

Table 5-Comparison of prevailing Terms of REC, PFC and IREDA

Sr. No.	Particulars	PFC	REC	IREDA
1	Tenor of loan	The max repayment period up to 15 Years for all RE projects except Hydro which is upto 20 years	The repayment period (in addition to moratorium period) for hydro projects shall be 15 years while the rest of the projects will have a repayment of 12 years	The repayment periods shall be maximum of 15 years (maximum 20 years in case of Hydro projects)

The Commission observed that various financial institutions provide loan tenure ranging from 10-15 years. However, for Small Hydro Projects, the loan tenure has been given up to 20 years. Upon review of the information submitted by the financial institutions like PFC, IREDA, the analysis of actual loan tenure for the Projects funded during the last three (3) years is given in Table below:

Table 6-Comparison of Actual Loan Tenure of Renewable Energy Projects (Nos.)

Technology	Up to 10 years	>10 up to 12 years	> 12 up to 15 years	>15 years
Wind	0	1	11	9
Small Hydro Projects	3	0	4	6
Solar	4	4	35	35
Biomass	1	0	0	0
Cogeneration	1	0	0	0
MSW Projects	0	1	9	0

Source: Data received from IREDA and PFC

From the data received for various projects, the Commission observed that loan tenure was in range of 12-21 years for Wind Projects, 9-20 years for Small Hydro Projects, 8-20 years for Solar Projects, 15 years for MSW projects and 8-10 years for Biomass projects.

In line with the current market trends, the Commission proposes to increase the loan tenure to 15 years from the present 13 years for all the RE Projects.

Accordingly, the provision related to Loan Tenure proposed in the Draft CERC RE Tariff Regulations, 2020 is as follows:

“(1) Loan Tenure

For determination of generic tariff and project specific traiff, loan tenure of 15 years shall be considered.”

4.4 INTEREST RATE

The existing provisions in the RE Tariff Regulations, 2017 regarding interest rate are as follows:

"Interest Rate:-

- a. *The loans arrived at in the manner indicated in Regulation 13 shall be considered as gross normative loan for calculation for interest on loan. The normative loan outstanding as on April 1st of every year shall be worked out by deducting the cumulative repayment up to March 31st of previous year from the gross normative loan.*
- b. *For the purpose of computation of tariff, normative interest rate of two hundred (200) basis points above the average State Bank of India Marginal Cost of Funds based Lending Rate (MCLR) (one year tenor) prevalent during the last available six months shall be considered.*
- c. *Notwithstanding any moratorium period availed by the generating company, the repayment of loan shall be considered from the first year of commercial operation of the project and shall be equal to the annual depreciation allowed.*

For analysing the present market conditions, the prevailing terms stipulated by REC, PFC and IREDA are summarised as shown in the following Table:

Table 7-Comparison of prevailing Terms of REC, PFC and IREDA

Sr. No.	Particulars	PFC	REC	IREDA
1	Rate of Interest	RE projects except Biomass - 10.10% to 11.50% Biomass & Waste to Energy (WTE) - 11.00% to 12.50% (with reset after every 3, 5 & 10 years)	RE projects except Biomass - 10.10% to 11.50% Biomass & Waste to Energy (WTE) - 11.00% to 12.50% (with reset after every 3 years)	RE projects except Biomass & Waste to Energy- 9.80% to 11.45% Biomass & Waste to Energy (WTE) - 10.25% to 11.45% (with reset after every 1 years)

The Commission observed that, present rate of interest of PFC, REC and IREDA is in the range of 10.25% - 12.50% for Biomass and WTE projects and 9.80% to 11.45% for other technologies. The analysis of actual loan interest rates for the Projects funded during the last 3 years is given in Table below:

Table 8-Comparison of Actual Interest Rates for Renewable Energy Projects (Nos.)

Technology	Up to 10%	>10% to 10.50%	> 10.50%/- 11%	>11%- 11.50%	>11.50%
Wind	2	5	11	3	1
Small Hydro Projects	0	0	4	8	1
Solar	13	25	38	2	0
Biomass	1	0	0	1	0
Cogeneration	1	0	0	1	0
MSW Projects	0	0	1	8	1

Source: Data received from IREDA and PFC

Based on actual data of projects received, present applicable lending rates are 9.55% to 11.45% for Solar Projects, 10% to 16.33% for Wind Projects, 10.75% to 11.75% for Small Hydro Projects, 10.85% to 12.29% for MSW projects and 11.45%-11.50% for Biomass and Co-generation Projects. The Interest rates for funded projects has been analysed with respect to SBI MCLR/PLR applicable at the time of sanction of loans for those projects.

Table 9-Analysis of MCLR Rates in Actual Projects

Technology	Year	No. of Projects	Range of spread above SBI MCLR rates (in Basis Points)		
			Minimum	Average	Maximum
Solar	FY 2017-18	19	175	245	300
	FY 2018-19	17	140	203	285
	FY 2019-20	23	185	221	295

From the above analysis, the Commission observes that the margin over the MCLR rates considered for the sanctioned projects for FY 2017-18 are in the range of 175 - 300 bps, for FY 2018-19 are in the range of 140 - 285 bps and for FY 2019-20 in the range of 185 - 295 bps.

Considering the above, the Commission proposes to continue with the existing interest rate provisions as per RE Tariff Regulations, 2017 in Draft CERC RE Tariff Regulations, 2020.

4.5 DEPRECIATION

As per the existing provisions in the RE Tariff Regulations 2017, Depreciation is determined at depreciation rate of 5.28% per annum for first 13 years and

remaining depreciation to be spread over the remaining useful life of the RE projects, as per straight line method and considering the salvage value of the project as 10% of project cost .

The depreciation is utilised to meet the debt repayment and hence the depreciation for first 70% of the Project may be spread over the loan tenure (15 years) and balance depreciation at the end of loan tenure can be spread over the remaining life of the Project.

Following the 'Differential Depreciation Approach over the loan tenure and beyond loan tenure over useful life computed on 'Straight Line Method', the Commission now proposes depreciation rate of 4.67% per annum for first 15 years and remaining depreciation to be spread during remaining useful life of the RE projects considering the salvage value of the project as 10% of project cost.

4.6 INTEREST ON WORKING CAPITAL

The existing provisions in the RE Tariff Regulations, 2017 are as follows:

- "
- (1) *The Working Capital requirement in respect of Wind energy projects, Small Hydro Power, Solar PV and Solar thermal power projects shall be computed in accordance with the following:*
 - a) *Operation & Maintenance expenses for one month;*
 - b) *Receivablesequivalent to 2 (Two) months of energy chargesforsale of electricity calculated on the normative Capacity Utilisation Factor (CUF);*
 - c) *Maintenance spare @ 15% of operation and maintenance expenses*
 - (2) *The Working Capital requirement in respect of Biomass power projects with Rankine Cycle technology, Biogas, Biomass Gasifier based power projects, non-fossil fuel based Co-generation, Municipal Solid Waste and Refuse Derived Fuel projects shall be computed in accordance with the following clause :*
 - a) *Fuel costs for four months equivalent to normative Plant Load Factor (PLF);*
 - b) *Operation & Maintenance expense for one month;*
 - c) *Receivables equivalent to 2 (Two) months of fixed and variable charges for sale of electricity calculated on the target PLF;*
 - d) *Maintenance spare @ 15% of operation and maintenance expenses*
 - (3) *Interest on Working Capital shall be at interest rate equivalent to the normative interest rate of three hundred (300) basis points above the average State Bank of India MCLR (One Year Tenor) prevalent during the last available six months for the determination of tariff. "*

It is observed that most of the SERCs are following the same principles as specified in RE Tariff Regulations, 2017.

The prevailing interest rates in market are analysed and it is observed that the prevailing interest rates stipulated by REC and PFC (*for private sector*) for short term loans are as under:

- PFC - 11.50% (3-6 months) and 11.75% (6-12 months)
- REC - 11.25% (3-6 months) and 11.50% (6-12 months)

The Commission in the CERC (Terms and Conditions of Tariff) Regulations, 2019 (hereinafter referred to as the Tariff Regulations, 2019 for conventional projects) has stipulated that the interest rate for interest on working capital shall be equal to one year marginal cost of lending rate (MCLR) of the State Bank of India plus 350 basis points. It is proposed to follow the same approach in Draft CERC RE Tariff Regulations, 2020. CERC in the Tariff Regulations, 2019 for conventional projects has reduced the receivables from 60 days to 45 days and it is proposed to follow the same approach in Draft CERC RE Tariff Regulations, 2020.

4.7 O&M EXPENSES

RE Tariff Regulations, 2017 specifies the escalation rate of 5.72% for determination of O&M Expenses for second and third year of the Control Period.

The Commission observed that there is wide variation in the range of the O&M expenses. Considering the wide variation in the O&M expenses, the Commission proposes to normalise the O&M expenses by applying average escalation rate determined for FY 2014-15 to FY 2018-19 which works out to be WPI of 1.31% and CPI of 4.92%. Thus, the escalation rate has been calculated based on the five (5) years average of CPI and WPI indices and by considering the weightage of CPI and WPI in the ratio of 70:30. Hence, the escalation factor for O&M expenses works out to be 3.84%.

Accordingly, the Commission proposes the following in Draft CERC RE Tariff Regulations, 2020:

“Operation and Maintenance Expenses

- (1) *Operation and Maintenance expenses shall be determined for the Tariff Period of the project based on normative O&M expenses specified in these regulations for the first year of the Control Period.*
- (2) *Normative O&M expenses allowed during first year of the Control Period i.e. financial year 2020-21 under these regulations shall be escalated at the rate of 3.84% per annum for the Tariff Period. "*

4.8 REBATE AND LATE PAYMENT SURCHARGE

The rebate and late payment surcharge as per existing provisions in the RE Tariff Regulations, 2017 are as follows:

"Rebate

1. *For payment of bills of the generating company through letter of credit, a rebate of 2% shall be allowed.*
2. *Where payments are made other than through letter of credit within a period of one month of presentation of bills by the generating company, a rebate of 1% shall be allowed.*

Late payment surcharge

In case the payment of any bill for charges payable under these regulations is delayed beyond a period of 60 days from the date of billing, a late payment surcharge at the rate of 1.25% per month shall be levied by the generating company. "

The Commission observes that there should be provisions for ensuring ease of payment mechanisms and hence proposes to include payment through National Electronic Fund Transfer (NEFT) or Real Time Gross Settlement (RTGS) payment.

As the Receivables to be considered as part of Working Capital are proposed to be reduced from 60 days to 45 days, the applicability of late payment surcharge needs to be changed accordingly.

The Commission, after considering all aspects, has proposed the provisions for Rebate and Late Payment Surcharge in the Draft CERC RE Tariff Regulations, 2020 on above lines.

