Central Electricity Regulatory Commission
New Delhi

Explanatory Memorandum

On

Draft Central Electricity Regulatory Commission (Terms and Conditions for Tariff Determination from Renewable Energy Sources) Regulations, 2020

May, 2020

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LIST OF ABBREVIATIONS

AERC	Assam Electricity Regulatory Commission
BERC	Bihar Electricity Regulatory Commission
BSE	Bombay Stock Exchange
CAPM	Capital Asset Pricing Model
CEA	Central Electricity Authority
CERC	Central Electricity Regulatory Commission
COD	Commercial Operation Date
CPI	Consumer Price Index
CSERC	Chhattisgarh State Electricity Regulatory Commission
CSP	Concentrated Solar Power
CUF	Capacity Utilisation Factor
DSCR	Debt Service Coverage Ratio
EOI	Expression of Interest
ESS	Energy Storage System
ERCs	Electricity Regulatory Commissions
GBI	Generation Based Incentive
GCV	Gross Calorific Value
GERC	Gujarat Electricity Regulatory Commission
GOI	Government of India
GST	Goods and Services Tax
HERC	Haryana Electricity Regulatory Commission
HPERC	Himachal Pradesh Electricity Regulatory Commission
H&M	Hydro Mechanical
IDC	Interest During Construction
IEGC	Indian Electricity Grid Code
IoWC	Interest on Working Capital
IREDA	Indian Renewable Energy Development Agency
JERC	Joint Electricity Regulatory Commission
KERC	Karnataka Electricity Regulatory Commission
Kg	Kilogram
kWh	Kilowatt Hour
LC	Letter of Credit
MAT	Minimum Alternate Tax
MCLR	Marginal Cost of Fund Based Lending Rate
MERC	Maharashtra Electricity Regulatory Commission
MNRE	Ministry of New and Renewable Energy
MPERC	Madhya Pradesh Electricity Regulatory Commission
MSW	Municipal Solid Waste
NIWE	National Institute of Wind Energy
NLDC	National Load Despatch Centre
O&M	Operation & Maintenance
PFC	Power Finance Corporation Limited
PLF	Plant Load Factor
PLCC	Power Line Carrier Communication

PLR	Prime Lending Rate
POSOCO	Power System Operation Corporation Limited
PPA	Power Purchase Agreement
PSERC	Punjab State Electricity Regulatory Commission
RDF	Refuse Derived Fuel
RES	Renewable Energy Sources
REC	Rural Electrification Corporation
RERC	Rajasthan Electricity Regulatory Commission
RES	Renewable Energy Sources
RfS	Request for Selection
ROE	Return on Equity
RPO	Renewable Purchase Obligation
R&R	Rehabilitation & Resettlement
SBI	State Bank Of India
SECI	Solar Energy Corporation of India Limited
SERC	State Electricity Regulatory Commission
SHR	Station Heat Rate
TNERC	Tamil Nadu Electricity Regulatory Commission
TSERC	Telangana State Electricity Regulatory Commission
UERC	Uttarakhand Electricity Regulatory Commission
WACC	Weighted Average Cost of Capital
WPG	Wind Power Generator
WPI	Wholesale Price Index
WTE	Waste to Energy

1 BACKGROUND

1.1 BACKGROUND

Central Electricity Regulatory Commission (CERC or the Commission) is a statutory body constituted under the Electricity Regulatory Commission Act, 1998 and continues to be recognised under the Electricity Act, 2003 ("the Act"). CERC has been vested with the functions under the Act, inter alia to regulate the tariff of the Generating Companies owned or controlled by Central Government and Generating Companies having a composite scheme for generation and sale of electricity in more than one State, to regulate inter-State transmission of electricity and to determine the tariff for inter-State transmission of electricity.

In accordance with Section 61 of the Act, the Central Commission has to specify the terms and conditions for determination of tariff. Further, in accordance with sub-clause (s) of Clause (2) of Section 178 of the Act, Central Commission is empowered to determine terms and conditions for the determination of Renewable Energy tariff. Accordingly, the Commission, while determining the tariff, takes into account objectives of safeguarding consumer's interest as well as ensuring recovery of the cost of electricity in a reasonable manner.

To achieve these objectives, the Commission undertakes various regulatory measures, which are in consonance with the principles set out under Section 61 of the Act. The terms and conditions of Renewable Energy tariff specified by the Commission also act as guiding principles for SERCs.

The Commission, since 2009, has been issuing Regulations for Terms and Conditions for Tariff determination from Renewable Energy sources based on multi-year tariff principles over the various Control Periods as under:

Table 1– Issuance of RE Tariff Regulations

Tariff Regulations	**Issuance**	**Control Period**
Central Electricity Regulatory Commission (Terms and Conditions for Tariff determination from Renewable Energy Sources) Regulations, 2009	September 16, 2009	2009-2012
Central Electricity Regulatory Commission (Terms and Conditions for Tariff determination from Renewable Energy Sources) Regulations, 2012	February 6, 2012	2012-2017
Central Electricity Regulatory Commission (Terms and Conditions for Tariff determination from Renewable Energy Sources Regulations, 2017 (CERC RE Tariff Regulations, 2017)	April 17, 2017	2017-2020

After notification of CERC RE Tariff Regulations, 2017, CERC issued three (3) Orders on Determination of levellised generic tariff for FY 2017-18, FY 2018-19 and FY 2019-20 on May 31, 2017; March 28, 2018; and March 19, 2019 respectively.

