Run of River
VKT	Vehicle Kilometer Travel
WAMPCF	Weightage Average Monthly Plant Capacity Factor

CHAPTER 1: INTRODUCTION

1.1 Background

The scarcity of electric power always compelled electric utility to fulfill the basic need; committing basic electric power to the consumers for meeting their needs. That is the case which has been compelling our power plants to give emphasis to meet active power at most at present scenario. Furthermore, the recent end of load shedding is new achievement of Nepal in the power sector which is hugely supported by import of electrical power from our neighboring country. To enhance the power system security and reliability, government of Nepal and India has come up with idea of working jointly in energy banking between these two power systems recently.

Nepal and India have agreed on energy banking action in principle (not realized in practical) as soon as the production of Upper Tamakoshi Hydropower starts in upcoming period. The general pattern of this banking is that surplus power available in Nepal during the wet months is absorbed by the power system of India and Nepal will retrieve the banked energy when the usual dire need of power strikes during dry months.

Energy banking is accompanied by bidirectional flow of energy within two or more synchronized power systems in similar manner to storage and retrieval of energy from battery based syetem. Unlike battery based storage system, energy is not stored in energy banking. For energy banking, two power systems must have surplus and deficiencies of energy in differenet points of time but not simultaneously. If a power system has surplus energy at one point of time and another system is suffering deficit in same point, then the former system supplies surplus energy to latter. Similarly, surplus and deficit status of two systems are interchanged at some other points of time, and the latter system can supply back energy to the former one.

Nepal, which faced acute energy crisis till 2016 AD, has just become a almost load shedding free for around four years. However, this is achieved not only by our internal generation but also with import energy from India. The total import points in INPS include eight points viz. Tanakpur, Birgunj, Muzzafurpur, Kataiya, Jaleshower, Bisanpur, Ramnagar and Nepalgunj at present. Nepal is expected to have surplus

energy during wet months after the completion of Upper Tamakoshi Hydropower Project with installed capacity of 456 MW. But the deficit of energy in dry months is expected to continue even after the commissioning commissioning of Upper Tamakoshi hydroelectric project. Regarding the generation strategy, the recently published White Paper by Ministry of Energy, Water Resources and Irrigation has planned 10000 MW as tenth year planning from now onward including generations from Nepal Government, Nepal Electricity Authority and its subsidiary companies as well as private companies (MoEN, 2018). Similarly, WECS the Government of Nepal has also forecasted the load demand from 2015 AD to 2040 AD (MoE, 2017) as well. However, commsioning all the generation projects in exact time in accordance with Power Purchase Agreement (PPA) has always been biggest challenege in Nepal and are accompanied with delays in commissioning due to different factors.

The general daily peak demand met pattern and daily energy consumption pattern of all India have been found to increase from May (Baisakh of BS Calendar) to October (Ashoj of BS Calendar) and then decrease from October (Kartik of BS Calendar) to April (Chaitra of BS Calndar). Similarly, the daily peak demand met pattern and energy consumption pattern of Uttar Pradesh and Bihar (i.e. Northern Region of India) states follow increase from April to October and from there onwards it goes on decreasing (Power System Operation Corporation Limited, 2016). This seasonal variation in demand and energy of nearest Indian region to Southern Nepal shows these regions experience high demand of energy in the period from around Baisakh to Ashoj in which seasonal impact causes maximum generations from hydropower projects in Nepal and INPS is expected to have surplus energy at this period. This show there is opportunity of supplying energy in this period from Nepal to Uttar Pradesh and Bihar at least and takes back the supplied energy during energy scarcity period.

In this thesis, an attempt has been made to study the scenario analysis of monthly surplus – deficit energy for projected ten years period with the consideration of different scenarios in both the generation and consumption aspects. Three scenarios viz. commissioning of upcoming projects in accordance to Power Purchase Agreement (PPA) concluded date, with one year delay for projects coming under Independent Power Producers (IPPs) & additional three years delay in projects

coming under Nepal Electricity Authority (NEA) and its sister organization are considered in generation aspects. The energy sector is advancing towards replacing the petroleum and coal based consumption by electrical energy based consumption in recent years. So, to study opportunities of increasing internal electrical based consumption and its influence on energy banking as well, the consumption sector is introduced with additional scenarios of intervention with Induction Chulo, intervention with Electric Vehicle and combined intervention of Induction Chulo and Electric Vehicle to normal consumption growth observed in rectent years in Nepal resulting into five scenarios in consumption aspects.

Furthermore, INPS has been modeled for third scenario of generation i.e. for consideration of one year delay for projects coming under Independent Power Producers (IPPs) & additional three years delay in projects coming under Nepal Electricity Authority (NEA) and its sister organizations and five scenarios of energy consumption are studied to predict the status of INPS for fiscal year 084/85 as well.

1.2 Problem Statement

The factors such as delays in completion of transmission projects and substations, improper work planning while construction, lengthy paperwork procedures in government offices and political interference in construction site are major causes which are responsible for delay in completion of generation projects in accordance to PPA concluded date in Nepal. The general delay encountered are; one year delay in projects going to be constructed by IPPs and three year delay in project goint go be constructed by NEA and its sister organizations. This delay has major impact resulting into significant deviation from normal generation planning and import export energy planning.

The seasonal variation in demand and energy of nearest Indian regions (Uttar Pradesh & Bihar) to Nepal experience high demand of energy from Baisakh to Ashoj and INPS is expected to have surplus energy at this period and remaining period of year generally demands import from India. This show there is opportunity of Energy Banking (supplying energy in this period from Nepal to Northern Grid of India at least during this surplus energy period and taking back the supplied energy during energy scarcity period in Nepal) between Nepal & India.

The large dependency on imported petroleum based fuel consumption for country like us; country with technically and economically feasible hydropower potential of around 56,278 MW on Q40 basis (Kandel, 2018), necessiates proper study for possibility of increasing internal electrical energy consumption as well as we are expecting surplus energy in near future.

INPS is expecting surplus energy in wet months and deficit energy in dry months in near future. However, the lack of projection of monthly surplus – deficit energy in future planning with possible delays in upcoming projects, as both government and NEA present the yearly planning, is resulting into no idea about monthly quantitative energy for energy banking strategy as well till date. Similarly, the planning for INPS for future period to acoomodate all the genartions and expected consumption should be studied in advance to tackle any abnormalities in future INPS. This necessitates a through analysis of energy banking scenarios.

1.3 Objective and Scope

The main objective of this thesis work is to analyze the prospective scenarios of energy banking between Nepal and India from Nepalese perspective and to predict the status of INPS after saturation of generation projects in future with consideration of opportunities for increasing internal electrical based consumption within Nepal as well. In order to achieve the main objective, the following sub – objectives are set;

1) To determine monthly expected energy generations for projected ten years with consideration of three scenarios in generation aspects; commissioning of upcoming projects in accordance to Power Purchase Agreement (PPA) concluded date, with one year delay for projects coming under Independent Power Producers (IPPs) & additional three years delay in projects coming under Nepal Electricity Authority (NEA) and its sister organizations.
2) To determine monthly expected energyconsumptions for projected ten years with consideration of five scenarios in consumption aspects; Normal (eight percent per annum growth in consumption), Growth with Categorization of Consumption, Intervention with Induction Chulo, Intervention with Electric Vehicle and Combined Intervention of Induction Chulo and Electric Vehicle

3) To verify the analysis through calculated import and actual import energy for year 2076 BS
4) To recommend monthly surplus – deficit energy for projected ten fiscal years for each combination of scenarios generation and consumption aspects
5) To model planned INPS for most likely generation scenario and perform load flow simulation with aim to study status of INPS just after saturation of generation

1.4 Outline of Thesis

This thesis has been organized into five chapters:

Chapter 1 gives brief introduction of energy banking, necessity of monthly surplus – deficit energy analysis for projected ten years and objective of this thesis.

Chapter 2 gives the overview of literature review of energy banking strategy between Nepal and India, generations planning and load demand forecast.

Chapter 3 gives the methodology used in this thesis. It also includes all the scenarios of generation aspects, consumption apsects and verification process with necessary formulation and calculations. This also includes modeling of planned INPS and simulation of thus modeled INPS to study the status of INPS just after saturation of new generation projects.

Chapter 4 describes expected monthly surplus – deficit energy results for projected ten years period for each combination of generation and consumption scenario with necessary discussions. This also describes the import and export possibilities through INPS for energy banking, bus voltage results, line loading and transformer loading results of INPS for fiscal year 084/85 for five considered scenarios.

Chapter 5 summarizes the thesis and proposes recommendations for further research.

CHAPTER 2: LITERATURE REVIEW

2.1 Recent Trends of Energy Exchange between Nepal & India

The yearly energy consumption of Nepal till date is balanced by generations from hydropower projects developed by NEA and its sister organizations, hydropower projects developed by IPPs and import energy from India. The balancing has been used through two approaches viz. capacity balance and energy balance. The lowest capacity balance through import from India in fiscal year 2075/76 was observed in the month of Kartik which was about 374.77 MW. Similarly, the highest capacity balance through import from India in fiscal year 2075/76 was observed in the month of Poush which was about 653.47 MW. The energy balance in INPS was achieved through import of 2813.07 GWh in fiscal year 2075/76. The highest and lowest monthly imports were observed in the months of Kartik and Poush and the corresponding imported energy recorded were found to be 87.05 GWh and 326.58 GWh respectively. The total energy imported from India to balance our energy requirement in last three years (i.e. 2016, 2017 and 2018 AD) were recored as 1777.68 GWh, 2175.04 GWh and 2581.8 GWh respectively. Similarly, there were some exports of energy as well in fiscal year 2075/76 through four exports point viz. Kataiya I, Kataiya II, Ramnagar and Raxaul. The total exports of around 42.5 GWh energy was achieved in fiscal year 2075/75. The major exports of energy were achieved in the seven months period from Baisakh to Kartik. (Nepal Electricity Authority, 2019).

2.2 Energy Consumption Growth Study

2.2.1 Demand Forecast Study by Water and Energy Commission Secretariat

Water and Energy Commission Secretariat (WECS) is mandated to carry out various energy related studies including demand forecast. WECS had forecasted the total installed capacity as well as energy requirement from 2015 AD to 2040 AD in Nepal. In this forecast, three main scenarios; Business as usual (4.5% GDP growth rate), reference (7.2% GDP growth rate), and high growth (9.2% GDP growth rate) are considered along with two more scenarios with consideration of growth with policy intervention as well. Policy intervention is characterized by following assumptions:

- 75% of water heating with electricity in urban household will be done by 2020 AD
- 100% of cooking with electricity in urban household will be done by 2020 AD

- At least 7% of cooking with electricity will be done in rural area AD
- 18% of total passenger kilometers will be fulfilled by electric car and 7% by electric metro in city by 2025 AD

The energy demand forecast is studied MAED model with scenarios of possible development. The final electricity demand from this study is presented in Table 2. 1.

Table 2. 1 Final Electricity Demand from 2015 AD to 2040 AD in different Scenarios

Year (AD)	Final Electricity Demand (GWh)				
	BAU	Reference Scenario	High Scenario	Policy Intervention @ 7.2%	Policy Intervention @ 9.2%
2015	3866.36	3866.36	3866.36	3866.36	3866.36
2020	7600.75	8110.66	8522.97	14870.92	15304.29
2025	12998.25	14863.67	16545.84	22431.68	24265.05
2030	20073.83	24956.79	29864.09	35334.66	41264.82
2035	29744.69	40709.77	52983.16	51771.84	65657.50
2040	43016.68	66096.60	94851.97	81958.97	115294.44

Source: (MoE, 2017)

The growth rate of final electricity demand for different scenarios is concluded from this study which is presented in Table 2. 2. (MoE, 2017)

Table 2. 2 Average Growth Rates of Final Electricity Demand

Year (AD)	Growth Rate of Final Electricity Demand (% p.a.)				
	BAU	Reference Scenario	High Scenario	Policy Intervention @ 7.2%	Policy Intervention @ 9.2%
2015	-	-	-	-	-
2020	14.50	15.10	17.13	30.92	31.67
2025	11.30	12.19	14.19	8.57	9.66
2030	9.10	10.25	12.54	9.51	11.20
2035	8.20	9.64	12.15	7.94	9.73
2040	7.70	9.50	12.35	9.62	11.92

Source: (MoE, 2017)

2.2.2 Energy Demand Projection Study by Investment Board of Nepal

The National Planning Commission and Investment Board of Nepal have jointly conducted this energy demand projection and predicted energy requirements of Nepal in the year 2030 AD. This study takes into account the evolution of the social needs of population, such as the demand for transportation, lighting and air conditioning. This model encompasses all form of energy rather than solely electricity requirements. However, this study does not take into account the willingness and ability to pay for energy/electricity. The base case assumptions considered in this study are (Investment Board of Nepal, 2014):

- 2014 AD is base year.
- Population growth is 1.35% p.a.
- The urban population is 40% of total population in 2014 AD and will reach to 49% of toal population in 2013 AD.
- The GDP of Nepal is 5%.
- By 2030 AD, agriculture and irrigation will be powered by electricity exclusively and fossil fuel & transportation partially.
- Electricity will be 52% of total cooking energy for urban households in 2030 AD.
- Electricity will be 45% of total household cooking energy in rural household.

This study has used MAED policy tool which is useful in forecasting a country's total energy (and electricity) demand given its economic, social and technological evolution pattern incorporating energy mix aspects. The final electricity demand for different scenarios is concluded from this study which is presented in Table 2. 3.

Table 2. 3 Energy Demand Forecast – Base Case Scenario

Year (AD)	Energy Demand (GWyr)
2014	0.707
2020	1.493
2025	2.462
2030	3.817

Source: (Investment Board of Nepal, 2014)

While analyzing the percentage growth in forecasted electricity demand in constant annual rise basis, there is 13.26% growth p.a. from year 2014 AD to 2020 AD,

10.52% growth p.a. from year 2020 AD to 2025 AD and 9.16% growth p.a. from 2025 AD to 2030 AD.

2.2.3 Load Forecast study by Nepal Electricity Authority

This study is conducted by System Planning Department, Nepal Electricity Authority in July, 2015 and is based on Load Forecast Report, 1997 by the Norconsult under ADB'S programme. This study covers Nepal's internal load growth from the period of fiscal year 2014/15 to fiscal year 2033/34. The assumptions for this study are:

- The per capita GDP is projected to grow at an average rate of 1.98% on fiscal year 2014/15, 4.59% from fiscal year 2015/16 to 2017/18, 5.08% from fiscal year 2018/19 to 2022/23, 5.57% from fiscal year 2023/24 to 2027/28 and 6.07% from fiscal year 2028/29 to 2033/34.
- The new consumers of NEA are assumed to grow by 4% annually from fiscal year 2014/15 to 2020/21 to meet 80% electrification ratio in fiscal year 2020/21. It is assumed to reduce by 44, 100 annually from fiscal year 2021/22 to 2027/28 to meet electrification ratio of 90% in fiscal year 2027/28. Similarly, new consumer growth rate is assumed to increase in such a way from fiscal year 2027/28 to 2033/34 so as to keep an Electrification ratio of 90% in the subsequent years.
- The remaining 10% of the population will use alternative sources as source of electricity.
- The annual consumption figure for new consumers is taken as 368 kWh in the base case on fiscal year 2014/15.
- The inflation of 7% has been taken for the whole planning period and the real price increase is taken as 0% meaning there by tariff is increased such as to balance the inflation.
- Tariff increment is considered as 15% in fiscal year 2015/16 and 20% in 2022/23 and 2032/33 in Domestic, Industrial, Commercial and Other consumers.

Based on those assumptions, this study concludes that the total energy requirement in Nepal is projected to grow by an average of 8.1 % p.a. over the forecated period, from 5988.98 GWh in fiscal year 2013/14 to 28, 329.85 GWh in fiscal year 2033/34 including export to india as well. Similarly, the peak demand

is projected to grow from 1201 MW in fiscal year 2013/14 to 5785.3 MW in 2033/34 (Nepal Electricity Authority, 2015).

2.2.4 Energy Forecast Study by Asian Development Bank

This study presents the past trends of energy consumption and peak demand from year 2011 AD to 2016 AD and annual growth rate of respective parameters which is presented in Table 2. 4.

Table 2. 4 Electricity Demand and Supply, Fiscal year 2011 - Fiscal Year 2016

Item	Year 2011 AD	Year 2012 AD	Year 2013 AD	Year 2014 AD	Year 2015 AD	Year 2016 AD	Annual Growth Rate (%)
Installed Capacity (MW)	706	719	762	787	787	856	3.9
Peak Demand (MW)	946	1027	1095	1201	1292	1385	7.9
Supply Cpacity Shortage (MW)	240	308	333	414	505	529	17.1
Electricity Requirement (GWh)	4833	5195	5446	5910	6335	6920	7.4

Source: (Asian Development Bank, 2017)

This study concludes the respective final energy demand by both the source and sector as well from year 2015 AD to 2035 AD. The average annual growth rate for final energy demand by industrial and transport sectors in Nepal for the period under consideration are 4% and 3.5% respectively. Similarly, the average annual growth rate of final energy demand by Coal, Oil and Electricity from 2015 AD to 2035 AD is 3.5%, 3% and 5.4% respectively (Asian Development Bank, 2017).

2.2.5 Power Demand Forecast Study by Government of Nepal & Japan International Cooperation Agency (JICA)

The Government of Nepal and JICA had jointly prepared a master plan for storage – type hydroelectric development for domestic demand in Nepal. The power development plan is optimized based on the power demand forecast of the sectoral GDP growth rates, forecasted price increase of electricity and so on. This study had forecasted 20 – year evolution of power demand using dynamic model employing principles of economic theories. This model was then employed to determine 1997 forecasts by Asian Development Bank and 2008 forecasts by NEA and thus these

model implements comparisons with other demand forecasts as well. This model considers economic, policy and technical factors of power market like the future path of the economic development in Nepal, the pricing scenarios developed to ease market distortion in order to attract private sector investment, a modality to handle the lost electricity demand because of intensive power shedding, the way to handle assumed damage caused by load shedding to the industry and service sectors etc. The forecasted sectoral GDP growth rates for power demand forecasting from this model are presented in Table 2. 5.

Table 2. 5 Sectoral GDP Growth Forecasts

Fiscal Year	Sector – wise GDP Growth (%)			
	Domestic	Industry	Commerce	Other
2019/20	4.00	5.20	6.00	5.50
2020/21	4.10	5.20	6.00	5.50
2021/22	4.20	5.30	6.00	6.00
2022/23	4.30	5.50	6.50	6.00
2023/24	4.40	6.00	6.50	6.00
2024/25	4.50	6.00	6.50	6.00
2025/26	4.50	6.00	6.50	6.00
2026/27	4.50	6.00	6.50	6.00
2027/28	4.50	6.50	6.50	6.00
2028/29	4.50	6.50	7.00	6.00
2029/30	4.50	6.50	7.00	6.00

Source: (Japan International Corporation Agency, 2014)

2.2.6 Capacity and Enrgy Growth Rate Adopted in Load Dispatch Center, NEA for Analayis Purpose

The current INPS of Nepal has one dispatch center named as Load Dispatch Center (LDC), NEA located at Suichatar, Kathmandu. During visit to LDC, it was found that for the fiscal year 2078/79, 2079/80 and 2080/81, the forecast analysis is performed in two aspects viz. Capacity Growth and Energy Growth but with different scenarios. The capacity growth is analyzed in two scenarios viz. Genaration available from NEA and IPP both will be 100% and 90% respectively. For the former scenario, the analysis was performed with capacity growth rate of 6% and 8% p.a. Similarly, the capacity growth rate for the latter scenario is taken as 8% p.a. and analysis is carried

out. The energy growth is analyzed in three scenarios viz. 10% growth p.a. when generations available from both NEA and IPP will be 100%, 8% growth p.a. when generations available from NEA will be 100% and generations available from IPP will be 90% and 8% growth p.a. when generations available from both the NEA and IPP will be 90%. However for the recent year i.e. from fiscal year 2017/18 to 2018/19, the energy consumption growth rate has been found as 13.89% (Nepal Electricity Authority, 2019).

2.2.7 Brief Introduction to Indian Power System and Its Demand Projection

India ranks fourth in the world in terms of power generation capacity with a total installed base of 274,818 MW (as on Jun'15). This is a significant increase from 120,514 MW at the end of FY05. Expansion in generation capacity has been led by the thermal sector which recorded a growth of ~110 GW from FY05 to FY15. Coal dominates the current capacity mix and accounts for 60.84% of installed capacity. Analysis shows that India will continue to be a net exporter of power. Being primarily a coal based economy, Coal will continue to account for nearly 72% of the total electricity requirement. At the same time the importance of renewable energy is growing with generation accounting for nearly 14% of generation by 2034.

In the near-term (2015 to 2020): India going from being a net importer in 2015 to becoming a net exporter in 2016 and 2017 and again becoming net importer again in 2018 to 2020. In medium- to long-term (2021 to 2034), as system becomes unconstrained (not limited by transmission constraints), India becomes a net exporter. Study shows the peak shortages (MW) had been reduced from 15,747 MW to 6285 MW in four years from FY10. The demand projection of this study from 2019 AD to 2034 AD in subsequent five years is 231.97 GW, 329.986 GW, 468.13 GW and 662.882 GW respectively. In addition, the Indian Government has increased the solar capacity target by five folds from 20,000 MW to 100,000 MW by 2022. This capacity is expected to double to 200 GW by 2034. (SARI/EI Task Force-2, 2016)

2.3 Vehicle Kilometer Run & Electric Vehicle Energy Consumption Study

2.3.1 Road Trasportation Energy Demand and Environmental Emission: A Case of Kathmandu Valley

Dr. Bajracharya and Dr. Bhattarai have presented the growth trend in the evolution of different vehicle types, their energy demand and associated environmental emissions in the Kathmandu valley in coming fifteen years with study period ranging form 2016 AD to 2030 AD and also shown the various possible mitigation scenarios to manage growth of vehicles, reduce energy demand and environmental emissions. The modeling tools, LEAPS (Long – range Energy Alternative Planning System) ahs been used to develop a bottom – up road transportation model based on four parameters viz. present and future vehicle stock, vehicle – use intensity expressed in kilometers travelled by a vehicle per year (VKT), vehicle fuel – use intensity and emission factors.

Table 2. 5 Average Annual Vehicle Kilometer Travel (VKT) in Kathmandu Valley

Vehicle Type	Average Annual Vehicle Kilometer Travel (VKT) in Kathmandu Valley
Bus	44105
Minibus	43307
Private (Car/Jeep/Vans)	12310
Public (Taxi)	25356
Microbus	38520
Motorbike	8952
Heavy Duty Vehicles	37800
Mini truck	37415

Source: (Bajracharya & Bhattarai, 2016)

The result has shown that there will be large growth of small vehicles like motorbikes and light duty vehicles in Kathmandu Valley in coming fifteen years and small vehicle will consume 65% of the cumulative fuel demand in valley and produce 58% of total CO_2, 84% of total CO, 92% of total HC, 32% of total NO_x and 65% of total PM_{10} emissions within analysis period (Bajracharya & Bhattarai, 2016). This study has also presented the average annual vehicle kilometer travel in Kathmandu valley which is presented in Table 2. 5.

2.3.2 Energy Cosumption Study of Different Electric Vehicles

Sharmad Zaman Rajper and Johan Albrecht have presented the prospects of electric four – wheelers (E4Ws), electric two – wheelers (E2Ws) and hybrid electric vehicles (HEVs) in developing countries. In this paper, different types of driving forces and their influences for the electric vehicles (EVs) are analyzed. The authors have studied reduction in greenhouse gases emissions, energy savings, extra cost of infrastructure, low operational cost, affordable purchase price of E2Ws, mode shift from public transportation to E2Ws and congestion cost as driving forces for EVs. Similarly,high cost of infrastructure for implementation of E4Ws, high purchase cost of E4Ws and HEVs, lack of government policies, lack of awareness, presence of strong market for gasoline – based vehicles, range anxiety, long charging time, harmful emissions, increase in demand for power generation, low speed of E2Ws, resale issue, consideration of E2Ws on the lack of road safety, lack of E2Ws' capacity to carry more people and weight are studied under resisting forces for EVs in developing countries (Sarmad & Albrecht, 2020). A comparative analysis among different electric mobility modes have been carried out whose result are presented in Table 2.6.

Table 2.6 Comaparative Analysis Among Different Electric Mobility Modes

Mode	Tank – to – Wheel Energy Use (kWh per km)
E – Bicycle	0.015 ± 0.005
Midsize E2Ws or electric scooters	0.045 ± 0.02
Midsize gasoline – powered two wheelers	0.25 ± 0.09
Large E2W or electric motorcycles	0.07 ± 0.03
Large gasoline – powered two wheelers	0.41 ± 0.13
E4Ws	0.15 ± 0.04
HEVs	0.4 ± 0.1

Source: (Sarmad & Albrecht, 2020)

The efficiency of electric motorcycle based on this paper is 0.07 ± 0.03 kWh per km. The efficiency for RV400 electric motorcycle in India is 0.083 kWh per km and as that of RV300 electric motorcycle is 0.045 kWh per km (Revolt Motors, 2019).

The efficiency of electric four wheeler vehicles based on this paper is 0.15 ± 0.04 kWh per km. For four wheelers car/jeep/van, the efficiency is different for different models. The most used vehicles observed in Nepalses scenarios are of Hyundai, Ford, Mahindra, Volkswagen and Suzuki. In Hyundai model, the Hyundai Kona Electric 64 kWh offers efficiency of 0.16 kWh per km, Hyundai Kona Electric 39 kWh offers

efficiency of 0.154 kWh per km and Hyundai IONIQ Electric offers efficiency of 0.153 kWh per km. Similarly, in Ford model, Mustang Mach variants offer efficiency varying between 0.194 kWh per km to 0.209 kWh per km. In Volkswagen model, this offered efficiency from company varies between 0.166 kWh per km to 0.183 kWh per km (Electric Vehicle Database, 2020). One of the mostly observed electric four wheelers hatchbacks in Nepalese city is Mahindra e_2O plus offers efficiency of around 0.1 kWh per km (Mahindra Electric, 2020).

Global Green Growth Institute, Seoul, Republic of Korea has performed pre – fesibility study on Deploying Electric Buses in the Kathmandu Valley to support Sajha Yatayat's desire to transition to electric buses.This study has considered Sajha Yatayat's fleet and operations to predict the electric bus feasibility in Kathmandu Valley. This study has assumed life of electric bus as 8 – 12 years, days of operation per year as 345 days, efficiency of electric vehicle as 1.12 kWh per km,daily distance travelled as 126.3 km resulting into annual distance of 43, 574 km etc. This study has proposed both the route for electric bus and vehicle options as well. The Lagankhel – Budhanilkantha route has been concluded as effective route for electric bus transition of Sajha Yatayat. (Global Green Growth Institute, 2018)

MARCON performed a feasibility study regarding implementation of battery electric buses (e – buses) service in Edmonton, Canada (MARCON, 2016). It has used field trials, expected realities of e – buses in service, costs and benefits associated with the choice to invest in e – buses and environmental impact of e – buses as major analysis aspects in this study. The efficiency of different electric buses as result of this study are represented in Table 2. 7.

Table 2. 7 Efficiency of Some Electric Buses

Bus Model	Efficiency (kWh per km)	Estimated Range (km)
BYD 40'	1.26	205
BYD 40'	1.2 – 1.5	240
BYD 40'	1.3	220
New Flyer 40'	1.08 – 1.30	110 – 148
New Flyer 40'	1.45	100
New Flyer 40'	1.83	140
Proterra 35'	1.08 – 1.34	

Sourec: (MARCON, 2016)

2.4 Energy Banking Strategy between Nepal - India Cooperation in Power Sector

The formation of Joint Working Group (JWG) between Nepal and India has been currently working on energy banking between these two countries and came through some conclusions till date. The interconnections between two countries required as proposed by these two parties are (MoEWRI, 2019):

1. For Year 2021/22

- Muzzaffarpur - Dhalkebar 400 kV Double Circuit (Twin Moose) line (Presently operated at 220 kV) & New Butwal - Gorakhpur (New) 400 kV Double Circuit (Quad Moose) line

2. For Year 2025 AD

- Muzzaffarpur - Dhalkebar 400 kV second Double Circuit (Quad Moose) line associated with Arun - III (900 MW) Hydroelectric Project
- Lumki - Bareilly 400 kV Double Circuit (Quad Moose) line associated with upper Karnali (900 MW) Hydroelectric Project
- New Duhabi - New Purnea 400 kV Double Circuit (Quad Moose) line associated with Upper Arun (800 MW) Hydroelectric Project

3. Some of the lines with 132 kV that are to be planned are:

- Stringing of second circuit of Kataiya - Kusaha 132 kV Single Circuit on Double Circuit line
- Construction of Nanpara (UP, India) - Kohalpur (Nepal) 132 kV Double Circuit line, Construction of New Nautanwa (UP, India) - Mainhiya (Nepal) 132 kV line & Raxaul (Old) - Raxaul (New) 132 kV Double Circuit Line

The agreed planned installed capacity and peak demand of Nepal as assessed based on the information provided by Nepal Electricity Authority in different time frames are presented in Table 2. 8 .

Table 2. 8 Planned Installed Capacity and Peak Demand agreed in Minute

	Present	2021-22	2025
Installed Capacity(MW)	1080	3112	10942
Peak Demand(MW)	1300	2415	2981

Source: (MoEWRI, 2019)

CHAPTER 3: METHODOLOGY

3.1 Methodology Approach

The overall algorithm that has been followed for completion of thesis is listed as follows:

1. Identification of problems in completion of generation schedule of upcoming projects and identification of different possibilities of scenarios of energy consumption to determine the idea of energy banking from Nepalese perspective and Literature Review
2. Data Collection
   (i) Collection of data of monthly energy generation of hydropower plants owned and operated by NEA and IPP & monthly energy consumption of Nepal of past years from LDC
   (ii) Collection of data of Power Purchase Agreement concluded projects between NEA and IPPs from Power Trade Department, System Planning Office of NEA and Department of Electricity Development
   (iii) Collection of data of vehicle registration numbers of past years from Department of Transport Management & household statistics from population census
3. Performing the mathematical analysis in MS Excel to calculate the monthly capacity factor of individual hydropower projects and assigning monthly group capacity factor for upcoming IPP projects and NEA projects
4. Performing the calculations of expected energy generation in Nepal for coming ten years and expected energy consumption for different scenarios
5. Verification of Actual import energy with Calculated import energy of last year (2076 B.S.) to check reliability of the data
6. Performing the expected surplus/deficit energy analysis for coming ten years with consideration of delays in completion schedule of generating projects in generation side and different load growth possibilities in consumption side
7. Modeling and Simulating the Planned INPS after saturation of commissioning of generation projects (for FY 084/85) in most likely “Shift IPP and NEA Plants” generation scenario for maximum import, maximum export and intermediate imports and exports in different energy consumption scenarios
8. Conclusion and Recommendation

The methodological approaches that have been adopted in this thesis are shown in Figure 3. 1.

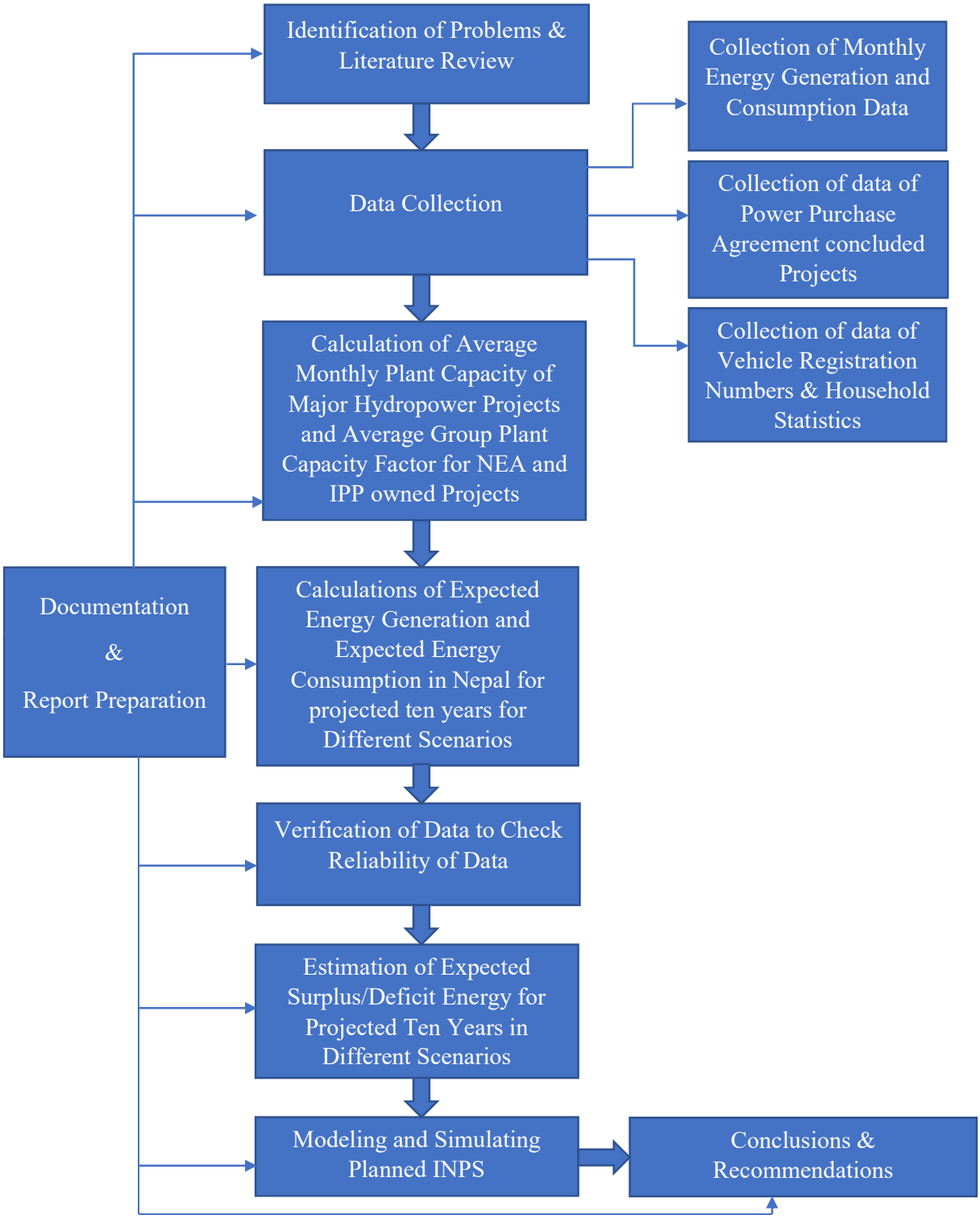


Figure 3. 1 Flowchart Illustrating Algorithm of Methodology of Thesis

In brief, the historical trend for monthly energy generations from major existing Run of River (RoR) & storage type hydropower projects of NEA and IPPs for fiscal years in between 066/67 to 075/76 have been studied. The monthly energy generations of upcoming projects are then calculated. Following three scenarios for the upcoming generations have been considered in the study;

i. Normal: commissioning of upcoming projects in accordance to Power Purchase Agreement (PPA) concluded date
ii. Likely: commissioning of upcoming projects with one-year delay for projects coming under Independent Power Producers (IPPs)
iii. Most likely: additional three years' delay in projects coming under Nepal Electricity Authority (NEA) and its sister organization in addition to second scenario

The expected monthly domestic energy consumption is estimated for following five scenarios;

i. Normal scenario: Constant per annum energy consumption growth
ii. Most likely energy consumption: categorized growth for domestic, commercial, industrial and other categories as per the NEA past consumption trend
iii. Intervention with induction Chulo
iv. Intervention of Electric Vehicle
v. Combined intervention of both Induction Chulo & Electric Vehicle

The mismatch between expected generation and consumption are expressed in terms of expected monthly surplus and deficit energy and S-D ratio. Furthermore, the adequacies of INPS and associated cross border transmission lines have been examined. INPS has been modelled for simulation for this purpose in the fiscal year 084/85 for most likely generation scenario.

3.2 Data Collection

The data regarding monthly energy generation for about past ten years are and monthly energy consumption of past three years are collected from LDC, NEA. The data regarding upcoming Power Purchase Agreement (PPA) concluded projects are

collected through NEA annual reports and database of Department of Electricity Development (DoED) from which the month wise upcoming projects schedules are finalized and some revised date of PPA concluded projects are collected through the information from System Planning Department, NEA. The possible integration of Induction Chulo and Electric Vehicle requires household statistics and vehicle sales per year. These data are collected through the latest statistics of district level population and vehicle registration number from the respective government departments.

3.2.1 Monthly Energy Generation and Monthly Energy Consumption Data

The data of monthly energy (MWh) generation for almost all major operating projects for about past 10 years are collected through LDC, NEA. There are two stakeholders in the generation sector viz. NEA and IPPs in Nepal at present. Similarly, broadly speaking, almost all projects of Nepal are of ROR type except Kulekhani (I) and Kulekhani (II); which are storage projects. Thus collected data are categorized into three types viz. NEA operated ROR hydropower projects, Storage hydropower projects and Independent Power Producers (IPPs) operated Run of River (ROR) hydropower projects so that the monthly group plant factor can be calculated to assign to these categories and those respective values can be assigned to the future upcoming projects to assess their monthly expected energy generation. The monthly energy consumption data are collected to observe the trends of energy consumption in past years.

3.2.1.1 Monthly Energy Generations of NEA operated ROR hydropower projects

There is all total of around 450.05 MW capacity of NEA operated projects which is observed in real time simulation of LDC, NEA of which ten projects with capacity 398.05 MW had been recorded with their past generations data as these projects have significant capacity in comparison to other remaining projects of around 52 MW. These some major NEA operated ROR hydropower projects and their respective capacity resulting into total capacity of 398.05 MW are presented in

Table 3. 1. The monthly energy generations of these projects in months of past fiscal years and respective generations in megawatt hours (MWh) obtained from LDC, NEA are presented in Appendix – A.

Table 3. 1 Some NEA Operated ROR Projects with Capacity

Project Name	Capacity (in MW)
Kaligandaki – A Hydropower Project	144
Middle Marsyangdi Hydropower Project	70
Marsyangdi Hydropower Project	69
Trishuli Hydropower Project	24
Gandak Hydropower Project	15
Modi Hydropower Project	14.8
Devighat Hydropower Project	15
Sunkoshi Hydropower Project	10.05
Puwa Khola Hydropower Project	6.2
Chameliya Hydropower Project	30

3.2.1.2 Monthly Energy Generations of Storage hydropower projects

There are two Storage hydropower projects viz. Kulekhani (I) with 60 MW capacity and Kulekhani (II) with 32 MW capacity operating in Makwanpur district of Bagmati province, Nepal from past years resulting into total capacity of 92 MW for storage hydropower projects. These are only two storage projects with past data of generations as these projects were commissioned in 1982 AD and 1986 AD respectively. The monthly energy generations of these projects in months of past fiscal years and respective generations in megawatt hours (MWh) obtained from LDC, NEA are presented in Appendix – B.

3.2.1.3 Monthly Energy Generations of IPP operated ROR hydropower projects

There is about 625 MW capacity contributions from IPP side in INPS simulated in LDC, NEA at present of which fourteen major IPP operated ROR projects and their respective capacities resulting into total capacity of 276.91 MW are presented in Table 3.2. The monthly energy generations of these fourteen hydropower projects in months of past fiscal years and respective generations in megawatt hours (MWh) are obtained from LDC, NEA are presented in Appendix – C. The remaining IPP operated ROR projects are classified into three types viz. less than 5 MW capacity, 5 MW to 10 MW capacity and Other IPP projects for bulk calculation of energy generations. There is total contribution of around 109. 947 MW from projects with capacity less than 5 MW, 111.68 MW from projects with capacity between 5 MW to 10 MW and 126.463 MW from other IPP operated projects till date. (Nepal Electricity Authority, 2019).

Table 3.2 Some IPP Operated ROR Projects with Capacity

Project Name	Capacity (in MW)
Khimti Hydropower Project	60
Chilime Hydropower Project	22.1
Indrawati Hydropower Project	7.5
Jhimruk Hydropower Project	12
Aandhikhola Hydropower Project	9.4
Lower Modi Hydropower Project	10
Bijaypur (I) Hydropower Project	4.41
Sanima Mai Hydropower Project	22
Sipring Khola Hydropower Project	10
Mai Khola Hydropower Project	4.5
Khudi Hydropower Project	4
Bhotekoshi Hydropower Project	36
Upper Marsyangdi A Hydropower Project	50
Upper Madi Hydropower Project	25

3.2.1.4 Base Monthly Energy Consumptions

The monthly base energy consumption is taken as that of fiscal year 2075/76 and are calculated from daily reports collected through LDC, NEA for exact consumption. The 42% of the total energy consumption was contributed by domestic consumers, 7.3% by commercial consumers, 38.2% by industrial consumers and remaining 12.5% by other category (Nepal Electricity Authority, 2019). Depending upon these two data, the monthly base energy consumption and categorized base monthly energy consumption are presented in Table 3. 3.

Table 3. 3 Total Monthly Energy Consumption & Categorized Monthly Energy Consumption of Base Fiscal Year 2075/76 (in MWh)

Consumption /Month	Total Consumption	Domestic Consumption	Commercial Consumption	Industrial Consumption	Other Consumption
Shrawan	700763.01	294320.4642	51155.69973	267691.4698	87595.37625
Bhadra	714660.69	300157.4898	52170.23037	273000.3836	89332.58625
Ashoj	640320.28	268934.5176	46743.38044	244602.347	80040.035
Kartik	610928.76	256590.0792	44597.79948	233374.7863	76366.095
Mangsir	553983.14	232672.9188	40440.76922	211621.5595	69247.8925
Poush	621754.8	261137.016	45388.1004	237510.3336	77719.35
Magh	570097.5	239440.95	41617.1175	217777.245	71262.1875
Falgun	580924.78	243988.4076	42407.50894	221913.266	72615.5975

Consumption /Month	Total Consumption	Domestic Consumption	Commercial Consumption	Industrial Consumption	Other Consumption
Chaitra	591830.53	248568.8226	43203.62869	226079.2625	73978.81625
Baisakh	706803.84	296857.6128	51596.68032	269999.0669	88350.48
Jestha	775719.49	325802.1858	56627.52277	296324.8452	96964.93625
Ashad	766213.05	321809.481	55933.55265	292693.3851	95776.63125

Source: (LDC, NEA 2019)

3.2.2 Upcoming Power Purchase Agreement Concluded Projects and commissioning date

The data of upcoming PPA concluded projects and their required commercial date of operation are collected from NEA and database of DoED & the revised date of some projects are gathered from System Planning Department, NEA to identify exact capacity and commissioning of correspondings in coming ten years. It has been observed that hydropower projects of total capacity 5170.092 MW are PPA concluded projects till date and these all projects will be commissioned within Bhadra, 2082 BS. Kasuwa Khola Hydropower project of capacity 45 MW is farthest commission date concluded project at present with commissioning date of Bhadra, 2082 BS. .

Table 3. 4 Capacity of Projects Expected to be Commissioned in Each Months of Coming Years (in MW)

Month/FY	077/78	078/79	079/80	080/81	081/82	082/83
Shrawan	1034.877	621.76	101.406	201.75	4.99	0
Bhadra	118.46	11.8	215.974	161.709	0	45
Ashoj	110.72	83.89	30.55	64.12	0	0
Kartik	82.32	19.92	102	89.1	0	0
Mangshir	1	9.51	14.5	29	0	0
Poush	4.8	34.1	57.43	86.5	85.675	0
Magh	31.828	120	50	126.62	86.59	0
Falgun	13.5	14	41.506	58.922	0	0
Chaitra	74.196	51.58	43.52	93.55	0	0
Baisakh	13.35	52	72.4	389.14	0	0
Jestha	0.98	32	8.8	0	0	0
Ashad	296.289	0	47.46	0	30	0
Total Capacity	1782.32	1049.56	785.546	1300.411	207.255	45

Source: (Nepal Electricity Authority, 2019)

There will be highest capacity addition in Shrawan, 2077 which sums up to around 1034.877 MW including Upper Tamakoshi hydropower project of capacity 456 MW. The total capacity of PPA concluded projects going to be commissioned in each month of coming years as per PPA are presented in Table 3. 4. (Nepal Electricity Authority, 2019)

3.2.3 Vehicle Registration Numbers and Household Statistics

The data of yearly vehicle registration is collected Department of Transport Management, Minbhawan, Kathmandu in the view to perform analysis for electric vehicle penetration which is presented in Table 3.5 which shows yearly registration of vehicles from fiscal year 065/66 to 074/75 (Department of Transport Management, 2019).

Table 3.5 Yearly Vehicle Registration Number of Past Ten Years in Nepal

Fiscal Year	Bus	Car/Jip Van	Micro	Tempo	Bike	E Rickshaw
065/66	1843	6857	128	20	83334	0
066/067	1888	12268	145	9	168707	0
067/068	1610	8510	115	2	138907	0
068/069	2085	8711	155	10	145135	0
069/070	3263	9595	158	57	175381	0
2070/71	2776	11372	178	17	163945	0
2071/72	3737	13560	932	1541	196383	0
2072/73	4353	28361	1137	2613	267439	11894
2073/74	5342	21292	841	17782	354071	2247
2074/75	2972	24338	1934	16209	341623	12325
2075/76*	2354	17953	1431	9785	249581	8654

Source: (Department of Transport Management, 2019)

The data of household status is collected through Central Bureau of Statistics in the view to perform analysis for Induction Chulo penetration. The corresponding household numbers in each province of Nepal is presented in Table 3. 6 which shows provincial household statistics of Nepal (Central Bureau of Statictics, 2019).

Table 3. 6 Provincial Households Statictics of Nepal

Province	Households
1	992445
2	932308
Bagmati	1270797

Province	Households
Gandaki	578249
5	885203
Karnali	298359
Far western	469971
Total	5427332

Source: (Central Bureau of Statictics, 2019)

3.3 Plant Capacity Factor Determination

The capacity factor of a hydropower plant or project is the ratio of its actual output over a period of time, to its potential output if it were possible for it to operate at full nameplate capacity indefinitely. The plant capacity factor relates actual energy generations as a fraction of maximum energy that can be generated under the period of consideration. The plant capacity factor is calculated using Equation 3.1.

$$PCF = \frac{AEG}{PIC \times T} \qquad \text{Equation 3. 1}$$

Where

AEG = Actual Energy generations (MWh) in a time under consideration

PIC = Plant Installed Capacity (MW)

T = Time interval under consideration (hr)

PCF = Plant capacity Factor

PCF can be computed annually, monthly or as per the desired time frame of interest. The actual monthly plant capacity factor of individual NEA operated ROR hydropower projects, Storage hydropower projects and IPP operated ROR hydropower projects are determined based on past data of energy generations from LDC, NEA to assign most reliable plant capacity factor to these projects for reliable calculations of energy generations from these projects in future. The actual monthly plant capacity factor for past years of these individual NEA operated ROR hydropower projects, Storage hydropower projects and IPP operated ROR hydropower projects based on monthly data collected from LDC, NEA are presented in Appendix – D, Appendix – E and Appendix – F respectively. The monthly plant capacity factors of NEA operated ROR hydropower projects, storage projects and IPP operated ROR hydropower projects of past years are taken into consideration and

average value is calculated for each month of a year by averaging the monthly data of individual plants which are presented in Appendix – G. These average monthly plant factors of individual projects are assigned to calculate the expected energy generation from such individual projects in coming years as this will be the usual case of operational availability for already operating projects at present. However, for any ROR project going to be developed by NEA or its sister organization or storage projects or ROR projects going to be developed by IPP and which are going to be commissioned in coming ten years, the expected generation needs most reliable monthly plant capacity factor for these three groups of projects. This is calculated by taking weightage average of all monthly average plant capacity factors for a particular month by using formula;

$$WAMPCF = \frac{PIC_1 \times AMPCF_1 + PIC_2 \times AMPCF_2 + ...+ PIC_N \times AMPCF_N}{PIC_1 + PIC_2 + ...+ PIC_N}$$

Where,

PIC_N = Plant Installed Capacity of N^{th} Project

$AMPCF_N$ = Average Monthly Plant Capacity Factor of same project for a particular month

WAMPCF = Weightage Average Monthly Plant Capacity Factor for a group of projects for a particular month

3.4 Scenarios of Upcoming PPA Concluded Generation Projects Commissioning

The generation projects that are going to be commissioned in upcoming time are analyzed under three scenarios viz. Normal, Shift IPP Plants & Shift IPP and NEA Plants. Normal scenario corresponds to the commissioning of the PPA concluded projects on their exact Required Commercial Operation Date (RCOD) as of their PPA. This case has been described earlier in section 3.2.2 which shows 5170.092 MW is finalized till date through PPA and this capacity is going to be commissioned in next six years.

The accomplishment of commissioning of hydropower projects on exact RCOD has always been the biggest challenge in Nepal and is usyally encountered with delay due to delay in transmission structure development and operation, force majeure such as landslide, flood etc., political instability, delay in supply of materials etc. There has been delay of about a year in completion of projects in IPP side. Similarly, for the

projects going to be constructed from NEA side, the delay of around two to four years is encountered in completion and commissioning of projects. So, the second scenario in generation aspect considered is "Shift IPP Plants" in which the required commissioning date of all the future IPP Plants are considered with delay of a year & the plants going to be developed by NEA and its sister organizations will come as in Normal scenario. The total capacity of PPA concluded projects going to be commissioned in each month of coming years under this scenario are presented in the tabular matrix form in Table 3. 7. This will result into only about 270.3 MW addition in fiscal year 2077/78 and significant addition of projects will be observed in fiscal years 2078/79 and 2081/82 with capacities of 2005.02 MW and 1160.411 MW respectively. The last addition as per present PPA concluded projects will be observed in Bhadra of fiscal year 2083 BS and it will have addition of 45 MW at that time.

Table 3. 7 Capacity of Projects Expected to be Commissioned in Each Months of Coming Years under Shift IPP Plants Scenario (in MW)

Month/FY	077/78	078/79	079/80	080/81	081/82	082/83	083/84
Shrawan	125.8	1365.077	165.76	101.406	201.75	4.99	0
Bhadra	0	118.46	11.8	215.974	161.709	0	45
Ashoj	0	110.72	83.89	30.55	64.12	0	0
Kartik	0	82.32	18.92	102	89.1	0	0
Mangshir	0	1	9.51	14.5	29	0	0
Poush	0	4.8	34.1	57.43	86.5	85.675	0
Magh	0	31.828	120	50	126.62	86.59	0
Falgun	0	13.5	14	41.506	58.922	0	0
Chaitra	0	111.196	14.58	43.52	93.55	0	0
Baisakh	0	13.35	52	212.4	249.14	0	0
Jestha	0	0.98	32	8.8	0	0	0
Ashad	144.5	151.789	0	47.46	0	30	0
Total Capacity	270.3	2005.02	556.56	925.546	1160.411	207.255	45

Similarly, the third scenario in generation aspect considered is "Shift IPP and NEA Plants" in which the required commissioning date of all the future IPP Plants are considered with delay of a year & required commissioning date of all the NEA and its sister organizations' plants are considered with delay of three years. The total capacity of PPA concluded projects going to be commissioned in each month of coming years under this scenario are presented in the tabular matrix form in Table 3. 8. This scenario will cause no any addition of capacity in fiscal year 2077/78. This scenario

will cause significant addition of projects in fiscal year 2078/79 and 2081/82 with capacities of 1968.02 MW and 1197.411 MW respectively. Similarly, there will be last addition of projects in Baisakh, 2084 and it will have addition of around 140 MW at that point.

Table 3. 8 Capacity of Projects Expected to be Commissioned in Each Months of Coming Years under Shift IPP and NEA Plants Scenario (in MW)

Month/FY	077/78	078/79	079/80	080/81	081/82	082/83	083/84
Shrawan	0	1365.07	165.76	227.206	201.75	4.99	0
Bhadra	0	118.46	11.8	215.974	161.709	0	45
Ashoj	0	110.72	83.89	30.55	64.12	0	0
Kartik	0	82.32	18.92	102	89.1	0	0
Mangshir	0	1	9.51	14.5	29	0	0
Poush	0	4.8	34.1	57.43	86.5	85.675	0
Magh	0	31.828	120	50	126.62	86.59	0
Falgun	0	13.5	14	41.506	58.922	0	0
Chaitra	0	74.196	14.58	43.52	130.55	0	0
Baisakh	0	13.35	52	72.4	249.14	0	140
Jestha	0	0.98	32	8.8	0	0	0
Ashad	0	151.789	0	191.96	0	30	0
Total Capacity	0	1968.02	556.56	1055.846	1197.411	207.255	185

3.5 Scenarios of Expected Energy Consumption

It has been studied different forecasted growth rate of monthly energy consumption or demand through different literatures in Chapter 2. Those growth rates are forecasted in both the business as usual case and also with policy intervention as well. However, the most reliable forecast till date has been as that forecasted by NEA in Nepal as being only one major power supplying utility, it facilitates both expansion of transmission and distributons to the consumer and it has the real data base of consumption and customer growth. This study has focused the expected energy consumption in normal business and also with policy intervention of Induction Chulo and Electric Vehicles as well. So, the expected energy (MWh) consumption are analyzed under five scenarios viz. Normal, Growth with Categorization of Consumption, Intervention with Induction Chulo, Intervention with Electric Vehicle and Combined Intervention of Induction Chulo and Electric Vehicle.

3.5.1 Expected Energy Consumption in Normal Scenario

Normal scenario corresponds to the constant yearly growth on overall energy consumption and assumes same percentage growth in energy consumption from a month of present year to same month of next year. In this scenario, the base monthly energy consumption is taken for each month of FY 075/76 presented section 3.2.1.4 and the yearly MWh growth of 8% per annum is considered. In this scenario, the expected energy consumption in each month of upcoming fiscal years is increased by 8% as that of present consumption in corresponding month using Equation 3.2.

$$MEC_i = MEC_{base} \times \left(1 + \frac{r}{100}\right)^i \qquad \text{Equation 3. 2}$$

Where,

MEC_{base} = Monthly Energy Consumption of a particular month of base year 075/76

MEC_i = Monthly Energy Consumption of same month after i^{th} year from base year

r = Monthly Energy Consumption growth rate per annum (8%)

The expected monthly energy consumption in each month of coming ten years under this scenario are presented in tabular form in Appendix – H.

3.5.2 Expected Energy Consumption in Growth with Categorization of Consumption Scenario

The growth of energy consumption in categorized consumption sector viz. Domestic, Commercial, Industrial and Other is different than the growth in bulk amount of yearly consumption. Nepal, being developing country, these categorized growth should also be taken under consideration as our power sector is also growing just after the starting of post load shedding era and this will be the most likely consumption scenario for coming ten years. While analyzing the collected categorized consumption from LDC, NEA, the consumption of energy in fiscal year 2074/75 in domestic, commercial, industrial and other sector were found to be 2163.51 GWh, 350.58 GWh, 1719.26 GWh and 543.18 GWh respectively. Similarly, these consumptions for fiscal year 2075/76 were found to be 2441.67 GWh, 407.59 GWh, 2074.17 GWh and 636.81 GWh respectively. There are per annum growth of 12.85%, 16.26%, 20.64%

and 17.23% in Domestic consumption, Commercial consumption, Industrial consumption, and other consumption, respectively from FY 074/75 to 075/76. The categorized energy consuming class has different growth rate than that of 8% p.a. growth. So, the second scenario considered is "Growth with Categorization of Consumption". In this scenario, instead of considering as whole energy consumption in a month, the total monthly energy consumption in base case is categorized into four types of consumptions viz. Domestic consumption, Commercial consumption, Industrial consumption, and Other consumption as illustrated in section 3.2.1.4 earlier and observed growth rate from FY 074/75 to 075/76 are considered for next ten years. This scenario is considered in aim to determine most likely energy consumption in future based on categorized consumption rather than as a whole growth in monthly consumption. This scenario calculates the expected monthly energy consumption for coming ten years considering these categorized growth rates in four categories in similar manner to first scenario in section 3.5.1 and then sums up those energy consumptions to determine the total expected monthly energy consumption using Equation 3.3.

$$MEC_i = MEC_{i,domestic} + MEC_{i,commercial} + MEC_{i,industrial} + MEC_{i,other} \quad \text{Equation 3. 3}$$

Where,

$MEC_{i,domestic}$ = Monthly Energy Consumption of particular month after i^{th} year from base year by domestic consumers

$MEC_{i,commercial}$ = Monthly Energy Consumption of particular month after i^{th} year from base year by commercial consumers

$MEC_{i,industrial}$ = Monthly Energy Consumption of particular month after i^{th} year from base year by industrial consumers

$MEC_{i,others}$ = Monthly Energy Consumption of particular month after i^{th} year from base year by Other consumers

The expected monthly energy consumption in each month of coming ten years under this scenario are presented in tabular form in Appendix – H.

3.5.3 Expected Energy Consumption in Intervention with Induction Chulo Scenario

The most possible internal energy consumption policy for growing electricity generations in Nepal will be encouragement in using Induction Chulo as Nepal is heavily dependent on Liquefied Petroleum Gas (LPG) till date and is mostly imported from India. The LPG has dominant proportions as cooking means urban area in Nepal and has increased exponentially in recent years. It has been consumed by around 25.8% of households and is second – most used cooking fuel in Nepal and most used cooking fuel in urban areas, at about 58.5%. The import of LPG has increased by 3.3 times from 81,005 Metric tons in year 2005/06 AD to 258,299 Metric tons in year 2014/15. (Bhandari & Pandit, 2018). Increasing internal consumtption through electricity as cooking means will not only reduce the dependency on neighbouring country for its import but also strengthen national economy and incentivize the hydropower development within the country as well.

The third scenario is "Intervention with Induction Chulo". This intervention considers the addition of one induction chulo per house in constant 10% household p.a. growth rate at the start of each Fiscal Year with total households of 54,27,332 at present (Central Bureau of Statictics, 2019). This intervention has been added to the most likely energy consumption scenario i.e. the second scenario illustrated earlier in section 3.5.2. This intervention considers the addition of 5,42,733 induction chulo per year for coming ten years at the start of Fiscal Year and anticipates the one induction chulo per household of Nepal in coming ten years so as to replace LPG and increase the domestic consumption within Nepal.

