

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, 2024

February, 2024

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LIST OF ABBREVIATIONS

BERC	Bihar Electricity Regulatory Commission
BSE	Bombay Stock Exchange
CAPM	Capital Asset Pricing Model
CERC	Central Electricity Regulatory Commission
COD	Commercial Operation Date
CPI	Consumer Price Index
CSERC	Chhattisgarh State Electricity Regulatory Commission
CUF	Capacity Utilisation Factor
ERCs	Electricity Regulatory Commissions
GCV	Gross Calorific Value
GERC	Gujarat Electricity Regulatory Commission
HERC	Haryana Electricity Regulatory Commission
HPERC	Himachal Pradesh Electricity Regulatory Commission
IDC	Interest During Construction
IREDA	Indian Renewable Energy Development Agency
JERC	Joint Electricity Regulatory Commission
KERC	Karnataka Electricity Regulatory Commission
Kg	Kilogram
kWh	Kilowatt Hour
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
MOHUA	Ministry of Housing and Urban Affairs
MSW	Municipal Solid Waste
O&M	Operation & Maintenance
PFC	Power Finance Corporation Limited
PLF	Plant Load Factor
PLR	Prime Lending Rate
PPA	Power Purchase Agreement
PSERC	Punjab State Electricity Regulatory Commission
RDF	Refuse Derived Fuel
REC	Rural Electrification Corporation
RERC	Rajasthan Electricity Regulatory Commission
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

The 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”). The Act confers upon the CERC the functions of regulating the tariff of the generating companies owned or controlled by the Central Government and generating companies having a composite scheme for generation and sale of electricity in more than one State, regulating inter-State transmission of electricity and determining the tariff for inter-State transmission of electricity.

The Act mandates the Central Commission to specify the terms and conditions for determination of tariff under sub-clause (s) of Clause (2) of Section 178 of the Act read with Section 61 of the Act. The Commission, while determining the tariff, considers the objectives of safeguarding consumers’ interests as well as ensuring the 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 State Electricity Regulatory Commission (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 follows:

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	April 17, 2017	2017-2020
Central Electricity Regulatory Commission (Terms and Conditions for Tariff determination from Renewable Energy Sources) Regulations, 2020	June 23, 2020	2020-2024

After notification of the CERC RE Tariff Regulations, 2020, CERC issued three (3) Orders on the determination of the levelized generic tariff for FY 2020-21, FY 2021-22 and FY 2022-23 on July 21, 2020; March 31, 2021; and November 7, 2022, respectively.

The Commission notified the Central Electricity Regulatory Commission (Terms and Conditions for Tariff determination from Renewable Energy Sources) Regulations, 2020 on June 23, 2020 effective from July 1, 2020 to March 31, 2023. Subsequently, the Commission, through separate notifications, extended the applicability of the CERC RE Tariff Regulations, 2020 for an additional period of one (1) year i.e., from April 1, 2023 up to March 31, 2024.

Accordingly, the next Control Period shall commence from April 1, 2024. The Commission has prepared this Draft Regulation [Draft CERC (Terms and Conditions for Tariff Determination from Renewable Energy Sources) Regulations, 2024] for laying down the terms and conditions for tariffs for generation from renewable energy sources for the next Control Period.

During the Control Period 2020–2023, 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) has reduced. The total installed capacity of grid-interactive renewable energy (excluding large hydro) in India stands at 133,886 MW as on December 31, 2023, with the largest share of solar energy at 73,318 MW, followed by wind energy at 44,736 MW. The share of grid-interactive renewable capacity (excluding large hydro) in the total generation installed capacity mix is around 31.3%. As of 2023, India is ranked 4th in wind power capacity and 5th in solar power capacity, as per the International Renewable Energy Agency – Renewable capacity statistics 2023.

The Commission has been determining the tariff for grid interactive power projects based on renewable energy sources through a 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 the Control Period commencing on April 1, 2024.

This Explanatory Memorandum is being issued with the intent of explaining the rationale behind the Draft CERC (Terms and Conditions for Tariff Determination from Renewable Energy Sources) Regulations, 2024 (“Draft CERC RE Tariff Regulations, 2024”).

While preparing the draft CERC RE Tariff Regulations, 2024 data has been obtained from the Indian Renewable Energy Development Agency (IREDA) and Solar Energy Corporation of India Limited (SECI) 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
Wind	16

Technology	No. of Projects for which data was received
Small Hydro Projects	7
Solar	35
Biomass Gasifier	1
Hybrid	12
MSW Projects	3
RE with Storage	4
Total	78

The information received from the above agencies has been analysed and duly considered while framing the draft CERC RE Tariff Regulations, 2024. Further, the Commission also held meetings with Associations of MSW based developers and Biomass Associations and on the performance and operative parameters of such projects. The concerned officers of the Ministry of Housing and Urban Affairs were also consulted to gain insight into the policies of the Government on the promotion of Waste to Energy plants so that the same could be duly factored in by CERC while formulating the Regulations.

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 a composite scheme for the sale of electricity to more than one State. Accordingly, it is proposed that the CERC RE Tariff Regulations, 2024, shall be applicable in all cases where the tariff for a generating station or a unit thereof is based on renewable sources of energy, and is covered under Sections 79(1) (a) & (b) read with Section 62 of the Act.

Section 6.4 (3) of the 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 projects 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 projects, 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 the RE technologies meeting specific eligibility criteria. The Commission proposes to retain the Eligibility Criteria as specified in RE Tariff Regulations, 2020 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.

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

It is noted that MNRE stipulates that a Wind-Solar plant will be recognized as a hybrid plant if the rated power capacity of one resource is at least 33% of the total capacity of the RE hybrid energy project.

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 33% of the total capacity of the RE hybrid energy project and they operate at the same point of interconnection.

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 tariffs for a specific RE technology.
- b) Review and analysis of the actual project cost details and information about performance parameters in respect of the existing RE projects based on information received from financial institutions, public agencies, and other State Electricity Regulatory Commissions.
- c) Feedback/views/comments of the various stakeholders to seek insights on operative parameters of RE Technologies
- d) Feedback/views/comments on RE Technologies from the concerned Ministries of the Central Government such as MNRE, MOHUA etc. .