The Commission vide Order dated March 24, 2020 in Petition No. 3/SM/2020 (Suo-Motu) has extended the applicability of CERC RE Tariff Regulations, 2017 for a further period of three (3) months i.e., from April 1, 2020 upto June 30, 2020. Accordingly, the next Control Period shall commence from July 1, 2020. The Commission has prepared this Draft Regulation [Draft CERC (Terms and Conditions for Tariff Determination from Renewable Energy Sources) Regulations, 2020] for laying down the Terms and conditions for Tariff Determination from Renewable Energy Sources for next Control Period.

During the Control Period 2017–2020, Renewable Energy technologies have matured and the gap between the cost of generation using conventional sources of energy and Renewable Energy sources (especially wind and solar) have reduced. The total installed capacity of grid-interactive Renewable Energy in India stands at 86,321 MW as on January 31, 2020, with the largest share of Wind Energy at 37,608 MW, followed by Solar Energy at 34,036 MW[1]. The share of grid-interactive renewable capacity in total generation installed capacity mix is around 23%[2]. As of 2019, India is ranked 4th in Wind Energy, 5th in Solar Energy and 5th in Renewable Energy installed capacity.

The Government of India has set an ambitious target to have 175 GW of Installed Capacity from Renewable Energy Sources (RES) by March 2022.

The Commission has been determining the tariff of the grid interactive power projects based on Renewable Energy sources through transparent and participative process. The Commission has deemed it necessary to consider the developments in the sector while framing the fresh terms and conditions of tariff for Control Period commencing from July 1, 2020.

This Explanatory Memorandum is being issued with the intent of explaining the rationale behind Draft CERC (Terms and Conditions for Tariff Determination

[1]Data from Ministry of New and Renewable Energy

[2]Data from Central Electricity Authority

from Renewable Energy Sources) Regulations, 2020. ("Draft CERC RE Tariff Regulations, 2020").

While preparing the Draft CERC RE Tariff Regulations, 2020 data has been obtained from Indian Renewable Energy Development Agency (IREDA) and Power Finance Corporation Limited (PFC) about the Renewable Energy Projects funded/executed for the last three years. The details of the data received from different agencies are as follows:

Table 2– Data Received from Different Agencies

Technology	**No. of Projects for which data was received**	**Projects Not Considered due to some discrepancy in data**	**Projects Considered for Analysis**
Wind	32	10	22
Small Hydro Projects	16	3	13
Solar	88	10	78
Biomass	16	3	13
Cogeneration	1	-	1
MSW Projects	12	1	11
Total	**165**	**27**	**138**

The data has also been received from National Institute of Wind Energy (NIWE) for wind projects and from Power System Operation Corporation (POSOCO) for various RE projects which has been duly considered while framing Draft CERC RE Tariff Regulations, 2020.

The information received from the above agencies has been analysed in the Explanation Memorandum.

2 SCOPE OF RE TARIFF REGULATIONS

2.1 APPLICABILITY OF REGULATIONS

In accordance with Section 79 read with Section 62 of the Act, the Commission is required to determine the tariff for the central sector generating stations or the generating stations with composite scheme for sale of electricity to more than one State. Accordingly, it is proposed that CERC RE Tariff Regulations, 2020 shall be applicable in all cases where tariff for a generating station or a unit thereof is based on renewable sources of energy, and are covered under Section 79(1)(a) & (b) read with Section 62 of the Act.

Section 6.4 (3) of Tariff Policy notified on January 28, 2016 empowers the Commission to lay down the guidelines for pricing of non-firm power. The Para 6.4 (3) reads as under:

> *"The Central Commission should lay down guidelines for pricing intermittent power, especially from Renewable Energy sources, where such procurement is not through competitive bidding. The tariff stipulated by CERC shall act as a ceiling for that category."*

In cases of Wind power projects, Small hydro projects, Biomass power project with Rankine cycle technology, Non-fossil fuel based co-generation projects, Solar PV power projects, Floating Solar projects, Solar thermal power projects, Renewable Hybrid Energy projects, Renewable Energy with Storage projects, Biomass gasifier based power project, Biogas based power project, Municipal solid waste based power projects and Refuse derived fuel based power projects, these regulations shall apply subject to the fulfilment of eligibility criteria as specified under the Regulations.

2.2 ELIGIBILITY CRITERIA

The tariff determined under these Regulations shall be applicable in respect of RE technologies meeting specific Eligibility Criteria. The Commission proposes to retain the Eligibility Criteria as specified in RE Tariff Regulations, 2017 for the Wind power project, Small hydro project, Biomass power project with Rankine

Cycle Technology, Non-fossil fuel based Co-generation project, Biomass gasifier based power project, Biogas based power project, Municipal Solid Waste based project, Refuse Derived Fuel based power project, Solar PV power project and Solar Thermal Power project.

The Commission proposes to specify the parameters for new Renewable Energy technologies such as Floating Solar Project, Renewable Hybrid Energy Project and Renewable Energy Project with Storage in the Draft CERC RE Tariff Regulations, 2020.

For the purpose of these Regulations, Renewable Hybrid Energy Project and Renewable Project with Storage have been treated separately.

2.3 APPROACH FOR DEVELOPMENT OF TARIFF NORMS

While determining the tariff norms, the following approaches have been considered:-

a) Detailed review of the Tariff Orders / Regulations notified by various SERCs and the approaches considered in determining the norms for tariff for a specific RE technology.
b) Review and analysis of the actual project cost details and information about performance parameters in respect of existing RE projects based on information received from financial institutions, public agencies and other State Electricity Regulatory Commissions.
c) Comparative analysis of project cost and performance parameters in respect of similar RE technology applications in the international context.
d) Feedback/views/comments of the various stakeholders received on the RE Tariff Regulations, 2017.