The currently LPG of different companies are available in Nepal with net weight of 14.2 kg on one cylinder. The equivalent mega joule of energy to 1 kg of LPG is 49 MJ and it results into total of 695.8 MJ from one cylinder LPG. One kilowatt hour (or unit) energy consumption is equal to 3.6 MJ of energy. The consumption of one cylinder LPG, depending upon the family members, generally varies from 45 days, 60 days or 75 days which is equivalent to per day average electrical energy consumption of 4.295 kilowatt hours, 3.221 kilowatt hours or 2.577 kilowatt hours respectively by a single Induction Chulo. This average daily consumption is responsible for all the cooking application performed daily in a household. In this " Intervention with Induction Chulo" scenario, the daily consumption of a single Induction Chulo is

considered as four kilowatt-hour and the monthly energy consumption of each month of a year is calculated using Equation 3.4.

$MEC_{induction\ chulo}$ = Number of household × Per house per day energy consumption × 30 Equation 3. 4

Where,

$MEC_{induction\ chulo}$ = Monthly energy consumption due to induction chulo intervention for each months of a particular fiscal year in KWh

This causes addition of 65,127.96 MWh of energy consumption at the start of each Fiscal Year for coming ten years. The expected monthly energy consumption in each month of coming ten years under this scenario are presented in tabular form in Appendix – H.

3.5.4 Expected Energy Consumption in Intervention with Electric Vehicle Scenario

Another possible internal energy consumption policy for growing electricity generations in Nepal will be implementation of Electric Vehicle as significantly large volume of petroleum products are imported from India each year. The petrol and diesel have been mostly used vehicle fuel over years in the country. The import of petrol has increased by 162902 KL in fiscal year 2066/67 to 566827 KL in fiscal year 2075/76. Similarly, the import of diesel has increased by 608065 KL in fiscal year 2066/67 to 1714917 KL in fiscal year 2075/76 (Nepal Oil Corporation, 2020). Increasing internal consumtption through electric vehicle as transportation will strengthen national economy and incentivize the hydropower development within the country as well.

The fourth scenario is “Intervention with Electric Vehicle”. This intervention considers that 10% of total sales of Bike, Car, Jeep, Van and Bus of Nepal is electrical energy based sales in first year and the sales fraction should be increased on integer multiple of initial 10% in each coming fiscal year such that the aforementioned five vehicle types will be fully electrical type in tenth year i.e. in fiscal year 086/87. This intervention has been added to the most likely energy consumption scenario i.e. the second scenario illustrated earlier in section 3.5.2. Unlike induction chulo

intervention, here the total yearly sales is divided into monthly sales and addition of new electric vehicle sales is performed on month by month basis and expected monthly energy consumption for each month of coming ten years is calculated by using Equation 3.5.

$$MEC_{electric\ vehicle} = MEC_{electric\ bike} + MEC_{electric\ car,jeep,van} + MEC_{electric\ bus} \quad \text{Equation 3. 5}$$

Where,

$MEC_{electric\ bike}$ = Number of electric bike at start of each month of a fiscal year × Per bike KWh energy consumption by one electric bike in a month

$MEC_{electric\ car,jeep,van}$ = Number of electric car, jeep, van at start of each month of a fiscal year × Per car, jeep, van KWh energy consumption by one electric car, jeep, van in a month

$MEC_{electric\ bus}$ = Number of electric bus at start of each month of a fiscal year × Per bus KWh energy consumption by one electric bus in a month

$MEC_{electric\ vehicle}$ = Monthly energy consumption due to electric vehicle intervention for each months of a particular fiscal year in KWh

The per any electric vehicle type energy (KWh) consumption in one month in each of the quantities is calculated by using Equation 3.6.

$$AMEC_{electric\ vehicle\ type} = N \times \text{Energy consumption in One Charging} \quad \text{Equation 3. 6}$$

Where,

N = Number of charging per month

$$= \frac{\text{Average Monthly Kilometer Run}}{\text{Kilometer run by vehicle type in one charge}} \text{ and}$$

$AMEC_{electric\ vehicle\ type}$ = Average monthly energy consumption by an electric vehicle type (i.e. per any electric vehicle type energy (KWh) consumption in one month)

This intervention will result into 55% of total sales of aforementioned five vehicles will be electrical energy based in coming ten years and this will surely decrease the

imported petroleum consumption and increase internal electrical energy consumption in Nepal. This intervention is based on monthly energy consumption of electric bike as 67.5 kilowatt-hours, that of car/jeep/van as 200 kilowatt-hours and that of bus as 5514 kilowatt-hour through different literature reviewed in Chapter 2. The expected monthly energy consumption based on these data in each month of coming ten years under this scenario are presented in tabular form in Appendix – H.

3.5.5 Expected Energy Consumption in Combined Intervention of Induction Chulo and Electric Vehicle Scenario

Combined Intervention of Induction Chulo and Electric Vehicle is fifth scenario considered in expected energy consumption for coming ten years. In this scenario, both Induction Chulo and Electric Vehicle intervention strategies discussed in section 3.5.3 and 3.5.4 scenarios respectively are combined and added to the most likely energy consumption scenario i.e. the second scenario illustrated earlier in 3.5.2 simultaneously. The extra expected monthly energy consumption due to this combined intervention is calculated using Equation 3.7.

$$MEC_{combined} = MEC_{induction\ chulo} + MEC_{electric\ vehicle} \quad \text{Equation 3. 7}$$

The total energy consumption after intervention of this combined energy on second scenario for each month of coming ten years are presented in tabular form in Appendix – H.

3.6 Estimation of Expected Energy Generation

The expected energy generation estimation has been performed on monthly basis of for coming fiscal years. These estimations have been performed considering three scenarios of generation projects commissioning as illustrated in section 3.4.

The expected energy generation estimation involves calculation of energy generations from the current installed hydropower projects and formthe projects that are going to be commissioned in future. The most reliable plant capacity factor is used for each hydropower projects to calculate these expected generations which are summarized as:

1. The expected monthly energy generations from NEA operated major ROR hydropower projects of capacity 398.05 MW as listed in section 3.2.1.1 are calculated

using their own average monthly plant capacity factor which is calculated from their past data using Equation 3.8.

$$EMEG = PIC \times AMPCF \times T \quad \text{Equation 3. 8}$$

Where,

PIC = Plant Installed Capacity (MW) of a particular plant

T = Time interval under consideration (hr)

AMPCF = Average Monthly Plant Capacity Factor of same plant

EMEG = Expected Monthly Energy generations (MWh) in a time under consideration

2. The expected energy generations from storage hydropower projects, Kulekhani (I) – 60 MW and Kulekhani (II) – 32 MW, are calculated using their own average monthly plant capacity factor which is calculated from the data of past ten years using Equation 3.8. However, the expected energy generations of Kulekhani (III) – 14 MW which is recently added in year 2076 B.S. is calculated using Equation 3.9.

$$EMEG = PIC \times WAMPCF \times T \quad \text{Equation 3. 9}$$

Where,

PIC = Plant Installed Capacity (MW) of a particular plant

T = Time interval under consideration (hr)

WAMPCF = Weightage Average Monthly Plant Capacity Factor of storage hydropower projects

EMEG = Expected Monthly Energy generations (MWh) in a time under consideration

3. The expected energy generations from IPP operated major ROR hydropower projects of capacity 201.91 MW except Upper Marsyangdi A and Upper Madi as listed in section 3.2.1.3 are calculated using Equation 3.8 using their own average monthly plant capacity factor which is calculated from their past data. For Upper Marsyangdi A and Upper Madi, as these projects are recently added to INPS, the expected monthly energy generations are calculated using Equation 3.9 with WAMPCF of IPP operated major ROR projects .

4. Furthermore, the other IPP operated ROR projects commissioned till date are classified into three groups viz. less that 5 MW of total capacity 109.947 MW, between 5 MW to 10 MW of total capacity 111.68 MW and remaining other IPP projects of capacity 126.463 MW. Expected monthly energy generations from these projects are calculated Equation 3.9 with WAMPCF of IPP operated major ROR projects.

5. The other remaining projects operated by NEA constitutes for total capacity of 52 MW whose expected energy generations are calculated Equation 3.9 with WAMPCF of NEA operated ROR hydropower projects.

6. For the PPA concluded projects which are going to be commissioned in the required commercial operation date accordingly as their power purchase agreement, the expected monthly energy generations are calculated Equation 3.9 with WAMPCF of IPP operated major ROR projects.

3.7 Verification of Data

The reliability of the results is assured through this verification mechanism. In which, the monthly consumption MWh and import MWh data of year 2076 B.S. are taken from LDC, NEA. The monthly expected generations of the total installed projects for this year are calculated. The difference of actual monthly consumption obtained from LDC, NEA and these expected monthly MWh generations results into calculated monthly import MWh which is formulated as in Equation 3.10.

$$CMIE = AMEC - EMEG \qquad \text{Equation 3. 10}$$

Where,

AMEC = Actual monthly energy consumption of 2076 B.S.

EMEG = Expected monthly energy generation of 2076 B.S.

CMIE = Calculated monthly import energy

These calculated monthly imports MWh are then compared with the actual monthly import energy (AMIE) for verification of the data in terms of percentage variartion in monthly import (PVMI) in positive value given by Equation 3.11 which shows variation with reference to actual monthly import energy (AMIE).

$$PVMI = \left| \frac{AMIE - CMIE}{AMIE} \times 100\% \right| \qquad \text{Equation 3. 11}$$

The initial PVMI calculation is performed with installed capacity of NEA generations as 450.05 MW and IPP generations of 625 MW which including 45 MW of Bhotekoshi hydropower projects and 60 MW of Upper Trishuli 3A from initial months of 2076 BS for calculation purpose. The PVMI calculation is performed in two steps viz. first considering without outage of any projects and then the outages of projects in each months of 2076 BS is taken into consideration to calculate real PVMI for the year. Additional projects Kulekhani III (14 MW), Kapadigadh (3.3 MW), Pikhuwa Khola (5MW), Lower Chhotte Khola (0.996 MW), Uppar mardi (7 MW), Iwa Khola (9.9 MW) and Kabeli B1 (25 MW) had been commissioned in midway in 2076 BS. So, generation of these projects is added from the respective commissioned months. Based on these generation capacity, PVMI without outage are calculated firstly and then following outages are taken care in each month based on data from LDC, NEA and equivalent outage energy is subtracted from the expected monthly energy generation to calculate real PVMI with outage energy as well.

1. Baisakh: Bhotekoshi (45 MW) was out of service over full month and Upper Trishuli 3A (60 MW) was still not connected at this point.
2. Jestha: Bhotekoshi, Chaku (3 MW), Lower Chaku (1.5 MW), Middle Chaku (1.5 MW), Lower Piluwa (1 MW), Rairang (0.5 MW), Salinadi (0.3 MW), Thapakhola (11 MW) was out of service over full month and Upper Trishuli 3A was still not connected at this point.
3. Ashad: Bhotekoshi, Chaku, Lower Chaku, Middle Chaku, Lower Piluwa, Rairang, Salinadi, Thapakhola was out of service over full month and Upper Trishuli 3A was still not connected at this point. Upper Madi was also out of service for 14 days in this month.
4. Shrawan & Bhadra: Bhotekoshi was out of service for this month.
5. Ashoj & Kartik: Bhotekoshi, Chaku, Lower Chaku, Middle Chaku, Lower Piluwa, Rairang, Salinadi, Thapakhola and Upper Trishuli 3A was out of service over full month.
6. Mangshir: Middle Marsyangdi (70 MW), Ankhu (8.4 MW), Mardi (4.8 MW) and Pheme (1 MW) were out of service for 15 days. Mai Cascade (7 MW) and Mailung (5 MW) were out of service for 25 days. Maikhola (4.5 MW) and Upper Mai (11 MW) were out of service for 26 days. Upper Madi (25MW) and Jiri Bojini (2 MW) were out of service over full month.

7. Poush: Khudi (4 MW) was out of service for 9 days. Tinau (1.02 MW) was out of service for 13 days, Uppper Madi for 14 days and Jiri Bojini for 16 days. Chilime (22.1 MW) was out of service for 20 days and Tatopani (2 MW) was out of service for 25 days. Fewa (1 MW), Mai Cascade, Maikhola and Mailung (5 MW) were out of service for 28 days. Upper Mai was out of service for 29 days.
8. Magh: Chaku, Lower Chaku, Middle Chaku, Lower Piluwa, Rairang, Salinadi and Thapakhola were out of service over full month.
9. Falgun & Chaitra: Chaku, Lower Chaku, Middle Chaku, Lower Piluwa, Rairang, and Salinadi were out of service over full month.

3.8 Surplus Deficit Ratio (S/D – Ratio) Estimation

Surplus Deficit Ratio (S/D – Ratio) is ratio of total expected surplus energy (MWh) and total expected deficit energy (MWh) in a fiscal year. The total expected surplus energy is sum of surplus energy of months with monthly expected generation greater than monthly expected consumption. In the same manner, the total expected deficit energy is sum of deficit energy of months with monthly expected consumption greater than monthly expected generation. This ratio has been defined to decide for as a whole surplus or deficit of energy over a fiscal year. The S/D – Ratio is formulated as;

$$\text{S/D – Ratio} = \frac{\text{Total Expected Surplus Energy(MWhr) over a year}}{\text{Total Expected Deficit Energy (MWhr) over a year}}$$

This S/D – Ratio can be interpreted as,

S/D – Ratio = 0	There is deficit of energy (MWh) in each month of a year
∞	There is surplus of energy (MWh) in each month of a year
1	Total Expected Surplus energy (MWh) and total Expected Deficit energy (MWh) are equal over a year
> 1	Total Expected Surplus energy (MWh) exceeds total Expected Deficit energy (MWh) over a year
< 1	Total Expected Deficit energy (MWh) exceeds total Expected Surplus energy (MWh) over a year

The S/D – Ratio gives the idea of quantity of energy for banking possibility. The ideal energy banking will be observed for unity ratio as it depicts the surplus energy over a year will be equal to deficit of energy over a year at different months.So, energy can be exported in banking in months with surplus energy and equal amount of energy can be imported from the banking facility for other energy deficit months. The zero S/D – ratio signifies for import of energy for all months and infinite ratio signifies for export of energy for all months of year. The S/D – ratio greater than unity signifies for export energy to banking facility to be greater than import energy. The S/D – ratio less than unity signifies for import energy from banking facility to be greater than export energy.

3.9 Modeling of Planned INPS after Saturation of Commisoning of Generation Projects for Load Flow Simulation

3.9.1 Monthly Import and Export Peak Demand Calculation for Simulation

The expected energy consumption in different scenarios varies in monthly manner for coming periods taken under consideration for study in this thesis. This expected energy consumption will be converted into monthly peak demand using monthly load factor. Monthly Load Factor (MLF) is defined as the ratio of actual energy used in a given period to the total maximum possible energy that could have been used in the same period and is given by Equation 3.12.

$$\text{MLF} = \frac{\text{Atual energy consumed in a month}}{\text{Monthly Peak Demand} \times 30 \times 24} \qquad \text{Equation 3.12}$$

The monthly load factor for fiscal year 2075/76 is calculated using Equation 3.12 and are presented in Table 3. 9. These load factors are used for corresponding calculation of monthly peak demand for the simulation purpose.

Table 3. 9 Monthly Load Factor (MLF) for Fiscal Year 2075/76

Month	Monthly Energy Consumption (GWh)	Monthly Peak Demand (MW)	M LF
Shrawan	700.76	1242.87	0.783088962
Bhadra	714.66	1284.28	0.77287144
Ashoj	695.98	1242.87	0.777747382
Kartik	555.27	1185.76	0.650391591
Mangshir	573.35	1171.19	0.679923364
Poush	602.39	1244.17	0.672458569

Month	Monthly Energy Consumption (GWh)	Monthly Peak Demand (MW)	M LF
Magh	570.1	1203.4	0.657973704
Falgun	580.92	1156.28	0.697783697
Chaitra	591.83	1201.44	0.684167425
Baisakh	706.8	1296.02	0.757447159
Jestha	775.72	1309.52	0.822735727
Ashadh	766.31	1343.06	0.792458598

Source: (Nepal Electricity Authority, 2019)

Similarly, there will be variation of expected energy generation in different month from installed generation projects in accordance with the monthly plant capacity factor as well. The total installed capacity of a particular month is calculated as sum of capacities of each generation plants in accordance with the monthly plant capacity. The import and export peak demand for a particular month is then calculated as the difference between the monthly peak demand and monthly installed capacity.

3.9.2 Modeling of Planned INPS

The installed capacity of INPS is 1073 MW.The real time data of Integrated Nepal Power System (INPS) was obtained from Load Dispatch Center (LDC), Syuchatar. The current INPS is modeled with two sub – sytems viz. Kathmandu sub – system and Hetauda sub – system and load flow is simulated and matched with the real time flow of the LDC. The digaramatical representation of then matched INPS is shown in Appendix - O (Puri, 2018).

The most likely generation scenario is “Shift IPP and NEA Plants” in which usual delay of a year and three years are observed in Nepal in commissioning of generation projects constructed through IPPs and NEA respectively. In this scenario, there will be last addition of projects in Baisakh, 2084 BS and it will have addition of around 140 MW at that point. So, the planned INPS is modeled and simulated for the fiscal year 084/85. The planned INPS for year 084/85 is modeled in ETAP 12.6.0 with the consideration of future generations planning from Nepal Government, Nepal Electricity Authority and its subsidiary companies as well as IPPs. Similarly, transmission networks are proposed by Rastriya Prasaran Grid Company Limited (RPGCL) which are also considered for future networks in this model and are planned

to be completed across the country by fiscal year 082/83 i.e. by 2025 AD (Nepal Electricity Authority, 2015). The generation as well as transmission are modeled on the zone basis i.e. five distinct zones viz. Zone – 1, Zone – 2, Zone – 3, Zone – 4 and Zone – 5 (RPGCL, 2018). The individual Zone modeling for integration with current INPS are described and represented as follows and the digramatical representation of modeling are presented in Appendix - L.

3.9.2.1 Modeling of Zone - 1

Zone - 1 includes province - 7 and some districts of Province - 6 as well. The following planned projects are commissioned to the respective buses in accordance with their commissioning date of PPA in ETAP 12.6.0 model of Zone 1. The projects, connected bus and respective capacity are presented in Table 3. 10.

Table 3. 10 Hydropower Projects and Buses in Zone – 1

S.N.	Hydropower Projects	Connected Bus	Capacity (MW)
1.	Chameliya	Balanch Hub (132 kV)	30
2.	Upper Chameliya		40
3.	Makarigad		10
4.	Upper Naugadh Gad		8
5.	Api		8.5
6.	Sunigad	Upper Kalangagad Hub (132 kV)	11.05
7.	Kalangad		15.33
8.	Upper Sanigad		10.7
9.	Upper Kalangagad		38.46
10.	Salubyani Gad Small		0.233
11.	Jeuligad Small		0.996
12.	Jadari Gad Small		1
13.	Upper Gaddigad	West Seti (132 kV)	1.55
14.	Ruru Banchu-1	Phukot (400 kV)	13.5
15.	Ruru Banchu Khola - 2		12

Similarly, the transmission line coming under operation by 2025 AD in Zone – 1 is listed in Table 3. 11

Table 3. 11 Transmission Projects in Zone – 1

S.N.	Transmission Project	Voltage Level (kV)	Conductor	Length (Km)
1.	Dododhara - Phukot	400	Quad Moose	80

S.N.	Transmission Project	Voltage Level (kV)	Conductor	Length (Km)
2.	Balanch -Upper Kalangagad	132	Bison	54
3.	Upper Kalangagad- West seti	132	Bison	64

3.9.2.2 Modeling of Zone - 2

Zone – 2 includes province – 5 and some districts of Province – 6 as well. The following planned projects are commissioned to the respective buses in accordance with their commissioning date of PPA in ETAP 12.6.0 model of Zone – 2. The projects, connected bus and respective capacity are presented in Table 3. 12.

Table 3. 12 Hydropower Projects and Buses in Zone – 2

S.N.	Hydropower Projects	Connected Bus	Capacity (MW)
1.	Padam Khola	Mainatara (132 kV)	4.8
2.	Upper Parajuli Khola		2.15
3.	Lohore Khola		4.2
4.	Upper Lohore		4

Similarly, the transmission line coming under operation by 2025 AD in Zone – 2 is listed in Table 3. 13.

Table 3. 13 Transmission Projects in Zone – 2

S.N.	Transmission Project	Voltage Level (kV)	Conductor	Length (Km)
1.	Dododhara - Maina Tara	400	Quad Moose	86
2.	Phulbari - Maina Tara	400	Quad Moose	62
3.	Maina Tara - Kohalpur	400	Quad Moose	31
4.	Maina Tara - Kohalpur	132	Bison	31

3.9.2.3 Modeling of Zone - 3

Zone – 3 includes different parts of Province – 5, Province – 4 and Province – 3 as well. It contains major hydropower projects in Kaligandaki corridor and Marsyangdi corridor. The following planned projects are commissioned to the respective buses in accordance with their commissioning date of PPA in ETAP 12.6.0 model of Zone – 3. The projects, connected bus and respective capacity are presented in Table 3.14.

Table 3.14 Hydropower Projects and Buses in Zone – 3

S.N.	Hydropower Projects	Connected Bus	Capacity (MW)
1.	Myagdi Khola	DandaKhet (220 kV)	57.3
2.	Upper Myagdi		20
3.	Kunaban Khola		20
4.	Bhim Khola		4.96
5.	Lower Modi	Dana (220 kV)	20
6.	Landruk Modi		86.59
7.	Ghalemdi Khola		1
8.	Super Ghalemdi		9.14
9.	Thulo Khola	Rahughat (220 kV)	21.3
10.	Upper Thulo Khola		15
11.	Rahughat		40
12.	Rahughat Mangale		35.5
13.	Ghar Khola		14
14.	Nilgiri Khola		38
15.	Nilgiri Khola - 2		62
16.	Rele Khola		6
17.	Daram Khola	Kusma (220 kV)	9.6
18.	Middle Daram A		3
19.	Middle Daram B		4.5
20.	Middle Tara Khola Smal	Kusma (132 kV)	1.7
21.	Middle Modi	Upper Modi (132 kV)	15.1
22.	Burtibang	Burtibang (132 kV)	21
23.	Tinau Khola Small	Butwal (220 kV)	1.665
24.	Namarjun Madi	Upper Madi (220 kV	11.8
25.	Upper Bhurundi		3.75
26.	Super Madi		44
27.	Madame Khola		24
28.	Idi Khola	Lekhnath (220 kV)	0.975
29.	Chepe Khola Small	Damauli (220 kV)	8.63
30.	Chepe Khola A		7.5
31.	Super Chepe		9.05
32.	Dudhpokhari Chepe		8.8
33.	Super Trishuli		70
34.	Tanahu Seti	Damauli (400 kV)	140
35.	Dudh Khola	Manang (220 kV)	65
36.	Nyadi Khola		30
37.	Nyadi Phidi		21.4

S.N.	Hydropower Projects	Connected Bus	Capacity (MW)
38.	Super Nyadi	Khudi (220 kV)	40.27
39.	Rudi Khola B		6.6
40.	Upper Syange	Udipur (220 kV)	2.4
41.	Midim – 1		13.424
42.	Middle Midim		3.1
43.	Dordi – 1 Khola		12
44.	Super Dordi		54
45.	Dordi Khola		27
46.	Upper Dordi – A		25
47.	Marsyangdi Besi		50
48.	Upper Midim		7.5
49.	Hidi Khola		6.82
50.	Richet Khola	New Marsyangdi (220 kV)	4.98
51.	Upper Richet		2
52.	Upper Daraudi B		8.3
53.	Upper Daraudi C		9.82
54.	Middle Super Daraudi		10
55.	Istul Khola		1.506

Similarly, the transmission line coming under operation by 2025 AD in Zone – 3 is listed in Table 3. 15.

Table 3. 15 Transmission Projects in Zone – 3

S.N.	Transmission Project	Voltage Level (kV)	Conductor	Length (Km)
1.	Dadakheti - Rahughat	220	Twin Bison	15
2.	Rahughat - Dana	220	Twin Bison	20
3.	Rahughat - Kusma	220	Twin Zebra	30
4.	Upper modi - Kusma	132	Single Bison	6.5
5.	Kusma - Aandhikhola	220	Twin Bison	76
6.	Kusma - New Damauli	400	Quad Moose	69
7.	Aandhikhola - Butwal	220	Twin Bison	76
8.	Phulbari - Butwal	400	Quad Moose	229
9.	New Damauli - Butwal	400	Quad Moose	75
10.	New Damauli - Ratmate	400	Quad Moose	79
11.	Lekhnath - Damauli	220	Single Moose	40
12.	Upper Madi - Lekhnath	220	Single Moose	46
13.	Khudi - New Damauli	220	Twin Moose	60
14.	Manang - Khudi	220	Twin Zebra	27
15.	Khudi - Udipur	220	Twin Bison	16
16.	Udipur- New Marsyangdi	220	Twin Zebra	31

S.N.	Transmission Project	Voltage Level (kV)	Conductor	Length (Km)
17.	Marsyangdi - Bharatpur	220	Twin Zebra	32
18.	Butwal – Gorakhpur Cross Border Transmission Line	400	Quad Moose	125

3.9.2.4 Modeling of Zone - 4

Zone – 4 includes includes province – 3 and some districts of Province – 2 as well. The following planned projects are commissioned to the respective buses in accordance with their commissioning date of PPA in ETAP 12.6.0 model of Zone – 4. The projects, connected bus and respective capacity are presented in Table 3. 16.

Table 3. 16 Hydropower Projects and Buses in Zone – 4

S.N.	Hydropower Projects	Connected Bus	Capacity (MW)
1.	Ilep (Tatopani)	Trishuli 3B Hub (220 kV)	23.675
2.	Bhotekoshi - 1		40
3.	Sanjen		42.5
4.	Middle Trishuli Ganga		19.41
5.	Sanjen Khola		78
6.	Upper Sanjen		14.8
7.	Rasuwagadhi		111
8.	Upper Mailung A		6.42
9.	Super Ankhu Khola		23.5
10.	Upper Ankhu		38
11.	Rasuwa Bhotekoshi		120
12.	Langtang Khola		20
13.	Upper Trishuli – 3A		60
14.	Upper Trishuli – 3B		37
15.	Nyam Nyam Khola		6
16.	Upper Trishuli 1		216
17.	Upper Belkhu	Ratmate (220 kV)	0.996
18.	Trishuli Galchi		75
19.	Menchet Khola		7
20.	Khani Khola – 1	Barhabise (400 kV)	40
21.	Khare		24.1
22.	Khani Khola (Dolakha)		30
23.	Middle Bhotekoshi		102
24.	Upper Nyasim		41.4
25.	Balephi		23.52
26.	Bhotekoshi – 5		62
27.	Nyasim Khola		35
28.	Brahamayani		35.47

S.N.	Hydropower Projects	Connected Bus	Capacity (MW)
29.	Upper Brahamayani		15.15
30.	Upper Nyasim Khola – A		21
31.	Ksumti Khola	Barhabise (220 kV)	0.683
32.	Lower Balephi		20
33.	Gohore Khola		0.95
34.	Ghatte Khola Small		0.97
35.	Upper Chauri		6
36.	Lower Selang		1.5
37.	Liping Khola		16.26
38.	Selang		0.99
39.	Upper Chaku A		22.2
40.	Yambaling Khola		7.27
41.	Gelun		3.2
42.	Chauri Khola		6
43.	Upper Balephi A		36
44.	Hadi Khola Sunkoshi A		0.997
45.	Upper Lapche	Tamakoshi (220 kV)	52
46.	Suri Khola		6.4
47.	Ghatte Khola		5
48.	Lower Khare		11
49.	Upper Tamakoshi		456
50.	Tinekhu Khola		0.99
51.	Singati Khola		9
52.	Lapche Khola		99.4
53.	Upper Suri		7
54.	Sagu Khola		20
55.	Sagu Khola – 1		5.5
56.	Sangu (Sorun)		5
57.	Gumu Khola		0.95
58.	Buku Kapati	Likhu (132 kV)	5
59.	Junbesi Khola		5.2
60.	Lower Likhu		28.1
61.	Likhu - IV		52.4
62.	Likhu Khola - A		24.2
63.	Likhu - 1		51.4
64.	Likhu - 2		33.4

Similarly, the transmission line coming under operation by 2025 AD in Zone – 4 is listed in Table 3. 17.

Table 3. 17 Transmission Projects in Zone – 4

S.N.	Transmission Project	Voltage Level (kV)	Conductor	Length (Km)
1.	Trishuli 3B – Ratmate	220	Twin Moose	24
2.	LapsePhedi – Ratmate	400	Quad Moose	28
3.	LapsePhedi – Bahrabise	400	Quad Moose	60
4.	Bahrabise – New Khimti	400	Quad Moose	46
5.	Bahrabise – Tamakoshi	220	Quad Moose	6.5
6.	Tamakoshi – New Khimti	220	Twin Moose	46
7.	Likhu – Khimti	132	Single Bison	31
8.	Trishuli 3B – Matatirtha	220	Twin Moose	45
9.	New Khimti – Dhalkebar	400	Quad Moose	60

3.9.2.5 Modeling of Zone - 5

Zone – 5 includes includes province – 1 and some districts of Province – 2 as well. The following planned projects are commissioned to the respective buses in accordance with their commissioning date of PPA in ETAP 12.6.0 model of Zone – 5. The projects, connected bus and respective capacity are presented in Table 3. 18.

Table 3. 18 Hydropower Projects and Buses in Zone – 5

S.N.	Hydropower Projects	Connected Bus	Capacity (MW)
1.	Upper Rawa	Tingla (220 kV)	3
2.	Rawa Khola		6.5
3.	Solu Khola (Dudhkoshi)		86
4.	Lower Solu		82
5.	Solu		23.5
6.	Middle Solu Khola		9.5
7.	Upper Solu		18
8.	Sisa Khola A		2.8
9.	Middle Hyongu Khola B		22.9
10.	Dudhkunda Khola		12
11.	Middle Hyongu Khola A		22
12.	Luja Khola		23.55
13.	Rauje Khola		17.712
14.	Isuwa Khola	Arun (400 kV)	97.2
15.	Kasuwa Khola		45
26.	Lower Irkhuwa		13.04
17.	Irkhuwa Khola B		15.524
18.	Lower Chirkhawa		4.06

S.N.	Hydropower Projects	Connected Bus	Capacity (MW)
19.	Upper Chirkhawa	Sitalpati (220 kV)	4.7
20.	Sabha Khola B		15.1
21.	Phedi Khola (Thumlung)		3.52
22.	Lankhuwa Khola		5
23.	Upper Irkhuwa		14.5
24.	Sabha Khola C	Khadbari (220 kV)	4.196
25.	Super Sabha Khola		4.1
26.	Upper Piluwa Khola - 3	Baneshwor (220 kV)	4.95
27.	Upper Piluwa Hills		4.99
28.	Super Hewa		5
29.	Maya Khola		14.9
30.	Down Piluwa		9.5
31.	Upper Piluwa Khola - 2		4.72
32.	Lower Khorunga	New Basantapur (220 kV)	5.4
33.	Upper Khorunga		7.5
34.	Khorunga Khola		4.8
35.	Sapsup Khola		6.6
36.	Taksar Pikhuwa		8

Similarly, the transmission line coming under operation by 2025 AD in Zone – 5 is listed in Table 3. 19.

Table 3. 19 Transmission Projects in Zone – 5

S.N.	Transmission Project	Voltage Level (kV)	Conductor	Length (Km)
1.	Dhalkebar - Mirchaiya	400	Quad Moose	64
2.	Mirchiya - Inaruwa	400	Quad Moose	64
3.	Inaruwa - Damak	400	Quad Moose	80
4.	Arun Hub - Sitalpati	220	Twin Bison	9
5.	Sitalpati - Khadbari	220	Twin Bison	24
6.	Khadbari - Baneshwor	220	Twin Moose	10
7.	Baneshwor – New Basantapur	220	Twin Moose	21
8.	New Basantapur - Inaruwa	220	Quad Moose	77
9.	New Khimti - Dhalkebar	400	Quad Moose	60

3.9.2.6 Additional Buses, Projects and Lines in Current INPS

The current INPS described in section 3.9.2 has been added with some projects, buses and also transmission lines from the date of 2018 AD to till date which includes additional Phidim (Thapatar) – 132 kV bus and Amarpur (Panchthar) – 132 kV buses. The transmission line incterconnecting these two buses is about 13.33 km with single

bear consductor in double circuit configuration. The Phidim (Thapatar) bus is connected to the 132 kV Ilam (Godak) bus through 43 km double circuit transmission line with single Bear conductor. Similarly, Bafikot Hub – 400 kV is added in INPS which is connected from Phulbari – 400 kV bus through 85 km quad moose double circuit transmission line and Rukumgad Hydrpower project of capacity 5 MW is connected to this Bafikot Hub. The following additional planned projects are commissioned to the respective buses in accordance with their commissioning date of PPA in ETAP 12.6.0 model of new INPS. The projects, connected bus, respective capacity and commissioning date of peroject are presented in Table 3. 20. The overall diagram of planned INPS with maximum import cross – border transmission line is presented in Appendix – L.

Table 3. 20 Additional Hydropower Projects and Buses in new INPS

S.N.	Hydropower Projects	Connected Bus	Capacity (MW)
1.	Palun Khola	Amarpur (Panchthar) (132 kV)	21
2.	Sona Khola		9
3.	Upper Phawa		5.8
4.	Mewa		50
5.	Middle Tamor		73
6.	Kabeli B1		25
7.	Super Kabeli - A		13.5
8.	Iwa Khola		9.9
9.	Super Kabeli		12
10.	Tamor Khola - 5		37.52
11.	Kabeli 3		21.93
12.	Kabeli B1 Cascade		9.94
13.	Mewa Khola		23
14.	Kabeli - A		37.6
15.	Middle Mewa		49
16.	Upper Hewa Khola Small	Phidim (Thapatar) (132 kV)	8.5
17.	Upper Hewa		14.9
18.	Hewa Khola A		5
19.	Lower Hewa		21.6
26.	Teliya Khola	Ilam (Godak) (132 kV)	0.996
17.	Jogmai Cascade		6
18.	Lower Jogmai		6.2
19.	Super Mai Cascade		3.8
20.	Puwa - 2		4.96
21.	Mai Beni		9.51
22.	Super Mai - A		9.6

3.9.3 Scenarios of Imports and Exports in Load Flow Simulation

There will be saturation of commissioning of generation projects according to current PPA concluded date after Baisakh, 2084 BS in "Shift IPP and NEA Plants" generation scenario. The load flow simulation has been performed after this saturation i.e. in fiscal year 084/85 to accommodate all the PPA finalized hydro projects till date. There will be around 6236 MW of installed capacity in the INPS by that time. However, monthly installed capacity will be different in each month as per monthly plant capacity factor. While analyzing the surplus deficit expected energy in fiscal year 084/85, in this scenario of generation, there will be maximum export in the month of Ashoj in Normal expected energy consumption scenario.Similarly, there will be necessary of maximum import in Falgun under Combined Intervention of Induction Chulo and Electric Vehicle scenario of expected energy consumption.These two scenarios have been simulated as these include maximum export and maximum import condition. Three more scenarios viz. Growth with Categorization of consumption – Falgun (Import), Intervention with Induction Chulo – Falgun (Import) and Intervention with Electric Vehicle – Ashoj (Export) have also been simulated to analyze the INPS for intermediate import and exports.

The total generations from the all installed projects in the month of Ashoj and Falgun in accordance with calculated plant capacity factor will result into 5622.8 MW and 2427 MW respectively. The monthly expected energy consumption in each scenario is converted into respective monthly peak demand assuming constant load factor for planed ten years and using those load factors calculated in section 3.9.1 with the help of Equation 3.12. The the difference between expected generation capacity and monthly peak demand is calculated as peak import and export demand which will occur at some point in that particular month. The load flow has been carried out then with distribution of this corresponding peak demand all over the INPS and also the capacitor banks (if necessary) as presented in Appendix - L and generator in voltage control mode for following five scenarios in fiscal year 084/85 which are summarized as follows.

1. **Scenario – I: Maximum Export (Normal Energy Consumption – Ashoj)**
   Expected Monthly Energy Consumption: 1280003.2 MWh
   Monthly Load Factor for Ashoj: 0.7777
   Corresponding Monthly Peak Demand: 2285.94 MW

Expected Generation Capacity: 5622.8 MW

However, incase of maximum export with available surplus energy, the necessity of running storage projects Kulekhani – I, Kulekhani – II and Kulekhani – III is avoided.

2. **Scenario – II: Maximum Import (Combined Intervention with Induction Chulo and Electric Vehicle – Falgun)**

   Expected Monthly Energy Consumption: 3084460.54 MWh

   Monthly Load Factor for Falgun: 0.6977

   Corresponding Monthly Peak Demand: 6139.39 MW

   Expected Generation Capacity: 2427 MW

3. **Scenario – III: Intermediate Import (Growth with Categorization of Consumption – Falgun**)

   Expected Monthly Energy Consumption: 2394500.2

   Monthly Load Factor for Falgun: 0.6977

   Corresponding Monthly Peak Demand: 4766.08 MW

   Expected Generation Capacity: 2427 MW

4. **Scenario – IV: Intermediate Import (Intervention with Induction Chulo – Falgun**)

   Expected Monthly Energy Consumption: 2915523.882 MWh

   Monthly Load Factor for Falgun: 0.6977

   Corresponding Monthly Peak Demand: 5803.14 MW

   Expected Generation Capacity: 2427 MW

5. **Scenario – V: Intermediate Export (Intervention with Electric Vehicle – Ashoj**)

   Expected Monthly Energy Consumption: 2791364.118 MWh

   Monthly Load Factor for Falgun: 0.7777

   Corresponding Monthly Peak Demand: 4985.07 MW

   Expected Generation Capacity: 5622.8 MW

However, incase of maximum export with available surplus energy, the necessity of running storage projects Kulekhani – I, Kulekhani – II and Kulekhani – III is avoided.

Furthermore, load flow simulation has also been carried out for growth with categorization of consumption incorporating sectoral energy consumption growth rate as 1.5 times the sectoral GDP growth as forecasted by JICA for the months of Ashoj for fiscal year 084/85 to study the comparison with different expected energy consumption aspects adopted in this study as well.

CHAPTER 4: RESULTS AND DISCUSSIONS

4.1 Weightage Average Monthly Plant Capacity Factor (WAMPCF) for Groups of Projects

The weightage average monthly plant capacity factor for NEA operated ROR projects for all twelve months of year are calculated by taking into consideration of average monthly plant capacity factors of ten projects of total capacity of 398.05 MW. The WAMPCF for such NEA operated ROR projects has been found highest for the month of Ashad with the value of 0.827334. Similarly, the lowest value has been found for the month of Falgun with the value of 0.396320. The WAMPCF for this group has been found more than 0.8 for the month of Jestha, Ashad, Bhadra and Ashoj. The NEA operated ROR projects are characterized with less than 0.4 WAMPCF for the months of Magh and Falgun. The estimated WAMPCF for this NEA operated ROR hydropower projects are presented in Appendix – G and graphical representation of those obtained weightage average monthly plant capacity factor is presented in Figure 4. 1.

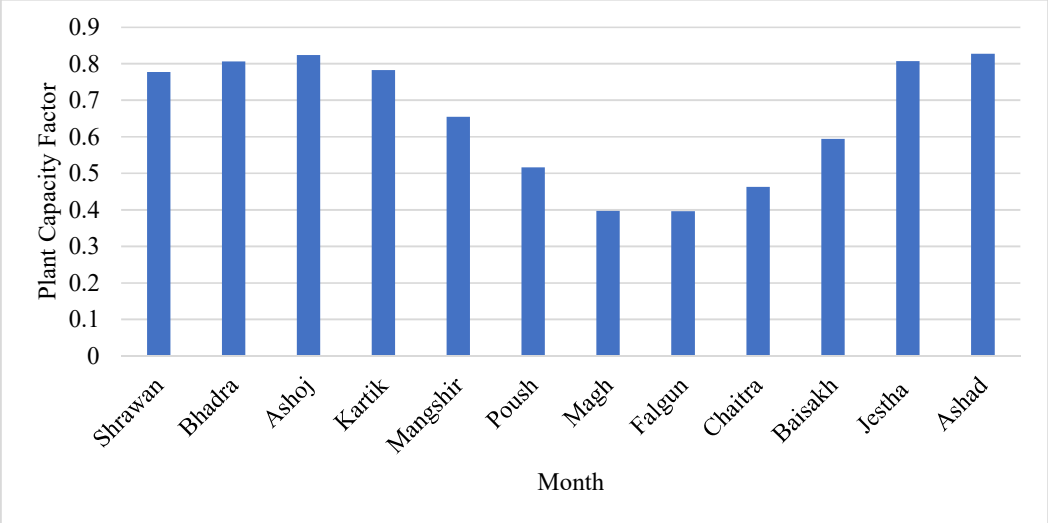


Figure 4. 1 Weightage Average Monthly Plant Capacity Factor of NEA Operated ROR Projects

The storage hydropower projects of Nepal are Kulekhani (I) and Kulekhani (II) of capacities 60 MW and 32 MW respectively. The monthly plant capacity factors of these two storage hydropower projects of past ten years are taken into consideration and average monthly plant capacity factor of individual projects is calculated.

However, for any storage hydropower projects which are going to be commissioned in coming ten years, the expected generation needs most reliable monthly plant capacity factor. This is calculated by taking weightage average of both average plant capacity factors of these two projects of total capacity 92 MW for each month of the year. The highest WAMPCF calculated is found to be 0.358007 in the month of Falgun and second highest value is found to be 0.355152 in the month of Chaitra. The six months period from Poush to Jestha are characterized with WAMPCF greater than 0.15 and less than 0.36. The lowest WAMPCF is found to be in the month of Bhadra and is about 0.056801. The estimated WAMPCF values are shown in Appendix – G and the graphical representation of those weightage average monthly plant capacity factor is presented in Figure 4. 2.

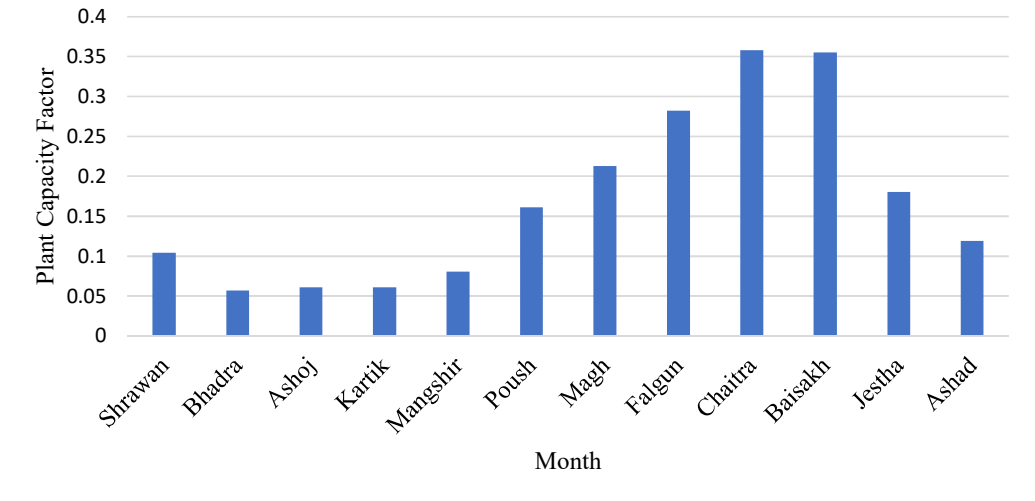


Figure 4. 2 Weightage Average Monthly Plant Capacity Factor of Storage Projects

Furthermore, almost all of the projects coming in future are of IPP operated ROR types, the calculation of monthly expected generation needs most reliable monthly plant capacity factor. This is calculated by taking weightage average, for total capacity of 276.91 MW, of all average monthly plant capacity factor of such projects operated by IPP for each month of the year. The WAMPCF for these IPP operated ROR projects is found be highest for the month of Ashoj with value of 0.92367 and lowest for the month of Falgunn 0.39053. This group of projects are characterized with WAMPCF greater than 0.85 for five months viz. Ashad, Shrawan, Bhadra, Ashoj and Kartik and found to be around 0.7 for months of Jestha and Mangshir. The estimated values are shown in Appendix – G and the graphical representation of those weightage average monthly plant capacity factor is presented Figure 4. 3.

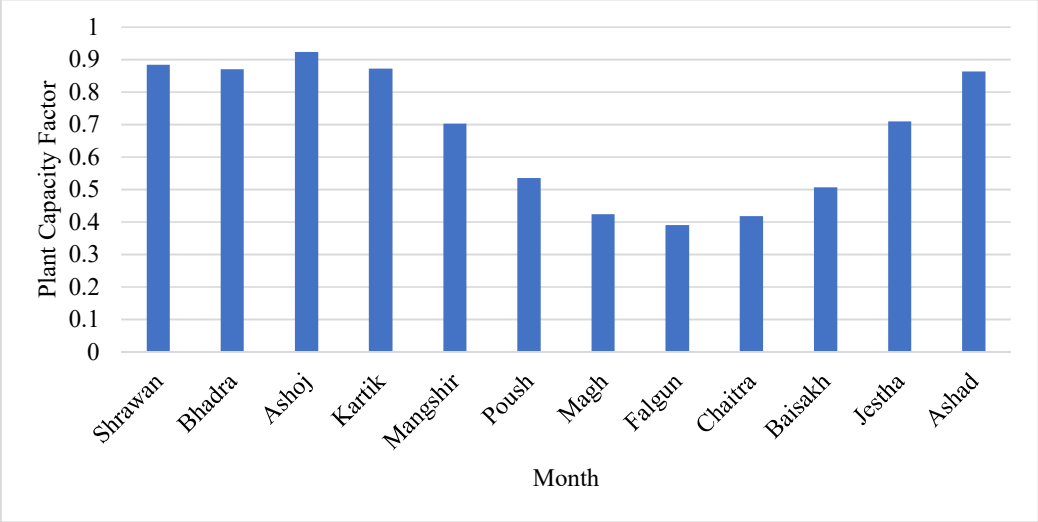


Figure 4. 3 Weightage Average Monthly Plant Capacity Factor of IPP Operated ROR Projects

4.2 Monthly Expected Energy Generation & Verification Results

4.2.1 Monthly Expected Energy Generation

The results from these estimations will be total expected energy generations from presently installed projects in our INPS which is presented in Table 4. 1.

Table 4. 1 Expected Monthly Enegy Genrations from Installed Projects (in MWh)

Month/Projects	Expected Monthly Energy Generations from NEA operated installed Projects	Expected Monthly Energy Generations from IPP operated Installed Projects
Shrawan	259854.1515	394284.5828
Bhadra	265806.0716	391958.5918
Ashoj	271637.0346	412056.7272
Kartik	258327.7961	392014.5682
Mangshir	218454.5878	313806.4742
Poush	179761.8481	238078.4809
Magh	144917.4779	186487.2929
Falgun	149978.7515	173131.1313
Chaitra	177291.3301	181759.073
Baisakh	219620.2194	218551.6881
Jestha	275554.8964	310910.2499
Ashad	277187.7483	389211.7537

These generations are base monthly values for FY 077/78 and after then the expected generations according to commissioning date of the PPA concluded projects as

illustrated in section 3.2.2 are calculated and added with these values to calculate total expected generations in each month of FY 077/78. The extra additional expected energy generations due to commissioning of PPA concluded project according to their date of commissioning and total expected energy generations for FY 077/78 are presented in Table 4. 2. The calculations of expected energy generations for coming ten years in Normal scenario including FY 077/78 are presented in Appendix – I. There will be no addition of PPA concluded hydropower projects from year of FY 083/84 and the expected energy generations is considered same for next three years.

Table 4. 2 Monthly Expected Energy Generations in Fiscal year 2077/78 (in MWh)

Month/Projects	Additional Expected Monthly Energy Generations from PPA concluded Projects	Total Expected Generations
Shrawan	658499.0547	1312637.789
Bhadra	722381.6598	1380146.323
Ashoj	840653.8795	1524347.641
Kartik	845423.9858	1495766.35
Mangshir	681721.9721	1213983.034
Poush	520567.4835	938407.8125
Magh	422670.7632	754075.534
Falgun	392952.1222	716062.005
Chaitra	442948.046	801998.4491
Baisakh	541710.2665	979882.174
Jestha	759587.7458	1346052.892
Ashad	1108705.125	1775104.627

Furthermore, the estimation of expected energy generations are also carried out for remaining two scenarios viz. Shift IPP Plants & Shift IPP and NEA Plants in similar manner. These generations are listed in Appendix – J in which the monthly generations for coming Fiscal years are estimated for both the cases. There will be no addition of PPA concluded projects from FY 084/85 in both cases. So, the expected energy generations are considered same for next two years onwards from FY 084/85 for the purpose of performing the surplus deficit analysis.

4.2.2 Verification Results

Thus Percentage Variation in Monthly Import (PVMI) obtained for each month of year 2076 are presented in Table 4. 3. The calculation of absolute PVMI is attached in Appendix – K.

Table 4. 3 PVMI Values in Each Month of Year 2076 for Verification

Month of Year 2076	Percentage Variation in Monthly Import (PVMI)
Baisakh	0.76
Jestha	8.53
Ashad	13.86
Shrawan	14.89
Bhadra	8.42
Ashoj	6.62
Kartik	13.60
Mangshir	13.53
Poush	8.04
Magh	0.34
Falgun	6.71
Chaitra	12.98

4.3 Analysis Approach

The basis for analysis is formed with three scenarios in generation aspects; Normal, Shift IPP Plants & Shift NEA and IPP Plants and five scenarios in demand consumption aspects; Normal, Growth with Categorization of Consumption, Intervention with Induction Chulo, Intervention with Electric Vehicle & Combined Intervention of Induction Chulo and Electric Vehicle. For each of the demand consumption scenario, the expected surplus deficit energy (MWh) are estimated for three scenarios of generation aspects for coming ten years and the prospects of energy banking from Nepalese perspective is analyzed with corresponding S/D – ratio and the time period of those expected surplus or deficit of energy over a year. The estimation of those figures are presented in Appendix –M on monthly basis for each fiscal year of coming ten years. The surplus – deficit energy results and discussions for fiscal years 077/78, 078/79, 083/84, 084/85 and 086/87 are presented as follows. Furthermore, load flow simulation results of five scenarios are analyzed to study the status of INPS for fiscal year 084/85 for Shift NEA & IPP Plants scenario.

4.4 Monthly Surplus Deficit Energy Results for Fiscal Year 077/78

4.4.1 Normal Energy Consumption Scenario in Different Generation Scenarios

The expected demand growth in normal scenario has been analyzed with three scenarios of expected generations of energy in fiscal year 077/78 which is shown in Figure 4. 4. When the generation occurs in Normal scenario, there will be surplus energy available in all months of the year resulting into about 5100.887 GWh surplus energy. If generation occurs in Shift IPP Plants scenario, there will be only surplus energy in the month of Ashoj (Mid September – Mid October) and Kartik (Mid October – Mid November) and remaining ten months will experience deficit of energy of about 2011.824 GWh. In this scenario, the surplus energy available during two months will be only about 2% of the total deficit experienced throughout the year. When the generation occurs in Shift NEA and IPP plants scenario, there will be all deficit of about 2704.234 GWh energy throughout the year.

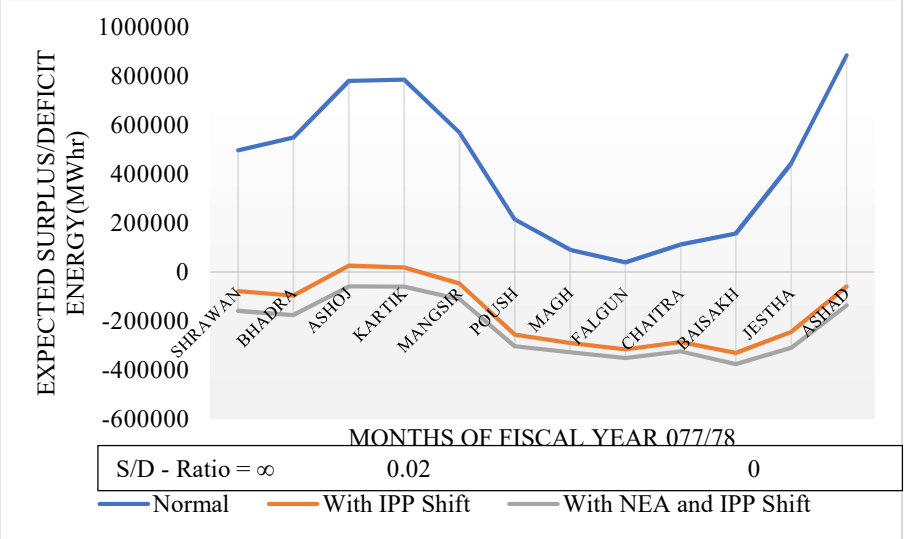


Figure 4. 4 Monthly Surplus – Deficit Energy in Normal Expected Energy Consumption Scenario for Fiscal Year 077/78

4.4.2 Growth with Categorization of Consumption Scenario in Different Generation Scenarios

When the consumption is considered in the scenario of growth with categorization of consumption, there will be deficit of energy about 100.6 GWh in three months viz. Magh, Falgun and Chaitra. The surplus energy in remaining nine months will be 36.51 times as that of deficit as S/D – Ratio of 36.51 is obtained for this case. When

the PPA concluded generations projects coming from IPP side are introduced with delay of a year, there will be deficit of energy in each month of year resulting into total deficit of 3498.286 GWh in fiscal year of 077/78. When this demand consumption scenario is analyzed for third scenario of generation aspect i.e. further three years of delay in PPA concluded generations projects coming from NEA side, there will be deficit in all months of year and this will result into increase of about 733.679 GWh deficit in comparison to Shift IPP Plants scenario. The result is shown in Figure 4. 5.

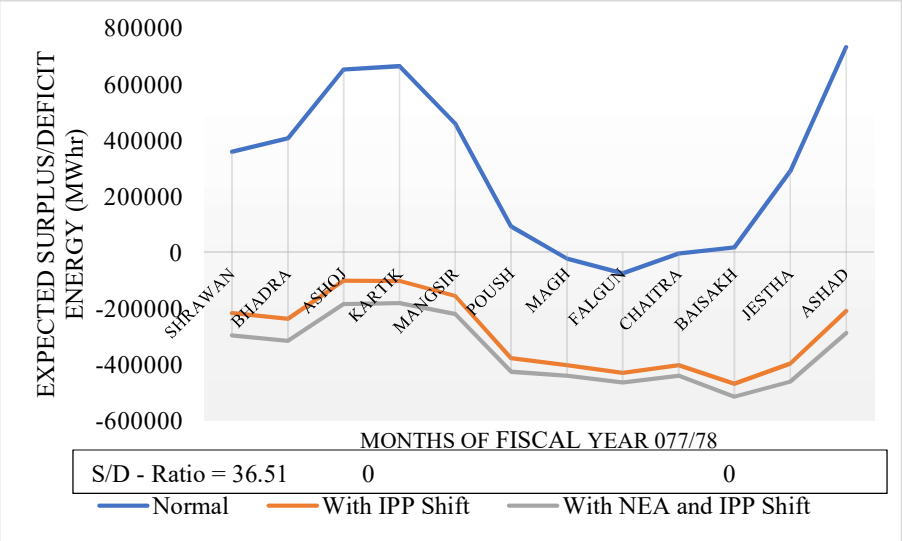


Figure 4. 5 Monthly Surplus – Deficit Energy in Growth with Categorization of Consumption Scenario for Fiscal Year 077/78

4.4.3 Intervention with Induction Chulo in Different Generation Scenarios

The expected deficit of energy increases by a month i.e. Magh, Falgun, Chaitra and Baisakh when intervention of induction chulo is implemented in consumption side in Normal scenario of generation and S/D – Ratio observed in this scenario is 9.12. If this intervention is implemented with a year delay in commissioning date of projects constructed by IPPs, there will be deficit of energy in all months of year which constitutes for almost 4289.822 GWh energy. In addition, if further delay of three years commissioning date of projects constructed by NEA is introduced, this deficit will increase up to 5013.5 GWh in fiscal year 077/78.

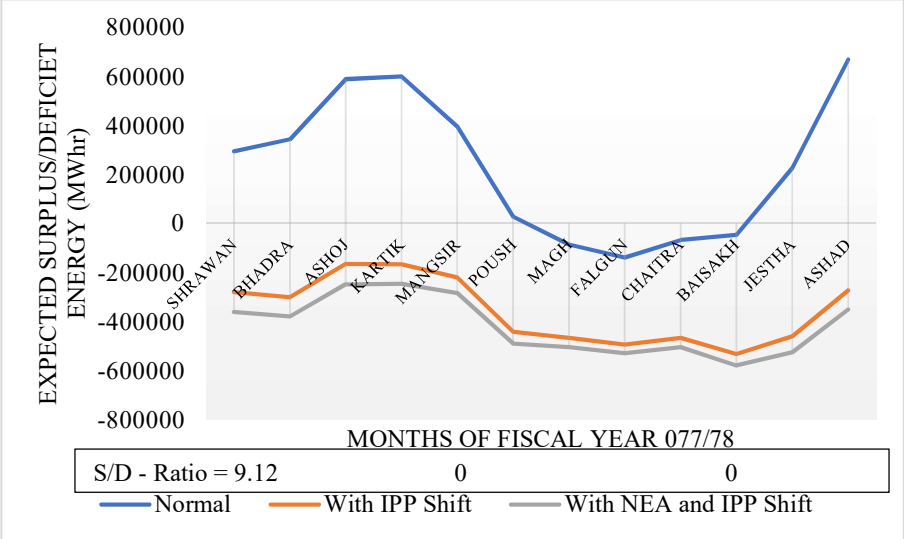


Figure 4. 6 Monthly Surplus – Deficit Energy in Intervention of Induction Chulo Scenario for Fiscal Year 077/78

There will be extra addition of 781.5 GWh energy in comparison to growth with categorized consumption in Shift IPP plants scenario and Shift NEA & IPP Plants scenario due to Induction Chulo intervention. The estimated figures are presented in Figure 4. 6.

4.4.4 Intervention with Electric Vehicle in Different Generation Scenarios

The intervention Electric Vehicle causes a little bit lower deficit of energy than that of intervention with Induction Chulo i.e. 1107.42 GWh in the months of Magh, Falgun and Chaitra and the remaining nine months will have surplus energy with S/D – Ratio of 32.96 in Normal scenario of generation. When the commissioning date of upcoming IPP projects are introduced with a delay of a year, the S/D – Ratio turns to zero and there will be total deficit of around 3531.229 GWh energy over year. Similarly, if further delay of three years in upcoming NEA projects is introduced, the deficit further rises by 733.678 GWh in fiscal year 077/78 and there will be deficit of energy in each month of the whole year. The pictorial illustration of the estimated figures is presented in Figure 4. 7.