4.9 SUBSIDY OR INCENTIVE BY CENTRAL/ STATE GOVERNMENT

As regards the subsidy or incentive from Central/ State Government, the RE Tariff Regulations, 2017 specifies as under:

"Subsidy or incentive by the Central/ State Government

The Commission shall take into consideration any incentive or subsidy offered by the Central or State Government, including accelerated depreciation benefit if availed by the generating company, for the renewable energy power plants while determining the tariff under these Regulations.

Provided that the following principles shall be considered for ascertaining income tax benefit on account of accelerated depreciation, if availed, for the purpose of tariff determination:

- i) Assessment of benefit shall be based on normative capital cost, accelerated depreciation rate as per relevant provisions under Income Tax Act and corporate income tax rate.*
- ii) Capitalization of RE projects during second half of the fiscal year. Per unit benefit shall be derived on levelled basis at discount factor equivalent to weighted average cost of capital."*

The Commission proposes that it shall take into account subsidy or incentive offered by Central or State Government at time of determination of tariff under these regulations. In case of Project specific tariff, subsidy or incentive are being accounted. However, in case of generic tariff, there may be cases where project may receive subsidy or incentive after determination of tariff and which is not accounted for during determination of tariff. Hence, for such subsidy or incentive, which is not considered in tariff determination, it is proposed that the same shall be adjusted in subsequent bills after receipt of such grant, subsidy or incentive in suitable instalments or within such period as may be stipulated by the Commission. It is also proposed that any generation-based incentive, which is specifically over and above the tariff, shall neither be taken into account while determining the tariff nor be adjusted in subsequent bills.

4.10 STATUTORY CHARGES

The RE Tariff Regulations, 2017 provides that tariff determined shall be exclusive of Taxes and duties and shall be allowed as pass through on actual incurred basis. The Commission has modified the provision and made it in line with Tariff

Regulations, 2019 for conventional projects. The proposed provision in Draft CERC RE Tariff Regulations, 2020 is as under:

"Statutory Charges

The renewable energy project developer shall recover from the beneficiaries, the statutory charges imposed by the State and Central Government such as water cess, electricity duty on auxiliary consumption."

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5 TECHNOLOGY SPECIFIC PARAMETERS

5.1 PARAMETERS FOR WIND POWER PROJECTS

5.1.1 CAPITAL COST

The existing provisions regarding parameters for wind power projects in RE Tariff Regulations, 2017 are as follows:

"25.Capital Cost

The Commission determine only project specific capital cost and tariff based on prevailing market trends for wind energy project."

The Commission analysed actual Capital Cost of wind power projects funded during last three years as given in Table below:

Table 10- Comparison of parameters of Actual Wind Power Projects

Size	Nos. of Projects	Capital Cost (Rs. Crore/MW)
Upto 10 MW	1	8.33
>10MW to 50 MW	10	5.98 to 8.60
>50MW to 100 MW	1	6.76
>100MW to 150 MW	5	6.66-8.99
>150MW	5	6.23-7.68

Source: Data received from IREDA and PFC

From the analysis of the actual data obtained from PFC and IREDA, the Commission observed that the capital cost for the different wind power projects are in the range of Rs. 6.23 Crore/MW to Rs. 8.99 Crore/MW. The variation in the capital cost also depends on the location and size of the projects. Further, the lowest wind energy tariff of Rs 2.79/kWh discovered through competitive bidding has been simulated backwards to arrive at various parameters that might have been considered for bidding for these Projects. It is observed that the Capital Cost for power projects awarded through competitive bidding is in the range of Rs 6-7 Crore/MW.

As most of the wind power projects are coming under competitive bidding route, the Commission proposes to determine only Project Specific Capital Cost for

At

Wind Power Projects for the next Control Period considering the prevailing market trends.

5.1.2 CAPACITY UTILIZATION FACTOR (CUF)

Capacity Utilization factor represents important parameter that influences the economics of a wind project at a particular wind site. Generally, coastal and hilly regions have better wind regime as compared to sites located in plain region and hence yield better CUF. The capacity utilization factor depends on site specific parameters (Wind velocity, wind density and weibull shape parameter) as well as machine specific parameters (Hub height, rotor diameter and power curve).

In order to factor the diversity in CUF due to varying wind regimes, Wind Zone mapping was considered based on Wind Power density which is function of wind velocity and air density. Accordingly, the Commission in its RE Tariff Regulations, 2009 had specified CUF norms for different Wind Zones based on Wind power density as (i) 200-250, (ii) 250-300, (iii) 300-400 and (iv) above 400. Further, in its RE Tariff Regulations, 2012, based on analysis of Wind turbine model available and LBNL study report, the Commission specified CUF for five (5) Wind Zones as (i) Upto 200 -20%, (ii) 200-250 - 22%, (iii) 250-300 - 25%, (iv) 300-400 - 30% and (v) above 400 - 32% at 80 m hub height.

With changing trends in the wind turbine technology, large numbers of turbine models with hub height higher than 80 m and with larger rotor diameter are available in the market. The general trend is towards steadily growing hub heights, with major wind turbine manufacturers now routinely offering turbines with hub heights of around 100 meters. The Commission considered the impact of increase in hub height on CUF, while framing the RE Tariff Regulations, 2017. Because of increase in hub height, their corresponding wind power density was calculated at 100 m hub height for air density of 1.225 kg/m³.

Accordingly, the Commission specified CUF for wind power projects in the RE Tariff Regulations, 2017 are as follows:

"26. Capacity Utilisation Factor (CUF)

(1) CUF norms for this control period shall be as follows:

Annual Mean Wind Power Density (W/m ²)	CUF
Upto 220	22%
221-275	24%
276-330	28%
331-440	33%
> 440	35%

- (2) The annual mean wind power density specified in (1) above shall be measured at 100 meter hub-height.
- (3) For the purpose of classification of wind energy project into particular wind zone class, as per MNRE guidelines for wind measurement, wind mast either put-up by NIWE or a private developer and validated by NIWE, would be normally extended 10 km from the mast point in all directions for uniform terrain and limited to appropriate distance in complex terrain with regard to complexity of the site. Based on such validation by NIWE, state nodal agency should certify zoning of the proposed wind farm complex."

The Commission observed that in case of Capacity Utilization Factor only Rajasthan and Maharashtra have adopted area wise Capacity Utilization Factor for wind power projects, i.e., 21% for Jaisalmer, Jodhpur and Barmer area, and 20% for Others. Capacity Utilization Factor adopted by other SERCs varies between 24.5% to 29.15% (GERC - 24.5%, MPERC - 23%, KERC - 31% and TNERC - 29.15%).

From the data obtained from the different agencies, the State wise comparison of CUF for recent wind power projects funded by lenders is depicted below:

Table 11- Comparison of State wise comparison of CUF of wind projects

Size	Tamil Nadu		Gujarat		Andhra Pradesh	
	No. of Projects	CUF	No. of Projects	CUF	No. of Projects	CUF
Upto 10 MW						
>10MW to 50 MW			2	28%-29%		
>50MW to 100 MW			1	34%		
>100MW to 150 MW	1	31%	1	35%	1	34%
>150MW	3	33%-36%	4	23%-39%	2	23%-27%

Regarding the CUF, the data sought from NIWE has been analysed. This includes the data of monitoring sites at 100 m hub height as well as 80 m hub height (which is extrapolated to 100 m). The zone-wise data are summarised below:

Table 12- Comparison of Zone wise Wind Power projects

Annual Mean Wind Power Density (W/m^2)	Average Wind Speed (M/s)
> 440	8.01
331-440	7.49
276-330	6.83
221-275	6.49
Upto 220	5.27

Source: Data received from NIWE

Based on analysis of data prepared for various sites across States, it can be inferred that most of wind sites are with range of annual mean wind power density upto 220 W/m^2 . Wind turbines available in India having 100 meter hub-heights are considered for analysis. To estimate energy content of available wind resource, Weibull distribution approach is adopted which is well accepted in wind industry and is the basis for all high end wind flow modelling softwares. It gives a good representation of the variation in hourly mean speed over a year at many typical sites. It indicates fraction of time for which wind is at a given velocity V and is characterized by two parameters - "scale parameter" and "shape parameter". For the computation of Weibull distribution, zone wise average wind speed along with the Air Density of 1.225 kg/m^3 , Shape factor (k)³ of 2 (which resembles constant wind speed) and Scale factor has been considered.

Scale factor has been computed as follows:

$$\text{Scale Factor} = \text{Average Wind Speed} / \text{Gamma}(1+1/k)$$

The standard power curve of turbines is applied as input along with frequency distribution for determination of gross electricity generation/Capacity Utilization Factor (CUF). Based on the analysis of data, it is observed that CUF worked out based on analysis are in line with the CUF specified in the RE Tariff Regulations,

³*k is the Weibull shape parameter. It specifies the shape of a Weibull distribution and takes on a value of between 1 and 3. A small value for k signifies very variable winds, while constant winds are characterized by a larger k. For the purpose of this exercise, k has been considered as 2.*

2017. Accordingly, it is proposed to continue with Zone wise minimum CUF for 100 m hub height as specified in RE Tariff Regulation, 2017.

Further, it is noted that for the classification of wind energy project into particular wind zone, as per MNRE guidelines for wind measurement, wind mast either put-up by NIWE or a private developer and validated by NIWE, would be normally extended 10 km from the mast point in all directions for uniform terrain and limited to appropriate distance in complex terrain with regard to complexity of the site. Based on such validation by NIWE, state nodal agency should certify zoning of the proposed wind farm complex.

5.1.3 OPERATION AND MAINTENANCE EXPENSES

The existing provisions regarding technology specific parameters for wind power projects in RE Tariff Regulations, 2017 are as follows:

"27. Operation and Maintenance (O & M) Expenses

The Commission shall determine only Project Specific O&M Expenses based on the prevailing market information."

The Commission observed that most of the SERCs have specified Operation and Maintenance (O&M) Expenses for Wind Energy Projects in RE Tariff Regulations in the range of Rs. 7.40 Lakh/MW to Rs. 9 Lakh/MW. The Commission analysed actual O&M Cost of wind power projects funded during last three years and is given in Table below:

Table 13- Comparison of parameters of Actual Wind Power Projects

Size	No. of Projects	O&M/MW(Rs. Lakh)
>10MW to 50 MW	10	6 - 12.5
>50MW to 100 MW	1	Not available
>100MW to 150 MW	5	5.09-14.95
>150MW	5	7.6-8.20

Source: Data received from IREDA and PFC

From the analysis of the data obtained from different agencies, the Commission observed that the O&M expenses for the different projects are in the range of Rs. 5.09 lakh/MW to Rs. 14.95 lakh/MW. The variation in the O&M cost also depends on the location and size of the projects.