The tariff norms have been categorized broadly under three Sections, namely General Principles, Financial Principles and Technology Specific Parameters. On the basis of RE technologies covered under the Regulations, the Explanatory Memorandum has been divided into the following sections:

a) General Principles
b) Financial Principles
c) Parameters for wind power projects

d) Parameters for Small hydro project
e) Parameters for biomass power projects based on Rankine cycle technology
f) Parameters for non-fossil fuel based co-generation projects
g) Parameters for solar PV power projects, solar thermal power projects and floating solar projects
h) Parameters for biomass gasifier based power projects
i) Parameters for biogas based power projects
j) Parameters for municipal solid waste based power projects/ refuse derived fuel based power projects
k) Parameters for Renewable hybrid energy projects
l) Parameters for Renewable energy with storage projects

The comprehensive approach adopted for development of norms for the purpose of tariff determination for power in respect of various Renewable Energy technologies has been presented below and the same has been elaborated under subsequent sections.

3 GENERAL PRINCIPLES

3.1 CONTROL PERIOD

The existing provisions in the RE Tariff Regulations, 2017 specifies Control Period or Review Period of three (3) years viz. FY 2017-18 to FY 2019-20.

The Commission observes that most of the ERCs have adopted a three year control period, except for States like Maharashtra, Madhya Pradesh, Chhattisgarh which have opted for Control Period of 5 years. In case of Rajasthan, different Control Period has been adopted for various technologies as per the maturity level of the technology.

During the Control Period from FY 2017-20, the maturity level of Renewable Energy technologies has grown significantly. In addition, majority of the capacity addition through Solar PV technology and Wind Technologyis are taking place through the competitive bidding route.

Considering the discovery of lower tariff regimes through competitive bidding and with due regard to frequent changes in market dynamics in all upcoming technologies, the Commission proposes to continue with the short duration of Control Period of three (3) years from FY 2020-21 (1st July 2020) to FY 2022-23.

3.2 TARIFF PERIOD

In the RE Tariff Regulations 2017, it is specified that Tariff Period for all Renewable Energy power projects shall be same as useful life. In case of Small Hydro projects, the tariff period shall be thirty five (35) years. For Wind, Solar PV and Solar Thermal projects, the Tariff Period shall be twenty five (25) years. In case of Biomass based projects with Rankine cycle technology, Biomass Gasifier, Non fossil-fuel co-generation projects, Biogas based projects, Municipal Solid Waste and Refuse Derived Fuel based projects the tariff period shall be twenty (20) years.

The Commission proposes to continue with the existing provisions of Tariff Period equal to useful life of the project. Since, the tariff period is equal to useful life of the project, tit will enable the Project Developers to ensure returns from projects and will help in reasonable tariff discovery as the benefits of the same can be passed to end consumers.

In case of Renewable Hybrid Energy projects, the Commission proposes that the Useful life of the project shall be the minimum of the useful life of different Renewable Energy technologies combined for Renewable Hybrid Energy Project and the same shall be considered as Tariff Period. For Renewable energy with storage project, the Commission proposes that the Useful life shall be same as useful life of project assuming that there is no storage.

In case of Floating Solar PV Project, the Commission proposes to keep Tariff Period of 25 years as technology of Floating Solar is same as Solar PV and Solar Thermal.

3.3 GENERIC TARIFF AND PROJECT SPECIFIC TARIFF

RE Tariff Regulations, 2017 specify determination of Project Specific Tariff for Solar PV and Solar Thermal, Wind Energy (including on-shore and off-shore), Biomass Gasifier based projects, Biogas based projects, Municipal Solid Waste and Refuse Derived Fuel based projects with Rankine cycle technology, Hybrid Solar Thermal Power Projects and other Hybrid Project.

The Commission observes that many SERCs are still continuing with the determination of RE Generic Tariff for most of the technologies. However, Himachal Pradesh and Maharashtra have adopted the approach for specifying the generic tariff for only few technologies.

In line with the existing RE Tariff Regulations, 2017, the Commission proposes to continue with the determination of Generic Tariff for Small Hydro Power Projects, Biomass Power Projects with Rankine Cycle technology, Non-fossil fuel-based co-generation Plants, Biomass Gasifier based power projects and Biogas based power projects.

Regarding the determination of project specific tariff, the Commission proposes to continue with RE Technologies specified in RE Tariff Regulations, 2017. Also, the Commission has included the provisions of new RE Technologies such as Floating Solar projects, Off-shore wind power projects, Renewable Hybrid Energy projects and Renewable energy Project with storage under the project specific tariff determination.

3.4 PETITION FOR PROCEEDINGS FOR DETERMINATION OF TARIFF

Regulation 8 of RE Tariff Regulations, 2017 specifies proceedings of determination of Tariff. The Regulations specify that the Commission shall determine the generic tariff on the basis of suo-motu petition six months in advance at beginning of each year of the Control Period. In the proposed draft, the Commission proposes to determine the generic tariff on the basis of suo-motu petition one month before commencement of tariff for each year of the Control Period. However, as first year of Control Period is from 1.7.2020, the Commission proposes to determine the Generic Tariff prior to 30.6.2020 for the period 1.7.2020 to 31.3.2021.

The list of documents to be submitted with Petition for determination of project specific tariff are also specified. Further, the Commission is of the view that the application for project specific tariff determination should be filed based on consent from the Beneficiary that they will procure the power at the project specific tariff determined by the Commission. Hence, the Commission has proposed to include this condition of consent from the Beneficiary along with the Petition for project specific tariff determination.