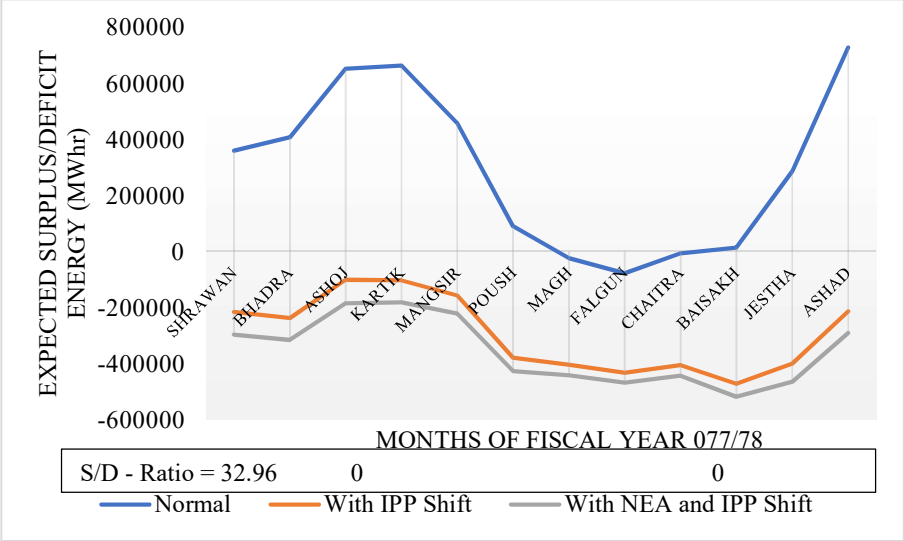


Figure 4. 7 Monthly Surplus – Deficit Energy in Intervention of Electric Vehicle Scenario for Fiscal Year 077/78

4.4.5 Combined Intervention of Induction Chulo and Electric Vehicle in Different Generation Scenarios

The combined intervention results into the deficit of energy for four months viz. Magh, Falgun, Chaitra and Baisakh which sums up to give total deficit of energy around 357.847 GWh with S/D – Ratio of 8.7. If this combined intervention is analyzed with Shift IPP Plants scenario, there will be all around deficit of energy of about 4312.764 GWh over year.

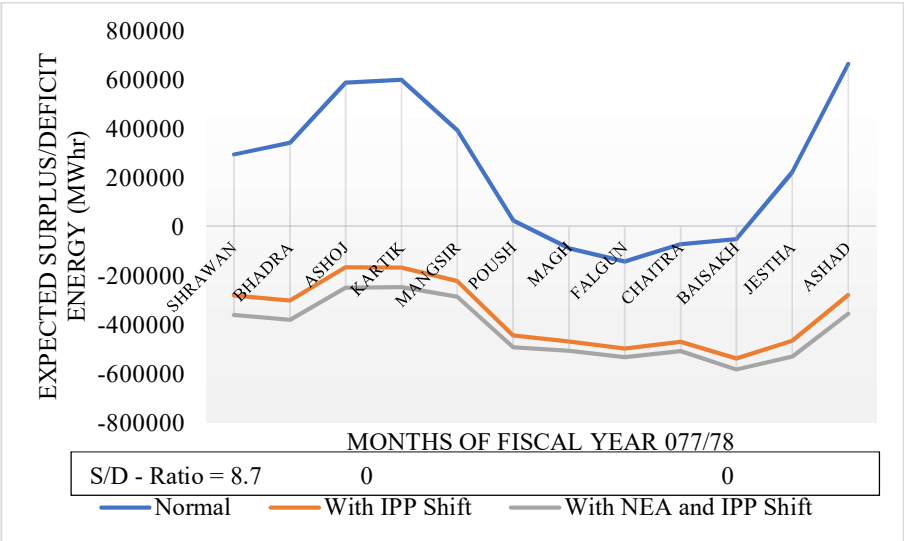


Figure 4. 8 Monthly Surplus – Deficit Energy in Combined Intervention ofInduction Chulo & Electric Vehicle Scenario for Fiscal Year 077/78

The deficit will rise to 5046.443 GWh when there is insertion of three years delay in the commissioning date of upcoming NEA projects. The illustrations are shown in Figure 4. 8.

4.5 Monthly Surplus Deficit Energy Results for Fiscal Year 078/79

4.5.1 Normal Energy Consumption Scenario in Different Generation Scenarios

There will be surplus energy in all months for all the scenarios of generation aspects as S/D – Ratio for each case is infinite. There will be about 11619.385 GWh, 7891.547 GWh and 6248.568 GWh surplus energy in Normal, Shift IPP Plants and Shift NEA & IPP Plants scenario respectively when consumption side is considered with 8% p.a. increase in total monthly base load scenario i.e. Normal scenario of expected energy consumption. The estimated values are shown in histogram in Figure 4. 9

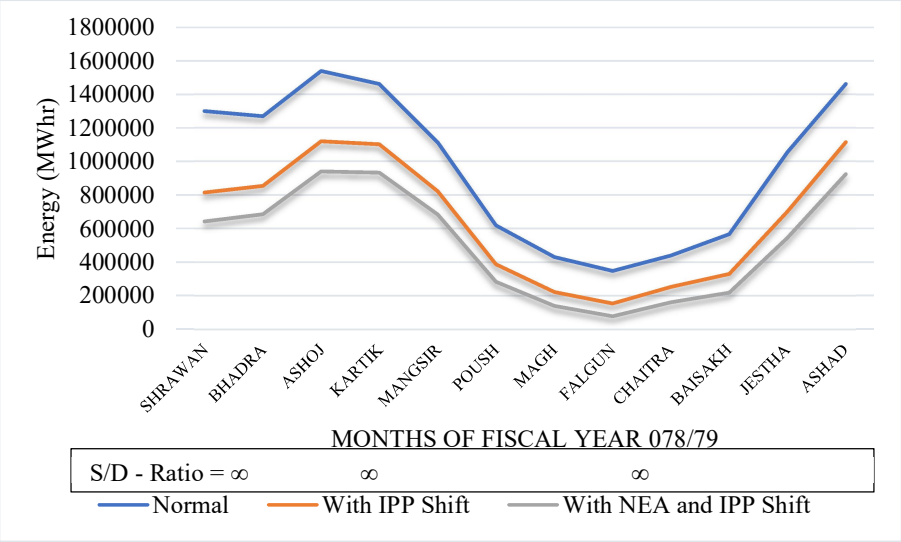


Figure 4. 9 Monthly Surplus – Deficit Energy in Normal Expected Energy Consumption Scenario for Fiscal Year 078/79

4.5.2 Growth with Categorization of Consumption Scenario in Different Generation Scenarios

When the expected energy consumption is assumed to follow growth of last year in category wise manner, then there will be surplus energy available in each month of the year in Normal scenario of generation aspects. The surplus energy throughout the year will be about 9027.012 GWh.

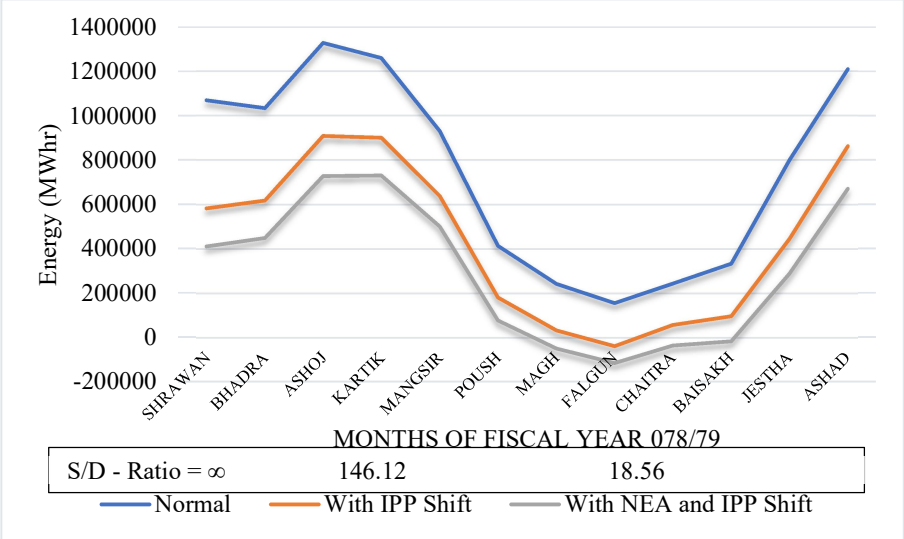


Figure 4. 10 Monthly Surplus – Deficit Energy in Growth with Categorization of Consumption Scenario for Fiscal Year 078/79

If it is analyzed in the case of shifting all upcoming IPP plants with a delay of year, then there will be deficit of energy in the month of Falgun of about 36.515 GWh energy with S/D – Ratio of 146.12. When this consumption scenario is considered in combination with Shift NEA and IPP Plants scenario, the deficit will rise to four months of the year viz. Magh, Falgun, Chaitra and Baisakh resulting into total deficit of 208.17 GWh throughout the year with S/D – Ratio of 18.56. The estimated figures are shown in the histogram in Figure 4. 10.

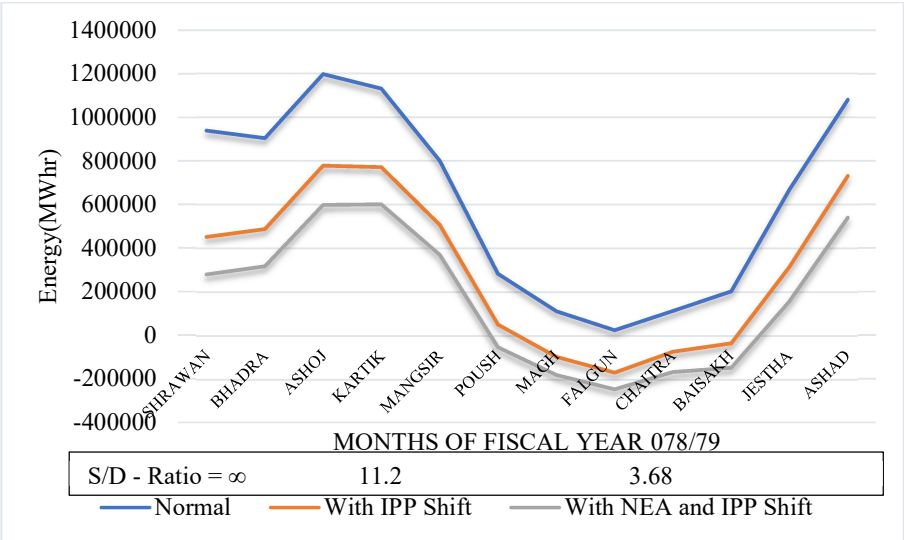


Figure 4. 11 Monthly Surplus – Deficit Energy in Intervention of Induction Chulo Scenario for Fiscal Year 078/79

4.5.3 Intervention with Induction Chulo in Different Generation Scenarios

There will be no deficit of energy even if the intervention of induction chulo is implemented policy wise in the case of Normal scenario commissioning of generating projects. The country will still have a surplus of about 7463.941 GWh energy throughout the year. However, if projects coming under IPP are delayed with a year from their commissioning date, the country will face deficit of energy for four months in Magh, Falgun, Chaitra and Baisakh and this deficit will be of about 366 GWh with S/D – Ratio of 11.2. With introduction of three years delay in projects coming under NEA or its sister organization, there will be additional deficit in the month of poush as well and the deficit energy will rise to 780.36 GWh with S/D – Ratio of 3.68. The estimated figures are represented in the histogram in Figure 4. 11.

4.5.4 Intervention with Electric Vehicle in Different Generation Scenarios

The intervention of Electric Vehicle taken for analysis consumes less energy than intervention of Induction Chulo. When this policy is intervened at Normal expected energy consumption scenario, there will be surplus in each month throughout the year and it is of about 8900 GWh. For one year delayed commissioning of PPA concluded IPP projects, there will be deficit of about 48.34 GWh energy in the month of Falgun with high value of S/D – Ratio of 108.

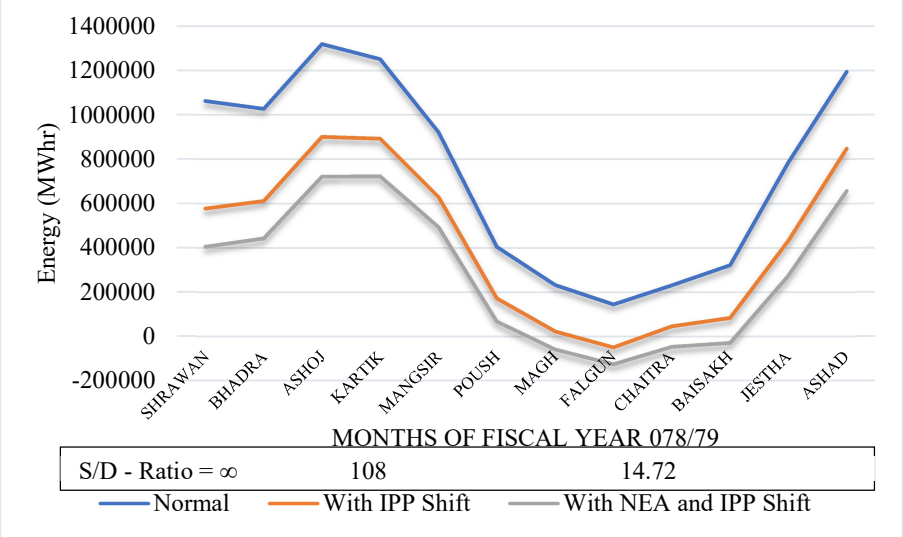


Figure 4. 12 Monthly Surplus – Deficit Energy in Intervention of Electric Vehicle Scenario for Fiscal Year 078/79

Furthermore, for Shift NEA and IPP Plants scenario of generation, the deficit will rise up to total value of 257.16 GWh and occurs for months of Magh, Falgun, Chaitra and Baisakh. However, the S/D – Ratio is in higher side with the value of 14.72 for this year in this scenario. The estimation are presented in histogram in Figure 4. 12.

4.5.5 Combined Intervention of Induction Chulo and Electric Vehicle in Different Generation Scenarios

The combined intervention of Induction Chulo and Electric Vehicle will result into drop of surplus energy to 7337.23 GWh and still there will be surplus in each month of the year. In Shift IPP Plants scenario of generation, the country will face total deficit of about 415.04 GWh in the months of Magh, Falgun, Chaitra and Baisakh with S/D – Ratio of 9.69. This ratio will drop to 3.34 when further three years delay in commissioning of projects under NEA or its sister organizations is considered and the deficit lasts for five month with additional deficit in the month of Poush. There will still be 2805.91 GWh surplus over the year in remaining seven months. The estimated values are shown in the histogram in Figure 4. 13.

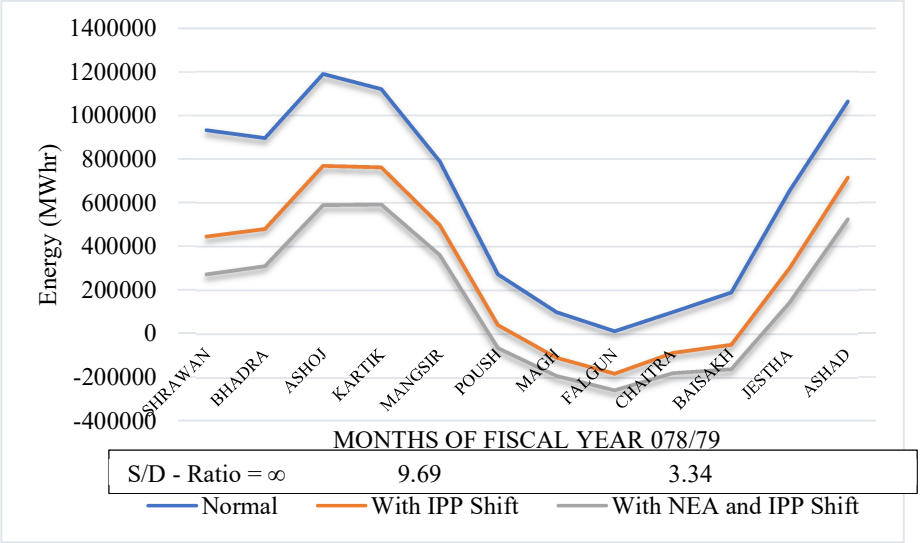


Figure 4. 13 Monthly Surplus – Deficit Energy in Combined Intervention ofInduction Chulo & Electric Vehicle Scenario for Fiscal Year 078/79

4.6 Monthly Surplus Deficit Energy Results for Fiscal Year 083/84

4.6.1 Normal Energy Consumption Scenario in Different Generation Scenarios

There will be surplus energy in all months for all the scenarios of generation aspects as S/D – Ratio for each case is infinite. There will be total surplus energy of about21952.966 GWh, 21967.146 GWh and 21360.37 GWh in Normal, Shift IPP Plants and Shift NEA & IPP Plants respectively. The calculated values are shown diagrammatically in Figure 4. 14.

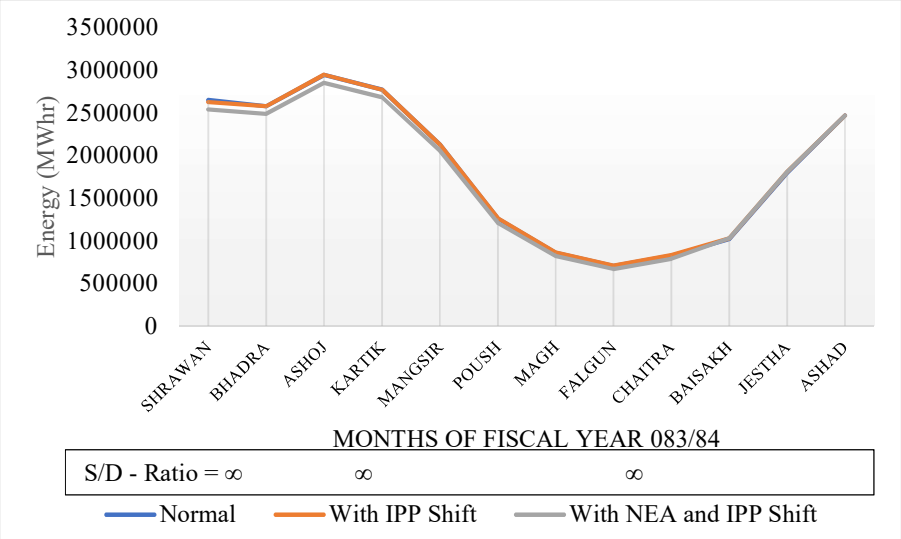


Figure 4. 14 Monthly Surplus – Deficit Energy in Normal Expected Energy Consumption Scenario for Fiscal Year 083/84

4.6.2 Growth with Categorization of Consumption Scenario in Different Generation Scenarios

When the expected energy consumption is considered in constant rise of category wise consumption at the rate of last year's growth, there will be deficit of energy for months of Magh, Falgun, Chaitra and Baisakh for all three scenarios of generation aspects.

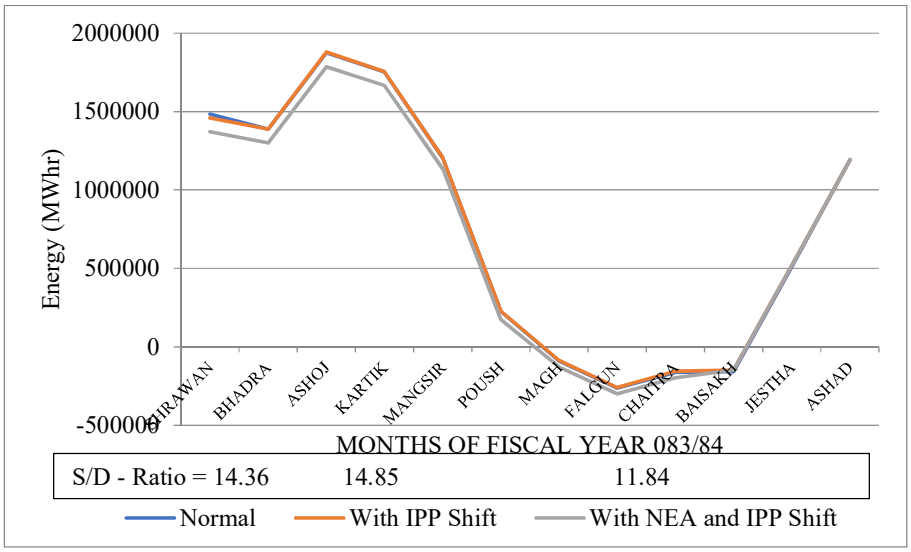


Figure 4. 15 Monthly Surplus – Deficit Energy in Growth with Categorization of Consumption Scenario for Fiscal Year 083/84

The total deficit for these time periods are 670.334 GWh, 647.556 GWh and 771.814 GWh for Normal, Shift IPP Plants and Shift NEA & IPP Plants scenarios respectively. The corresponding S/D – Ratio values are 14.36, 14.85 and 11.84 respectively for those three scenarios of generation aspects. The estimated expected surplus and deficit of energy are represented diagrammatically in Figure 4. 15.

4.6.3 Intervention with Induction Chulo in Different Generation Scenarios

When policy intervention of induction chulo is imposed in the consumption side, there will be deficit of energy in five months viz. Poush, Magh, Falgun, Chaitra and Baisakh and remaining months are characterized with surplus energy. There will be 2723.529 GWh, 2698.215 GWh and 2876.371 GWh deficit in these five months period in Normal, Shift IPP Plants and Shift NEA & IPP Plants scenarios of generation aspects respectively. However, the surplus energy available in remaining seven months will be more than these respective deficits as S/D – Ratio of 2.28, 2.29 and 2 are recorded for these scenarios respectively. The calculated values are represented diagrammatically in Figure 4. 16.

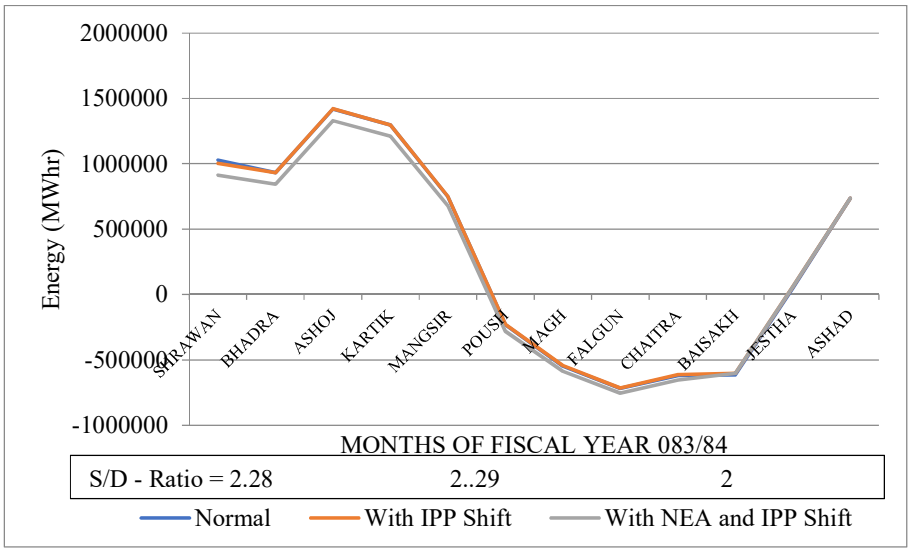


Figure 4. 16 Monthly Surplus – Deficit Energy in Intervention of Induction Chulo Scenario for Fiscal Year 083/84

4.6.4 Intervention with Electric Vehicle in Different Generation Scenarios

When policy intervention of Electric Vehicle is imposed in the consumption side, there will be deficit of energy in four months viz. Magh, Falgun, Chaitra and Baisakh and remaining months are characterized with surplus energy. There will be 1196.572

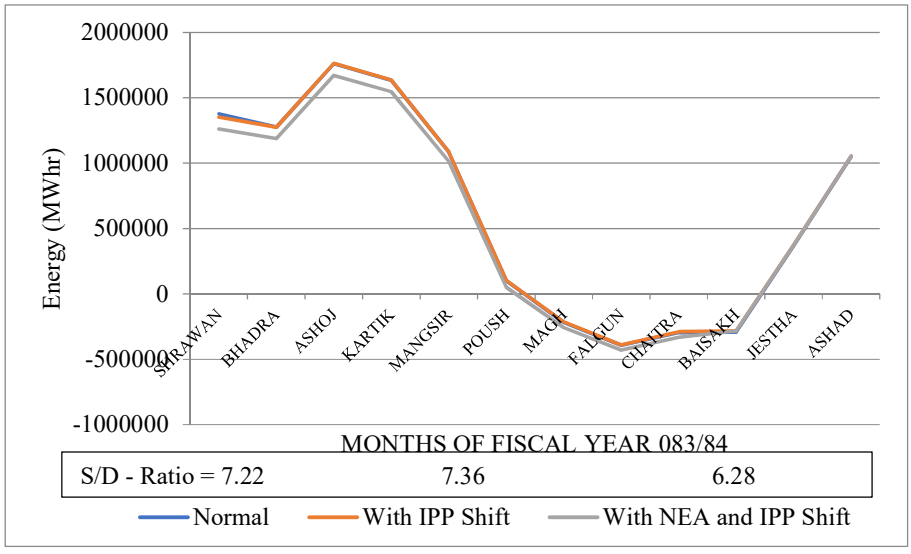


Figure 4. 17 Monthly Surplus – Deficit Energy in Intervention of Electric Vehicle Scenario for Fiscal Year 083/84

GWh, 1173.794 GWh and 1298 GWh deficit in these four months period in Normal, Shift IPP Plants and Shift NEA & IPP Plants scenarios of generation aspects

respectively. However, the surplus energy available in remaining seven months will be more than these respective deficits as S/D – Ratio of 7.22, 7.36 and 6.28 are recorded for these scenarios respectively. The calculated values are shown in Figure 4. 17.

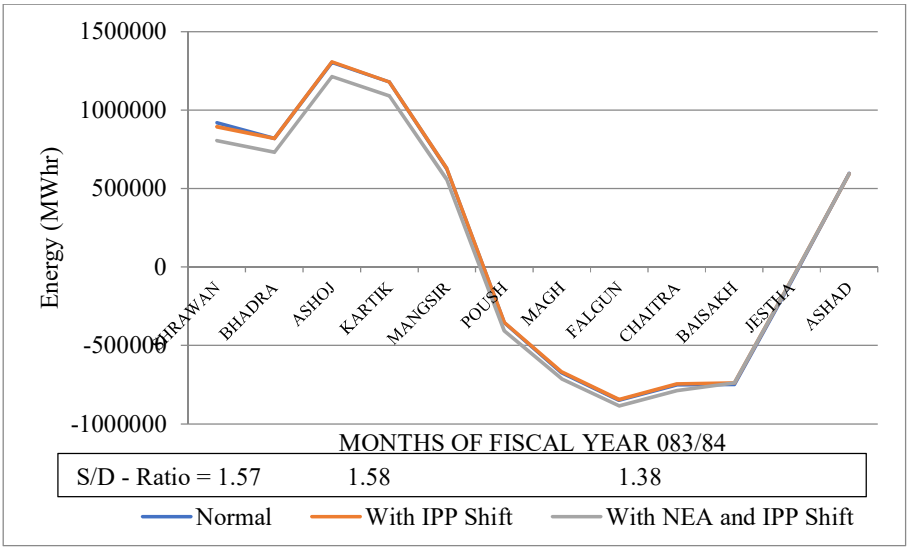


Figure 4. 18 Monthly Surplus – Deficit Energy in Combined Intervention ofInduction Chulo & Electric Vehicle Scenario for Fiscal Year 083/84

4.6.5 Combined Intervention of Induction Chulo and Electric Vehicle in Different Generation Scenarios

When the combined intervention Induction Chulo and Electric Vehicle is imposed in the consumption side, the months with surplus and deficit energy are divided into equal halves of year. There will be surplus energy in each generation scenario in months of Ashad, Shrawan, Bhadra, Ashoj and Kartik. Similarly, remaining six months will experience deficit of energy in all scenarios. There will be total deficits of 3461.895 GWh, 3428 GWh and 3606.176 GWh in Normal, Shift IPP Plants and Shift NEA & IPP Plants scenarios respectively. Similarly, the total respective surplus energy available in the remaining six months will be 5444.189 GWh, 5424.495 GWh and 4995.874 GWh. The estimated values for this combined intervention are shown in the histogram in Figure 4. 18.

4.7 Monthly Surplus Deficit Energy Results for Fiscal Year 084/85

4.7.1 Normal Energy Consumption Scenario in Different Generation Scenarios

There will be surplus energy in all months for all the scenarios of generation aspects as S/D – Ratio for each case is infinite. There will be total surplus energy of about 20792.95 GWh in Normal scenario of generation aspects.

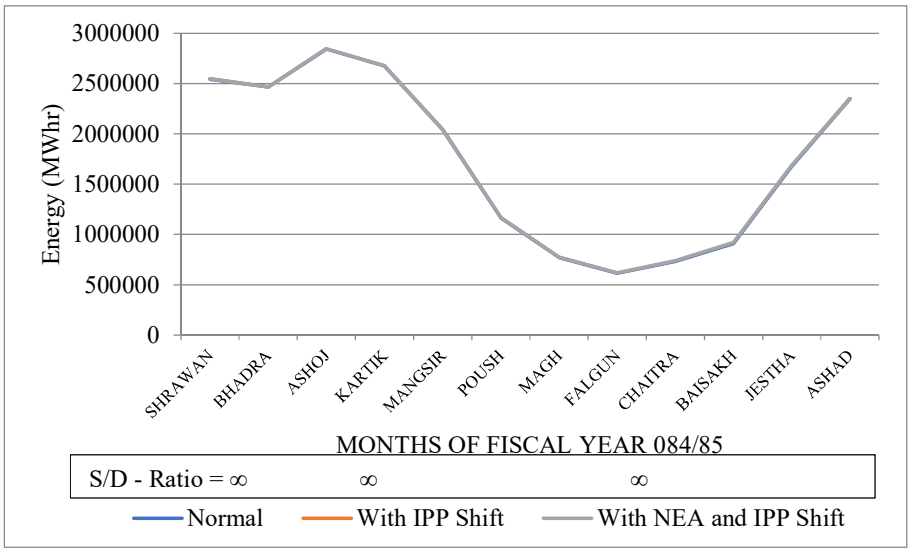


Figure 4. 19 Monthly Surplus – Deficit Energy in Normal Expected Energy Consumption Scenario for Fiscal Year 084/85

The total surplus energy for Shift IPP Plants and Shift NEA & IPP Plants scenario will be equal and will have value equal to 20835.76 GWh. The calculated expected surplus energy values are shown in Figure 4. 19.

4.7.2 Growth with Categorization of Consumption Scenario in Different Generation Scenarios

When the consumption is taken as growth with categorization of consumption scenario, there will be deficit of energy in five months viz. Poush, Magh, Falgun, Chaitra and Baisakh in all scenarios of generation aspects. There will be deficit of 2325.33 GWh energy in Normal scenario of generation aspects with S/D – Ratio of 2.79. The total deficit energy will be equal in remaining two scenarios of generation aspects i.e. Shift IPP Plants and Shift NEA & IPP Plants. This total deficit energy will be around 2300 GWh with S/D – Ratio of 2.82. There will still be total surplus energy in seven months greater than that of total deficit energy in five months for each of the

generation scenario. The estimated surplus and deficit of energy are shown in Figure 4. 20.

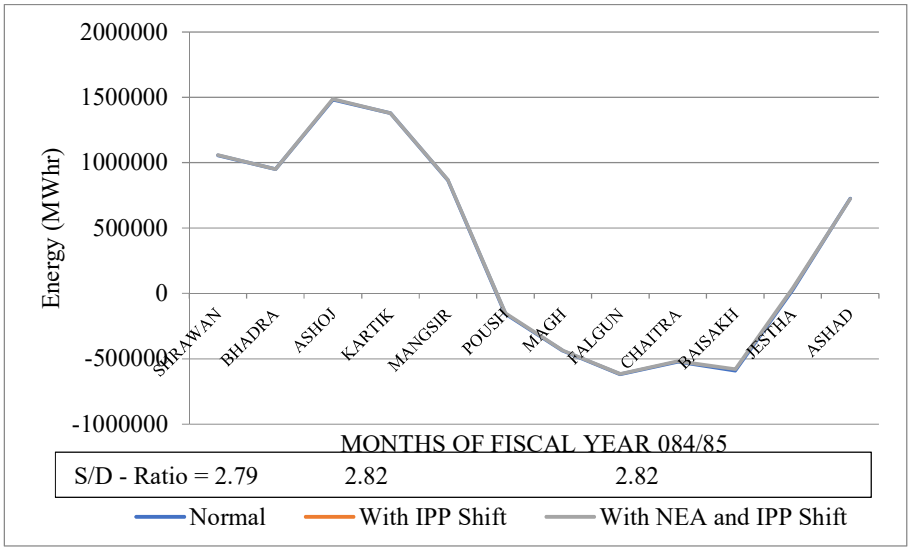


Figure 4. 20 Monthly Surplus – Deficit Energy in Growth with Categorization of Consumption Scenario for Fiscal Year 084/85

4.7.3 Intervention with Induction Chulo in Different Generation Scenarios

There will be deficit of energy in six months viz. Poush, Magh, Falgun, Chaitra, Baisakh and Jestha and surplus of energy in remaining six months of year. For the first time, the total deficit of energy will exceed total surplus energy throughout year

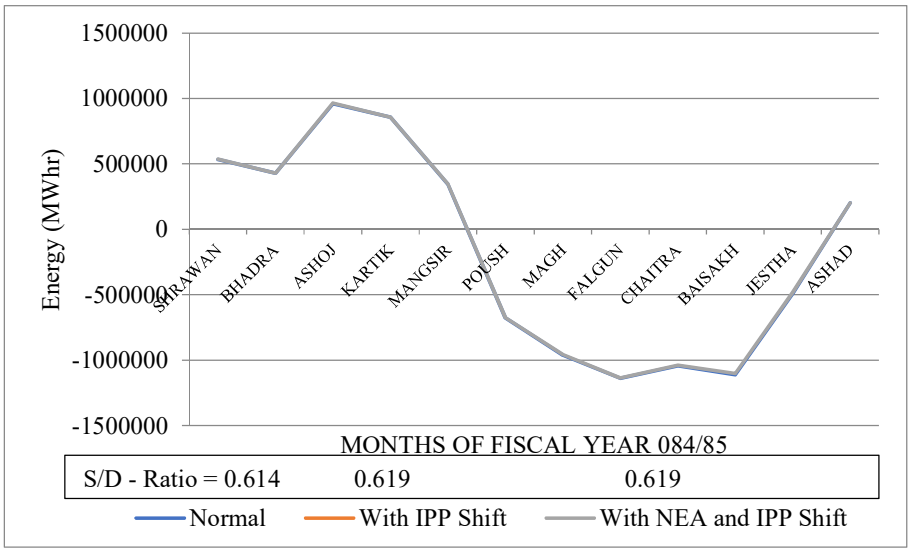


Figure 4. 21 Monthly Surplus – Deficit Energy in Intervention of Induction Chulo Scenario for Fiscal Year 084/85

resulting into S/D – Ratio of value between zero and unity. The total deficit and surplus energy for Normal scenario of generation aspects will be 5419.725 GWh and 3329.814 GWh respectively resulting into S/D – Ratio of 0.614. The total surplus and deficit energy for Shift IPP Plants and Shift NEA & IPP Plants scenarios will be equal and will have values of 3338.754 GWh 5385.851 GWh respectively. The S/D – Ratio for these two scenarios will be around 0.619. The calculated values are shown in Figure 4. 21.

4.7.4 Intervention with Electric Vehicle in Different Generation Scenarios

There will be greater total surplus energy in six months of the year than total deficit energy in remaining six months viz. Poush, Magh, Falgun, Chaitra, Baisakh and Jestha when policy of Electric Vehicle is implemented. There will be surplus energy and deficit energy of around 5513.29 GWh and 3317.34 GWh respectively when all the upcoming generating projects get commissioned in their ideal required commercial operation date. When there is delay of one year in commissioning date of projects coming under IPP, the total surplus energy and total deficit energy will be around 5522.23 GWh and 3283.46 GWh respectively. If we introduce further delay of three years in commissioning date of projects coming under NEA or its sister organization, the total surplus energy, total deficit of energy and S/D – Ratio will not change. The estimated values are represented diagrammatically in Figure 4. 22.

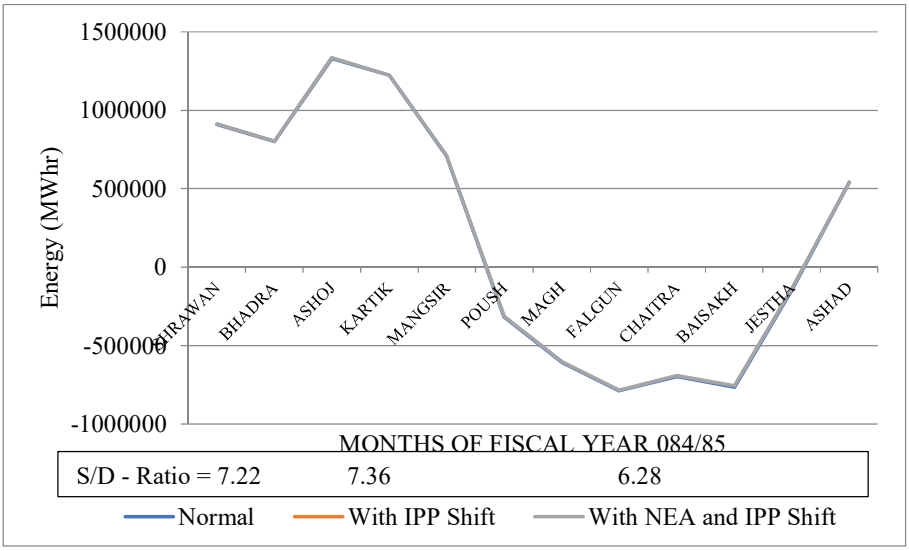


Figure 4. 22 Monthly Surplus – Deficit Energy in Intervention of Electric Vehicle Scenario for Fiscal Year 084/85

4.7.5 Combined Intervention of Induction Chulo and Electric Vehicle in Different Generation Scenarios

When the combined intervention Induction Chulo and Electric Vehicle is imposed in the consumption side, the months with surplus and deficit energy are divided into equal halves of year. The total deficit energy resulting form deficit of energy in the months of Poush, Magh, Falgun, Chaitra, Baisakh and Jestha will be greater than total surplus energy available in the remaining six months.

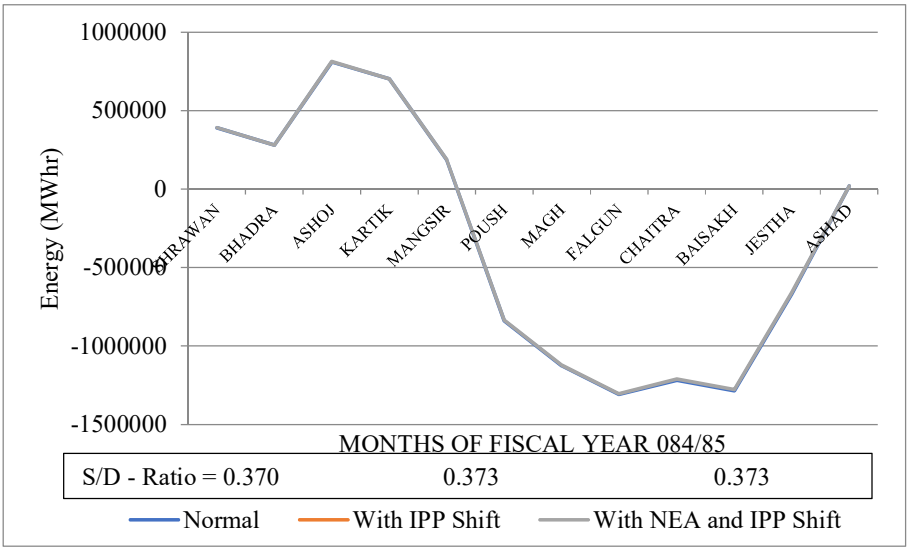


Figure 4. 23 Monthly Surplus – Deficit Energy in Combined Intervention ofInduction Chulo & Electric Vehicle Scenario for Fiscal Year 084/85

The total surplus energy will be around 37% of total deficit energy for each scenario of generation aspects. There will be total surplus energy of 2387.14 GWh with S/D – Ratio of 0.37 for Normal scenario of generation aspects. The surplus and deficit energy will be equal for remaining two scenarios of generation aspects which will be about 2396 GWh with S/D – Ratio of 0.373. The estimated values are shown in Figure 4. 23.

4.8 Monthly Surplus Deficit Energy Results for Fiscal Year 086/87

4.8.1 Normal Energy Consumption Scenario in Different Generation Scenarios

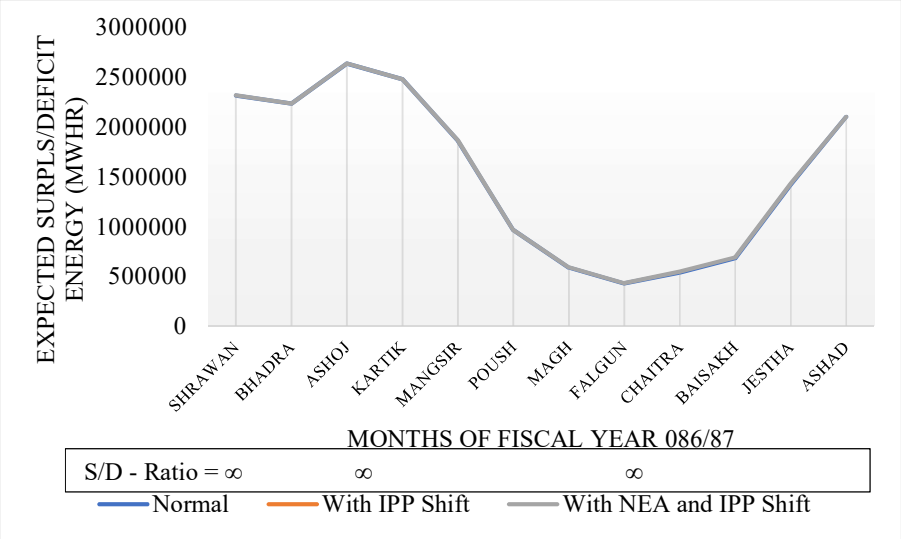


Figure 4. 24 Monthly Surplus – Deficit Energy in Normal Expected Energy Consumption Scenario for Fiscal Year 086/87

There will be surplus energy in all months for all the scenarios of generation aspects as S/D – Ratio for each case is infinite. There will be total surplus energy of about 18187 GWh in Normal scenario of generation aspects. The total surplus energy for Shift IPP Plants and Shift NEA & IPP Plants scenario will be equal and will have value equal to 18230 GWh. The calculated values are shown in Figure 4. 24.

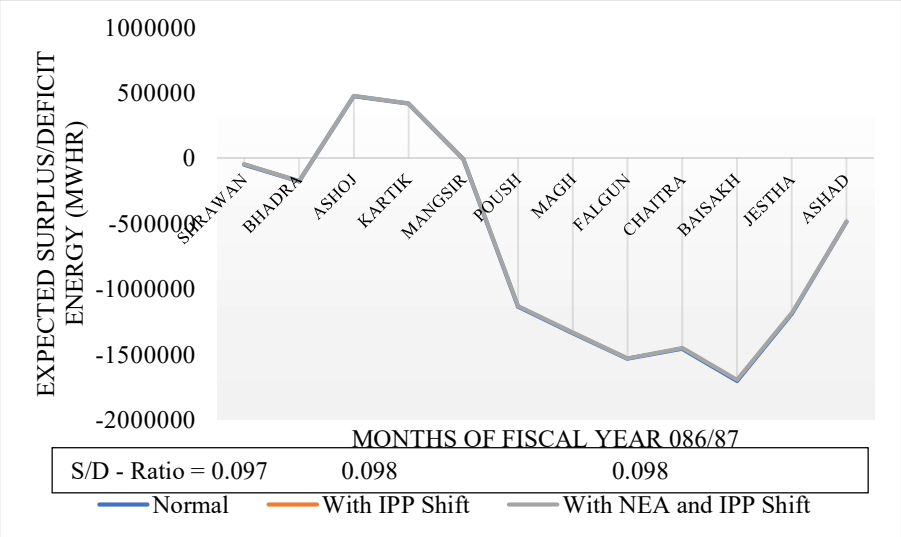


Figure 4. 25 Monthly Surplus – Deficit Energy in Growth with Categorization of Consumption Scenario for Fiscal Year 086/87

4.8.2 Growth with Categorization of Consumption Scenario in Different Generation Scenarios

When the consumption is taken as growth with categorization of consumption scenario, there will be surplus of energy in only two months viz. Ashoj and Kartik in all scenarios of generation aspects. The total deficit energy over ten months is much higher than the total surplus energy that will be available in only two months. The surplus energy will only cover for 9.7% of total deficit energy in Normal generation scenario and 9.8% for remaining two scenarios of generation aspects. The total deficit energy that will be faced by the country will be around 9092 GWh in Normal scenario of generation aspects. The total deficit for Shift IPP Plants and Shift NEA & IPP Plants scenario will be equal and will have value around 9053 GWh. These estimated values of surplus energy, deficit energy and S/D – Ratio are shown in Figure 4. 25.

4.8.3 Intervention with Induction Chulo in Different Generation Scenarios

The intervention of Induction Chulo will bring severe deficit of energy in all months throughout the year in each generation aspects scenarios resulting into zero S/D – Ratio. The total deficit of energy that will be faced will be around 16022 GWh in Normal generation scenario and 15979 GWh in Shift IPP Plants and Shift NEA & IPP Plants scenarios, respectively.

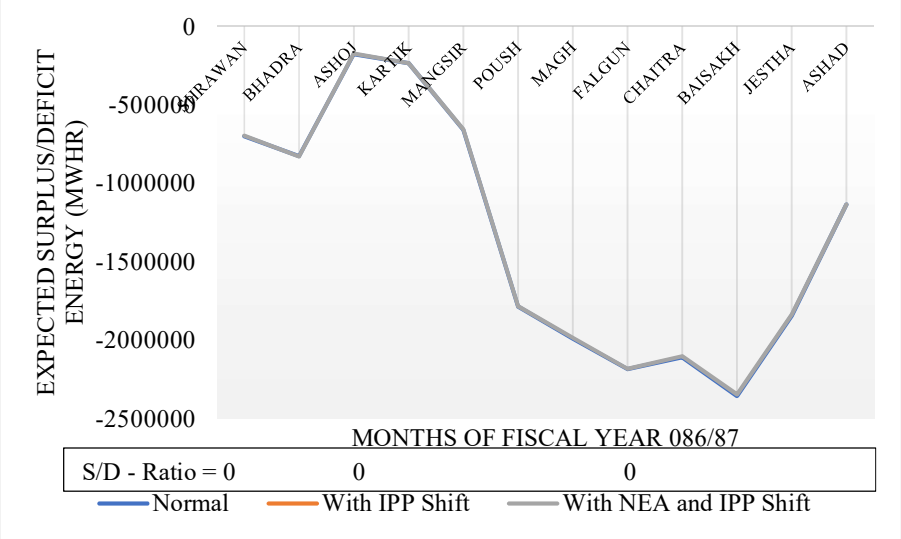


Figure 4. 26 Monthly Surplus – Deficit Energy in Intervention of Induction Chulo Scenario for Fiscal Year 086/87

The deficit will increase from months of Ashoj and reaches at maximum deficit in month of Baisakh and then it will again experience fall in deficit amount towards the month of Ashoj. The estimated values are represented in Figure 4. 26.

4.8.4 Intervention with Electric Vehicle in Different Generation Scenarios

The intervention of Electric Vehicle will result into deficit of energy in all months except Ashoj and Kartik. The total surplus energy around Ashoj and Kartik will only about 3.4% of the total deficit of energy in remaining ten months period.

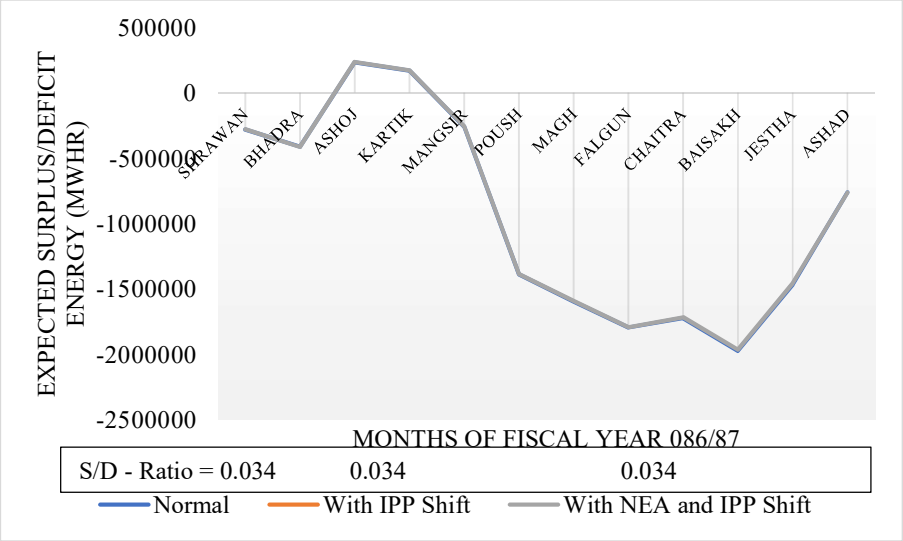


Figure 4. 27 Monthly Surplus – Deficit Energy in Intervention of Electric Vehicle Scenario for Fiscal Year 086/87

The total deficit energy will be about 11673 GWh in Normal generation scenario and 11634 GWh for remaining two generations scenarios with delay in commissioning of upcoming hydropower projects. The estimated surplus energy, deficit energy and S/D – Ratio are shown in the graph in Figure 4. 27.

4.8.5 Combined Intervention of Induction Chulo and Electric Vehicle in Different Generation Scenarios

The combined intervention of Induction Chulo and Electric Vehicle in fiscal year 086/87 will cause severe deficit of energy in all three scenarios of generation aspects resulting into zero S/D - Ratio.

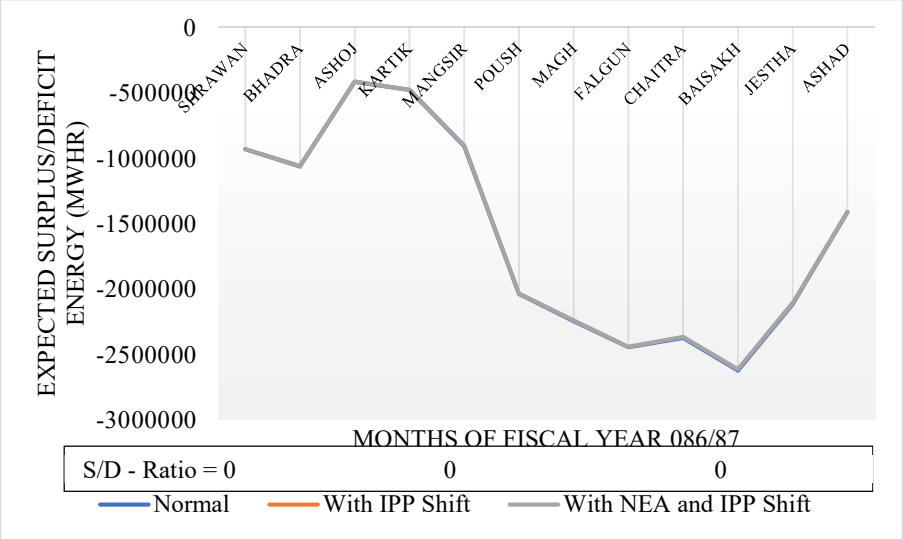


Figure 4. 28 Monthly Surplus – Deficit Energy in Combined Intervention ofInduction Chulo & Electric Vehicle Scenario for Fiscal Year 086/87

There will be deficit of energy 19088 GWh in Normal scenario with lowest deficit in Ashoj and highest deficit in Baisakh. This deficit will change to 19045 GWh for remaining two scenarios of generation aspects with respective delay in upcoming projects. The estimated values are shown in Figure 4. 28.

4.9 Expected Surplus & Deficit Energy

Figure 4. 29 depicts the expected net annual energy surplus and deficit for three fiscal years during the study period as a percentage of generation in each scenarios. It is to be noted that fiscal year 078/79 will have annual surplus in each of the scenario. In terms of energy, there will be largest surplus energy as 54% of generation energy for

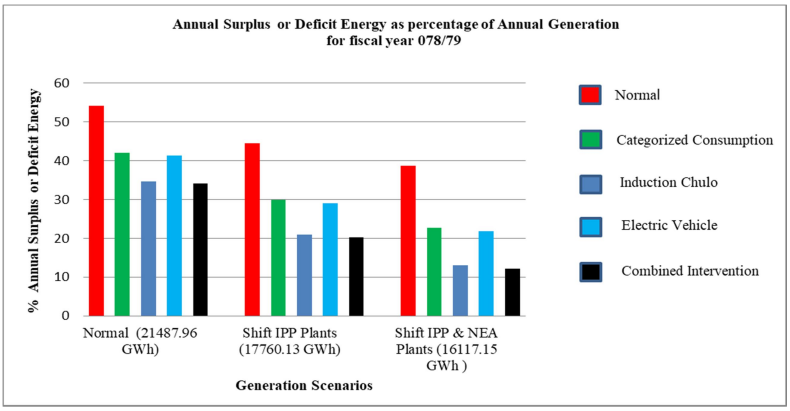


Fig. (a) For fiscal year 078/79

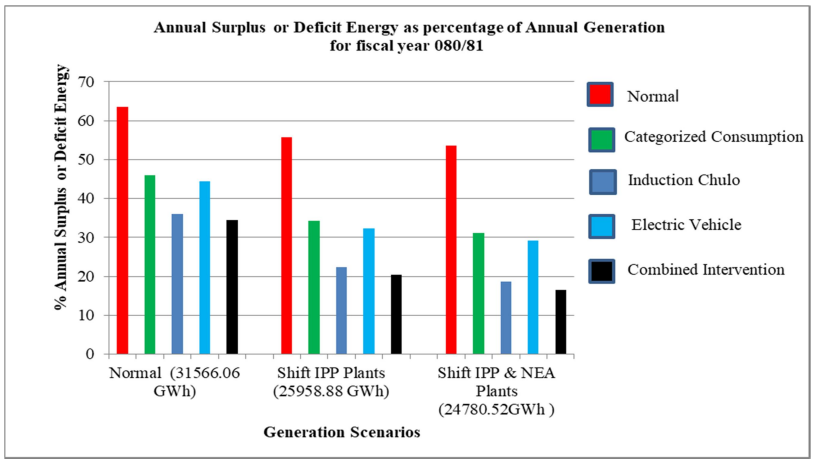


Fig. (b) For fiscal year 080/81

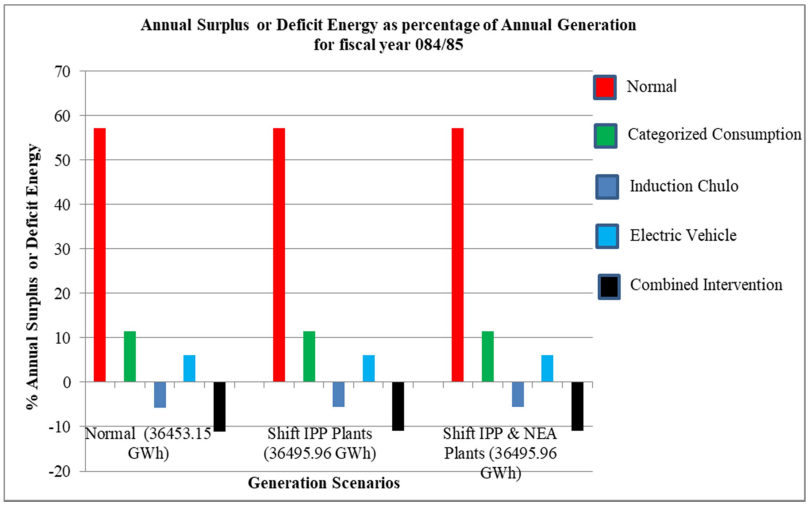


Fig. (c) For fiscal year 084/85

Figure 4. 29 Annual Surplus or Deficit Energy as Percentage of Annual Generation for fiscal year 078/79, 080/81 & 084/85

combination of normal generation scenario and constant per annum growth in energy consumption scenario. Similarly, lowest surplus energy as 12.2% of generation energy is observed in Shift IPP & NEA Plants scenario of generation and combined intervention scenario of consumption. Fiscal year 080/81 is expected to follow similar surplus energy trend with relatively higher percentage of energy surplus in comparison to fiscal year 078/79.

For fiscal year 084/85, annual surplus and deficit of energy varies widely depending upon generation and consumption scenario. This year is expected to observe net annual surplus energy for three of the consumption scenarios viz. normal, growth with categorized and intervention with electric vehicle consumptions. However, there will

be net annual deficit of energy in intervention with induction Chulo and combined intervention scenarios. Having surplus or deficit annual energy doesnot indicate there will be surplus or deficit of energy in each months of that particular year. So, monthly surplus and deficit energy for study periods are shown in Appendix – M.

