Government of Nepal

Water and Energy Commission Secretariat

Electricity Demand Forecast Report

(2015-2040)

January 2017

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1. Introduction

The Water and Energy Commission Secretariat (WECS) is responsible for collection and analysis of the energy related data in Nepal. The Energy Division of the secretariat, in particular, has been doing such data collection, analysis and future planning of energy sector. . With immense efforts and resources, WECS prepared National Energy Strategy and Energy Vision, 2050 in 2002 and 2013, respectively. . In both of these documents Energy demand has been forecasted. The energy demand forecast is necessary for the future energy planning of the country. Though there are various method of forecasting, Model for Energy Demand Analysis (MAED) has been used in this study, which is a bottom up model. As energy planning is not an one stop activity, it needs regular update.

Of different forms of energy, demand forecast of electric energy, and hence that of total installed power generation capacity in the country is quite an issue, chiefly because of two factors - firstly, it is the responsibility of any government to supply enough power to meet its demand in order to energize the entire economic sector; and secondly because it is an area where a lot of private sector developers, national and international, are interested in making investments apart from the public sector investments. It is even more so because of overwhelming domination of hydro in Nepal's power sector, which innately has long gestation period and almost all generation cost is in the form of upfront capital investment.

In the past, load forecast used to be carried out by the Nepal Electricity Authority, the country's public sector electricity utility. Those forecasts were extrapolation of historical demand records, and used to have reasonable degree accuracies on account of the facts that increase in demand was only for the reasons - (i) grid extension, (ii) population growth within the grid connected areas, and (iii) more or less stagnant growth in the economy. Scenarios involving special policy interventions in order to boost economy and also to enhance power demand by turning the users from other energy forms to electricity were missing in those forecasts. In 2015, Investment Board of Nepal, together with some involvement of National Planning Commission, also carried out load forecast exercise. However, a question as to whether the board is a right agency to do such forecast was ubiquitously raised in different quarters. Thus with a firm resolve, WECS has assumed and discharged its responsibility of carrying out electricity load forecast as a part of the agency's overall responsibility of energy planning for the Government and thus, prepared the present report containing results of several analytical works.

In the current forecast, three scenarios of economic development have been taken into consideration - (i) Business as usual (4.5% GDP growth rate), (ii) Reference (7.2% GDP growth rate), and (iii) High growth (9.2% GDP growth rate). An extra analysis has been done with various policy interventions, e.g. 100% of the cooking with electricity and 75% of water heating with electricity in urban areas by 2020, metro in cities by 2025, etc., at 7.2% and 9.2% GDP growth rate. The planning period of 25 years has been taken into consideration, which gives electricity demand forecast for the period of 2015-2040.

1.1. *Objective of the study*

- The objective of the study is to analyze the future Electricity Demand using MAED Model up to the year 2040.

1.2. *Scope of the study*

The following scopes are set out for meeting the objectives.

- Study the past and current electricity demand and consumption pattern.
- Forecast the electricity demand in different economic sectors up to the year 2040.

2. Methodology adopted for the study

2.1 General

Model for Analysis of Energy Demand (MAED) evaluates future energy demand based on a set of consistent assumptions on medium to long term socio-economic, technological and demographic developments in a country or a region. The schematic representation of various inputs and outputs that are required and obtained, respectively, is given in Figure 1 . Future energy needs are linked to: (i) the production and consumption of goods and services; (ii) lifestyle changes caused by increasing personal incomes; and (iii) mobility needs, etc. Energy demand is computed for a host of end use activities for three main "demand sectors": household, services, industry and transport. MAED provides a systematic framework for mapping trends and anticipating change in energy needs, particularly as they correspond to alternative scenarios for socioeconomic development.