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

As per the RE Tariff Regulations, 2020, the current Control Period or Review Period for determining the tariff for renewable energy sources is three (3) years. The Commission has noted that this duration is in line with the majority of the State Electricity Regulatory Commissions (SERCs) across the country. However, some states like Uttarakhand and Rajasthan have opted for different Control Periods for different renewable energy technologies, depending on their level of maturity and adoption. The Commission acknowledges that the renewable energy sector is undergoing rapid changes in terms of technology, cost, and market conditions, which are reflected in the lower tariffs discovered through competitive bidding processes. Therefore, the Commission intends to maintain the flexibility and responsiveness of the tariff determination mechanism by retaining the duration of Control Period of three (3) years for the next cycle, i.e., from FY 2024-25 (1st April 2024) to FY 2026-27.

3.2. TARIFF PERIOD

The RE Tariff Regulations 2020 define the Tariff Period as the duration for which the tariff determined by the Commission is applicable to a Renewable Energy power project. The Tariff Period is equal to the Useful life of the project, which is the expected operational life of the project as per the norms of the Commission. The Useful life varies depending on the type of renewable energy technology used in the project. The following table summarizes the values of Useful life and Tariff Period for different Renewable Energy technologies:

Table 3: Useful Life of RE Technologies

RE Technology	Useful life (in years)
Small Hydro	40
Onshore Wind	25
Solar PV/Thermal/Floating	25
Biomass based with Rankine cycle technology	25
Biomass Gasifier	25
Non fossil-fuel co-generation	25
Biogas based	25
Municipal Solid Waste and Refuse Derived Fuel based	20

The Commission intends to maintain the existing provisions of Tariff Period equal to the useful life of RE technology for the next cycle of tariff determination. This will ensure that the project developers can recover their investment and earn reasonable returns from the projects over their entire operational life. This will also facilitate the discovery of competitive and realistic tariffs through the

bidding process, as the project developers can factor in the benefits of long-term tariff stability and pass them on to end consumers.

The RE Tariff Regulations 2020 specified 25 years as useful life for projects based on Municipal Solid Waste and Refused Derived Fuel (RDF). However, the majority of SERCs have determined the useful life of WTE projects to be 20 years, and the same opinion was shared by the MOHUA based on the inputs received from WTE developers. In view of this, the Commission proposes to specify the useful life for MSW and RDF based Projects as 20 years.

For Renewable Hybrid Energy projects, which combine two or more renewable energy technologies, the Commission proposes that the Useful life of the project be the minimum of the Useful life of the individual renewable energy technologies involved in the project. For example, if a project combines Wind and Solar PV technologies, the Useful life of the project shall be 25 years, which is the minimum of the Useful life of Wind (25 years) and Solar PV (25 years) technologies. The same value shall be considered as the Tariff Period for the project.

For renewable energy with storage projects, which integrate renewable energy generation with energy storage systems, the Commission proposes that the Useful life of the project shall be the same as the Useful life of the project without the storage component. For example, if a project integrates solar PV generation with battery storage, the Useful life of the project shall be 25 years, which is the same as the Useful life of Solar PV technology. The same value shall be considered as the Tariff Period for the project.

For Floating Solar PV projects, which deploy Solar PV panels on floating structures over water bodies, the Commission proposes to keep the Tariff Period of 25 years, as the technology of Floating Solar is similar to that of Solar PV technology.

3.3. GENERIC TARIFF AND PROJECT SPECIFIC TARIFF

The RE Tariff Regulations, 2020, provide the framework for determining the Project Specific Tariff for various Renewable Energy (RE) technologies. The Project Specific Tariff is the tariff that is applicable to a specific RE project based on its unique characteristics and parameters.

The Commission has observed that most of the SERCs are still following the practice of determining the RE Generic Tariff for most of the RE technologies. The RE Generic Tariff is the tariff that is applicable to a category of RE projects based on certain common assumptions and benchmarks. However, some states like Himachal Pradesh and Maharashtra have adopted a different approach and have specified the RE Generic Tariff for only a few RE technologies.

Earlier, in the RE Tariff Regulations 2020, the Commission adopted a project-specific tariff approach for Municipal Solid Waste (MSW) projects, which has also been embraced by some SERCs, like MERC, in its Tariff Order dated 22nd March 2021. However, other SERCs such as the Tamil Nadu State ERC (TNERC), have opted for a Generic Tariff model encompassing all technologies related to MSW. Telangana State ERC (TSERC) has implemented a Generic Tariff solely for RDF technology, while KERC has adopted a Generic Tariff approach across the board.

Presently, the utilization of MSW for the establishment of MSW to energy projects remains limited, with Delhi and Telangana having the highest capacities at 52 MW and 49 MW, respectively. The overall capacity for such endeavours in India stands at only 170 MW.

It is worthwhile to mention here that the efficient management of MSW remains an enduring challenge for Urban Local Bodies (ULBs) nationwide. It is imperative to implement a comprehensive strategy to improve the collection and proper disposal of MSW. One promising avenue involves harnessing MSW for electricity generation. Despite its potential as a renewable energy source, systematic, large-scale exploitation of MSW remains largely untapped. Utilizing MSW as a fuel for electricity generation can enhance collection efficiency while promoting environmentally conscious waste disposal practices.

According to the amended Tariff Policy, the distribution licensees are mandated to procure 100% of the power generated from all Waste-to-Energy plants in the State. This procurement is to occur at tariffs determined by the Appropriate Commission under Section 62 of the Act. This directive aims to facilitate the fulfilment of the Swachh Bharat Mission's objectives concerning waste disposal alongside electricity generation. Hence, the Commission is of the opinion that to foster initiatives related to efficient management of MSW and utilizing MSW for electricity generation, it is necessary to establish a generic tariff approach for waste to energy technologies namely, MSW and RDF.

Hence, the Commission proposes to introduce a generic tariff for MSW in addition to the following RE technologies:

- Small Hydro Power Projects
- Biomass Power Projects with Rankine Cycle technology
- MSW and RDF based projects
- Non-fossil fuel-based cogeneration Plants
- Biomass Gasifier based power projects
- Biogas based power projects

The Commission believes that the determination of Generic Tariff for these technologies is appropriate as they have relatively stable and predictable cost and performance parameters. The Commission also proposes to continue with the determination of Project Specific Tariff for the following RE technologies;

- Solar PV projects, Solar Thermal projects and Floating Solar projects
- Wind Power Projects (including on-shore and off-shore)
- Biomass Gasifier and Biogas based projects- if project developer opts for project specific tariff
- Municipal Solid waste and Refused Derived Fuel based power projects – if project developer opts for project specific tariff
- Renewable Hybrid Energy Projects
- Renewable energy with storage projects

The Commission considers that the determination of the Project Specific Tariff for the aforesaid technologies is necessary as they have dynamic and variable cost and performance parameters that depend on site-specific and project-specific factors. The Commission aims to ensure that the tariff determination mechanism is fair, transparent, and reflective of market realities.