4.10 Load Flow Simulation Results & Discussions

The load flow simulation has been carried out for following five scenarios of energy consumption for fiscal year 084/85 for Shift NEA & IPP Plants generation scenario and the result has been analyzed for import and export lines, line loading, transformer loading and bus voltages. The generator are taken as voltage control modes and cross border transmission links are provided as required export or import swing units. The observed results are presented in Appendix – N. The results are analyzed and are listed as follows:

4.10.1 Scenario – I: Maximum Export (Normal Energy Consumption – Ashoj)

The followings results and discussions are listed from load flow simulation:

- There will be flow of around 1200 MW to the Muzzafarpur bus (400kV) and the Gorakhpur Grid will draw around 2093.9 MW when the load flow is carried out for load of 2285. 47 MW. This concludes the capacity of Dhalkebar – Muzzafarpur line will be fully used whereas the Butwal – Gorakhpur Line must be designed so as to carry the aforementioned flow.
- Amlekhgunj – Hetauda (66 kV), Amlekhgunj – Simara (66 kV), Balaju – Lainchaur (66 kV), Baneshwor – Bhakapur (66 kV), Chapali – Chabahil (66 kV), Muzzafarpur – Dhalkebar (400 kV), Dhalkebar – Hetauda (400 kV), Duhabi – Damak (132 kV), Ilam – Damak (132 kV), Phidim – Ilam (132 kV), Phidim – Thapatar (132 kV), Khimti – Lamosangu (132 kV), Damauli – Butwal (400 kV), Ratamate – Damauli (400 kV), Dhalkebar – New Khimti (400 kV), Tingla – Mirchiya (132 kV), Trishuli 3B – Ratamate (200 kV), Butwal – Gorakhpur (400 kV), Parwanipur – Birgunj (66 kV), Teku – Suichatar (66 kV) lines have been found as critically overloaded.
- The transformer of Hetauda, Suichatar and Parwanipur grids have been found critically overloaded.

- Bus Results:
    1. All twenty two 66 kV buses have been operating with critical bus voltages.
    2. Among sixty one 132 kV buses, only fourteen buses (Amarpur, Bharatpur, Damauli, Kawasoti, Kaligandaki, Khimti, Lekhnath, Likhu, Middle Marsyangdi, Marsyangdi, Modi, Phidim, Pokhara and Tingla) have been operating with healthy bus voltages.
    3. Among twenty eight 220 kV buses, no buses have been found to operate with critical bus voltages. However, eight buses (Andhikhola, Butwal, Damauli, Dandakhet, Dhalkebar, Inaruwa, Kusma and Rahughat) have been found to operate with marginal bus voltage.
    4. Only six buses (Arun Hub, Barhabise, Gorakhpur, Laphsiphedi, New Khimti and Ratamate) out of twenty one 400 kV buses have been found to operate with healthy bus voltage.

4.10.2 Scenario – II: Maximum Import (Combined Intervention with Induction Chulo and Electric Vehicle – Falgun)

The followings results and discussions are listed from load flow simulation:

- The load flow simulation is converged for addition of 260 MVar capacitor bank on buses of Birgung loop. Capacitor Bank each of 50 MVar have been used in buses Parwanipur (132 kV), Birgunj (66 kV), Simara (66 kV), Amlekhgunj (66 kV), 40 MVar in Kamane (132 kV) and 20 MVar in Pathlaiya (132 kV).
- Six import lines in accordance with cross – border planning have been used to accommodate the total import peak demand considering their capacity. The import of 100 MW from Tanakpur import, 1200 MW from Butwal – Gorakhpur 400 kV line, 150 MW from Parwanipur – Raxaul 132 kV line, 1200 MW from Dhalkebar – Muzzafarpur 400 kV line, 150 MW from Kusaha – Kataiya 132 kV line and remaining 907 MW from Duhabi – Purnea 400 kV line have been simulated to meet the monthly peak demand of around 6139 MW.
- Balaju - Suichatar (66 kV), Balaju – Lainchaur (66 kV), Baneshwor – Bhakapur (66 kV), Bhaktapur – Banepa (66 kV), Bharatpur – Damauli (132 kV), Chapali – Chabahil (66 kV), Dhalkebar – New Duhabi (400 kV), Duhabi

– Lahan (132 kV), Damak – Duhabi (132 kV), Hetauda – Kulekhani II (132 kV), Hetauda – Kulekhani III (132 kV), Khimti – Lamosangu (132 kV), Kusaha – Lahan (132 kV), Kusaha – New Duhabi (132 kV), Matatirtha – Kulekhani II (132 kV), Matatirtha – Suichatar (132 kV), Mirchiya – Lahan (132 kV), Parwanipur – Birgunj (66 kV), Simara – Parwanipur (66 kV), Suichatar – Singhadurbar (66 kV), Suichatar – Kulekhani I (66 kV),Teku – Suichatar (66 kV), Butwal – Gorakhpur (400 kV) and Duhabi – Purnea (400 kV) lines have been found as critically overloaded .

- The transformer of Balaju, Bhaktapur, Chapali, Dhalkebar, Hetauda, Suichatar and Parwanipur grids have been found critically overloaded.
- Bus Results:
    1. None of twenty two 66 kV buses have been operating with healthy bus voltage.
    2. Among sixty two 132 kV buses, only thirteen buses (Amarpur, Damauli, Dhalkebar, Duhabi, Kataiya, Kaligandaki, Kusaha, Lekhnath, Likhu, Middle Marsyangdi, Phidim, Pokhara and Tingla) have been operating with healthy bus voltages.
    3. Among twenty eight 220 kV buses, eight buses (Andhikhola, Bharatpur, Butwal, Dana, Dandakhet, Kusma, New Marsyangdi and Rahughat) have been found to operate with critical bus voltage and four buses (Khudi, Manang, Matatirtha, and Udipur) have been found to operate with critical bus voltage..
    4. Only nine buses (Arun Hub, Barhabise, Dhalkebar, Duhabi, Inaruwa, Mirchiya, Muzzafarpur, New Khimti and Purnea) out of twenty three 400 kV buses have been found to operate with healthy bus voltage.

4.10.3 Scenario – III: Intermediate Import (Growth with Categorization of Consumption – Falgun)

The followings results and discussions are listed from load flow simulation:

- Four import lines in accordance with cross – border planning have been used to accommodate the total import peak demand considering their capacity. The import of 100 MW from Tanakpur import, 1110 MW from Butwal – Gorakhpur 400 kV line, 1000 MW from Dhalkebar – Muzzafarpur 400 kV

line, 129 MW from Kusaha – Kataiya 132 kV line have been simulated to meet the monthly peak demand of around 4766 MW.

- Amlekhgunj – Hetauda (66 kV), Amlekhgunj – Simara (66 kV), Balaju - Suichatar (66 kV), Balaju – Lainchaur (66 kV), Baneshwor – Bhakapur (66 kV), Bhaktapur – Banepa (66 kV), Bharatpur – Damauli (132 kV), Chapali – Chabahil (66 kV), Duhabi – Damak (132 kV), Hetauda – Kamane (132 kV), Hetauda – Kulekhani II (132 kV), Hetauda – Kulekhani I (66 kV), Hetauda – Kulekhani III (132 kV), Hetauda – Pathlaiya (132 kV), Kamane – Pathlaiya (132 kV) , Khimti – Lamosangu (132 kV), Teku – Singhadurbar (66 kV), Kulekhani III – Kulekhani II (132 kV), Kusaha – New Duhabi (132 kV), Butwal – Phulbari (400 kV), Butwal – Damauli (400 kV), Matatirtha – Kulekhani II (132 kV), Matatirtha – Suichatar (132 kV), Parwanipur – Birgunj (66 kV), Simara – Parwanipur (66 kV), Pathlaiya – Parwanipur (66 kV), Suichatar – Singhadurbar (66 kV), Teku – Suichatar (66 kV), Suichatar – Patan (66 kV), Suichatar – Kulekhani I (66 kV) lines have been found as critically overloaded.
- The transformer of Balaju, Bhaktapur, Chapali, Dhalkebar, Hetauda, Suichatar, Khimti and Parwanipur grids have been found critically overloaded.
- Bus Results:
    1. Among twenty two 66 kV buses, only Birgunj bus has been found to operate with normal bus voltage and all other buses have been operating with critical bus voltage.
    2. Among sixty one 132 kV buses, only three buses (Bharatpur, Middle Marsyangdi and Marsyangdi) have been operating with healthy bus voltages. All remaining buses have been found to operate under marginal and critical bus voltage condition.
    3. Among twenty eight 220 kV buses, eight buses (Barhabise, Bharatpur, Dhalkebar, Matatirtha, New Khimti, New Marsyangdi, Tamakoshi and Tingla) have been found to operate with normal bus voltage..
    4. Only five buses (Dhalkebar, Inaruwa, Mirchiya, Muzzafarpur and New Khimti) out of twenty one 400 kV buses have been found to operate with healthy bus voltage.

4.10.4 Scenario – IV: Intermediate Import (Intervention with Induction Chulo – Falgun)

The followings results and discussions are listed from load flow simulation:

- The load flow simulation is converged for addition of 80 MVar capacitor bank on buses of Birgung loop. Capacitor Bank each of 50 MVar have been used in buses Parwanipur (132 kV) and Birgunj (66 kV) buses and 30 MVar capacitor bank has been used in Pathlaiya (132 kV) bus.
- Six import lines in accordance with cross – border planning have been used to accommodate the total import peak demand considering their capacity. The import of 100 MW from Tanakpur import, 1100 MW from Butwal – Gorakhpur 400 kV line, 1100 MW from Dhalkebar – Muzzafarpur 400 kV line, 125 MW from Kusaha – Kataiya 132 kV,150 MW from Parwanipur – Raxaul 132 kV line and remaining 793.6 MW from Duhabi – Purnea 400 kV lines have been simulated to meet the monthly peak demand of around 5803 MW.
- Balaju - Suichatar (66 kV), Balaju – Lainchaur (66 kV), Baneshwor – Bhakapur (66 kV), Bhaktapur – Banepa (66 kV), Bharatpur – Damauli (132 kV), Chapali – Chabahil (66 kV), Duhabi – Damak (132 kV), Hetauda – Kulekhani II (132 kV), Hetauda – Kulekhani I (66 kV), Suichatar – Singhadurbar (66 kV), Khimti – Lamosangu (132 kV), Kulekhani III – Kulekhani II (132 kV), Kusaha – Lahan (132 kV),Duhabi – Purnea (400 kV), Matatirtha – Kulekhani II (132 kV), Matatirtha – Suichatar (132 kV), Parwanipur – Birgunj (66 kV), Simara – Parwanipur (66 kV), Pathlaiya – Parwanipur (66 kV), Teku – Suichatar (66 kV), Suichatar – Kulekhani I (66 kV) lines have been found as critically overloaded.
- The transformer of Balaju, Bhaktapur, Chapali, Dhalkebar, Hetauda, Suichatar, Khimti and Parwanipur grids have been found critically overloaded.
- Bus Results:
    1. Among twenty two 66 kV buses, all buses have been found to operate with critical bus voltage.
    2. Among sixty two 132 kV buses, only twelve buses (Amarpur, Duhabi, Ilam, Katiya, Kawasoti, Kusaha, Likhu, Middle Marsyangdi, Marsyangdi, Modi, Phidim and Pokhara) have been operating with

healthy bus voltages. All remaining buses have been found to operate under marginal and critical bus voltage condition.

3. Among twenty eight 220 kV buses, six buses (Andhikhola, Butwal, Dana, Dandakhet, Kusma and Rahughat) have been found to operate with critical bus voltage. Other six buses (Bharatpur, Damauli, Lekhnath, Matatirtha, Tamakoshi and Upper Madi) have found to operate on marginal bus voltage.
4. Only nine buses (Arun Hub, Barhabise, Dhalkebar, Duhabi, Inaruwa, Mirchiya, Muzzafarpur, New Khimti and Purnea) out of twenty three 400 kV buses have been found to operate with healthy bus voltage.

4.10.5 Scenario – V: Intermediate Export (Intervention with Electric Vehicle – Ashoj)

The followings results and discussions are listed from load flow simulation:

- Only Muzzafarpur – Dhalkebar 400 kV line will be required to export 594.1 MW from Nepal to India.
- Balaju - Suichatar (66 kV), Balaju – Lainchaur (66 kV), Baneshwor – Bhakapur (66 kV), Chapali – Chabahil (66 kV), Duhabi – Damak (132 kV), Hetauda – Kamane (132 kV), Hetauda – Kulekhani II (132 kV), Ilam – Damak (132 kV), Ilam – Phidim (132 kV), Phidim – Amarpur (132 kV), Khimti – Lamosangu (132 kV), Kulekhani III – Kulekhani II (132 kV), Lamosangu – Bhaktapur (132 kV), Lekhnath - Pokhara (132), Barhabise – New Khimti (400 kV), Dhalkebar – New Khimti (400 kV), Tingla – Mirchiya (132 kV), Trishuli 3B – Ratamate (220 kV), Matatirtha – Kulekhani II (132 kV), Matatirtha – Suichatar (132 kV), Parwanipur – Birgunj (66 kV), Simara – Parwanipur (66 kV), Pathlaiya – Parwanipur (66 kV), Teku – Suichatar (66 kV), Suichatar – Singhadurbar (66 kV), lines have been found as critically overloaded.
- The transformer of Balaju, Bhaktapur, Chapali, Dhalkebar, Hetauda, Suichatar and Parwanipur grids have been found critically overloaded.
- Bus Results:
    1. Among twenty two 66 kV buses, all buses have been found to operate with critical bus voltage.

2. Among sixty one 132 kV buses, Kohalpur buses and Marsyangdi bus have been operating with healthy bus voltages. All remaining buses have been found to operate under marginal and critical bus voltage condition.
3. Among twenty eight 220 kV buses, only Arun 3 bus has been found to operate with normal bus voltage.
4. Only two buses (Arun Hub and Muzzafarpur) out of twenty one 400 kV buses have been found to operate with healthy bus voltage.

4.11 Verification of Expected Energy Consumption Scenario

When expected energy consumption is estimated based on sectoral energy growth rate as 1.5 times GDP growth rate as given by study performed by Government of Nepal and JICA, expected monthly peak demand for Ashoj of fiscal year 084/85 has been found to decrease by 25 MW as comparison to Normal energy consumption scenario for the same. There was flow of about 2094 MW (export) from butwal - Gorakhpur link in Normal scenario of energy consumption in load flow simulation for Ashoj of fiscal year 084/85 while 2118.6 MW power flow (export) is observed in this categorized consumption with aforementioned different yearly sectoral growth rates. These shows the results from expected energy growth implementing sectoral growth rates for coming ten years given by study of JICA and adopted Normal consumption scenario (8% p.a.growth on monthly bulk consumption) in this study are almost same.

CHAPTER 5: CONCLUSIONS & RECOMMENDATIONS

5.1 Conclusions

5.1.1 Conclusions on Surplus – Deficit Energy

The thesis studied the scenario analysis for surplus – deficit energy analysis for projected ten years for energy banking from Nepalese perspective. The conslusions drawn from the study are illustrated case – wise as follows:

(i) Normal Expected Energy Consumption Scenario

1. There will be surplus energy in each month from fiscal year 077/78 to 086/87 for Normal scenario of generation. The surplus energy goes on increasing from fiscal year 077/78 to 082/83 and starts to decrease thereafter as there will be no addition of generation project but the consumption is assumed to be in constant growth. The surplus energy available will increase from month of Chaitra to Ashoj and thereafter starts to decrease in each fiscal year. There will be all export case for energy banking facility in this scenario.
2. In "Shift IPP Plants" scenario, there will be deficit energy in all months except months of Ashoj and Kartik in Fiscal year 077/78 resulting into need of export to energy banking facility in these two months and remaining ten months will be characterized with import from energy banking facility. From fiscal year 078/79 to 086/87, there will be surplus energy in each month and export of energy is needed.
3. In "Shift NEA and IPP Plants" scenario, fiscal year 077/78 will have all months with deficit of energy and quantity of deficit will be greater than in "Shift IPP Plants" scenario. All months of this year will need import of energy form energy banking facility. There will be need of export of energy in each month from fiscal year 078/79 to 086/87 but the export amount in respective months will be less than that in "Shift IPP Plants" scenario.

(ii) Growth with Categorization of Consumption Scenario

1. There will be requirement of energy import in Magh, Falgun and Chaitra and export of energy from energy banking facility in remaining nine months of fiscal year 077/78 in "Normal" scenario of generation. There will be surplus energy in each months of fiscal year 078/79 to 082/83 and there should be need of export. There will be months with both the surplus and deficit energy onwards from fiscal

year 083/84 to 086/87 and need of both the export and import through banking facility in this period. There will be deficit of energy in Magh, Falgun, Chaitra and Baisakh in fiscal year 083/84. The deficit energy month will be added by one month i.e. Poush in fiscal year 084/85. Fiscal year 085/86 will experience energy deficit in six months viz.Poush, Magh, Falgun, Chaitra, Baisakh and Jestha and remaining six months will have surplus energy. Silimarly, fiscal year 086/87 will have ten months energy deficit except the month of Ashoj and Kartik.

2. There will be requirement of energy import in all months of fiscal year 077/78 in "Shift IPP Plants" scenario of generation. There will be surplus energy in each months of fiscal year 078/79 to 082/83 and there should be need of export. However, the surplus energy in each month in this period will be less than that in "Normal" scenario of generation. There will be months with both the surplus and deficit energy onwards from fiscal year 083/84 to 086/87 and need of both the export and import through banking facility in this period. There will be deficit of energy in Magh, Falgun, Chaitra and Baisakh in fiscal year 083/84. The deficit energy month will be added by one month i.e. Poush in fiscal year 084/85. Fiscal year 085/86 will experience energy deficit in six months viz.Poush, Magh, Falgun, Chaitra, Baisakh and Jestha and remaining six months will have surplus energy. Silimarly, fiscal year 086/87 will have ten months energy deficit except the month of Ashoj and Kartik. All these deficit and surplus energy are very near to those in the "Normal" scenario.
3. In "Shift NEA and IPP Plants" scenario, energy import from energy banking is needed in all months of fiscal year 077/78. There will be four months (Magh, Falgun, Chaitra, Baisakh), two months (Falgun & Chaitra) and a month (Falgun) with energy deficit in fiscal years 078/79, 079/80 and 080/81 respectively and these fiscal years will need both import as well as export through energy banking. Fisacal year 081/82 will have all months with surplus energy and energy export is needed. There will be energy deficit in only Falgun of fiscal year 082/83. Fiscal year 083/84 will have energy deficit from Magh to Baisakh and additional deficit of energy in Poush will be experienced in 084/85. There will be energy deficit in six months (Poush – Jestha) and energy surplus in remaining six months in fiscal year 085/86. The energy deficit and surplus for fiscal year 086/87 will be same as that in the "Shift IPP Plants" scenario.

(iii) Intervention with Induction Chulo Senario

1. In “Normal” scenario of generation, there will be deficit of energy in four months viz. Magh, Falgun, Chaitra and Baisakh in fiscal year 077/78 and there will be surplus energy in each month from fiscal year 078/79 to 080/81. There will be deficit of energy only in the month of Falgun in fiscal year 081/82. There will be both import as well as export through energy banking from fiscal year 082/83 to 086/87 as these fiscal year will be characterized with months with surplus and deficit energy. There will be deficit of energy from Magh to Baisakh in fiscal year 082/83. An additional deficit of energy will be experienced in the month of Poush as well in fiscal year 083/84 in comparison to that of fiscal year 082/83. Similarly, there will be deficit of energy in six months i.e. Poush to Jestha in fiscal year fiscal year 084/85. There will be only two months viz.Ashoj and Kartik with surplus energy in fiscal year 085/86. There will be need of import of energy in all months of fiscal year 086/87 as these months will experience deficit of energy.
2. There will be deficit of energy in all months of fiscal year 077/78 in “Shift IPP Plants” scenario and deficit of energy in four months i.e. from Magh to Baisakh will be experienced from fiscal year 078/79 to 080/81. Similarly, the month of Magh, Falgun and Chaitra will experience deficit of energy and remaining nine months with surplus energy for fiscal year 081/82. There will be deficit of energy in four months (Magh to Baisakh), five months (Poush to Baisakh) and six months (Poush to Jestha) in fiscal years 082/83, 083/84 and 084/85 respectively. The fiscal year 085/86 will have only two months viz. Ashoj and Kartik with surplus energy and there will be no surplus energy in any month of fiscal year 086/87. The deficit of energy in each month of this fiscal year are comparable to that in the case of “Normal” scenario of generation.
3. In “Shift NEA and IPP Plants” the fiscal years 077/78 and 086/87 will experience deficit of energy and needs import for energy balancing. Three fiscal years 078/79, 079/80 and 083/84 will have deficit of energy from Poush to Baisakh i.e. five months period and these deficit amount will go on increasing form initial year to later years. The years 080/81 and 082/83 are characterzed with deficit of energy from Magh to Baisakh & fiscal year 081/82 will experience deficit for only three months period from Magh to Chaitra. The amount of deficit of energy and surplus

energy of fiscal years 085/86 and 086/87 are same for both "Shift IPP Plants" and "Shift NEA and IPP Plants" scenarios.

(iv) Intervention with Electric Vehicle Scenario

1. The surplus and deficit energy in this intervention are greater and lesser than that of intervention with Induction Chulo intervention. There will be energy deficit around three months i.e. Magh, Falgun and Chaitra in fiscal year 077/78 whereas there will be surplus energy in each month from fiscal year 078/79 to 081/82. There will be deficit of energy in only the month of Falgun in fiscal year 082/83. There will be around four months (Magh to Baisakh), six months (Poush to Jestha) and seven months (Poush to Ashad) in fiscal year 083/84, 084/85 and 085/86 respectively. Similarly, fiscal year 086/87 will experience deficit of energy in ten months and surplus energy in the months of Ashoj and Kartik.
2. In "Shift IPP Plants" scenario, there will be deficit of energy in all months of fiscal year 077/78. There will be deficit of energy only in the month of Falgun from fiscal year 078/79 to 080/81.The monthly surplus and deficit of energy scenario from fiscal year 081/82 to 086/87 are exhibits same nature as that of "Normal" scenario of generations.
3. Fiscal year 077/78 will experience deficit of energy in each month whereas 081/82 will experience surplus of energy in each month throughout the year. There will be deficit of energy in four months (Magh to Baisakh), three months (Magh to Chaitra) and one month (Falgun) in fiscal years 078/79, 079/80 and 080/81 respectively and there is need of both import and export through energy banking facility in these years. Similarly, there will be deficit of energy in two months (Falgun and Chaitra) and four months (Magh to Baisakh) in fiscal years 082/83 and 083/84 respectively.The surplus and deficit energy monthly scenario from fiscal years 084/85 to 086/87 in "Shift NEA and IPP Plants" scenario will be identical to "Shift IPP Plants" scenario.

(v) Combined Intervention with Induction Chulo and Electric Vehicle Scenario

1. In "Normal" scenario of generation, there will be deficit of energy in four months (Magh to Baisakh) in fiscal years 077/78 and 082/83. There will be surplus energy available in each month of fiscal years 078/79 and 080/81. Fiscal year 079/80 will experience deficit of energy in only one month i.e. Falgun and 081/82 will experience deficit of energy for two months period i.e. Falgun and Chaitra. There

will be deficit of energy in six months and surplus energy in six months period in fiscal years 083/84 and 084/85 and hence both import and export will be required through energy banking facility in these years. Fiscal year 085/86 will be available with two surplus energy months i.e. Ashoj and Kartik. There will be no month with surplus energy in fiscal year 086/87.

2. In "Shift IPP Plants" scenario, there will be deficit of energy in each months of fiscal year 077/78. There will be deficit of energy from Magh to Baisakh in each fiscal year from 078/79 to 080/81. Similarly, the deficit will reduced to three months i.e. Magh to Chaitra for fiscal year 081/82.The monthly surplus deficit scenario from fiscal year 082/83 to 086/87 almost similar to as in "Normal" scenario as surplus and deficit months of each fiscal years are same but the surplus energy will be increased and deficit energy will be reduced in comparison to "Normal" scenario.
3. In "Shift NEA and IPP Plants" scenario, fiscal year 077/78 will have more deficit of energy in all months in comparison to "Shift IPP Plants" scenario. There will be deficit of energy for five months (Poush to Baisakh) from fiscal year 078/79 to 080/81 and also in fiscal year 082/83. Fiscal year 081/82 will suffer deficit of energy in only four months period (Magh to Baisakh). Fiscal year 083/84 will suffer deficit and surplus of energy in same months as in "Shift IPP Plants" scenario but with reduced surplus amount and increased deficit energy amount. The fiscal years 084/85, 085/86 and 086/87 will experience identical surplus and deficit energy in same months as in "Shift IPP Plants" scenario.

5.1.2 Conclusions on Planned INPS for Fiscal Year 084/85 based on Load Flow Simulation Results

The followings have been concluded for planned INPS for coming fiscal year 084/85 based on load flow simulation incorporating the saturation of new generation projects with "Shift IPP & NEA Plants" generation scenario and different energy consumption scenarios:

1. When the energy demand is expected to grow at the rate of 8% per annum, the maximum export of energy has been observed for months of Ashoj. The Dhalkebar – Muzzafarupur 400 kV line has been fully used upto its capacity and there has been need of two 400 kV double circuit lines in Butwal – Gorakhpur route to send about 2094 MW power.

2. When the energy demand is expected to grow as per growth rate with categorization of consumption, the maximum import (in the month of Falgun) has been achieved with four import lines viz. Dhalkebar – Muzzafarpur 400 kV line, Tanakpur import, Butwal – Gorakhpur 400 kV line and Kusaha – Katiya 132 kV line.
3. When the energy consumption policy is implemented as intervention with induction chulo or combined intervention of both induction chulo and electric vehicle for maximum import in these scenarios with monthly peak demands of about 5803MW and 6139 MW respectively, six import lines in accordance with cross – border planning have been neede to accommodate the total import peak demand within their loading capacity. These lines are Tanakpur import, Butwal – Gorakhpur 400 kV line, Dhalkebar – Muzzafarpur 400 kV line, Kusaha – Kataiya 132 kV, Parwanipur – Raxaul 132 kV line and Duhabi – Purnea 400 kV lines. However, Amlekhgunj – Kamane – Pathlaiya – Parwanipur – Birgunj – Simara – Amlekhgunj loop and Kulekhani – 1 bus have been provided with additional capacitor banks to compensate for reactive power need.
4. When the export scenario is analyzed with electric vehicle integration policy in the months of Ashoj, only Dhalkebar – Muzzafarpur 400 kV line has been sufficient to accommodate the export demand which is in the range of capacity of this line (i.e. 1200 MW).
5. The transformer of Balaju, Bhaktapur, Chapali, Dhalkebar, Hetauda, Suichatar, Khimti and Parwanipur grids have been found critically overloaded in all scenarios and should be upgraded once the generation projects saturates in INPS.
6. The 66 kV and 132 kV transmission lines of Kathmandu sub – system and Amlekhgunj – Kamane – Pathlaiya – Parwanipur – Birgunj – Simara – Amlekhgunj sub – sytem have been found critically overloaded in all scenarios.
7. Almost all 66 kV buses and 132 kV buses have been found to operate with critical bus voltage after generation saturation in planned INPS according to current PPA concluded projects.

5.2 Recommendations

1. The presense of Pondage Run of River (PROR) Plant is not separated from ROR projects in this study as all PROR projects are considered as ROR projects as most of the projects of Nepal are of ROR types. The categorization of hydro projects

into ROR and PROR can be considered for further study. One can analyze the PROR projects and their past operating conditions and also categorize coming projects into ROR and PROR type with their monthly pondage period as well for energy banking from Nepalese perspective.

2. The final delay of one year in completion of projects going to be constructed by IPP and three years in completion of projects going to be consturucted by NEA and its sister organizations are considered by taking all the delaying factors in bulk concept for this study purpose. Similarly, completion of individual transmission line and corridor transmission line project and associated delay can be considered and incorporated for some corridor based generation projects in further study as well.
3. The simulation study has shown that almost all 66 kV and 132 kV buses in planned INPS have been suffered from undervoltage and overvoltage problem once the generation saturates in it. Similarly, there is presence of both healthy and abnormal 220 kV and 400 kV buses as well. One can further extend the given study to reactive compensation study to achieve healthy planned INPS in future incorporating both the strengthening of transmission lines of Kathmandu region and Birgunj region with proper upgradation of aforementioned transformers as well.

REFERENCES

[1]. *Revolt Motors*. (2019, December). Retrieved from https://www.revoltmotors.com/: https://www.revoltmotors.com/rv300,https://www.revoltmotors.com/rv400

[2]. *Electric Vehicle Database*. (2020, December). Retrieved from ev-database.org: https://ev-database.org/compare/electric-vehicle-longest-range#sort:path~type~order=.erange_real~number~desc|range-slider-range:prev~next=0~1200|range-slider-acceleration:prev~next=2~23|range-slider-topspeed:prev~next=110~450|range-slider-battery:prev~nex

[3]. *Mahindra Electric*. (2020). Retrieved from www.mahindraelectric.com: www.mahindraelectric.com/vehicles/e2oPlus/

[4]. Asian Development Bank. (2017). *NEPAL ENERGY SECTOR ASSESSMENT, STRATEGY, AND ROADMAP.* 6 ADB Avenue, Mandaluyong City, 1550 Metro Manila, Philippines: Asian Development Bank.

[5]. Bajracharya, D., & Bhattarai, D. (2016). Road Transportation Energy Demand and Environmental Emission: A Case of Kathmandu Valley. *HYDRO NEPAL (ISSUE NO. 18)*, 11.

[6]. Bhandari, R., & Pandit, S. (2018). Electricity as Cooking Means in Nepal - A modelling Tool Approach. *Sustainibility, MDPI*, 17.

[7]. Central Bureau of Statictics. (2019). *National Planning Commission, Central Bureau of Statictic.* Retrieved October 10, 2019, from www.cbs.gov.np: www.cbs.gov.np

[8]. Department of Transport Management. (2019). *Department of Transport Management, Kathmandu.* Retrieved October 10, 2019, from www.dotm.gov.np: https://www.dotm.gov.np/Files/NoticePDF/Vehicledatatill20762020-01-17_04-54-21-965.pdf

[9]. Global Green Growth Institute. (2018). *A Prefeasibility Study on Deploying Electric Buses in Kathmandu Valley* . Seoul, Korea: Global Green Growth Institute.

[10]. Investment Board of Nepal. (2014). *Energy Demand Projection 2030: A MAED Based Approach.* Kathmandu.

[11]. Japan International Corporation Agency. (2014). *Nationwide Master Plan Study on Stogae - type Hydroelectric Power Development in Nepal.*

[12].Kandel, E. K. (2018, May 04). Retrieved from http://www.wecan.org.np/uploaded/Hydro%20Potential%20of%20Nepal.pdf.

[13]. MARCON. (2016). *ELECTRIC BUS FEASIBILITY STUDY.* MARCON.

[14]. MoE. (2017). *Electricity Demand Forecast Report(2015-2040).* Water and Energy Commission Secreteriat, Government of Nepal.

[15]. MoEN. (2018). *Present Condition and Future Roadmap of Energy, Water Resources and Irrigation Sectors.* Ministry of Energy, Water Resources and Irrigation, Government of Nepal.

[16]. MoEWRI. (2019, Jan 23). *Minutes of Joint Working Group (JWG) Meeting on Nepal - India Cooperation in Power Sector.* Retrieved from Government of Nepal, Ministry of Energy, Water Resources and Irrigation: http://www.moewri.gov.np/en

[17]. Nepal Electricity Authority. (2015). *Final Transmission Master Plan R-7.* Kathmandu: Nepal Electricity Authority.

[18]. Nepal Electricity Authority. (2015). *Load Forecast Report.* Kathmandu: Nepal Electricity Authority.

[19]. Nepal Electricity Authority. (2019). *A YEAR IN REVIEW - FISCAL YEAR 2018/2019.* Kathmandu: NepalElectricity Authority.

[20]. Nepal Oil Corporation. (2020). *Nepal Oil Corporation*. Retrieved March 13, 2020, from www.noc.org.np: www.noc.org.np/import

[21]. Power System Operation Corporation Limited. (2016). *Electricity Demand Pattern Analysis Volume - I.* New Delhi: POSOCO.

[22]. Puri, B. (2018). *A scenario Analysis of Reactive Power Flow in Integrated Nepal Power System for 10th Year Planned Generation, Transmission and Load.*

[23]. RPGCL. (2018). *Transmission System Development Plan of Nepal.* Rastriya Prasaran Grid Company Limited.

[24]. Sarmad , R. Z., & Albrecht, J. (2020). Prospects of Electric Vehicles in Developing Countries:A Literature Review. *Sustainability*, 19.

[25]. SARI/EI Task Force-2. (2016). *(Assessment of the Electricity Trading Potential in the South.* IRADe

APPENDICES

Appendix - A: Monthly Energy Generations Of NEA Operated ROR Hydropower Projects

1. Monthly Energy Generation (MWh) of Kaligandaki – A Hydropower Project

FY/MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangsir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
066/67	79908	77250.34	80453	73534	74330	51276	38365	36379	44849	52543	75813	69020.1
067/68	53322	87849.23	82754	76309	72236	65989	40701	38377	38774.22	52763	85700	93294
068/69	97246	95151	89481	85971	76340	53254	23778.3	38628.3	46979	52625	93203	90846
069/70	89658	97869	90341	82537	64872	45964	42002	33124	44129	63313	90378	94378
070/71	98236	96168	91030	90167.11	76445	54678	43803	39834	41104.8	53606	84171	97815
071/72	92888	94818	93840	89757	79806	63975	47625	50204	54446	60928	96732	94329
072/73	96662	93090	93241	87744	62800	45192	39555	36403	44056	60928	66985	68014
073/74	60206	89688	90504	90989	80126	53706	42031	39194	51122	60930	88405	96108
074/75	101934	101928	102768	92310	65176	48676	41111	36975	38915	50174	84642	104179
075/76	97837	97987	75650	67824	63725	48224	43677	44830	54340	91441	101717	99201

2. Monthly Energy Generation (MWh) of Middle Marsyangdi Hydropower Project

FY/MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangsir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
066/67	38089.45	40565.64	34085.09	37717.03	36881.46	26207.8	21379	18987	23862.2	32218.7	41167.79	38952
067/68	38837.1	34919.4	38295.4	38056.9	19613.61	27559.2	20940.1	19778.2	20831.4	28730.8	44814.87	43601.3
068/69	43057.2	46378.1	42883.85	45997.94	36898.2	27596.15	11167.88	22226.6	26132.2	31158.5	48522.26	44918.1
069/70	46075.19	45379.02	43397.02	41390.23	33556.14	24267.68	21573.86	21007.25	22738.41	33224.83	46612.15	46468.19
070/71	47436.35	43101.11	43464.55	44204.7	37731.77	28723.43	22539.82	20779.55	22066.22	30090.51	47470.96	48747.25
071/72	47219.8	48324.33	47179.72	47231.25	37349.3	30517.11	11838.72	23631.85	26455.01	32740.27	47694.8	50325
072/73	51717.01	49829.06	49695.87	44633.17	32917.45	25080	20686.74	19244.04	22017	32740.27	43549.63	49757.85
073/74	48932.38	49469.13	46942.38	47559.7	38548.25	27121.48	21284.83	20665.42	27627.26	32371.08	43833.28	49800.1
074/75	51183.28	50881.27	50314.74	44467.4	31968.77	24708.09	20099.48	14860.38	20346.5	27266.25	48613.38	54416.17
075/76	50759.31	49428.16	51527.68	44704.2	32082.3	24431.73	21089	23237.12	28292.7	49958.98	51147.21	48467.93

3. Monthly Energy Generation (MWh) of Marsyangdi Hydropower Project

FY/MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangsir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
066/67	37695.4	39339.3	39009.81	37150.3	39226.51	28521.7	23177.3	21406.1	24466.9	34228.5	41190.17	38850.3
067/68	38360.1	42228.3	41359.5	40607.2	39828.5	30600.3	23660	22755.7	21893.4	29347	46447.14	45385
068/69	45668.7	45603.1	37489.4	44564.46	34683	31714.7	15516.6	24526.7	26428.8	32558.2	48619.1	46720.56
069/70	48106.7	45602.8	45210.6	45619.9	38134.2	27756.7	24507.1	23506.57	23854.9	34362.73	46631.1	46186.4
070/71	61319.15	47357.8	47394.3	46238.3	42266.12	32649.99	25951.4	23348.63	24024.3	30313.8	46217.25	50190.1
071/72	45934.4	46659.27	36827.6	48993.8	41677.5	35540.8	26605.8	26809.3	29409	30725	49584.66	47863.1
072/73	48826.47	46974.5	47612.6	45791.7	36959.76	28660.4	23531.4	21779.4	22821.7	30725.6	45032.5	46102.5
073/74	46750.4	46225.1	46015.9	47621.7	43117.6	30838.2	24926	22961.17	31122	34827	44950.8	45850.3
074/75	45330.1	45987.9	48568	46168.5	35988.5	28317.7	23420.8	21454.8	23329.6	31968.8	50012.7	48746.6
075/76	45197.2	44448.51	48936.5	46863.2	36038.3	27926.5	25280.5	24821.5	30413.33	47422.2	52096.78	43832.6

4. Monthly Energy Generation (MWh) of Trishuli Hydropower Project

FY/MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangsir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
066/67	12614	11529.1	12206.5	11646.3	11912.57	11116.65	8664.1	8032.7	9639.7	10974.7	12767.9	12859.12
067/68	13831.6	12741.7	12016.1	10132.4	10586.9	10424.8	8562.5	7745.6	7456.1	9352.8	13428.6	12669
068/69	12250.2	11934.2	11840.3	13360	12618.4	11282.47	5108.6	8653	10258.1	11030.6	12732.7	10162.23
069/70	9557	9833	10876.07	11865.93	12017.6	9712.2	8416.5	8262.3	9759.1	11825.1	11370.2	11244.2
070/71	10313.1	9118.29	9829.3	9918.9	9716.16	9737.9	8010.9	7162	7402	9413	13293	10856.11
071/72	10471.55	10963.77	11985	12209.7	11671.6	11234	8702.2	9375.3	10898.3	4084.8	12150.9	10946.9
072/73	12799.8	11496.2	11796.1	12136.8	11766.5	10906.3	8855.4	8064.7	8351.8	4084.8	9248.4	10084.6
073/74	10410.9	10159.5	10321.6	11331	11516.5	10939.5	9568.37	9163.2	9007.67	11224.8	11481.3	10810.4
074/75	10956.5	9649	10677.3	12026.7	11331.5	9556.3	8501.51	8422.2	8761.93	9869.9	10781.7	10783.4
075/76	8739.61	11158.7	10447.3	10371.14	11178.7	9575.02	10080.56	403.6	9521	9042.1	11489.6	11382.8

5. Monthly Energy Generation (MWh) of Gandak Hydropower Project

FY/MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangsir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
066/67	2501.8	895.8	1125.5	595.3	976.8	1821.4	1132.9	1931.85	755.6	147.8	802.8	1346.3
067/68	2006.26	1285.1	1859.2	1011	0	1493.9	1563.3	896	491.9	0	0	430
068/69	2061.32	2536.7	2550.3	177.6	0	0	504.818	2856.6	926.4	0	0	392.4
069/70	2083.54	2547.9	3443.3	773.8	0	1688.1	2013.3	1348.1	997.7	0	1727.1	2476.2
070/71	1440.6	2382.2	2638.5	92.2	0	1089.5	970.1	624.4	490.48	96.9	29.7	0
071/72	0	0	0	0	0	0	0	510.7	0	0	0	1284.31
072/73	1887.5	2063.9	2398.3	570.2	0	2209.1	2376.7	2442.7	941.1	0	0	1287.1
073/74	943.1	1747.96	1926.3	28.5	927.7	3094.8	3015.1	2994.5	1254	0	1635.75	3416.2
074/75	3371.5	0	1927.9	870.5	0	1968.32	2631.9	3007.7	886.2	0	54.5	2262
075/76	1890.2	1636.5	1662.96	195.2	0	1616.3	844.99	70.07	707.5	0	479.5	1111.81

6. Monthly Energy Generation (MWh) of Modi Hydropower Project

FY/MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangsir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
066/67	5085.47	3610.56	4228	4973.6	4813.4	3597.4	2475.84	2429.3	3707.56	4316.4	4760.66	4353.9
067/68	3151.74	4330.3	8842.5	7433.26	4924.36	3868.26	2612.4	2033.5	2923.66	4475.86	6428.61	5950.46
068/69	3013.76	4081.8	2257	3312	2968.76	2552.1	1339.4	2279.1	3301.66	4487.6	3309.7	814
069/70	682.96	1938.6	3989.3	3612.86	2484.83	2057.26	1932.1	1840	2641.9	3007.7	3438.66	2555.3
070/71	3065.34	4762.8	4490.49	2641.3	3134.87	3537.56	2608.07	2780.1	3182.6	3963.26	5179.46	3389.84
071/72	2357.97	5560.5	6195.4	8281.96	5733.6	4430.26	3360.14	3418.9	3909	2305.2	5840.84	5859.16
072/73	4539.9	6909.66	8385.21	7294	5236.9	3890.26	3079.6	2731.3	3460	2305.2	7162.1	5294.24
073/74	4242.08	6606.5	8187.38	9022.08	6664.2	4508.32	3128.41	2952.1	4006.11	5477.3	7891	5913.1
074/75	7055.77	7352.96	10173.2	7536.6	4831.9	3607.9	2849.9	1355	794.7	3656.5	5678.3	6846.26
075/76	6021.66	7051.06	9947.53	6801.26	4738.9	3343.1	2656.72	2630.4	3646.96	6717.35	8131.76	7114.6

7. Monthly Energy Generation (MWh) of Devighat Hydropower Project

FY/MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangsir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
066/67	8117.25	6822.14	8496.74	8070.47	8593.35	7416.51	5807.39	5964.54	6744.28	7938.12	7872	8459.73
067/68	7414.15	7859.65	5873.4	0	5282.92	6195.96	6467.98	5933.61	6251.5	6196.62	6430.51	7369.43
068/69	9416.11	8338.54	9111.01	10180.66	9587.43	7240.13	4312.22	7264.76	8443.76	8988.31	9594.39	7846.06
069/70	7354.61	7477.56	8422.62	8194.8	10004.55	8549.09	7504.4	7470.31	8247.02	9247.04	8965.29	8649.85
070/71	8003.81	7680.56	8309.16	9077.2	8885.33	8956.69	9573.95	6561.18	6307.18	7810.33	8327.69	8275.71
071/72	7782.36	8735.77	9209.25	9251.27	9322.86	9276.21	7337.36	7684.29	9081.98	3215.71	7862.68	8449.1
072/73	9033.26	6914.42	6602.85	8939.6	8891.96	8994.86	7589.12	6948.52	7157.79	3215.71	7330.92	7535.29
073/74	7837.84	8092.38	7707.52	8613.44	8966.07	8679.58	7640.63	7007.29	6466.89	8246.34	8330.65	8138.78
074/75	7935.32	6712	8022.5	8811.54	8431.58	7039.53	6155.59	5203.94	6288.87	6254.12	6764.59	5327.68
075/76	5854.32	7415.5	6844.66	7841.9	6263.14	7136.13	7135.21	7053.69	7036.57	6204.44	8302.12	7922.24

8. Monthly Energy Generation (MWh) of Sunkoshi Hydropower Project

FY/MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangsir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
066/67	6707.8	6823.9	6784.3	6512.6	5231.5	3764.3	2956.1	2586.5	2716.5	2804.5	4284.7	5986.8
067/68	6500.2	6500.7	6698.6	6820.14	5245.5	3789.3	3160.7	2889.1	2763.35	3433.6	6966	6885.4
068/69	7213.2	6965.4	7150.6	7150.8	5715.6	4390.8	1849.2	3297.51	3704.9	3744.4	6335.21	7147.7
069/70	7131.3	7193.9	7151.2	7063.2	5097.5	3633.7	3148.3	3211.6	3338.2	5700.7	6632.2	5496.1
070/71	7049.4	6752.3	6683.11	6915	6298.02	4629.5	3512.8	3120.81	3355.16	3879.6	6164.9	6781
071/72	2943.6	483.1	0	0	3185.36	4326.86	3215.9	3170.81	3617.8	1539.7	0	0
072/73	2357	1653.8	2127.1	4766.5	4712.2	4272.4	3617.58	3193.26	2784.6	1539.7	1736	1379.7
073/74	8.6	2620.3	3118.53	6590.71	5727.7	3369.99	3318.02	2170.53	2590.27	3492.8	4593.9	3471.4
074/75	5117.7	4270.11	5829.1	5940.8	3279.9	3657.1	3092.1	3137.3	2242.9	2869.4	4495.4	5675.6
075/76	4199.4	5147.2	6451.18	6870.6	5314.6	3576.7	3260.2	3211.51	3566	6015.6	6688.9	6280.38

9. Monthly Energy Generation (MWh) of Puwa Khola Hydropower Project

FY/MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangsir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
066/67	3698.53	3387.11	4880.05	3697.23	2817.57	2070.33	1284.71	914.82	916.08	1327.68	1522.87	3499.14
067/68	3689.05	3527.08	3166.6	3694.9	1957.39	1887.9	1481.47	1005.97	1178.69	1965.41	2703.02	2895.17
068/69	3016.25	3525	3861.08	4196.44	2761.06	1621.49	829.65	989.8	1161.9	1074.23	1210.68	2305.64
069/70	4010.2	2576.23	3751.09	3372.501	2314.223	1523.45	1001.87	938.37	731.8	1783.25	2890.464	3543.738
070/71	4016.62	3341.265	3556.315	4143.968	2653.449	1935.966	1095.021	951.542	955.67	667.841	1301.707	3179.945
071/72	3363.55	3848.24	4043.28	4859.9	2544.6	1844.71	1438.38	1452.26	1208.94	1667.21	2013.66	2881.65
072/73	4097.5	3981.33	4178.6	4289.03	2700.38	2015.19	1701.45	1344.06	1281.01	1667.21	2697.12	4020.31
073/74	4454.13	4259.52	3787.42	4108.2	3407.82	2098.64	1449.16	1288.58	1701.26	3492.8	1854.23	3160.92
074/75	3364.03	3214.63	3044.25	2791.58	2043.08	1642.01	1188.98	1249.57	1129.05	2056.65	2553.851	3823.15
075/76	3947.77	3716.93	3918.34	3219.128	2189.61	1734.62	1317.366	1593.748	1295.64	1970.85	2413.61	2314.94

10. Monthly Energy Generation (MWh) of Chameliya Hydropower Project

FY/MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangsir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
074/75							6053.05	4839.03	6822.32	12669	12163.6	13141.26
075/76	9675.41	13407.2	21005.22	15770.6	10764.44	8576.56	6635.18	7887.41	12438.27	18363.49	17463.6	18913.12

Appendix - B: Monthly Energy Generations Of Storage Hydropower Projects

1. Monthly Energy Generation (MWh) of Kulekhani (I) Hydropower Project

FY/MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangsir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
066/67	4492	4641	5209	4625	6793	12672	9851	9951.5	10533.8	6798	5552	5866
067/68	9639	3018	4318.33	4141	5705	9781	12403	12528	16860	8016.73	6804.8	5651
068/69	7777	7668	13971	8070	7159	8651	5012	25971	25171	17192	4015	3767
069/70	5142	1749	462	1148	3958	8608	8281	15507	27394	10459	3613	6370
070/71	9615	3767	521	3000	4051	4539	9733	16711	15278	20471	5979	474
071/72	39	9	79	3177	3645	3732	9481	5494	9797	20800	22677	7243
072/73	626	171	221	723	297	5776	16038.57	9500	13184	20800	2844	3604
073/74	3946	576	236	723	918	6253	10773	13289	14234	13126	5978	3109
074/75	860	297	181	225	211	4345	5283	14322	12727	12669	6468	4573
075/76	4488	2894	2209	1349.85	2249	5878	5417	112.92	12936	20932	16616	13069

2. Monthly Energy Generation (MWh) of Kulekhani (II) Hydropower Project

FY/MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangsir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
066/67	2078	2141.66	2381.76	2185.29	3500.64	6537.84	4754.66	5041.18	5481.98	3471.96	2852.28	2642.3
067/68	4926.66	1478.04	2018.2	1892.11	3042.98	5113.01	6541	6565.7	8703.21	4144.24	3346.04	2727.19
068/69	3769.66	3559.85	6575.13	3765.22	3706.71	4499.95	2562.21	13196.17	12471.11	8913.67	2045.04	1894.26
069/70	2466.7	762.56	210.5	585.18	1948.4	4408.91	4212.37	7707.02	13636.35	1127.61	844.15	2120.33
070/71	4265.01	1686.17	228.84	1410.73	2004.29	2187.34	5074.59	8626	7659.03	10162.28	3057.42	235.87
071/72	18.9	0	25.58	1613.06	1942.35	2053.87	6614.14	2742.31	4744.73	16494.23	11188.16	3512.47
072/73	300.25	80.53	75.51	356.72	167.92	2980.03	8214.28	4847.48	6607.4	16494.23	1382.49	1720.97
073/74	1768.98	296.41	257.92	442.15	619.91	3176.09	5249.79	6573.28	7112.29	6770.2	3237.1	1643.38
074/75	526.5	176.5	231.3	266.3	281.1	2350.2	2727.4	7052.2	6453.2	6367.88	3062.27	2224.5
075/76	2094	1369.87	1054.3	701.1	1156.3	3031.2	2809.5	1359.9	6160	10042.5	8124.4	6547.8

Appendix - C: Monthly Energy Generations Of IPP Operated ROR Hydropower Projects

1. Monthly Energy Generation (MWh) of Khimti Hydropower Project

FY/MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangsir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
066/67	40432.04	43297.56	41627.19	39013.91	33352.08	25444.85	19338.77	16665.05	15104.44	18961.81	20027.61	41142.62
067/68	42176.65	41976.9	41876.03	38440.77	46866.59	26674.53	19950.6	18442.63	16050.54	21207.69	28973.34	43459.51
068/69	43116.86	41948.73	40880.08	40590.61	37241.85	27244.41	12800.25	17397.68	17603.91	16725.39	21357.01	40246.39
069/70	43341.93	42666.02	41099.02	42250.73	31463.22	23135.37	18884.2	17797.94	16154.87	18780.07	38149.84	43036.63
070/71	43126.63	42217.63	42478.02	42348.83	40213.18	29252.43	20633.25	18989.3	16999.19	16095.84	22284.83	42958.47
071/72	43160.72	56450.66	43787.52	42874.86	36354.27	28192.39	21089.32	20315.27	19393.21	24339.4	42123.28	42161.09
072/73	42384.27	42835.29	37909.54	40754.33	31247.9	24697.97	20305.58	17948.7	15339.55	23439.4	25690.44	42962.41
073/74	44149.92	43645.23	41826.62	43209.27	40455.18	29426.31	23152.66	17989.91	21483.41	19801.59	30482.53	39944.28
074/75	35367.63	37161.53	50657.73	42300.62	33717.62	24029.69	20065.43	17805.14	16658.17	18585.7	31374.5	44105.7
075/76	40784.3	43535.97	43493.39	41286.06	30468.76	23605.83	19727.66	17795.99	18422.91	24628.21	26886.28	41860.62

2. Monthly Energy Generation (MWh) of Chilime Hydropower Project

FY/MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangsir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
066/67	11260	11288	14073	14364	11089	8342	6251.4	6352.5	7765.5	9643	11723	14958.7
067/68	14427	15781	16250	15125	12227	8678	6654	5683	7417	12109	16073	16256
068/69	15968	16203	15708.8	15441	14337	9529.7	4303	6603	10407	12674	16944	14682
069/70	15884	16097	15817	14990.2	11478.55	8063	7131	7571.93	9838	14085	15768	16465
070/71	15952	16123	15949.8	16497	13673	9414	7218	6620	7967.6	10333	15343	16694
071/72	16207	13833	13284	16006	13126	10169	7663	7991.3	11500	5039	15612	16469
072/73	16371	15696	15960	15757	13778	9936	8022	7538	9679	11467	15278	14302
073/74	15441	15532	14694	14938.85	14996	10620	7451	7483	11783.9	13119.41	14707	16374
074/75	16185	15678	14889	13770	10553	8375	6979	5767	6986	10760	13115	15422.9
075/76	14529	16299	16622	15046	11507	7990	6566.42	7075	10864	15283	15717	15425

3. Monthly Energy Generation (MWh) of Indrawati Hydropower Project

FY/MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangsir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
066/67	4186.37	4354.51	4682.73	4167.26	3861.5	2790.12	2121.18	1757.25	1707.5	1966.21	2342.54	4760.74
067/68	5008.35	4581.6	3230.11	4371.29	3797.421	2932	2279.84	1871.78	1548.24	1832.94	2997.977	4498.7
068/69	4037.15	4578.12	4140.63	4845.175	3580.88	3066.32	1284.76	1827.69	2016.49	2017.57	1582.38	4586.2
069/70	4686.461	4405.25	4086.797	4352.09	4111.38	2620.63	1759.48	2048.75	1855.93	2400.71	3324.35	4070.55
070/71	4428.81	4295.76	4282.42	3847.47	3579.68	2961.356	1723.58	1920.32	1460.84	1639.307	2136.1	2490.665
071/72	4279.01	2284.68	4577.3	4172.02	3661.31	2991.03	1977.06	1701.73	2195.65	2121.01	3635.02	3339.47
072/73	3576.94	4100.09	3797.31	3720.47	2979.75	2637.28	2118.46	1897.77	1655.57	2246.05	1909.42	2315.98
073/74	2868.97	3813.4	3227.85	4014.208	3862.65	2835.47	2102.76	1822.6	1428.63	2011.55	2003.963	2525.22
074/75	2304.56	3151.28	3054.2	2132.46	2247.14	2058.03	1769.53	1564.08	1004.9	1481.74	2246.44	3293.02
075/76	4141.15	3763.3	4082.05	3463.34	3493.31	2363.43	1950.87	1485.73	1842.72	2056.52	2216.12	3190.08

4. Monthly Energy Generation (MWh) of Jhimruk Hydropower Project

FY/MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangsir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
066/67	2090.469	3812.809	7380.448	8103.175	7565.459	6584.773	4452.478	4150.654	3242.114	1705.908	832.47	4659.67
067/68	6853.332	4087.916	8322.498	7353.946	7979.817	7381.615	5584.688	4643.73	3880.981	2696.421	1476.328	3661.926
068/69	5150.74	4524.903	8028.941	8584.085	8277.924	7558.531	3741.571	4575.648	4093.939	1730.295	1119.41	4708.31
069/70	5406.158	5201.526	8359.326	8742.113	8153.055	4990.164	5639.765	5292.215	3509.593	2595.905	5343.988	4145.173
070/71	4772.267	5812.56	8442.747	8899.664	8405.986	7888.556	6623.319	6203.146	4362.91	2191.875	1454.204	4949.078
071/72	4398.66	7082.44	8034.24	8565.9	7974.91	8514.24	6566.88	6030.61	5168.16	3369.68	2366.27	6050.3
072/73	5568.9	6190.58	8034.31	8442.93	8074.17	6493.2	5198.09	4513.41	3650.52	3369.38	4162.9	6327.2
073/74	3795.05	5130.97	7105.06	8935.73	8865.65	6960.41	5740.01	5279.778	4400.83	2979.51	2961.591	2403.89
074/75	4874.37	4823.14	6074.05	8418.24	6651.98	6320.48	5330.56	3384.22	3430.95	2446.7	2650.771	4733.288
075/76	4888.38	5986.9	8202.08	8291.625	7173.32	6294.917	4629.038	6124.853	3344.608	2671.317	1972.258	4330.277

5. Monthly Energy Generation (MWh) of Aandhikhola Hydropower Project

FY/MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangsir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
066/67												
067/68												
068/69												
069/70												
070/71												
071/72												
072/73	0	6919.38	6921	6392.98	5840.78	4677.26	3788.74	3028.3	2139.82	4504.23	6899.38	6969.86
073/74	6854.82	6945.06	6885.94	6917.01	6553.24	5350.33	4369.48	3540.67	3444.67	4098.65	6641.98	6425.25
074/75	6768.5	7151.92	6855.31	6512.16	6044.16	4506.12	3495.12	2947.9	2592.6	3045.52	6366.08	6595.96
075/76	6118.53	5777.4	6475.14	6719.28	5828.82	3902.51	4240.012	4129.74	2760.74	5258.28	6971.24	7036.99

6. Monthly Energy Generation (MWh) of Lower Modi Hydropower Project

FY/MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangsir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
066/67												
067/68												
068/69												
069/70									2199.08	3333.06	5592.06	5523.17
070/71	6011.79	6612.194	6949.794	6180.86	3830.13	2755.756	2069.911	1683.516	1613.94	2903.82	4840.77	5585.34
071/72	5489.54	3738	6646.71	6338.82	4231.14	3082.71	2330.62	2221.73	1232.44	2600.4	5373.42	3872.78
072/73	1735.88	0	0	0	242.02	2156.22	2149.57	1824.54	1285.23	2685.4	3498.6	3943.98
073/74	4708.18	4536.37	3517.03	4942.32	4341.98	2988.7	1427.17	1392.796	1321.42	2812.52	1882.76	3920.34
074/75	2851.18	2847.12	3213.78	3889.79	2261.21	1927.92	1640.3	1257.5	1218.21	1725.2	2987.9	4215.1
075/76	4881.36	5407.76	5231.94	3025.52	2638.87	2358.68	1854.48	1205.88	1440.165	2737.44	3282.14	4084.81

7. Monthly Energy Generation (MWh) of Bijaypur (I) Hydropower Project

FY/MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangsir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
066/67												
067/68												
068/69												
069/70			2587.29	2703.753	2505.79	2354.614	2177.76	2094.56	1766.068	1458.95	1700.96	3100.93
070/71	3255.25	3126.53	2364.26	3206.337	2554.141	2508.55	2230.2	1995.791	1574.06	1528.536	1273.32	2292.39
071/72	2951.72	3064.54	2877.82	2109.79	955.55	403.77	0	166.82	1193.6	658.27	972.79	2113.34
072/73	3064.57	3274.28	2974.03	2606.51	2156.25	2292.62	2122.68	1949.92	1601.85	1728.16	1376.78	2661.88
073/74	2256.64	1588.96	1830.88	1874.43	1496.89	1464.57	1322.66	1139.755	1278.39	198.52	0	1553.03
074/75	2643.74	1986.76	2437.08	1815.83	1381.568	699.695	1097.27	1684.52	1135.5	128.82	73.44	525.65
075/76	1808.04	2569.23	2625.1	2158.67	1725.36	1729.95	1079.55	564.48	234.26	123.52	0	1194.7

8. Monthly Energy Generation (MWh) of Sanima Mai Hydropower Project

FY/MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangsir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
066/67												
067/68												
068/69												
069/70												
070/71												
071/72										3110.01	4324.19	2251.89
072/73	2690.21	2187.95	5851.96	10891.88	6323.52	4897.62	3956.32	3073.33	2425.1	3293.08	6902.33	14489.22
073/74	16434.92	16424.29	15099.31	15889.12	9349.65	5687.24	3998.53	3319.988	4069.2	3442.08	6761.21	14393.61
074/75	13394.01	9942.109	14507.04	12028.21	6353.56	4674.72	3081.89	2843.59	2911.03	5886.363	11786.99	14419.88
075/76	16433.62	15132.87	15332.07	9563.178	5140.77	4248.89	2688.288	3691.276	3573.127	5393.249	5961.831	9375.214