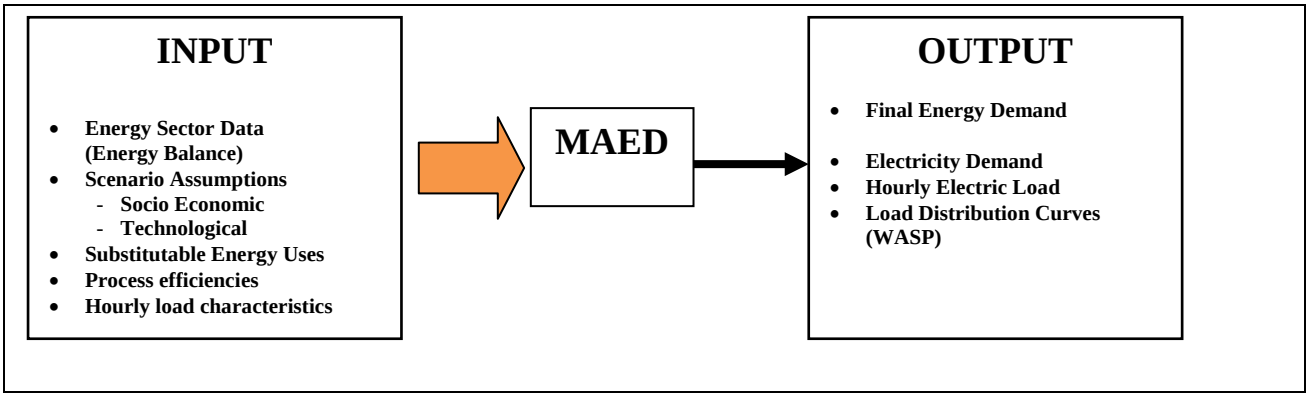

Figure 1 : Main Inputs and Outputs of MAED

2.2 Energy Demand Calculations

The energy demand is calculated by the model MAED_D as a function of a scenario of possible development. This scenario covers two types of scenario elements

- One is related to one socio-economic system and describes the fundamental characteristics of the social and economic evolution of the country.
- The other one is related to the technological factors, which should be taken into account in the calculation of energy demand, for example the efficiency of each alternative energy form and its penetration into its potential markets.

2.3 Secondary Data Collection

Relevant energy data from different government agencies e.g. CBS, NEA, NOC, AEPC, DoMG, etc. were collected. Published reports and Websites of different national and international agencies were used as sources for data and information.

2.4 Analysis of Data and Modelling

The collected data were reconstructed to make compatible for input in MAED Model. For the Energy Demand Analysis, three different scenarios were prepared considering GDP growth rates of 4.5%, 7.2 % and 9.2%. These Business as usual, reference and high growth rates are assumed analyzing the past growth rates and the targets set out by the government through various plan documents.

2.5 Interpretation of the Model output and Preparation of the Report

The output of the models were analyzed and presented in the form of report, which can be used for long term integrated energy planning of the country.

3. Pattern of Energy Consumption

3.1 Energy Consumption

Nepal's energy sources have been categorized under three broad types (i) traditional, (ii) commercial and (iii) alternative energy sources. Aalternative energy is synonymous with new, renewable and non conventional forms of energy. This categorization pertains to the modality of use of the resources in abstracting the inherent energy contents. Traditional source of energy include biomass fuels particularly fuel wood, agricultural residues and animal dung used in the traditional way which is direct combustion, wherein traditional energy sources undergo transformations into modern types of fuels. Commercial sources of energy are fossil fuels and electricity. Alternative

sources of energy include micro hydro, solar, wind power, biogas and briquettes etc. Biomass, hydropower and Solar are the three major indigenous energy resource bases in the country.

Though Nepal has a huge potential for hydropower production, its exploitation has been to a very minimal, and therefore, significant amount of energy supply comes from traditional energy sources such as biomass. Heavy dependence for energy on biomass resources has accelerated the depletion of natural resources and contributed to the degradation of natural environment. It is the biomass sector which dominates the overall energy supply and consumption in the country.

Table 1 and Figure 2 show the total supply and their share of energy consumption by various fuel types in Fiscal Year 2014/15. It reveals the share of fuel types in total energy demand system of the country. Total energy consumption in FY 2014/15 is 500 million Giga Joule (GJ); among which, fuel-wood is the largest energy resources and occupies about 70.47% of the total energy demand. Other sources of bio-masses are agricultural residues and animal dung which contribute about 3.48% and 3.68%, respectively. Share of petroleum fuels in the total energy system is about 12.53 %. Other sources of commercial energy are coal and electricity, which contribute about 3.97% and 3.39%, respectively in the total energy supply. In aggregate, the share of traditional fuel is 77.63%, Commercial (coal, petroleum and electricity) is 19.88 % and Renewable (Solar, Biogas, Micro hydro, Wind) is 2.49%

Table 1: Distribution of Energy Consumption by fuel types in FY 2014/15

S. No.	Fuel Types	Amount (000GJ)	Percentage share
1	Fuel Wood	352229.10	70.47
2	Agriculture-residue	17408.43	3.48
3	Animal dung	18401.96	3.68
4	Coal	19819.09	3.97
5	Petroleum	62618.27	12.53
6	Electricity	16932.75	3.39
7	Renewable	12430.26	2.49
	Total	499839.86	