As discussed earlier, most of the Wind and Solar capacity addition is taking place through competitive bidding and hence, in case the project specific tariff is to be determined for these RE technologies for which the competitive bidding is taking place, it becomes important to assess the reasonableness of tariff proposed with the tariffs discovered through competitive bidding. Hence, the Commission has proposed to include specific provisions in this regard in the Petition to be filed for project specific tariff determination.

3.5 TARIFF STRUCTURE AND TARIFF DESIGN

The Tariff structure and design as per the existing provisions in the RE Tariff Regulations, 2017 are as follows:

*"**9.Tariff Structure***

The tariff for renewable energy technologies shall be single part tariff consisting of the following fixed cost components:

(a) Return on equity;

(b) Interest on loan capital;

(c) Depreciation;

(d) Interest on working capital;

(e) Operation and maintenance expenses;

Provided that for renewable energy technologies having fuel cost components, like biomass power projects and non-fossil fuel based cogeneration, a single part tariff with two components, fixed cost component and fuel cost component, shall be determined.

10. Tariff Design

1) *The generic tariff shall be determined considering the year of commissioning of the project, on levellised basis for the Tariff Period. Provided that for Renewable Energy technologies having single part tariff with two components, tariff shall be determined on levellised basis considering the year of commissioning of the project for fixed cost component while the fuel cost component shall be specified on year of operation basis.*
2) *For the purpose of levellised tariff computation, the discount factor equivalent to Post Tax weighted average cost of capital shall be considered.*
3) *Levellisation shall be carried out for the 'useful life' of the Renewable Energy project.*
4) *The above principles shall also apply for project specific tariff. "*

For Renewable Energy technologies having fuel cost component, like biomass power projects and non-fossil fuel based cogeneration, single part tariff with two components, i.e. fixed cost component and fuel cost component, was specified. The Commission considered that for RE technologies involving no fuel cost component, single part tariff structure is the simplest method to operationalize considering number of projects and unit size of each project. Also, the same has been in practice for RE technologies for long time.

The Commission proposes to continue with the same tariff structure for the next Control Period (2020-2023).

While specifying the tariff for all RE Technologies, Levellised tariff approach is a balanced approach amongst various tariff determination mechanisms like front loaded tariff, back loaded tariff, etc. The Commission has also considered Levellised tariff with appropriate discount rate representing weighted average cost of capital on the basis of normative debt-equity ratio as specified in the Regulations. The discount rate used for Renewable Energy tariff determination was the pre-tax Weighted Average Cost of Capital (WACC). The WACC was computed as under:

Post Tax WACC = Cost of Debt + Cost of Equity

Where,

Cost of Debt = Normative Debt X (Normative Rate of Interest) X (1-Corporate Tax Rate)

Cost of Equity= Normative Equity X (Post Tax Return on Equity)

The Commission proposes to continue with Levellisation of tariff for the useful life of the Renewable Energy project.

3.6 TREATMENT FOR OVER-GENERATION

The Commission is of the view thatas the entire costs are allowed to be recovered through tariff at normative capacity utilisation factor or plant load factor considered for tariff determination, the tariff applicable for over-generation in excess of normative capacity utilisation factor or plant load factor should not be same as tariff determined for full recovery at normative capacity utilisation factor or plant load factor and benefits of over-generation needs to be shared with the beneficiaries. Further, the renewable energy project should be free to sell such excess energy to any other entity and at the same time priority should be given to the concerned beneficiary for procuring the energy generated in excess of normative capacity utilisation factor or plant load factor. The Commission observed that similar provision has been made by the Ministry of Power in Guidelines for tariff based competitive bidding process for procurement of power from grid connected wind power projects and solar PV power projects. The relevant provision of guidelines for wind power projects are as follows:

"7.2.3 In case of availability of power more than the maximum CUF specified, WPG will be able to free to sell it to any other entity provided first right of refusal will vest with the

Procurer(s). In case the Procurer purchases the excess generation, the same may be done at 75% of the PPA tariff, and provision of this effect shall be clearly indicated in the RfS document."

Accordingly, the Commission proposes to add provisions regarding Treatment for Over- Generation for Renewable Energy Technologies in the Draft CERC RE Tariff Regulations, 2020, on above lines.

4 FINANCIAL PRINCIPLES

4.1 DEBT - EQUITY RATIO

As per the existing provisions in the RE Tariff Regulations, 2017, Debt Equity ratio is specified as follows:

1. *"For generic tariff to be determined based on suo-motu petition, the debt equity ratio shall be 70:30.*
2. *For Project specific tariff, the following provisions shall apply:-*
    a. *If the equity actually deployed is more than 30% of the capital cost, equity in excess of 30% shall be treated as normative loan.*
    b. *Provided that where equity actually deployed is less than 30% of the capital cost, the actual equity shall be considered for determination of tariff.*
    c. *Provided further that the equity invested in foreign currency shall be designated in Indian rupees on the date of each investment. "*

For analysing the trend in the Debt-Equity ratio of various Renewable Energy projects, comparison of debt-equity ratio considered by various SERCs has been done and the Commission observed that most of the SERCs have adopted the normative Debt Equity ratio of 70:30.