9. Monthly Energy Generation (MWh) of Sipring Khola Hydropower Project

FY/MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangsir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
066/67												
067/68												
068/69												
069/70												
070/71	3491.952	2645.695	2593.351	3228.337	2480.424	1338.332	890.615	672.17	350.55	476.022	1663.476	6260.869
071/72	3882.775	6708.81	5880.81	4179.21	1952.458	1103.86	875.06	795.5	1323.53	785.61	0	0
072/73	0	9.07	0	0	0	0	0	0	0	688.42	1321.21	3852.09
073/74	4158.67	3805.81	1707.42	4278.648	2560.23	1338.09	1115.59	840.867	1292.29	1074.07	2681.95	5128.85
074/75	6332.92	4184.529	4634.92	3449.12	480.958	0	0	641.44	775.07	782.138	2670.252	5068.416
075/76	4099.19	5518.87	4764.32	2582.871	1460.57	1073.18	347.967	513.907	551.17	1245.58	1831.177	3745.225

10. Monthly Energy Generation (MWh) of Mai Khola Hydropower Project

FY/MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangsir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
066/67												
067/68												
068/69												
069/70												
070/71												
071/72												
072/73	1428.98	2307.87	2629.13	2110.09	1563.36	1062.96	913.95	793.02	576.63	1044.46	1423.86	2404.69
073/74	2547.59	2530.02	2147	2432.327	1455.97	1071.56	621	654.02	847.52	729.82	992.92	2202.1
074/75	1893.9	2231.2	1825.108	2319.68	1289.934	961.686	622.27	557.76	519.01	945.12	1728.14	2328.4
075/76	2323.89	2366.85	2150.42	1983.778	1135.64	914.77	662.812	642	629.156	1117.72	1110.08	2377.48

11. Monthly Energy Generation (MWh) of Khudi Hydropower Project

FY/MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangsir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
066/67												
067/68												
068/69												
069/70									1131.94	1354.41	1720.348	2527.013
070/71	2487.44	2608.97	2634.834	2484.845	2023.95	1336.07	724.88	341.95	40.3	730.14	388.69	1496.47
071/72	2636.27	1235.64	1835.35	2015.67	1235.53	1123.23	381.91	528.09	343.91	736.66	765.57	998.8
072/73	1272.55	522.31	1505.04	2040.3	1904.81	1191.46	803.29	144.44	292.35	728.43	1282.82	937.03
073/74	662.06	1101.72	824.14	1151.13	2076.57	1157.65	728.11	694.58	704.39	1151.21	891.25	500.56
074/75	771.1	743.24	231.47	20.41	25	777.43	0	504.53	239.3	47.06	0	13.08
075/76	0	425.74	104.44	0	1256.1	0	0	0	0	0	0	0

12. Monthly Energy Generation (MWh) of Bhotekoshi Hydropower Project

FY/MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangsir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
066/67	26983.41	26224.99	25190.22	19519.39	16230.96	13732.12	10879.2	8188.382	10316.91	13175.71	13551.79	26941.44
067/68	26359.86	26066.79	25890.57	23756.27	16658.66	12477.82	11475.61	11188.27	10709.91	13639	21484.31	24208.47
068/69	26936.97	24300.64	25158.38	26644.91	19140.02	14455.58	7463.878	12528.36	9245.92	14532.48	23840	27123.11
069/70	29251.87	29976.13	28044.7	23697.83	17028.95	12778.64	10630.51	11596.43	12348.53	18188.78	29566.12	31240.52
070/71	33478.89	32674.05	32834.27	31150.93	20270.15	15451.68	12615.68	11901.11	13115.94	15768.69	25480.12	31858.07
071/72	16633.94	0	0	0	0	0	9567.57	12848.72	15099.67	6570.84	0	0
072/73												
073/74												
074/75												
075/76												

13. Monthly Energy Generation (MWh) of Upper Marsyangdi-A Hydropower Project

FY/MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangsir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
073/74							19575.3	17349.53	26280.19	34167.5	35178.88	33401
074/75	35310.79	35520.2	35688.36	35626.44	32479.23	26308.02	24973.22	18998.42	20793.71	23142.47	35712.1	35363.26
075/76	34908.41	35143.83	35532.52	34329.53	32805.36	23851.97	20356.84	18269.73	17608.55	30966.83	34977.25	34997.38

14. Monthly Energy Generation (MWh) of Upper Madi Hydropower Project

FY/MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangsir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
073/74							6012.92	5732.38	7078.82	9518.52	11194.4	9277.18
074/75	4213.97	11418.82	17779.66	13754.5	8239.888	7181.956	5634.74	5108.02	7737.36	5411.71	10707.86	16628.2
075/76	16020.43	10876.65	17948	11355.61	7209.8	5479.7	5318.48	5629.03	7275.7	7166.52	12918	9018

Appendix - D: Monthly Plant Capacity Factor Of NEA Operated ROR Hydropower Projects

1. Monthly Plant Capacity Factor of Kaligandaki – A Hydropower Project

FY/ MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangsir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
066/67	0.7707175	0.7450842	0.7759741	0.709239	0.7169174	0.4945601	0.3700327	0.3508777	0.4325713	0.506780	0.731221	0.6657
067/68	0.5142939	0.8473112	0.7981674	0.736005	0.6967206	0.6364679	0.3925636	0.3701485	0.3739797	0.508902	0.826581	0.8998
068/69	0.9379436	0.9177372	0.8630497	0.829195	0.7363040	0.5136381	0.2293431	0.3725723	0.4531153	0.507571	0.898948	0.8762
069/70	0.8647569	0.9439525	0.8713445	0.796074	0.6256944	0.4433256	0.4051118	0.3194830	0.4256269	0.610657	0.871701	0.9102
070/71	0.9474922	0.9275462	0.8779899	0.869667	0.7373167	0.5273726	0.4224826	0.3842013	0.3964583	0.517033	0.811834	0.9434
071/72	0.8959104	0.9145254	0.9050925	0.865711	0.7697337	0.6170428	0.4593460	0.4842206	0.5251350	0.587654	0.932986	0.9098
072/73	0.9323109	0.8978587	0.8993152	0.846296	0.6057098	0.4358796	0.3815104	0.3511091	0.4249228	0.587654	0.646074	0.6559
073/74	0.5806905	0.8650462	0.8729166	0.877594	0.7728202	0.5179976	0.4053915	0.3780285	0.4930748	0.587673	0.852671	0.9269
074/75	0.9831597	0.9831018	0.9912037	0.890335	0.6286265	0.4694830	0.3965181	0.3566261	0.3753375	0.483931	0.816377	1.0048
075/76	0.9436439	0.9450906	0.7296489	0.654166	0.6146315	0.4651234	0.4212673	0.4323881	0.5241126	0.881954	0.981066	0.9568

2. Monthly Plant Capacity Factor of Middle Marsyangdi Hydropower Project

FY/ MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangsir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
066/67	0.755743	0.8048738	0.6762914	0.748353	0.731775	0.5199960	0.4241865	0.3767261	0.4734563	0.639259	0.816821	0.77285
067/68	0.770577	0.6928452	0.7598293	0.755097	0.3891589	0.5468095	0.4154781	0.3924246	0.4133214	0.570055	0.889183	0.86510
068/69	0.854309	0.9202003	0.8508700	0.912657	0.7321071	0.5475426	0.2215849	0.4410039	0.5184960	0.618224	0.962743	0.89123
069/70	0.914190	0.9003773	0.8610519	0.821234	0.6657964	0.4815015	0.4280527	0.4168105	0.4511589	0.659222	0.924844	0.92198
070/71	0.941197	0.8551807	0.8623918	0.877077	0.7486462	0.5699093	0.4472186	0.4122926	0.4378218	0.597033	0.941884	0.96720
071/72	0.936900	0.9588160	0.9361055	0.937127	0.7410575	0.6054982	0.2348952	0.4688859	0.5249009	0.649608	0.946325	0.99851
072/73	1.026131	0.9886718	0.9860291	0.885578	0.6531240	0.4976190	0.4104511	0.3818261	0.4368452	0.649608	0.864079	0.98725
073/74	0.970880	0.9815303	0.9313964	0.943644	0.7648462	0.5381246	0.4223180	0.4100281	0.5481599	0.642283	0.869707	0.98809
074/75	1.015541	1.0095490	0.9983083	0.882289	0.6343009	0.4902398	0.3987992	0.2948488	0.4037003	0.540997	0.964551	1.07968
075/76	1.007129	0.9807174	1.0223746	0.886988	0.6365535	0.4847565	0.4184325	0.4610539	0.5613630	0.991249	1.014825	0.96166

3. Monthly Plant Capacity Factor of Marsyangdi Hydropower Project

FY/ MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangsir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
066/67	0.7587640	0.7918538	0.7852216	0.7477918	0.789583	0.574108	0.466531	0.430879	0.492489	0.688979	0.829109	0.782010
067/68	0.7721437	0.8500060	0.8325181	0.8173752	0.801700	0.615948	0.476247	0.458045	0.440688	0.590720	0.934926	0.913546
068/69	0.9192572	0.9179367	0.7546175	0.8970301	0.698128	0.638379	0.312330	0.493693	0.531980	0.655358	0.978645	0.940429
069/70	0.9683313	0.9179307	0.9100362	0.9182749	0.767596	0.558709	0.493299	0.473159	0.480171	0.691681	0.938629	0.929677
070/71	1.2342824	0.9532568	0.9539915	0.9307226	0.850767	0.657205	0.522371	0.469980	0.483580	0.610181	0.930298	1.010267
071/72	0.9246054	0.9391962	0.7412962	0.9861876	0.838919	0.715394	0.535543	0.539639	0.591968	0.618458	0.998080	0.963427
072/73	0.9828194	0.9455414	0.9583856	0.9217330	0.743956	0.576900	0.473659	0.438393	0.459374	0.618470	0.906451	0.927989
073/74	0.9410305	0.9304569	0.9262459	0.9585688	0.867906	0.620736	0.501731	0.462181	0.626449	0.701026	0.904806	0.922912
074/75	0.9124416	0.9256823	0.9776167	0.9293176	0.724406	0.570002	0.471433	0.431859	0.469597	0.643494	1.006696	0.981211
075/76	0.9097665	0.8946962	0.9850342	0.9433011	0.725408	0.562127	0.508866	0.499627	0.612184	0.954553	1.048646	0.882298

4. Monthly Plant Capacity Factor of Trishuli Hydropower Project

FY/ MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangsir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
066/67	0.729976	0.667193	0.706394	0.673975	0.689384	0.643324	0.501394	0.46485	0.557853	0.635109	0.738883	0.744162
067/68	0.800439	0.737366	0.695376	0.5863657	0.6126678	0.6032870	0.4955150	0.448240	0.4314872	0.54125	0.7771180	0.7331597
068/69	0.708923	0.690636	0.685202	0.7731481	0.7302314	0.6529207	0.2956365	0.500752	0.5936400	0.6383449	0.7368460	0.5880920
069/70	0.553067	0.569039	0.629402	0.6866857	0.6954629	0.5620486	0.4870659	0.478142	0.5647627	0.6843229	0.6579976	0.6507060
070/71	0.596822	0.527678	0.568825	0.5740104	0.5622777	0.5635358	0.4635937	0.414467	0.4283564	0.5447337	0.7692708	0.6282471
071/72	0.605992	0.634477	0.693576	0.7065798	0.6754398	0.6501157	0.5035995	0.542552	0.6306886	0.2363888	0.7031770	0.6335011
072/73	0.740729	0.665289	0.682644	0.7023611	0.6809317	0.6311516	0.5124652	0.466707	0.4833217	0.2363888	0.5352083	0.5835995
073/74	0.602482	0.587934	0.597314	0.6557291	0.6664641	0.6330729	0.5537251	0.530277	0.5212771	0.6495833	0.6644270	0.6256018
074/75	0.634056	0.558391	0.617899	0.6959895	0.6557581	0.5530266	0.4919855	0.487395	0.5070561	0.5711747	0.6239409	0.6240393
075/76	0.505764	0.645758	0.604589	0.6001817	0.6469155	0.5541099	0.5833657	0.023356	0.5509837	0.5232696	0.6649074	0.6587268

5. Monthly Plant Capacity Factor of Gandak Hydropower Project

FY/ MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangsir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
066/67	0.2316481	0.082944	0.104212	0.055120	0.0904444	0.1686481	0.1048981	0.178875	0.0699629	0.0136851	0.0743333	0.124657
067/68	0.1857648	0.118990	0.172148	0.093611	0	0.1383240	0.14475	0.0829629	0.0455463	0	0	0.039814
068/69	0.1908629	0.234879	0.236138	0.016444	0	0	0.0467424	0.2645	0.0857777	0	0	0.036333
069/70	0.1929203	0.235916	0.318824	0.071648	0	0.1563055	0.1864166	0.1248240	0.0923796	0	0.1599166	0.229277
070/71	0.1333888	0.220574	0.244305	0.008537	0	0.1008796	0.0898240	0.0578148	0.0454148	0.008972	0.00275	0
071/72		0	0	0	0	0	0	0.0472870	0	0	0	0.118917
072/73	0.1747685	0.191101	0.222064	0.052796	0	0.2045463	0.2200648	0.2261759	0.0871388	0	0	0.119175
073/74	0.0873240	0.161848	0.178361	0.002638	0.0858981	0.2865555	0.2791759	0.2772685	0.1161111	0	0.1514583	0.316314
074/75	0.3121759	0	0.178509	0.080601	0	0.1822518	0.2436944	0.2784907	0.0820555	0	0.0050463	0.209444
075/76	0.1750185	0.151527	0.153977	0.018074	0	0.1496574	0.0782398	0.0064879	0.0655092	0	0.0443981	0.102945

6. Monthly Plant Capacity Factor of Modi Hydropower Project

FY/ MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangsir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
066/67	0.477240	0.338828	0.396771	0.466741	0.4517080	0.3375938	0.2323423	0.2279748	0.3479317	0.4050676	0.4467586	0.4085867
067/68	0.295771	0.406372	0.829814	0.697565	0.4621209	0.3630124	0.2451577	0.1908315	0.2743675	0.4200319	0.6032855	0.5584140
068/69	0.282822	0.383051	0.211805	0.310810	0.2785998	0.2394989	0.1256944	0.2138795	0.3098405	0.4211336	0.3105950	0.0763889
069/70	0.064091	0.181925	0.374371	0.339044	0.2331860	0.1930612	0.1813157	0.1726727	0.2479261	0.2822541	0.3226971	0.2397992
070/71	0.287663	0.446959	0.421404	0.247869	0.2941883	0.3319782	0.2447513	0.2608953	0.2986674	0.3719276	0.4860604	0.3181156
071/72	0.221281	0.521818	0.581400	0.777211	0.5380631	0.4157526	0.3153285	0.3208427	0.3668356	0.2163288	0.5481269	0.5498461
072/73	0.426041	0.648429	0.786900	0.684497	0.4914508	0.3650770	0.2890015	0.2563157	0.3246997	0.2163288	0.6721190	0.4968318
073/74	0.398093	0.619979	0.768335	0.846666	0.6253941	0.4230781	0.2935820	0.2770364	0.3759488	0.5140109	0.7405218	0.5549080
074/75	0.662140	0.690030	0.954692	0.707263	0.4534441	0.3385792	0.2674456	0.1271584	0.0745777	0.3431400	0.5328735	0.6424794
075/76	0.565095	0.661698	0.933514	0.638256	0.4447166	0.3137294	0.2493168	0.2468468	0.3422447	0.6303819	0.7631156	0.6676614

7. Monthly Plant Capacity Factor of Devighat Hydropower Project

FY/ MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangsir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
066/67	0.751597	0.631679	0.786735	0.747265	0.7956806	0.6867139	0.5377213	0.5522722	0.6244704	0.7350111	0.7288889	0.7833083
067/68	0.686495	0.727745	0.543833	0.000000	0.4891593	0.5737000	0.5988870	0.5494083	0.5788426	0.5737611	0.5954176	0.6823546
068/69	0.871862	0.772087	0.843612	0.942654	0.8877250	0.6703824	0.3992796	0.6726630	0.7818296	0.8322509	0.8883694	0.7264870
069/70	0.680982	0.692366	0.779872	0.758778	0.9263472	0.7915824	0.6948519	0.6916954	0.7636130	0.8562074	0.8301194	0.8009120
070/71	0.741093	0.711163	0.769366	0.840481	0.8227157	0.8293231	0.8864769	0.6075167	0.5839981	0.7231787	0.7710824	0.7662694
071/72	0.720588	0.808867	0.852708	0.856599	0.8632278	0.8589083	0.6793852	0.7115083	0.8409241	0.2977509	0.7280259	0.7823241
072/73	0.836413	0.640224	0.611375	0.827740	0.8233296	0.8328574	0.7026963	0.6433815	0.6627583	0.2977509	0.6787889	0.6977120
073/74	0.725725	0.749294	0.713659	0.797540	0.8301917	0.8036648	0.7074657	0.6488231	0.5987861	0.7635500	0.7713565	0.7535907
074/75	0.734751	0.621481	0.742824	0.815883	0.7807019	0.6518083	0.5699620	0.4818463	0.5823028	0.5790852	0.6263509	0.4933037
075/76	0.542066	0.686620	0.633764	0.726101	0.5799204	0.6607528	0.6606676	0.6531194	0.6515343	0.5744852	0.7687148	0.7335407

8. Monthly Plant Capacity Factor of Sunkoshi Hydropower Project

FY/ MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangsir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
066/67	0.927004	0.943049	0.937576	0.900028	0.722982	0.520218	0.408527	0.357449	0.375415	0.387576	0.592137	0.827363
067/68	0.898314	0.898383	0.925732	0.942529	0.724917	0.523673	0.436802	0.399268	0.381889	0.474516	0.962687	0.951548
068/69	0.996849	0.962604	0.988198	0.988226	0.789884	0.606799	0.255556	0.455709	0.512009	0.517468	0.875513	0.987797
069/70	0.985531	0.994182	0.988281	0.976119	0.704464	0.502170	0.435088	0.443836	0.461332	0.787825	0.916556	0.759549
070/71	0.974212	0.933154	0.923592	0.955638	0.870373	0.639787	0.485462	0.431289	0.463676	0.536153	0.851976	0.937120
071/72	0.406799	0.066763	0.000000	0.000000	0.440210	0.597963	0.444431	0.438199	0.499972	0.212783	0.000000	0.000000
072/73	0.325732	0.228552	0.293961	0.658720	0.651216	0.590437	0.499942	0.441302	0.384826	0.212783	0.239912	0.190672
073/74	0.001189	0.362120	0.430974	0.910822	0.791556	0.465726	0.458543	0.299963	0.357970	0.482698	0.634867	0.479740
074/75	0.707255	0.590120	0.805569	0.821006	0.453275	0.505404	0.427322	0.433568	0.309964	0.396545	0.621255	0.784356
075/76	0.580348	0.711332	0.891540	0.949502	0.734467	0.494292	0.450553	0.443824	0.492814	0.831343	0.924392	0.867935

9. Monthly Plant Capacity Factor of Puwa Khola Hydropower Project

FY/ MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangsir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
066/67	0.828524	0.758761	1.093201	0.828232	0.6311761	0.4637836	0.2877935	0.2049328	0.2052151	0.2974194	0.3411447	0.7838575
067/68	0.826400	0.790116	0.709363	0.827710	0.4384834	0.4229167	0.3318705	0.2253517	0.2640435	0.4402800	0.6055152	0.6485596
068/69	0.675683	0.789650	0.864937	0.940062	0.6185170	0.3632370	0.1858535	0.2217294	0.2602823	0.2406429	0.2712097	0.5164964
069/70	0.898342	0.577112	0.840297	0.755488	0.5184191	0.3412746	0.2244332	0.2102083	0.1639337	0.3994736	0.6475054	0.7938481
070/71	0.899780	0.748491	0.796665	0.928308	0.5944106	0.4336841	0.2453004	0.2131591	0.2140838	0.1496060	0.2916010	0.7123533
071/72	0.753483	0.862060	0.905752	1.088687	0.5700269	0.4132415	0.3222177	0.3253271	0.2708199	0.3734789	0.4510887	0.6455309
072/73	0.917899	0.891875	0.936066	0.960804	0.6049238	0.4514315	0.3811492	0.3010887	0.2869646	0.3734789	0.6041935	0.9006071
073/74	0.997789	0.954193	0.848436	0.920295	0.7634005	0.4701254	0.3246326	0.2886604	0.3811066	0.7824373	0.4153741	0.7080914
074/75	0.753590	0.720123	0.681955	0.625353	0.4576792	0.3678338	0.2663486	0.2799216	0.2529234	0.4607191	0.5720992	0.8564404
075/76	0.884357	0.832645	0.877764	0.721130	0.4905040	0.3885797	0.2951089	0.3570224	0.2902419	0.4414987	0.5406832	0.5185797

10. Monthly Energy Generation (MWh) of Chameliya Hydropower Project

FY/ MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangsir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
074/75	0	0	0	0	0	0	0.280234	0.224029	0.315848	0.586528	0.56313	0.608392
075/76	0.447935648	0.620704	0.972464	0.73012	0.498354	0.397063	0.307184	0.365158	0.575846	0.850162	0.8085	0.875607

Appendix - E: Monthly Plant Capacity Factor Of Storage Hydropower Projects

1. Monthly Plant Capacity Factor of Kulekhani (I) Hydropower Project

FY/ MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangsir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
066/67	0.103981	0.107431	0.120579	0.107060	0.157245	0.293333	0.228032	0.230359	0.243838	0.157361	0.128519	0.135787
067/68	0.223125	0.069861	0.099961	0.095856	0.132060	0.226412	0.287106	0.290000	0.390278	0.185572	0.157519	0.130810
068/69	0.180023	0.177500	0.323403	0.186806	0.165718	0.200255	0.116019	0.601181	0.582662	0.397963	0.092940	0.087199
069/70	0.119028	0.040486	0.010694	0.026574	0.091620	0.199259	0.191690	0.358958	0.634120	0.242106	0.083634	0.147454
070/71	0.222569	0.087199	0.012060	0.069444	0.093773	0.105069	0.225301	0.386829	0.353657	0.473866	0.138403	0.010972
071/72	0.000903	0.000208	0.001829	0.073542	0.084375	0.086389	0.219468	0.127176	0.226782	0.481481	0.524931	0.167662
072/73	0.014491	0.003958	0.005116	0.016736	0.006875	0.133704	0.371263	0.219907	0.305185	0.481481	0.065833	0.083426
073/74	0.091343	0.013333	0.005463	0.016736	0.021250	0.144745	0.249375	0.307616	0.329491	0.303843	0.138380	0.071968
074/75	0.019907	0.006875	0.004190	0.005208	0.004884	0.100579	0.122292	0.331528	0.294606	0.293264	0.149722	0.105856
075/76	0.103889	0.066991	0.051134	0.031247	0.052060	0.136065	0.125394	0.002614	0.299444	0.484537	0.384630	0.302523

2. Monthly Plant Capacity Factor of Kulekhani (II) Hydropower Project

FY/ MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangsir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
066/67	0.090191	0.092954	0.103375	0.094848	0.151938	0.283760	0.206365	0.218801	0.237933	0.150693	0.123797	0.114683
067/68	0.213831	0.064151	0.087595	0.082123	0.132074	0.221919	0.283898	0.284970	0.377743	0.179872	0.145227	0.118368
068/69	0.163614	0.154507	0.285379	0.163421	0.160882	0.195310	0.111207	0.572750	0.541281	0.386878	0.088760	0.082216
069/70	0.107062	0.033097	0.009136	0.025398	0.084566	0.191359	0.182829	0.334506	0.591855	0.048941	0.036638	0.092028
070/71	0.185113	0.073184	0.009932	0.061230	0.086992	0.094937	0.220251	0.374392	0.332423	0.441071	0.132701	0.010237
071/72	0.000820	0.000000	0.001110	0.070011	0.084303	0.089144	0.287072	0.119024	0.205934	0.715895	0.485597	0.152451
072/73	0.013032	0.003495	0.003277	0.015483	0.007288	0.129342	0.356523	0.210394	0.286780	0.715895	0.060004	0.074695
073/74	0.076779	0.012865	0.011194	0.019191	0.026906	0.137851	0.227855	0.285299	0.308693	0.293845	0.140499	0.071327
074/75	0.022852	0.007661	0.010039	0.011558	0.012201	0.102005	0.118377	0.306085	0.280087	0.276384	0.132911	0.096549
075/76	0.090885	0.059456	0.045760	0.030430	0.050187	0.131563	0.121940	0.059023	0.267361	0.435872	0.352622	0.284193

Appendix - F: Monthly Plant Capacity Factor Of IPP Operated ROR Hydropower Projects

1. Monthly Plant Capacity Factor of Khimti Hydropower Project

FY/ MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangsir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
066/67	0.935926	1.002258	0.963592	0.903099	0.7720389	0.5890012	0.4476567	0.3857650	0.3496398	0.4389308	0.4636021	0.9523755
067/68	0.976311	0.971687	0.969352	0.889832	1.0848748	0.6174660	0.4618194	0.4269127	0.3715403	0.4909188	0.6706792	1.0060072
068/69	0.998075	0.971035	0.946298	0.939597	0.8620799	0.6306576	0.2963021	0.4027241	0.4074979	0.3871618	0.4943752	0.9316294
069/70	1.003285	0.987639	0.951366	0.978026	0.7283153	0.5355410	0.4371343	0.4119894	0.3739553	0.4347238	0.8830981	0.9962183
070/71	0.998301	0.977260	0.983287	0.980297	0.9308606	0.6771396	0.4776215	0.4395671	0.3934998	0.3725889	0.5158525	0.9944090
071/72	0.999090	1.306728	1.013600	0.992473	0.8415340	0.6526016	0.4881787	0.4702609	0.4489169	0.5634120	0.9750759	0.9759512
072/73	0.981117	0.991557	0.877535	0.943387	0.7233310	0.5717123	0.4700366	0.4154792	0.3550822	0.5425787	0.5946861	0.9945002
073/74	1.021988	1.010306	0.968208	1.000214	0.9364625	0.6811646	0.5359412	0.4164331	0.4973012	0.4583701	0.7056141	0.9246361
074/75	0.818695	0.860220	1.172632	0.979181	0.7805005	0.5562428	0.4644775	0.4121560	0.3856058	0.4302245	0.7262616	1.0209653
075/76	0.944081	1.007777	1.006791	0.955695	0.7052954	0.5464313	0.4566588	0.4119442	0.4264563	0.5700975	0.6223676	0.9689958

2. Monthly Plant Capacity Factor of Chilime Hydropower Project

FY/ MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangsir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
066/67	0.707642	0.709401	0.884426	0.902714	0.6968954	0.5242584	0.3928733	0.3992270	0.4880279	0.6060206	0.7367396	0.9400892
067/68	0.906674	0.991767	1.021241	0.950540	0.7684138	0.5453746	0.4181750	0.3571518	0.4661262	0.7609980	1.0101181	1.0216189
068/69	1.003519	1.018288	0.987229	0.970399	0.9010181	0.5989002	0.2704248	0.4149698	0.6540347	0.7965058	1.0648567	0.9226998
069/70	0.998240	1.011626	0.994029	0.942068	0.7213769	0.5067245	0.4481523	0.4758629	0.6182755	0.8851810	0.9909502	1.0347536
070/71	1.002513	1.013260	1.002375	1.036764	0.8592886	0.5916290	0.4536199	0.4160382	0.5007290	0.6493841	0.9642408	1.0491453
071/72	1.018539	0.869343	0.834841	1.005907	0.8249120	0.6390774	0.4815862	0.5022185	0.7227250	0.3166792	0.9811463	1.0350050
072/73	1.028846	0.986425	1.003016	0.990258	0.8658874	0.6244344	0.5041478	0.4737305	0.6082831	0.7206511	0.9601559	0.8988185
073/74	0.970399	0.976118	0.923454	0.938841	0.9424334	0.6674208	0.4682629	0.4702740	0.7405669	0.8244979	0.9242710	1.0290347
074/75	1.017156	0.985294	0.935708	0.865384	0.6632102	0.5263323	0.4385998	0.3624309	0.4390397	0.6762192	0.8242207	0.9692622
075/76	0.913084	1.024321	1.044620	0.945575	0.7231649	0.5021368	0.4126709	0.4446330	0.6827552	0.9604701	0.9877451	0.9693942

3. Monthly Plant Capacity Factor of Indrawati Hydropower Project

FY/ MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangsir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
066/67	0.775253	0.806390	0.867172	0.771714	0.7150926	0.5166889	0.3928111	0.3254167	0.3162037	0.3641130	0.4338037	0.8816185
067/68	0.927472	0.848444	0.598168	0.809498	0.7032261	0.5429630	0.4221926	0.3466259	0.2867111	0.3394333	0.5551809	0.8330926
068/69	0.747620	0.847800	0.766783	0.897254	0.6631259	0.5678370	0.2379185	0.3384611	0.3734241	0.3736241	0.2930333	0.8492963
069/70	0.867863	0.815787	0.756814	0.805942	0.7613667	0.4853019	0.3258296	0.3793981	0.3436907	0.4445759	0.6156204	0.7538056
070/71	0.820150	0.795511	0.793040	0.712494	0.6629037	0.5483993	0.3191815	0.3556148	0.2705259	0.3035754	0.3955741	0.4612343
071/72	0.792409	0.423088	0.847648	0.772596	0.6780204	0.5538944	0.3661222	0.3151352	0.4066019	0.3927796	0.6731519	0.6184204
072/73	0.662396	0.759275	0.703205	0.688975	0.5518056	0.4883852	0.3923074	0.3514389	0.3065870	0.4159352	0.3535963	0.4288852
073/74	0.531290	0.706185	0.597750	0.743371	0.7153056	0.5250870	0.3894000	0.3375185	0.2645611	0.3725093	0.3711043	0.4676333
074/75	0.426770	0.583570	0.565592	0.394900	0.4161370	0.3811167	0.3276907	0.2896444	0.1860926	0.2743963	0.4160074	0.6098185
075/76	0.766879	0.696907	0.755935	0.641359	0.6469093	0.4376722	0.3612722	0.2751352	0.3412444	0.3808370	0.4103926	0.5907556

4. Monthly Plant Capacity Factor of Jhimruk Hydropower Project

FY/ MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangsir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
066/67	0.241952	0.441297	0.854218	0.937867	0.8756318	0.7621265	0.5153331	0.4803998	0.3752447	0.1974431	0.0963507	0.5393137
067/68	0.793209	0.473138	0.963252	0.851151	0.9235899	0.8543536	0.6463759	0.5374688	0.4491876	0.3120858	0.1708713	0.4238340
068/69	0.596150	0.523715	0.929275	0.993528	0.9580931	0.8748300	0.4330522	0.5295889	0.4738355	0.2002656	0.1295613	0.5449433
069/70	0.625712	0.602028	0.967514	1.011818	0.9436406	0.5775653	0.6527506	0.6125249	0.4062029	0.3004520	0.6185171	0.4797654
070/71	0.552345	0.672750	0.977169	1.030053	0.9729150	0.9130273	0.7665878	0.7179567	0.5049664	0.2536892	0.1683106	0.5728100
071/72	0.509104	0.819726	0.929888	0.991423	0.9230220	0.9854444	0.7600556	0.6979873	0.5981667	0.3900093	0.2738738	0.7002662
072/73	0.644548	0.716502	0.929897	0.977191	0.9345104	0.7515278	0.6016308	0.5223854	0.4225139	0.3899745	0.4818171	0.7323148
073/74	0.439241	0.593862	0.822344	1.034228	1.0261169	0.8056030	0.6643530	0.6110854	0.5093553	0.3448507	0.3427767	0.2782280
074/75	0.564163	0.558233	0.703015	0.974333	0.7699051	0.7315370	0.6169630	0.3916921	0.3971007	0.2831829	0.3068022	0.5478343
075/76	0.565784	0.692928	0.949314	0.959678	0.8302454	0.7285784	0.5357683	0.7088950	0.3871074	0.3091802	0.2282706	0.5011895

5. Monthly Plant Capacity Factor of Aandhikhola Hydropower Project

FY/ MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangsir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
066/67	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
067/68	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
068/69	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
069/70	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
070/71	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
071/72	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
072/73	0.0000	1.0224	1.0226	0.9446	0.8630	0.6911	0.5598	0.4474	0.3162	0.6655	1.0194	1.0298
073/74	1.0128	1.0262	1.0174	1.0220	0.9683	0.7905	0.6456	0.5231	0.5090	0.6056	0.9814	0.9494
074/75	1.0001	1.0567	1.0129	0.9622	0.8930	0.6658	0.5164	0.4356	0.3831	0.4500	0.9406	0.9746
075/76	0.9040	0.8536	0.9567	0.9928	0.8612	0.5766	0.6265	0.6102	0.4079	0.7769	1.0300	1.0397

6. Monthly Energy Generation (MWh) of Lower Modi Hydropower Project

FY/ MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangsir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
066/67	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
067/68	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
068/69	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
069/70	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.3054	0.4629	0.7767	0.7671
070/71	0.8350	0.9184	0.9652	0.8585	0.5320	0.3827	0.2875	0.2338	0.2242	0.4033	0.6723	0.7757
071/72	0.7624	0.5192	0.9232	0.8804	0.5877	0.4282	0.3237	0.3086	0.1712	0.3612	0.7463	0.5379
072/73	0.2411	0.0000	0.0000	0.0000	0.0336	0.2995	0.2986	0.2534	0.1785	0.3730	0.4859	0.5478
073/74	0.6539	0.6301	0.4885	0.6864	0.6031	0.4151	0.1982	0.1934	0.1835	0.3906	0.2615	0.5445
074/75	0.3960	0.3954	0.4464	0.5402	0.3141	0.2678	0.2278	0.1747	0.1692	0.2396	0.4150	0.5854
075/76	0.6780	0.7511	0.7267	0.4202	0.3665	0.3276	0.2576	0.1675	0.2000	0.3802	0.4559	0.5673

7. Monthly Plant Capacity Factor of Bijaypur (I) Hydropower Project

FY/ MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangsir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
066/67	0.000000	0.000000	0.000000	0.000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
067/68	0.000000	0.000000	0.000000	0.000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
068/69	0.000000	0.000000	0.000000	0.000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
069/70	0.000000	0.000000	0.814843	0.851522	0.7891755	0.7415640	0.6858655	0.6596624	0.5562069	0.4594829	0.5357017	0.9766093
070/71	1.025211	0.984671	0.744601	1.009806	0.8044032	0.7900447	0.7023810	0.6285560	0.4957357	0.4813983	0.4010204	0.7219671
071/72	0.929617	0.965148	0.906342	0.664458	0.3009417	0.1271636	0.0000000	0.0525384	0.3759133	0.2073161	0.3063713	0.6655770
072/73	0.965158	1.031204	0.936643	0.820896	0.6790911	0.7220396	0.6685185	0.6141093	0.5044879	0.5442681	0.4336042	0.8383346
073/74	0.710708	0.500428	0.576618	0.590334	0.4714317	0.4612528	0.4165596	0.3589553	0.4026172	0.0625220	0.0000000	0.4891125
074/75	0.832621	0.625711	0.767535	0.571878	0.4351121	0.2203625	0.3455751	0.5305241	0.3576153	0.0405707	0.0231293	0.1655486
075/76	0.569425	0.809155	0.826751	0.679853	0.5433862	0.5448318	0.3399943	0.1777778	0.0737780	0.0389015	0.0000000	0.3762598

8. Monthly Plant Capacity Factor of Sanima Mai Hydropower Project

FY/ MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangsir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
066/67	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
067/68	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
068/69	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
069/70	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
070/71	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
071/72	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1963	0.2730	0.1422
072/73	0.1698	0.1381	0.3694	0.6876	0.3992	0.3092	0.2498	0.1940	0.1531	0.2079	0.4358	0.9147
073/74	1.0376	1.0369	0.9532	1.0031	0.5903	0.3590	0.2524	0.2096	0.2569	0.2173	0.4268	0.9087
074/75	0.8456	0.6277	0.9158	0.7594	0.4011	0.2951	0.1946	0.1795	0.1838	0.3716	0.7441	0.9103
075/76	1.0375	0.9554	0.9679	0.6037	0.3245	0.2682	0.1697	0.2330	0.2256	0.3405	0.3764	0.5919

9. Monthly Plant Capacity Factor of Sipring Khola Hydropower Project

FY/ MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangsir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
066/67	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
067/68	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
068/69	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
069/70	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
070/71	0.4850	0.3675	0.3602	0.4484	0.3445	0.1859	0.1237	0.0934	0.0487	0.0661	0.2310	0.8696
071/72	0.5393	0.9318	0.8168	0.5804	0.2712	0.1533	0.1215	0.1105	0.1838	0.1091	0.0000	0.0000
072/73	0.0000	0.0013	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0956	0.1835	0.5350
073/74	0.5776	0.5286	0.2371	0.5943	0.3556	0.1858	0.1549	0.1168	0.1795	0.1492	0.3725	0.7123
074/75	0.8796	0.5812	0.6437	0.4790	0.0668	0.0000	0.0000	0.0891	0.1076	0.1086	0.3709	0.7039
075/76	0.5693	0.7665	0.6617	0.3587	0.2029	0.1491	0.0483	0.0714	0.0766	0.1730	0.2543	0.5202

10. Monthly Plant Capacity Factor of Mai Khola Hydropower Project

FY/ MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangsir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
066/67	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
067/68	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
068/69	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
069/70	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
070/71	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
071/72	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
072/73	0.4410	0.7123	0.8115	0.6513	0.4825	0.3281	0.2821	0.2448	0.1780	0.3224	0.4395	0.7422
073/74	0.7863	0.7809	0.6627	0.7507	0.4494	0.3307	0.1917	0.2019	0.2616	0.2253	0.3065	0.6797
074/75	0.5845	0.6886	0.5633	0.7160	0.3981	0.2968	0.1921	0.1721	0.1602	0.2917	0.5334	0.7186
075/76	0.7173	0.7305	0.6637	0.6123	0.3505	0.2823	0.2046	0.1981	0.1942	0.3450	0.3426	0.7338

11. Monthly Plant Capacity Factor of Khudi Hydropower Project

FY/ MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangsir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
066/67	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
067/68	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
068/69	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
069/70	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.3930	0.4703	0.5973	0.8774
070/71	0.8637	0.9059	0.9149	0.8628	0.7028	0.4639	0.2517	0.1187	0.0140	0.2535	0.1350	0.5196
071/72	0.9154	0.4290	0.6373	0.6999	0.4290	0.3900	0.1326	0.1834	0.1194	0.2558	0.2658	0.3468
072/73	0.4419	0.1814	0.5226	0.7084	0.6614	0.4137	0.2789	0.0502	0.1015	0.2529	0.4454	0.3254
073/74	0.2299	0.3825	0.2862	0.3997	0.7210	0.4020	0.2528	0.2412	0.2446	0.3997	0.3095	0.1738
074/75	0.2677	0.2581	0.0804	0.0071	0.0087	0.2699	0.0000	0.1752	0.0831	0.0163	0.0000	0.0045
075/76	0.0000	0.1478	0.0363	0.0000	0.4361	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

12. Monthly Plant Capacity Factor of Bhotekoshi Hydropower Project

FY/ MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangsir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
066/67	1.041027	1.011767	0.971845	0.753063	0.626194	0.529789	0.419722	0.315910	0.398029	0.508322	0.522831	1.039407
067/68	1.016970	1.005663	0.998865	0.916523	0.642695	0.481397	0.442732	0.431646	0.413191	0.526196	0.828870	0.933969
068/69	1.039235	0.937525	0.970617	1.027967	0.738427	0.557700	0.287958	0.483347	0.356710	0.560667	0.919753	1.046416
069/70	1.128544	1.156486	1.081971	0.914268	0.656981	0.493003	0.410128	0.447393	0.476409	0.701728	1.140668	1.205267
070/71	1.291624	1.260573	1.266754	1.201811	0.782027	0.596130	0.486716	0.459148	0.506016	0.608360	0.983029	1.229092
071/72	0.641742	0.000000	0.000000	0.000000	0.000000	0.000000	0.369119	0.495707	0.582549	0.253505	0.000000	0.000000
072/73	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
073/74	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
074/75	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
075/76	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000

13. Monthly Plant Capacity Factor of Upper Marsyangdi-A Hydropower Project

FY/ MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangsir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
073/74	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.543758	0.481931	0.730005	0.949097	0.977191	0.927806
074/75	0.980855	0.986672	0.991343	0.989623	0.902201	0.730778	0.693701	0.527734	0.577603	0.642846	0.992003	0.982313
075/76	0.969678	0.976218	0.987014	0.953598	0.91126	0.662555	0.565468	0.507493	0.489126	0.86019	0.97159	0.972149

14. Monthly Plant Capacity Factor of Upper Madi Hydropower Project

FY/ MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangsir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
073/74	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.334051	0.318466	0.393268	0.528807	0.621911	0.515399
074/75	0.234109	0.634379	0.987759	0.764139	0.457772	0.398998	0.313041	0.283779	0.429853	0.300651	0.594881	0.923789
075/76	0.890024	0.604258	0.997111	0.630867	0.400544	0.304428	0.295471	0.312724	0.404206	0.39814	0.717667	0.501

Appendix - G: Average Monthly Plant Capacity Factor & Weightage Average Monthly Plant Capacity Factor Of NEA Operated RoR Hydropower Projects, Storage Hydrpower Projects & IPP Operated RoR Hydropower Projects

1. Monthly Average Plant Capacity Factor of NEA Operated ROR Hydropower Projects

PROJECTS/ MONTHS	Shrawan	Bhadra	Ashoj	Kartik	Mangshir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
Kaligandaki -A	0.837092	0.898725	0.858470	0.807429	0.690448	0.512089	0.388357	0.379966	0.442433	0.577981	0.836946	0.874985
Middle Marsyangdi	0.919260	0.909276	0.888465	0.865005	0.669737	0.528200	0.382142	0.405590	0.476922	0.655754	0.919497	0.943361
Marsyangdi	0.932344	0.906656	0.882496	0.905030	0.780837	0.608951	0.476201	0.469746	0.518848	0.677292	0.947629	0.925377
Trishuli	0.647826	0.628377	0.648123	0.665503	0.661553	0.604659	0.488835	0.435675	0.526943	0.526057	0.687178	0.646984
Gandak	0.187097	0.161132	0.200949	0.044386	0.088171	0.173396	0.147053	0.154469	0.076655	0.011329	0.072984	0.144098
Modi	0.368024	0.489909	0.625901	0.571593	0.427287	0.332136	0.244394	0.229445	0.296304	0.382061	0.542615	0.451303
Devighat	0.729158	0.704153	0.727775	0.731304	0.779900	0.735969	0.643739	0.621223	0.666906	0.623303	0.738711	0.721980
Sunkoshi	0.680323	0.669026	0.798380	0.900288	0.688334	0.544647	0.430222	0.414441	0.423987	0.483969	0.735477	0.754009
Puwa Khola	0.843585	0.792503	0.855444	0.859607	0.568754	0.411611	0.286471	0.262740	0.258961	0.395903	0.474041	0.708436
Chameliya	0.447936	0.620704	0.972464	0.730120	0.498354	0.397063	0.293709	0.294594	0.445847	0.718345	0.685815	0.742000

2. Weightage Monthly Average Plant Capacity Factor of NEA Operated ROR Hydropower Projects

MONTHS	Shrawan	Bhadra	Ashoj	Kartik	Mangshir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
Weightage Monthly Average Plant Capacity Factor	0.777453	0.806920	0.823904	0.782855	0.655196	0.516865	0.397080	0.396320	0.462813	0.594116	0.807827	0.827334

3. Monthly Average Plant Capacity Factor of Storage Hydropower Projects

PROJECTS/ MONTHS	Shrawan	Bhadra	Ashoj	Kartik	Mangshir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
Kulekhani (I)	0.107926	0.057384	0.063443	0.062921	0.080986	0.162581	0.213594	0.285617	0.366006	0.350148	0.186451	0.124366
Kulekhani (II)	0.096417	0.055708	0.056679	0.057369	0.0797335	0.157718	0.211631	0.2765245	0.343009	0.364534	0.169875	0.109674

4. Weightage Monthly Average Plant Capacity Factor of Storage Hydropower Projects

MONTHS	Shrawan	Bhadra	Ashoj	Kartik	Mangshir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
Weightage Monthly Average Plant Capacity Factor	0.103923	0.056801	0.061091	0.060990	0.080550	0.160890	0.212911	0.282454	0.358007	0.355152	0.180686	0.119256

5. Monthly Average Plant Capacity Factor of IPP Operated ROR Hydropower Projects

PROJECTS/ MONTHS	Shrawan	Bhadra	Ashoj	Kartik	Mangshir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
Khimti	0.9677	1.0086	0.9853	0.9562	0.8365	0.6058	0.4536	0.4193	0.4009	0.4689	0.6652	0.9766
Chilime	0.9567	0.9586	0.9631	0.9548	0.7967	0.5726	0.4289	0.4317	0.5921	0.7197	0.9444	0.9870
Indrawati	0.7318	0.7283	0.7252	0.7238	0.6514	0.5047	0.3535	0.3314	0.3096	0.3662	0.4517	0.6495
Jhimruk	0.5532	0.6094	0.9026	0.9761	0.9158	0.7985	0.6193	0.5810	0.4524	0.2981	0.2817	0.5320
Aandhikhola	0.9723	0.9897	1.0024	0.9804	0.8964	0.6810	0.5871	0.5041	0.4040	0.6245	0.9929	0.9984
Lower Modi	0.5944	0.6428	0.7100	0.6771	0.4061	0.3535	0.2656	0.2219	0.2046	0.3730	0.5448	0.6180
Bijaypur (I)	0.5033	0.4916	0.5573	0.5189	0.4024	0.3607	0.5265	0.3022	0.2766	0.1834	0.3400	0.4233
Sanima Mai	0.7726	0.6895	0.8016	0.7635	0.4288	0.3079	0.2166	0.2040	0.2048	0.2667	0.4512	0.6936
Sipring Khola	0.6102	0.5295	0.5439	0.4922	0.2482	0.1685	0.1121	0.0962	0.1192	0.1169	0.2824	0.6682
Mai Khola	0.6323	0.7281	0.6753	0.6826	0.4201	0.3095	0.2176	0.2042	0.1985	0.2961	0.4055	0.7186
Khudi	0.5437	0.3841	0.4129	0.5356	0.4932	0.3879	0.2290	0.1537	0.1593	0.2748	0.3506	0.3746
Bhotekoshi	1.0265	1.0744	1.0580	0.9627	0.6893	0.5316	0.4027	0.4389	0.4555	0.5265	0.8790	1.0908
Upper Marsyangdi A	0.9753	0.9814	0.9892	0.9716	0.9067	0.6967	0.6010	0.5057	0.5989	0.8174	0.9803	0.9608
Upper Madi	0.5621	0.6193	0.9924	0.6975	0.4292	0.3517	0.3142	0.3050	0.4091	0.4092	0.6448	0.6467

6. Weightage Monthly Average Plant Capacity Factor of IPP Operated ROR Hydropower Projects

MONTHS	Shrawan	Bhadra	Ashoj	Kartik	Mangshir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
Weightage Monthly Average Plant Capacity Factor	0.88376	0.86992	0.92367	0.87212	0.70273	0.53470	0.42416	0.39053	0.41802	0.50663	0.70993	0.86397

Appendix - H: Scenarios Of Monthly Expected Energy Consumption

1. Expected Monthly Energy (MWh) Consumption in coming ten years in Normal Scenario

FY/ Month	Shrawan	Bhadra	Ashoj	Kartik	Mangshir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
077/78	817370.0	833580.2	746869.6	712587.3	646165.9	725214.8	664961.7	677590.7	690311.1	824416.0	904799.2	893710.9
078/79	882759.6	900266.6	806619.1	769594.3	697859.2	783232.0	718158.7	731797.9	745536.0	890369.3	977183.2	965207.8
079/80	953380.3	972288.0	871148.7	831161.8	753687.9	845890.5	775611.4	790341.7	805178.9	961598.8	1055357.8	1042424.4
080/81	1029650.8	1050071.0	940840.6	897654.8	813983.0	913561.8	837660.3	853569.1	869593.2	1038526.7	1139786.4	1125818.3
081/82	1112022.8	1134076.7	1016107.8	969467.2	879101.6	986646.7	904673.1	921854.6	939160.7	1121608.9	1230969.3	1215883.8
082/83	1200984.7	1224802.8	1097396.4	1047024.5	949429.7	1065578.5	977046.9	995603.0	1014293.5	1211337.6	1329446.9	1313154.5
083/84	1297063.4	1322787.1	1185188.2	1130786.5	1025384.1	1150824.7	1055210.7	1075251.2	1095437.0	1308244.6	1435802.6	1418206.9
084/85	1400828.5	1428610.0	1280003.2	1221249.4	1107414.9	1242890.7	1139627.5	1161271.3	1183072.0	1412904.1	1550666.8	1531663.4
085/86	1512894.8	1542898.8	1382403.5	1318949.4	1196008.0	1342322.0	1230797.7	1254173.0	1277717.7	1525936.5	1674720.2	1654196.5
086/87	1633926.4	1666330.7	1492995.7	1424465.3	1291688.7	1449707.7	1329261.6	1354506.9	1379935.1	1648011.4	1808697.8	1786532.2

2. Expected Monthly Energy (MWh) Consumption in coming ten years in Growth with Categorization of Consumption Scenario

FY/ Month	Shrawan	Bhadra	Ashoj	Kartik	Mangshir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
077/78	954027.8	972948.3	871740.3	831726.3	754199.8	846465.0	776138.1	790878.5	805725.7	962251.9	1056074.5	1043132.3
078/79	1114651.2	1136757.2	1018509.5	971758.6	881179.4	988978.7	906811.4	924033.5	941380.5	1124259.9	1233878.8	1218757.7
079/80	1303480.2	1329331.1	1191051.4	1136380.6	1030456.8	1156518.0	1060430.9	1080570.6	1100856.3	1314716.6	1442905.7	1425222.9
080/81	1525652.8	1555909.9	1394061.1	1330071.9	1206093.8	1353641.6	1241176.9	1264749.3	1288492.6	1538804.5	1688842.9	1668146.1
081/82	1787271.9	1822717.5	1633114.8	1558152.8	1412914.9	1585764.2	1454014.0	1481628.6	1509443.4	1802678.8	1978445.8	1954200.0
082/83	2095590.1	2137150.3	1914839.7	1826946.1	1656653.7	1859320.8	1704842.7	1737221.0	1769834.0	2113654.9	2319743.0	2291314.6
083/84	2459231.9	2508003.9	2247116.4	2143970.9	1944128.0	2181963.4	2000679.2	2038676.0	2076948.3	2480431.4	2722281.4	2688919.9
084/85	2888458.6	2945743.1	2639321.1	2518172.9	2283450.1	2562796.5	2349871.5	2394500.2	2439452.4	2913358.1	3197419.9	3158235.6
085/86	3395485.6	3462825.6	3102615.7	2960201.6	2684276.6	3012658.3	2762357.4	2814820.0	2867662.8	3424755.9	3758680.6	3712618.0
086/87	3994862.3	4074089.3	3650294.5	3482741.3	3158109.6	3544457.7	3249973.2	3311696.7	3373867.4	4029299.5	4422169.2	4367975.5

3. Expected Monthly Energy (MWh) Consumption in coming ten years in Intervention with Induction Chulo Scenario

FY/ Month	Shrawan	Bhadra	Ashoj	Kartik	Mangshir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
077/78	1019155.8	1038076.2	936868.3	896854.3	819327.8	911593.0	841266.1	856006.5	870853.7	1027379.8	1121202.5	1108260.3
078/79	1244907.1	1267013.1	1148765.4	1102014.5	1011435.4	1119234.7	1037067.3	1054289.4	1071636.4	1254515.8	1364134.8	1349013.6
079/80	1498864.0	1524714.9	1386435.3	1331764.5	1225840.7	1351901.9	1255814.8	1275954.5	1296240.1	1510100.5	1638289.6	1620606.8
080/81	1786164.7	1816421.7	1654572.9	1590583.7	1466605.7	1614153.5	1501688.7	1525261.2	1549004.4	1799316.4	1949354.7	1928658.0
081/82	2112911.7	2148357.3	1958754.6	1883792.6	1738554.7	1911404.0	1779653.8	1807268.4	1835083.2	2128318.6	2304085.6	2279839.8
082/83	2486357.9	2527918.1	2305607.5	2217713.9	2047421.4	2250088.5	2095610.5	2127988.8	2160601.8	2504422.6	2710510.8	2682082.3
083/84	2915127.6	2963899.6	2703012.1	2599866.6	2400023.8	2637859.1	2456574.9	2494571.8	2532844.0	2936327.1	3178177.2	3144815.6
084/85	3409482.3	3466766.8	3160344.8	3039196.6	2804473.8	3083820.2	2870895.2	2915523.9	2960476.0	3434381.8	3718443.6	3679259.2
085/86	3981637.2	4048977.2	3688767.3	3546353.3	3270428.3	3598809.9	3348509.0	3400971.6	3453814.5	4010907.6	4344832.3	4298769.7
086/87	4646141.9	4725368.9	4301574.1	4134020.9	3809389.2	4195737.3	3901252.8	3962976.3	4025147.0	4680579.1	5073448.8	5019255.1

4. Expected Monthly Energy (MWh) Consumption in coming ten years in Intervention with Electric Vehicle Scenario

FY/ Month	Shrawan	Bhadra	Ashoj	Kartik	Mangshir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
077/78	954450.1	973793.0	873007.3	833415.7	756311.5	848999.1	779094.5	794257.2	809526.8	966475.3	1060720.3	1048200.4
078/79	1120564.0	1143514.6	1026111.6	980205.4	890471.0	999114.9	917792.2	935859.1	954050.7	1137774.8	1248238.5	1233962.0
079/80	1319951.5	1347069.4	1210056.8	1156653.0	1051996.3	1179324.5	1084504.4	1105911.1	1127463.8	1342591.2	1472047.3	1455631.5
080/81	1557750.8	1589697.2	1429537.8	1367238.0	1244949.3	1394186.4	1283411.1	1308672.8	1334105.5	1586106.8	1737834.5	1718827.1
081/82	1840064.6	1877621.9	1690130.9	1617280.6	1474154.5	1649115.4	1519477.0	1549203.3	1579129.8	1874476.9	2052355.6	2030221.5
082/83	2174145.7	2218239.9	1998463.4	1913103.8	1745345.4	1950546.6	1798602.5	1833514.9	1868662.0	2215016.9	2423639.1	2397744.7
083/84	2568618.4	2620346.8	2362415.7	2262226.6	2065340.1	2306131.9	2127804.0	2168757.3	2209985.9	2616425.4	2861231.8	2830826.7
084/85	3033744.1	3094407.4	2791364.1	2673594.6	2442250.6	2724975.7	2515429.4	2563436.9	2611767.8	3089052.3	3376492.8	3340687.2
085/86	3581738.3	3652879.3	3296470.5	3157857.5	2885733.6	3217916.3	2971416.5	3027680.2	3084324.1	3645218.3	3982944.1	3940682.5
086/87	4227150.3	4310600.6	3891029.3	3727699.5	3407291.2	3797862.7	3507601.7	3573548.5	3639942.7	4299598.2	4696691.2	4646721.0

5. Expected Monthly Energy (MWh) Consumption in coming ten years in Combined Intervention of Induction Chulo & Electric Vehicle Scenario

FY/ Month	Shrawan	Bhadra	Ashoj	Kartik	Mangshir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
077/78	1019578.1	1038920.9	938135.3	898543.6	821439.5	914127.0	844222.4	859385.2	874654.8	1031603.2	1125848.2	1113328.4
078/79	1250819.9	1273770.6	1156367.5	1110461.3	1020726.9	1129370.9	1048048.2	1066115.0	1084306.6	1268030.7	1378494.4	1364217.9
079/80	1515335.4	1542453.3	1405440.7	1352036.9	1247380.1	1374708.3	1279888.3	1301295.0	1322847.7	1537975.1	1667431.2	1651015.4
080/81	1818262.6	1850209.1	1690049.6	1627749.8	1505461.1	1654698.3	1543922.9	1569184.7	1594617.3	1846618.6	1998346.4	1979339.0
081/82	2165704.4	2203261.7	2015770.7	1942920.4	1799794.3	1974755.2	1845116.8	1874843.1	1904769.6	2200116.7	2377995.4	2355861.3
082/83	2564913.4	2609007.7	2389231.2	2303871.6	2136113.2	2341314.3	2189370.3	2224282.7	2259429.7	2605784.6	2814406.8	2788512.4
083/84	3024514.1	3076242.5	2818311.4	2718122.3	2521235.8	2762027.6	2583699.7	2624653.0	2665881.6	3072321.1	3317127.6	3286722.4
084/85	3554767.8	3615431.1	3312387.8	3194618.3	2963274.2	3245999.4	3036453.1	3084460.5	3132791.4	3610076.0	3897516.5	3861710.8
085/86	4167889.9	4239031.0	3882622.1	3744009.2	3471885.3	3804068.0	3557568.1	3613831.8	3670475.8	4231369.9	4569095.7	4526834.2
086/87	4878429.9	4961880.2	4542308.9	4378979.1	4058570.8	4449142.3	4158881.3	4224828.1	4291222.3	4950877.8	5347970.8	5298000.6

Appendix - I: Estimation Of Monthly Expected Energy Generations In Normal Scenario

