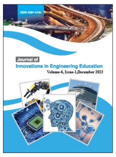

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Institute of Engineering
Tribhuvan University

Impact of hydropower construction delay in energy banking opportunities between Nepal and India

Sunil Subedi[a,*], Nawraj Bhattarai[a] and Ramhari Paudel[a]

[a]*Department of Mechanical and Aerospace Engineering, Pulchowk Campus, Instititute of Engineering, Tribhuwan University, Nepal*

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Abstract

Nepal has been electrical power surplus country since 2021 during wet season and electrical energy deficiency in the dry season is increasing year by year as most of the hydropower are of RoR type and they generate full capacity in wet season and produce almost one third of energy in the dry months compared to wet months as the water flow in the river decreases. The surplus energy in the wet season can be exported to India and it could be imported back to Nepal in dry months when there is energy deficiency using the concept of energy banking. In this work, the electrical energy demand and generation scenario of Nepal in the present and future are studied and technical possibility of Energy Banking are discussed between India and Nepal from Nepal's perspectives.

Though yearly energy requirement can be met from the internal production if the present under construction projects are completed on time but major problem is that during wet season Nepal's energy gets spilled and during dry season Nepal could not produce electricity as required. In order to solve this problem, Nepal could make arrangement of reliable energy banking mechanism with India so that excess energy in the wet months is exported to India and deficient energy in the dry months are imported back to Nepal. Under Reference Scenario of demand, net electrical energy surplus decreases by 69%, 72%, 56%, 47%, 44% and 24% for year 2022 to 2027 for one year delay in construction of project and for two-year delay in construction net energy surplus decreases by 69%, 78%, 62%, 86%, 80% and 67% respectively. Nepal should focus primarily on construction of hydroelectric projects and cross border transmission line after assuring market for excess produced electricity in India.

1. Introduction

Total hydropower installed capacity in the world reached to 1360 GW in 2021 which is an increase by 26 GW from previous year[1]. The share of Renewable energy in electrical sector in the world is about 26% only in 2020[2].Though there is huge potential of renewable energy worldwide only 27% of world population obtains electricity from renewable energy [3].In South Asia region, Bangladesh India and Pakistan use fossil fuels as primary source of electricity on the other hand Nepal and Bhutan relay on hydropower[4]. The huge potential of hydropower in Nepal and Bhutan can be used to meet growing electricity need of South Asia[5]. There are potential opportunities of hydroelectricity for reducing carbon emission by replacing fossil fuel energy sources in this region[6].

There are altogether 6,000 rivers in Nepal with cumulative length of 45,000 km. There are about 24 rivers that are more than 100 km long and 1000 rivers longer than 10 km in length [7]. Nepal's estimated water resources is 225 billion m^3/km^2/year. It is four times higher than world's average [8]. Nepal has huge potential of hydropower, but about two percent of the 83,000 MW (technically possible) of hydropower is currently harnessed. 42,000MW is feasible with no environmental hazards [9].

In fiscal year 2019/20, 1,729 GWh of electricity was imported through various transmission links by Nepal which increased to 2,826 GWh in FY 2020/21. Nepal has also been able to export 107 GWh of electricity to India, an increase of 18.6% from the previous year through power exchange mechanism [10][11].

*Corresponding author:
s.sunilsubedi@gmail.com (S. Subedi)

The power system in Nepal is dominated by run-of-river (ROR) hydropower plants. There is a shortage of storage type hydropower plants [12]. Nepal should not rush for construction of storage projects just for energy trade as a multiple benefit could be obtained in irrigation, tourism, flood control and others [13]. The national utility must invest in Demand Side Management to make a balance between demand and supply [14].

Nepal is being able to produce more electricity than required in the wet season as installed capacity is higher than peak demand. On the other hand, Nepal could not produce required amount of electricity to meet its demand in the dry season. This gap of spill energy in wet season and deficiency in dry season will be higher in coming years as most of the hydropower under construction are of ROR type. Nepal need to develop mechanism of banking spill energy in the wet season with India so that dry season demand could be met by using the banked energy in wet season. This supply side management strategy could be useful to solve the present problem of Nepalese power system.

Nepal has unbalanced type of Demand and Supply. Indicative electricity production and demand in both wet and dry season as shown in figure 1. Both domestic and cross-border power markets need to be explored in possible dimensions to cope with the balancing of seasonal energy mismatch.