However, as most of the wind power projects are coming under competitive bidding route, the Commission proposes to determine only Project Specific O&M Expenses for wind power projects for the next Control Period.

5.1.4 PARAMETERS FOR OFF SHORE WIND PROJECTS

The focus on offshore has increased in recent years partly due to its global rise and partly due to the ongoing lull in the onshore wind energy segment. MNRE had notified Off-shore Wind Policy in October 2015 to realise the offshore Wind potential in the country. As per the MNRE, the targets for off-shore wind installation capacity are fixed at 5 GW by 2022 and 30 GW by 2030. The policy allows for setting up of offshore wind farms up to 200 nautical miles. Developers can undertake project exploration and construction activities only after procuring a 35-year lease from the Government.

Project sites have been identified off the coasts of Gujarat and Tamil Nadu through a programme called Facilitating Offshore Wind in India (FOWIND) launched in December 2013. The FOWIND project came up with eight potential zones in the two States that are most suitable for offshore wind development. Preliminary assessments indicate that Tamil Nadu and Gujarat each have an offshore potential of around 100 GW with existing technology.

The off-shore wind technology is different from onshore wind technology. Since wind turbines are located in Sea, the various impact assessment studies are required to be carried out such as impact from noise and vibration, water column, sea navigation routes, mangroves, commercial fisheries, archaeological studies, avifauna, etc. LiDAR (Light Detection and Ranging) systems are required to be installed to give visibility of sites. The capital cost of offshore wind projects is approximately five-seven times higher than onshore projects. Turbines are only 30-50 per cent of the cost in case of an offshore project. Instead, the share of grid

connection costs are higher at 15-30 per cent in case of offshore wind due to the requirement of laying sub-sea cables.

It is noted that Off-shore wind Technology is at nascent stage and is yet to be explored in the country. Hence, the project specific tariff is to be determined for such project. The capital cost of the project and other parameters need to be considered based on location of the project.

5.2 PARAMETERS FOR SMALL HYDRO PROJECTS

Under this section, parameters such as Capital Cost norm, capital cost indexation mechanism, Capacity Utilization Factor, Auxiliary Consumption and O&M Expenses for small hydro power projects have been discussed.

5.2.1 CAPITAL COST

The Commission has specified higher Capital Cost norms for SHP projects below 5 MW compared to the Capital Cost Norms for SHP between 5 MW to 25 MW as hydro projects below 5 MW have higher capital cost and higher operating cost due to their small size, remote locations, grid connectivity issues etc.

The Commission observed, that most of the SERCs have notified the capital cost of Small hydro projects through Tariff Regulations/Order. These orders are based on the SHP potential available in the State and the type and design of the SHP projects going to be set up in the control period. The SERCs have kept capital cost for Small Hydro Projects in the range of Rs. 6 lakh/ MW to 8.20 lakh/ MW.

Table 14-Comparison of Capital Cost of Small Hydro Plants

MERC '19	JERC '19	UERC '18	KERC '18	MPERC '17	GERC (T.O.)
Project Specific	Rs. 6 to 7 Cr/MW	Rs. 9 to Rs. 10 Cr/MW	Rs. 6.33 Cr/MW	Rs. 6.35 to Rs. 6.50 Cr/MW	Rs. 7.48 to Rs. 8.20 Cr/MW

The existing provisions regarding Capital Cost for Small Hydro Projects in RE Tariff Regulations, 2017 are as follows:

"28.CapitalCost

The normative capital cost for small hydro projects during the ControlPeriod (FY 2017-18) are as follows

Region	Project Size	Capital Cost (Rs. Lakh/ MW)
Himachal Pradesh, Uttarakhand, West Bengal and North Eastern States	Below 5 MW	1000
	5 MW to 25 MW	900
Other States	Below 5 MW	779
	5 MW to 25 MW	707

Actual Project Cost Analysis

The trends of actual capital of small hydro projects as received from IREDA and PFC are as follows:

Table 15- Capital Cost information for Small Hydro Projects

Region	Project Size	No. of Projects	Capital Cost (Rs. Crore/ MW)
Himachal Pradesh, Uttarakhand, West Bengal and North Eastern States	Below 5 MW	1	8
	5 MW to 25 MW	7	10.58-15.92
Other States	Below 5 MW	1	9.06
	5 MW to 25 MW	4	6.06-16.01

Source: Data received from IREDA and PFC

Further, various components of the capital cost such as plant and machinery cost, erection and commissioning expenses, land development and civil works and financing cost including interest during construction (IDC) cost has been analysed. A trend analysis in terms of movement of capital cost for the projects funded by different agencies for the period from the FY 2017-18 to FY 2019-20 has been carried out to understand the variation in capital cost over the period, as shown in the following table.

The Capital Cost information submitted by IREDA for Small Hydro projects is as under:

Table 16- Capital Cost information for Small Hydro Projects

Capital Cost Component	Cost(Rs. Crore/MW)		
	Minimum	Average	Maximum
Land & Site Development	0.07	0.28	0.71
Civil Works and H&M works including Engineering and Consultancy	3.19	5.79	9.45
Electro-mechanical Works & Installation	0.96	1.51	1.99
Power Evacuation (Transmission Line)	0.22	0.89	2.18
Preliminary & Pre-operative expenses including IDC and contingency	0.74	2.71	4.71
Total Project Cost with IDC	6.06	11.20	15.92

Source: Data received from IREDA

It is observed that the actual capital cost of small hydro projects varies significantly which depends upon several factors such as land related issues, R&R, transmission line, etc. The increase in capital cost of the project is mainly on account of preliminary and pre-operative expenses including IDC, which are site specific. Further, the capital cost for projects in Himachal Pradesh, Uttarakhand, West Bengal, North Eastern States are in the range of Rs. 10.58 Crore/MW to Rs. 15.92 Crore/MW for the projects above 5 MW and up to 25 MW and Rs. 8 Crore/MW for projects less than 5 MW. The variation in the Capital cost also depends on the location of the projects. From the data, it is observed that, higher capital cost for high capacity of plant is on account of preliminary and pre-operative expenses, which are in the range of Rs. 2.71 Crore/MW to Rs. 4.71 Crore/MW which may be due to R&R aspects.

Based on the analysis of the component wise capital cost and the capital cost of various projects, the Commission proposes to retain the Capital cost norm for Small Hydro Project as per RE Tariff Regulations, 2017.

5.2.2 CAPACITY UTILISATION FACTOR

The existing provisions regarding Capacity Utilization Factor for Small hydro projects in RE Tariff Regulations, 2017 are as follows

"29. Capacity Utilisation Factor

CUF for the small hydro projects located in Himachal Pradesh, Uttarakhand, West Bengal and North Eastern States shall be 45% and for other States, CUF shall be

30%.

Explanation: For the purpose of this Regulation normative CUF is net of free power to the home state if any, and any quantum of free power if committed by the developer over and above the normative CUF shall not be factored into the tariff."

The Commission observed that most of the SERCs have specified Capacity Utilization Factor for Small hydro projects in RE Tariff Regulations as per CERC norms except for GERC (CUF as 42%) and UERC (CUF as 40%).

Further, the Commission analysed CUF of SHPs considered by Lenders while funding the projects during last 3 years that is given in Table below:

Table 17- Comparison of Actual Small Hydro Parameters

Region	Size	No. of Projects	CUF (%)
Himachal Pradesh, Uttarakhand, West Bengal and North Eastern States	Below 5 MW	1	50%
	5 MW to 25 MW	7	45% - 55%
Other States	Below 5 MW	1	40%
	5 MW to 25 MW	4	29% - 48%

Source: Data received from IREDA and PFC

From the above analysis, the commission observed that the CUF for the various projects are in the specified range of the norms specified by the Commission in the RE Tariff Regulations, 2017. Hence, the Commission proposes to continue with the existing norms specified in RE Tariff Regulations, 2017. Further, the Commission clarifies that such CUF shall be considered net of free power to the Home State, if any.

5.2.3 AUXILIARY CONSUMPTION

The existing provisions regarding Auxiliary Consumption for Small hydro projects in RE Tariff Regulations, 2017 are as follows:

"30. Auxiliary Consumption

Normative Auxiliary Consumption for the small hydro projects shall be 1.0%."

The Commission also observed that most of the SERCs have specified auxiliary consumption of 1% for Small hydro projects as per RE Tariff Regulations, 2017.

The Commission proposes to continue with the existing provision as specified in RE Tariff Regulations, 2017.

5.2.4 OPERATION AND MAINTENANCE EXPENSES

The existing provisions regarding Operation and Maintenance Expenses for Small Hydro Projects in RE Tariff Regulations, 2017 are as follows:

"31. Operation and Maintenance Expenses

Normative O&M expenses for the Control period (i.e. FY 2017-18) are as follows.

Region	Project Size	O&M Expense (Rs. Lakh/MW)
Himachal Pradesh, Uttarakhand, West Bengal and North Eastern States	Below 5 MW	36
	5 MW to 25 MW	27
Other States	Below 5 MW	29
	5 MW to 25 MW	21

- (1) *Normative O&M expenses allowed under existing regulations shall be escalated at the rate of 5.72% per annum for the Tariff Period for the purpose of determination of levellised tariff."*

The Commission also analysed the O&M Expenses norms specified by various SERCs for small hydro projects, which are as follows:

Table 18- Comparison of O&M Expenses specified for SHPs by various SERCs

ERC	Capacity	O&M Expenses
MERC'19	Micro- ≤ 500 kW Mini- >500 kW & ≤ 1 MW SHP- >1 MW & ≤ 25 MW	Up to 500 kW 4.00% of the Capital Cost ≥ 500 kW and including 1 MW 4.00% of the Capital Cost ≥ 1 MW and including 5 MW 3.60% of the Capital Cost ≥ 5 MW and including 25 MW 2.80% of the Capital Cost
UERC'18	Upto 5 MW > 5 MW & up to 15 MW > 15 to 25 MW	Upto 5 MW - Rs. 45 Lakh/MW) > 5 MW & up to 15 MW- Rs. 40.38 Lakh/MW) > 15 to 25 MW - Rs. 36 Lakh/MW)
GERC (T.O)	Micro - ≤100 kW Mini - >100 kW & ≤ 2 MW (unit size of up to 1 MW) Small hydro: >2 MW & ≤ 25 MW (unit size up	Up to 5MW- 3.3% of capital cost, 5 to 25 MW- 2.5% of capital cost

ERC	Capacity	O&M Expenses
	to 5 MW)	
MPERC'17	Upto 25 MW	3% of capital cost
KERC'18	Upto 25 MW	Rs 14.66 lakh/MW
CSERC	Upto 25 MW	Below 5 MW - Rs. 20 Lakh/MW 5 -25 MW - Rs. 14 Lakh/MW
HPERC	Upto 25 MW	> 100 kW to 2 MW - (Rs. 33 Lakh/MW) >2 to 5 MW (Rs. 29 Lakh/MW) > 5 to 25 MW (Rs. 24 Lakh/MW)

The analysis of O&M expenses funded by various agencies is as given in Table below:

Table 19-Comparison of Actual O&M for Small Hydro Projects

Region	Size	No. of Projects	O&M Expenses/MW (Rs In Lakhs)
Himachal Pradesh, Uttarakhand, West Bengal and North Eastern States	Below 5 MW	1	23.20
	5 MW to 25 MW	7	16.66-37.70
Other States	Below 5 MW	1	13.33
	5 MW to 25 MW	4	10.00 - 24.00

Source: Data received from IREDA and PFC

From the analysis of the data obtained from different agencies, it is observed that the O&M expenses for the different projects in Himachal Pradesh, Uttarakhand, West Bengal and North Eastern States are in the range of Rs. 16.66 Lakh/MW to Rs. 37.70 Lakh/MW for the projects above 5 MW and up to 25MW and Rs. 23.20 Lakh/MW for the projects less than 5 MW. For other States, O&M expenses for the different projects above 5 MW and up to 25 MW are in the range of Rs. 10.00 Lakh/MW to Rs.24.00 Lakh /MW and Rs. 13.33 Lakh/MW for the projects less than 5 MW.