1. Expected Monthly Energy (MWh) Generation in Fiscal Year 077/78

GENERATIONS/ MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangshir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
From 77 Shrawan	658499.1	648185.4	688239.0	649825.3	523608.8	398411.8	316048.2	290987.9	311474.1	377497.8	528979.5	643752.8
From 77 Bhadra	0.0	74196.3	78781.1	74384.0	59936.3	45605.3	36177.3	33308.7	35653.7	43211.3	60551.1	73688.9
From 77 Ashoj	0.0	0.0	73633.7	69523.9	56020.1	42625.5	33813.5	31132.4	33324.2	40387.9	56594.8	68874.2
From 77 Kartik	0.0	0.0	0.0	51690.8	41650.8	31691.9	25140.3	23146.8	24776.4	30028.3	42078.0	51207.8
From 77 Mangshir	0.0	0.0	0.0	0.0	506.0	385.0	305.4	281.2	301.0	364.8	511.2	622.1
From 77 Poush	0.0	0.0	0.0	0.0	0.0	1847.9	1465.9	1349.7	1444.7	1750.9	2453.5	2985.9
From 77 Magh	0.0	0.0	0.0	0.0	0.0	0.0	9720.2	8949.4	9579.5	11610.1	16268.9	19798.8
From 77 Falgun	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3795.9	4063.2	4924.5	6900.6	8397.8
From 77 Chaitra	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	22331.3	27064.9	37925.4	46154.2
From 78 Baisakh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4869.8	6823.9	8304.5
From 78 Jestha	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	500.9	609.6
From 78 Ashad	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	184308.7
Ex.Gen. NEA	**259854.2**	**265806.1**	**271637.0**	**258327.8**	**218454.6**	**179761.8**	**144917.5**	**149978.8**	**177291.3**	**219620.2**	**275554.9**	**277187.7**
Ex. Gen. IPP	**394284.6**	**391958.6**	**412056.7**	**392014.6**	**313806.5**	**238078.5**	**186487.3**	**173131.1**	**181759.1**	**218551.7**	**310910.2**	**389211.8**
Ex.Gen.Additon	**658499.1**	**722381.7**	**840653.9**	**845424.0**	**681722.0**	**520567.5**	**422670.8**	**392952.1**	**442948.0**	**541710.3**	**759587.7**	**1108705.1**
Total Ex.En.Gen.	**1312637.8**	**1380146.3**	**1524347.6**	**1495766.4**	**1213983.0**	**938407.8**	**754075.5**	**716062.0**	**801998.4**	**979882.2**	**1346052.9**	**1775104.6**

2. Expected Monthly Energy (MWh) Generation in Fiscal Year 078/79

GENERATIONS/ MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangshir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
Addition in 077/78	1134102	1116339	1185322	1119164	901787	686166	544315	501155	536437	650147	911036	1108705
From 78 Shrawan	395630	389433	413498	390419	314587	239368	189884	174827	187135	226803	317814	386770
From 78 Bhadra	0	7391	7848	7410	5970	4543	3604	3318	3552	4304	6032	7340
From 78 Ashoj	0	0	55791	52677	42445	32296	25620	23588	25249	30601	42881	52184
From 78 Kartik	0	0	0	11880	9573	7284	5778	5320	5694	6902	9671	11769
From 78 Mangshir	0	0	0	0	4812	3661	2904	2674	2862	3469	4861	5916
From 78 Poush	0	0	0	0	0	13128	10414	9588	10263	12439	17430	21212
From 78 Magh	0	0	0	0	0	0	36648	33742	36117	43773	61338	74647
From 78 Falgun	0	0	0	0	0	0	0	3937	4214	5107	7156	8709
From 78 Chaitra	0	0	0	0	0	0	0	0	15524	18815	26365	32086
From 79 Baisakh	0	0	0	0	0	0	0	0	0	18968	26580	32347
From 79 Jestha	0	0	0	0	0	0	0	0	0	0	16357	19906
From 79 Ashad	0	0	0	0	0	0	0	0	0	0	0	0
Ex.Gen. NEA	**259854**	**265806**	**271637**	**258328**	**218455**	**179762**	**144917**	**149979**	**177291**	**219620**	**275555**	**277188**
Ex. Gen. IPP	**394285**	**391959**	**412057**	**392015**	**313806**	**238078**	**186487**	**173131**	**181759**	**218552**	**310910**	**389212**
Ex.Gen.Additon	**395630**	**396824**	**477136**	**462385**	**377387**	**300280**	**274851**	**256994**	**290611**	**371181**	**536485**	**652886**
Total Ex.En.Gen.	**2183871**	**2170928**	**2346152**	**2231891**	**1811435**	**1404287**	**1150571**	**1081259**	**1186099**	**1459500**	**2033986**	**2427991**

3. Expected Monthly Energy (MWh) Generation in Fiscal Year 079/80

GENERATIONS/ MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangshir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
Addition in 077/78	1134102	1116339	1185322	1119164	901787	686166	544315	501155	536437	650147	911036	1108705
Addition in 078/79	667842	657382	698004	659045	531038	404065	320532	295117	315893	382854	536485	652886
From 79 Shrawan	64525	63515	67439	63675	51308	39040	30969	28513	30521	36990	51834	63080
From 79 Bhadra	0	135273	143632	135616	109275	83147	65958	60728	65003	78782	110396	134348
From 79 Ashoj	0	0	20317	19183	15457	11761	9330	8590	9195	11144	15616	19004
From 79 Kartik	0	0	0	64048	51608	39268	31150	28680	30700	37207	52138	63450
From 79 Mangshir	0	0	0	0	7336	5582	4428	4077	4364	5289	7412	9020
From 79 Poush	0	0	0	0	0	22110	17539	16148	17285	20949	29355	35725
From 79 Magh	0	0	0	0	0	0	15270	14059	15049	18239	25558	31103
From 79 Falgun	0	0	0	0	0	0	0	11671	12492	15140	21216	25819
From 79 Chaitra	0	0	0	0	0	0	0	0	13099	15875	22245	27072
From 80 Baisakh	0	0	0	0	0	0	0	0	0	26410	37007	45037
From 80 Jestha	0	0	0	0	0	0	0	0	0	0	4498	5474
From 80 Ashad	0	0	0	0	0	0	0	0	0	0	0	29523
Ex.Gen. NEA	**259854**	**265806**	**271637**	**258328**	**218455**	**179762**	**144917**	**149979**	**177291**	**219620**	**275555**	**277188**
Ex. Gen. IPP	**394285**	**391959**	**412057**	**392015**	**313806**	**238078**	**186487**	**173131**	**181759**	**218552**	**310910**	**389212**
Ex.Gen.Additon	**64525**	**198788**	**231389**	**282522**	**234984**	**200908**	**174644**	**172467**	**197708**	**266026**	**377274**	**488655**
Total Ex.En.Gen.	**2520608**	**2630274**	**2798408**	**2711073**	**2200070**	**1708979**	**1370896**	**1291848**	**1409088**	**1737198**	**2411260**	**2916646**

4. Expected Monthly Energy (MWh) Generation in Fiscal Year 080/81

GENERATIONS/ MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangshir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
Addition in 077/78	1134102	1116339	1185322	1119164	901787	686166	544315	501155	536437	650147	911036	1108705
Addition in 078/79	667842	657382	698004	659045	531038	404065	320532	295117	315893	382854	536485	652886
Addition in 079/80	499848	492019	522423	493264	397457	302423	239903	220881	236431	286548	401533	488655
From 80 Shrawan	128375	126364	134173	126684	102078	77671	61614	56728	60722	73593	103125	125500
From 80 Bhadra	0	101285	107544	101541	81819	62255	49385	45470	48671	58987	82658	100592
From 80 Ashoj	0	0	42643	40263	32442	24685	19582	18029	19299	23389	32775	39886
From 80 Kartik	0	0	0	55948	45081	34302	27211	25053	26817	32501	45544	55425
From 80 Mangshir	0	0	0	0	14673	11165	8857	8154	8728	10578	14823	18040
From 80 Poush	0	0	0	0	0	33301	26417	24322	26035	31553	44215	53808
From 80 Magh	0	0	0	0	0	0	38669	35603	38110	46188	64722	78765
From 80 Falgun	0	0	0	0	0	0	0	16568	17734	21493	30118	36653
From 80 Chaitra	0	0	0	0	0	0	0	0	28156	34125	47818	58193
From 81 Baisakh	0	0	0	0	0	0	0	0	0	141949	198910	242067
From 81 Jestha	0	0	0	0	0	0	0	0	0	0	0	0
From 81 Ashad	0	0	0	0	0	0	0	0	0	0	0	0
Ex.Gen. NEA	**259854**	**265806**	**271637**	**258328**	**218455**	**179762**	**144917**	**149979**	**177291**	**219620**	**275555**	**277188**
Ex. Gen. IPP	**394285**	**391959**	**412057**	**392015**	**313806**	**238078**	**186487**	**173131**	**181759**	**218552**	**310910**	**389212**
Ex.Gen.Additon	**128375**	**227649**	**284359**	**324436**	**276093**	**243379**	**231735**	**229928**	**274272**	**474358**	**664708**	**808930**
Total Ex.En.Gen.	**3084306**	**3151154**	**3373801**	**3246251**	**2638635**	**2053873**	**1667890**	**1570190**	**1722084**	**2232079**	**3100227**	**3725576**

5. Expected Monthly Energy (MWh) Generation in Fiscal Year 081/82

GENERATIONS/ MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangshir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
Addition in 077/78	1134102	1116339	1185322	1119164	901787	686166	544315	501155	536437	650147	911036	1108705
Addition in 078/79	667842	657382	698004	659045	531038	404065	320532	295117	315893	382854	536485	652886
Addition in 079/80	499848	492019	522423	493264	397457	302423	239903	220881	236431	286548	401533	488655
Addition in 080/81	827460	814500	864831	816561	657959	500638	397141	365651	391394	474358	664708	808930
From 81 Shrawan	3175	3125	3319	3133	2525	1921	1524	1403	1502	1820	2551	3104
From 81 Bhadra	0	0	0	0	0	0	0	0	0	0	0	0
From 81 Ashoj	0	0	0	0	0	0	0	0	0	0	0	0
From 81 Kartik	0	0	0	0	0	0	0	0	0	0	0	0
From 81 Mangshir	0	0	0	0	0	0	0	0	0	0	0	0
From 81 Poush	0	0	0	0	0	32984	26165	24090	25786	31252	43793	53295
From 81 Magh	0	0	0	0	0	0	26444	24347	26062	31586	44261	53864
From 81 Falgun	0	0	0	0	0	0	0	0	0	0	0	0
From 81 Chaitra	0	0	0	0	0	0	0	0	0	0	0	0
From 82 Baisakh	0	0	0	0	0	0	0	0	0	0	0	0
From 82 Jestha	0	0	0	0	0	0	0	0	0	0	0	0
From 82 Ashad	0	0	0	0	0	0	0	0	0	0	0	18662
Ex.Gen. NEA	**259854**	**265806**	**271637**	**258328**	**218455**	**179762**	**144917**	**149979**	**177291**	**219620**	**275555**	**277188**
Ex. Gen. IPP	**394285**	**391959**	**412057**	**392015**	**313806**	**238078**	**186487**	**173131**	**181759**	**218552**	**310910**	**389212**
Ex.Gen.Additon	**3175**	**3125**	**3319**	**3133**	**2525**	**34905**	**54133**	**49841**	**53350**	**64658**	**90604**	**128924**
Total Ex.En.Gen.	**3786566**	**3741131**	**3957592**	**3741509**	**3023026**	**2346037**	**1887430**	**1755754**	**1892556**	**2296737**	**3190832**	**3854500**

6. Expected Monthly Energy (MWh) Generation in Fiscal Year 082/83

GENERATIONS/ MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangshir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
Addition in 077/78	1134102	1116339	1185322	1119164	901787	686166	544315	501155	536437	650147	911036	1108705
Addition in 078/79	667842	657382	698004	659045	531038	404065	320532	295117	315893	382854	536485	652886
Addition in 079/80	499848	492019	522423	493264	397457	302423	239903	220881	236431	286548	401533	488655
Addition in 080/81	827460	814500	864831	816561	657959	500638	397141	365651	391394	474358	664708	808930
Addition in 081/82	131878	129812	137834	130141	104863	79790	63295	58276	62379	75602	105939	128924
From 82 Shrawan	0	0	0	0	0	0	0	0	0	0	0	0
From 82 Bhadra	0	28185	29927	28257	22768	17324	13743	12653	13544	16415	23002	27993
From 82 Ashoj	0	0	0	0	0	0	0	0	0	0	0	0
From 82 Kartik	0	0	0	0	0	0	0	0	0	0	0	0
From 82 Mangshir	0	0	0	0	0	0	0	0	0	0	0	0
From 82 Poush	0	0	0	0	0	0	0	0	0	0	0	0
From 82 Magh	0	0	0	0	0	0	0	0	0	0	0	0
From 82 Falgun	0	0	0	0	0	0	0	0	0	0	0	0
From 82 Chaitra	0	0	0	0	0	0	0	0	0	0	0	0
From 83 Baisakh	0	0	0	0	0	0	0	0	0	0	0	0
From 83 Jestha	0	0	0	0	0	0	0	0	0	0	0	0
From 83 Ashad	0	0	0	0	0	0	0	0	0	0	0	0
Ex.Gen. NEA	**259854**	**265806**	**271637**	**258328**	**218455**	**179762**	**144917**	**149979**	**177291**	**219620**	**275555**	**277188**
Ex. Gen. IPP	**394285**	**391959**	**412057**	**392015**	**313806**	**238078**	**186487**	**173131**	**181759**	**218552**	**310910**	**389212**
Ex.Gen.Additon	**0**	**28185**	**29927**	**28257**	**22768**	**17324**	**13743**	**12653**	**13544**	**16415**	**23002**	**27993**
Total Ex.En.Gen.	**3915269**	**3896003**	**4122034**	**3896773**	**3148133**	**2408247**	**1910335**	**1776843**	**1915129**	**2324095**	**3229168**	**3882493**

7. Expected Monthly Energy (MWh) Generation in Fiscal Year 083/84

GENERATIONS/ MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangshir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
Addition in 077/78	1134102	1116339	1185322	1119164	901787	686166	544315	501155	536437	650147	911036	1108705
Addition in 078/79	667842	657382	698004	659045	531038	404065	320532	295117	315893	382854	536485	652886
Addition in 079/80	499848	492019	522423	493264	397457	302423	239903	220881	236431	286548	401533	488655
Addition in 080/81	827460	814500	864831	816561	657959	500638	397141	365651	391394	474358	664708	808930
Addition in 081/82	131878	129812	137834	130141	104863	79790	63295	58276	62379	75602	105939	128924
Addition in 082/83	28634	28185	29927	28257	22768	17324	13743	12653	13544	16415	23002	27993
From 83 Shrawan	0	0	0	0	0	0	0	0	0	0	0	0
From 83 Bhadra	0	0	0	0	0	0	0	0	0	0	0	0
From 83 Ashoj	0	0	0	0	0	0	0	0	0	0	0	0
From 83 Kartik	0	0	0	0	0	0	0	0	0	0	0	0
From 83 Mangshir	0	0	0	0	0	0	0	0	0	0	0	0
From 83 Poush	0	0	0	0	0	0	0	0	0	0	0	0
From 83 Magh	0	0	0	0	0	0	0	0	0	0	0	0
From 83 Falgun	0	0	0	0	0	0	0	0	0	0	0	0
From 83 Chaitra	0	0	0	0	0	0	0	0	0	0	0	0
From 84 Baisakh	0	0	0	0	0	0	0	0	0	0	0	0
From 84 Jestha	0	0	0	0	0	0	0	0	0	0	0	0
From 84 Ashad	0	0	0	0	0	0	0	0	0	0	0	0
Ex.Gen. NEA	**259854**	**265806**	**271637**	**258328**	**218455**	**179762**	**144917**	**149979**	**177291**	**219620**	**275555**	**277188**
Ex. Gen. IPP	**394285**	**391959**	**412057**	**392015**	**313806**	**238078**	**186487**	**173131**	**181759**	**218552**	**310910**	**389212**
Ex.Gen.Additon	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Total Ex.En.Gen.	**3943902**	**3896003**	**4122034**	**3896773**	**3148133**	**2408247**	**1910335**	**1776843**	**1915129**	**2324095**	**3229168**	**3882493**

Appendix - J: Estimation Of Monthly Expected Energy Generations In Shift IPP Plants & Shift IPP And NEA Plants Scenarios

1. Monthly Expected Energy (MWh) Generations for SHIFT IPP PLANTS scenario

FY/MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangshir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
077/78	737593.1	736062.5	770952.3	729774.0	598331.1	468808.4	374209.4	361089.6	403264.8	493493.7	659327.8	834115.6
078/79	1698146.9	1755768.0	1927302.7	1873274.1	1520233.4	1172128.1	941852.1	887518.4	1000222.7	1221859.6	1680472.1	2081352.9
079/80	2210821.1	2193606.9	2374354.1	2255563.1	1832575.5	1421068.1	1166256.2	1094269.5	1192450.4	1468932.6	2042546.1	2427565.1
080/81	2524015.0	2629777.9	2802004.2	2711512.1	2202489.6	1711516.0	1375282.0	1294455.4	1415440.0	1797699.7	2491381.5	3003307.7
081/82	3176795.5	3238346.0	3470503.4	3334599.1	2711890.0	2110308.1	1715031.4	1612162.3	1770572.0	2241511.5	3108787.2	3725149.8
082/83	3789973.0	3740634.7	3961187.7	3741947.9	3025445.9	2348574.0	1891815.5	1758361.0	1898907.0	2306169.8	3199391.5	3854074.3
083/84	3918675.6	3895506.8	4125629.8	3897211.8	3150552.7	2410783.7	1914720.3	1779449.6	1921480.3	2333528.0	3237727.9	3882066.9
084/85	3947309.4	3895506.8	4125629.8	3897211.8	3150552.7	2410783.7	1914720.3	1779449.6	1921480.3	2333528.0	3237727.9	3882066.9

2. Monthly Expected Energy (MWh) Generations for SHIFT NEA & IPP PLANTS scenario

FY/MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangshir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
077/78	657545.8	657268.9	687289.7	650781.0	534681.0	420377.3	335790.5	325717.0	365401.9	447604.9	595024.9	755860.8
078/79	1526153.3	1586468.2	1747541.2	1703545.9	1383471.8	1068066.7	859303.3	811515.1	907732.5	1109764.1	1523395.1	1890194.7
079/80	2015284.0	2001132.5	2169986.0	2062601.7	1677093.3	1302762.3	1072407.7	1007862.6	1099960.2	1356837.1	1885469.1	2236406.9
080/81	2408525.3	2516097.1	2681298.6	2597543.7	2110657.5	1641641.2	1319852.4	1243421.0	1360812.7	1680424.4	2327046.1	2893203.6
081/82	3064169.3	3127483.7	3352790.5	3223456.3	2622334.6	2042165.9	1660976.1	1562393.2	1728435.2	2190443.0	3037225.9	3638061.8
082/83	3700890.1	3652947.1	3868081.5	3654038.4	2954611.2	2294676.2	1849060.0	1718995.7	1856770.3	2255101.2	3127830.2	3766986.3
083/84	3829592.7	3807819.2	4032523.6	3809302.3	3079718.0	2356885.9	1871964.7	1740084.3	1879343.5	2333528.0	3237727.9	3882066.9
084/85	3947309.4	3895506.8	4125629.8	3897211.8	3150552.7	2410783.7	1914720.3	1779449.6	1921480.3	2333528.0	3237727.9	3882066.9

Appendix - K: Verification Results

PVMI Calculation Incorporating Actual Monthly Import Energy (GWh) and Calculated Monthly Import Energy (GWh) for Each Month of Year 2076 BS for Verification

NEA Generation: 450.05 MW

IPP Generation: 625 MW

Month	Baisakh	Jestha	Ashar	Shrawan	Bhadra	Ashoj	Kartik	Mangshir	Poush	Magh	Falgun	chaitra
Kulekhani -I (60 MW)	15.34	7.81	5.15	4.49	2.45	2.64	2.63	3.48	6.95	9.20	12.20	15.47
Kulekhani - II (32 MW)	8.18	4.16	2.75	2.39	1.31	1.41	1.41	1.86	3.71	4.91	6.51	8.25
Kulekhani -III (14 MW)	0.00	0.00	0.00	0.00	0.00	0.00	0.61	0.81	1.62	2.15	2.85	3.61
Kapadigadh HP (3.3 MW)	0.00	0.39	2.05	2.10	2.07	2.19	2.07	1.67	1.27	1.01	0.93	0.99
Pikhuwa Khola 5 (MW)	0.00	0.43	3.11	3.18	3.13	3.33	3.14	2.53	1.92	1.53	1.41	1.50
Lower Hewa Khola (22.1 MW)	0.00	0.00	0.00	5.16	13.84	14.70	13.88	11.18	8.51	6.75	6.21	6.65
Lower Chhote Kh (0.996MW)	0.00	0.00	0.00	0.00	0.23	0.66	0.63	0.50	0.38	0.30	0.28	0.30
Upper Mardi (7MW)	0.00	0.00	0.00	0.00	0.00	1.55	4.40	3.54	2.69	2.14	1.97	2.11
Iwa Khola (9.9 MW)	0.00	0.00	0.00	0.00	0.00	2.19	6.22	5.01	3.81	3.02	2.78	2.98
Kabeli B1 (25 MW)	0.00	0.00	0.00	0.00	0.00	0.00	3.66	12.65	9.62	7.63	7.03	7.52
NEA Gen	192.52	261.76	268.09	251.92	261.47	266.97	253.67	212.31	167.48	128.67	128.42	149.97
IPP Gen	227.98	319.47	388.79	397.69	391.46	415.65	392.45	316.23	240.62	190.87	175.74	188.11
EMEG	444.02	594.02	669.93	666.94	675.97	711.30	684.77	571.77	448.60	358.17	346.33	387.46
AMIE	298.82	267.83	208.80	151.45	192.97	45.59	20.24	102.07	254.85	290.49	290.06	147.60
AMEC	706.80	775.72	766.21	812.30	824.51	671.54	624.52	614.41	660.77	643.91	614.73	510.24
CMIE	262.78	181.70	96.28	145.36	148.54	-39.76	-60.25	42.64	212.17	285.74	268.40	122.78
PVMI without Outage Energy	12.06	32.16	53.89	4.02	23.02	187.21	397.68	58.22	16.75	1.64	7.47	16.82
Final PVMI with Outage Energy	**0.76**	**8.53**	**13.86**	**14.89**	**8.42**	**6.62**	**13.60**	**13.53**	**8.04**	**0.34**	**6.71**	**12.98**

Appendix - L: Distribution of Load and Capacitor across planned INPS for Load Flow Simulation to Accommodate the Required Monthly Peak Demand for fiscal year 084/85

Loads/Capacitors	Connected Bus	Power Factor (%)	Scenario - I		Scenario - II		Scenario - III		Scenario - IV		Scenario – V	
			Rating	% Loading	Rating	% Loading	Rating	% Loading	Rating	% Loading	Rating	% Loading
AadhiKhola	KGA 132 kV	89.44	8497 kVA	130	8497 kVA	198.7	8497 kVA	163.8	8497 kVA	173.8	8497 kVA	173.2
Added Cap_1	Parwanipur 132 kV	0			-50000 kvar	95.4			-25000 kvar	84.7		
Added Cap_2	Birgunj 66 kV	0			-50000 kvar	95			-25000 kvar	79.9		
Added Cap_3	Simara 66 kV	0			-50000 kvar	94.1						
Added Cap_4	Amlekhgunj 66 kV	0			-50000 kvar	95.7						
Added Cap_5	Pathlaiya 132 kV	0			-20000 kvar	95.3			-30000 kvar	87.2		
Added Cap_6	Kamane 132 kV	0			-40000 kvar	95.5						
Added L1	Balanch 132 kV	89.33			50000 kVA	267.8	20000 kVA	192.8	45000 kVA	246.7	40000 kVA	412.3
Added L3	Mainatara 132 kV	89.33			50000 kVA	246.4	20000 kVA	183.3	45000 kVA	238.9	40000 kVA	296.1
Added L5	Kusma 132 kV	89.33			50000 kVA	286.1	30000 kVA	219.5	40000 kVA	282.7	40000 kVA	326.1
Added L6	Damauli 220 kV	89.33			70000 kVA	295.7	40000 kVA	228.5	45000 kVA	288.5	45000 kVA	339.3
Added L7	Butwal 220 kV	89			80000 kVA	278.4	45000 kVA	211.4	60000 kVA	271.8	45000 kVA	320.4
Added L8	Udipur 220 kV	89.33			50000 kVA	314	30000 kVA	241.1	60000 kVA	297.6	45000 kVA	367.9
Added L9	Bharatpur 220 kV	89.33			80000 kVA	321.5	40000 kVA	246.7	60000 kVA	307.4	45000 kVA	378.7
Added L10	Trishuli 3B 220 kV	89.33			50000 kVA	305	30000 kVA	243.2	60000 kVA	306	45000 kVA	341
Added L12	Barhabise 220 kV	89.33			50000 kVA	304.1	40000 kVA	245.2	45000 kVA	304.8	45000 kVA	323
Added L13	Tamakoshi 220 kV	89.33			50000 kVA	306	30000 kVA	248.2	60000 kVA	307.6	40000 kVA	322.9
Added L14	Tingla	89.33			50000	305.1	30000	254.5	50000	306.2	45000	317.8

Loads/Capacitors	Connected Bus	Power Factor (%)	Scenario - I		Scenario - II		Scenario - III		Scenario - IV		Scenario – V	
			Rating	% Loading	Rating	% Loading	Rating	% Loading	Rating	% Loading	Rating	% Loading
	132 kV				kVA		kVA		kVA		kVA	
Added L16	Khadbari 220 kV	89.33			60000 kVA	301.6	40000 kVA	260.8	50000 kVA	301.2	40000 kVA	308.2
Added L17	Damak 400 kV	89.33			80000 kVA	310.1	50000 kVA	255.4	50000 kVA	308.6	45000 kVA	318.9
Added L19	Mirchaiya 400 kV	89.33			50000 kVA	304.1	50000 kVA	251.5	50000 kVA	305.6	40000 kVA	311.5
Added L20	Hetauda 400 kV	89.33			80000 kVA	308.3	50000 kVA	260.4	50000 kVA	315.7	40000 kVA	324.9
Added L22	Dodhara 400 kV	89.33			40000 kVA	241	20000 kVA	179.7	48000 kVA	234.2	45000 kVA	288.3
Added L26	New Marsyangdi 220 kV	89.33			50000 kVA	317.5	30000 kVA	244.8	40000 kVA	303.3	48000 kVA	375.4
Added L28	Dandakhet 220 kV	89.33			50000 kVA	284.6	30000 kVA	220.5	40000 kVA	284.6	45000 kVA	324.3
Added L30	Laphsiphedi 400 kV	89.33			50000 kVA	293.2	30000 kVA	232.7	40000 kVA	291.7		
Added L32	Inaruwa 220 kV	89.33			60000 kVA	300.9	50000 kVA	256.4	45000 kVA	305.3	50000 kVA	313.6
Added L35	Mahendranagar 132 kV	89.33			30000 kVA	267.8	20000 kVA	138.4	20000 kVA	249.9	45000 kVA	462.6
AirportLoad	New Chabahil 66 kV	89.44	21019 kVA	150.2	21019 kVA	244.9	21019 kVA	330.1	21019 kVA	281.3	21019 kVA	241.5
Amlekhgunj Load	Amlekhgunj 66 kV	88.58	2371 kVA	166.2	2371 kVA	156.8	2371 kVA	212.3	2371 kVA	222.5	2371 kVA	188.1
Anarmani Load	Anarmani 132 kV	89.44	43603 kVA	139.9	43603 kVA	193.7	43603 kVA	191.4	43603 kVA	192.1	43603 kVA	167.6
AnarmaniCap	Anarmani 132 kV	0	-20000 kvar	92.9	-20000 kvar	92.9	-20000 kvar	94	-20000 kvar	93.7	-20000 kvar	89.5
AshokSteel	Simara 66 kV	89.44	6708 kVA	178.8	6708 kVA	159.5	6708 kVA	210.9	6708 kVA	230.2	6708 kVA	195
Attariya Load	Attariya 132 kV	89.44	31305 kVA	107.1	31305 kVA	160.4	31305 kVA	138.3	31305 kVA	149	31305 kVA	208
Balaju Load	Balaju	89.44	34883	71.5	34883	119.2	34883	156.4	34883	135.8	34883	117.1

Loads/Capacitors	Connected Bus	Power Factor (%)	Scenario - I		Scenario - II		Scenario - III		Scenario - IV		Scenario – V	
			Rating	% Loading	Rating	% Loading	Rating	% Loading	Rating	% Loading	Rating	% Loading
	66 kV		kVA		kVA		kVA		kVA		kVA	
Balaju cap	Balaju 66 kV	0	-25000 kvar	87.4	-25000 kvar	75.5	-25000 kvar	57.5	-25000 kvar	66.3	-25000 kvar	64.1
Banepa Load	Banepa 66 kV	89.31	15339 kVA	147.7	15339 kVA	244.6	15339 kVA	335.8	15339 kVA	279.5	15339 kVA	235.5
BaneshworCap	Baneshwor 66 kV	0	-25000 kvar	87.4	-25000 kvar	75.1	-25000 kvar	56.4	-25000 kvar	65.8	-25000 kvar	63.4
Baneswor Load	Baneshwor 66 kV	89.38	31439 kVA	71.5	31439 kVA	119.8	31439 kVA	159.5	31439 kVA	136.8	31439 kVA	118.2
Bardghat Load	Bardghat 132 kV	89.44	8273 kVA	126.5	8273 kVA	172.8	8273 kVA	158	8273 kVA	168	8273 kVA	168.2
BhairahawaCap	Shivapur 132 kV	0	-10000 kvar	107.4	-10000 kvar	109.3	-10000 kvar	120.9	-10000 kvar	112.6	-10000 kvar	92.1
Bhaktpur Cap	Bhaktapur 132 kV	0	-50000 kvar	91.6	-50000 kvar	84.1	-50000 kvar	70.2	-50000 kvar	78	-50000 kvar	72.6
Bhaktpur Load	Bhaktapur 132 kV	89.44	38460 kVA	136.5	38460 kVA	214.1	38460 kVA	256.4	38460 kVA	230.8	38460 kVA	206.6
Bharatpur Load	Bharatpur 132 kV	89.44	99952 kVA	131.4	99952 kVA	192.4	99952 kVA	178.8	99952 kVA	185.1	99952 kVA	188.4
BharatpurCap	Bharatpur 132 kV	0	-27500 kvar	99.7	-27500 kvar	93.6	-27500 kvar	100.7	-27500 kvar	97.2	-27500 kvar	79.6
Birjung Cap	Birgunj 66 kV	0	-36000 kvar	70.8	-36000 kvar	95	-36000 kvar	100	-36000 kvar	79.9	-36000 kvar	72.6
Birjung Load	Birgunj 66 kV	89.55	58406 kVA	183.5	58406 kVA	157.9	58406 kVA	210	58406 kVA	225.4	58406 kVA	192.7
Butwal Cap	Butwal 132 kV	0	-40000 kvar	103.2	-40000 kvar	106.4	-40000 kvar	116.5	-40000 kvar	109.3	-40000 kvar	91.4
Butwal Load	Butwal 132 kV	89.46	124638 kVA	121.1	124638 kVA	169.1	124638 kVA	154.4	124638 kVA	164.8	124638 kVA	164.1
Cha.pur Load	Chapur 132 kV	89.4	50222 kVA	145.2	50222 kVA	189.8	50222 kVA	203.7	50222 kVA	202.9	50222 kVA	165.3
Chabel Load	New Chabahil 66 kV	89.44	38908 kVA	144.4	38908 kVA	244.9	38908 kVA	330.1	38908 kVA	281.3	38908 kVA	241.5
Chapali Load	Chapali 66 kV	89.36	25402 kVA	141.5	25402 kVA	236.6	25402 kVA	310	25402 kVA	268.2	25402 kVA	231.1

Loads/Capacitors	Connected Bus	Power Factor (%)	Scenario - I		Scenario - II		Scenario - III		Scenario - IV		Scenario – V	
			Rating	% Loading	Rating	% Loading	Rating	% Loading	Rating	% Loading	Rating	% Loading
Damak Load	Damak 132 kV	89.44	23702 kVA	138	23702 kVA	189.5	23702 kVA	187.4	23702 kVA	188	23702 kVA	164.5
Damauli Load	Damauli 132 kV	89.03	29204 kVA	128.6	29204 kVA	179.1	29204 kVA	166.6	29204 kVA	174.4	29204 kVA	172
DevighatLoad	Devighat 66 kV	89.17	7290 kVA	138.8	7290 kVA	223.8	7290 kVA	283.4	7290 kVA	250.6	7290 kVA	209.7
Dhalkebar Cap	Dhalkebar 132 kV	0	-25000 kvar	94.8	-25000 kvar	98.4	-25000 kvar	96.8	-25000 kvar	97	-25000 kvar	93.2
Dhalkebar Load	Dhalkebar 132 kV	89.46	89756 kVA	131.9	89756 kVA	152.4	89756 kVA	185.9	89756 kVA	185.5	89756 kVA	166.4
Duhabi Cap	Duhabi 132 kV	0	-67000 kvar	87.8	-67000 kvar	99.5	-67000 kvar	86	-67000 kvar	99	-67000 kvar	81.6
DuhabiandDhankuta	Duhabi 132 kV	89.44	97045 kVA	148	97045 kVA	180.8	97045 kVA	209.2	97045 kVA	177.7	97045 kVA	183.8
GhorahiCement	Lamahi 132 kV	80	12500 kVA	117.8	12500 kVA	161.4	12500 kVA	145	12500 kVA	156.2	12500 kVA	161.9
Hama Steel	Simara 66 kV	89.44	3801 kVA	171.9	3801 kVA	159.5	3801 kVA	210.9	3801 kVA	230.2	3801 kVA	195
Harisidhhi	Patan 66 kV	89.38	29650 kVA	144.3	29650 kVA	242	29650 kVA	322.7	29650 kVA	277.2	29650 kVA	239.4
Hetauda cap	Hetauda 66 kV	0	-10000 kvar	92.8	-10000 kvar	95.5	-10000 kvar	90.2	-10000 kvar	90.7	-10000 kvar	85.5
Hetauda66 Load	Hetauda 66 kV	89.35	22271 kVA	148	22271 kVA	190.6	22271 kVA	208.8	22271 kVA	210.4	22271 kVA	189.8
HetaudaCement	Hetauda 66 kV	89.18	7737 kVA	148	7737 kVA	190.6	7737 kVA	208.8	7737 kVA	210.4	7737 kVA	189.8
HimalIron	Parwanipur 66 kV	90.02	3444 kVA	175.1	3444 kVA	156.6	3444 kVA	194.4	3444 kVA	215.8	3444 kVA	183.6
HulasSteel	Simara 66 kV	89.44	11851 kVA	180.2	11851 kVA	159.5	11851 kVA	210.9	11851 kVA	230.2	11851 kVA	195
Ilam	Ilam (Godak) 132 kV	89.44	55000 kVA	136	40000 kVA	153.1	55000 kVA	184.9	55000 kVA	183.7	55000 kVA	161.3
JagadambaSteel	Simara 66 kV	89.44	32647 kVA	180.2	32647 kVA	159.5	32647 kVA	210.9	32647 kVA	230.2	32647 kVA	208.9
Jhimruk Load	Jhimruk	89.44	5143	117.9	5143	160.7	5143	144.5	5143	155.6	5143	160.4

Loads/Capacitors	Connected Bus	Power Factor (%)	Scenario - I		Scenario - II		Scenario - III		Scenario - IV		Scenario – V	
			Rating	% Loading	Rating	% Loading	Rating	% Loading	Rating	% Loading	Rating	% Loading
	132 kV		kVA		kVA		kVA		kVA		kVA	
JyotiSpinning	Parwanipur 66 kV	88.58	2371 kVA	176.5	2371 kVA	156.6	2371 kVA	194.4	2371 kVA	215.8	2371 kVA	183.6
K-3 Cap	Singhadurbar 66 kV	0	-10 kvar	85	-10 kvar	72.9	-10 kvar	54.4	-10 kvar	63.2	-10 kvar	61.1
K-3 Load	Singhadurbar 66 kV	89.49	39891 kVA	154.2	39891 kVA	247.1	39891 kVA	331.1	39891 kVA	284.7	39891 kVA	245.5
Kamane Load	Kamane 132 kV	89.31	15116 kVA	142.4	15116 kVA	157	15116 kVA	201.2	15116 kVA	200	15116 kVA	165.6
Kawasoti Load	Kawasoti 132 kV	89.33	17128 kVA	130.8	17128 kVA	186.3	17128 kVA	171.7	17128 kVA	179.9	17128 kVA	182.1
KL-1(DCS)	Kulekhani – 1 66 kV	91.91	7616 kVA	148.5	7616 kVA	196.8	7616 kVA	223.2	7616 kVA	217.9	7616 kVA	200.6
KohalpurandSurkhet	Kohalpur 132 kV	89.44	29292 kVA	110.4	29292 kVA	149.9	29292 kVA	134.3	29292 kVA	144.9	29292 kVA	152.9
Lahan Load	Lahan 132 kV	89.44	72001 kVA	139.2	72001 kVA	186.2	72001 kVA	192.9	72001 kVA	186.9	72001 kVA	167.4
LahanCap	Lahan 132 kV	0	-30000 kvar	94.1	-30000 kvar	96.7	-30000 kvar	93.3	-30000 kvar	96.3	-30000 kvar	89.6
Lainchor Load	Lainchaur 66 kV	89.4	51340 kVA	151.4	51340 kVA	244.5	51340 kVA	328.5	51340 kVA	280.7	51340 kVA	241
LamahiDangandSalyan	Lamahi 132 kV	89.44	42262 kVA	118.8	42262 kVA	161.4	42262 kVA	145	42262 kVA	156.2	42262 kVA	161.9
Leknath Load	Lekhnath 132 kV	89.44	10510 kVA	130.7	10510 kVA	180.6	10510 kVA	167.2	10510 kVA	175.8	10510 kVA	174
Lumki Load	Lumki 132 kV	89.76	6351 kVA	108.6	6351 kVA	155.4	6351 kVA	136.2	6351 kVA	146.8	6351 kVA	180.3
Mahendra Load	Mahendranagar 132 kV	89.67	8587 kVA	107.3	8587 kVA	162.3	8587 kVA	230.6	8587 kVA	249.9	8587 kVA	231.3
MarsyandiDCS	Marsyangdi 132 kV	89.44	2460 kVA	130.3	2460 kVA	189.2	2460 kVA	178.5	2460 kVA	182.7	2460 kVA	188.7
Mirchiya Load	Mirchaiya 132 kV	89.44	8273 kVA	135.4	8273 kVA	184	8273 kVA	186.5	8273 kVA	308.4	8273 kVA	161.1
Modi Load	Modi 132 kV	89.44	8497 kVA	129.9	8497 kVA	184.9	8497 kVA	170.8	8497 kVA	179.8	8497 kVA	175.3

Loads/Capacitors	Connected Bus	Power Factor (%)	Scenario - I		Scenario - II		Scenario - III		Scenario - IV		Scenario – V	
			Rating	% Loading	Rating	% Loading	Rating	% Loading	Rating	% Loading	Rating	% Loading
Muzzafarpur Load	Muzzafarpur 400 kV	89.25	1344550 kVA	106.4								
Kulekhani Cap	Kulekhani 1 66 kV	0	-20000 kvar	88.2	-20000 kvar	91.5	-20000 kvar	80.6	-20000 kvar	82.6	-20000 kvar	74.8
NewChabilCap	New Chabahil 66 kV	0	-25000 kvar	86.6	-25000 kvar	73.5	-25000 kvar	54.5	-25000 kvar	64	-25000 kvar	62.1
NewDuhabi	Duhabi 132 kV	89.44	97045 kVA	148	97045 kVA	180.8	97045 kVA	209.2	97045 kVA	181.8	97045 kVA	183.8
Panchkhal Load	Panchkhal 66 kV	89.44	9168 kVA	147.1	9168 kVA	245.4	9168 kVA	338.4	9168 kVA	280.8	9168 kVA	234.7
Parwanipur Cap	Parwanipur 132 kV	0	-48000 kvar	86.4	-48000 kvar	95.4	-48000 kvar	84.7	-48000 kvar	84.7	-48000 kvar	77.6
Parwanipur load	Parwanipur 132 kV	89.55	58406 kVA	151.7	58406 kVA	157.2	58406 kVA	212.6	58406 kVA	212.5	57406 kVA	180.4
Patan Load	Patan 66 kV	89.35	22271 kVA	151.2	22271 kVA	242	22271 kVA	322.7	22271 kVA	277.2	22271 kVA	239.4
PatanCap	Patan 66 kV	0	-25000 kvar	86.6	-25000 kvar	74.4	-25000 kvar	55.8	-25000 kvar	64.9	-25000 kvar	62.7
Pathliya Load	Pathlaiya 132 kV	85	13240 kVA	140.4	13240 kVA	154.5	13240 kVA	197.3	13240 kVA	196.6	13240 kVA	172.7
Pokhara Load	Pokhara 132 kV	89.44	32647 kVA	130.1	32647 kVA	182.6	32647 kVA	169	32647 kVA	177.7	32647 kVA	175.3
ShivapurandDynasty	Shivapur 132 kV	89.44	26386 kVA	121.1	26386 kVA	164.7	26386 kVA	148.9	26386 kVA	159.9	26386 kVA	162.9
simara Load	Simara 66 kV	89.44	35777 kVA	180.2	35777 kVA	159.5	35777 kVA	210.9	35777 kVA	230.2	35777 kVA	208.9
SimaraCap	Simara 66 kV	0	-15000 kvar	72.7	-15000 kvar	94.1	-15000 kvar	85.4	-15000 kvar	78.2	-15000 kvar	71.8
Siuchatar cap1	Suchatar 132 kV	0	-25000 kvar	91.7	-25000 kvar	85.9	-25000 kvar	75.6	-25000 kvar	80.2	-25000 kvar	75.1
SuitchatarLoad	Suichatar 66 kV	89.39	39265 kVA	149.4	39265 kVA	236.4	39265 kVA	306.1	39265 kVA	268.5	39265 kVA	217.4
SunkoshiLoad	Sunkoshi 66 kV	89.17	7290 kVA	147.5	7290 kVA	247	7290 kVA	343.2	7290 kVA	283.4	7290 kVA	234.2
Teku Load	Teku	89.4	45526	152.3	45526	245	45526	326.2	45526	281.5	45526	243

Loads/Capacitors	Connected Bus	Power Factor (%)	Scenario - I		Scenario - II		Scenario - III		Scenario - IV		Scenario – V	
			Rating	% Loading	Rating	% Loading	Rating	% Loading	Rating	% Loading	Rating	% Loading
	66 kV		kVA		kVA		kVA		kVA		kVA	
Trishuli Load	Trishuli 66 kV	89.31	14892 kVA	137	14892 kVA	220.5	14892 kVA	276.6	14892 kVA	246	14892 kVA	205.3
Triveni Yarn	Birgunj 66 kV	89.44	4249 kVA	183.5	4249 kVA	157.9	4249 kVA	200	4249 kVA	225.4	4249 kVA	206.5
TriveniSpinningMill	Birgunj 66 kV	89.12	6172 kVA	183.5	6172 kVA	189.5	6172 kVA	200	6172 kVA	225.4	6172 kVA	192.7

Appendix - M: Results for Expected Monthly Surplus – Deficit Energy of Projected Ten Years Period

1. Expected Monthly Surplus (+) & Deficit (–) Energy (MWh) for Fiscal Year 077/78

(i) Normal Scenario of Expected Energy Consumption

SCENARIO/MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangshir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
Normal	495268	546566	777478	783179	567817	213193	89114	38471	111687	155466	441254	881394
With IPP Shift	-79777	-97518	24083	17187	-47835	-256406	-290752	-316501	-287046	-330922	-245471	-59595
With NEA and IPP Shift	-159824	-176311	-59580	-61806	-111485	-304838	-329171	-351874	-324909	-376811	-309774	-137850

(ii) Growth with Categorization of Consumption Scenario of Expected Energy Consumption

SCENARIO/MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangshir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
Normal	358610	407198	652607	664040	459783	91943	-22063	-74816	-3727	17630	289978	731972
With IPP Shift	-216435	-236886	-100788	-101952	-155869	-377657	-401929	-429789	-402461	-468758	-396747	-209017
With NEA and IPP Shift	-296482	-315679	-184451	-180945	-219519	-426088	-440348	-465161	-440324	-514647	-461050	-287272

(iii) Intervention with Induction Chulo Scenario of Expected Energy Consumption

SCENARIO/MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangshir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
Normal	293482	342070	587479	598912	394655	26815	-87191	-139944	-68855	-47498	224850	666844
With IPP Shift	-281563	-302014	-165916	-167080	-220997	-442785	-467057	-494917	-467589	-533886	-461875	-274145
With NEA and IPP Shift	-361610	-380807	-249579	-246073	-284647	-491216	-505476	-530289	-505452	-579775	-526178	-352399

(iv) Intervention with Electric Vehicle Scenario of Expected Energy Consumption

SCENARIO/MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangshir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
Normal	358188	406353	651340	662351	457672	89409	-25019	-78195	-7528	13407	285333	726904
With IPP Shift	-216857	-237730	-102055	-103642	-157980	-380191	-404885	-433168	-406262	-472982	-401392	-214085
With NEA and IPP Shift	-296904	-316524	-185718	-182635	-221630	-428622	-443304	-468540	-444125	-518870	-465695	-292340

(v) Combined Intervention with Electric Vehicle Scenario of Expected Energy Consumption

SCENARIO/MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangshir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
Normal	293060	341225	586212	597223	392544	24281	-90147	-143323	-72656	-51721	220205	661776
With IPP Shift	-281985	-302858	-167183	-168770	-223108	-445319	-470013	-498296	-471390	-538110	-466520	-279213
With NEA and IPP Shift	-362032	-381652	-250846	-247763	-286758	-493750	-508432	-533668	-509253	-583998	-530823	-357468

2. Expected Monthly Surplus (+) & Deficit (–) Energy (MWh) for Fiscal Year 078/79

(i) Normal Scenario of Expected Energy Consumption

SCENARIO/MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangshir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
Normal	1301111	1270661	1539532	1462297	1113576	621055	432412	349461	440563	569130	1056803	1462783
With IPP Shift	815387	855501	1120684	1103680	822374	388896	223693	155721	254687	331490	703289	1116145
With NEA and IPP Shift	643394	686202	940922	933952	685613	284835	141145	79717	162197	219395	546212	924987

(ii) Growth with Categorization of Consumption Scenario of Expected Energy Consumption

SCENARIO/MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangshir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
Normal	1069219	1034171	1327642	1260133	930256	415308	243759	157225	244718	335240	800107	1209233
With IPP Shift	583496	619011	908793	901515	639054	183149	35041	-36515	58842	97600	446593	862595
With NEA and IPP Shift	411502	449711	729032	731787	502292	79088	-47508	-112518	-33648	-14496	289516	671437

(iii) Intervention with Induction Chulo Scenario of Expected Energy Consumption

SCENARIO/MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangshir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
Normal	938964	903915	1197386	1129877	800000	285052	113503	26969	114463	204984	669852	1078977
With IPP Shift	453240	488755	778537	771260	508798	52893	-95215	-166771	-71414	-32656	316337	732339
With NEA and IPP Shift	281246	319455	598776	601531	372036	-51168	-177764	-242774	-163904	-144752	159260	541181

(iv) Intervention with Electric Vehicle Scenario of Expected Energy Consumption

SCENARIO/MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangshir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
Normal	1063307	1027413	1320040	1251686	920964	405172	232778	145400	232048	321725	785748	1194029
With IPP Shift	577583	612253	901191	893069	629762	173013	24060	-48341	46172	84085	432234	847391
With NEA and IPP Shift	405589	442954	721430	723340	493001	68952	-58489	-124344	-46318	-28011	275157	656233

(v) Combined Intervention with Electric Vehicle Scenario of Expected Energy Consumption

SCENARIO/MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangshir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
Normal	933051	897158	1189784	1121430	790708	274916	102523	15144	101792	191469	655492	1063773
With IPP Shift	447327	481997	770935	762813	499506	42757	-106196	-178597	-84084	-46171	301978	717135
With NEA and IPP Shift	275333	312698	591174	593085	362745	-61304	-188745	-254600	-176574	-158267	144901	525977

3. Expected Monthly Surplus (+) & Deficit (–) Energy (MWh) for Fiscal Year 079/80

(i) Normal Scenario of Expected Energy Consumption

SCENARIO/MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangshir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
Normal	1567228	1657986	1927260	1879912	1446382	863088	595285	501507	603910	775599	1355903	1874221
With IPP Shift	1257441	1221319	1503205	1424401	1078888	575178	390645	303928	387271	507334	987188	1385141
With NEA and IPP Shift	1061904	1028845	1298837	1231440	923405	456872	296796	217521	294781	395238	830111	1193983

(ii) Growth with Categorization of Consumption Scenario of Expected Energy Consumption

SCENARIO/MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangshir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
Normal	1217128	1300943	1607357	1574693	1169613	552461	310465	211278	308232	422481	968355	1491423
With IPP Shift	907341	864276	1183303	1119182	802119	264550	105825	13699	91594	154216	599640	1002342
With NEA and IPP Shift	711804	671801	978935	926221	646636	146244	11977	-72708	-896	42120	442563	811184

(iii) Intervention with Induction Chulo Scenario of Expected Energy Consumption

SCENARIO/MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangshir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
Normal	1021744	1105559	1411973	1379309	974229	357077	115081	15894	112848	227098	772971	1296039
With IPP Shift	711957	668892	987919	923799	606735	69166	-89559	-181685	-103790	-41168	404256	806958
With NEA and IPP Shift	516420	476418	783551	730837	451253	-49140	-183407	-268092	-196280	-153263	247179	615800

(iv) Intervention with Electric Vehicle Scenario of Expected Energy Consumption

SCENARIO/MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangshir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
Normal	1200656	1283204	1588351	1554420	1148073	529655	286392	185937	281625	394607	939213	1461014
With IPP Shift	890870	846538	1164297	1098910	780579	241744	81752	-11642	64987	126341	570499	971934
With NEA and IPP Shift	695333	654063	959929	905949	625097	123438	-12097	-98049	-27504	14246	413422	780775

(v) Combined Intervention with Electric Vehicle Scenario of Expected Energy Consumption

SCENARIO/MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangshir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
Normal	1005273	1087820	1392968	1359036	952690	334271	91008	-9447	86241	199223	743829	1265630
With IPP Shift	695486	651154	968913	903526	585195	46360	-113632	-207025	-130397	-69042	375115	776550
With NEA and IPP Shift	499949	458679	764545	710565	429713	-71946	-207481	-293432	-222887	-181138	218038	585392

4. Expected Monthly Surplus (+) & Deficit (–) Energy (MWh) for Fiscal Year 080/81

(i) Normal Scenario of Expected Energy Consumption

SCENARIO/MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangshir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
Normal	2054655	2101083	2432961	2348596	1824652	1140312	830230	716621	852490	1193552	1960441	2599757
With IPP Shift	1494364	1579707	1861164	1813857	1388507	797954	537622	440886	545847	759173	1351595	1877489
With NEA and IPP Shift	1378875	1466026	1740458	1699889	1296674	728079	482192	389852	491219	641898	1187260	1767385

(ii) Growth with Categorization of Consumption Scenario of Expected Energy Consumption

SCENARIO/MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangshir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
Normal	1558653	1595244	1979740	1916179	1432541	700232	426713	305440	433591	693274	1411385	2057430
With IPP Shift	998362	1073868	1407943	1381440	996396	357874	134105	29706	126947	258895	802539	1335162
With NEA and IPP Shift	882873	960187	1287238	1267472	904564	288000	78676	-21328	72320	141620	638203	1225057

(iii) Intervention with Induction Chulo Scenario of Expected Energy Consumption

SCENARIO/MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangshir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
Normal	1298141	1334732	1719228	1655667	1172030	439720	166201	44929	173079	432762	1150873	1796918
With IPP Shift	737850	813356	1147431	1120928	735884	97362	-126407	-230806	-133564	-1617	542027	1074650
With NEA and IPP Shift	622361	699675	1026726	1006960	644052	27488	-181836	-281840	-188192	-118892	377691	964546

(iv) Intervention with Electric Vehicle Scenario of Expected Energy Consumption

SCENARIO/MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangshir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
Normal	1526555	1561457	1944263	1879013	1393686	659687	384479	261517	387978	645972	1362393	2006749
With IPP Shift	966264	1040081	1372466	1344274	957540	317330	91871	-14217	81335	211593	753547	1284481
With NEA and IPP Shift	850775	926400	1251761	1230306	865708	247455	36441	-65252	26707	94318	589212	1174376

(v) Combined Intervention with Electric Vehicle Scenario of Expected Energy Consumption

SCENARIO/MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangshir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
Normal	1266043	1300945	1683752	1618501	1133174	399175	123967	1005	127466	385460	1101881	1746237
With IPP Shift	705752	779569	1111955	1083762	697029	56818	-168641	-274729	-179177	-48919	493035	1023969
With NEA and IPP Shift	590263	665888	991249	969794	605196	-13057	-224070	-325764	-233805	-166194	328700	913865

5. Expected Monthly Surplus (+) & Deficit (–) Energy (MWh) for Fiscal Year 081/82

(i) Normal Scenario of Expected Energy Consumption

SCENARIO/MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangshir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
Normal	2674543	2607054	2941484	2772042	2143924	1359390	982757	833899	953395	1175128	1959862	2638616
With IPP Shift	2064773	2104269	2454396	2365132	1832788	1123661	810358	690308	831411	1119903	1877818	2509266
With NEA and IPP Shift	1952146	1993407	2336683	2253989	1743233	1055519	756303	640539	789275	1068834	1806257	2422178

(ii) Growth with Categorization of Consumption Scenario of Expected Energy Consumption

SCENARIO/MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangshir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
Normal	1999294	1918413	2324477	2183357	1610111	760273	433416	274125	383112	494058	1212386	1900300
With IPP Shift	1389524	1415629	1837389	1776446	1298975	524544	261017	130534	261129	438833	1130341	1770950
With NEA and IPP Shift	1276897	1304766	1719676	1665304	1209420	456402	206962	80765	218992	387764	1058780	1683862

(iii) Intervention with Induction Chulo Scenario of Expected Energy Consumption

SCENARIO/MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangshir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
Normal	1673654	1592773	1998837	1857717	1284471	434633	107776	-51515	57472	168418	886746	1574660
With IPP Shift	1063884	1089989	1511749	1450807	973335	198904	-64622	-195106	-64511	113193	804702	1445310
With NEA and IPP Shift	951258	979126	1394036	1339664	883780	130762	-118678	-244875	-106648	62124	733140	1358222

(iv) Intervention with Electric Vehicle Scenario of Expected Energy Consumption

SCENARIO/MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangshir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
Normal	1946501	1863509	2267461	2124229	1548872	696922	367953	206551	313426	422260	1138476	1824279
With IPP Shift	1336731	1360724	1780372	1717318	1237735	461193	195554	62959	191442	367035	1056432	1694928
With NEA and IPP Shift	1224105	1249862	1662660	1606176	1148180	393050	141499	13190	149305	315966	984870	1607840

(v) Combined Intervention with Electric Vehicle Scenario of Expected Energy Consumption

SCENARIO/MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangshir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
Normal	1620862	1537869	1941821	1798589	1223232	371282	42313	-119089	-12214	96620	812836	1498639
With IPP Shift	1011091	1035084	1454733	1391679	912096	135553	-130085	-262681	-134198	41395	730792	1369289
With NEA and IPP Shift	898465	924222	1337020	1280536	822540	67411	-184141	-312450	-176334	-9674	659231	1282201

6. Expected Monthly Surplus (+) & Deficit (–) Energy (MWh) for Fiscal Year 082/83

(i) Normal Scenario of Expected Energy Consumption

SCENARIO/MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangshir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
Normal	2714284	2671200	3024637	2849749	2198703	1342668	933288	781240	900835	1112757	1899721	2569338
With IPP Shift	2588988	2515832	2863791	2694923	2076016	1282996	914769	762758	884614	1094832	1869945	2540920
With NEA and IPP Shift	2499905	2428144	2770685	2607014	2005181	1229098	872013	723393	842477	1043764	1798383	2453832

(ii) Growth with Categorization of Consumption Scenario of Expected Energy Consumption

SCENARIO/MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangshir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
Normal	1819678	1758852	2207194	2069827	1491479	548926	205492	39621	145295	210440	909425	1591178
With IPP Shift	1694383	1603484	2046348	1915002	1368792	489253	186973	21140	129073	192515	879648	1562760
With NEA and IPP Shift	1605300	1515797	1953242	1827092	1297958	435355	144217	-18225	86936	141446	808087	1475672

(iii) Intervention with Induction Chulo Scenario of Expected Energy Consumption

SCENARIO/MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangshir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
Normal	1428911	1368085	1816426	1679059	1100711	158158	-185276	-351146	-245473	-180328	518657	1200411
With IPP Shift	1303615	1212717	1655580	1524234	978025	98486	-203795	-369628	-261695	-198253	488881	1171992
With NEA and IPP Shift	1214532	1125029	1562474	1436324	907190	44588	-246550	-408993	-303832	-249321	417319	1084904

(iv) Intervention with Electric Vehicle Scenario of Expected Energy Consumption

SCENARIO/MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangshir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
Normal	1741123	1677763	2123570	1983669	1402787	457700	111732	-56672	46467	109078	805529	1484748
With IPP Shift	1615827	1522395	1962724	1828844	1280101	398027	93213	-75154	30245	91153	775752	1456330
With NEA and IPP Shift	1526744	1434707	1869618	1740935	1209266	344130	50457	-114519	-11892	40084	704191	1369242

(v) Combined Intervention with Electric Vehicle Scenario of Expected Energy Consumption

SCENARIO/MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangshir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
Normal	1350355	1286995	1732803	1592902	1012020	66932	-279036	-447440	-344301	-281690	414761	1093980
With IPP Shift	1225060	1131627	1571957	1438076	889333	7260	-297555	-465922	-360523	-299615	384985	1065562
With NEA and IPP Shift	1135977	1043939	1478850	1350167	818498	-46638	-340310	-505287	-402659	-350683	313423	978474

7. Expected Monthly Surplus (+) & Deficit (–) Energy (MWh) for Fiscal Year 083/84

(i) Normal Scenario of Expected Energy Consumption

SCENARIO/MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangshir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
Normal	2646839	2573216	2936846	2765987	2122749	1257422	855124	701591	819692	1015850	1793365	2464286
With IPP Shift	2621612	2572720	2940442	2766425	2125169	1259959	859510	704198	826043	1025283	1801925	2463860
With NEA and IPP Shift	2532529	2485032	2847335	2678516	2054334	1206061	816754	664833	783907	1025283	1801925	2463860

(ii) Growth with Categorization of Consumption Scenario of Expected Energy Consumption

