

Bhutan Electricity Authority



Mangdechhu Hydropower Plant Tariff Review Report 2019 to 2022

December 2019

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Executive Summary

The Druk Green Power Corporation Limited (DGPC) submitted the domestic generation tariff proposal for the 720 MW Mangdechhu Hydropower Plant (MHP) since the MHP project will be handed over to DGPC upon commissioning of the project. The DGPC has proposed MHP generation tariff of Nu. 3.91/kWh for the tariff period from 1st July 2019 to 30th June 2022 considering the project cost of Nu. 54.37 billion, CoE of 14.18%, CoD of 10%, gearing ratio of 70%, mean annual energy generation of 3008 GWh with an additional energy of 324 GWh from 2021 onwards from Nikachhu.

The cost allowances such as return on assets, depreciation, operation and maintenance cost and return on working capital have been set according to the provisions of the Tariff Determination Regulation 2016 (hereinafter referred to as TDR). The tariff application of MHP has been reviewed and BEA has set the pre-tax weighted average cost of capital (WACC) as 12.70% based on 13.31% after-tax cost of equity (CoE), 10% cost of debt (CoD) and 70% gearing ratio.

Considering the approved regulatory parameters, cost allowances and energy generation from MHP, the generation tariff was set to Nu. 3.77/kWh for the tariff period from 1st October 2019 to 30th June 2022 based on the subsidy approval provided by the Royal Government of Bhutan vide letter no. 24/DHPS/HQ/Tariff/2019-20/285 dated 19th September 2019.

The Clause 7.16 of Domestic Electricity Tariff Policy 2016 (hereinafter referred to as DETP) states that the energy drawn from new power plant for domestic supply should be determined based on weighted average cost of generation of the DGPC and new plant considering the quantum of energy to be used for domestic purpose from the new plant.

Considering the energy volume of 97 GWh to be supplied from MHP during the lean season to Bhutan Power Corporation Limited (BPC) annually in addition to supply from DGPC, the BEA approved the weighted domestic average tariff of Nu. 1.50/kWh while determining the cost of supply of BPC.

1 Background

The DGPC submitted the MHP domestic generation tariff proposal for the period 1st July 2019 to 30th June 2022 vide letter no. 08/DGPC/BEA/MD/2019/88 dated 25th June, 2019. The DGPC had submitted the tariff proposal on behalf of MHP since Mangdechhu Hydroelectric Project Authority (MHPA) has the mandate for construction of the project only and DGPC will be responsible for operation and maintenance of the project as clarified by Department of Hydropower and Power Systems (DHPS) during the meeting held on 23rd May, 2019 between Bhutan Electricity Authority (BEA), DHPS, DGPC, MHP and BPC.

Based on the decision of the meeting held on 23rd May 2019, the DGPC submitted that the 720 MW MHP domestic tariff proposal was prepared in line with the DETP and the TDR reflecting the actual cost of efficient business operation of MHP and considering the following principles for the tariff determination:

- Fairness to both service customers and service providers;
- No unjust discrimination against service providers or those who wish to use the services;
- Reflect the actual cost of efficient business operation;
- Conducive to efficiency improvement in business operation;
- Enhance efficient and adequate supply to satisfy the domestic demand; and
- Transparency in the determination and presentation of tariffs.

Since BEA received the MHP domestic tariff proposal only on 25th June 2019, the BEA could not conduct a public hearing on MHP tariff proposal as the new DGPC and BPC cost of supply needed to be approved prior to the expiry of the prevailing tariffs on 30th June 2019.

Since the MHP tariff is an input to the BPC tariff determination, the BEA approved the domestic generation tariff of MHP as Nu. 3.77/kWh for the period 1st October 2019 to 30th June 2022 to ensure the timely approval of the DGPC and BPC cost of supply.

2 Regulatory parameters

2.1 Tariff period

As per the Clause 7.19 of the DETP, the tariff revision cycle shall be normally three years unless there is substantial and significant difference in the business environment and generation scenario.

The DGPC had proposed a three years tariff period for MHP from 1st July 2019 to 30th June 2022, with the year 2018 as the reference year.