The analysis of actual Debt-Equity Ratio of the Renewable Energy projects funded during the last 3 years is summarised in Table below:

Table 3–Actual Debt Equity ratio of projects

Technology	Actual Funding Pattern
Wind Projects	• Maximum Debt Equity Ratio of 79.97:20.03 and Minimum Debt Equity Ratio of 60.61:39.39. • 16 projects out of total 22 projects have been funded with Debt more than 70% of Project Cost
Small Hydro Projects	• Maximum Debt Equity Ratio of 75:25 and Minimum Debt Equity Ratio of 62.54:37.36. • Two Projects with 70:30 Ratio and one Project with Debt more than 70% (Total 13 Projects)
Solar Projects	• Maximum Debt Equity Ratio of 79.95:20.05 and Minimum Debt Equity Ratio of 36.54:63.46. • 50 projects out of total 78 projects have been funded with Debt more than 70% of Project Cost
MSW Projects	All projects (10) are having Debt Equity Ratio 70:30
Cogeneration Projects	1 project with Debt Equity Ratio 46.49:53.51

Source: Data received from IREDA and PFC

The Commission observed that for most of the projects in Renewable Energy, debt financing is more than normative debt of 70% with few exceptions. The Commission proposes to continue with the existing approach of normative Debt Equity ratio of 70:30.

Further, the Commission notes that, in case of project specific Tariff, the project may have opted for Capital Subsidy. Hence, it is proposed that Debt Equity ratio shall be considered after reduction of capital subsidy from capital cost of the project.

4.2 RETURN ON EQUITY (ROE)

Return on equity (RoE) is one of the key components of tariff determination. As per the existing provisions in the RE Tariff Regulations, 2017, RoE is specified as follows:

"

1. *The value base for the equity shall be 30% of the capital cost or actual equity (in case of project specific tariff determination) as determined under Regulation.*
2. *The normative Return on Equity shall be 14%, to be grossed up by prevailing Minimum Alternate Tax (MAT) as on 1st April of previous year for the entire useful life of the project."*

For analysing the recent trend in the Return on Equity (RoE) of various Renewable Energy projects, comparison of Return on Equity (RoE) considered by various SERCs has been done and the Commission observed that most of SERCs have specified the rate of Return on Equity in the range of 14% to 16%.

Table 4–Comparison of Rate of Return on Equity for SERCs

ERC Name	Rate of Return of Equity
MERC	14% grossed up with the tax rate equivalent to MAT rate as on 1st April of previous financial year
JERC	14% for mainland areas and 16% for Island area. Grossed up by MAT as on 1st April of available year
UERC	16% post tax for RE power Projects, 20% (Pre-tax) for first 10 years considering Avg MAT rate and 22% (Pre-tax) from 11th year onwards considering Avg Corporate Tax.
GERC	14% post tax (grossed up with base rate); Tax Rate- MAT at 21.34% for first 10 years from COD, Corporate tax rate at 34.61% from 11th year onwards.

ERC Name	Rate of Return of Equity
RERC	14% grossed up with the tax rate equivalent to MAT rate.
MPERC	20% p.a. pre-tax RoE for first 10years, 24% pre-tax RoE from 11th year onwards.
KERC	14% grossed up with the tax rate equivalent to MAT rate
TNERC	17.60% pre-tax RoE
TSERC	16% pre-tax to be grossed up with actual tax rate
CSERC	20% per annum for the first l0 years; 24% per annum 11th year onwards.
HPERC	The normative return on Equity shall be 17% per annum on pre-tax basis and shall not be subject to any adjustment on account of any taxes

There are various methods of determining the cost of equity such as the Arbitrage Pricing Model, Dividend Growth Model, and Capital Asset Pricing Model (CAPM). The appropriate model may be used to benchmark the cost of equity. Among all the above models, CAPM is the most preferred model for determination of cost of equity in the Country where limited companies are listed and traded on the stock exchange. CAPM has also been accepted by various Regulators internationally. Further, CAPM model has also been adopted in specifying the Return on Equity for Conventional Generating Stations and Transmission Business.

Further, CAPM also captures issues related to expected risk premium for the market over the risk free rate. In order to arrive at the risk free rate historical trends of various benchmarks rates such as Bank Rate, SBI PLR, Deposit Rates and Government Securities rate can be considered. In order to assess the market risk premium, the returns provided by the market over the historical period can be considered. Based on the above analysis, the market risk premium has been derived.

The Commission has reviewed the 10 year G-Sec rates for the past six months and considered the average of the same as the Risk free Rate. The Commission has considered the average return of BSE Sensex over 20 years and considered the average of the same as Market Return Rate. The Commission has considered the measure of volatility of security in comparison to market as a whole.

The cost of equity through CAPM model has been worked out as follows:

Required/Expected Return = Risk Free Rate Rf + (Market Return Rm – Risk Free Rate Rf) x Beta,

Where Rf = average 10-year yield of zero coupon G-Sec, i.e., 6.71%;

Rm = average return of BSE Sensex over 20 years, i.e., 14%;

Beta = measure of volatility of security in comparison to market as a whole, i.e., around 1.01

With this approach the Cost of equity works out to be around 13.95% i.e., ~14%.

Considering the present market scenario, wherein competitively bid tariffs in solar and wind projects over the last couple of years have shown declining trends, the Commission has inferred that the market expectation of ROE has come down. Further, as compared to conventional Generation projects, the gestation period of RE project is significantly lower. Hence, RE projects are exposed to lower risk during the construction phase compared to conventional generation projects.