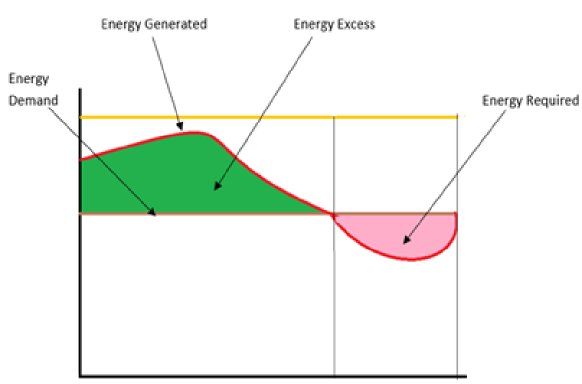

Figure 1: Typical energy generation and demand pattern of Nepal

This paper studies the future electricity generation and demand pattern under different scenario of Nepal and analyzes how future year monthly electrical energy demand of Nepal can be met by using energy banking with India.

2. Energy banking between Nepal and India

Nepal's power generation is predominantly hydro-based Run-Off-River (ROR) type. They generally generate energy in full capacity, in wet/monsoon however, the electricity demand in various States of India like Uttar Pradesh, Hariyana and Punjab is quite high during the same period due to highly increasing agricultural and cooling loads in these States. Nepal can supply power to India during wet season and help India to meet its increased load. It also helps in generation mix of hydro, solar and thermal power to some extent.

The seasonal imbalances of demand and supply of electricity that exist between Nepal and India make energy banking a highly suitable model for power transaction at seasonal basis to benefit both countries as shown in figure 2. Power can flow in reverse direction from India to Nepal in dry season period during which Nepal's electricity demand is high, but hydropower generation is drastically diminished to almost one third of the installed capacity of ROR hydropower plant due to low discharge in rivers.

It makes power import from India an inevitable option for Nepal for balancing demand and supply of electricity as Nepal does not have enough reservoir hydropower capacity right now. Energy banking can be looked as a process to turn ROR and PROR projects into storage projects without additional infrastructures for storing water[15].

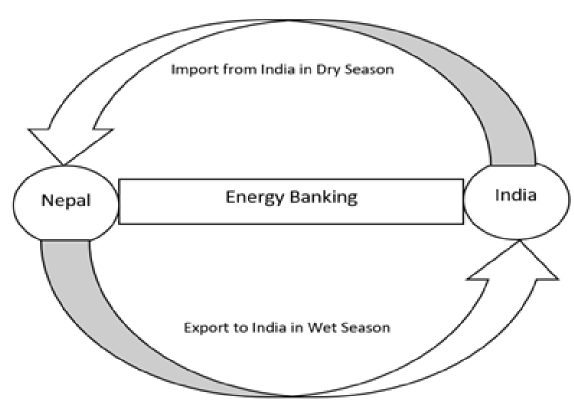

Figure 2: Conceptual framework of Energy Banking

Hydropower is regarded as the most suitable option for Nepal's future economic development [16]. If energy banking could work effectively in future, dry season tariff of the hydropower generator could be reduced which is higher than wet seasonal tariff at present[15]. The surplus energy available will increase from month of April to November and thereafter starts to decrease in each fiscal year[17].

The energy transaction between Nepal and India may be characterized by both energy banking and export for some years up to 2025/26 as the dry season deficit is less than the wet season surplus in these years[16]. India has committed to achieve net zero emission by 2070 in the climate change summit held in Glasgow. India needs to invest huge money during 2020-30 in power sector[18]. The monthly power requirements of India are shown in the figure 3 [19].

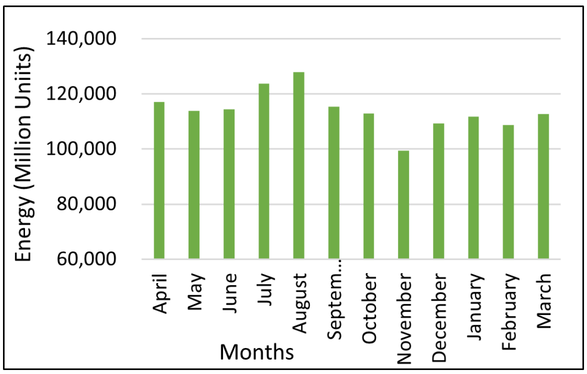

Figure 3: Monthly Energy Demand of India for 2021

It can be observed that power requirements from June to October is higher compared to other months in India, on the other hand Nepal will have spill energy during these months and amount of this spill energy goes on increasing as additional hydropower come into operation. The best practice could be energy banking to India during monsoon when Nepal's generation is higher than requirement and get back energy during dry month when Nepal suffers power shortage.