3.4. PETITION FOR PROCEEDINGS FOR DETERMINATION OF TARIFF

Regulation 8 of the 2020 RE Tariff Regulations specifies that the Commission shall determine the generic tariff on the basis of a suo-motu petition one month in advance at the beginning of each year of the Control Period. In the proposed draft, the Commission proposes to determine the generic tariff on the basis of the suo-motu petition prior to the commencement of the tariff for each year of the Control Period. However, as the first year of the Control Period is from 1.4.2024, the Commission proposes to determine the Generic Tariff for the period from 1.4.2024 to 31.3.2025 after the issuance of these regulations.

The list of documents to be submitted with the petition for the determination of a project specific tariff is 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 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.

The Petition for a project specific tariff should include the list of documents specified in the draft Regulations, such as the project details, the cost components, the performance parameters, the financial statements, etc. In addition, the Petition should also include the consent from the Beneficiary, who is the entity that will purchase the power from the RE project at the project specific tariff determined by the Commission. The Commission considers that this will ensure that the beneficiary is willing to procure power at the project specific tariff and avoid any dispute or delay in the power purchase agreement.

The project specific tariff for RE technologies that are procured through competitive bidding, such as Wind and Solar, should be reasonable. The Commission expects that the project developers will justify the need for a project specific tariff and provide the relevant evidence and analysis to support their claim. The Commission will evaluate the petition for a project specific tariff based on the merits of the case and the prevailing market conditions. The Commission aims to ensure that the project specific tariff is fair, transparent, and reflective of market realities.

3.5. TARIFF STRUCTURE AND TARIFF DESIGN

The Tariff structure and design as per the existing provisions in the 2020 RE Tariff Regulations 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 levelled 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 levelled tariff computation, the discount factor equivalent to Post Tax weighted average cost of capital shall be considered.

(3) The above principles shall also apply for project specific tariff. “

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, i.e. fixed cost component and fuel cost component, is specified. The Commission considers that for RE technologies involving no fuel cost component, a single part tariff structure is the simplest method to operationalize considering the number of projects and unit size of each project. Also, the same has been in practice for RE technologies for a long time.

The Commission proposes to continue with the same tariff structure for the next Control Period (FY 2024-2027).

While specifying the tariff for all RE Technologies, the levelized tariff approach is a balanced approach amongst various tariff determination mechanisms like front loaded tariffs, back loaded tariffs, etc. The Commission has also considered Levelized tariff with an appropriate discount rate representing the 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 post-tax Weighted Average Cost of Capital (WACC). The WACC was computed as under:

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 Levelized tariff for the useful life of the renewable energy project.

3.6. TREATMENT FOR OVER-GENERATION

The Ministry of Power has issued the revised Guidelines for Tariff Based Competitive Bidding Process for Procurement Power from Grid Connected Wind Power Projects by resolution dated July 26, 2023. The revised Guidelines state that the excess power procured by the beneficiary shall be at the PPA tariff. The Commission noted that the Ministry of Power has made a similar provision in the Guidelines

for a tariff based competitive bidding process for the procurement of power from grid connected solar PV power projects and wind solar hybrid power projects. The relevant provisions of guidelines for wind power projects are as follows:

“6.2.1 (b) In case of availability of energy more than the maximum CUF specified, WPG will be free to sell it to any other entity provided first right of refusal will vest with the Procurer(s). The Procurer(s) shall provide refusal within 15 days from the receipts of the request, beyond which it would be considered as deemed refusal. In case the Procurer purchases the excess generation, the same may be done at the PPA tariff, and provision to 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, 2024, on above lines.

4. FINANCIAL PRINCIPLES

4.1. DEBT – EQUITY RATIO

As per the existing provisions in the RE Tariff Regulations, 2020, Debt-Equity ratio is specified as follows:

(1) “For determination of generic tariff and project specific tariff, the debt equity ratio shall be considered as 70:30.

Provided that, for project specific tariff, where the equity actually deployed is more than 30% of the capital cost, equity in excess of 30% shall be treated as normative loan;

Provided further that for project specific tariff where equity actually deployed is less than 30% of the capital cost, the actual equity shall be considered for determination of tariff;

Provided also that the equity invested in foreign currency shall be designated in Indian rupees on the date of each investment;

Provided also that debt equity ratio shall be considered after deducting the amount of grant or capital subsidy received for the project for arriving at the amount of debt and equity.

Explanation – The premium, if any, raised by the generating company, while issuing share capital and investment of internal resources created out of its free reserve, for the funding of the project, shall be reckoned as paid up capital for the purpose of computing return on equity, only if such premium amount and internal resources are actually utilised for meeting the capital expenditure of the renewable energy project.

(2) The project developer shall submit the resolution of the Board of the company or approval of the competent authority in other cases regarding infusion of funds from internal resources in support of the utilization made or proposed to be made to meet the capital expenditure of the renewable energy project. “

In order to assess the trend in Debt-Equity ratios across different renewable energy projects, a comparative analysis of the debt-equity ratios utilized by various State Electricity Regulatory Commissions (SERCs) was conducted. The Commission noted that a majority of the SERCs embraced a normative Debt-Equity ratio of 70:30. A summary table outlining the analysis of the actual Debt-Equity ratios of Renewable Energy projects funded over the past three years is summarised in the table below:

Table 4 Actual Debt Equity ratio of projects

Technology	No. of Projects	Funding Pattern
Solar	19	Maximum D-E ratio - 75:25 Minimum D-E ratio - 62:38 10 projects out of total 19 projects have been funded with debt equal to 70% of Project cost
SHP	7	Maximum D-E ratio - 70:30 Minimum D-E ratio - 67:33 6 projects out of total 7 projects have been funded with debt equal to 70% of Project cost
Wind	1	D-E Ratio - 75:25
Solar - Wind Hybrid	1	D-E Ratio - 70:30
WTE	3	Maximum D-E ratio - 70:30 Minimum D-E ratio - 63:37
Biomass Gasifier	1	D-E Ratio - 58:42

The Commission observes that most of the RE projects have followed the normative debt-equity ratio of 70:30. Accordingly, the Commission recommends maintaining the current normative Debt-Equity ratio of 70:30.