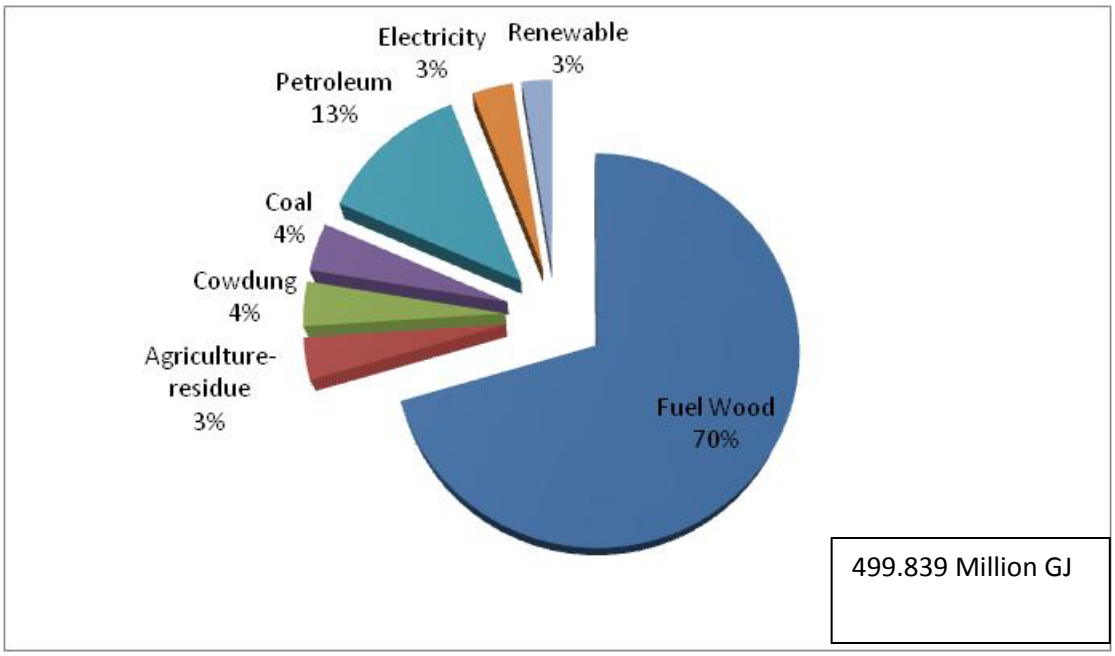

Figure 2 : Share of Energy Consumption by Fuel-types in 2014/15

4. Development of Scenarios

4.1 Introduction

The National Planning Commission of the Government formulates a periodic plan for socio-economic development for every quinquennium at the macro level. In the case of Energy sector, demand and supply requirement are analyzed by Water and Energy Commission Secretariat. This analysis is one of the important pre-requisite for formulating the Plan and defining the activities for implementation. During the process of analysis, different scenarios are assumed based on observations, past and current database and the development process.

Water and Energy Commission Secretariat compiles energy data and prepares the statistics of energy consumption and supply periodically. The last survey was carried out for the FY 2011/12. For the modelling purpose, the energy balance of the FY 2014/15 was used for reconstructing the base year data. The model considered the year 2020, 2025, 2030, 2035, 2040 as periodic timeframe for forecasting the electricity demand.

The important factors influencing energy demand that were used in the study are GDP growth rates and their structural changes, population growth and its distribution in the country (urban and rural), changes in life style, population mobility growth, passenger and freight transportation, and market penetration of competing energy forms.

4.2 Demography

Population growth at the constant rate has been considered throughout the modelling time period at different scenarios. It is considered that the total population will increase from 28.06 million at the base year to 39.72 million at the end of 2040 with the growth rate of 1.4%. It was assumed that, economic activities and economic growth directly effects on the employment opportunities as well as the urban and rural population proportion and accordingly, the urban and rural population are distributed in the model. The urban household will reach 5.7 million in 2040 from 2.7 million in 2015 in other hand rural household will reach 3.9 million in 2040 from 3.3 million in 2015. Demographic distributions for the Business as Usual (BAU) Scenario are given Table 2

Table 2: Demography

Item	Unit	2015	2020	2025	2030	2035	2040
Population*	**[million]**	28.060	30.080	32.245	34.567	37.055	39.722
Pop. gr. rate*	**[%p.a.]**	na**	1.400	1.400	1.400	1.400	1.400
Urban pop.	**[%]**	38.260	*42.080*	*45.900*	*49.720*	*53.540*	*57.360*
Capita/hh	**[cap]**	3.976	4.000	4.000	4.000	4.000	4.000
Households	**[million]**	**2.700**	**3.164**	**3.700**	**4.297**	**4.960**	**5.696**
Rural pop.	**[%]**	**61.740**	**57.920**	**54.100**	**50.280**	**46.460**	**42.640**
Capita/hh	**[cap]**	5.298	*5.113*	*4.927*	*4.742*	*4.556*	*4.371*
Households	**[million]**	**3.270**	**3.408**	**3.540**	**3.665**	**3.778**	**3.875**

4.3 Macro-economy

The Government through the periodic plans has prioritized the infrastructure, tourism and agriculture sectors for socio-economic development and also for increasing the GDP. Energy is one of the pre-requisite to support the Government's plan. Viewing the policies and plans and priorities; three strategic economic growth scenarios- a) BAU level economic scenario of 4.5% GDP growth rate, b) Reference level economic scenario of 7.2% GDP growth rate and c) High level economic scenario of 9.2 % GDP growth rate have been set out for the model. Table 3 and Table 4 give the growth rates of various economic sectors and their shares for the base year 2015 and projected values for other years, respectively.