Though Energy cooperation and grid connectivity at regional level are being discussed in SAARC forum, there is no any significant progress has been achieved in regional grid connectivity[20]. There are four major barriers to regional power market namely technical barriers, institutional barriers, commercial barriers and policy barrier[21]. Legal mistrust has been identified as major concern for energy cooperation in South Asian region[22]. There are examples in the world which shows that exporting electricity alone could not lead a country to prosperity. Paraguay, one of the main electricity exporters in South America is still the second poorest country in the region [23], Bhutan exports major share of its hydropower produced electricity to India in nominal rate in the wet season. On the other hand, in dry season Bhutan imports back electricity from India in higher rates[24].

3. Methodology

The forecast of future energy requirement are obtained from WECS publications and generation forecasting for three different scenario namely project completion within stipulated time, one year delay in generation and two-year delay in generation are obtained. Generation and demand under different scenario are matched for different year. Monthly generation and consumption energy for future year are matched and how energy banking shall help Nepal to obtain balance between generation and supply of electricity are analyzed.

3.1. Data collection

The contribution of different sources to meet demand of country is extracted from these reports. Similarly monthly energy demand and supply is extracted from these reports of previous years. The previous year's month wise generation of major hydropower are extracted from yearly publication of NEA. Contribution of major three sectors in electricity i.e., NEA, IPP and Import from India as obtained from NEA publications[10][11][25][26][27][28][29][30][31] to meet the demand of whole country are shown in table1.The future electricity generation data of Nepal from different utilities (NEA and IPP) are obtained from NEA publications and DOED website. Energy

Table 1: Energy Requirement of Nepal for different year.

Year	NEA	IPP	Import (India)
2012	2125	1038	694
2013	2358	1073	746
2014	2291	1175	790
2015	2297	1070	1318
2016	2366	1268	1369
2017	2305	1778	2175
2018	2308	2168	2582
2019	2548	2190	2813
2020	3021	2991	1729
2021	2808	3241	2826

and power demand forecast of Nepal are extracted from energy forecast developed by Water and Energy Commission Secretariat (WECS) published report "The Electricity Demand Forecast Report (2015-2040)". MAED model was used in load forecasting [32]. 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).

The average GDP growth rate in the period 2015-21 is about 4% [33]and under BAU scenario of WECS forecast, the considered growth rate is 4.5%. Actual Energy Consumption and WECS Energy Forecast of Business-as-Usual Scenario are plotted in the figure 4.

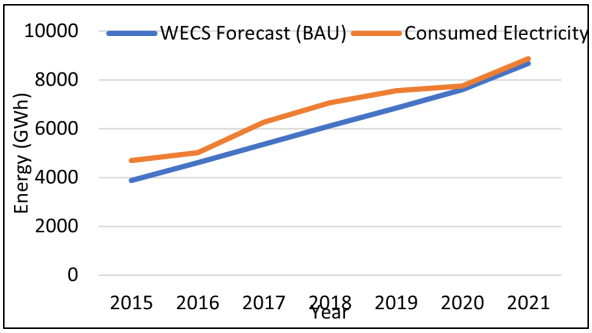

Figure 4: Actual Energy Consumption and WECS Energy Forecast Business-as-Usual Scenario

In order to obtain future energy generation scenario only projects under construction are considered. The projects under construction are divided into two categories, IPP projects and NEA and its subsidiary projects. Large hydropower projects in Nepal suffer from time overruns which leads to increased costs of the projects. The probable reasons for time extension of project are weak management capacity of NEA, lengthy procurement process and degraded capacity of contractors.[3]

In order to find out the completion period of the IPP project (above 10 MW) which are under construction, PPA date and completion date of the operating hydropower (above 10 MW) are listed and time period taken to complete project from PPA date of individual project are obtained. The average years for completion of project is obtained to be 8 years. The completion date of under construction IPP projects are obtained by adding the average completion time to their PPA date. The completion date of NEA and its subsidiary company projects are retrieved from NEA publications. For every year additional MW of power are obtained by adding the IPP and NEA projects that are scheduled to be completed in the particular year. The addition of electrical power from 2022 to 2027 from IPP and NEA are shown in the table 2.