As discussed in earlier Section, the escalation rate of 3.84% has been determined for Control period. Accordingly, the normative expenses approved for FY 2019-20 have been escalated with 3.84% to arrive at normative O&M expenses for FY 2020-21.

Further, normative O&M expenses as mentioned above for FY 2020-21 shall be escalated at the rate of 3.84% per annum for the Tariff Period for the purpose of determination of levelled tariff.

5.3 PARAMETERS FOR BIOMASS POWER PROJECTS BASED ON RANKINE CYCLE TECHNOLOGY

Under this section, parameters such as capital cost, plant load factor, auxiliary consumption, station heat rate, gross calorific value, biomass fuel price and O&M Expenses for biomass based power projects with Rankine cycle technology have been discussed.

5.3.1 CAPITAL COST

The Capital Cost for Biomass power projects based on Rankine cycle technology, as per the existing provisions in the RE Tariff Regulations, 2017 are as follows:

"33. Capital Cost

(1) The Commission proposes to determine normative capital cost for FY 2017-18 for Biomass Projects as under;

Biomass Rankine Cycle Projects	Capital Cost (Rs. Lakh/MW)
Project [other than rice straw and juliflora (plantation) based project] with water cooled condenser	559.03
Project [other than rice straw and Juliflora(plantation) based project] with air cooled condenser	600.44
For rice straw and juliflora (plantation) based project with water cooled condenser	610.80
For rice straw and juliflora (plantation) based project with aircooled condenser	652.20

The Commission observed that most of the SERCs have specified Capital Cost for Biomass projects in RE Tariff Regulations. MERC and JERC have specified Project Specific Tariff determination for the Capital Cost. The Capital Cost norms specified by various SERCs for biomass power projects are follows:

Table 20-Comparison of Capital Cost for Biomass Power Projects by various SERCs

MERC '19	JERC '19	UERC '18	KERC '18	MPERC '17	GERC (T.O.)	RERC '14 and '15
Project Specific	Project Specific	Rs. 5.59 to 6.52 Cr/MW	Rs. 5.76 to 5.86 Cr/MW	Rs. 4.50 Cr/MW	Rs. 4.66 Cr/MW	Rs. 4.52 Cr/MW

Based on the analysis of the capital cost considered by various SERCs, the Commission observed that capital cost specified by SERCs is in marginal variation with the Capital Cost approved by CERC in its RE Tariff Regulations, 2017. The actual Capital Cost of only one project was available and was substantially higher than the Capital Cost specified by CERC in its RE Tariff Regulations, 2017.

Hence, it is proposed to continue with the same benchmark capital cost by rounding off the capital cost as specified in RE Tariff Regulations, 2017.

5.3.2 PLANT LOAD FACTOR

The Plant Load Factor for Biomass power projects based on Rankine cycle, as per the existing provisions in the RE Tariff Regulations, 2017 are as follows:

"34. Plant Load Factor

1. *Threshold PLF for determining fixed charge component of Tariff shall be:*
 - i. *During Stabilisation: 60%*
 - ii. *During the remaining period of the first year (after stabilization): 70%*
 - iii. *From 2 Year onwards: 80%*
2. *The stabilisation period shall not be more than 6 months from the date of commissioning of the project."*

Based on the review of Orders of various SERCs, the Commission observed that SERCs of Tamil Nadu, Karnataka and Chhattisgarh are following approach of uniform PLF for all the years without any relaxation for stabilisation period. The Commission proposes to specify a uniform PLF of 80% PLF for all years without any relaxation during the stabilisation period in the Draft CERC RE Tariff Regulations, 2020.

5.3.3 AUXILIARY CONSUMPTION

The Auxiliary Consumption for Biomass power projects based on Rankine cycle, as per the existing provisions in the RE Tariff Regulations, 2017 are as follows:

"35. Auxiliary Consumption

The auxiliary power consumption factor shall be as follows:-

- a) *For the project using water cooled condenser:*
 - i. *During first year of operation :11%*
 - ii. *From 2nd year onwards :10%*
- b) *For the project using air cooled condenser:*

- i. During first year of operation :13%
- ii. From 2nd year onwards :12%

From the analysis of the data obtained from different projects, it can be observed that the average Auxiliary Consumption works out to be in the range of 10.76%.

Table 21- Analysis of Auxiliary Consumption of Biomass Project

Capacity of the Project	No. of Projects	Auxiliary Consumption
Up to 10 MW	5	8.33%-8.50%
>10MW to 20 MW	6	8.61% - 14.53%
>20MW to 60 MW	2	9.78%-12.40%

Source: Data received from IREDA, PFC and POSOCO

The Commission in the Tariff Regulations, 2019 for conventional projects specified Auxiliary consumption of 8.50% for 200 MW series thermal power projects without cooling towers. However, such norms are not strictly comparable with small size biomass power installations such as those of 6-10 MW capacity. Hence, the higher Auxiliary Consumption is considered for Biomass Projects.

As the Commission has proposed to specify a uniform PLF of 80% PLF for all years, the Commission proposes to specify a uniform auxiliary consumption norms without any relaxation in the Draft CERC RE Tariff Regulations, 2020.

"The normative auxiliary consumption shall be as follows: -

- a) For projects using water-cooled condenser: 10%
- b) For projects using air-cooled condenser: 12%"

5.3.4 STATION HEAT RATE

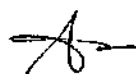
The Station Heat Rate for Biomass power projects based on Rankine cycle, as per the existing provisions in the RE Tariff Regulations, 2017 are as follows:

"36. Station Heat Rate

The Station Heat Rate for biomass power projects shall be:

- a) For projects using travelling grate boilers : 4200kCal/kWh
- b) For projects using AFBC boilers : 4125 kCal/kWh"

The Station Heat Rate specified by most of the SERCs is same as that specified by CERC in its RE Tariff Regulations, 2017 while GERC has specified lower Station



Heat Rate while Rajasthan has specified higher Station Heat Rate. The SHR norms specified by various SERCs for biomass power projects are as follows:

Table 22-Comparison of SHR for Biomass Power Projects by various SERCs

ERC	MERC'19	JERC'19	UERC'18	GERC (T.O)	RERC'14 and '15	MPERC'17
SHR	4200 kcal/kWh	4200 kcal/kWh for Travelling grate Boilers 4125 kcal/kWh for AFBC boilers	4200 kcal/kWh for Travelling grate Boilers 4125 kcal/kWh for AFBC boilers	3800 kcal/kWh for Water Cooled Condenser 3950 kcal/kWh for Air Cooled Condenser	For water cooled condenser: During Stabilization : 4300 kcal/kWh After stabilization: 4200 kcal/kWh For air cooled condenser: During Stabilization : 4540 kcal/kWh After stabilization: 4440 kcal/kWh	4200 kcal/kWh

As station heat rate is an efficiency parameter, based on the review of norms adopted by SERCs, it is proposed to continue with the Station Heat Rate norm as specified in RE Tariff Regulations, 2017.

5.3.5 OPERATION AND MAINTENANCE EXPENSES

The Operation and Maintenance Expenses for Biomass power projects based on Rankine cycle Technology, as per the existing provisions in the RE Tariff Regulations, 2017 are as follows:

"37. Operation and Maintenance Expenses

1. Normative O&M expenses for the Control period (i.e. FY 2017-18 shall be Rs. 40 Lakh per MW.
2. Normative O&M expenses allowed at the commencement of the Control Period (i.e. FY 2017-18) under these Regulations shall be escalated at the rate of 5.72% per annum."

As discussed earlier, the Commission has normalised the O&M expenses by applying average escalation rate determined for FY 2014-15 to FY 2018-19 which works out to be WPI of 1.31% and CPI of 4.92%. Thus, the escalation rate has been calculated based on the five years average CPI and WPI indices by considering the weightage of 70% CPI and 30% WPI. Hence, the proposed escalation factor for computing O&M expenses is 3.84%.

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Hence, the normative O&M expenses approved for FY 2019-20 have been escalated with 3.84% to arrive at normative O&M expenses for FY 2020-21 which works out to Rs. 46.42 Lakh/MW.

Further, normative O&M expenses as mentioned above for FY 2020-21 shall be escalated at the rate of 3.84% per annum for the Tariff Period for the purpose of determination of levelled tariff.

5.3.6 USE OF FOSSIL FUEL

The Use of Fossil fuel for Biomass power projects based on Rankine cycle Technology, as per the existing provisions in the RE Tariff Regulations, 2017 are as follows:

"39. Use of Fossil Fuel

1. *The use of fossil fuels shall not be allowed.*
2. *Provided that for the biomass power projects commissioned on or before 31.03.2017, the use of fossil fuels to the extent of 15% in terms of calorific value on annual basis shall be allowed for the tariff period from the date of commissioning."*

On the issue of usage of fossil fuel in Biomass based power projects, the Commission would like to emphasize that the prime objective of the Regulations are to promote usage of biomass for energy generation. Therefore, by allowing usage of fossil fuel, the very objective of using alternate fuel is defeated.

Thus, considering the necessity to promote the usage of biomass as fuel in power projects, the Commission proposes to not allow the usage of fossil fuel in biomass based power projects.