The BEA has approved two (2) years and nine (9) months tariff period, starting from 1st October 2019 to 30th June 2022 based on the approval of subsidy allocation for domestic electricity tariff provided by DHPS, Ministry of Economic Affairs (MoEA) vide letter no. 24/DHPS/HQ/Tariff/2019-20/285 dated 19th September 2019.

2.2 WACC Parameters

The WACC shall be calculated as the pre-tax Weighted Average Cost of Capital in accordance with Clause 66 in the TDR:

$$WACC_g = \frac{CoE_g(1 - Gearing_g)}{1 - Tax} + (CoD_g \times Gearing_g)$$

Where,

- WACC_g is the weighted average cost of capital for the Generation Licensee “g”, as a percentage;
- CoE_g is the cost of equity, as a percentage; as determined by the Authority for the Generation Licensee “g”;
- Gearing_g is the ratio of debt to total net fixed assets, as determined by the Authority for the Generation Licensee “g”;
- CoD_g is the actual cost of debt for the tariff period for the Generation Licensee “g”, as a percentage, being the weighted average interest rate of the Licensee’s loans with suitable allowance made for currency risk of any loans not made in local currency, provided that the cost of debt should not exceed reasonable benchmarks;
- Tax is the prevailing rate of company taxation, as a percentage.

2.2.1 Proposal

The DGPC had proposed a pre-tax WACC of 13.08% based on a gearing ratio of 70%, CoE of 14.18%, CoD of 10% and a tax rate of 30% for MHP. The details of the proposed parameters are discussed in the subsection below.

2.2.1.1 Gearing Ratio

It was stated that the proposed gearing ratio of 70% was as per the provision of DETP which states that the gearing ratio for the computation of WACC shall be higher than actual gearing ratio and up to maximum of 70:30.

2.2.1.2 Cost of Equity

The CoE of 14.18% has been proposed based on the provision of the DETP which states that the CoE shall be based on the average lending rates of the domestic financial institutions and BEA may allow a reasonable premium up to a maximum of 250 basis points on the above rates depending on the domestic market situation and gearing ratio applied. While proposing the average lending rate of 11.68%, the industrial/manufacturing loan interest rate of the four domestic financial institutions has been taken as shown in Table 1 below.

Table 1: Proposed average lending rate

Sl. No	Institutions	Loan Type	Interest Rate
1	Bank of Bhutan Limited	Manufacturing – Hydro Power Term Loan	11.86 %
2	Bhutan National Bank Limited	Manufacturing and Industry Loan	11.75 %
3	T Bank Limited	Manufacturing and Industry Loan	11.00 %
4	Bhutan Development Bank Limited	Industry Loan	12.10 %
Average Interest Rate			11.68 %

Accordingly, the DGPC had proposed a post-tax CoE of 14.18% for MHP based on the average lending rates of 11.68% and the maximum premium of 250 basis points.

2.2.1.3 Cost of Debt

The proposed CoD of 10% had been justified by referring the DETP which states that the actual CoD for the tariff period should be considered.

2.2.2 BEA review

The WACC parameters are determined in the TDR Schedule C and may be updated by the BEA from time to time in accordance with Clause 6 of the TDR. The reviewed parameters are discussed in the subsections below.

2.2.2.1 Tax

The BEA has verified that the proposed tax rate of 30% is in accordance with the rate prescribed in the Income Tax Act of the Kingdom of Bhutan 2001. Therefore, a tax rate of 30% is used for the determination of pre-tax WACC.

2.2.2.2 Gearing

As per the Clause 66 of TDR, Gearing is the ratio of debt to total net fixed assets, as determined by the Authority for the Generation Licensee.

The DETP states that the gearing ratio for computation of WACC shall be higher than the actual gearing ratio and up to a maximum of 70%.

The DGPC had proposed MHP gearing ratio of 70% which is actual gearing ratio of MHP.

Since the DETP recommends a maximum gearing of 70%, the proposed gearing ratio of MHP has been considered.

2.2.2.3 Cost of Debt

The DGPC had proposed MHP Cost of Debt of 10% which was stated as the actual interest rate of MHP loan as per Inter Government (IG) agreement for MHP loan.

The BEA reviewed the Inter-Governmental loan agreement signed between the Government of Republic of India and Royal Government of Bhutan on 30th April 2010 and found that the interest rate of 10% is correct. Therefore, BEA approved the loan interest rate of 10% for determination of MHP domestic generation tariff.