Table 3: GDP Structure of different economic sectors

Item	Unit	2015	2020	2025	2030	2035	2040
GDP*	**[10^9 US$]**	21.948	27.351	34.084	42.475	52.931	65.962
GDP gr. rate*	**[%p.a.]**		4.500	4.500	4.500	4.500	4.500
GDP/cap	**US$**	**782.2**	**909.3**	**1057.0**	**1228.8**	**1428.5**	**1660.6**
Agriculture	**[%]**	31.32	*28.98*	*26.65*	*24.32*	*21.99*	*19.66*
Construction	**[%]**	7.180	*7.297*	*7.414*	*7.531*	*7.649*	*7.766*
Mining	**[%]**	0.630	*0.826*	*1.021*	*1.217*	*1.413*	*1.609*
Manufacturing	**[%]**	6.330	*8.283*	*10.23*	*12.18*	*14.14*	*16.09*

Service	**[%]**	53.450	*53.243*	*53.036*	*52.829*	*52.621*	*52.414*
Energy	**[%]**	**1.090**	**1.363**	**1.636**	**1.909**	**2.181**	**2.454**

The above GDP structure (%) of the economic sectors applies to all the three economic scenarios

Table 4: Projected Economic Growth Rates of GDP at Constant Prices of 2015 (% P.a.)

Items	**2015-20**	**20-25**	**25-30**	**30-35**	**35-40**
4.5% Economic Growth Scenario					
Agriculture	2.896	2.762	2.605	2.415	2.184
Construction	4.839	4.833	4.828	4.823	4.818
Mining	10.310	9.042	8.229	7.663	7.247
Manufacturing	10.274	9.019	8.214	7.653	7.239
Basic material	9.757	8.496	7.682	7.110	6.684
Machinery & equipment	11.082	9.791	8.953	8.364	7.925
Non-durable goods	10.437	9.180	8.372	7.809	7.393
Service	4.419	4.419	4.418	4.418	4.418
Energy	9.275	8.385	7.775	7.330	6.992
Total GDP	4.50	4.50	4.50	4.50	4.50
7.2 % Economic Growth Scenario					
Agriculture	5.554	5.417	5.256	5.062	4.824
Construction	7.548	7.542	7.537	7.531	7.526
Mining	13.160	11.859	11.025	10.445	10.018
Manufacturing	13.123	11.836	11.010	10.434	10.010
Basic material	12.593	11.300	10.464	9.877	9.441
Machinery & equipment	13.952	12.627	11.768	11.164	10.713
Non-durable goods	13.290	12.001	11.172	10.594	10.168
Service	7.117	7.116	7.116	7.116	7.115
Energy	12.098	11.185	10.559	10.104	9.757
Total GDP	7.2	7.2	7.2	7.2	7.2
9.2% Economic Growth Scenario					
Agriculture	7.524	7.384	7.219	7.022	6.780
Construction	9.554	9.548	9.543	9.538	9.532
Mining	15.271	13.946	13.097	12.506	12.070

Manufacturing	15.233	13.923	13.081	12.494	12.062
Basic material	14.693	13.376	12.525	11.927	11.483
Machinery & equipment	16.078	14.729	13.854	13.238	12.779
Non-durable goods	15.404	14.090	13.246	12.657	12.223
Service	9.115	9.115	9.115	9.114	9.114
Energy	14.190	13.259	12.622	12.158	11.805
Total GDP	9.200	9.200	9.200	9.200	9.200

4.4 Energy Resources

Fuel-wood, agricultural residues, animal waste, hydropower and solar are the main sources of energy in the country. The potentiality of wind energy is yet to be explored. The energy resources are classified into three categories namely i) Traditional; ii) Commercial; and iii) Alternative. Traditional energy resource includes all types of biomass used for producing energy conventionally. Energy resources with well established market prices are grouped into commercial energy, which comprises coal, hydropower (except micro-hydro) and petroleum products, whereas indigenous renewable energy resources comprising biogas, micro-hydro, solar and wind energy are grouped into alternative or renewable category.

4.4.1 Hydro-Energy Resources

Water resources in Nepal can be harnessed to produce about 43000 MW. However, the theoretical potential is estimated to be around 83,000 MW. The theoretical, technical and economical potentials of hydropower are presented in Table **5**.

Table 5: Theoretical, Technical and Economical Hydropower Potential of Nepal

Major River Basins	**Theoretical Potential in MW**			**Technical Potential**		**Economical Potential**	
	Major river courses having catchments areas above 1000 km²	Small river courses having catchments areas 300-1000 km²	Total	Number of Project Sites	Technical Potential in MW	Number of Project Sites	Economical Potential in MW
Sapta Koshi	18750	3600	22350	53	11400	40	10860
Sapta Gandaki	17950	2700	20650	18	6660	12	5270
Karnali and Mahakali	32680	3500	36180	34	26570	9	25125
Southern River	3070	1040	4110	9	980	5	878
Country Total	**72450**	**10840**	**83290**	**114**	**45610**	**66**	**42133**

As of base year 2014/15, Nepal has a total installed capacity of 855.886 MW in which 53.41MW are thermal (multifuel) power plants and 100 KW solar plant. Unfortunately both thermal plants and solar plants are not in operation. Despite a huge potential for hydro-electricity, Nepal has not been able to fully harness its water resource for energy

generation purpose. As a result, electricity is available to only 70% of the population. Table 5 gives the current status of power plants and their capacity.