5.3.7 CALORIFIC VALUE

The Calorific Value for Biomass power projects based on Rankine cycle, as per the existing provisions in the RE Tariff Regulations, 2017 are as follows:

"41. Calorific Value

The Calorific Value of the biomass fuel used for the purpose of determination of tariff shall be at 3100 kCal/kg."

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It is observed that Calorific Value of Biomass considered by most of SERCs is in the range of 3100-3611 kCal/kg. The Calorific value norms specified by various SERCs for biomass power projects, are as follows.

Table 23-Comparison of Calorific Value for Biomass Power Projects by various SERCs

MERC'19	UERC'18	GERC	RERC'14 znd '15	MPERC'17	TNERC'17	CSERC'19
3611 kcal/kg	3100 kcal/kg	4423 kcal/kg	3400 kcal/kg	3100 kcal/kg	3200 kcal/kg	3100 kcal/kg

In the absence of actual data and review of calorific value notified by various SERCs, the Commission proposes to retain the Gross Calorific Value of 3100 kCal/kg as specified in RE Tariff Regulations, 2017.

5.3.8 FUEL COST

The Commission notes that, the price of the biomass fuel depends on various components such as remuneration to farmers, cost related to collection and storage, transportation, loading and unloading cost, agents commission, etc. The fuel procurement and transportation is handled by the highly unorganised sector and the prices are influenced by the local factors. Most of the biomass power projects use variety of biomass fuels with differing characteristics and calorific values, used in varying proportion.

While specifying the price of biomass, the Commission, in RE Tariff Regulations, 2009 adopted equivalent heat value approach for landed cost of coal for thermal power stations at respective States and specified price of Biomass for different states. Further, while considering the same, the Commission has also considered the availability and heat values of different types of Biomass viz. paddy, wheat, mustard, bajara, rice husk, etc. across different States. Also, findings of evaluation report on biomass price was also considered as suggested by MNRE during 2011.

Further, with the same approach, the Commission in Regulation 38 of RE Tariff Regulations, 2017 specified State-wise Biomass Price for FY 2017-18. It is also specified in RE Tariff Regulations, 2017 that such price shall be escalated @5% to arrive at the base price for subsequent years of the Control Period. Accordingly, the Biomass Price for FY 2019-20 as per above Regulation works out to be as follows:

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Table 24-Biomass Price for FY 2019-20

State	FY2019-20(Rs./MT)
Andhra Pradesh	3167.72
Haryana	3605.61
Maharashtra	3687.69
Punjab	3771.17
Rajasthan	3147.20
Tamil Nadu	3115.72
Uttar Pradesh	3222.45
Other States	3388.04

The Commission has reviewed the norms adopted by various SERCs which are as follows:

Table 25- Comparison of Fuel Cost for Biomass based projects by various SERCs

MERC '19	JERC '19	UERC '18	KERC '18	CSERC '19	BERC '17
Project Specific	Project Specific	Rs. 2355/MT	Rs. 2500/MT	Rs. 3388/MT	Rs. 3073.05/MT

In the absence of actual data of fuel cost and based on the review of norms adopted by various SERCs, the commission proposes to continue with the existing provision as per RE Tariff Regulations, 2017.

The Commission proposes to continue with the same approach of escalating the Biomass Price by 5% per annum as specified in RE Tariff Regulations, 2017. Accordingly, the Biomass Price for FY 2020-21 has been worked out in the Draft CERC RE Tariff Regulations, 2020.

5.4 PARAMETERS FOR NON-FOSSIL FUEL BASED CO-GENERATION PROJECTS

Under this section, parameters such as capital cost norm, plant load factor, auxiliary consumption, station heat rate, gross calorific value, bagasse fuel price and O&M Expenses for Non-fossil fuel based Cogeneration projects have been discussed.

5.4.1 CAPITAL COST

The existing provisions regarding Capital Cost for Non-fossil fuel based Cogeneration projects in RE Tariff Regulations, 2017 are as follows:

"44. Capital Cost

The normative capital cost for the non-fossil fuel based cogeneration projects shall be Rs. 492.5 Lakh/MW for high boiler pressure projects for the Control Period (i.e. FY 2017-18), and will remain valid for the entire duration of the control period unless reviewed earlier by the Commission."

Various SERCs have issued tariff orders for Non-fossil fuel based co-generation projects. The capital cost approved by them are as under:

Table 26-Comparison of Capital Cost for Non-fossil fuel based Co-generation projects by various SERCs

MERC '19	JERC '19	UERC '18	KERC '18	MPERC '17	GERC (T.O.)	RERC '14 and '15
Project Specific	Rs. 4.75 Cr to Rs. 5.25 Cr/MW	Rs. 4.93 Cr/MW	Rs. 4.70 Cr/MW	Rs. 4.36 Cr/MW	Rs. 4.66 Cr/MW	Rs. 4.52/Cr MW

Based on the review of capital cost specified by various SERCs, the Commission proposes to continue with the benchmark capital cost of Rs 492 lakh/MW by rounding off the capital cost as specified in RE Tariff Regulations, 2017.

5.4.2 PLANT LOAD FACTOR

The existing provisions regarding Plant Load Factor for Non-fossil fuel based Cogeneration projects in RE Tariff Regulations, 2017 are mentioned below:

"45. Plant Load Factor

(1) *For the purpose of determining fixed charge, the PLF for non- fossil fuel based cogeneration projects shall be computed on the basis of plant availability for number of operating days considering operations during crushing season and off-season as specified under clause (2) below and load factor of 92%.*

(2) *The number of operating days for different States shall be as follows:*

State	Operating Days	Plant Load Factor (%)
Uttar Pradesh and Andhra Pradesh	120 days (crushing) + 60 days (off- season) =180days operating days	45%

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TamilNadu and Maharashtra	180 days(crushing) + 60 days (off-season) = 240 days operatingdays	60%
Other States	150 days(crushing) + 60 days (off-season) = 210 days operatingdays	53%

The Commission has reviewed PLF norms specified by various SERCs for Non-fossil fuel based Cogeneration power projects, which are as follows.

Table 27-Comparison of PLF for Non-fossil fuel based Co-generation projects by various SERCs

ERC	MERC'19	UERC'18	GERC (T.O)	MPERC'17	KERC'18	TNERC'17
PLF (%)	60%	45%	60%	53%	60%	55%

It is noted that Plant load factor for non-fossil fuel based co-generation projects is computed on the basis of plant availability for number of operating days considering operations during crushing season and off-season and load factor of 92% for those days of operation. The basis and computations are as given below:

For 180 days as operating days, the PLF computed by considering 92% of load factor for operating days. Hence, PLF computed as 45% i.e., $(180/365) * 92\%$. Similarly, for 240 days and 210 days as operating days, PLF computed as 60% (i.e., $240/365 * 92\%$) and 53% (i.e., $210/365 * 92\%$) respectively.

In the absence of actual data and review of PLF notified by various SERCs, the Commission proposes to retain the PLF as specified in RE Tariff Regulations, 2017.

5.4.3 AUXILIARY CONSUMPTION

The existing provisions regarding Auxiliary Consumption for Non-fossil fuel based Cogeneration projects in RE Tariff Regulations, 2017 are mentioned below:

"46. Auxiliary Consumption

The auxiliary power consumption factor shall be 8.5% for the computation of tariff."

The Commission has reviewed Auxiliary Consumption norms specified by various SERCs for Non-fossil fuel based Cogeneration power projects, which are as follows:

Table 28-Comparison of Auxiliary Consumption for Non-fossil fuel based Co-generation projects by various SERCs

ERC	MERC'19	UERC'18	GERC (T.O)	MPERC'17	KERC'18	TNERC'17
Aux. Cons.	8.50%	8.50%	8.50%	8.50%	8.50%	8.50%

The Commission while framing the RE Tariff Regulations, 2017 duly considered that non-fossil fuel based cogeneration plants have some of the auxiliary equipment common between the sugar mill and the power generation unit. Also, bagasse requires less processing compared to biomass. Considering these facts, the Commission has specified the norm of auxiliary consumption lower than the auxiliary consumption norm for biomass based projects.

As Auxiliary Consumption is one of the performance parameters and based on the review of norms adopted by ERCs, the Commission proposes to retain the same norm for Auxiliary Consumption for non-fossil fuel based co-generation projects as specified in RE Tariff Regulations, 2017.

5.4.4 STATION HEAT RATE

The existing provisions regarding Station Heat Rate for Non-fossil fuel based Cogeneration projects in RE Tariff Regulations, 2017 are mentioned below:

"47. Station Heat Rate

The Station Heat Rate of 3600 kCal / kWh for power generation component alone shall be considered for computation of tariff for non-fossil fuel based Cogeneration projects."

The Commission has reviewed SHR norms specified by various SERCs for Non-fossil fuel based Cogeneration power projects, which are as follows.

Table 29-Comparison of SHR for Non-fossil fuel based Co-generation projects by various SERCs

ERC	MERC'19	UERC'18	GERC (T.O)	MPERC'17	KERC'18	TNERC'17
SHR	3600 kcal/kWh	3600 kcal/kWh	3600 kcal/kWh	3600 kcal/kWh	3600 kcal/kWh	3240 kcal/kWh

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The Station Heat Rate specified by most of the SERCs is same as that specified by CERC in its RE Tariff Regulations, 2017 while TNERC has specified a lower heat rate.

As Station Heat Rate is one of the performance parameters, the Commission proposes to retain the same norm for station heat rate as specified in RE Tariff Regulations, 2017.

5.4.5 CALORIFIC VALUE

The existing provision regarding Calorific Value for Non-fossil fuel based Cogeneration projects in RE Tariff Regulations, 2017 is as follows:

"Calorific Value

The Gross Calorific Value for Bagasse shall be considered as 2250 kCal/kg."

The Commission has reviewed Calorific Value norms specified by various SERCs for Non-fossil fuel based Cogeneration power projects, which are as follows:

Table 30-Comparison of Calorific value for Non-fossil fuel based Co-generation projects by various SERCs

ERC	MERC'19	UERC'18	GERC (T.O)	MPERC'17	KERC'18	TNERC'17
Calorific Value	2250 kcal/kg	2250 kcal/kg	2250 kcal/kg	2250 kcal/kg	2250 kcal/kg	2300 kcal/kg

The Commission observed that Calorific Value of Bagasse considered by most of SERCs is same as that specified in RE Tariff Regulations, 2017 i.e. 2250 kCal/kg except TNERC as they have specified higher GCV. Based on review of GCV adopted by different SERCs, the Commission proposes to retain the Gross Calorific Value of 2250 kcal/kg as specified in RE Tariff Regulations, 2017.