2.2.2.4 Cost of Equity

The DGPC had proposed MHP CoE of 14.18% based on the average lending rate of 11.68% and premium of 250 basis points on the above rate. It was stated that as per DETP, BEA could allow a reasonable premium up to a maximum of 250 basis points on the average lending rates of the financial institutions.

During the public hearing held on 30th April 2019 for DGPC and BPC tariff proposal, a representative from RSA Pvt. Ltd., a medium voltage customer had raised the issue on average lending rate calculation. He submitted that either average lending rates of all sectors of the domestic financial institution to be used or hydropower loan which was recently introduced by Bank of Bhutan to be used.

Based on the submissions on the average lending rate calculation, the BEA sought clarification on the correct interpretation of Clause 7.2 of DETP from DHPS, MoEA as it is the final Authority to interpret the various provisions of the policy.

Upon seeking clarification on the interpretation of policy provision, the DHPS recommended applying the “long term average lending rates of the domestic financial institutions for all sectors for determining CoE”.

In line with the above clarification, the BEA has considered the long-term average lending rates for all sectors provided by the domestic financial institutions including five (5) banks and three (3) non-bank institutions.

Accordingly, BEA calculated the average lending rates of the domestic financial and non-bank institutions for all sectors as shown in Table 2 below.

Table 2: Average long term lending rate of Financial Institutions in Bhutan

Sl. No.	Banks	Interest Rate
1	Bhutan Development Bank Limited (BDBL)	11.24 %
2	Bhutan Insurance Limited (BIL)	12.33 %
3	Bhutan National Bank Limited (BNBL)	12.17 %
4	Bank of Bhutan Limited (BoBL)	11.66 %
5	Druk Punjab National Bank (Druk PNB)	11.48 %
6	National Pension & Provident Fund (NPPF)	9.63 %
7	Royal Insurance Corporation of Bhutan Limited (RICBL)	12.14 %
8	Tashi Bank Limited (T Bank Ltd)	9.85 %
	Average Rate	11.31 %

BEA allowed a premium of 200 basis points depending on the gearing ratio allowed and average lending rate of the domestic financial institutions.

Based on the long-term average lending rate of 11.31% and 200 basis points, the Cost of Equity was set at 13.31% which is same as the CoE allowance for other Licensees in the electricity sector.

2.2.2.5 The WACC

Based on the approved gearing ratio of 70%, CoE of 13.31%, CoD of 10% and tax rate of 30%, BEA has approved a WACC of 12.70% for the MHP as shown in Table 3 below.

Table 3: Proposed and reviewed WACC

	MHP	BEA
Gearing:	70 %	70 %
CoE:	14.18 %	13.31 %
CoD:	10 %	10 %
Tax:	30 %	30 %
WACC:	13.08 %	12.70 %

2.3 Inflation

The historical average inflation rate is used to escalate the historical O&M costs to 2018 price levels and to escalate the O&M allowance over the tariff period. As per Clause 7.4 of DETP, inflation to be used for the O&M expenses shall be based on historical average inflation rates published by the National Statistics Bureau (NSB).

The historical inflation figures for the year 2016, 2017 and 2018 from the Consumer Price Index (CPI) Bulletin of NSB for non-food items had been used for MHP as shown in Table 4 below.

Table 4: Proposed historical inflation rates

Year	2016	2017	2018	Average
Inflation figures	2.80 %	3.57 %	1.23 %	2.53 %

The DGPC had proposed an average annual inflation rate of 2.53% for MHP to be used to calculate the historical O&M average cost and to escalate the yearly O&M allowance over the tariff period.

The BEA has verified the proposed historical inflation rates for the years 2016 until 2018 and found that the proposed historical inflation rate of a particular year had been calculated by taking average of monthly inflation rate of non-food items. Therefore, the BEA has recalculated the average rate for non-food items as the year on year inflation rate for the tariff period 2016 to 2018.

Based on the above methodology, the average historical inflation rate for the period 2016 to 2018 is 2.44% as shown in Table 5 below.

Table 5: Reviewed historical inflation rates

Inflation	2016	2017	2018	Average
Year on year inflation	3.73 %	0.93 %	2.65 %	2.44 %

Therefore, BEA has approved average historical inflation rate of 2.44% to be used as both historical inflation rates and forecasted inflation rate for this tariff period.