Table 6: Power Plants Installed up to year 2015

		2011	2012	2013	2014	2015
1	Total Major Hydro (NEA) - Grid Connected	472,994	473394	473394	473394	473394
2	Total Small Hydro (NEA) – Isolated	4,536	4536	4536	4536	4536
3	Total Hydro (NEA)	477,530	477,930	477,930	477,930	477,930
4	Total Hydro (IPP)	187,581	230589	255647	255647	324446
5	Total Hydro (Nepal)	665,111	708,519	733,577	733,577	802,376
6	Total Thermal (NEA)	53,410	53410	53410	53410	53410
7	Total Solar (NEA)	100	100	100	100	100
8	Total Installed Capacity (Including Private & Others)	718,621	762,029	787,087	787,087	855,886
9	Total Installed Capacity (NEA& IPP)-Grid	713985	757393	782451	782451	851250

5. Energy and Electricity Demand Projections

5.1. Introduction

Energy demand projection is the basic prerequisite for formulation of integrated energy policy, preparing plan and defining the activities for implementation. Different tools and techniques can be applied for demand projection. This study has applied the Model for Analysis of Energy Demand (MAED) prepared by IAEA. The model requires the existing data and information related to population, settlement pattern, macro-economic sector, energy consuming sectors etc.

The first step in the MAED model is to reconstruct the energy consumption by sector and by categories of end users for a base year. This step, which aims at facilitating the understanding of energy consumption mechanism, requires detailed information about demography, economy, energy consuming technologies/equipment and energy consumption. In the second step, several probable demographic, economic and technological development scenarios are constructed and the corresponding demand for energy is estimated.

The application of the MAED model requires detailed information about demography, economy, energy consuming technologies (e.g. number of tractors, vehicles on the road, etc.) and energy consumption, based on which, future energy scenarios are developed. This information is required to be assembled at first for a base year which is used as reference year for perceiving the evolution of the energy system in future. Selection of the base year is made on the basis of, (i) availability of data and (ii) the assessment that the data are representative of the economic and energy situation of the country. After

reviewing the available data the year 2014/15 has been selected as the base year for the study.

To analyze the medium to long term evolution of energy and electricity demand, three scenarios *viz* business as usual, reference and high economic growth scenario have been studied. As already mentioned, the total population growth in all the three scenarios has been assumed to be the same. The BAU, Reference and High correspond to the three national economic growth scenarios viz. BAU (4.5%), Reference Growth Scenario(7.2%) high economic growth scenario (9.2%) respectively. This growth has been considered on the basis of National Planning Commission Targets.

While developing scenarios, we have to think in both pessimistic and optimistic way. That is why here in this study the BAU growth rate is chosen based on the past decade growth rates and the probable future. Whereas 7.2% growth is taken on the basis of approach paper of the 14th plan of Nepal, which has set the target to achieve 7.2% by 2019. The 9.2% growth rate is required to have the per capita GDP of 2500 USD by 2030.

Most of the information needed for the application of the MAED model was available for the base year. However, for some parameters, either the information available was not up-to-date, or no information was available. For such parameters, estimates have been made on the basis of information available for some of previous years or reported in the literature for other countries.

5.2. Energy Balance for the Base Year 2014/15

An energy balance table has three main building blocks: the supply-side information, conversion details and the demand information. The energy balance table for the base year 2014/15 has been prepared as an input for the MAED Model. The annual report on energy supply and demand prepared by Water and Energy Commission Secretariat is the main source for preparing the base year data. Table 7 below shows the energy balance of the base year 2014/15

Table 7: Energy Balance for the Base Year 2015 (kToe)

Sectors	Substitutable Fossil Fuels						Motor Fuels						Electricity	Centralized Heat Supply	Total Commercial	Traditional Fuels	Modern Biomass	Grand Total
	Furnace Oil	Kerosene	Gas	LPG	Coal	*Total*	Diesel	Gasoline	Gas (CNG)	LPG	Jet fuel	*Total*						
Agriculture	-	-		-		*-*	130.1	2.1				*132.2*	7.0		*139.2*	-		*139.2*
Construction	-	-		-		*-*	-	-				*-*	-		*-*	-		*-*
Mining	-	-		-		*-*	-	-				*-*	-		*-*	-		*-*
Manufacturing	33.9	0.7		-	431.4	*466.0*	141.53	2.9				*144.5*	122.41		*732.8*	219.0	-	*951.8*
Transportation	-	-		-		*-*	508.1	214.4		7.4	121.4	*851.3*	0.7		*852.0*	-		*852.0*
Household	-	12.2		191.4	-	*203.6*		-				*-*	159.7		*363.3*	8,664.1	278.4	*9,305.9*
Services	-	3.2		101.2	33.7	*138.0*	0.4	0.4				*0.8*	43.3		*182.0*	221.5	-	*403.5*
Total	33.9	16.1	-	292.6	465.0	807.6	780.2	219.8	-	7.4	121.4	*1,128.8*	333.1	-	2,269.5	9,104.6	278.4	*11,652.5*