5.4.6 FUEL COST

The existing provisions regarding Fuel Cost for Non-fossil fuel based Cogeneration projects in RE Tariff Regulations, 2017 are mentioned below:

"Fuel Cost

- (1) The price of Bagasse for the Control Period (i.e. FY 2017-18) shall be as specified in the table below and shall be escalated at 5% to arrive at the base price for subsequent years of the Control Period, unless specifically reviewed by*

Commission. For the purpose of determining levellised tariff, a normative escalation factor of 5% per annum shall be applicable on bagasse prices."

Accordingly, the Bagasse Price for FY 2019-20 as per above Regulation works out to be as follows:

Table 31-Bagasse Price for FY 2019-20

State	Bagasse Price FY2019-20 (Rs. / MT)
Andhra Pradesh	1788.43
Haryana	2543.75
Maharashtra	2506.81
Punjab	2238.62
Tamil Nadu	1926.63
Uttar Pradesh	1995.05
Other States	2166.09

The Commission has reviewed the norms adopted by various SERCs which are as follows:

Table 32- Comparison of Fuel Cost for Bagasse based projects by various SERCs

MERC '19	UERC '18	KERC '18	CSERC '19	BERC '17	RERC '14 and '15
Project Specific	Rs. 1954/MT	Rs. 1309/MT	Rs. 2166/MT	Rs. 1964.71/MT	Rs. 1269/MT

In the absence of actual data and based on the review of norms adopted by various SERCs, the Commission proposes to continue with the existing provision as per RE Tariff Regulations, 2017. Also, the Commission proposes to continue with the same approach of escalating the Bagasse Price by 5% per annum as specified in RE Tariff Regulations, 2017. Accordingly, the Bagasse Price for FY 2020-21 works out to be as follows:

Table 33-Proposed Bagasse Price for FY 2020-21

State	Bagasse Price FY 2020-21 (Rs. /MT)
Andhra Pradesh	1878
Haryana	2671
Maharashtra	2632
Punjab	2351
Tamil Nadu	2023
Telangana	1877
Uttar Pradesh	2095
Other States	2274

5.4.7 OPERATION AND MAINTENANCE EXPENSES

The existing provisions regarding Operation and Maintenance expenses for Non-fossil fuel based Cogeneration projects in RE Tariff Regulations, 2017 are mentioned below:

"50. Operation and Maintenance Expenses

1. *Normative O&M expenses during first year of the Control period (i.e. FY 2017-18) shall be Rs. 21.13 Lakh per MW.*
2. *Normative O&M expenses allowed at the commencement of the Control Period (i.e. FY 2017-18) under these Regulations shall be escalated at the rate of 5.72% per annum."*

Details of only one cogeneration project could be obtained for which O&M expenses of this project was around Rs. 18.72 Lakh/MW which is lower than the approved norm. The Commission is of the view that it will not be appropriate to revise the norm based on actual data of only one project.

As discussed earlier, the Commission has normalised the O&M expenses by applying average escalation rate determined for FY 2014-15 to FY 2018-19 which works out to be WPI of 1.31% and CPI of 4.92%. Thus, the escalation rate has been calculated based on the five years average CPI and WPI indices by considering the weightage of 70% CPI and 30% WPI. Hence, the proposed escalation factor for computing O&M expenses is 3.84%.

Hence, the normative expenses approved for FY 2019-20 have been escalated with 3.84% to arrive at normative O&M expenses for FY 2020-21 which works out to Rs 24.52 Lakh/MW.

Further, normative O&M expenses as mentioned above for FY 2020-21 shall be escalated at the rate of 3.84% per annum for the Tariff Period for the purpose of determination of levellised tariff.

5.5 PARAMETERS FOR SOLAR PV POWER PROJECT, SOLAR THERMAL POWER PROJECTS AND FLOATING SOLAR PROJECTS

The Commission in Draft CERC RE Tariff Regulations, 2020 has specified combined parameters for Solar PV project, Solar Thermal Power Project and Floating Solar Project. Under this section, parameters such as Capital Cost Norm, Capacity Utilisation Factor, Auxiliary Consumption and O&M Expenses for these projects have been discussed.

5.5.1 CAPITAL COST

Solar PV Project

The Commission, based on the prevailing market condition decided to move from normative capital cost to only project specific capital cost for Tariff determination for the Control Period (2017-2020) for Solar PV Power Projects specified under Regulation 52 of the RE Tariff Regulations, 2017.

The existing provisions regarding Capital Cost for Solar PV Power Project in RE Tariff Regulations, 2017 are mentioned below:

"52. Capital Cost

The Commission will determine only project specific capital cost and tariff based on prevailing market trends for Solar PV projects."

The Commission observed that most of the SERCs have specified Capital Cost for Solar PV Power Projects in RE Tariff Regulations except MERC. The Commission has analysed actual Capital Cost of Solar PV Power Projects funded during last three years as given in Table below:

Table 34-Analysis of Actual Capital Cost of Solar PV Power Plants

Size	No. of Projects	Capital Cost/MW (Rs. Crore)
Up to 10 MW	17	4.11-6.06
>10MW to 50 MW	32	4.20-15.00
>50MW to 100 MW	17	4.10-7.90
>100MW to 150 MW	3	3.84-5.72
>150MW	9	3.75-6.43

Source: Data received from IREDA and PFC

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Based on actual Capital Cost data, the Commission observed that per MW cost of solar projects are getting lower. Further, the market conditions will have a huge impact in the cost of the Solar Power Plant.

Therefore, based on the prevailing market information and as most of the Solar PV Power projects are coming under competitive bidding route, the Commission proposes to determine only Project Specific Capital Cost for Solar PV Power Projects for the next Control Period 2020-2023.

Solar Thermal Power Project

The Commission, based on the prevailing market condition decided to move from normative capital cost to only project specific capital cost for Tariff determination for the Control Period (2017-2020) for Solar Thermal Power Projects specified under Regulation 57 of the RE Tariff Regulations, 2017. The existing provisions regarding capital cost for Solar Thermal power projects in RE Tariff Regulations, 2017 are mentioned below:

"57. Capital Cost

The Commission will determine only project specific capital cost and tariff based on prevailing market trends for Solar Thermal project."

The Commission observed that most of the SERCs have specified Capital Cost for Solar Thermal Power Projects in RE Tariff Regulations except MERC and JERC, which has issued the latest Renewable Energy regulations in which they have followed the approach of CERC for approving the Capital Cost for Solar Thermal Power Projects while determining the Project Specific Tariff.

Therefore, the Commission proposes to determine only Project Specific Capital Cost for Solar Thermal Power Projects for the next Control Period 2020-2023.

Floating Solar PV Project

The application of solar PV technology has transformed. The Floating Solar is considered as one of the alternatives for harnessing sun potential. The estimated potential of floating solar in the country is about 300 GW, which can be achieved by utilizing 10-15% of water bodies in States such as Kerala, Assam, Odisha, and West Bengal. It is noted that capacity of 2.72 MW has been commissioned (as on July 31,

2019) and capacity of 971 MW is under tendering phase with 4,255 MW announced by various agencies where tenders are not yet released. Moreover, Government of India has set a target to add 10 GW of floating Solar Capacity by FY 2020-21. The land scarcity, utilisation of existing grid infrastructure, higher generation and water conservation are considered as major drivers of floating solar. Besides saving land resources and potentially better use of water surfaces, Floating Solar Plants have certain benefits of increase in energy yield, synergizing with existing infrastructure, easier installation and deployment, etc.

Status of Floating Solar in India

The first floating solar power plant in India was commissioned in the year 2014 in Kolkata. This 10 KW floating solar plant was funded by the Ministry of New and Renewable Energy (MNRE) as a pilot project in the country. Over the next few years, several small and mid-sized floating solar power plants came up across the country. The current largest installation is a 2 MW plant at Visakhapatnam in Andhra Pradesh. Plans are also underway to develop such facilities across the country by Central and State government bodies.

Framework for Floating Solar

Currently, with significant development anticipated in coming years, appropriate regulatory framework is necessary. At present, it is noted that Floating Solar is at nascent stages in India because of its structure. The Competitive bidding for procurement of power from floating solar have already been floated in market. Hence, it is proposed to adopt the approach of project specific tariff for Floating Solar Project.

Capital Cost of floating solar

The capital cost of Floating Solar project is higher as compared to ground mounted Solar Projects. The higher cost is mainly on account of cost of structure, which includes cost of floater, anchoring and mooring system and more resilient electrical components. Furthermore, this cost variation also depends on the site location of the project, variations in the depth of the water bodies and the size of the plant. Floaters having significant cost, due to high logistics cost associated with import and

transportation. The domestic manufacturing facility may reduce the cost in future years. Also, transmission cost or cost of evacuation infrastructure is slightly higher than Ground mounted Solar PV projects as length of the transmission system is slightly higher.

The Capital Cost of Floating Solar Projects includes cost of module, inverters, Structure, Installation and commissioning, Civil and General works, Site testing and Survey, water body use cost, transmission cost and balance of system cost.

The Solar modules are located on Water body. It is desirable that the inverter module and distribution transformer shall be kept near to interconnection point and not on floats. Separate land is required for the same. The installation of distribution transformer on float may further increase the capital cost of the project.

In view of the above, benchmarking of capital cost of Floating Solar would not be appropriate at this stage. Also, some of the aspects of the project such as charges of uses of water body, environmental impact assessment, etc. are yet to be explored. Also, cost varies with the location of projects. Hence, it is proposed to determine only Project Specific Tariff.

5.5.2 CAPACITY UTILISATION FACTOR

Solar PV Project

The Commission in its RE Tariff Regulations, 2009 specified the Capacity Utilisation Factor for Solar PV project at 19%. Similarly, the Commission in its RE Tariff Regulation, 2012 specified the Capacity Utilisation Factor for Solar PV project at 19%. The existing provisions regarding Capacity Utilisation Factor parameters for Solar PV Power Project in RE Tariff Regulations, 2017 are mentioned below:

*“53. Capacity Utilisation Factor
The CUF for Solar PV project shall be 19%.”*

The Commission analysed CUF of Solar PV Power Projects funded during last three years and is given in Table below:

Table 35- Analysis of Actual CUF of Solar Power Plants

Size	No. of Projects	CUF (%)
Up to 10 MW	17	16%-27%
>10MW to 50 MW	32	17%-28%
>50MW to 100 MW	17	18%-29%
>100MW to 150 MW	3	23%-29%
>150MW	9	19%-28%

Source: Data received from IREDA andPFC

The Commission observes that the prevailing market trend of CUF has been in the range of 21% and above. In view of the above, the Commission proposes the minimum CUF norm for Solar PV power project as 21%.

Solar Thermal Project

The Commission in its RE Tariff Regulations, 2009 specified the Capacity Utilisation Factor for Solar PV project at 23%. Similarly, the Commission in its RE Tariff Regulation, 2012 specified the Capacity Utilisation Factor for Solar PV project at 23%.