However, these regulations are applicable to other technologies such as Small Hydro, Biomass, Bagasse based Co-generation, MSW, etc. Therefore, the Commission proposes that prevailing rate of RoE of 14% should be continued with grossing up with MAT Rate for the entire life of the project. Going forward, Minimum Alternate Tax/ Corporate Tax are expected to be lowered and the Commission has observed that the effective tax rate is lower than the Corporate Tax rate. Hence, for certainty of regulatory principles, the Commission proposes that the return on equity shall be grossed up by Minimum Alternate Tax prevailing as on 1st April of the previous financial year for the entire useful life of the project.

4.3 LOAN TENURE

The loan tenure is the key component of tariff determination, as per the existing provisions in the RE Tariff Regulations, 2017, loan tenure is as follows:

*"**Loan Tenure: -** For the purpose of determination of tariff, loan tenure of 13 years shall be considered. "*

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

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 speciifes 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 bythe 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 levellised 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. "

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.CapitalCost

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

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/m^3.

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 asfollows:

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 meterhub-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/m3, Shape factor (k)[3] of 2 (which resembles constant wind speed) and Scale factor has been considered.

Scale factor has been computed as follows:

Scale Factor = Average Wind Speed/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, avifuana, 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 paramters 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 acutal 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 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 asfollows.

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 levellised 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 technlology, as per the existing provisions in the RE Tariff Regulations, 2017 are as follows:

"33. *CapitalCost*

(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 Projectsby 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 Rs 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 componentof Tariff shallbe:*
   i. *During Stabilisation:60%*
   ii. *During the remaining period of the first year (after stabilization):70%*
   iii. *From 2 Year onwards: 80%*
2. *Thestabilisation period shall not be more than 6 months from the date of commissioning of theproject. "*

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 cooledcondenser:
   i. During first year of operation :11%
   ii. From 2nd year onwards :10%

b) For the project using air cooledcondenser:

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 Auxilary 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. *NormativeO&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% perannum."*

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 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 levellised 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."

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:

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 wich are as follows:

Table 25– Comparison of Fuel Cost for Biomass based projectsby 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%

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 Commisson 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 projectsby 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 Commisson 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 sha**ll** be considered for computation of tariff for non-fossil fuel based Cogeneration projects."*

The Commisson 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

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 Commisson 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% toarrive 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 bagasseprices."

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 wich are as follows:

Table 32– Comparison of Fuel Cost for Baggase 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 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 PVprojects."*

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 andPFC

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 Powr 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%.

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 andPFC

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*

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.

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 Gasifer 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:

Table 38– Comparison of PLF for Biomass Gasifer projectsby 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 Commisson 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 Gasifer 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 Commisson has reviewed specific fuel consumption norms specified by various SERCs for Biomass Gasifier power projects, which are as follows:

Table 40– Comparison of Specific Fuel Consumption for Biomass Gasifer 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 fortheControlperiod (i.e. FY 2017-18)shallbeRs. 52.83LakhperMW.

(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% perannum."

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 2017-18during 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 projectsby 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***

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 oftariff."

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 Controlperiod 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% perannum."*

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 wich are as follows:

Table 44– Comparison of Specific Fuel Consumption for Biogas based projectsby various SERCs

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

3 Kg/kWh	3 Kg/kWh	3 Kg/kWh	3 Kg/kWh	3 Kg/kWh

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 ControlPeriod (i.e. FY 2017-18) shall be Rs. 1228.72 /MT and shall be escalated at 5% to arrive at the base price for subsequentyears ofthe Control Period, unless specifically reviewed by Commission. For the purpose of determining levellised tariff, a normative escalation factor of 5% per annum shall beapplicable. "*

The Commission has reviewed the norms adopted by various SERCs wich 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.

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 andPFC

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

1. *Threshold PLF for determining fixed charge component of tariff for the power projects which use MSW and RDF shallbe:*

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

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

of theproject."

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.

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.

From the analysis of the data obtained from different agencies, the Commission observed that the O&M expenses for the different MSW projects varies significantly. In view of the above, the Commission proposes to continue with the existing approach of Project Specific determination of O&M expenses for MSW/RDF based on prevailing market trends.

5.8.6 CALORIFIC VALUE

The existing provision regarding Calorific Value for RDF in RE Tariff Regulations, 2017 is as follows:

> ***"82. Calorific Value***
>
> *The Calorific Value of the RDF fuel used for the purpose of determination of tariff shall be at 2500 kcal/kg."*

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

Table 49– Comparison of Calorific Value for RDF projects by various SERCs

JERC '19	UERC '18	BERC'17	AERC '18	PSERC'17	CSERC
Project Specific	2500 kCal/Kg	2500 kCal/Kg	2500 kCal/Kg	2500 kCal/Kg	2500 kCal/Kg

In view of the above, the Commission proposes to continue with the existing provisions for RDF as specified in RE Tariff Regulations, 2017. In case of MSW, the Commission proposes to approve the calorific value while determining the project specific tariff.

5.8.1 FUEL COST

The existing provision regarding Fuel Cost for RDF in RE Tariff Regulations, 2017 is as follows:

> ***"83. Fuel Cost***
>
> *RDF price during FY 2017-18 shall be Rs 1,800 per 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 levellized tariff, a normative escalation factor of 5% per annum shall be applicable.*
>
> *No fuel cost shall be considered for determination of tariff for the power projects*

using MSW"

The Commission has reviewed the norms of Fuel Cost for refuse derived fuel (RDF) considered by various SERCs which are as follows:

Table 50– Comparison of fuel cost for MSW/RDF projects by various SERCs

JERC '19	UERC '18	ASPERC '18	CSERC '19	AERC '17	BERC'17
Project Specific	Rs. 1800/MT	Rs. 1800/MT	Rs. 1985 /MT	Rs. 1800/MT	Rs. 1800/MT

In the absence of actual data and review of fuel costs notified by various SERCs , the Commission proposes to continue with the existing provision as specified in RE Tariff Regulations, 2017.