2.4 Other regulatory parameters

The O&M benchmark and O&M efficiency gain parameters are discussed in Section 3.2 in this review report. Any other amendments to the regulatory parameters had not been proposed and therefore not discussed in this review report.

3 Allowances, Cost of Supply and Energy Volumes

The total cost of supply for MHP in any tariff year shall be determined in accordance to Clause 67 of TDR,

$$TC_g = OM_g + DEP_g + RoA_g + RoWC_g + FEES_g$$

Where

- TC_g is the total cost of supply of the Generation Licensee “g” in million Ngultrum;
- OM_g is the allowance for operating and maintenance costs of the Generation Licensee “g” in million Ngultrum, including any regulatory and other fees;
- DEP_g is the allowance for depreciation of assets for the Generation Licensee “g” in million Ngultrum;
- RoA_g is the return on fixed assets of the Generation Licensee “g” in million Ngultrum, determined as,

$$RoA_g = WACC_g \times NA_g, \text{ where}$$

- $WACC_g$ is the weighted average cost of capital for the Generation Licensee “g”, as determined in accordance to Clause 66 of TDR
 - NA_g is the net value of all fixed assets at the start of the year for the Generation Licensee “g”, in million Ngultrum
- $RoWC_g$ is the return on working capital for the Generation Licensee “g” in million Ngultrum

3.1 Allowances for depreciations (DEP) and return on fixed assets (RoA)

As per Clause 41 to 48 of TDR, assets values are to be based on historical assets values and Licensees are allowed to include the interest during construction (IDC) and associated labour costs to be capitalized. The regulation also allows the allowance for assets additions and assets disposals and other assets value adjustments over the course of the tariff period. However, assets which are not in use and/or not used for generation of electricity or Licensed Activities are not considered for tariff determination.

The allowance for depreciation is based on the economic lifetime of the assets, in accordance with Schedule B of the TDR, which may be updated by the BEA from time to time. The allowance for depreciation allows taking assets additions and removals over the tariff period into consideration. The return on assets is to be determined as the product of the WACC and the net assets values.

3.1.1 Proposal

3.1.1.1 Assets schedule at the end of 2018

The DGPC had proposed a gross assets value of Nu 54.37 billion, net assets value of Nu 54.37 billion, and depreciation of Nu 2.65 billion at the end of year 2018 for MHP as shown in Table 6 below. It was stated that a gross assets value of Nu 54.37 billion is including interest during construction (IDC) which was considered during the determination of export tariff of MHP. Further, it was submitted that the assets schedule proposed is as per the depreciation rates given in Schedule B of TDR.

Table 6: Proposed assets schedule as of 2018

Fixed assets (Mill. Nu.)	Gross value	Acc. Dep.	Net value	Depreciation
Land	9.73	-	9.73	-
Buildings	1,974.33	-	1,974.33	65.76
Civil structures	1,335.22	-	1,335.22	44.51
Dam complex	16,050.94	-	16,050.94	535.03
Water conductor	9,286.49	-	9,286.49	309.55
Power house	25,026.24	-	25,026.24	1,571.05
Transmission equipment	-	-	-	-
Equipment	132.67	-	132.67	18.35
Office equipment	550.02	-	550.02	105.70
Total	54,365.64	-	54,365.64	2,649.95

3.1.1.2 Investments – Asset additions 2019 to 2022

No new investments had been proposed to be considered for the tariff period 2019 to 2022.

3.1.1.3 Proposed return on assets and depreciations

The proposed return on assets is calculated as the product of the proposed WACC (13.08%) and the calculated net asset value at the end of each year. The depreciation allowance calculated in Table 7 below are as per the depreciation rates in Schedule B of the TDR.