Moreover, the Commission acknowledges that in cases of project specific tariffs, some projects may have opted for capital subsidies. As such, it is proposed that the Debt-Equity ratio be calculated after deducting the capital subsidy from the project’s overall capital cost.

4.2. LOAN TENURE AND INTEREST ON LOAN

4.2.1. LOAN TENURE

loan tenure is the key component of tariff determination. As per the existing provisions in the RE Tariff Regulations, 2020, loan tenure is as follows:

“Loan Tenure: - For determination of generic tariff and project specific tariff, loan tenure of 15 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

Particulars	PFC	REC	IREDA
Tenor of Loan	The max repayment period up to 15 Years for all RE projects except Hydro which is up to 20 years	The repayment period (after moratorium period) for RE Projects shall be 15 years while may be extended of 25 years' subject to PPA availability.	The repayment periods shall be maximum of 25 years in case of Wind/Solar/Hydro Projects or 80% of balance PPA with right to call option after 15 years.

The Commission has observed that PFC/REC financial institutions provide loans for 15 years for all RE projects, except for Small Hydro Projects, which can get loans for up to 20 years. On the other hand, IREDA provides loans for up to 25 years for all RE projects, with a right to call option after 15 years. The Commission has analysed the loan tenure data from PFC and IREDA and found the actual loan durations for projects financed in the last three (3) years, as shown in the 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	0	0	1
Small Hydro Projects	0	0	3	4
Solar	0	3	1	11
Wind Solar Hybrid	0	0	0	1
MSW Projects	0	0	3	0

The Commission analysed the data from various projects and observed that the loan tenures for all RE projects ranged from 10 to 21 years. The Commission decided that it is appropriate to keep the loan tenure for all Renewable Energy (RE) projects at 15 years, in line with the current market conditions. Hence, the Commission proposes to maintain the loan tenure for all Renewable Energy (RE) projects at 15 years for the next control period.

4.2.2. INTEREST RATE

The existing provisions in the RE Tariff Regulations, 2020, regarding interest rates are as follows:

“Interest on Loan: -

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. For project specific tariff, the normative loan outstanding as on April 1st of every year shall be worked out by deducting the cumulative repayment up to 31st March 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 project developer, 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. “

To evaluate the current market conditions, a summary of the existing terms set by REC, PFC, and IREDA is presented in the following Table for analysis:

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

Particulars	PFC	REC	IREDA
Rate of Interest	RE projects except SHP and Biomass & Waste to Energy (WTE) – 8.95% to 9.70% SHP and Biomass & (WTE) – 50 bps higher than wind solar	RE projects except SHP and Biomass & Waste to Energy (WTE) – 8.95% to 9.70% SHP and Biomass & (WTE) – 50 bps higher than wind solar	RE projects except SHP and Biomass & (WTE) – 8.90% to 9.90% SHP – 9.40% to 10.40%; Biomass & (WTE) – 9.45% to 10.45%

The Commission noted that the current interest rates offered by PFC, REC, and IREDA fall within the range of 9.45% - 10.45% for Biomass and WTE projects, and within 8.90% to 10.40% for other technological projects.

Taking this into account, the Commission proposes to maintain the current interest rate provisions outlined in the 2020 RE Tariff Regulations in the Draft CERC RE Tariff Regulations, 2024.

4.3. DEPRECIATION

The existing provisions in the RE Tariff Regulations, 2020 regarding Depreciation are as follows:

“15. Depreciation: -

(1). The value base for the purpose of depreciation shall be the capital cost of the project admitted by the Commission. The salvage value of the project shall be considered as 10% and depreciation shall be allowed up to maximum of 90% of the capital cost of the project:

Provided that, no depreciation shall be allowed to the extent of grant or capital subsidy received for the project.

(2). Depreciation rate of 4.67% per annum shall be considered for the first 15 years and remaining depreciation shall be evenly spread during remaining Useful Life of the project.

(3). Depreciation shall be computed from the first year of commercial operation:

Provided that, for determination of project specific tariff, in case of commercial operation of the project for part of the year, depreciation shall be computed on pro rata basis.

Depreciation is allocated to facilitate debt repayment, allowing for the spreading of the first 70% of the Project’s depreciation over the loan tenure (15 years). The remaining depreciation at the end of the loan tenure can be distributed over the remaining life of the Project.

The proposed approach, termed the ‘Differential Depreciation Approach,’ involves utilizing the Straight-Line Method to compute depreciation over the loan tenure and beyond. The Commission suggests maintaining a depreciation rate of 4.67% per annum for the initial 15 years. Subsequently, the residual depreciation will be allocated across the remaining useful life of the RE projects, taking into account the project’s salvage value set at 10% of the project cost.

4.4. RETURN ON EQUITY (ROE)

Return on equity (RoE) is one of the key components of tariff determination. As per the existing provisions in the 2020 RE Tariff Regulations, the RoE is specified as follows:

- “1. The value base for the equity shall be determined under Regulation 13.*
- 2. The normative Return on Equity shall be 14%. The normative Return on Equity shall be grossed up by the latest available notified Minimum Alternate Tax (MAT) rate for the first 20 years of the Tariff Period and by the latest available notified Corporate Tax rate for the remaining Tariff Period.”*

To ascertain the recent trajectory of Return on Equity (RoE) in diverse Renewable Energy initiatives, a comprehensive assessment of Return on Equity (RoE) benchmarks across multiple SERCs was conducted. The Commission’s analysis revealed that a majority of SERCs have stipulated the Return on Equity within a spectrum of 14% to 16%.

Table 8 Comparison of Rate of Return on Equity for SERCs

SERC	Rate of Return of Equity
MERC	14% grossed up with the tax rate equivalent to MAT rate as on 1 st 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 11 th year onwards.
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.

SERC	Rate of Return of Equity
KERC	16% grossed up with the tax rate equivalent to MAT rate
TNERC	14% post-tax RoE
TSERC	16% pre-tax to be grossed up with actual tax rate
CSERC	14% grossed up with the tax rate equivalent to MAT rate for the useful life of the project.
HPERC	The normative return on Equity shall be 14% per annum on post-tax basis and shall be adjusted on account of taxes as applicable.

The cost of capital is the minimum rate of return that the project developers require to invest in renewable energy (RE) projects. The cost of capital can be estimated using various methods, such as the Gordon Dividend Model (GDM), the Earnings Capitalization Model (ECM), the Comparable Companies Analysis (CCA), the Bond Yield Plus Risk Premium Model (BYPRP), and the Capital Asset Pricing Model (CAPM). However, not all methods are suitable for the RE sector, as they have different assumptions and limitations.