Therefore, RDF price during FY 2020-21 shall be Rs. 2084 per MT and shall be escalated at 5% during the Control Period. In case of MSW, fuel cost shall be considered as nil and the Commission proposes to consider the transportation cost while determining the project specific tariff.

5.9 PARAMETERS FOR RENEWABLE HYBRID ENERGY PROJECT

5.9.1 Overview

Draft CERC RE Regulations, 2020 seek to provide the project developers option to use two RE technologies as Hybrid Project in order to optimise the use of resources. It also provides optimal and efficient utilization of transmission infrastructure and better grid stability by reducing the variability in daily and seasonal renewable power generation. Renewable Hybrid Energy Projects can also be seen as alternative for short term power purchase requirement. Regarding Wind Solar Hybrid, MNRE notified National Wind Solar-Hybrid Policy in May 2018. The policy defines various aspects of Hybrid projects. Considering the increasing capacity of RE Hybrid Projects, the regulatory framework is required to be defined for such projects. The issues related to Hybrid projects are discussed as under:

5.9.2 Definition and Eligibility Criteria

Regarding the RE Hybrid projects, the existing RE Tariff Regulations, 2017 provide for determination of Project Specific Tariff for hybrid projects including renewable–

renewable or renewable–conventional sources, for which renewable technology is approved by MNRE. In the prevailing Regulations, hybrid projects include renewable-conventional sources. However, it is proposed that Renewable Energy Projects and Conventional projects shall be treated separately. The tariff for Conventional sources is determined as per Central Electricity Regulatory Commission (Terms and Conditions of Tariff) Regulations, 2019. However, Tariff for RE Projects shall be determined under these Regulations. In case both RE projects and Conventional projects are installed and integrated at same point of interconnection, energy accounting for both projects shall be made separately with appropriate metering arrangement.

In view of the above, the Commission, in the Draft CERC RE Tariff Regulations, 2020, proposes to consider Hybrid Projects as combination of renewable-renewable sources integrated at the same point of interconnection.

Further, sizing of the plant depends on the resource availability. Combination of different RE technologies with appropriate sizing will lead to optimal utilisation of existing network.

It is noted that MNRE stipulates that a Wind-Solar plant will be recognized as hybrid plant if the rated power capacity of one resource is at least 25% of the rated power capacity of other resource. However, in case of other RE Hybrid projects e.g., small hydro and Solar PV, the 25% of rated capacity for Solar would be relatively lower. Since, it is minimum sizing criteria, the additional capacity of Solar can be installed.

In view of the above, the Commission proposes that RE projects shall be recognised as Hybrid Projects only if the rated capacity of one renewable energy technology is at least 25% of the rated capacity of other renewable energy technology(ies) and they operate at the same point of interconnection.

As discussed in earlier Section, the floating solar projects may be installed with the existing sites of Small Hydro projects. The usage of water body of Small Hydro projects will give an added benefit. Also, the existing electrical infrastructure can be used for evacuation of power from Floating Solar Plant. In light of foregoing, it is proposed that if the interconnection point of the both projects are different then both

projects are to be treated separately. However, if the interconnection point is the same, then the principles applicable for Renewable Hybrid Energy Projects shall be applicable in such case.

5.9.3 Capacity Utilisation Factor

The RE technologies used for Hybrid projects have different CUFs. The CUF for individual RE technology has been discussed in earlier Section. This CUF shall be considered as ceiling norm. The effective CUF of the RE Hybrid Plant shall be considered based on minimum CUF and rated power capacity of each technology. It is also noted that CUF of the Hybrid Plant shall be measured at interconnection point. In case of Wind Solar Hybrid Project, the minimum CUF has been stipulated as 30%. However, higher CUF can be achieved with the other RE technologies.

Comparative analysis of recent Hybrid Project Tenders has been done to analyse the trend of the Capacity Utilisation Factor.

Table 51– Comparison of CUF for Renewable Hybrid Energy projects

Date of Issuance	Details of the Project	CUF
22-06-2018	2500 MW ISTS-Connected Wind-Solar Hybrid Power Projects (Tranche-I)	40%
30-06-2018	ISTS-connected 2500 MW Wind-Solar Hybrid Power Projects	40%
22-06-2018	ISTS-connected 1200 MW Wind-Solar Hybrid Power Projects in India	40%
08-03-2019	1200 MW ISTS-connected Wind-Solar Hybrid Power Projects in India (Tranche-II)	30%
14-01-2020	1200 MW ISTS-connected Wind-Solar Hybrid Power Projects in India (Tranche-III)	30%
01-08-2019	RfS for Selection of Project Developers for setting up of 1200 MW ISTS-Connected RE Projects with assured Peak Power Supply in India (ISTS-VII)	35%

Further, as per the MNRE guidelines for Tariff Based Competitive Bidding process for procurement of power from grid connected wind solar hybrid project, the declared annual CUF shall not be less than 30%.

In the view of the above, it is proposed that minimum CUF for Renewable Hybrid Energy project shall be 30%. The CUF of the project shall be measured at

interconnection point. For computation of CUF, the rated capacity of project shall be considered in proportion to rated capacity of each Renewable Technology and applicable CUF for such RE Technology. The CUF for each technology may also be measured. However, any underachievement in CUF of particular technology in Hybrid Plant shall be ignored, if the Renewable Hybrid Energy project has achieved the minimum CUF.