The average plant factor of Nepalese hydropower is calculated from the past two years (2020, 2021) hydropower generation data and is obtained to be 0.66. Same plant factor is used to find out the additional energy produced in different years. Two additional cases are considered assuming there shall be delay in completion of project by one year and by two years.

The energy generation and consumption pattern for year

Table 2: Addition of Capacity (MW) and energy from 2022 to 2027 form IPP and NEA and its Subsidiaries

Year	Additional MW	Additional Energy (GWh)
2022	742.10	4,225.52
2023	470.03	2,676.35
2024	515.86	2,937.31
2025	604.22	3,440.43
2026	742.74	4,229.18
2027	380.80	2,168.28

2019, 2020 and 2021 are extracted from NEA publications A Year in Review book of different years in monthly basis. The average generation and consumption percentage for each month are calculated. The average factors of three years are used to obtain monthly available generation and consumption in the future from the yearly generated energy and consumption energy.

4. Results and discussions

4.1. Business as usual scenario of demand forecast

In this scenario, energy requirement is considered as WECS forecasted energy requirement under BAU scenario. In this condition GDP growth rate is considered as 4.5%. Normal generation condition is the condition in which hydropower completion takes place as planned without delay in construction, one year delay in generation refers to the condition in which hydropower completion is pushed one year later than as planned. Two-year delay in generation condition is the condition in which hydropower completion is pushed two year later than as planned with delay in construction. The figure 5 shows the year wise forecasted demand under BAU and generation forecast under different scenario.

In this condition all year energy demand is met by all three types of generation forecast and there is excess of energy in all year. The gap of excess energy seems increasing year by year. For the year 2024, 2025,2026 and 2027 there is energy excess of 6,880 GWh, 9,241.67 GWh, 12,055.74 GWh and 12,808.90 GWh respectively if normal generation is considered. Similarly, if two-year delay in construction is considered, there is energy excess of 3819 GWh, 3250 GWh, 4630 GWh and 6527 GWh respectively.

4.2. Reference scenario of demand forecast

In this scenario, energy requirement is considered as WECS forecasted energy requirement under Reference

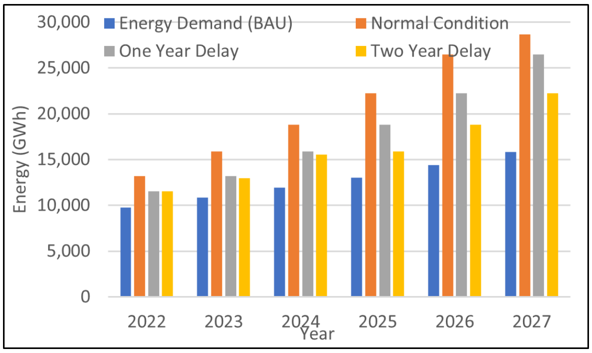

Figure 5: Forecasted Yearly Energy Requirement (BAU Scenario; Different Generation Condition)

scenario. In this condition GDP growth rate is considered as 7.2%. The figure 6 shows the year wise generation for different condition and demand of energy under this scenario for year 2022 to 2027.

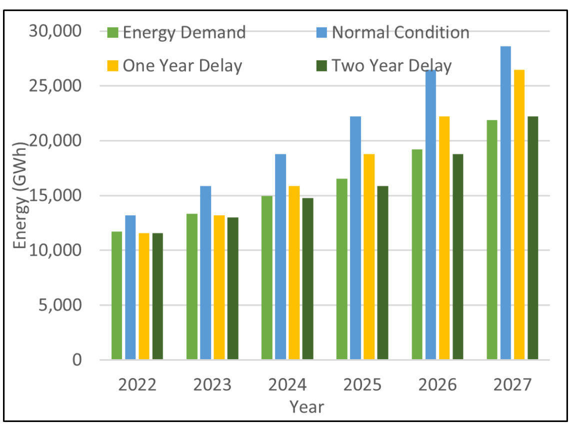

Figure 6: Forecasted Yearly Energy Requirement (Reference Scenario; Different Generation Condition)

In this condition all year energy demand is met by generation and there is excess of energy in all year. There is excess energy of 744 GWh, 1023 GWh and 7,711 GWh energy for year 2022, 2023 and 2027 respectively if there is one year delay in generation. In the recent year there is smaller gap between forecasted demand and generation as compared to later year.