5.3. Assumptions Made for Energy Consumptions for Economic Sectors

As per the framework of the MAED Model the economic sectors have been divided into eight major sectors, i.e., Agriculture, Construction, Mining, Manufacturing, Service, Energy, Transport and Household. Among these eight economic sectors, manufacturing is divided into basic material, machinery and equipment and non durables sub-sectors; transport is divided into freight and passenger transport sub-sectors; and household is divided into urban and rural sub-sectors.

- The service sector with a contribution of 52.4% to the GDP by 2040 will remain highest among various sectors. Next to service sector will be agriculture and manufacture with their contributions 19.6% and 16.09% respectively. Likewise, construction, mining and energy will have their contributions as 7.76%, 1.6% and 2.45% respectively.
- It is assumed that in all the sectors energy intensities would decrease periodically up to 5% in the year 2040 except agriculture sector. In the agriculture sector, energy intensity will increase.
- Use of electricity is encouraged to substitute more and more of other forms of energy.

5.4. Future Electricity Demand

5.4.1 Total sectoral Electricity Demand

The sectoral electricity Demand for the different scenarios are given in the table below:

Items	2015-20	20-25	25-30	30-35	35-40
GWh @ 4.5% Economic Growth Scenario					
Industry	1506.67	3309.69	5820.75	9647.33	15320.78
Manufacturing	1424.87	3174.90	5619.94	9366.28	14944.73
ACM	81.81	134.79	200.81	281.06	376.06
Transportation	0.06	45.54	567.62	919.58	1414.11
Household	1857.52	3601.85	5775.40	8432.38	11632.15
Service	503.20	655.11	862.81	1129.04	1471.62
Total	3867.45	7338.41	12242.23	18481.66	26819.22

7.2 % Economic Growth Scenario					
Industry	1506.67	3759.94	7512.14	14144.41	25518.25
Manufacturing	1424.87	3606.80	7252.98	13732.34	24891.89
ACM	81.81	153.13	259.16	412.07	626.36
Transportation	0.06	46.30	575.67	955.79	1528.65
Household	1857.52	3601.85	5775.40	8432.38	11632.15
Service	503.20	704.84	1004.62	1431.20	2042.13
Total	3867.45	8112.93	14867.84	24963.78	40721.17
9.2% Economic Growth Scenario					
Industry	1506.67	3782.85	7819.57	15478.22	29653.73
Manufacturing	1424.87	3614.89	7507.79	14934.49	28747.21
ACM	81.81	167.96	311.78	543.74	906.52
Transportation	0.06	46.91	582.93	992.17	1656.85
Household	1857.52	3601.85	5775.40	8432.38	11632.15
Service	503.20	752.59	1154.76	1783.99	2776.57
Total	3867.45	8525.36	16550.47	29872.45	52998.00

5.4.2 Total and Per-capita Final Electricity Demand

Future energy demand is determined by the levels of total population and gross domestic product (GDP). It has been assumed that the total population of the country will reach about 39.0 million in the year 2040, which is 1.4 times higher as compared to the base year. It has been assumed that the average GDP growth rate is 4.5%, 7.2% and 9.2% per annum in BAU, Reference and High growth scenarios, respectively. Figure 3 shows the trend of GDP in three economic growth scenarios.