The existing provision regarding technology specific parameters for Solar Thermal in RE Tariff Regulations, 2017 is mentioned below:

"58. Capacity Utilisation Factor

The CUF for solar thermal project shall be 23%."

The Commission observes that most of SERCs are following the approach followed by CERC. In view of the above, the Commission proposes the minimum CUF norm for Solar Thermal power project as 23%.

Floating Solar PV Project

Since, solar modules are used in Floating Solar Plant, CUF of this project is same as Ground mounted Solar Project. However, because of change in ambient conditions i.e., high ambient moisture content combined with UV exposure makes plants susceptible to higher degradation. All metallic components near water level are susceptible to corrosion. There is probability of water ingress in Modules. It is recommended that modules with higher protection against moisture and UV should be used in floating solar applications - glass-glass modules or modules with high-specification protective backsheets. In view of the above, it is proposed to keep the CUF of Floating Solar power plant as 19%.

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5.5.3 OPERATION AND MAINTENANCE EXPENSES

Solar PV Project

The existing provisions regarding Operation and Maintenance Expenses for Solar PV Power Projects in RE Tariff Regulations, 2017 are as follows

“54. Operation and Maintenance Expenses

The Commission will determine only project specific O&M expenses based on prevailing market trends for Solar PV project.”

The Commission analysed actual O&M Cost of Solar PV Power Projects funded during last three years and is given in Table below:

Table 36-Analysis of Actual Operation & Maintenance expenses of Solar Power Plants

Size	No. of Projects	O&M/MW(Rs. Lakh)
Up to 10 MW	17	3.00-7.82
>10MW to 50 MW	32	2.66-8.50
>50MW to 100 MW	17	1.80-5.90
>100MW to 150 MW	3	3.25-5.36
>150MW	9	3.00

Source: Data received from IREDA and PFC

From the analysis of the data obtained from different agencies, the Commission observes that the O&M expenses for different projects are in the range of Rs. 3.00 lakh/MW to Rs. 8.50 lakh/MW. The variation in O&M cost also depends on the location of the projects.

Therefore, based on the prevailing market information and as most of the Solar PV Power projects are coming under competitive bidding route, the Commission proposes to continue to determine only Project Specific O&M Expenses for Solar PV Power Projects in Draft CERC RE Tariff Regulations, 2020.

Solar Thermal Project

The existing provisions regarding Operation and Maintenance Expenses for Solar Thermal Power Projects in RE Tariff Regulations, 2017 are as follows

“59. Operation and Maintenance Expenses

The Commission will determine only project specific O&M expenses based on

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prevailing market trends for Solar Thermal project."

The Commission proposes to continue to determine only Project Specific O&M Expenses for Solar Thermal Power Projects for the next Control Period 2020-2023.

Floating Solar PV Project

It is proposed to determine O&M Expenses only for project specific tariff based on prevalent market conditions.

5.5.4 AUXILIARY CONSUMPTION

Solar PV Project

The existing provision regarding Auxiliary Consumption for Solar PV Power Projects in RE Tariff Regulations, 2017 is as follows:

"55. Auxiliary Consumption

The auxiliary consumption factor shall be 0.25% of gross generation."

The Commission has reviewed the Tariff Orders of various SERCs issued during the Control period 2017-2020 and observed that most of SERCs are following the approach followed by CERCs. In view of the above, the commission proposes maximum auxiliary consumption norm for Solar PV project as 0.25%.

Solar Thermal Project

The Commission in its RE Tariff Regulations, 2009 and RE Tariff Regulations, 2012 specified the auxiliary consumption for Solar Thermal Power Project at 10%. The existing provision regarding Auxiliary Consumption for Solar PV Power Projects in RE Tariff Regulations, 2017 is as follows:

"60. Auxiliary Consumption

The auxiliary consumption factor shall be 10%."

The Commission has reviewed the norms for Auxiliary Consumption considered by various SERCs issued during the Control period 2017-2020 and observed that most of SERCs are following the approach followed by CERC. In view of the above, the commission proposes maximum auxiliary consumption norm for solar thermal power project as 10%.

Floating Solar PV Project

Since, solar modules are used in Floating Solar Plant, it is proposed to keep Auxiliary consumption of Floating Solar power plant same as that of Solar PV projects.

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5.6 PARAMETERS FOR BIOMASS GASIFIER POWER PROJECTS

Under this section, parameters such as capital cost norm, plant load factor, auxiliary consumption, specific fuel consumption, fuel cost and O&M Expenses for Biomass Gasifier power projects have been discussed.

5.6.1 CAPITAL COST

The Capital Cost provision for Biomass Gasifier power projects, as per the existing provisions in the RE Tariff Regulations, 2017 is as follows:

“62. Capital Cost

The normative capital cost for the biomass gasifier power projects based on Rankine cycle shall be Rs. 592.88 Lakh/MW (FY 2017-18 during first year of the Control Period) and shall be same for subsequent years unless specifically ordered by the Commission. After taking into account of capital subsidy of Rs 150.00 lakhs/MW, net project cost shall be Rs. 442.88 Lakh/MW for FY2017-18.”

The Commission has reviewed Capital Cost norms specified by various SERCs for Biomass Gasifier power projects, which are as follows:

Table 37- Comparison of Capital Cost for Biomass Gasifier projects by various SERCs

JERC '19	UERC '18	TNERC'18	PSERC '17	HERC '17	RERC '14 and '15
Project Specific	Rs. 5.93 to 6.25 Cr/MW	Rs. 5.50 Cr/MW	Rs. 5.93 Cr/MW	Rs. 4.43 Cr/MW	Rs. 6.07 Cr/MW

In the absence of actual data for Biomass Gasifier Projects and based on review of norms adopted by other SERCs, the Commission proposes to retain the Capital Cost of Rs 593 lakh/MW.

5.6.2 PLANT LOAD FACTOR

The Plant Load Factor for Biomass Gasifier power projects, as per the existing provisions in the RE Tariff Regulations, 2017 is as follows:

“63. Plant Load Factor

Threshold PLF for determining fixed charge component of tariff shall be 85%.”

The Commission has reviewed PLF norms specified by various SERCs for Biomass Gasifier power projects, which are as follows:

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Table 38- Comparison of PLF for Biomass Gasifier projects by various SERCs

JERC '19	UERC '18	BERC '17	AERC '17	HERC '18	RERC '14 and '15
85%	85%	85%	85%	85%	85%

In the absence of actual data for Biomass Gasifier Projects and based on review of norms adopted by SERCs, the Commission proposes to retain the Plant Load Factor in the RE Tariff Regulations, 2017.

5.6.3 AUXILIARY CONSUMPTION

The Auxiliary Consumption for Biomass Gasifier power projects, as per the existing provisions in the RE Tariff Regulations, 2017 is as follows:

"64. Auxiliary Consumption

The auxiliary power consumption factor shall be 10% for the determination of tariff."

The Commission has reviewed auxiliary consumption norms specified by various SERCs for Biomass Gasifier power projects, which are as follows:

Table 39- Comparison of Auxiliary Consumption for Biomass Gasifier projects by various SERCs

JERC '19	UERC '18	MPERC '17	TNERC '17	HERC '17	RERC '14 and '15
12%	10%	10%	10%	10%	10%

Based on review of norms adopted by SERCs, the Commission proposes to retain the existing Auxiliary Consumption norms as in RE Tariff Regulations, 2017.

5.6.4 SPECIFIC FUEL CONSUMPTION

The Specific Fuel Consumption for Biomass Gasifier power projects, as per the existing provisions in the RE Tariff Regulations, 2017 are as follows:

"65. Specific fuel consumption

Normative specific fuel consumption shall be 1.25 kg per kWh."

The Commission has reviewed specific fuel consumption norms specified by various SERCs for Biomass Gasifier power projects, which are as follows:

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Table 40- Comparison of Specific Fuel Consumption for Biomass Gasifier projects by various SERCs

TNERC '18	UERC '18	PSERC '17	AERC '17	HERC '18	RERC '14 and '15
1.20 kg per kWh	1.50 kg per kWh	1.25 kg per kWh	1.25 kg per kWh	1.25 kg per kWh	1.25 kg per kWh

In absence of actual data for Biomass Gasifier Projects and based on review of norms adopted by SERCs, the Commission proposes to retain the Specific Fuel Consumption in RE Tariff Regulations, 2017.

5.6.5 OPERATION AND MAINTENANCE EXPENSES

The Operation and Maintenance expenses for Biomass Gasifier power projects, as per the existing provisions in the RE Tariff Regulations, 2017 are as follows:

"66. Operation and Maintenance Expenses

- (1) Normative O&M expenses for the Control period (i.e. FY 2017-18) shall be Rs. 52.83 Lakh per MW.
- (2) Normative O&M expenses allowed at the commencement of the Control Period (i.e. FY 2017-18) under these Regulations shall be escalated at the rate of 5.72% per annum."

As discussed earlier, the Commission has normalised the O&M expenses by applying average escalation rate determined for FY 2014-15 to FY 2018-19 which works out to be WPI of 1.31% and CPI of 4.92%. Thus, the escalation rate has been calculated based on the five years average CPI and WPI indices by considering the weightage of 70% CPI and 30% WPI. Hence, the proposed escalation factor for computing O&M expenses is 3.84%.

Hence, the normative expenses approved for FY 2019-20 have been escalated with 3.84% to arrive at normative O&M expenses for FY 2020-21 which works out to Rs 61.31 Lakh/MW.

Further, normative O&M expenses as mentioned above for FY 2020-21 shall be escalated at the rate of 3.84% per annum for the Tariff Period for the purpose of determination of levellised tariff.

5.7 PARAMETERS FOR BIOGAS BASED POWER PROJECTS

Under this section, parameters such as capital cost norm, plant load factor, auxiliary consumption, specific fuel consumption, fuel cost and O&M Expenses for Biogas power projects have been discussed.

5.7.1 CAPITAL COST

The existing provisions regarding Capital Cost for Biogas based Power Projects in RE Tariff Regulations, 2017 are mentioned below:

“Capital Cost

The normative capital cost for the biogas based power shall be Rs. 1185.76 Lakh/MW (FY 2017-18 during first year of Control Period) and will remain valid for the entire duration of the control period unless reviewed earlier by the Commission) After taking into account of capital subsidy of Rs 300 Lakhs/MW, net project cost is Rs 885.76 lakh/MW.”

The Commission has reviewed Capital Cost norms specified by various SERCs for Biogas power projects, which are as follows:

Table 41- Comparison of Capital Cost for Biogas based projects by various SERCs.