SCENARIO/MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangshir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
Normal	1484670	1387999	1874917	1752802	1204005	226283	-90345	-261834	-161819	-156336	506887	1193573
With IPP Shift	1459444	1387503	1878513	1753241	1206425	228820	-85959	-259226	-155468	-146903	515446	1193147
With NEA and IPP Shift	1370361	1299815	1785407	1665331	1135590	174922	-128714	-298592	-197605	-146903	515446	1193147

(iii) Intervention with Induction Chulo Scenario of Expected Energy Consumption

SCENARIO/MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangshir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
Normal	1028775	932103	1419022	1296907	748109	-229612	-546240	-717729	-617715	-612232	50991	737677
With IPP Shift	1003548	931607	1422618	1297345	750529	-227075	-541855	-715122	-611364	-602799	59551	737251
With NEA and IPP Shift	914465	843920	1329511	1209436	679694	-280973	-584610	-754488	-653500	-602799	59551	737251

(iv) Intervention with Electric Vehicle Scenario of Expected Energy Consumption

SCENARIO/MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangshir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
Normal	1375284	1275656	1759618	1634547	1082793	102115	-217469	-391915	-294857	-292330	367936	1051666
With IPP Shift	1350057	1275160	1763214	1634985	1085213	104652	-213084	-389308	-288506	-282897	376496	1051240
With NEA and IPP Shift	1260974	1187472	1670108	1547076	1014378	50754	-255839	-428673	-330642	-282897	376496	1051240

(v) Combined Intervention with Electric Vehicle Scenario of Expected Energy Consumption

SCENARIO/MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangshir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
Normal	919388	819760	1303722	1178651	626897	-353781	-673365	-847810	-750753	-748226	-87959	595770
With IPP Shift	894161	819264	1307318	1179090	629317	-351244	-668979	-845203	-744401	-738793	-79400	595344
With NEA and IPP Shift	805079	731577	1214212	1091180	558482	-405142	-711735	-884569	-786538	-738793	-79400	595344

8. Expected Monthly Surplus (+) & Deficit (–) Energy (MWh) for Fiscal Year 084/85

(i) Normal Scenario of Expected Energy Consumption

SCENARIO/MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangshir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
Normal	2543074	2467393	2842031	2675524	2040718	1165356	770707	615571	732057	911191	1678501	2350829
With IPP Shift	2546481	2466897	2845627	2675962	2043138	1167893	775093	618178	738408	920624	1687061	2350403
With NEA and IPP Shift	2546481	2466897	2845627	2675962	2043138	1167893	775093	618178	738408	920624	1687061	2350403

(ii) Growth with Categorization of Consumption Scenario of Expected Energy Consumption

SCENARIO/MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangshir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
Normal	1055444	950260	1482713	1378600	864683	-154550	-439537	-617658	-524324	-589263	31748	724257
With IPP Shift	1058851	949764	1486309	1379039	867103	-152013	-435151	-615051	-517972	-579830	40308	723831
With NEA and IPP Shift	1058851	949764	1486309	1379039	867103	-152013	-435151	-615051	-517972	-579830	40308	723831

(iii) Intervention with Induction Chulo Scenario of Expected Energy Consumption

SCENARIO/MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangshir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
Normal	534420	429236	961689	857577	343659	-675573	-960561	-1138681	-1045347	-1110287	-489276	203234
With IPP Shift	537827	428740	965285	858015	346079	-673036	-956175	-1136074	-1038996	-1100854	-480716	202808
With NEA and IPP Shift	537827	428740	965285	858015	346079	-673036	-956175	-1136074	-1038996	-1100854	-480716	202808

(iv) Intervention with Electric Vehicle Scenario of Expected Energy Consumption

SCENARIO/MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangshir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
Normal	910158	801595	1330670	1223179	705882	-316729	-605095	-786594	-696639	-764957	-147325	541806
With IPP Shift	913565	801099	1334266	1223617	708302	-314192	-600709	-783987	-690287	-755524	-138765	541380
With NEA and IPP Shift	913565	801099	1334266	1223617	708302	-314192	-600709	-783987	-690287	-755524	-138765	541380

(v) Combined Intervention with Electric Vehicle Scenario of Expected Energy Consumption

SCENARIO/MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangshir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
Normal	389135	280572	809646	702155	184858	-837753	-1126119	-1307618	-1217663	-1285981	-668348	20782
With IPP Shift	392542	280076	813242	702594	187278	-835216	-1121733	-1305011	-1211311	-1276548	-659789	20356
With NEA and IPP Shift	392542	280076	813242	702594	187278	-835216	-1121733	-1305011	-1211311	-1276548	-659789	20356

9. Expected Monthly Surplus (+) & Deficit (–) Energy (MWh) for Fiscal Year 085/86

(i) Normal Scenario of Expected Energy Consumption

SCENARIO/MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangshir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
Normal	2431008	2353104	2739630	2577824	1952125	1065925	679537	522669	637411	798158	1554448	2228296
With IPP Shift	2434415	2352608	2743226	2578262	1954545	1068462	683923	525277	643763	807592	1563008	2227870
With NEA and IPP Shift	2434415	2352608	2743226	2578262	1954545	1068462	683923	525277	643763	807592	1563008	2227870

(ii) Growth with Categorization of Consumption Scenario of Expected Energy Consumption

SCENARIO/MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangshir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
Normal	548417	433177	1019418	936572	463856	-604412	-852023	-1037977	-952534	-1100661	-529513	169875
With IPP Shift	551824	432681	1023014	937010	466276	-601875	-847637	-1035370	-946183	-1091228	-520953	169449
With NEA and IPP Shift	551824	432681	1023014	937010	466276	-601875	-847637	-1035370	-946183	-1091228	-520953	169449

(iii) Intervention with Induction Chulo Scenario of Expected Energy Consumption

SCENARIO /MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangshir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
Normal	-37735	-152975	433267	350420	-122296	-1190563	-1438174	-1624129	-1538686	-1686813	-1115664	-416277
With IPP Shift	-34328	-153470	436863	350859	-119876	-1188026	-1433789	-1621522	-1532334	-1677380	-1107104	-416703
With NEA and IPP Shift	-34328	-153470	436863	350859	-119876	-1188026	-1433789	-1621522	-1532334	-1677380	-1107104	-416703

(iv) Intervention with Electric Vehicle Scenario of Expected Energy Consumption

SCENARIO/MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangshir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
Normal	362164	243123	825563	738916	262399	-809670	-1061082	-1250838	-1169195	-1321123	-753776	-58190
With IPP Shift	365571	242627	829159	739354	264819	-807133	-1056696	-1248231	-1162844	-1311690	-745216	-58616
With NEA and IPP Shift	365571	242627	829159	739354	264819	-807133	-1056696	-1248231	-1162844	-1311690	-745216	-58616

(v) Combined Intervention with Electric Vehicle Scenario of Expected Energy Consumption

SCENARIO/ MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangshir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
Normal	-223988	-343028	239412	152764	-323753	-1395821	-1647234	-1836989	-1755347	-1907275	-1339928	-644341
With IPP Shift	-220581	-343524	243008	153203	-321333	-1393284	-1642848	-1834382	-1748995	-1897842	-1331368	-644767
With NEA and IPP Shift	-220581	-343524	243008	153203	-321333	-1393284	-1642848	-1834382	-1748995	-1897842	-1331368	-644767

10. Expected Monthly Surplus (+) & Deficit (–) Energy (MWh) for Fiscal Year 086/87

(i) Normal Scenario of Expected Energy Consumption

SCENARIO/MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangshir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
Normal	2309976	2229672	2629038	2472308	1856444	958539	581073	422336	535194	676084	1420470	2095961
With IPP Shift	2313383	2229176	2632634	2472747	1858864	961076	585459	424943	541545	685517	1429030	2095535
With NEA and IPP Shift	2313383	2229176	2632634	2472747	1858864	961076	585459	424943	541545	685517	1429030	2095535

(ii) Growth with Categorization of Consumption Scenario of Expected Energy Consumption

SCENARIO/ MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangshir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
Normal	-50960	-178087	471739	414032	-9977	-1136211	-1339639	-1534854	-1458739	-1705205	-1193001	-485483
With IPP Shift	-47553	-178582	475335	414471	-7557	-1133674	-1335253	-1532247	-1452387	-1695772	-1184441	-485909
With NEA and IPP Shift	-47553	-178582	475335	414471	-7557	-1133674	-1335253	-1532247	-1452387	-1695772	-1184441	-485909

(iii) Intervention with Induction Chulo Scenario of Expected Energy Consumption

SCENARIO/ MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangshir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
Normal	-702240	-829366	-179540	-237248	-661256	-1787491	-1990918	-2186134	-2110018	-2356484	-1844281	-1136762
With IPP Shift	-698833	-829862	-175944	-236809	-658836	-1784954	-1986533	-2183527	-2103667	-2347051	-1835721	-1137188
With NEA and IPP Shift	-698833	-829862	-175944	-236809	-658836	-1784954	-1986533	-2183527	-2103667	-2347051	-1835721	-1137188

(iv) Intervention with Electric Vehicle Scenario of Expected Energy Consumption

SCENARIO/ MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangshir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
Normal	-283248	-414598	231005	169074	-259158	-1389616	-1597267	-1796706	-1724814	-1975503	-1467523	-764228
With IPP Shift	-279841	-415094	234601	169512	-256738	-1387079	-1592881	-1794099	-1718462	-1966070	-1458963	-764654
With NEA and IPP Shift	-279841	-415094	234601	169512	-256738	-1387079	-1592881	-1794099	-1718462	-1966070	-1458963	-764654

(v) Combined Intervention with Electric Vehicle Scenario of Expected Energy Consumption

SCENARIO/MONTH	Shrawan	Bhadra	Ashoj	Kartik	Mangshir	Poush	Magh	Falgun	Chaitra	Baisakh	Jestha	Ashad
Normal	-934528	-1065878	-420275	-482206	-910438	-2040896	-2248547	-2447986	-2376093	-2626783	-2118803	-1415508
With IPP Shift	-931120	-1066373	-416679	-481767	-908018	-2038359	-2244161	-2445378	-2369742	-2617350	-2110243	-1415934
With NEA and IPP Shift	-931120	-1066373	-416679	-481767	-908018	-2038359	-2244161	-2445378	-2369742	-2617350	-2110243	-1415934

Appendix - N: Load Flow Simulation Results

Bus Voltage Results for Different Scenarios for fiscal year 084/85

Bus ID	Nominal Voltage (kV)	Bus Voltage Results (kV)				
		Scenario – I	Scenario - II	Scenario – III	Scenario - IV	Scenario - V
Amlekhgunj	66	51.61	63.147	55.945	53.401	49.132
Balaju_66	66	57.708	49.835	37.968	43.747	42.276
Banepa	66	58.082	48.56	35.378	42.499	42.03
Baneswor.	66	57.687	49.575	37.231	43.425	41.868
Bhaktpur	66	59.18	51.721	40.016	46.201	44.31
Birjung	66	46.759	62.701	66	52.718	47.949
Chapali	66	58.324	50.216	38.318	44.289	42.847
Devighat	66	61.827	53.074	41.921	47.411	47.213
Hetauda_66	66	57.956	62.314	56.89	56.473	52.147
Indrawati	66	59.169	49.39	36.432	43.421	43.308
K-3 (Singhadurbar)	66	56.081	48.081	35.878	41.735	40.333
KL-1	66	58.238	60.36	53.227	54.523	49.357
Lainchaur	66	57.101	48.592	36.168	42.324	41.071
New Chabel	66	57.139	48.51	35.99	42.235	40.999
Panchkhal	66	58.334	48.414	35.11	42.311	42.173
Parwanipur 66	66	48.998	63.209	61.111	55.057	50.33
Patan	66	57.176	49.101	36.813	42.857	41.356
Simara	66	47.984	62.082	56.341	51.601	47.386
Siuchatar66.	66	57.432	50.26	38.812	44.251	42.5
Sunkoshi	66	58.606	48.091	34.612	41.925	42.273
Teku	66	56.333	48.485	36.425	42.202	40.735
Trishuli	66	62.607	53.885	42.955	48.301	48.224
Amarpur (Panchthar)	132	131.142	132	129.036	132	126.692
Anarmani	132	122.692	122.658	124.11	123.703	118.115
Attariya	132	160.168	148.143	171.854	159.452	95.184
Bajhang	132	165.582	149.838	173.005	162.814	96.885
Balaju132	132	120.585	111.849	96.701	103.896	97.527
Balanch	132	162.929	147.862	170.453	160.51	96.05
Bardghat	132	135.702	137.522	150.346	141.464	117.734
Bhaktpur132	132	120.892	110.97	92.65	102.933	95.825
Bharatpur	132	131.633	123.51	132.867	128.339	105.1
Bhotekoshi	132	127.997	120.515	102.692	114.779	105.71
Bhuriguon	132	158.28	155.091	175.463	162.75	117.335

Bus ID	Nominal Voltage (kV)	Bus Voltage Results (kV)				
		Scenario – I	Scenario - II	Scenario – III	Scenario - IV	Scenario - V
Budiganga	132	160.028	153.287	174.918	162.286	110.566
Burtibang132	132	142.353	144.93	160.197	149.312	122.252
Kohalpur2	132	157.413	160.392	178.393	165.554	132.293
Butwal	132	136.235	140.467	153.842	144.216	120.647
Cha.pur	132	118.221	125.205	116.635	117.113	110.222
Changunarayan	132	120.714	110.834	92.881	102.73	95.832
Chapali 132	132	120.315	110.521	93.396	102.267	95.858
Damak	132	124.371	125.377	126.774	126.382	120.368
Damauli	132	133.452	132.695	142.599	136.205	115.089
Dhalkebar	132	125.133	129.889	127.822	128.094	122.966
Duhabi	132	115.918	131.39	113.58	130.727	107.746
Gandak	132	135.974	137.788	150.592	141.723	117.742
Hetauda132	132	122.498	126.053	119.07	119.786	112.848
Illam (Godak)	132	127.179	129.354	128.518	129.363	122.755
Jhimruk	132	146.723	147.822	164.422	152.67	123.411
Kamane	132	121.42	126.099	118.083	118.825	111.627
Katiya	132	118.641	132.508	119.648	131.671	111.169
Kawasoti	132	132.159	127.558	138.359	132.106	108.711
KGA	132	132	132.896	145.037	136.671	114.32
Khimti132	132	131.77	127.909	109.542	126.096	113.62
Kohalpur	132	156.571	158.556	176.858	164.02	129.523
KUL-II	132	122.177	123.245	114.525	116.668	109.191
KUL-III	132	122.304	124.445	116.419	117.995	110.63
Kushaha	132	118.634	131.691	118.871	130.983	111.162
kusma132	132	135.672	138.409	149.768	140.056	121.429
Kusum	132	151.171	152.957	170.417	158.119	125.997
Lahan	132	124.182	127.62	123.151	127.125	118.283
Lamahi	132	145.613	147.21	163.83	152.064	122.325
Lamosangu	132	125.799	118.2	99.984	112.351	103.068
Leknath.	132	132.259	131.59	142.141	135.151	113.8
Likhu132	132	132	132	107.856	132	112.935
Lumki	132	159.244	152.864	174.423	161.833	109.811
M-Marsyandi	132	132	132	132	132	97.932
Mahendranagar	132	159.944	146.37	171.733	158.479	85.599
Marsyandi.	132	132.684	160.723	179.281	165.75	133.75

Bus ID	Nominal Voltage (kV)	Bus Voltage Results (kV)				
		Scenario – I	Scenario - II	Scenario – III	Scenario - IV	Scenario - V
Matatirtha	132	121.56	125.61	133.117	130.034	104.91
Minatara_132	132	158.256	115.165	102.645	107.848	100.964
Mirchiaya	132	127.694	129.146	127.4	128.39	122.936
Modi	132	132.113	128.508	139.121	132.164	112.936
parwanipur 132	132	113.986	125.919	111.763	111.825	102.455
Pathliya	132	116.914	125.772	114.406	115.039	106.663
Phalmanpur	132	159.693	150.77	173.325	160.808	103.201
Phidim (Thapatar)	132	130.316	131.78	129.311	131.782	125.845
Pokhara	132	131.922	130.1	140.575	133.706	112.928
Raxaul	-	-	126.86	-	112.406	-
Shivapur.	132	141.747	144.223	159.538	148.62	121.577
Siuchatar132	132	121.022	113.427	99.84	105.833	99.132
Tingla_132	132	130.157	129.798	129.165	129.343	124.594
UModi132	132	135.673	138.344	149.708	139.992	121.43
UpperKhalangad	132	164.063	148.517	171.453	161.363	96.043
West_Seti	132	165.216	149.508	172.623	162.454	96.671
AandhiKhola	220	227.758	235.628	255.734	239.741	205.684
Arun3_220	220	220.068	220.035	209.31	220.035	215.95
Baneshwor_220	220	219.502	218.962	210.615	219.303	214.114
Barhabise220	220	220	217.01	223.372	216.57	204.315
Bharatpur220	220	220.348	205.291	222.035	214.736	174.292
Butwal220	220	228.338	237.029	259.117	242.806	205.988
Damauli220	220	223.758	223.194	239.714	228.76	194.526
Dana	220	225.646	231.832	248.857	232.608	203.573
Dandakhet	220	225.599	231.945	248.428	231.891	203.525
Dhalkebar220	220	215.193	218.129	219.617	216.578	207.746
Inaruwa_220	220	215.477	215.674	213.63	216.185	210.445
Khadbari_220	220	219.659	218.829	210.012	219.152	214.161
Khudi220	220	222.199	212.989	229.946	223.295	182.668
Kusma	220	226.287	232.659	250.639	235.086	204.272
lekhnath220	220	221.83	220.804	237.997	226.6	191.653
Manang220	220	222.302	213.017	229.986	223.33	182.754
Matatirtha_220	220	217.692	213.479	218.839	211.521	189.85
New Khimti220	220	218.573	217.705	220.121	216.462	206.384
NewBasantpur	220	218.727	218.656	211.275	219.033	213.535

Bus ID	Nominal Voltage (kV)	Bus Voltage Results (kV)				
		Scenario – I	Scenario - II	Scenario – III	Scenario - IV	Scenario - V
NewMarsyangdi	220	221.38	207.857	223.78	217.615	175.8
Rahughat220	220	225.67	231.958	248.967	232.733	203.612
Ratmate	220	220.275	220.26	230.236	220.467	197.406
SitalPati_220	220	220	220	209.338	220	215.357
Tamakoshi220	220	220	215.66	220.738	214.542	204.401
Tingla_220	220	220	220	220	220	212.634
Trishuli 3B	220	220	216.401	225.266	215.672	193.54
Udipur220	220	221.781	210.217	227.229	221.785	179.382
UMadi220	220	221.135	219.538	236.868	225.382	190.722
Arun Hub_400	400	400	400	380.006	400	396.524
Bafikot Hub	400	476.754	490.117	542.299	503.839	413.863
Barhabise	400	400	402.903	414.94	402.681	377.974
Butwal400	400	418.797	443.002	481.132	452.498	387.438
Damak400	400	385.509	387	389.999	388.864	376.278
Damauli400	400	412.247	425.153	455.776	432.022	376.79
Dhalkebar400	400	384.489	396.551	398.223	392.769	387.417
Dodhara	400	488.626	497.992	554.158	512.488	416.171
Duhabi_400	-	-	399.057	-	398.501	-
Gorkahpur	400	400	447.376	486.198	457.158	391.018
Hetauda400	400	381.2	389.205	382.491	380.13	369.358
Inaruwa400	400	388.377	392.241	393.319	392.27	382.45
Kohalpur400	400	481.052	491.318	545.87	506.003	410.387
Kusma400	400	412.843	425.258	456.653	431.426	375.914
LampsiPhedi	400	404.51	409.341	428.038	411.418	375.991
Mainatara	400	481.485	492.037	546.523	506.532	411.908
Mirchaiya	400	387.25	394.569	396.004	392.687	385.227
Muzzafapur	400	375.851	397.45	399.068	393.64	400
New Khmti400	400	394.248	400.091	407.125	398.255	381.209
Phukot	400	490.52	499.911	556.321	501.832	417.746
Pulbari	400	474.823	488.17	540.126	514.471	412.201
Purnea	-	-	400	-	400	-
Ratamate	400	406.06	412.435	433.865	415.435	374.557

Line Loadings and Transformer Loadings for Scenario –I in fiscal year 084/85

From Bus	To Bus	% Loading
Hetauda_66	Amlekhgunj	135.4
Hetauda_66	Amlekhgunj	135.4
Simara	Amlekhgunj	131.6
Simara	Amlekhgunj	131.6
AandhiKhola	Butwal220	48.5
AandhiKhola	Butwal220	48.5
Attariya	Phalmanpur	36.6
Attariya	Phalmanpur	36.6
Bafikot Hub	Pulbari	23.6
Bafikot Hub	Pulbari	23.6
Bajhang	West_Seti	4
Bajhang	West_Seti	4
Balaju_66	Balaju132	88.5
Chapali 132	Balaju132	14.5
Chapali 132	Balaju132	14.5
Balaju132	Siuchatar132	37.9
Trishuli	Balaju_66	70.4
Balaju_66	Lainchaur	116.1
Trishuli	Balaju_66	70.4
Balanch	Attariya	29.3
Balanch	Attariya	73.2
UpperKhalangad	Balanch	19.2
UpperKhalangad	Balanch	19.2
Banepa	Panchkhal	9.4
Baneswor.	Bhaktpur	118.5
Bardghat	Gandak	5.4
Bardghat	Gandak	5.4
Kawasoti	Bardghat	48.7
Bhaktpur	Banepa	41.1
Bhaktpur132	Bhaktpur	89.6
Bharatpur	Damauli	19.5
Marsyandi.	Bharatpur	79.1
Lamosangu	Bhotekoshi	44.3
Bhuriguon	Kohalpur	39.7
Bhuriguon	Kohalpur	39.7
Phalmanpur	Lumki	36.1
Phalmanpur	Lumki	36.1
Budiganga	Lumki	6.9
Budiganga	Lumki	6.9
Burtibang132	Shivapur.	8.6
Burtibang132	Shivapur.	8.6
Cha.pur	Dhalkebar	53.5
Cha.pur	Dhalkebar	53.5
Changunarayan	Bhaktpur132	45.8
Changunarayan	Bhaktpur132	45.8
Chapali 132	Chapali	83.9
New Chabel	Chapali	120.3
New Chabel	Chapali	120.3
Chapali 132	Changunarayan	45.8

From Bus	To Bus	% Loading
Chapali 132	Changunarayan	45.8
Chapali	Devighat	48.3
Chapali	Devighat	48.3
Hetauda132	Bharatpur	53.7
Anarmani	Damak	44.4
Damauli400	Kusma400	22.6
Damauli400	Kusma400	22.6
Dana	Rahughat220	23.6
Dana	Rahughat220	23.6
Dandakhet	Rahughat220	20.9
Dandakhet	Rahughat220	20.9
Dhalkebar400	Dhalkebar	15.9
Dhalkebar400	Dhalkebar	15.9
Dhalkebar400	Dhalkebar220	50.8
Dhalkebar220	New Khimti220	28.8
Muzzafapur	Dhalkebar400	112
Muzzafapur	Dhalkebar400	112
Dhalkebar220	New Khimti220	28.8
Dhalkebar	Mirchiaya	61
Dhalkebar	Mirchiaya	61
Lahan	Duhabi	31
Damak	Duhabi	140.1
Hetauda132	Hetauda_66	416.2
Hetauda132	Hetauda400	729.9
Hetauda132	Kamane	80.2
Kamane	Pathliya	71.7
Kamane	Pathliya	71.7
Hetauda_66	KL-1	12.2
Hetauda_66	KL-1	1.2
Hetauda132	KUL-II	17.9
Hetauda132	KUL-III	17.8
Hetauda132	Kamane	80.2
Illam (Godak)	Damak	184.7
Illam (Godak)	Damak	184.7
Phidim (Thapatar)	Illam (Godak)	164.6
Phidim (Thapatar)	Illam (Godak)	164.6
Phidim (Thapatar)	Amarpur (Panchthar)	148.7
Phidim (Thapatar)	Amarpur (Panchthar)	148.7
Teku	K-3 (Singhadurbar)	45.6
Kawasoti	Bharatpur	60.3
KGA	Butwal	77.3
KGA	Butwal	57.7
Lamosangu	Khimti132	142.3
Kohalpur	Minatara_132	13.3
Kohalpur	Minatara_132	16.7
Kusum	Kohalpur	45.1
Kusum	Kohalpur	45.1
KUL-III	KUL-II	17.9
Katiya	Kushaha	0.5
Katiya	Kushaha	0.5
Lahan	Kushaha	40.1

From Bus	To Bus	% Loading
Kushaha	Duhabi	42
Kusma	AandhiKhola	50
Kusma	AandhiKhola	50
Lamahi	Kusum	47
Lamahi	Kusum	47
Jhimruk	Lamahi	9.6
Shivapur.	Lamahi	33.6
Shivapur.	Lamahi	33.6
Bhaktpur132	Lamosangu	94.5
Bhaktpur132	Lamosangu	94.5
Leknath.	Damauli	23.4
Pokhara	Leknath.	97.1
Butwal400	Pulbari	95
Butwal400	Pulbari	95
Damauli400	Butwal400	176.3
Damauli400	Butwal400	176.3
Ratamate	Damauli400	105.8
Ratamate	Damauli400	105.8
LampsiPhedi	Ratamate	36.4
LampsiPhedi	Ratamate	36.4
Barhabise	LampsiPhedi	42.2
Barhabise	LampsiPhedi	42.2
Barhabise	New Khmti400	63.4
Barhabise	New Khmti400	63.4
Dhalkebar400	New Khmti400	106.2
Inaruwa400	Mirchaiya	47
Inaruwa400	Mirchaiya	47
Damak400	Inaruwa400	25.4
Damak400	Inaruwa400	25.4
lekhnath220	Damauli220	22.7
lekhnath220	Damauli220	22.7
UMadi220	lekhnath220	28.9
NewMarsyangdi	Bharatpur220	32.4
NewMarsyangdi	Bharatpur220	32.4
Udipur220	NewMarsyangdi	17.6
Udipur220	NewMarsyangdi	17.6
Khudi220	Udipur220	24.9
Khudi220	Udipur220	24.9
Manang220	Khudi220	12.3
Manang220	Khudi220	12.3
Khudi220	Damauli220	46.9
Khudi220	Damauli220	46.9
Likhu132	Khimti132	68.5
Likhu132	Khimti132	68.5
Tamakoshi220	New Khimti220	63.9
Tamakoshi220	New Khimti220	63.9
Barhabise220	Tamakoshi220	61.6
Barhabise220	Tamakoshi220	61.6
Arun3_220	SitalPati_220	29.1
Arun3_220	SitalPati_220	29.1
SitalPati_220	Khadbari_220	44.5

From Bus	To Bus	% Loading
SitalPati_220	Khadbari_220	44.5
Khadbari_220	Baneshwor_220	38
Khadbari_220	Baneshwor_220	38
NewBasantpur	Inaruwa_220	53
NewBasantpur	Inaruwa_220	53
Baneshwor_220	NewBasantpur	45.9
Baneshwor_220	NewBasantpur	45.9
Mirchaiya	Dhalkebar400	49.1
Mirchaiya	Dhalkebar400	49.1
Dhalkebar400	New Khmti400	106.2
Tingla_132	Mirchiaya	164.7
Tingla_132	Mirchiaya	164.7
Trishuli 3B	Ratmate	118.4
Trishuli 3B	Ratmate	118.4
Trishuli 3B	Matatirtha_220	29.1
Trishuli 3B	Matatirtha_220	29.1
Hetauda400	Dhalkebar400	30.7
Hetauda400	Dhalkebar400	30.7
Butwal400	Gorkahpur	208
Butwal400	Gorkahpur	208
Lumki	Bhuriguon	39.9
Lumki	Bhuriguon	39.9
M-Marsyandi	Marsyandi.	61.2
Mahendranagar	Attariya	3.7
Mahendranagar	Attariya	3.7
Mainatara	Dodhara	33.9
Mainatara	Kohalpur400	9.1
Mainatara	Kohalpur400	7.3
Mainatara	Dodhara	33.9
Siuchatar132	Marsyandi.	47.7
KUL-II	Matatirtha	18.8
KUL-II	Matatirtha	18.8
Siuchatar132	Matatirtha	59.2
Siuchatar132	Matatirtha	59.2
Mirchiaya	Lahan	66.6
Mirchiaya	Lahan	66.6
Bardghat	Butwal	19.3
Bardghat	Butwal	19.3
New Chabel	Lainchaur	7.4
New Chabel	Lainchaur	7.4
Panchkhal	Indrawati	23
Panchkhal	Sunkoshi	3.8
parwanipur 132	Parwanipur 66	150.7
parwanipur 132	Parwanipur 66	150.7
Parwanipur 66	Birjung	119.1
Parwanipur 66	Birjung	119.1
Patan	Baneswor.	82.6
Pathliya	Cha.pur	25.7
Pathliya	Cha.pur	25.7
parwanipur 132	Pathliya	90
parwanipur 132	Pathliya	90

From Bus	To Bus	% Loading
Phukot	Dodhara	18.5
Phukot	Dodhara	18.5
Pulbari	Mainatara	39.5
Pulbari	Mainatara	39.5
Modi	Pokhara	73.1
Rahughat220	Kusma	84.9
Rahughat220	Kusma	84.9
Butwal	Shivapur.	41.1
Butwal	Shivapur.	41.1
Parwanipur 66	Simara	35.1
Parwanipur 66	Simara	35.1
Balaju_66	Siuchatar66.	20.8
Balaju_66	Siuchatar66.	20.8
Siuchatar66.	K-3 (Singhadurbar)	79.4
Siuchatar66.	Patan	30.6
Siuchatar66.	Patan	30.6
Siuchatar66.	Teku	148.1
Siuchatar66.	Siuchatar132	90.5
Siuchatar66.	Siuchatar132	90.5
Matatirtha	Matatirtha_220	158
KL-1	Siuchatar66.	8.5
KL-1	Siuchatar66.	8.5
Leknath.	KGA	11.8
Leknath.	KGA	11.8
Khimti132	New Khimti220	73.1
Kohalpur	Kohalpur400	9.9
Kusma	Kusma400	22.5
Mainatara	Minatara_132	4.9
Butwal220	Butwal400	28.4
Butwal220	Butwal	6.9
Damak400	Damak	24.4
kusma132	Kusma	1.7
Damauli220	Damauli400	45.8
Damauli	Damauli220	5.1
Leknath.	lekhnath220	5.9
Marsyandi.	NewMarsyangdi	3.7
Bharatpur	Bharatpur220	15.7
New Khmti400	New Khimti220	43
Barhabise	Barhabise220	38.9
Arun Hub_400	Arun3_220	13.1
Inaruwa_220	Inaruwa400	28.5
Ratmate	Ratamate	73.7
Tingla_220	Tingla_132	32.4
Devighat	Trishuli	63.5
UModi132	kusma132	15
West_Seti	UpperKhalangad	8
West_Seti	UpperKhalangad	8

Line Loadings and Transformer Loadings for Scenario –II in fiscal year 084/85

From Bus	To Bus	% Loading
Hetauda_66	Amlekhgunj	26.7
Hetauda_66	Amlekhgunj	26.7
Simara	Amlekhgunj	26.9
Simara	Amlekhgunj	26.9
Raxaul	parwanipur 132	79.4
Raxaul	parwanipur 132	79.4
Attariya	Phalmanpur	42
Attariya	Phalmanpur	42
Bafikot Hub	Pulbari	24.1
Bafikot Hub	Pulbari	24.1
Balaju_66	Balaju132	143.6
Chapali 132	Balaju132	54.5
Chapali 132	Balaju132	54.5
Balaju132	Siuchatar132	176.9
Trishuli	Balaju_66	62.3
Balaju_66	Lainchaur	250.7
Trishuli	Balaju_66	62.3
Balanch	Attariya	15.3
Balanch	Attariya	36.4
UpperKhalangad	Balanch	10.5
UpperKhalangad	Balanch	10.5
Banepa	Panchkhal	41
Baneswor.	Bhaktpur	130.8
Bardghat	Gandak	5.3
Bardghat	Gandak	5.3
Kawasoti	Bardghat	66.3
Bhaktpur	Banepa	118.7
Bhaktpur132	Bhaktpur	128.9
Bharatpur	Damauli	107.6
Marsyandi.	Bharatpur	40.7
Lamosangu	Bhotekoshi	36.4
Bhuriguon	Kohalpur	40.3
Bhuriguon	Kohalpur	40.3
Phalmanpur	Lumki	41.6
Phalmanpur	Lumki	41.6
Budiganga	Lumki	4
Budiganga	Lumki	4
Cha.pur	Dhalkebar	85.2
Cha.pur	Dhalkebar	85.2
Changunarayan	Bhaktpur132	10.8
Changunarayan	Bhaktpur132	10.8
Chapali 132	Chapali	134.3
New Chabel	Chapali	156
New Chabel	Chapali	156
Chapali 132	Changunarayan	11.1
Chapali 132	Changunarayan	11.1
Chapali	Devighat	43.9
Chapali	Devighat	43.9
Hetauda132	Bharatpur	36.5

From Bus	To Bus	% Loading
Anarmani	Damak	62.6
Dhalkebar400	Dhalkebar	32.9
Dhalkebar400	Dhalkebar	32.9
Dhalkebar400	Dhalkebar220	1.3
Duhabi_400	Duhabi	301.4
Dhalkebar220	New Khimti220	3
Muzzafapur	Dhalkebar400	96.2
Muzzafapur	Dhalkebar400	96.2
Dhalkebar220	New Khimti220	3
Dhalkebar	Mirchiaya	90.2
Dhalkebar	Mirchiaya	90.2
Lahan	Duhabi	112.9
Damak	Duhabi	310.6
Hetauda132	Hetauda_66	385
Hetauda132	Hetauda400	1396
Hetauda132	Kamane	35.2
Kamane	Pathliya	22.9
Kamane	Pathliya	22.9
Hetauda_66	KL-1	97.5
Hetauda_66	KL-1	9.8
Hetauda132	KUL-II	130.1
Hetauda132	KUL-III	126.6
Hetauda132	Kamane	35.2
Illam (Godak)	Damak	71.8
Illam (Godak)	Damak	71.8
Phidim (Thapatar)	Illam (Godak)	70.5
Phidim (Thapatar)	Illam (Godak)	70.5
Phidim (Thapatar)	Amarpur (Panchthar)	65.9
Phidim (Thapatar)	Amarpur (Panchthar)	65.9
Teku	K-3(Singhadurbar)	73
Kawasoti	Bharatpur	41.2
KGA	Butwal	41.8
KGA	Butwal	31.3
Lamosangu	Khimti132	138.1
Kusum	Kohalpur	47.5
Kusum	Kohalpur	47.5
KUL-III	KUL-II	135.8
Katiya	Kushaha	60.3
Katiya	Kushaha	60.3
Lahan	Kushaha	182.5
Kushaha	Duhabi	67.7
Purnea	Duhabi_400	121.5
Purnea	Duhabi_400	121.5
Lamahi	Kusum	47.5
Lamahi	Kusum	47.5
Jhimruk	Lamahi	8.4
Shivapur.	Lamahi	28.3
Shivapur.	Lamahi	28.3
Bhaktpur132	Lamosangu	84.7
Bhaktpur132	Lamosangu	84.7
Leknath.	Damauli	20.6

From Bus	To Bus	% Loading
Pokhara	Leknath.	80.6
AandhiKhola	Butwal220	12.8
AandhiKhola	Butwal220	12.8
Kusma	AandhiKhola	18.1
Kusma	AandhiKhola	18.1
Bajhang	West_Seti	3.6
Bajhang	West_Seti	3.6
West_Seti	UpperKhalangad	7
West_Seti	UpperKhalangad	7
Phukot	Dodhara	18.8
Phukot	Dodhara	18.8
Mainatara	Dodhara	31.2
Mainatara	Dodhara	31.2
Kohalpur	Mainatara_132	26.2
Kohalpur	Mainatara_132	21.1
Mainatara	Kohalpur400	17.1
Mainatara	Kohalpur400	20.7
Pulbari	Mainatara	47.5
Pulbari	Mainatara	47.5
Butwal400	Pulbari	92.7
Butwal400	Pulbari	92.7
Damauli400	Butwal400	83
Damauli400	Butwal400	83
Ratamate	Damauli400	66.8
Ratamate	Damauli400	66.8
LampsiPhedi	Ratamate	44.1
LampsiPhedi	Ratamate	44.1
Barhabise	LampsiPhedi	53.6
Barhabise	LampsiPhedi	53.6
Barhabise	New Khmti400	29.5
Barhabise	New Khmti400	29.5
Dhalkebar400	New Khmti400	27.3
Inaruwa400	Mirchaiya	16.3
Inaruwa400	Mirchaiya	16.3
Damak400	Inaruwa400	32.6
Damak400	Inaruwa400	32.6
Burtibang132	Shivapur.	7.4
Burtibang132	Shivapur.	7.4
Rahughat220	Kusma	12
Rahughat220	Kusma	12
Dandakhet	Rahughat220	19.9
Dandakhet	Rahughat220	19.9
Dana	Rahughat220	10.3
Dana	Rahughat220	10.3
UModi132	kusma132	8
Damauli400	Kusma400	13
Damauli400	Kusma400	13
lekhnath220	Damauli220	13.6
lekhnath220	Damauli220	13.6
UMadi220	lekhnath220	14.2
NewMarsyangdi	Bharatpur220	40.9

From Bus	To Bus	% Loading
NewMarsyangdi	Bharatpur220	40.9
Udipur220	NewMarsyangdi	57.3
Udipur220	NewMarsyangdi	57.3
Khudi220	Udipur220	83.9
Khudi220	Udipur220	83.9
Manang220	Khudi220	5.5
Manang220	Khudi220	5.5
Khudi220	Damauli220	59.1
Khudi220	Damauli220	59.1
Likhu132	Khimti132	37.7
Likhu132	Khimti132	37.7
Tamakoshi220	New Khimti220	14.7
Tamakoshi220	New Khimti220	14.7
Barhabise220	Tamakoshi220	26.6
Barhabise220	Tamakoshi220	26.6
Arun3_220	SitalPati_220	12.3
Arun3_220	SitalPati_220	12.3
SitalPati_220	Khadbari_220	23.2
SitalPati_220	Khadbari_220	23.2
Khadbari_220	Baneshwor_220	13.6
Khadbari_220	Baneshwor_220	13.6
NewBasantpur	Inaruwa_220	17.6
NewBasantpur	Inaruwa_220	17.6
Baneshwor_220	NewBasantpur	11.5
Baneshwor_220	NewBasantpur	11.5
Mirchaiya	Dhalkebar400	21.4
Mirchaiya	Dhalkebar400	21.4
Dhalkebar400	New Khmti400	27.3
Tingla_132	Mirchiaya	31.4
Tingla_132	Mirchiaya	31.4
Trishuli 3B	Ratmate	45.4
Trishuli 3B	Ratmate	45.4
Trishuli 3B	Matatirtha_220	28.1
Trishuli 3B	Matatirtha_220	28.1
Hetauda400	Dhalkebar400	81.9
Hetauda400	Dhalkebar400	81.9
Butwal400	Gorkahpur	107.5
Butwal400	Gorkahpur	107.5
Lumki	Bhuriguon	40.9
Lumki	Bhuriguon	40.9
M-Marsyandi	Marsyandi.	36.3
Mahendranagar	Attariya	17.2
Mahendranagar	Attariya	17.2
Siuchatar132	Marsyandi.	30.2
KUL-II	Matatirtha	139.6
KUL-II	Matatirtha	139.6
Siuchatar132	Matatirtha	202.2
Siuchatar132	Matatirtha	202.2
Mirchiaya	Lahan	108.9
Mirchiaya	Lahan	108.9
Bardghat	Butwal	34

From Bus	To Bus	% Loading
Bardghat	Butwal	34
New Chabel	Lainchaur	20.6
New Chabel	Lainchaur	20.6
Panchkhal	Indrawati	22.6
Panchkhal	Sunkoshi	17.7
parwanipur 132	Parwanipur 66	246.7
parwanipur 132	Parwanipur 66	246.7
Parwanipur 66	Birjung	106
Parwanipur 66	Birjung	106
Patan	Baneswor.	67.6
Pathliya	Cha.pur	57.9
Pathliya	Cha.pur	57.9
parwanipur 132	Pathliya	71.2
parwanipur 132	Pathliya	71.2
Modi	Pokhara	39.9
Butwal	Shivapur.	38.6
Butwal	Shivapur.	38.6
Parwanipur 66	Simara	123
Parwanipur 66	Simara	123
Balaju_66	Siuchatar66.	85.9
Balaju_66	Siuchatar66.	85.9
Siuchatar66.	K-3(Singhadurbar)	127.4
Siuchatar66.	Patan	87.3
Siuchatar66.	Patan	87.3
Siuchatar66.	Teku	237.9
Siuchatar66.	Siuchatar132	143.9
Siuchatar66.	Siuchatar132	143.9
Matatirtha	Matatirtha_220	149.4
KL-1	Siuchatar66.	129.6
KL-1	Siuchatar66.	129.6
Leknath.	KGA	8.6
Leknath.	KGA	8.6
Khimti132	New Khimti220	58.5
Kohalpur	Kohalpur400	23.2
Kusma	Kusma400	12.8
Mainatara	Mainatara_132	21.8
Butwal220	Butwal400	54.4
Butwal220	Butwal	32.1
Damak400	Damak	41.7
kusma132	Kusma	14.7
Damauli220	Damauli400	65.5
Damauli	Damauli220	15.3
Leknath.	lekhnath220	5.5
Marsyandi.	NewMarsyangdi	5.8
Bharatpur	Bharatpur220	5.6
New Khmti400	New Khimti220	9.7
Barhabise	Barhabise220	16.9
Arun Hub_400	Arun3_220	5.6
Inaruwa_220	Inaruwa400	20.1
Ratmate	Ratamate	27.3
Tingla_220	Tingla_132	18.4

From Bus	To Bus	% Loading
Devighat	Trishuli	59.3

Line Loadings and Transformer Loadings for Scenario – III in fiscal year 084/85

From Bus	To Bus	% Loading
Hetauda_66	Amlekhgunj	156.3
Hetauda_66	Amlekhgunj	156.3
Simara	Amlekhgunj	153
Simara	Amlekhgunj	153
Attariya	Phalmanpur	22
Attariya	Phalmanpur	22
Bafikot Hub	Pulbari	26.7
Bafikot Hub	Pulbari	26.7
Balaju_66	Balaju132	172.3
Chapali 132	Balaju132	99.7
Chapali 132	Balaju132	99.7
Balaju132	Siuchatar132	294.2
Trishuli	Balaju_66	77.2
Balaju_66	Lainchaur	342.6
Trishuli	Balaju_66	77.2
Balanch	Attariya	9.5
Balanch	Attariya	18.3
UpperKhalangad	Balanch	10.8
UpperKhalangad	Balanch	10.8
Banepa	Panchkhal	56.6
Baneswor.	Bhaktpur	168.9
Bardghat	Gandak	5
Bardghat	Gandak	5
Kawasoti	Bardghat	75.3
Bhaktpur	Banepa	164.8
Bhaktpur132	Bhaktpur	143.9
Bharatpur	Damauli	103.6
Marsyandi.	Bharatpur	31.9
Lamosangu	Bhotekoshi	41.9
Bhuriguon	Kohalpur	15.2
Bhuriguon	Kohalpur	15.2
Phalmanpur	Lumki	20.1
Phalmanpur	Lumki	20.1
Budiganga	Lumki	4.4
Budiganga	Lumki	4.4
Cha.pur	Dhalkebar	93
Cha.pur	Dhalkebar	93
Changunarayan	Bhaktpur132	16.7
Changunarayan	Bhaktpur132	16.7
Chapali 132	Chapali	153.6
New Chabel	Chapali	212.2
New Chabel	Chapali	212.2
Chapali 132	Changunarayan	16.6
Chapali 132	Changunarayan	16.6
Chapali	Devighat	55.9
Chapali	Devighat	55.9

From Bus	To Bus	% Loading
Hetauda132	Bharatpur	72.8
Anarmani	Damak	61.8
Dhalkebar400	Dhalkebar	79.7
Dhalkebar400	Dhalkebar	79.7
Dhalkebar400	Dhalkebar220	20.3
Dhalkebar220	New Khimti220	11.4
Muzzafapur	Dhalkebar400	79.8
Muzzafapur	Dhalkebar400	79.8
Dhalkebar220	New Khimti220	11.4
Dhalkebar	Mirchiaya	44.3
Dhalkebar	Mirchiaya	44.3
Lahan	Duhabi	35.8
Damak	Duhabi	150
Hetauda132	Hetauda_66	680.6
Hetauda132	Hetauda400	1942.6
Hetauda132	Kamane	111.7
Kamane	Pathliya	100.2
Kamane	Pathliya	100.2
Hetauda_66	KL-1	107.3
Hetauda_66	KL-1	107.3
Hetauda132	KUL-II	155.7
Hetauda132	KUL-III	150.4
Hetauda132	Kamane	111.7
Illam (Godak)	Damak	53.7
Illam (Godak)	Damak	53.7
Phidim (Thapatar)	Illam (Godak)	74.7
Phidim (Thapatar)	Illam (Godak)	74.7
Phidim (Thapatar)	Amarpur (Panchthar)	73.6
Phidim (Thapatar)	Amarpur (Panchthar)	73.6
Teku	K-3 (Singhadurbar)	98.3
Kawasoti	Bharatpur	53.1
KGA	Butwal	46
KGA	Butwal	34.4
Lamosangu	Khimti132	144.8
Kusum	Kohalpur	54.4
Kusum	Kohalpur	54.4
KUL-III	KUL-II	164
Katiya	Kushaha	57.5
Katiya	Kushaha	57.5
Lahan	Kushaha	30.5
Kushaha	Duhabi	119.4
Lamahi	Kusum	56.3
Lamahi	Kusum	56.3
Jhimruk	Lamahi	8.3
Shivapur.	Lamahi	34.4
Shivapur.	Lamahi	34.4
Bhaktpur132	Lamosangu	90
Bhaktpur132	Lamosangu	90
Leknath.	Damauli	19.5
Pokhara	Leknath.	85.9
AandhiKhola	Butwal220	18.5

From Bus	To Bus	% Loading
AandhiKhola	Butwal220	18.5
Kusma	AandhiKhola	25.1
Kusma	AandhiKhola	25.1
Bajhang	West_Seti	4.2
Bajhang	West_Seti	4.2
West_Seti	UpperKhalangad	8.2
West_Seti	UpperKhalangad	8.2
Phukot	Dodhara	21
Phukot	Dodhara	21
Mainatara	Dodhara	37
Mainatara	Dodhara	37
Kohalpur	Mainatara_132	24.4
Kohalpur	Mainatara_132	19.6
Mainatara	Kohalpur400	12.1
Mainatara	Kohalpur400	14.8
Pulbari	Mainatara	43.3
Pulbari	Mainatara	43.3
Butwal400	Pulbari	104.5
Butwal400	Pulbari	104.5
Damauli400	Butwal400	119.3
Damauli400	Butwal400	119.3
Ratamate	Damauli400	95.8
Ratamate	Damauli400	95.8
LampsiPhedi	Ratamate	75.6
LampsiPhedi	Ratamate	75.6
Barhabise	LampsiPhedi	78.4
Barhabise	LampsiPhedi	78.4
Barhabise	New Khmti400	74.4
Barhabise	New Khmti400	74.4
Dhalkebar400	New Khmti400	77.7
Inaruwa400	Mirchaiya	38.1
Inaruwa400	Mirchaiya	38.1
Damak400	Inaruwa400	31.6
Damak400	Inaruwa400	31.6
Burtibang132	Shivapur.	7
Burtibang132	Shivapur.	7
Rahughat220	Kusma	27.7
Rahughat220	Kusma	27.7
Dandakhet	Rahughat220	12.2
Dandakhet	Rahughat220	12.2
Dana	Rahughat220	9.6
Dana	Rahughat220	9.6
UModi132	kusma132	7.4
Damauli400	Kusma400	10
Damauli400	Kusma400	10
lekhnath220	Damauli220	11.3
lekhnath220	Damauli220	11.3
UMadi220	lekhnath220	13.2
NewMarsyangdi	Bharatpur220	33.3
NewMarsyangdi	Bharatpur220	33.3
Udipur220	NewMarsyangdi	58.1

From Bus	To Bus	% Loading
Udipur220	NewMarsyangdi	58.1
Khudi220	Udipur220	69.4
Khudi220	Udipur220	69.4
Manang220	Khudi220	5.1
Manang220	Khudi220	5.1
Khudi220	Damauli220	51.2
Khudi220	Damauli220	51.2
Likhu132	Khimti132	39.1
Likhu132	Khimti132	39.1
Tamakoshi220	New Khimti220	24.4
Tamakoshi220	New Khimti220	24.4
Barhabise220	Tamakoshi220	26.3
Barhabise220	Tamakoshi220	26.3
Arun3_220	SitalPati_220	13.2
Arun3_220	SitalPati_220	13.2
SitalPati_220	Khadbari_220	23
SitalPati_220	Khadbari_220	23
Khadbari_220	Baneshwor_220	15.7
Khadbari_220	Baneshwor_220	15.7
NewBasantpur	Inaruwa_220	14.1
NewBasantpur	Inaruwa_220	14.1
Baneshwor_220	NewBasantpur	9.5
Baneshwor_220	NewBasantpur	9.5
Mirchaiya	Dhalkebar400	47.5
Mirchaiya	Dhalkebar400	47.5
Dhalkebar400	New Khmti400	77.7
Tingla_132	Mirchiaya	75.2
Tingla_132	Mirchiaya	75.2
Trishuli 3B	Ratmate	58
Trishuli 3B	Ratmate	58
Trishuli 3B	Matatirtha_220	46.6
Trishuli 3B	Matatirtha_220	46.6
Hetauda400	Dhalkebar400	94.4
Hetauda400	Dhalkebar400	94.4
Butwal400	Gorkahpur	93.4
Butwal400	Gorkahpur	93.4
Lumki	Bhuriguon	17
Lumki	Bhuriguon	17
M-Marsyandi	Marsyandi.	28.6
Mahendranagar	Attariya	16.3
Mahendranagar	Attariya	16.3
Siuchatar132	Marsyandi.	98
KUL-II	Matatirtha	168.2
KUL-II	Matatirtha	168.2
Siuchatar132	Matatirtha	269
Siuchatar132	Matatirtha	269
Mirchiaya	Lahan	72.6
Mirchiaya	Lahan	72.6
Bardghat	Butwal	37.7
Bardghat	Butwal	37.7
New Chabel	Lainchaur	29.5

From Bus	To Bus	% Loading
New Chabel	Lainchaur	29.5
Panchkhal	Indrawati	30.6
Panchkhal	Sunkoshi	24.6
parwanipur 132	Parwanipur 66	255.3
parwanipur 132	Parwanipur 66	255.3
Parwanipur 66	Birjung	318.7
Parwanipur 66	Birjung	318.7
Patan	Baneswor.	76.2
Pathliya	Cha.pur	53.8
Pathliya	Cha.pur	53.8
parwanipur 132	Pathliya	144.8
parwanipur 132	Pathliya	144.8
Modi	Pokhara	36.9
Butwal	Shivapur.	40.9
Butwal	Shivapur.	40.9
Parwanipur 66	Simara	164.9
Parwanipur 66	Simara	164.9
Balaju_66	Siuchatar66.	110.7
Balaju_66	Siuchatar66.	110.7
Siuchatar66.	K-3 (Singhadurbar)	170.4
Siuchatar66.	Patan	127
Siuchatar66.	Patan	127
Siuchatar66.	Teku	317.6
Siuchatar66.	Siuchatar132	179
Siuchatar66.	Siuchatar132	179
Matatirtha	Matatirtha_220	254.3
KL-1	Siuchatar66.	160.3
KL-1	Siuchatar66.	160.3
Leknath.	KGA	14.9
Leknath.	KGA	14.9
Khimti132	New Khimti220	142.9
Kohalpur	Kohalpur400	18.3
Kusma	Kusma400	3.5
Mainatara	Mainatara_132	11.9
Butwal220	Butwal400	42.5
Butwal220	Butwal	30.2
Damak400	Damak	18.4
kusma132	Kusma	7.3
Damauli220	Damauli400	55.9
Damauli	Damauli220	15.4
Leknath.	lekhnath220	4.3
Marsyandi.	NewMarsyangdi	8.7
Bharatpur	Bharatpur220	6.4
New Khmti400	New Khimti220	17.2
Barhabise	Barhabise220	18.5
Arun Hub_400	Arun3_220	5.7
Inaruwa_220	Inaruwa400	12.6
Ratmate	Ratamate	36
Tingla_220	Tingla_132	21.3
Devighat	Trishuli	75.7

Line Loadings and Transformer Loadings for Scenario – IV in fiscal year 084/85

From Bus	To Bus	% Loading
Hetauda_66	Amlekhgunj	51.7
Hetauda_66	Amlekhgunj	51.7
Simara	Amlekhgunj	47
Simara	Amlekhgunj	47
Attariya	Phalmanpur	27.4
Attariya	Phalmanpur	27.4
Bafikot Hub	Pulbari	24.8
Bafikot Hub	Pulbari	24.8
Balaju_66	Balaju132	156.8
Chapali 132	Balaju132	62.7
Chapali 132	Balaju132	62.7
Balaju132	Siuchatar132	205.1
Trishuli	Balaju_66	70.1
Balaju_66	Lainchaur	284.4
Trishuli	Balaju_66	70.1
Balanch	Attariya	13.9
Balanch	Attariya	31.2
UpperKhalangad	Balanch	10.5
UpperKhalangad	Balanch	10.5
Banepa	Panchkhal	46.9
Baneswor.	Bhaktpur	156.6
Bardghat	Gandak	5.2
Bardghat	Gandak	5.2
Kawasoti	Bardghat	62.8
Bhaktpur	Banepa	136.2
Bhaktpur132	Bhaktpur	140.3
Bharatpur	Damauli	100.2
Marsyandi.	Bharatpur	35.3
Lamosangu	Bhotekoshi	37.5
Bhuriguon	Kohalpur	27.5
Bhuriguon	Kohalpur	27.5
Phalmanpur	Lumki	27
Phalmanpur	Lumki	27
Budiganga	Lumki	4.2
Budiganga	Lumki	4.2
Cha.pur	Dhalkebar	97.5
Cha.pur	Dhalkebar	97.5
Changunarayan	Bhaktpur132	14.9
Changunarayan	Bhaktpur132	14.9
Chapali 132	Chapali	145.5
New Chabel	Chapali	184.6
New Chabel	Chapali	184.6
Chapali 132	Changunarayan	15.2
Chapali 132	Changunarayan	15.2
Chapali	Devighat	48.3
Chapali	Devighat	48.3
Hetauda132	Bharatpur	38
Anarmani	Damak	62.1
Dhalkebar400	Dhalkebar	48.7

From Bus	To Bus	% Loading
Dhalkebar400	Dhalkebar	48.7
Dhalkebar400	Dhalkebar220	2
Duhabi_400	Duhabi	264.5
Dhalkebar220	New Khimti220	2
Muzzafapur	Dhalkebar400	89
Muzzafapur	Dhalkebar400	89
Dhalkebar220	New Khimti220	2
Dhalkebar	Mirchiaya	61.4
Dhalkebar	Mirchiaya	61.4
Lahan	Duhabi	96.8
Damak	Duhabi	248.1
Hetauda132	Hetauda_66	455
Hetauda132	Hetauda400	1619.7
Hetauda132	Kamane	66.4
Kamane	Pathliya	54.6
Kamane	Pathliya	54.6
Hetauda_66	KL-1	100.3
Hetauda_66	KL-1	10
Hetauda132	KUL-II	136.7
Hetauda132	KUL-III	132.8
Hetauda132	Kamane	66.4
Illam (Godak)	Damak	56
Illam (Godak)	Damak	56
Phidim (Thapatar)	Illam (Godak)	70.5
Phidim (Thapatar)	Illam (Godak)	70.5
Phidim (Thapatar)	Amarpur (Panchthar)	65.9
Phidim (Thapatar)	Amarpur (Panchthar)	65.9
Teku	K-3 (Singhadurbar)	84.3
Kawasoti	Bharatpur	38.5
KGA	Butwal	41.8
KGA	Butwal	31.3
Lamosangu	Khimti132	156.6
Kusum	Kohalpur	49.9
Kusum	Kohalpur	49.9
KUL-III	KUL-II	143.1
Katiya	Kushaha	50.6
Katiya	Kushaha	50.6
Purnea	Duhabi_400	106.1
Purnea	Duhabi_400	106.1
Lahan	Kushaha	155.7
Kushaha	Duhabi	59.5
Lamahi	Kusum	49.9
Lamahi	Kusum	49.9
Jhimruk	Lamahi	8.3
Shivapur.	Lamahi	31.2
Shivapur.	Lamahi	31.2
Bhaktpur132	Lamosangu	97.3
Bhaktpur132	Lamosangu	97.3
Leknath.	Damauli	19.9
Pokhara	Leknath.	78.2
AandhiKhola	Butwal220	18.7

From Bus	To Bus	% Loading
AandhiKhola	Butwal220	18.7
Kusma	AandhiKhola	24.5
Kusma	AandhiKhola	24.5
Bajhang	West_Seti	4
Bajhang	West_Seti	4
West_Seti	UpperKhalangad	7.7
West_Seti	UpperKhalangad	7.7
Phukot	Dodhara	19.4
Phukot	Dodhara	19.4
Mainatara	Dodhara	31.9
Mainatara	Dodhara	31.9
Kohalpur	Mainatara_132	21.7
Kohalpur	Mainatara_132	17.5
Mainatara	Kohalpur400	14.5
Mainatara	Kohalpur400	17.5
Pulbari	Mainatara	48
Pulbari	Mainatara	48
Butwal400	Pulbari	97
Butwal400	Pulbari	97
Damauli400	Butwal400	93.5
Damauli400	Butwal400	93.5
Ratamate	Damauli400	76.9
Ratamate	Damauli400	76.9
LampsiPhedi	Ratamate	50.6
LampsiPhedi	Ratamate	50.6
Barhabise	LampsiPhedi	57.9
Barhabise	LampsiPhedi	57.9
Barhabise	New Khmti400	35.5
Barhabise	New Khmti400	35.5
Dhalkebar400	New Khmti400	34.2
Inaruwa400	Mirchaiya	7.1
Inaruwa400	Mirchaiya	7.1
Damak400	Inaruwa400	25.7
Damak400	Inaruwa400	25.7
Burtibang132	Shivapur.	7.3
Burtibang132	Shivapur.	7.3
Rahughat220	Kusma	28.4
Rahughat220	Kusma	28.4
Dandakhet	Rahughat220	21.4
Dandakhet	Rahughat220	21.4
Dana	Rahughat220	10.3
Dana	Rahughat220	10.3
UModi132	kusma132	7.9
Damauli400	Kusma400	10.1
Damauli400	Kusma400	10.1
lekhnath220	Damauli220	12.6
lekhnath220	Damauli220	12.6
UMadi220	lekhnath220	13.9
NewMarsyangdi	Bharatpur220	38.5
NewMarsyangdi	Bharatpur220	38.5
Udipur220	NewMarsyangdi	59.4