The Commission has adopted the Capital Asset Price Model (CAPM) model to determine the cost of equity in the 2020 RE Tariff Regulations. The CAPM model, accepted by various regulators internationally, accounts for the expected risk premium for the market over the risk-free rate. In order to arrive at the risk-free rate, the Commission has reviewed historical trends of various benchmark rates, such as the Bank Rate, SBI PLR, Deposit Rates and Government Securities rate. For calculating the market risk premium, market return over a historical period has been considered.

The Commission has considered a risk-free rate derived from the average yield on 10-year government securities (referenced from RBI Notification) for the previous financial year. In the calculation of the Market Risk Premium (Rm), the Commission has determined the market's expected return by leveraging historical returns from the equity market, which serve as a reflection of investor expectations.

Additionally, Beta, which serves as a metric for the volatility of a security relative to the overall market, has been incorporated into the current assessment.

The Commission has calculated the cost of equity through the CAPM model 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., 7.35%;

Rm = average return of BSE Sensex, i.e., 18.04%;

Beta = measure of volatility of Renewable Energy companies security in comparison to market as a whole, i.e., around 0.63

With this approach the Cost of equity works out to be around 14.06 % i.e., ~14%.

Therefore, the Commission proposes to continue with the prevailing rate of RoE as 14% and grossing up ROE with the MAT rate for the first 20 years of the project and by the latest notified Corporate Tax rate for the remaining Tariff Period while determining the tariff.

It is imperative to highlight that, in contrast to certain other renewable energy (RE) technologies, Small Hydro Projects (SHPs) typically have a longer gestation period. The elongated gestation period in small hydro compared to other RE technologies signifies a substantial investment timeframe with delayed revenue realization, thereby elevating inherent risks. As such, the Commission proposes a 14.50% Return on Equity for SHP projects, which is 0.50% higher than what is proposed for other RE projects.

4.5. INTEREST ON WORKING CAPITAL

The existing provisions in the 2020 RE Tariff Regulations are as follows:

“(1) The Working Capital requirement in respect of wind power projects, small hydro projects, solar PV power projects, floating solar projects, solar thermal power projects, and renewable energy with storage projects shall be computed in accordance with the following:

- a) Operation & Maintenance expenses for one month;*
- b) Receivables equivalent to 45 days of tariff for sale of electricity calculated on normative Capacity Utilisation Factor or Plant Load Factor, as the case may be; and*
- c) Maintenance spares equivalent to 15% of Operation and Maintenance expenses.*

(2) The Working Capital requirement in respect of biomass power projects with Rankine Cycle technology, biogas power projects, biomass gasifier based power projects, non-fossil fuel based co-generation projects, municipal solid waste based power projects and refuse derived fuel based power projects shall be computed in accordance with the following:

- a) Fuel costs for four months equivalent to normative Plant Load Factor;*
- b) Operation & Maintenance expense for one month;*
- c) Receivables equivalent to 45 days of tariff for sale of electricity calculated on the plant load factor; and*
- d) Maintenance spares equivalent to 15% of operation and Maintenance expenses.*

(3) In case of renewable hybrid energy projects, the Working Capital requirement shall be sum of the Working Capital requirement determined as per norms applicable for renewable energy sources, in proportion to their rated capacity in the project.

(4) Interest on Working Capital shall be at interest rate equivalent to the normative interest rate of three hundred and fifty (350) 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.”

The 2020 RE Tariff Regulations provide the framework for determining the tariff for renewable energy (RE) projects. Most of the SERCs are adhering to the same principles as specified in the regulations. The Commission has analysed the prevailing interest rates in the market and found that the interest rates for short term loans (up to 12 months) for the private sector offered by PFC and REC are within the range of 10.40% to 11.40%.

The Commission has proposed the Draft CERC (Terms and Conditions of Tariff) Regulations, 2024, for conventional projects, which state that the interest rate for interest on working capital shall be equal to the one-year marginal cost of lending rate (MCLR) of the State Bank of India plus 325 basis points. The Commission proposes to adopt the same approach in the Draft CERC RE Tariff Regulations, 2024.

4.6. O&M EXPENSES

The 2020 CERC RE Tariff Regulations specify an escalation rate of 3.84% for the determination of O&M Expenses for the second and third years of the Control Period.

The escalation factor for the purpose of normalisation of operation and maintenance expenses is carried out in line with the draft CERC (Terms and Conditions of Tariff) Regulations, 2024. The escalation rate is computed based on the five-year average of WPI for FY 2018-19 to FY 2022-23, which works out to 5.93% per annum, while that of CPI for the same period works out to 5.84% per annum. Considering the 60:40 weightage for WPI and CPI, respectively, the escalation rate works out to 5.89% per annum.

Accordingly, the Commission proposes the following in the Draft CERC RE Tariff Regulations, 2024:

“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 2024-25 under these regulations shall be escalated at the rate of 5.89% per annum for the Tariff Period. ”

4.7. REBATE AND LATE PAYMENT SURCHARGE

The provision for rebates and late payment surcharges as per existing RE Tariff Regulations, 2020 is as follows:

“Rebate

1. For payment of bills of the generating company through revolving and valid letter of credit on presentation or through National Electronic Fund Transfer (NEFT) or Real Time Gross Settlement (RTGS) payment mode within a period of 5 days of presentation of bills, a rebate of 1.5% on bill amount shall be allowed.

Explanation: In case of computation of ‘5 Days’, the number of days shall be counted consecutively without considering any holiday. However, in case the last day or 5th day is official holiday, the 5th day for the purpose of rebate shall be construed as the immediate succeeding working day.

2. Where payments are made on any day after 5 days within a period of one month from date 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 45 days from the date of presentation of bills, a late payment surcharge at the rate of 1.50% per month shall be levied by the generating company.”

The Commission has proposed the Draft CERC (Terms and Conditions of Tariff) Regulations, 2024 for conventional projects, which states that a rebate of 1.50% shall be allowed for payment of bills within a period of 5 days from the date of presentation of bills via a NEFT/RTGS payment mode. The Commission proposes to adopt the same approach in the Draft CERC RE Tariff Regulations, 2024. While, in case of late payment to the generating company beyond a period of 45 days from the date of presentation of bills, the Late Payment Surcharge shall be payable as specified in the Ministry of Power – Electricity (Late Payment Surcharge and Related Matters) Rules, 2022 as amended from time to time.