JERC '19	UERC '18	MPERC'18	PSERC '17	AERC '17	RERC '14 and '15
Project Specific	Rs.11.85 Cr/MW	Rs. 9.50 Cr/MW	Rs.11.85 Cr/MW	Rs.11.85 Cr/MW	Rs.11.83 Cr/MW

In the absence of actual data for Biogas power projects and based on review of norms adopted by SERCs, the Commission proposes to retain the Capital Cost in RE Tariff Regulations, 2017.

Therefore, the Capital Cost of Biogas based Power Projects shall be Rs. 1185 Lakh/MW for FY 2020-21 during first year of Control Period and will remain valid for the entire duration of the control period unless reviewed earlier by the Commission.

5.7.2 PLANT LOAD FACTOR

The existing provisions regarding PLF for Biogas based Power Projects in RE Tariff Regulations, 2017 are mentioned below:

“Plant Load Factor

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Threshold PLF for determining fixed charge component of Tariff shall be 90%."

The Commission has reviewed PLF norms specified by various SERCs for Biogas power projects, which are as follows:

Table 42- Comparison of PLF for Biogas power projects

JERC '19	UERC '18	BERC '17	AERC '17	HERC '18	RERC '14 and '15
90%	90%	90%	90%	90%	85%

In absence of actual data and based on the review of norms adopted by various SERCs, the Commission proposes to continue with the existing provision as per RE Tariff Regulations, 2017.

5.7.3 AUXILIARY CONSUMPTION

The existing provisions regarding Auxiliary Consumption for Biogas based Power Projects in RE Tariff Regulations, 2017 are mentioned below:

"Auxiliary Consumption

The auxiliary power consumption factor shall be 12% for the determination of tariff."

The auxiliary power consumption for Biogas Power Plants will include electricity consumption in upstream (feedstock preparation and substrate mix) and downstream (digester effluent treatment) units. Auxiliary Consumption specified by various SERCs has been summarised below:

Table 43- Comparison of Auxiliary Consumption for Biogas based projects

JERC '19	UERC '18	MPERC '17	PSERC '17	AERC '17	RERC '14 and '15
12%	12%	10%	12%	12%	12%

Based on the analysis of auxiliary power consumption notified by various SERCs, the Commission proposes to continue with the existing provision as per RE Tariff Regulations, 2017.

5.7.4 OPERATION AND MAINTENANCE EXPENSES

The existing provisions regarding O&M Expenses for Biogas based Power Projects in RE Tariff Regulations, 2017 are mentioned below:

“Operation and Maintenance Expenses

- (1) Normative O&M expenses for first year of Control period i.e. FY 2017-18 shall be Rs. 52.83 Lakh per MW
- (2) Normative O&M expenses allowed at the commencement of the Control Period (i.e. FY 2017-18) under these Regulations shall be escalated at the rate of 5.72% per annum.”

As discussed earlier, the Commission has normalised the O&M expenses by applying average escalation rate determined for FY 2014-15 to FY 2018-19 which works out to be WPI of 1.31% and CPI of 4.92%. Thus, the escalation rate has been calculated based on the five years average CPI and WPI indices by considering the weightage of 70% CPI and 30% WPI. Hence, the proposed escalation factor for computing O&M expenses is 3.84%.

Hence, the normative expenses approved for FY 2019-20 have been escalated with 3.84% to arrive at normative O&M expenses for FY 2020-21 which works out to Rs 61.31 Lakh/MW.

Further, normative O&M expenses as mentioned above for FY 2020-21 shall be escalated at the rate of 3.84% per annum for the Tariff Period for the purpose of determination of levellised tariff.

5.7.5 SPECIFIC FUEL CONSUMPTION

The existing provisions regarding Specific Fuel Consumption for Biogas based Power Projects in RE Tariff Regulations, 2017 are mentioned below:

“Specific Fuel Consumption

Normative specific fuel consumption shall be 3 kg of substrate mix per kWh.”

The Commission has reviewed the norms adopted by various SERCs which are as follows:

Table 44- Comparison of Specific Fuel Consumption for Biogas based projects by various SERCs

PSERC '17	UERC '18	HERC '17	AERC '17	RERC '14 and '15

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3 Kg/kWh	3 Kg/kWh	3 Kg/kWh	3 Kg/kWh	3 Kg/kWh
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In the absence of actual data and based on the review of norms adopted by various ERCs, the Commission proposes to continue with the existing provision as per RE Tariff Regulations, 2017.

5.7.6 FUEL COST (FEED STOCK PRICE)

The existing provisions regarding Fuel Cost for Biogas based Power Projects in RE Tariff Regulations, 2017 are mentioned below:

"Fuel Cost (Feed stock Price)

Feed stock price during first year of the Control Period (i.e. FY 2017-18) shall be Rs. 1228.72 /MT and shall be escalated at 5% to arrive at the base price for subsequent years of the Control Period, unless specifically reviewed by Commission. For the purpose of determining levelled tariff, a normative escalation factor of 5% per annum shall be applicable."

The Commission has reviewed the norms adopted by various SERCs which are as follows:

Table 45- Comparison of Fuel Cost for Biogas based projects by various SERCs

JERC '19	UERC '18	HERC '17	PSERC '17	AERC '17	RERC '14 and '15
Project Specific	Rs. 1327/MT	Rs. 1229/MT	Rs. 1228.72/MT	Rs. 1228.72/MT	Rs. 1269/MT

In the absence of actual data and based on the review of norms adopted by various SERCs, the Commission proposes to continue with the existing provision as per RE Tariff Regulations, 2017. Therefore, feed stock price during FY 2020-21 works out to Rs 1422 per MT and shall be escalated @5% during the Control Period.

5.8 PARAMETERS FOR MUNICIPAL SOLID WASTE BASED POWER PROJECTS AND REFUSE DERIVED FUEL BASED POWER PROJECTS

Under this section, parameters such as capital cost norm, plant load factor, auxiliary consumption, station heat rate, calorific value, fuel cost and O&M Expenses for MSW/RDF power projects have been discussed.

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5.8.1 CAPITAL COST

The existing provisions regarding Capital Cost for MSW/RDF in RE Tariff Regulations, 2017, are mentioned below:

"77. Capital Cost

The Commission shall determine only project specific capital cost and tariff based on prevailing market trends for MSW/RDF projects."

From the analysis of the data obtained from different agencies, the Commission observed that the capital cost for the different MSW projects are in the range of Rs. 13.09 Crore/MW to Rs. 17.70 Crore/MW. The variation in the capital cost depends on the location and size of the projects.

Table 46-Analysis of Capital Cost of MSW Power plants

Size	No. of Projects	Capital Cost/MW (Rs. Crore)
Up to 15 MW	9	13.09-17.70
Above 15 MW	1	15.91

Source: Data received from IREDA and PFC

In view of the above and based on the prevailing market information, the Commission proposes to continue with the existing approach of Project Specific determination for MSW/RDF based projects.

5.8.2 PLANT LOAD FACTOR

The existing provisions regarding Plant Load Factor for MSW/RDF in RE Tariff Regulations, 2017 are mentioned below:

"78. Plant Load Factor

- Threshold PLF for determining fixed charge component of tariff for the power projects which use MSW and RDF shall be:*

	PLF	MSW	RDF
a)	During Stabilisation	65%	65%
b)	During the remaining period of the first year(after stabilization)	65%	65%
c)	From 2 nd year onwards	75%	80%

- The stabilization period shall not be more than 6 months from the date of commissioning*

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of the project."

The Commission has reviewed the norms of PLF for municipal solid waste (MSW) and refuse derived fuel (RDF) considered by various SERCs and observed that most of SERCs are following the approach followed by CERCs.

From the analysis of the data obtained from different agencies, it can be observed that the PLF for the different MSW projects is in range of 55-74%. In view of the above the commission proposes to continue with the existing provision as specified in RE Tariff Regulations, 2017.

5.8.3 AUXILIARY CONSUMPTION

The existing provision regarding Auxiliary Consumption for MSW/RDF in RE Tariff Regulations, 2017 is as follows:

"79. Auxiliary Consumption

The auxiliary power consumption for MSW/RDF based power projects shall be 15%."

The Commission has reviewed the norms of Auxiliary Consumption for municipal solid waste (MSW) and refuse derived fuel (RDF) considered by various SERCs and observed that most of the SERCs are following the approach followed by CERCs. The comparison of auxiliary consumption for SERCs is summarised below:

Table 47- Comparison of Auxiliary Consumption for MSW/RDF projects by various SERCs

JERC '19	UERC '18	GERC (T.O.)	MPERC '17	KERC	TSERC
15%	15%	16% (MSW), 12% (RDF)	15%	12% (RDF)	12% (MSW), 11% (RDF)

The Commission notes that for biomass projects, auxiliary consumption is fixed at 10%. However, unlike any other power station, the Rankine Cycle Combustion Based Power Plants utilizing MSW as input requires to install MSW handling facilities that consume higher electricity. Accordingly, higher Auxiliary Consumption was approved as 15% for MSW/RDF projects.

As Auxiliary consumption is one of the controllable factor and based on above analysis, the Commission proposes to continue with the existing provision as specified in RE Tariff Regulations, 2017.

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5.8.4 STATION HEAT RATE

The existing provision regarding Station Heat Rate for MSW/RDF in RE Tariff Regulations, 2017 is as follows:

"80. Station Heat Rate

The Station Heat Rate for MSW/RDF based power projects shall be 4200 kcal/kWh."

The Commission has reviewed the norms of Station Heat Rate for municipal solid waste (MSW) and refuse derived fuel (RDF) considered by various SERCs are as follows:

Table 48- Comparison of SHR for MSW/RDF projects by various SERCs

JERC '19	UERC '18	BERC'18	AERC '18	PSERC'17	CSERC
Project Specific	4200 kCal/kWh	4200 kCal/kWh	4020 kCal/kWh	4200 kCal/kWh	3600 kCal/kWh

From the analysis of the data obtained from different agencies, it can be observed that the SHR for the different MSW projects varies significantly and is in range of 3438-5396 kcal/kWh.

As Heat Rate is one of the performance parameter, and after considering the actual data and norms specified by SERCs, the Commission proposes to continue with the existing provision as specified in RE Tariff Regulations, 2017.

5.8.5 OPERATION AND MAINTENANCE EXPENSES

The existing provision regarding O&M Expenses for MSW/RDF in RE Tariff Regulations, 2017 is as follows:

"81. Operation and Maintenance Expenses

The Commission shall determine only project specific O&M expenses based on prevailing market trends for MSW/RDF projects."

The Commission has reviewed the approach adopted by various SERCs for Operation and Maintenance Expenses for municipal solid waste (MSW) and refuse derived fuel (RDF) and observed that most of SERCs are following the approach followed by CERCs.

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