Table 7: Proposed allowances for return on assets and depreciations

RoA and DEP (Mill. Nu.)	2019/20	2020/21	2021/22
Gross asset values	54,366	54,366	54,366
Accumulated depreciations	1,442	3,975	6,625
Net asset value	52,924	50,391	47,741
Return on asset (RoA)	6,921	6,590	6,243
Depreciation (DEP)	2,650	2,650	2,650

3.1.2 BEA review

3.1.2.1 Assets schedule at the end of 2018

The BEA has verified the proposed gross asset values, accumulated depreciation and net asset values with the MHP and DHPS, MoEA and it was submitted that it has been reported correctly

by DGPC. Based on the detailed review of the assets schedule, the BEA has deducted the buildings such as Executive and Non-executive field hostels, guesthouses, ECCD, club houses, swimming pool, shopping complex, canteen and temporary buildings (which are to be removed soon). The BEA is of the view that these buildings are not essential for delivering the core business of electricity generation and it has been deducted from the assets schedule.

However, BEA has considered all the residential buildings of MHP considering that the hydropower plant is located in remote area where private buildings are not available for rent.

Since no accumulated depreciation had been proposed in the tariff proposal which was submitted by DGPC on 25th June 2019, BEA used the MHP accumulated depreciation from the tariff model of MHP submitted by DGPC on 21st June 2019. Therefore, BEA recalculated the accumulated depreciation based on the reviewed asset schedule of MHP.

Based on the above deductions, the reviewed assets schedule of MHP is shown in Table 8 below.

Table 8: Reviewed Assets schedule (Mill. Nu.) as of 2018

Fixed assets (Nu. mill.)	Gross value	Acc. Dep.	Net value	Depreciation
Land	9.73	-	9.73	
Buildings	1,258.78	164.60	1,094.18	41.93
Civil structures	1,334.98	143.71	1,191.28	44.50
Dam complex	16,057.79	-	16,057.79	535.26
Water conductor	9,284.83	-	9,284.83	309.49
Power house	25,702.23	-	25,702.23	1,560.12
Transmission equipment	-	-	-	12.32
Equipment	132.64	64.48	68.17	18.35
Office equipment	549.92	129.57	420.36	105.68
Total	53,330.92	502.36	52,828.56	2,615.33

3.1.3 Summary on Depreciations and Return on Assets

Based on the review, assets schedule as proposed has been used. However, the BEA upon review deducted the depreciation values of the assets which are not used and/or utilized for the generation, transmission and distribution of electricity and the assets handed over to other agencies. The accumulated depreciation based on the reviewed asset schedule had been included in the MHP allowances. Since no new investment had been proposed, no new investment is considered for the tariff period 2019 to 2022.

Based on the reviewed assets schedule and the approved pre-tax WACC of 12.70% for MHP, the BEA has approved the allowances for return on assets, accumulated depreciation and depreciations as shown in the Table 9 below.

Table 9: Reviewed allowances for return on assets and depreciations

RoA and DEP (Mill. Nu.)	2019/20	2020/21	2021/22
Gross asset values	53,331	53,331	53,331
Accumulated depreciations	1,810	4,425	7,041
Net asset value	51,521	48,906	46,290
Return on Asset (RoA)	6,545	6,213	5,881
Depreciation (DEP)	2,615	2,615	2,615

3.2 O&M allowances

The determination of operating and maintenance costs is described in Clause 34 to 40 of the TDR. The allowance for O&M costs is calculated each tariff year. The O&M allowance is determined for the reference year 2018 which will be increased by inflation less efficiency gain targets through the tariff period. For each year in the tariff period an additional O&M allowance is added for new assets as per the investments schedule using benchmarks as set out in the TDR Schedule A. The annual regulatory fees are added to the O&M costs.

3.2.1 Proposal

3.2.1.1 Historical O&M Cost

The DGPC had proposed O&M allowance of Nu. 0.66 billion for MHP which is 1.21% of the total project cost. It was stated that the proposed O&M benchmark of 1.21% is reasonable compared to India's CERC norms.

3.2.1.2 O&M Efficiency Gain and Benchmark O&M Cost

The DGPC had proposed 0% efficiency gains on O&M costs for MHP during the tariff period from 2019 to 2022 and proposed O&M benchmark of 1.21%.

3.2.2 BEA review

The BEA upon review, allowed the O&M allowances of Nu. 0.53 billion which is 1% of the reviewed gross asset value of Nu. 53.33 billion since MHP is a new plant and is expected to have higher efficiency than the existing plants under DGPC. The BEA has approved O&M benchmark of 1.00% considering the provision of TDR and DETP. The O&M efficiency gain of 2% has been approved at par with that of DGPC for tariff calculation.