The amount of excess energy is 744 GWh, 2021 GWh, 2022 GWh, 998 GWh and 1917 GWh and 3339 GWh for the years 2022 to 2027 respectively if there is two-year delay in construction of project.

4.3. High scenario of demand forecast

In this scenario, energy requirement is considered as WECS forecasted energy requirement under High scenario. In this condition GDP growth rate is considered as 9.2%. There is energy excess through all year under consideration if there is no delay in hydropower construction as shown in figure 7. There is energy deficiency of 175 GWh and 150 GWh in the year 2022 and 2023 and there is excess generation of 920 GWh, 2253 GWh, 3030 GWh and 4595 GWh respectively from year 2024 to 2027 under one year delay in generation condition. When there is two-year delay in construction, there is energy deficiency up to 2026.

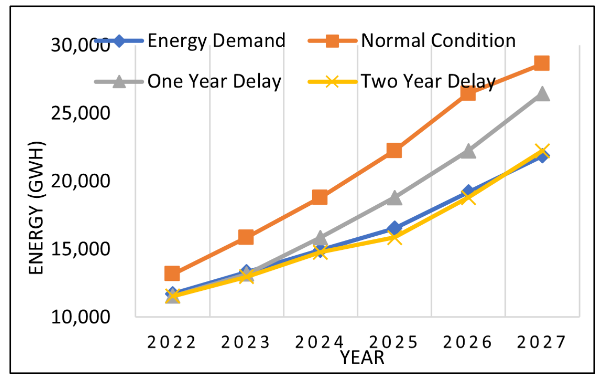

Figure 7: Forecasted Energy Requirement (High Scenario; Different Generation Condition)

4.4. Policy intervention at reference scenario demand forecast

In this scenario, electrical energy requirement is considered as WECS forecasted energy requirement under Reference Scenario with policy intervention. Policy intervention scenario considers 100% of cooking in urban area is done by electricity. It also considers penetration of electric vehicles in transportation sector. It can be observed from figure 8 that under normal generation forecast, Nepal faces energy deficiency by 4529 GWh, 3425 GWh, 2060 GWh and 191 GWh respectively from 2022 to 2025. The energy deficiency gap goes on decreasing trend from 2022 to 2025. From 2025 onward yearly energy required is met by country's generation. There is excess of generation by 1456 GWh and 1044 GWh respectively for year 2026 and 2027. For delay in generation condition Nepal could not meet its demand for all the year under consideration.

4.5. Comparison of demand and generation of electrical energy for year 2023 and 2025

The result of sum of wet energy surplus and dry energy deficiency for the year 2023 under different scenario considered are tabulated in table 3. It can be observed from the table that there is energy surplus of 5022.93 GWh under BAU demand scenario and normal gener-

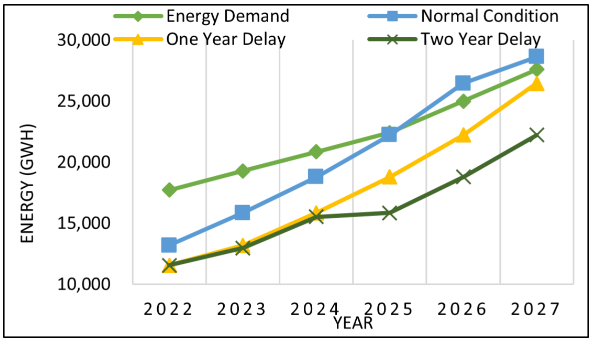

Figure 8: Electrical Energy Requirement (Policy Intervention 7.2%) and Different Generation Forecast

ation condition. There is surplus energy generation of 1023.37 GWh under reference scenario in demand and one year delay in Generation. Similarly, there is energy surplus of 824.33 GWh under references scenario of demand and two-year delay in generation. There is energy deficiency by 150.85 GWh and 3425.19 GWh respectively under high scenario of demand and one year delay generation scenario and under policy intervention (at 7.2% GDP) and normal generation condition. Though under high scenario of demand and one year delay generation scenario, there is energy deficiency of 1230.31 GWh, the excess energy 1079.45 GWh in the wet months can be banked to India and used in the dry months. However, under policy intervention (at 7.2% GDP) and normal generation condition, the deficient amount of energy amounts to 3425.19 GWh in dry season and there is excess generation of only 149.67 GWh in wet season. Under this scenario country need to import almost all the deficient energy to balance demand and supply.