From Bus	To Bus	% Loading
Udipur220	NewMarsyangdi	59.4
Khudi220	Udipur220	72.1
Khudi220	Udipur220	72.1
Manang220	Khudi220	5.3
Manang220	Khudi220	5.3
Khudi220	Damauli220	49.8
Khudi220	Damauli220	49.8
Likhu132	Khimti132	47.3
Likhu132	Khimti132	47.3
Tamakoshi220	New Khimti220	13.9
Tamakoshi220	New Khimti220	13.9
Barhabise220	Tamakoshi220	24.7
Barhabise220	Tamakoshi220	24.7
Arun3_220	SitalPati_220	12.3
Arun3_220	SitalPati_220	12.3
SitalPati_220	Khadbari_220	21.1
SitalPati_220	Khadbari_220	21.1
Khadbari_220	Baneshwor_220	9.1
Khadbari_220	Baneshwor_220	9.1
NewBasantpur	Inaruwa_220	15.2
NewBasantpur	Inaruwa_220	15.2
Baneshwor_220	NewBasantpur	6.9
Baneshwor_220	NewBasantpur	6.9
Mirchaiya	Dhalkebar400	12.7
Mirchaiya	Dhalkebar400	12.7
Dhalkebar400	New Khmti400	34.2
Tingla_132	Mirchiaya	45
Tingla_132	Mirchiaya	45
Trishuli 3B	Ratmate	53.5
Trishuli 3B	Ratmate	53.5
Trishuli 3B	Matatirtha_220	32.7
Trishuli 3B	Matatirtha_220	32.7
Hetauda400	Dhalkebar400	84.1
Hetauda400	Dhalkebar400	84.1
Butwal400	Gorkahpur	97.9
Butwal400	Gorkahpur	97.9
Lumki	Bhuriguon	27.2
Lumki	Bhuriguon	27.2
M-Marsyandi	Marsyandi.	26.3
Mahendranagar	Attariya	15.1
Mahendranagar	Attariya	15.1
Siuchatar132	Marsyandi.	62
KUL-II	Matatirtha	147.2
KUL-II	Matatirtha	147.2
Siuchatar132	Matatirtha	220
Siuchatar132	Matatirtha	220
Mirchiaya	Lahan	86.9
Mirchiaya	Lahan	86.9
Bardghat	Butwal	32.3
Bardghat	Butwal	32.3
New Chabel	Lainchaur	21.8

From Bus	To Bus	% Loading
New Chabel	Lainchaur	21.8
Panchkhal	Indrawati	25.7
Panchkhal	Sunkoshi	20.3
parwanipur 132	Parwanipur 66	296.6
parwanipur 132	Parwanipur 66	296.6
Parwanipur 66	Birjung	142.7
Parwanipur 66	Birjung	142.7
parwanipur 132	Raxaul	89.6
parwanipur 132	Raxaul	89.6
Patan	Baneswor.	81.8
Pathliya	Cha.pur	59.1
Pathliya	Cha.pur	59.1
parwanipur 132	Pathliya	101.9
parwanipur 132	Pathliya	101.9
Modi	Pokhara	38.8
Butwal	Shivapur.	41
Butwal	Shivapur.	41
Parwanipur 66	Simara	166.1
Parwanipur 66	Simara	166.1
Balaju_66	Siuchatar66.	94.8
Balaju_66	Siuchatar66.	94.8
Siuchatar66.	K-3 (Singhadurbar)	146.7
Siuchatar66.	Patan	99.3
Siuchatar66.	Patan	99.3
Siuchatar66.	Teku	273.7
Siuchatar66.	Siuchatar132	158.5
Siuchatar66.	Siuchatar132	158.5
Matatirtha	Matatirtha_220	172.4
KL-1	Siuchatar66.	134.1
KL-1	Siuchatar66.	134.1
Leknath.	KGA	9.1
Leknath.	KGA	9.1
Khimti132	New Khimti220	67.3
Kohalpur	Kohalpur400	20.2
Kusma	Kusma400	10.9
Mainatara	Mainatara_132	19.3
Butwal220	Butwal400	48.2
Butwal220	Butwal	31
Damak400	Damak	31.6
kusma132	Kusma	11.9
Damauli220	Damauli400	56.3
Damauli	Damauli220	14.7
Leknath.	lekhnath220	5.1
Marsyandi.	NewMarsyangdi	3.2
Bharatpur	Bharatpur220	3.4
New Khmti400	New Khimti220	9.9
Barhabise	Barhabise220	18
Arun Hub_400	Arun3_220	5.6
Inaruwa_220	Inaruwa400	13.8
Ratmate	Ratamate	31.6
Tingla_220	Tingla_132	20.5

From Bus	To Bus	% Loading
Devighat	Trishuli	65.2

Line Loadings and Transformer Loadings for Scenario – V in fiscal year 084/85

From Bus	To Bus	% Loading
Hetauda_66	Amlekhgunj	60.4
Hetauda_66	Amlekhgunj	60.4
Simara	Amlekhgunj	56.1
Simara	Amlekhgunj	56.1
Attariya	Phalmanpur	98.2
Attariya	Phalmanpur	98.2
Bafikot Hub	Pulbari	20.4
Bafikot Hub	Pulbari	20.4
Balaju_66	Balaju132	115.5
Chapali 132	Balaju132	43.8
Chapali 132	Balaju132	43.8
Balaju132	Siuchatar132	139.2
Trishuli	Balaju_66	85.1
Balaju_66	Lainchaur	222.6
Trishuli	Balaju_66	85.1
Balanch	Attariya	15.8
Balanch	Attariya	39
UpperKhalangad	Balanch	31
UpperKhalangad	Balanch	31
Banepa	Panchkhal	10.3
Baneswor.	Bhaktpur	162.1
Bardghat	Gandak	1.5
Bardghat	Gandak	1.5
Kawasoti	Bardghat	49
Bhaktpur	Banepa	77.1
Bhaktpur132	Bhaktpur	106.5
Bharatpur	Damauli	89.4
Marsyandi.	Bharatpur	81.5
Lamosangu	Bhotekoshi	53.6
Bhuriguon	Kohalpur	90.6
Bhuriguon	Kohalpur	90.6
Phalmanpur	Lumki	97.6
Phalmanpur	Lumki	97.6
Budiganga	Lumki	9.1
Budiganga	Lumki	9.1
Cha.pur	Dhalkebar	85.2
Cha.pur	Dhalkebar	85.2
Changunarayan	Bhaktpur132	46.6
Changunarayan	Bhaktpur132	46.6
Chapali 132	Chapali	106.4
New Chabel	Chapali	176.7
New Chabel	Chapali	176.7
Chapali 132	Changunarayan	46.6
Chapali 132	Changunarayan	46.6
Chapali	Devighat	60.7
Chapali	Devighat	60.7

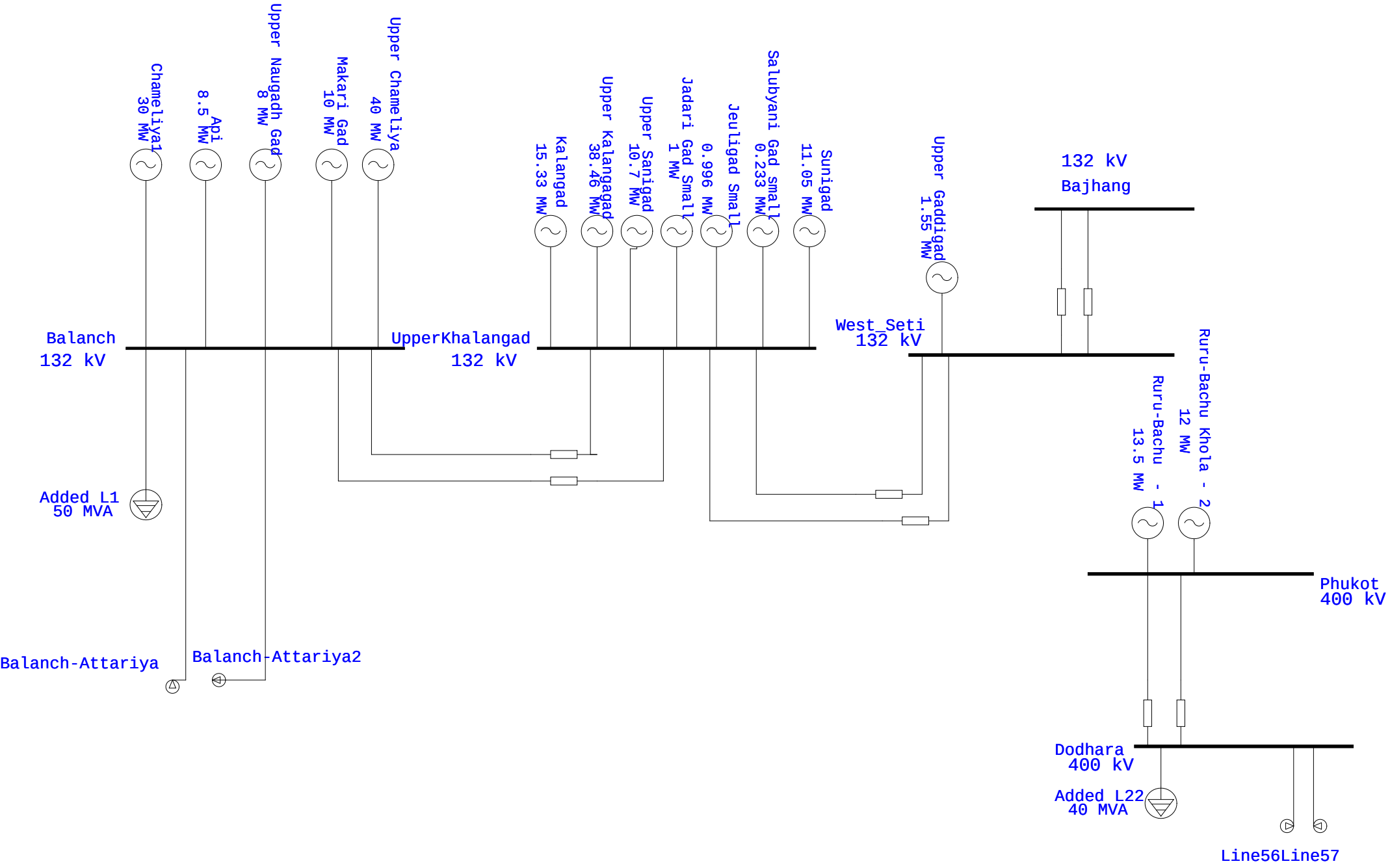
From Bus	To Bus	% Loading
Hetauda132	Bharatpur	60.8
Anarmani	Damak	53.9
Dhalkebar400	Dhalkebar	56.2
Dhalkebar400	Dhalkebar	56.2
Dhalkebar400	Dhalkebar220	57
Dhalkebar220	New Khimti220	33.6
Muzzafapur	Dhalkebar400	100.2
Muzzafapur	Dhalkebar400	100.2
Dhalkebar220	New Khimti220	33.6
Dhalkebar	Mirchiaya	1
Dhalkebar	Mirchiaya	1
Lahan	Duhabi	39.4
Damak	Duhabi	175.6
Hetauda132	Hetauda_66	400.8
Hetauda132	Hetauda400	1541.9
Hetauda132	Kamane	107.6
Kamane	Pathliya	97.7
Kamane	Pathliya	97.7
Hetauda_66	KL-1	72.5
Hetauda_66	KL-1	7.2
Hetauda132	KUL-II	116.4
Hetauda132	KUL-III	116.4
Hetauda132	Kamane	107.6
Illam (Godak)	Damak	187.2
Illam (Godak)	Damak	187.2
Phidim (Thapatar)	Illam (Godak)	170.3
Phidim (Thapatar)	Illam (Godak)	170.3
Phidim (Thapatar)	Amarpur (Panchthar)	153.9
Phidim (Thapatar)	Amarpur (Panchthar)	153.9
Teku	K - 3 (Sighadurbar)	72.6
Kawasoti	Bharatpur	35.8
KGA	Butwal	73.2
KGA	Butwal	54.7
Lamosangu	Khimti132	168.6
Kusum	Kohalpur	29.9
Kusum	Kohalpur	29.9
KUL-III	KUL-II	116.5
Katiya	Kushaha	0.4
Katiya	Kushaha	0.4
Lahan	Kushaha	50.9
Kushaha	Duhabi	52.8
Lamahi	Kusum	31.7
Lamahi	Kusum	31.7
Jhimruk	Lamahi	9.2
Shivapur.	Lamahi	28.2
Shivapur.	Lamahi	28.2
Bhaktpur132	Lamosangu	114.7
Bhaktpur132	Lamosangu	114.7
Leknath.	Damauli	39.6
Pokhara	Leknath.	121.2
AandhiKhola	Butwal220	30.5

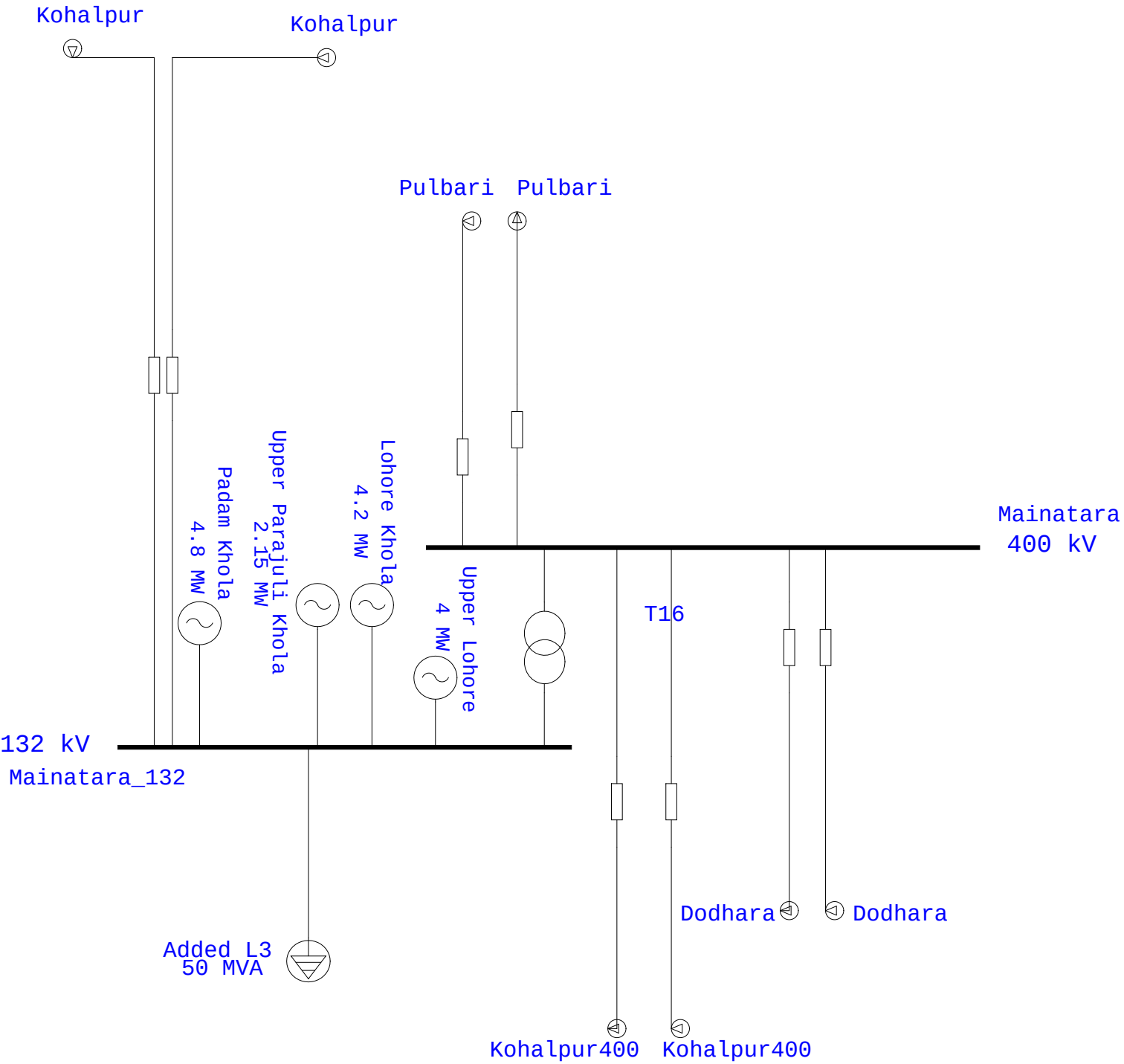
From Bus	To Bus	% Loading
AandhiKhola	Butwal220	30.5
Kusma	AandhiKhola	32.1
Kusma	AandhiKhola	32.1
Bajhang	West_Seti	2.4
Bajhang	West_Seti	2.4
West_Seti	UpperKhalangad	4.4
West_Seti	UpperKhalangad	4.4
Phukot	Dodhara	15.6
Phukot	Dodhara	15.6
Mainatara	Dodhara	24.6
Mainatara	Dodhara	24.6
Kohalpur	Mainatara_132	40
Kohalpur	Mainatara_132	31.9
Mainatara	Kohalpur400	22.2
Mainatara	Kohalpur400	26.8
Pulbari	Mainatara	39.4
Pulbari	Mainatara	39.4
Butwal400	Pulbari	65.9
Butwal400	Pulbari	65.9
Damauli400	Butwal400	77.5
Damauli400	Butwal400	77.5
Ratamate	Damauli400	34.1
Ratamate	Damauli400	34.1
LampsiPhedi	Ratamate	37.5
LampsiPhedi	Ratamate	37.5
Barhabise	LampsiPhedi	35.6
Barhabise	LampsiPhedi	35.6
Barhabise	New Khmti400	100.1
Barhabise	New Khmti400	100.1
Dhalkebar400	New Khmti400	138.8
Inaruwa400	Mirchaiya	18.8
Inaruwa400	Mirchaiya	18.8
Damak400	Inaruwa400	30
Damak400	Inaruwa400	30
Burtibang132	Shivapur.	9.7
Burtibang132	Shivapur.	9.7
Rahughat220	Kusma	67.2
Rahughat220	Kusma	67.2
Dandakhet	Rahughat220	6.4
Dandakhet	Rahughat220	6.4
Dana	Rahughat220	26.1
Dana	Rahughat220	26.1
UModi132	kusma132	16.7
Damauli400	Kusma400	13.6
Damauli400	Kusma400	13.6
lekhnath220	Damauli220	31.3
lekhnath220	Damauli220	31.3
UMadi220	lekhnath220	33.5
NewMarsyangdi	Bharatpur220	45.6
NewMarsyangdi	Bharatpur220	45.6
Udipur220	NewMarsyangdi	58.2

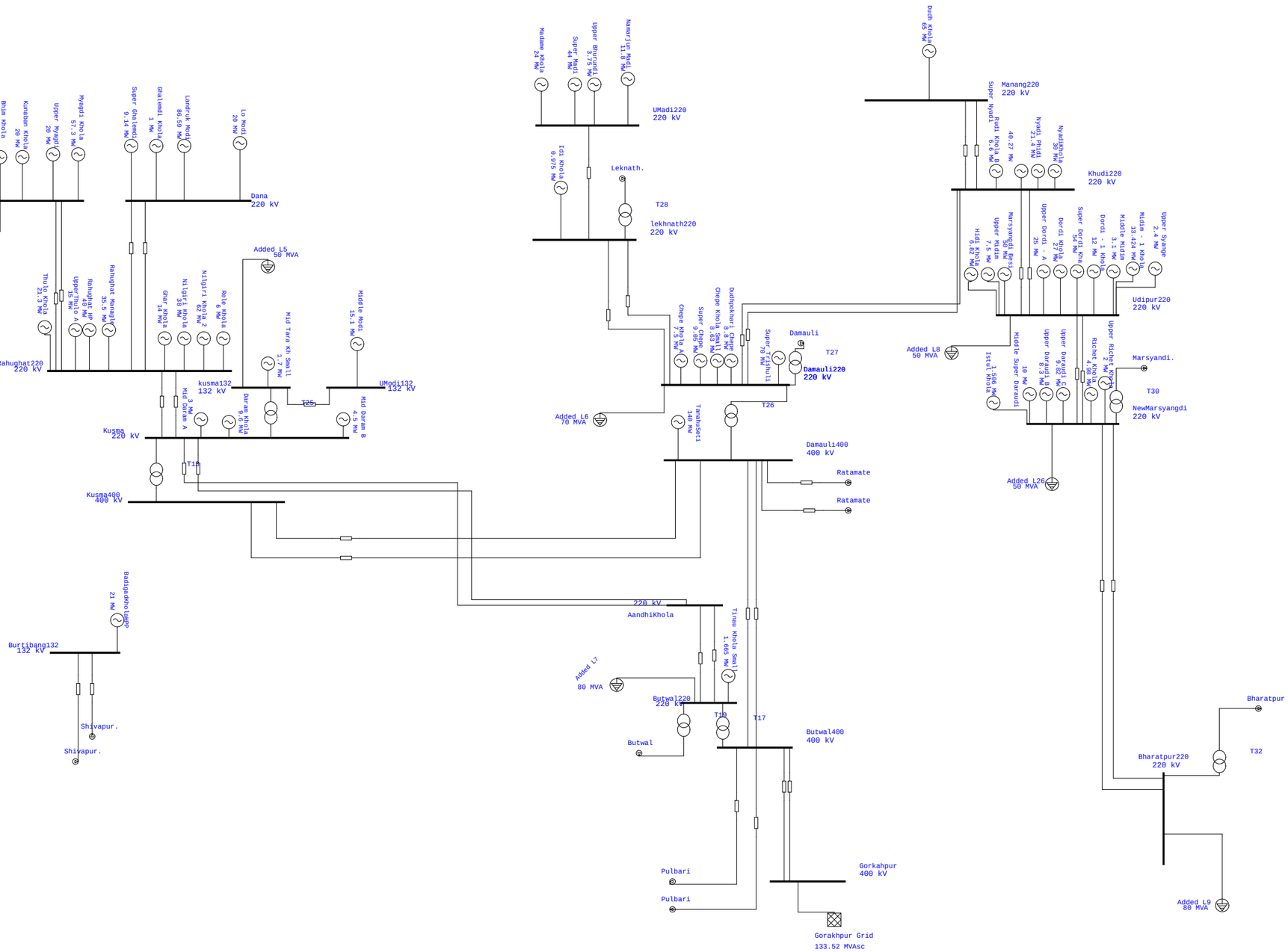
From Bus	To Bus	% Loading
Udipur220	NewMarsyangdi	58.2
Khudi220	Udipur220	68.7
Khudi220	Udipur220	68.7
Manang220	Khudi220	15
Manang220	Khudi220	15
Khudi220	Damauli220	52.4
Khudi220	Damauli220	52.4
Likhu132	Khimti132	80.7
Likhu132	Khimti132	80.7
Tamakoshi220	New Khimti220	61.4
Tamakoshi220	New Khimti220	61.4
Barhabise220	Tamakoshi220	52.1
Barhabise220	Tamakoshi220	52.1
Arun3_220	SitalPati_220	34.1
Arun3_220	SitalPati_220	34.1
SitalPati_220	Khadbari_220	46.7
SitalPati_220	Khadbari_220	46.7
Khadbari_220	Baneshwor_220	18.9
Khadbari_220	Baneshwor_220	18.9
NewBasantpur	Inaruwa_220	35.2
NewBasantpur	Inaruwa_220	35.2
Baneshwor_220	NewBasantpur	27.1
Baneshwor_220	NewBasantpur	27.1
Mirchaiya	Dhalkebar400	16.8
Mirchaiya	Dhalkebar400	16.8
Dhalkebar400	New Khmti400	138.8
Tingla_132	Mirchiaya	120
Tingla_132	Mirchiaya	105.5
Trishuli 3B	Ratmate	115.1
Trishuli 3B	Ratmate	115.1
Trishuli 3B	Matatirtha_220	39
Trishuli 3B	Matatirtha_220	39
Hetauda400	Dhalkebar400	78.6
Hetauda400	Dhalkebar400	78.6
Butwal400	Gorkahpur	18
Butwal400	Gorkahpur	18
Lumki	Bhuriguon	92.2
Lumki	Bhuriguon	92.2
M-Marsyandi	Marsyandi.	92.2
Mahendranagar	Attariya	91.3
Mahendranagar	Attariya	91.3
Siuchatar132	Marsyandi.	45.8
KUL-II	Matatirtha	116.7
KUL-II	Matatirtha	116.7
Siuchatar132	Matatirtha	168.2
Siuchatar132	Matatirtha	168.2
Mirchiaya	Lahan	83.9
Mirchiaya	Lahan	83.9
Bardghat	Butwal	27.3
Bardghat	Butwal	27.3
New Chabel	Lainchaur	9

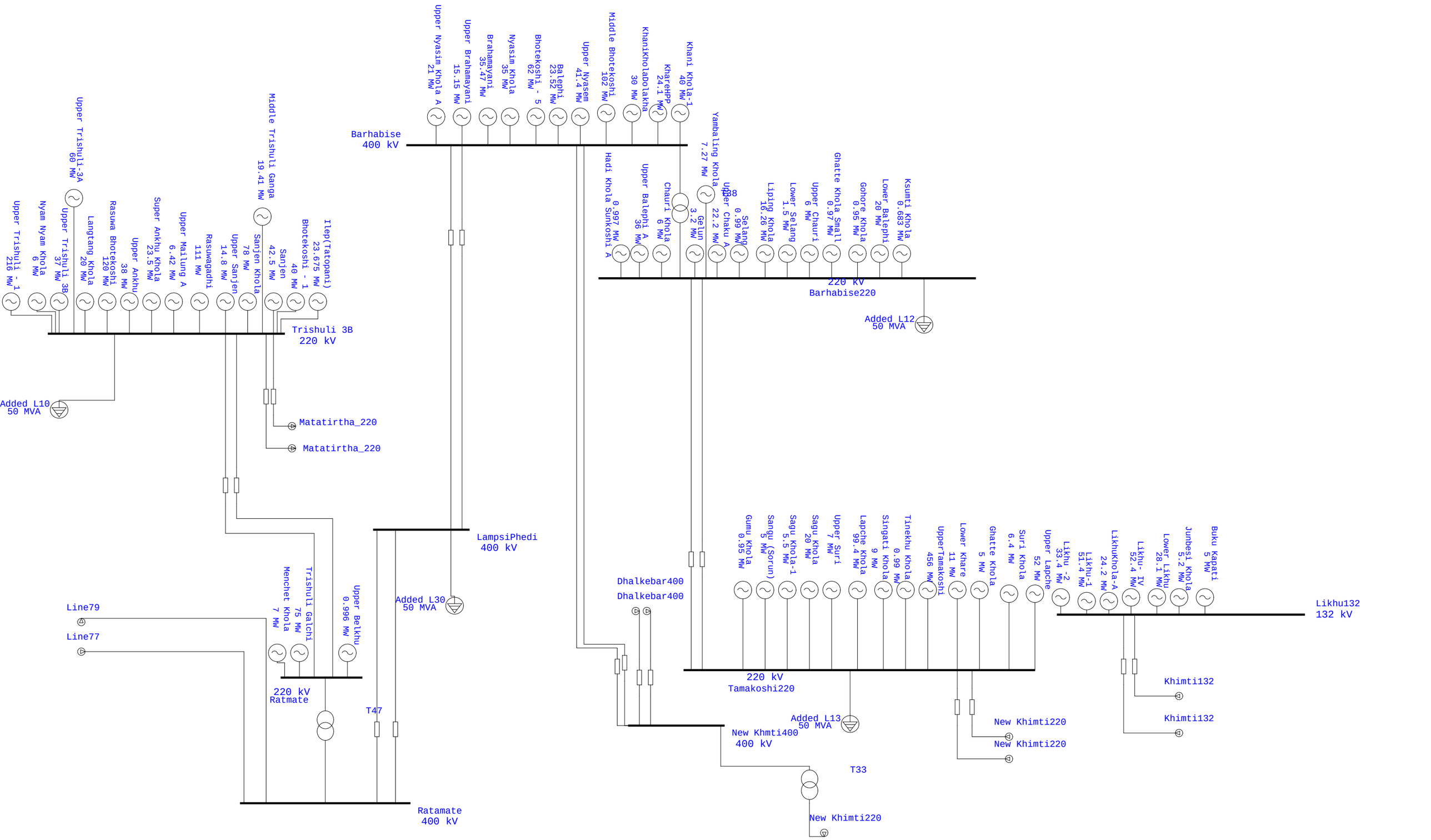
From Bus	To Bus	% Loading
New Chabel	Lainchaur	9
Panchkhal	Indrawati	31.4
Panchkhal	Sunkoshi	5.5
parwanipur 132	Parwanipur 66	224.7
parwanipur 132	Parwanipur 66	224.7
Parwanipur 66	Birjung	125.9
Parwanipur 66	Birjung	125.9
Patan	Baneswor.	95.3
Pathliya	Cha.pur	53.2
Pathliya	Cha.pur	53.2
parwanipur 132	Pathliya	141
parwanipur 132	Pathliya	141
Modi	Pokhara	84.4
Butwal	Shivapur.	36.6
Butwal	Shivapur.	36.6
Parwanipur 66	Simara	128.9
Parwanipur 66	Simara	128.9
Balaju_66	Siuchatar66.	26.1
Balaju_66	Siuchatar66.	26.1
Siuchatar66.	K - 3 (Sighadurbar)	126.5
Siuchatar66.	Patan	73.2
Siuchatar66.	Patan	73.2
Siuchatar66.	Teku	236.1
Siuchatar66.	Siuchatar132	119.3
Siuchatar66.	Siuchatar132	119.3
Matatirtha	Matatirtha_220	184.7
KL-1	Siuchatar66.	75.3
KL-1	Siuchatar66.	75.3
Leknath.	KGA	2.9
Leknath.	KGA	2.9
Khimti132	New Khimti220	96.1
Kohalpur	Kohalpur400	25.1
Kusma	Kusma400	12.7
Mainatara	Mainatara_132	19.6
Butwal220	Butwal400	28.3
Butwal220	Butwal	21.8
Damak400	Damak	25
kusma132	Kusma	11.1
Damauli220	Damauli400	43.8
Damauli	Damauli220	11.4
Leknath.	lekhnath220	7.9
Marsyandi.	NewMarsyangdi	7.3
Bharatpur	Bharatpur220	5.9
New Khmti400	New Khimti220	38.7
Barhabise	Barhabise220	24.6
Arun Hub_400	Arun3_220	15.1
Inaruwa_220	Inaruwa400	3.7
Ratmate	Ratamate	66.8
Tingla_220	Tingla_132	35.1
Devighat	Trishuli	83.7

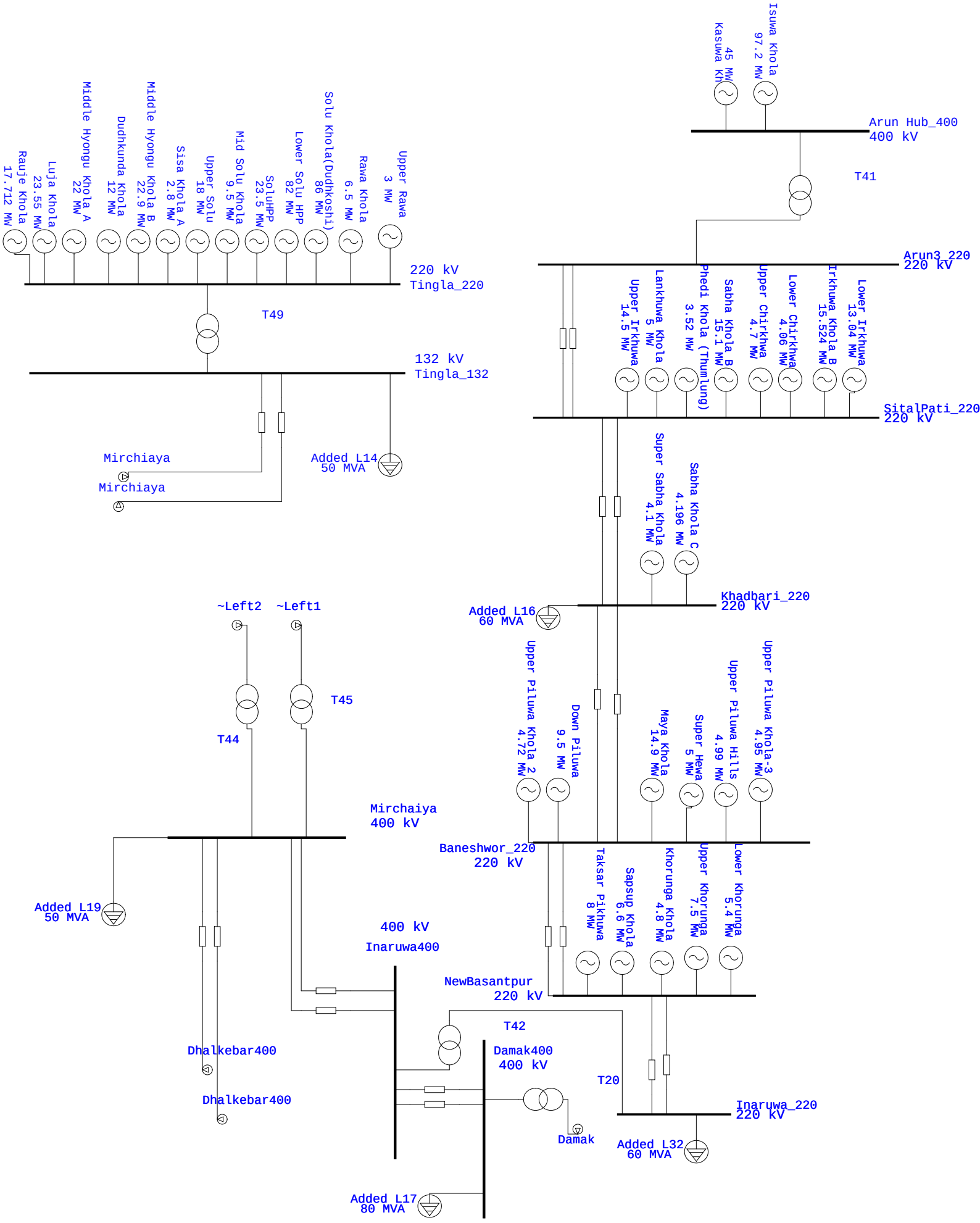
Appendix - O: Diagramtical Representation of Planned INPS Model

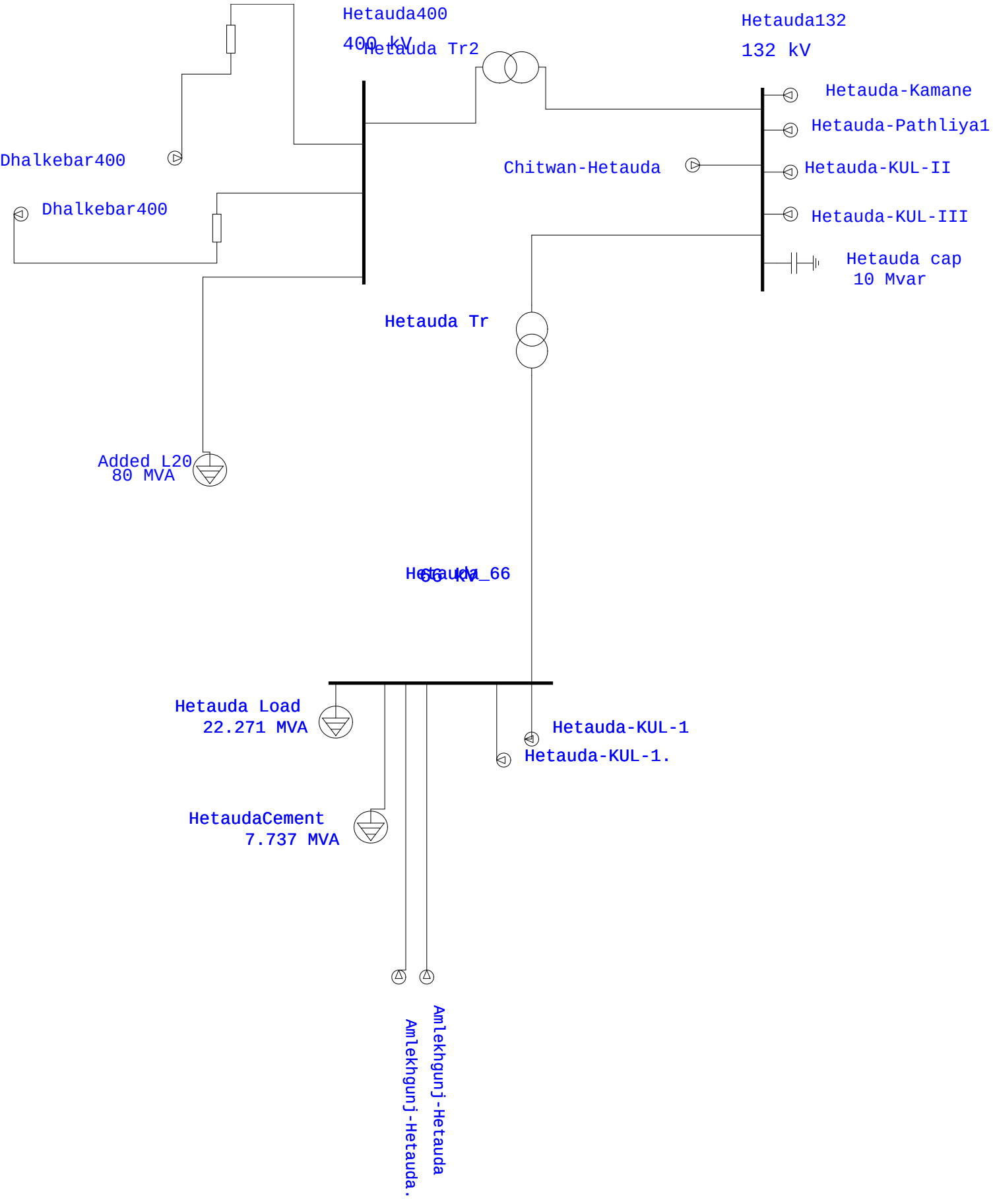

Chameliya1
30 MW
Api
8.5 MW
Upper Naugadh Gad
8 MW
Makari Gad
10 MW
Upper Chamelliya
40 MW
Kalangad
15.33 MW
Upper Kalangagad
38.46 MW
Upper Sanigad
10.7 MW
Jadari Gad Small
1 MW
0.996 MW
Jeuligad Small
Salubyani Gad small
0.233 MW
Sunigad
11.05 MW
Upper Gaddigad
1.55 MW
132 kV
Bajhang
Balanch
132 kV
UpperKhalangad
132 kV
West_Seti
132 kV
Ruru-Bachu Khola - 2
12 MW
Ruru-Bachu - 1
13.5 MW
Added L1
50 MVA
Balanch-Attariya
Balanch-Attariya2
Phukot
400 kV
Dodhara
400 kV
Added L22
40 MVA
Line56Line57

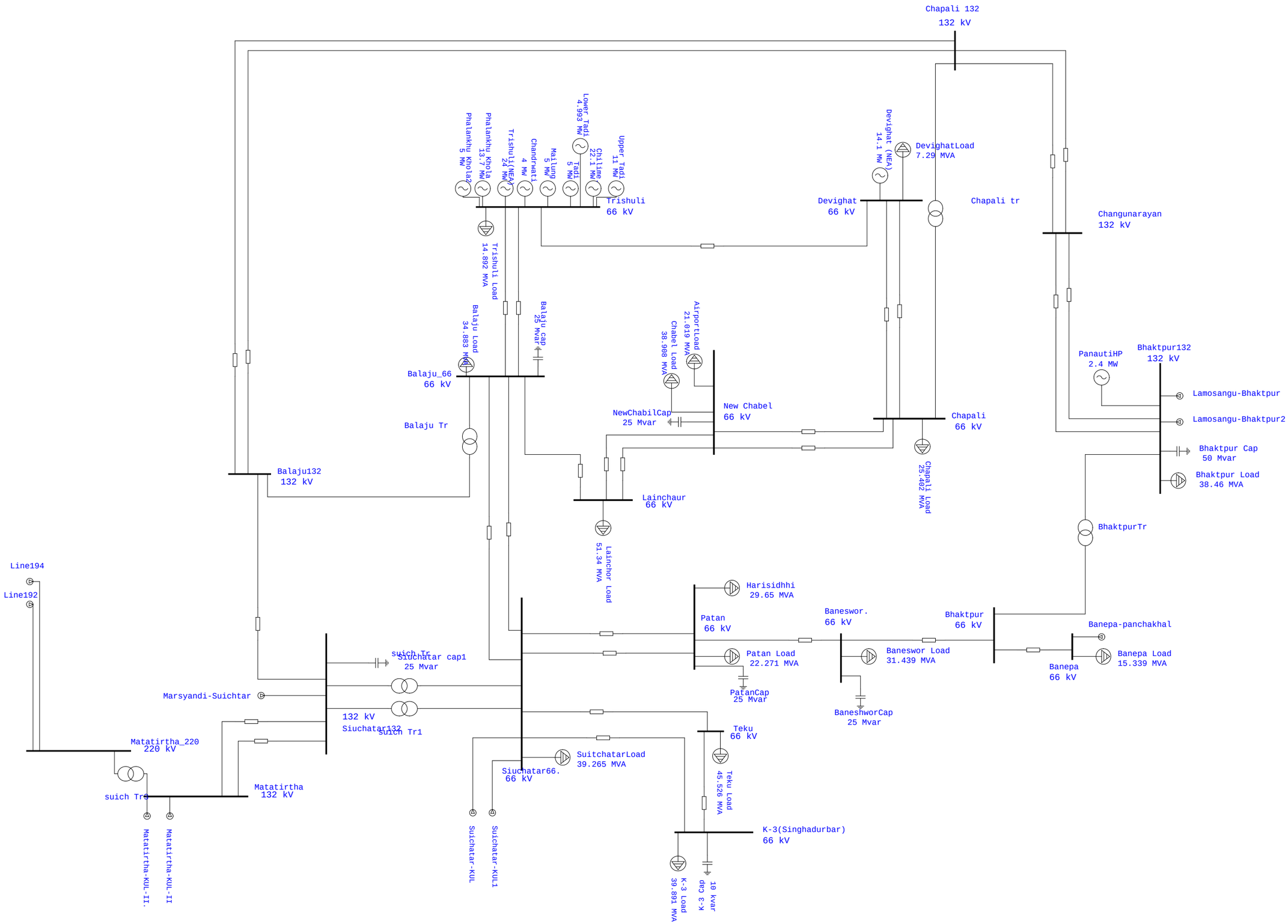

Kohalpur
Kohalpur
Pulbari
Pulbari
Mainatara
400 kV
Padam Khola
4.8 MW
Upper Parajuli Khola
2.15 MW
Lohore Khola
4.2 MW
Upper Lohore
4 MW
T16
132 kV
Mainatara_132
Added L3
50 MVA
Dodhara
Dodhara
Kohalpur400
Kohalpur400


Bhim Khola
4.96 MW
Kunaban Khola
20 MW
Upper Myagdi
20 MW
Myagdi Khola
57.3 MW
Super Ghalemdi
9.14 MW
Ghalemdi Khola
1 MW
Landruk Modi
80.59 MW
Lo Modi
20 MW
Dandakhet
220 kV
Dana
220 kV
Added L28
50 MVA
Added L5
50 MVA
Thulo Khola
21.3 MW
Upper Thulo A
15 MW
Rahughat HP
35.5 MW
Rahughat Manang
Ghar Khola
14 MW
Nilgiri Khola
30 MW
Nilgiri Khola 2
62 MW
Rele Khola
6 MW
Rahughat220
220 kV
Mid Tara Kh Small
1.7 MW
Middle Modi
15.1 MW
kusma132
132 kV
UModi132
132 kV
T25
Mid Daram A
3 MW
Daram Khola
9.6 MW
Mid Daram B
4.5 MW
Kusma
220 kV
T18
Kusma400
400 kV
Badigadhi Hydro
21 MW
Burtibang132
132 kV
Shivapur.
Shivapur.
Madane Khola
24 MW
Super Mardi
44 MW
Upper Biyanjor
17 MW
Namarjun Modi
11.8 MW
UMadi220
220 kV
Idi Khola
0.975 MW
Leknath.
T28
lekhnath220
220 kV
Chepe Khola A
7.5 MW
Super Chepe
9.05 MW
Chepe Khola Small
8.63 MW
Dadhpokhari
8.5 MW
Super Trishuli
70 MW
Damauli
T27
Damauli220
220 kV
Added L6
70 MVA
T26
Tanahusect
140 MW
Damauli400
400 kV
Ratamate
Ratamate
220 kV
AandhiKhola
Titauri Khola Small
1.655 MW
Added L7
80 MVA
Butwal220
220 kV
T19
T17
Butwal
Butwal400
400 kV
Pulbari
Pulbari
Gorkahpur
400 kV
Gorakhpur Grid
133.52 MVAsc
Duyh Khola
63 MW
Manang220
220 kV
Super Mardi
Rudi Khola B
6.9 MW
40.27 MW
Kyandi Phidi
21.4 MW
Nyadikhola
30 MW
Khudi220
220 kV
Hidi Khola
6.82 MW
Upper Midim
7.5 MW
Marsyangdi Bara
50 MW
Upper Dordi
25 MW
Dordi Khola
27 MW
Super Dordi Khola
54 MW
Dordi - 1 Khola
12 MW
Middle Midim
Midim - 1 Khola
13.424 MW
Upper Syange
2.4 MW
Udipur220
220 kV
Added L8
50 MVA
Istuli Khola
1.596 MW
Middle Super Daraudi
30 MW
Upper Daraudi A
8.3 MW
Upper Daraudi C
9.82 MW
Richet Khola
4.99 MW
Upper Richet Khola
2 MW
Marsyandi.
T30
NewMarsyangdi
220 kV
Added L26
50 MVA
Bharatpur
T32
Bharatpur220
220 kV
Added L9
80 MVA

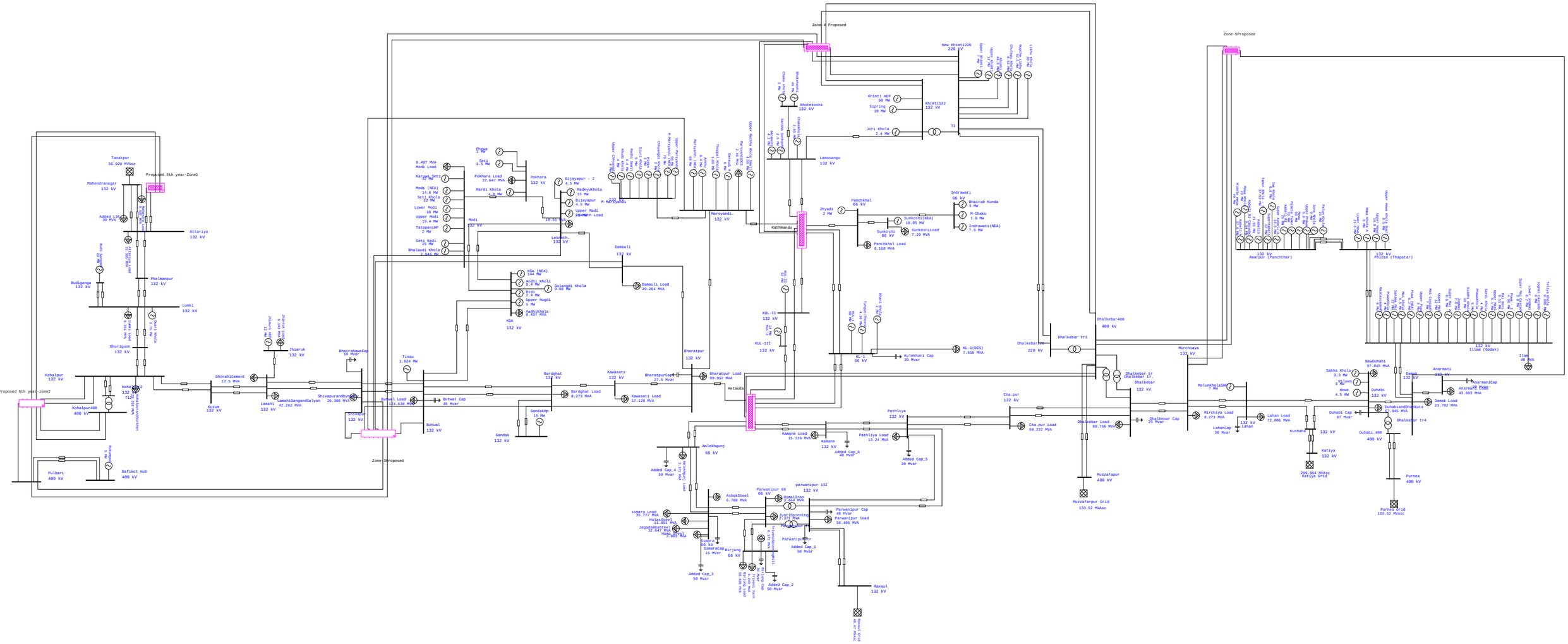

Upper Nyasim Khola A
21 MW
Upper Brahamayani
15.15 MW
Brahamayani
35.47 MW
Nyasim Khola
35 MW
Bhotekoshi - 5
62 MW
Balephi
23.52 MW
Upper Nyasem
41.4 MW
Middle Bhotekoshi
102 MW
KhaniKholaDolakha
30 MW
KhareHPP
24.1 MW
Khani Khola-1
40 MW
Barhabise
400 kV
Yambaling Khola
7.27 MW
Hadi Khola Sunkoshi A
0.997 MW
Upper Balephi A
36 MW
Chauri Khola
6 MW
Gelun
3.2 MW
Upper Chaku A
22.2 MW
Selang
0.99 MW
Liping Khola
16.26 MW
Lower Selang
1.5 MW
Upper Chauri
6 MW
Ghatte Khola Small
0.97 MW
Gohore Khola
0.95 MW
Lower Balephi
20 MW
Ksumti Khola
0.683 MW
220 kV
Barhabise220
Added L12
50 MVA
Upper Trishuli-3A
60 MW
Middle Trishuli Ganga
19.41 MW
Upper Trishuli - 1
216 MW
Nyam Nyam Khola
6 MW
Upper Trishuli 3B
37 MW
Langtang Khola
20 MW
Rasuwa Bhotekoshi
120 MW
Upper Ankhu
38 MW
Super Ankhu Khola
23.5 MW
Upper Mailung A
6.42 MW
Rasuwagadhi
111 MW
Upper Sanjen
14.8 MW
Sanjen Khola
78 MW
Sanjen
42.5 MW
Bhotekoshi - 1
40 MW
Ilep(Tatopani)
23.675 MW
Trishuli 3B
220 kV
Added L10
50 MVA
Matatirtha_220
Matatirtha_220
LampsiPhedi
400 kV
Added L30
50 MVA
Menchet Khola
7 MW
Trishuli Galchi
75 MW
Upper Belkhu
0.996 MW
Line79
Line77
220 kV
Ratmate
T47
Ratamate
400 kV
Dhalkebar400
Dhalkebar400
Gumu Khola
0.95 MW
Sangu (Sorun)
3 MW
Sagu Khola-1
5.5 MW
Sagu Khola
20 MW
Upper Suri
7 MW
Lapche Khola
99.4 MW
Singati Khola
9 MW
Tinekhu Khola
0.99 MW
UpperTamakoshi
456 MW
Lower Khare
11 MW
Ghatte Khola
5 MW
Suri Khola
6.4 MW
Upper Lapche
52 MW
220 kV
Tamakoshi220
Added L13
50 MVA
New Khmti400
400 kV
T33
New Khimti220
New Khimti220
New Khimti220
Likhu -2
33.4 MW
Likhu-1
51.4 MW
Likhukhola-A
24.2 MW
Likhu- IV
52.4 MW
Lower Likhu
20.1 MW
Junbesi Khola
5.2 MW
Buku Kapati
5 MW
Likhu132
132 kV
Khimti132
Khimti132


Rauje Khola
17.712 MW
Luja Khola
23.55 MW
Middle Hyongu Khola A
22 MW
Dudhkunda Khola
12 MW
Middle Hyongu Khola B
22.9 MW
Sisa Khola A
2.8 MW
Upper Solu
18 MW
Mid Solu Khola
9.5 MW
SoluHPP
23.5 MW
Lower Solu HPP
82 MW
Solu Khola(Dudhkoshi)
86 MW
Rawa Khola
6.5 MW
Upper Rawa
3 MW
220 kV
Tingla_220
T49
132 kV
Tingla_132
Mirchiaya
Mirchiaya
Added L14
50 MVA
45 MW
Kasuwa Kh
Isuwa Khola
97.2 MW
Arun Hub_400
400 kV
T41
Arun3_220
220 kV
Upper Irkhuwa
14.5 MW
Lankhuwa Khola
5 MW
Phedi Khola (Thumlung)
3.52 MW
Sabha Khola B
15.1 MW
Upper Chirkhwa
4.7 MW
Lower Chirkhwa
4.06 MW
Irkhuwa Khola B
15.524 MW
Lower Irkhuwa
13.04 MW
SitalPati_220
220 kV
Super Sabha Khola
4.1 MW
Sabha Khola C
4.196 MW
Khadbari_220
220 kV
Added L16
60 MVA
~Left2
~Left1
T45
T44
Upper Piluwa Khola 2
4.72 MW
Down Piluwa
9.5 MW
Maya Khola
14.9 MW
Super Hewa
5 MW
Upper Piluwa Hills
4.99 MW
Upper Piluwa Khola-3
4.95 MW
Mirchaiya
400 kV
Baneshwor_220
220 kV
Added L19
50 MVA
Taksar Pikhuwa
8 MW
Sapsup Khola
6.6 MW
Khorunga Khola
4.8 MW
Upper Khorunga
7.5 MW
Lower Khorunga
5.4 MW
400 kV
Inaruwa400
NewBasantpur
220 kV
T42
Dhalkebar400
Dhalkebar400
Damak400
400 kV
T20
Inaruwa_220
220 kV
Damak
Added L32
60 MVA
Added L17
80 MVA


Hetauda400
400 kV
Hetauda Tr2
Hetauda132
132 kV
Hetauda-Kamane
Hetauda-Pathliya1
Dhalkebar400
Chitwan-Hetauda
Hetauda-KUL-II
Dhalkebar400
Hetauda-KUL-III
Hetauda cap
10 Mvar
Hetauda Tr
Added L20
80 MVA
Hetauda_66
66 kV
Hetauda Load
22.271 MVA
Hetauda-KUL-1
Hetauda-KUL-1.
HetaudaCement
7.737 MVA
Amlekhgunj-Hetauda
Amlekhgunj-Hetauda.


Chapali 132
132 kV
Phalankhu Khola2
5 MW
Phalankhu Khola
13.7 MW
Trishuli(NEA)
24 MW
Chandrwati
4 MW
Mailung
5 MW
Tadi
5 MW
Lower Tadi
4.993 MW
Chilime
22.1 MW
Upper Tadi
11 MW
Trishuli
66 kV
Trishuli Load
14.892 MVA
Devighat (NEA)
14.1 MW
DevighatLoad
7.29 MVA
Devighat
66 kV
Chapali tr
Changunarayan
132 kV
Balaju Load
34.883 MW
Balaju cap
25 Mvar
Balaju_66
66 kV
Airportload
21.019 MVA
Chabel Load
38.908 MVA
NewChabilCap
25 Mvar
New Chabel
66 kV
Chapali
66 kV
Chapali Load
25.402 MVA
PanautiHP
2.4 MW
Bhaktpur132
132 kV
Lamosangu-Bhaktpur
Lamosangu-Bhaktpur2
Bhaktpur Cap
50 Mvar
Bhaktpur Load
38.46 MVA
Balaju Tr
Balaju132
132 kV
Lainchaur
66 kV
Lainchor Load
51.34 MVA
BhaktpurTr
Line194
Line192
Harisidhhi
29.65 MVA
Patan
66 kV
Baneswor.
66 kV
Bhaktpur
66 kV
Banepa-panchakhal
Patan Load
22.271 MVA
Baneswor Load
31.439 MVA
Banepa Load
15.339 MVA
Banepa
66 kV
PatanCap
25 Mvar
BaneshworCap
25 Mvar
suich Tr
Siuchatar cap1
25 Mvar
Marsyandi-Suichtar
132 kV
Siuchatar132
suich Tr1
Teku
66 kV
Matatirtha_220
220 kV
SuitchatarLoad
39.265 MVA
Siuchatar66.
66 kV
Teku Load
45.526 MVA
suich Tr2
Matatirtha
132 kV
K-3(Singhadurbar)
66 kV
Matatirtha-KUL-II.
Matatirtha-KUL-II
Suichatar-KUL
Suichatar-KUL1
K-3 Load
39.891 MVA
K-3 Cap
10 kvar

PLANNED INPS NEW (Load Flow Analysis)



Appendix - P: Input Parameter of Transmission Line in Planned INPS & Equivalent Month Conversions from Nepali to English Calendar

Equivalent Month Conversions

Nepali Months	English Equivalent period
Baisakh	Mid April – Mid May
Jestha	Mid May – Mid June
Ashad	Mid June – Mid July
Shrawan	Mid July – Mid August
Bhadra	Mid August – Mid September
Ashoj	Mid September – Mid October
Kartik	Mid October – Mid November
Mangshir	Mid November – Mid December
Poush	Mid December – Mid January
Magh	Mid January – Mid February
Falgun	Mid February – Mid March
Chaitra	Mid March – Mid April

Input Parameter of Transmission Line in Planned INPS (BS 215 British Standards – 54 strands)

ACSRConductor	Ampacity	Resistance per km (at 20^0C, Ω/km)	Reactance per km (Ω/km)
Moose	980A	0.0546	0.1987
Zebra	860 A	0.0674	0.2079
Bison	800 A	0.0755	0.2166