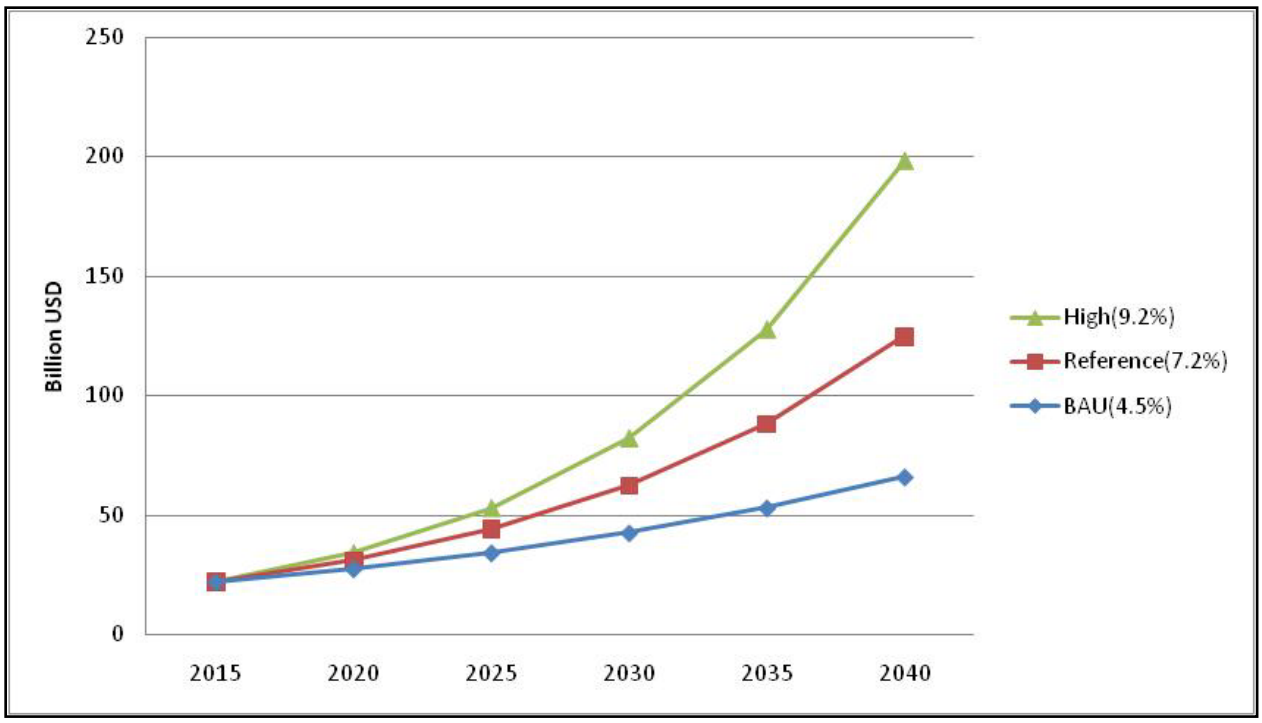

Figure 3: GDP in BAU, Reference and High Growth Scenario

The change of the final electricity demand from 2015 to 2040 at different time steps which is obtained from the analyses performed by the MAED model is given in Table 8.

Table 8: Total Final Electricity Demand and Average Growth Rates

Year	Final Electricity Demand (GWh)					Growth Rate of Final Electricity Demand (% p.a.)				
	BAU	Reference Scenario	High Scenario	Policy Intervention @ 7.2%	Policy Intervention @ 9.2%	BAU	Reference Scenario	High Scenario	Policy Intervention @ 7.2%	Policy Intervention @ 9.2%
2015	3866.3639	3866.363904	3866.36	3866.36	3866.36					
2020	7600.75872	8110.66	8522.97	14870.92	15304.29	14.5	15.10	17.13	30.92	31.67
2025	12998.2503	14863.67	16545.84	22431.68	24265.05	11.3	12.19	14.19	8.57	9.66
2030	20073.8344	24956.79	29864.09	35334.66	41264.82	9.1	10.25	12.54	9.51	11.20
2035	29744.6919	40709.77	52983.16	51771.84	65657.50	8.2	9.64	12.15	7.94	9.73
2040	43016.6893	66096.60	94851.06	81958.97	115294.44	7.7	9.50	12.35	9.62	11.92

Table 9 shows the per capita electricity demand in different scenarios and Figure 4 shows the per capita electricity in BAU scenario.

Table 9: Per Capita Electricity in Different Scenario

Year	Per Capita Electricity Demand (kWh)				
	BAU 4.5%	Reference Scenario 7.2%	High Scenario 9.2%	Policy Intervention @ 7.2%	Policy Intervention @ 9.2%
2015	138.08	138.08	138.08	138	138
2020	271	291	304	531	547
2025	464	531	591	801	867
2030	716	891	1067	1261	1474
2035	1062	1454	1892	1848	2345
2040	1536	2361	3388	2927	4118