The result of sum of energy surplus and energy deficiency for the year 2025 under different scenario considered are presented in the table 4. It can be observed from the table that there is energy surplus in all scenario under consideration except policy intervention (at 7.2% GDP). There is energy surplus of 9241.67 GWh under BAU demand scenario and normal generation condition, 3935.83 GWh under reference scenario of demand; one year delay in generation. There is energy surplus of 998.52 GWh under reference scenario; two-year delay in generation and 2253.66 GWh under high scenario; one year delay in generation respectively.

Under reference scenario of demand and one year delay in generation, there is energy deficiency of 313.73 GWh in dry season, which can be met from energy banking with India. The excess amount of 3935.83 GWh can be sold to India. Similarly, under reference scenario of demand and two-year delay in generation, the dry season deficiency of 1019.03 GWh can be fulfilled by proper

Table 3: Sum of Monthly Excess Electrical Energy and Deficient Energy for Different Scenarios for Year 2023

Scenario	**Generation Condition**	**Wet Energy Outflow**	**Dry Energy Inflow**	**Net Energy in GWh**
BAU (4.5% GDP)	Normal Condition	5,071.49	48.56	5,022.93
	One Year Delay	2,678.78	332.19	2,346.58
	Two Year Delay	2,525.38	377.85	2,147.54
Reference Scenario (7.2% GDP)	Normal Condition	3,905.66	205.94	3,699.72
	One Year Delay	1,794.93	771.56	1,023.37
	Two Year Delay	1,655.97	831.64	824.33
High Scenario (9.2% GDP)	Normal Condition	3,017.20	491.70	2,525.50
	One Year Delay	1,079.45	1,230.31	(150.85)
	Two Year Delay	955.98	1,305.88	(349.90)
Policy Intervention at 7.2% GDP	Normal Condition	149.67	3,574.86	(3,425.19)
	One Year Delay	-	6,101.54	(6,101.54)
	Two Year Delay	-	6,300.58	(6,300.58)

energy banking with India. Similarly, under policy intervention at 7.2% and normal generation condition, energy deficiency in dry month is 2050.61 GWh. However, 1858.86 GWh energy can be fulfilled by proper energy banking with India.

4.6. Comparison of excess and deficient electricity for year 2024 and 2027 under different scenario

The month wise energy excess for different month for the year 2024 and 2027 under reference scenario of demand and two-year delay in generation are shown in the figure 9. For year 2024 there is energy deficiency from

Table 4: Sum of Monthly Excess Electrical Energy and Deficient Energy for Different Scenarios for Year 2025

Scenario	Generation Condition	Wet Energy Outflow	Dry Energy Inflow	Net Energy in GWh
BAU (4.5% GDP)	Normal Condition	9,241.67	-	9,241.67
	One Year Delay	5,870.36	69.12	5,801.24
	Two Year Delay	3,250.84	386.90	2,863.94
Reference Scenario (7.2% GDP)	Normal Condition	7,418.90	42.65	7,376.25
	One Year Delay	4,249.56	313.73	3,935.83
	Two Year Delay	2,017.54	1,019.03	998.52
Reference Scenario (9.2% GDP)	Normal Condition	5,905.93	211.85	5,694.08
	One Year Delay	3,065.41	811.75	2,253.66
	Two Year Delay	1,034.44	1,718.09	(683.65)
Policy Intervention at 7.2% GDP	Normal Condition	1,858.86	2,050.61	(191.76)
	One Year Delay	-	3,881.96	(3,881.96)
	Two Year Delay	-	6,569.49	(6,569.49)

January to April and for the rest of the months energy generated is higher than that of consumption. There is excess energy of 2022 GWh in this year under the said scenario after supplying the deficient energy in the dry months. There is excess energy of 3339 GWh for year 2027 for the same scenario.

The month wise energy excess/deficiency for different month for the year 2024 and 2027 under high scenario of demand and one-year delay in generation are shown in the figure 10.