Accordingly, the Commission proposes the provisions for Rebate and Late Payment Surcharge in the Draft CERC RE Tariff Regulations, 2024:

“Rebate

1. For payment of bills of the generating company through revolving and valid letter of credit on presentation or through National Electronic Fund Transfer (NEFT) or Real Time Gross

Settlement (RTGS) payment mode within a period of 5 days of presentation of bills, a rebate of 1.5% on bill amount shall be allowed.

Explanation: In case of computation of '5 Days', the number of days shall be counted consecutively without considering any holiday. However, in case the last day or 5th day is official holiday, the 5th day for the purpose of rebate shall be construed as the immediate succeeding working day.

2. Where payments are made on any day after 5 days within a period of one month from date 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 45 days from the date of presentation of bills, a late payment surcharge as specified in the Ministry of Power – Electricity (Late Payment Surcharge and Related Matters) Rules, 2022 as amended from time to time shall be levied. "

4.8. SUBSIDY OR INCENTIVE BY CENTRAL/ STATE GOVERNMENT

The existing provision for subsidy or incentive from Central/ State Government as per the existing RE Tariff Regulations, 2020 specifies as under:

"Subsidy or incentive by the Central / State Government

1. The Commission shall take into consideration any incentive or subsidy from the Central or State Government, including accelerated depreciation benefit, availed by the project, 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 and corporate income tax rate as per relevant provisions under Income Tax Act, 1961 as amended from time to time; and

ii) Capitalization of renewable energy projects during second half of the fiscal year.

iii) Per unit benefit shall be derived on levelled basis at discount factor equivalent to weighted average cost of capital."

2. Any grant, subsidy or incentives availed by renewable energy project, which is not considered at time of determination of tariff, shall be deducted by the beneficiary 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.

3. In case the Central or State Government or their agencies provide any generation based incentive, which is specifically over and above the tariff, such incentive shall neither be taken into account while determining the tariff nor be deducted by the beneficiary in subsequent bills raised by the particular Renewable energy project.”

The Commission proposes that it shall take into account subsidies or incentives offered by the Central or State Governments at the time of determining tariff under these regulations. In the case of Project specific tariff, subsidy or incentive are being accounted for. However, in the case of a generic tariff, there may be cases where the project may receive a subsidy or incentive after the determination of tariff, which is not accounted for during the 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.

4.9. STATUTORY CHARGES

The RE Tariff Regulations, 2020 stipulate that the tariff determined shall be exclusive of taxes and duties and shall be allowed as pass through on an actual incurred basis to the generating companies or the licensees. The Commission proposes to retain the provisions regarding the statutory charges as per the RE Tariff regulations 2020.

5. TECHNOLOGY SPECIFIC PARAMETERS

5.1. PARAMETERS FOR WIND POWER PROJECTS

Under this section, parameters such as Capital Cost norm, Capacity Utilization Factor, and O&M Expenses for Wind Power projects have been discussed.

5.1.1. CAPITAL COST

The existing provisions regarding parameters for wind power projects in the RE Tariff Regulations, 2020 are as follows:

“24. Capital Cost

The Commission shall determine only project specific capital cost considering the prevailing market trends.”

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

Table 9 Comparison of Capital Cost of Actual Wind Power Projects

S. No.	Size	No. of Projects	Capital Cost (Rs. Cr./MW)
1	Up to 100 MW	1	7.5
2	101-150 MW	3	6.94-7.1
3	151-200 MW	5	6.9-8.5
4	201 - 300 MW	6	6.7 - 9.1
5	Above 300 MW	1	7.7

Source: Data received from IREDA and SECI

The Commission has analysed the data received from IREDA and SECI, it was observed that the capital costs for different power projects are in the range of Rs. 6.7 Cr./MW to Rs. 9.1 Cr./MW. The variation of the capital cost also depends on the various factors like the location of the plant, the size of the plant, etc.

Table 10 Average Cost of Components of Wind Power Projects

S. No.	Capital Cost Components	Average Cost (Rs. Cr./MW)
1	Nacelle	2.05
2	Hub	0.81
3	Blade	0.90
4	Power Conditioning Units	0.26
5	Hardware + Cable	0.21
6	Tower	1.07
7	Tower Logistics	0.22
8	Cables/ Inter-connects/ Switchgear/ Control Panel/ Monitoring and Control System	0.18

S. No.	Capital Cost Components	Average Cost (Rs. Cr./MW)
9	Power Evacuation Arrangement up to Inter-Connection Point (Cables and Transformers)	0.50
10	Land Acquisition	0.42
11	Civil and General Works	0.53
12	Preliminary and Pre-Operative Expenses including IDC and Contingency	0.51
13	Consultancy Charges	0.14
Total Cost		7.9

Source: Data received from SECI

As most of the wind power projects are coming through a 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)

The existing provisions regarding parameters for wind power projects in the 2020 RE Tariff Regulations are as follows:

“25. Capacity Utilisation Factor

(1) Capacity utilization factor norms for this Control Period shall as follows:

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

(2) The annual mean wind power density specified in sub-regulation (1) above shall be measured at 100-meter hub-height.

(3) Wind power projects shall be classified into particular wind zone site as per MNRE guidelines for wind measurement. Based on validation of wind mast by National Institute of Wind Energy, State Nodal Agency should certify zoning of the proposed wind farm complex.”

Capacity Utilisation Factor (CUF) depends on various site specific parameters like wind speed, wind density, etc., as well as machine specific parameters like hub height, rotor diameter and power curve. Commission has analysed CUF for various SERCs, which varies within 20% to 33% (RERC – 20%, KERC – 33%, MPERC – 23%, TNERC – 29.15%, MERC – 30%).

In the absence of actual data and a review of CUF notified by various SERCs, the Commission proposes to retain the CUF of Wind power projects as specified in the RE Tariff Regulations, 2020.

5.1.3. OPERATION AND MAINTENANCE EXPENSES

The existing provisions regarding parameters for wind power projects in the RE Tariff Regulations, 2020 are as follows:

“26. Operation and Maintenance expenses

The Commission shall determine only project specific O&M expenses considering the prevailing market trends.”

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. 5.75 Lakh/MW to Rs. 12.55 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 through a 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 OFFSHORE WIND PROJECTS

Offshore wind energy, a technology in its early stages, is currently experiencing a rapid development marked by optimization and achieving better economies of scale over the past decade. Innovations across diverse domains such as material science, electrical and electronics engineering, marine technology, meteorology, computer-aided design, and simulations have been instrumental in propelling the industry's growth.