5.10 PARAMETERS FOR RENEWABLE ENERGY WITH STORAGE PROJECT

5.10.1 **Overview**

The generation from RE technologies has been increasing. Large scale Renewable Energy integration with grid has significant challenges, which are both technical and economic in nature. The intermittent generation from Renewable sources due to seasonal weather fluctuations introduces uncertainty in the generation trend.

On 4th January 2017, CERC issued a Staff Paper on Introduction of Electricity Storage System (ESS) in India. This Paper covers the probable uses of storage technologies, operational framework, tariff and other related aspects. Energy Storage System (ESS) is envisaged for optimal utilization of the available generation, shifting of generation at the time when it is required, and utilization of the RE generator for longer period. At present, there are various uncertainties on practical use, applications and the governing market rules for ESS technologies. A well-established policy and regulatory framework at this infancy stage may channelize the investment in this segment of the power sector. The developed countries have already set up several pilot projects. However, in India, at present, there are few projects running based on non-traditional storage technologies.

The grid level applications of Energy storage system include optimization of generation, controlling intermittent generation from RE sources, reliable operation of power system operation, minimizing the deviation from scheduled dispatch or drawl, storage of excess generation of grid, and ancillary services.

ESS can provide a range of services to the electric grid and can be positioned based on their cost and performance. The only electricity storage technology that has been traditionally adopted is pumpstorage hydropower. Storage facilities can be designed with non-traditional technologies such as large number of Electrochemical Battery Cells, Flywheels and Compressed Air Energy Storage.The generic technical parameters about various ESS technologies are as follows:

Table 52–Technical Parameters of various ESS Technologies

Type of Storage	Net Energy Yield	Discharge Capacity	Range of Capacity
Pumped Storage	75-80%	6-10 hours	250-1000 MW
Electrochemical Battery	60-75%	4-5 hours	100-200 MW
Flywheel	80-90%	¼ hours	10-20 MW
Compressed Air	73-80%	8-20 hours	0-180 MW

Considering the increasing need of storage facility in the near future, the regulatory framework is required to be defined for such projects.

Accordingly, in the present draft RE Tariff Regulations, 2020, the Commission intends to propose the regulatory framework to promote use of ESS along with Renewable Energy project. Accoringly, various aspects of RE projects combined with storage technologies viz Battery Storage and Pumped Storage have been discussed in the draft RE Regulations.

5.10.2 **Definition and Eligible Storage Technologies**

In storage facility, the RE Generator can exercise the option for selecting any storage facility for balancing the generation from project. Such balancing of generation can be for Round the Clock basis or for selected time periods. It is intended that ESS and RE projected shall be connected at the same inter-connection point and energy generated from RE project shall be used as input to Storage. Further, it is noted that Hybrid Policy envisages the use of Storage along with Hybrid Project. Hence, the combination of Renewable Hybrid Energy project and Storage has also been considered as Renewable Energy with Storage Project.

In view of the above, the Commission, in the Draft CERC RE Tariff Regulations, 2020, proposes to consider RE with Stoage projects as combination of renewable including hybrid projects that combines with ESS to use partly or fully renewable

energy generated from such project to store and connected at the same point of interconnection.

5.10.3 **Capital Cost**

The capital cost of RE woth Storage project includes the capital cost of RE project, capital cost of Storage and other common infrastrucuture. The capital of RE project has been discussed in earlier Section. At such nascent stage, the capital cost of storage cannot be benchmarked. Also, the configuration of storage is depend of RE technologies and applications. Hence, it is proposed to determine the cost of RE with storage project on project specific basis. The capital cost of RE with Storage project shall be determined considering the prevailing market trends.

Similarly, it is also proposed to determine only project specific O&M Expenses considering the prevailing market trends.

5.10.4 **Storage Efficiency and Tariff framework**

As discussed earlier, pumpstorage hydropower is only electricity storage technology which has been traditionally adopted. As regards Pumped Storage, energy produced by solar power or base load stations during off peak hours is stored through Pumped storage hydroelectric power stations. Further, the energy generated from the water stored in the dams or reservoirs can be used to meet energy needs during peak demand seasons.Lithium-ion batteries are by far the most popular battery storage option today and control more than 90 percent of the global grid battery storage market. Compared to other battery options, lithium-ion batteries have high energy density and are lightweight.

Energy Storage can be conceived as purchase from RE which is used for storage purposes and the sale of such stored energy with fixed and variable charges of the storage system is to be recovered through supply of energy. Thus, cost of stored energy supplied to Grid is nothing but the summation of cost of energy to be stored at project specific Tariff and cost of storage facility. The efficiency of storage facility is important.

The cost of stored energy is dependent on cost of power supplied for storage, efficiency of storage and cost of storage facility. For storage of RE energy in captive / shared hydro station by conservation of water in dam and retrieval of energy later, the operational cost will not change, and energy retrieval will be same as energy

conserved less transmission losses. Also, the cost of stored energy depends on amount of energy stored into storage facility. This means that the sizing of storage facility also affects the output from RE plus Storage Projects. Hence, the Commission intends to provide norms for Storage efficiency. However, the sizing of storage shall be decided to optimise the energy output and balancing the generation from project. Efficiency of storage component of RE with Storage project shall be measured as ratio of output energy received from storage and input energy supplied to the storage component of such project, on annual basis.

In view of the above, it is proposed to specify norms for Storage efficiency as 75% for Pumped Storage and 80% for Battery Storage. Also, the project specific tariff is proposed to be determined for RE with Storage Project.