For year 2024 there is energy deficiency from December to April and for the rest of the month energy generated is higher than that of consumption. There is energy spill of 3044 GWh in this year under the said scenario. For year 2027 there is energy deficiency from January to April and for the rest of the month energy generated is higher than that of consumption. There is energy spill of 6722 GWh for year 2027 for the same scenario.

The month wise energy excess/deficiency for different month for the year 2024 and 2027 under policy intervention (at 7.2% of GDP) demand and normal generation of projects are presented in the figure 11 below. For year 2024 there is energy deficiency from December to June and amount of deficient energy is 2688 GWh for these months.

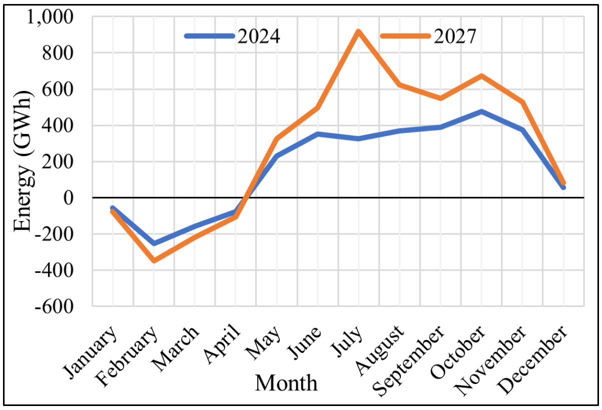

Figure 9: Excess Electrical Energy (Reference Scenario; Two Year Delay Generation) in GWh for year 2024 and 2027

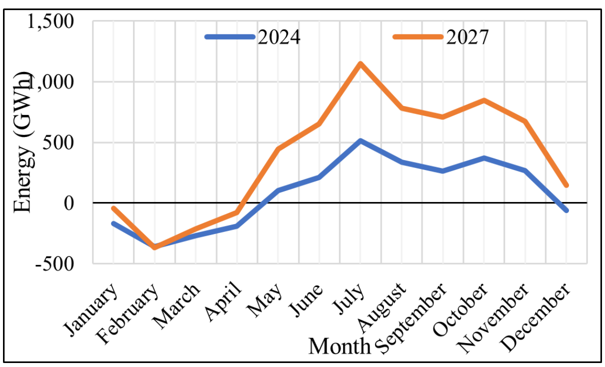

Figure 10: Excess Energy (High Scenario; One Year Delay Generation) in GWh for year 2024 and 2027

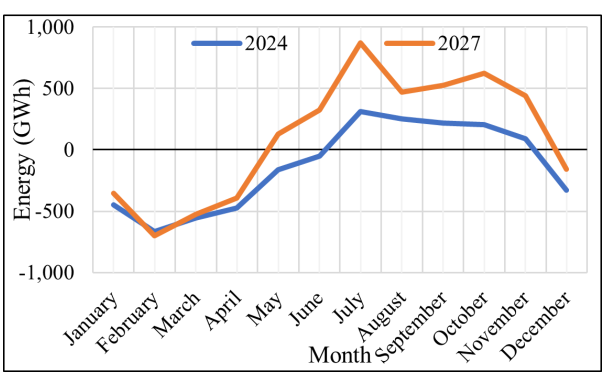

Figure 11: Excess Electrical Energy (policy intervention and normal generation) in GWh for year 2024 and 2027

The amount of excess energy from July to November is 1074 GWh. Hence there is energy deficiency of 1614 GWh for the year if proper energy banking is done.For year 2027 there is energy deficiency from December to April and amount of deficient energy is 2135 GWh for these months. For the rest of the months, energy generated is higher than that of consumption. The amount of excess energy from May to November is 3380 GWh. Hence there is energy excess of 1245 GWh for the year if proper energy banking is done.

4.7. Capacity requirement of cross boarder transmission line

The monthly forecasted optimum power flow for different scenario for the year 2024 are listed in the table 5. It is observed that the maximum power out flow occur for the BAU scenario of demand and normal generation condition for the month of July. The capacity requirement of transmission line is 1935 MW. The present capacity of transmission line considering only above 132 kV voltage level is 1455 MW only. So under this condition transmission line capacity is not enough. Hence transmission line capacity should be increased. Moreover, there may be several constraints to flow this power like substation capacity, existing supply systems, transmission line capacity etc. Similarly maximum capacity of power flow for reference scenario and normal generation is 1681.67 MW and for high scenario one year delay in generation is 858.33 MW.