Distinct capital costs are associated with floating floor and fixed-bottom installations, with onshore and offshore transmission systems incurring varying expenses, leading to diverse CAPEX costs. The distance to the evacuation system significantly impacts CAPEX (capital expenditure). While offshore wind energy is a global industry, cost parameters vary across markets due to factors such as technical specifications, geographical location, seabed lease fees, taxation and subsidy regimes, and overhead expenditures.

Despite the increased complexity of projects in the offshore wind energy sector, there has been a notable decline in the capital costs required for such projects. According to the 'Renewable Power Generation Cost in 2021' report by the International Renewable Energy Agency (IRENA), the global average installed cost of offshore wind energy projects decreased by over 41 percent between 2010 and 2021, reducing from USD 4.88 million (INR 36 crore) per MW to USD 2.86 million (INR 21.13 crore) per MW. Various studies conducted reveal tariffs discovered for offshore wind projects over the last 5 years, ranging between ~14.6 INR/kWh to ~3.85 INR/kWh in different countries.

Pilot projects and feasibility studies were conducted in states such as Gujarat, Tamil Nadu, and Maharashtra, showcasing potential zones for exploring the feasibility of offshore wind farms. The Financial Modelling of Offshore Wind in India (FIMOI) report, published in April 2022, highlights a capacity factor (considering wake losses, electrical losses, and planned outages) of 36% for Gujarat and 53% for Tamil Nadu (Zone –B) locations.

It is noted that off-shore wind technology is a relatively new technology and is yet to be explored in the country. Hence, the project specific tariff is to be determined for such a project. The capital cost of the project and other parameters need to be considered based on location of the project.

5.2. PARAMETERS FOR SMALL HYDRO PROJECTS

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

5.2.1. CAPITAL COST

The provision for Capital Cost for Small Hydro projects as per the existing RE Tariff Regulations, 2020 is as follows:

“27. Capital Cost

(1) The normative capital cost for small hydro projects during first year of Control Period i.e. financial year 2020-21 shall be as follows:

Region	Project Size	Capital Cost (Rs. Lakh/MW)
<i>Himachal Pradesh, Uttarakhand, West Bengal, Union Territory of Jammu and Kashmir, Union Territory of Ladakh and North Eastern States</i>	<i>Below 5 MW</i>	<i>1100</i>
	<i>5 MW to 25 MW</i>	<i>1100</i>
<i>Other States</i>	<i>Below 5 MW</i>	<i>780</i>
	<i>5 MW to 25 MW</i>	<i>900</i>

(2) The capital cost for small hydro projects as specified for first year of the Control Period shall remain valid for the entire duration of the Control Period unless reviewed earlier by the Commission.”

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

In order to benchmark the capital cost of SHP, the Commission analysed various small hydro projects

considered by some SERCs. The capital costs determined by various SERCs are based on the type and design of the SHP projects going to be set up in the control period.

Table 11 Comparison of Capital Cost of Small Hydro Plants

SERCs	HPERC	UERC	PSERC	HERC	OERC
Year of Order/Regulation	2023	2023	2020	2021	2023
Capital Cost (Rs. Cr. MW)	Rs. 11.25 to 11.60 Cr/MW	Rs. 11.00 to 11.50 Cr/MW	Rs. 7.80 to 9.00 Cr/MW	Rs. 7.80 to 9.00 Cr/MW	Rs. 7.80 to 9.00 Cr/MW

Actual Project Cost Approach

In the ‘Actual project cost approach’ the capital cost information for SHP Projects provided by IREDA is as follows:

Table 12 Capital Cost information for Small Hydro Projects

Region	Project Size	No. of Projects	Capital Cost (Rs. Cr/MW)
Hilly Regions	Below 5 MW	1	11.94
	5 MW to 25 MW	3	9.58 to 12.22
Other States	Below 5 MW	-	-
	5 MW to 25 MW	3	10.41 to 11.12

In addition to the above, the Commission has also analysed the latest project specific tariff orders of a few SERCs in order to arrive at capital costs, which are as follows:

Table 13 Capital Cost information for Small Hydro Projects

Region	Project Size	No. of Projects	Capital Cost (Rs. Cr/MW)
Hilly Regions	Below 5 MW	4	7.20 to 15.37
	5 MW to 25 MW	-	-
Other States	Below 5 MW	2	11.82 to 13.48
	5 MW to 25 MW	3	7.05 to 15.02

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 lines, etc. The increase in the capital cost of the project is mainly on account of preliminary and pre-operative expenses, including IDC, which are site specific. Therefore, these may not be an ideal benchmark for approval of the capital cost by the Commission in the Draft RE Tariff Regulations, 2024. Further, the capital cost for projects in Hilly Regions is in the range of Rs. 7.05 Crore/MW to Rs. 15.02 Crore/MW, and for the other states the project cost ranges from Rs. 7.20 Crore/MW to Rs. 15.37 Crore/MW above 5 MW and up to 25 MW and for projects less than 5 MW the range is from Rs. 11.82 Crore/MW to Rs. 13.48 Crore/MW.

Based on the analysis of the capital cost considered by various SERCs and in Project Specific Tariff Orders, the Commission observed that the capital cost approved is in marginal variation with the

capital cost approved by the Commission in its RE Tariff Regulations, 2020. Given that State-wise capital costs undergo the Commission’s scrutiny and in consideration of the limited availability of actual data for the past three years, it is proposed to revisit the capital cost norms for SHPs for the upcoming control period based on the capital cost indexation mechanism.

Escalation of Capital Cost

To establish a trend in capital cost over the years, it is suggested that escalation factors, based on indices like the manufacturing Index, wholesale price index, and infrastructure industry index, be applied to the approved capital cost. This will help normalise and compare the regulated capital costs over the specified period.

In order to comprehensively assess the trajectory of these capital costs, the Commission has undertaken a thorough analysis of the Wholesale Price Index, Manufacturing Index and Infrastructure Industry Index for FY 2020- 2023. The tabulated data depicts the growth rates of these indices, with an average rate of approximately 14% serving as the adopted escalation factor for the calculation of the revised Capital Cost.