3.3 RoWC Allowances

The RoWC is the allowances for Return on Working Capital in million Ngultrum, in the TDR Clause 67 (5) which is determined as:

$$RoWC_g = I \times \left[REV_g \times \frac{ARREARS_g}{365} + INVENTORIES_g \right]$$

Where

- I is the interest rate for working capital as determined in Clause 55 of TDR 2016;
- $REV_g = OM_g + DEP_g + RoA_g$ where DEP, RoA and OM is as described in Section 3.1 and 3.2 in this review;
- $ARREARS_g$ is the allowed days receivables for the Generation Licensee “g”, in days;
- $INVENTORIES_g$ is the allowance for inventories for the Generation Licensee “g”, in million Ngultrum.

The purpose of the RoWC allowances is to compensate for the loss of revenues caused by the lag between the time, the costs occurs and the time of receivables from the customers.

3.3.1 Proposal

The DGPC had proposed RoWC allowances for MHP per year as shown in Table 10 below.

Table 10: Proposed allowances for RoWC

	2019/20	2020/21	2021/22
RoWC (Mill. Nu.)	223	219	256

The proposal is based on arrears of 55 days, inventories of Nu.0.47 billion which is 0.87% of MHP proposed capital cost of Nu. 54.37 billion which is same as the inventory level of DGPC, interest on working capital of 11% and DEP, RoA and O&M allowances as described under Section 3.1 and 3.2 of this review report.

3.3.2 BEA review

3.3.2.1 Arrears

The BEA has reduced the arrears from 55 days to 40 days as shown in the Table 11 below to reduce the cost of working capital which is high on account of longer bill preparation, delivery and payment duration.

Based on the above, BEA has approved arrears of 40 days for MHP which is same as approved for DGPC plants.

Table 11: Proposed and reviewed arrears

Arrears (Days)	MHP	BEA
Average energy consumption duration	15	15
Bill preparation and delivery duration	10	5
Bill payment due date	30	20
Total Arrears	55	40

3.3.2.2 Inventories

The DGPC had proposed inventories of Nu.0.47 billion which is 0.87% of MHP proposed capital cost of Nu. 54.37 billion which is same as the inventory level of DGPC. However, the DGPC while submitting in generation tariff application on 28th February 2019 for the DGPC

plants had estimated the MHP inventories requirement of 0.425% of gross asset value of MHP. Therefore, the BEA has used 0.425% of the reviewed capital cost of Nu. 53.33 billion resulting inventories value of Nu. 0.23 billion as much of the required spares has already been procured by MHP.

3.3.2.3 Return on Working Capital (RoWC)

The proposed RoWC has been calculated as the product of proposed interest on working capital and the amount of proposed working capital in line with Clause 56 of TDR. The Clause 7.7 of DETP states that the interest on working capital need to be determined based on the prevailing lowest short-term lending rate of financial institution of Bhutan.

The BEA reviewed the working capital interest rates offered by the seven (7) financial institutions in Bhutan and found that the lowest rate of 9.97 % for working capital was offered by Bank of Bhutan Limited. Accordingly, the BEA applied the lowest prevailing lowest short term lending rate of 9.97 % to calculate the return on working capital. The BEA reviewed allowances for RoWC per year is as shown in Table 12 below.

Table 12: Reviewed RoWC allowances

	2019/20	2020/21	2021/22
RoWC (Mill. Nu.)	129	126	157

3.3.3 Conclusions on the Return on Working Capital

The BEA has decided to reduce the arrears from 55 days to 40 days, to use inventories of Nu. 0.23 billion and to apply the lowest prevailing short-term working capital interest rate of 9.97% when calculating the return on working capital. The Table 13 below shows the proposed and approved arrears, inventories and rates used to calculate the RoWC allowances.

Table 13: Proposed and reviewed arrears, inventories and rates

	MHP	BEA
Arrears (Days)	55	40
Inventories (Nu. Mill.)	472.98	226.66
Working capital Interest Rate	11 %	9.97 %

3.4 Energy Volumes

The annual energy volumes are used to calculate the average cost of supply per unit per year, which will be the approved generation tariff. The average cost of supply is calculated by dividing the discounted total cost of supply on the discounted annual energy.