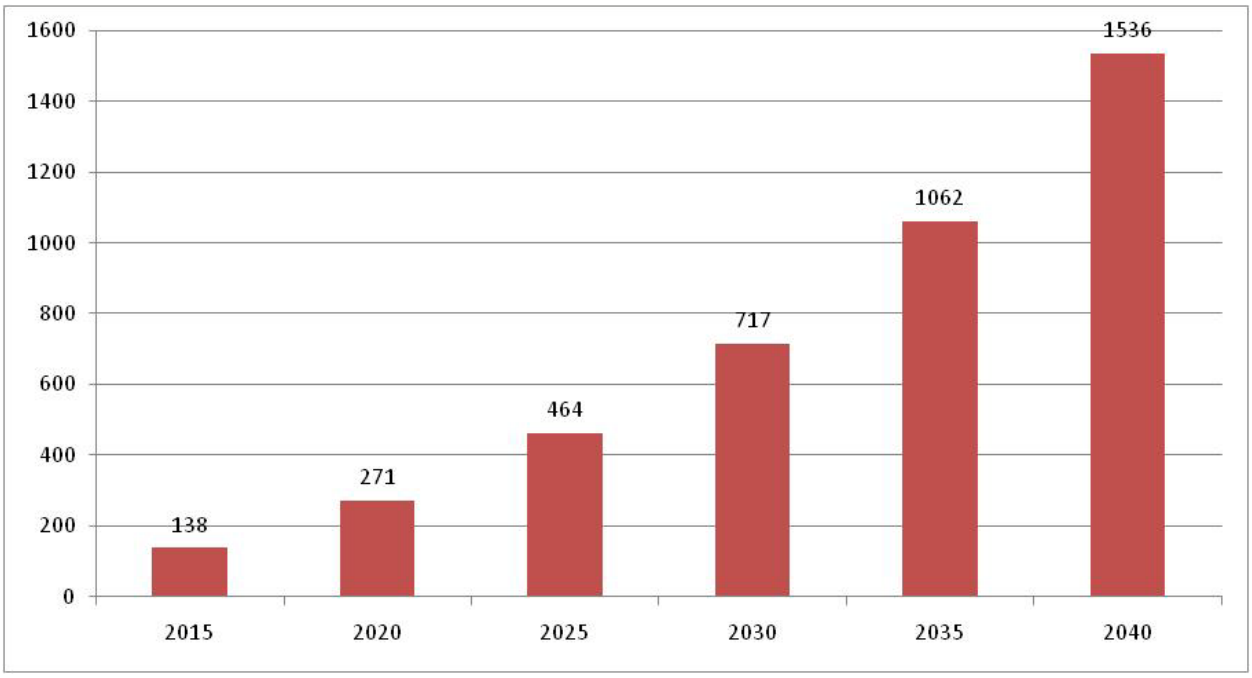

Figure 4: Per Capita Electricity in BAU Scenario

Table 10 below shows the installed capacity requirement to supply the energy requirement given in table 8

Table 10: Installed Capacity Requirement in Different Scenarios

Year	Total Installed Capacity Requirement (MW)				
	BAU 4.5 %	**Reference Scenario 7.2%**	**High Scenario 9.2%**	**@ 7.2% growth with policy intervention**	**@ 9.2% growth with policy intervention**
2015	1721	1721	1721	1721	1721
2020	3384	3611	3794	6621	6814
2025	5787	6617	7366	9987	10803
2030	8937	11111	13296	15731	18371
2035	13242	18124	23588	23049	29231
2040	19151	29427	42228	36489	51330

Note: Installed capacity has been calculated considering the following parameters

Capacity factor: 50%

Regular outage and unexpected outage: 20%

T&D loss: 25%

Additional Power requirement to support the peak demand: 30%

Assumptions made for the Policy Intervention Scenario:

- 75% of the water heating in urban household will be done by electricity by 2020
- 100% of the cooking in urban household will be done by electricity by 2020
- At least 7% of the cooking in rural household will be done by electricity by 2020
- 100% electrification by 2020
- 18 % of the total passenger Kilometres demand will be fulfilled by electric car and 7% by electric metro in city by 2025

6. Conclusions and Recommendations

6.1. Conclusions

The electricity requirement depends mainly on the population and Economic conditions/activities (eg. GDP) of the country. In addition, electricity consumption depends on the development path followed by the country. If we follow low carbon path, the demand pattern follows a certain pattern. Likewise, following a high growth path changes the demand pattern accordingly.

Mostly the plan, policy and overall national vision guide the predictions of future energy/electricity requirement of the country. In the present forecast study, if the policy interventions are made and an enabling environment is created for using electricity in cooking and water heating in urban areas, mechanization in agriculture, operation of electric trains, then the electricity demand will increase.

The study shows that if we were able to make the above mentioned interventions, there would be 30% rise in demand of electricity by 2020 compared to that in 2015. The actual installed capacity requirement was 1,721 MW in the year 2015, but we hardly had 800 MW of installed capacity, which made us to face the problem of load shedding. Even if we follow the past trend of GDP growth, i.e. 4.5%, there will be a need of 3,384 MW of installed capacity by 2020, whereas in case of policy intervention scenario the requirement will double to 6,621 MW. By 2030, the installed capacity requirement is about 15,000 MW, whereas by 2040, the demand will increase to 82,000 GWh for which the corresponding installed capacity requirement is more than 35,000 MW. If the same kind of policy interventions are made while achieving 9.2% GDP growth rate, the installed capacity requirement will reach up to 18,000 MW in 2025 and more than 50,000 MW by 2040.

In the forecast study, it was found that the highest power demanding sector was industry followed by household, service and transport sectors.

A strong political will involving adequate infrastructure development and financial investment is necessary to achieve this target.

6.2. Recommendations

Energy demand forecast, and for that matter, electricity load forecast is not an one-shot work. In absence of up to date data in many respects, several assumptions have been made in the present forecast study. Hence, it is recommended that continual updating has to be done in the present electricity forecast work with additional up to date data and information, at least every year and made the results public officially.

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