The monthly forecasted optimum power flow for different scenario for the year 2027 are listed in the table 6. It is observed that the maximum power out flow occur for the BAU scenario of demand and normal generation condition for the month of July. The capacity requirement of transmission line is 3318.33 MW. Sim-

Table 5: Capacity Requirement of Transmission Line for Year 2024 under Different Scenarios

S.N.	Scenario	Maximum Monthly Energy	Month	Capacity of Transmission Line (MW)
1	BAU and Normal	1161	July	1935.00
2	Reference and Normal	1009	July	1681.67
3	High and One Year Delay	515	July	858.33
4	Policy Intervention and Two-Year Delay	828	February	1380.00

ilarly maximum capacity of power flow for reference scenario and normal generation is 2830 MW and for high scenario one year delay in generation is 1566.67 MW. Hence transmission line capacity should be increased. Moreover, 900 MW Arun III project is under construction and scheduled to be completed by 2024. The energy generated from this hydropower is exported to India. So, the existing transmission structure needs to be enhanced.

Hence in order to make reliable power flow more transmission lines needed to be constructed. The agreement for construction of New Butwal – Gorakhpur Transmission Line (400 kV) which shall have power flow capacity of 3500 MW has been done. The transmission lines Inaruwa - Purnia (400 kV), Dododhara - Bareilli (400 kV) and Lamki - Bareilli (400 kV) which are at the stage of DPR preparation should be soon started for construction.

5. Conclusion

As almost all of the construction license issued from DOED are of ROR types at present; the electrical energy demand supply matching is going to be very difficult task in Nepalese power system during dry season in coming year.

For year 2022 energy deficiency occurs only under the policy intervention scenario of demand in all other conditions country's energy requirements can be met by proper energy banking mechanism. In 2023 there is electrical energy deficiency in the country under high scenario (9.2% GDP) and policy intervention (at 7.2% GDP) scenario of demand. For year 2024 there is energy deficiency only under policy intervention (at 7.2% GDP) in all other conditions, country's demand can be met by proper energy banking mechanism. The result of sum of energy surplus and energy deficiency of different months for the year 2025, 2026 and 2027 under different scenario considered shows that if there is proper mechanism of energy banking, Nepal has surplus energy generation in all scenario under consideration except for policy intervention (at 7.2% GDP) of energy demand.

For year 2025 under reference scenario of demand and one year delay in generation, there is electrical energy deficiency of 313 GWh in dry months and excess energy in wet month is 4249 GWh. The yearly excess amount of 3935 GWh can be sold to India. Similarly, under reference scenario of demand and two-year delay in generation, the dry season deficiency of 1019 GWh can be fulfilled by proper energy banking with India s during wet season 2017 GWh excess energy is produced. Similarly, under policy intervention at 7.2% and normal generation condition, energy deficiency in dry month is

Table 6: Capacity Requirement of Transmission Line for Year 2027 under Different Scenarios

S.N.	Scenario	Maximum Monthly Energy	Month	Capacity of Transmission Line (MW)
1	BAU and Normal	1991	July	3318.33
2	Reference and Normal	1698	July	2830.00
3	High and One Year Delay	940	July	1566.67
4	Policy Intervention and Two-Year Delay	1016	February	1693.33

2050 GWh. However, 1858 GWh energy is excess in generation in wet months so dry month deficient energy can be fulfilled by proper energy banking with India.

Under Business As Usual Scenario of demand, net electrical energy surplus decreases by 48%, 53%, 43%, 37%, 35% and 19% for year 2022 to 2027 for one year delay in construction of project and net energy surplus decreases by 48%, 57%, 47%, 69%, 64% and 50% respectively for year 2022 to 2027 if there is two year delay in construction of projects.

Under Reference Scenario of demand, net electrical energy surplus decreases by 69%, 72%, 56%, 47%, 44 % and 24% for year 2022 to 2027 for one year delay in construction of project and net energy surplus decreases by 69%, 78%, 62%, 86%, 80% and 67%respectively for year 2022 to 2027 if there is two-year delay in construction of projects.

Under High Scenario, there is electrical energy deficiency for both delays in generation for all year under consideration.

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