As per Clause 68 of the TDR, the annual energy volumes shall be determined as the mean annual energy generation of the past three years based on 98% water utilization factor to the extent of generation capacity less royalty energy adjusted for auxiliary consumption as:

$$ENERGY = \sum_i ENERGY_i \times (1 - AUX_i) \times (1 - ROYALTY_i)$$

Where,

- ENERGY is the annual energy volume in any year, in GWh;
- ENERGY_i is the average historical mean annual energy generation of the past three years for plant “i”, in GWh;
- AUX_i is the allowance for auxiliary consumption at plant “i”, as set out in Schedule D of TDR, 2016, as a percentage; and
- ROYALTY_i is the free energy which is made available to RGoB by plant “i”, as a percentage.

3.4.1 Proposal

3.4.1.1 Forecasted generation

The DGPC had proposed generation forecast of MHP as 3008 GWh for the year 2019 and 2020 and 3332 GWh in 2021 and 2022 including 324 GWh from Nikachhu from 2021 onwards. DGPC had also proposed an auxiliary consumption of 1.12% and Royalty energy of 15% resulting in royalty energy of 2,528 GWh for 2019 and 2020 and 2,800 GWh in 2021 and 2022 as shown in Table 14 below.

Table 14: Proposed annual energy volume (GWh)

Year	2019/20	2020/21	2021/22
Mean annual energy	3008	3008	3332
Auxiliary Losses (1.12%)	34	34	37
Royalty (15%)	446	446	494
Annual Energy Volume	2528	2528	2800

3.4.2 BEA review

Upon discussion with DHPS, the BEA was informed that an additional energy flow of 324 GWh from Nikachhu may not be likely in 2021 considering the uncertainties in the completion of the Project. Therefore, for the determination of MHP tariff, additional energy from Nikachhu has not been included and only energy generation from MHP has been taken into consideration. The BEA considered 1% auxiliary consumption which is same as that approved for DGPC.

As per Clause 7.18 of DETP, all generation plants fully owned by the RGoB have to provide 15% of an annual generation as Royalty Energy to RGoB.

Accordingly, the BEA calculated the annual energy volumes as the mean annual energy generation of MHP less royalty energy of 15% adjusted for reviewed auxiliary consumption of 1.00% as shown in the Table 15 below.

Table 15: Reviewed Energy volume (GWh)

Year	2019/20	2020/21	2021/22
Proposed Generation	3008	3008	3332
Less generation from Nikachhu water	3008	3,008	3008
Less 1% Auxiliary Consumption	2978	2978	2978
Less 15% Royalty Energy	2531	2531	2531
Annual Energy Volume	2,531	2,531	2,531

4 Tariff determination

As per Clause 69 of the TDR, the average cost of supply shall be taken as the ratio of the discounted annual costs of supply to the discounted energy volumes, with discounting applied over the Tariff Period using the $WACC_g$, as follows:

$$AC_g = \frac{\sum_{n=1}^{TP} TC_{g,n} / (1 + WACC_g)^n}{\sum_{n=1}^{TP} ENERGY_n / (1 + WACC_g)^n}$$

Where,

- AC_g is the average cost of supply for the Generation Licensee “g”, in Ngultrum per kWh;
- TP is the number of years in the Tariff Period;
- $TC_{g,n}$ is the total cost of supply of Generation Licensee “g” in year “n” in million Ngultrum, as determined in accordance with clause 67 of TDR, 2016;
- $ENERGY_n$ is the energy volume in year “n” in GWh, as determined in accordance with Clause 68 of TDR, 2016; and
- $WACC_g$ is the weighted average cost of capital for the Generation Licensee “g”, as determined in Clause 66 of TDR, 2016.

The BEA’s review has resulted in the MHP allowances for this tariff period as shown in Table 16 below.

Table 16: Approved Cost allowances (Mill. Nu.)

	2019/20	2020/21	2021/22
OM	543	545	548
DEP	2,615	2,615	2,615
RoA	6,545	6,213	5,881
RoWC	129	126	157
Total Cost	9,833	9,500	9,201
Energy Volume (GWh)	2,531	2,531	2,531

By discounting the Total Cost of Supply and the Energy using a pre-tax WACC of 12.70%, the BEA has determined the MHP generation tariff to be Nu. 3.77/kWh for the period 1st October 2019 to 30th June 2022.