Table 14 Growth in Indexation for Capital Cost

Parameters	FY 2020	FY 2023	Growth % from 2020-2023	Source
Manufacturing Index	129.6	137.1	6%	National Statistical Office (NSO), Govt. of India.
Wholesale Price Index	121.8	152.5	25%	Office of the Economic Adviser, Ministry of Commerce and Industry, Govt. of India
Infrastructure Industry Index	131.6	146.7	11%	Ministry of Commerce and Industry, Govt. of India

Based on the actual capital cost analysis of the SHPs and the escalation factor arrived at in the table above, the capital cost as approved in the 2020 RE Tariff Regulations is escalated to arrive at the capital cost for FY 2024-25. Therefore, the capital cost of SHP based power projects shall be as per the table below for the first year of the Control Period and will remain valid for the entire duration of the control period unless reviewed earlier by the Commission.

Table 15: Proposed Capital Cost for SHP Projects (Rs. Lakhs/MW)

Region	Project Size	Capital Cost (Rs. Lakh/MW)
Himachal Pradesh, Uttarakhand, West Bengal, Union Territory of Jammu and Kashmir, Union Territory of Ladakh and North Eastern States	Below 5 MW	1,200
	5 MW to 25 MW	1,200
Other States	Below 5 MW	890
	5 MW to 25 MW	1,027

5.2.2. CAPACITY UTILISATION FACTOR

The existing provisions regarding Capacity Utilization Factor for Small Hydro Projects in RE Tariff Regulations, 2020 are as follows:

“28. Capacity Utilisation Factor

Normative Capacity Utilisation factor for the small hydro projects located in Himachal Pradesh, Uttarakhand, West Bengal, Jammu and Kashmir, Ladakh, and North-Eastern States shall be 45% and for other states, it shall be 30%.”

The Capacity Utilization Factor (CUF) for small hydro plants predominantly relies on site-specific factors such as water flow rate, year-round water availability, elevation difference (head), and irrigation schedules, especially for projects linked to canal-based irrigation. Regions like Himachal Pradesh and Uttarakhand in the northern part of the country benefit from consistent water streams, resulting in better water availability throughout the year. Conversely, in the southern and western regions, water availability is high only during the monsoon season and diminishes during other periods.

This variance in water availability significantly impacts the average CUF for Small Hydro Projects (SHPs) across different regions. As a consequence, SHP projects in Himachal Pradesh, Uttarakhand, and north-eastern states tend to have a higher average CUF compared to those located in the southern and western parts of the country. Hence, the normative CUF endorsed by the State Electricity Regulatory Commissions (SERCs) should be seen as an indicator of these differences in CUF across states. It's essential to consider this while establishing CUF norms for SHP across various states.

It is worthwhile to mention here that the actual project data shared by IREDA are all under-construction project; thus, in the absence of actual data on CUF, the Commission proposes to continue with the existing norms specified in RE Tariff Regulations, 2020. 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 provision regarding Auxiliary Consumption for Small hydro projects in RE Tariff Regulations, 2020 is as follows:

“29. Auxiliary Consumption

Normative Auxiliary Consumption for the small hydro projects shall be considered as 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, 2020. Hence, the Commission proposes to continue with the existing provision as specified in the RE Tariff Regulations, 2020.

5.2.4. OPERATION & MAINTENANCE EXPENSES

The existing provisions regarding Operation and Maintenance expenses for SHP projects in RE Tariff Regulations, 2020 are mentioned below:

“30. Operation and Maintenance Expenses

(1) Normative O&M expenses for the first year of the Control Period i.e., financial year 2020-21 shall be as under:

Region	Project Size	O&M Expenses (Rs. Lakh/MW)
<i>Himachal Pradesh, Uttarakhand, West Bengal, Union Territory of Jammu and Kashmir, Union Territory of Ladakh and North Eastern States</i>	<i>Below 5 MW</i>	<i>41.78</i>
	<i>5 MW to 25 MW</i>	<i>31.34</i>
<i>Other States</i>	<i>Below 5 MW</i>	<i>33.66</i>
	<i>5 MW to 25 MW</i>	<i>24.37</i>

(2) Normative O&M Expenses allowed at the commencement of the Control Period i.e., financial year 2020-21 under these regulations shall be escalated at the rate specified in Regulation 19 of these Regulations for Tariff Period.”

In the absence of actual data on O&M expenses, it is suggested to continue with the existing approach for O&M expenses for the upcoming control period. As discussed earlier, the escalation rate has been calculated based on the five years’ average CPI and WPI indices by considering the weightage of 60:40 for WPI and CPI 41. Hence, the proposed escalation factor for computing O&M expenses is 5.89%.

Further, the Commission had continued/extended the FY 2022-23 Tariff Order dated November 7, 2022 for FY 2023-24 and accordingly, various norms for the technology remained the same for FY 2023-24. Therefore, the present base O&M Expense norms for FY 2023-24 are arrived at by escalating FY 2022-23 O&M expense norms by 3.84%, prior to applying escalation factor for arriving at FY 2024-25 O&M expense norms. Hence, the normative O&M expenses approved for FY 2023-24 have been escalated by 5.89% to arrive at normative O&M expenses for FY 2024-25, which are as follows:

Table 16: Proposed O&M expenses for SHP Projects (Rs. Lakhs/MW)

Region	Project Size	O&M Expenses (Rs. Lakh/MW)
Himachal Pradesh, Uttarakhand, West Bengal, Union Territory of Jammu and Kashmir, Union Territory of Ladakh and North Eastern States	Below 5 MW	49.54
	5 MW to 25 MW	37.15
Other States	Below 5 MW	39.90
	5 MW to 25 MW	28.90

Further, the normative O&M expenses, as mentioned above, for FY 2024-25 shall be escalated at the rate of 5.89% per annum for the Tariff Period for the purpose of determination of the 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 provision for the capital cost for biomass power projects based on the Rankine cycle technology as per the existing provisions in the RE Tariff Regulations, 2020 is as follows:

“31. Capital Cost

(1) The normative capital cost for first year of the Control Period i.e. financial year 2020-21 shall be as under:

Biomass Rankine Cycle Projects	Capital Costs (Rs. Lakh/MW)
<i>Project [other than rice straw and juliflora (plantation) based project] with water cooled condenser</i>	559
<i>Project [other than rice straw and juliflora (plantation) based project] with air cooled condenser</i>	600
<i>For rice straw and juliflora (plantation) based project with water cooled condenser</i>	611
<i>For rice straw and juliflora (plantation) based project with air cooled condenser</i>	652

(2) The capital cost for biomass power projects based on Rankine cycle technology as specified for first year of the Control Period shall remain valid for the entire duration of the Control Period unless reviewed earlier by the Commission.”

To establish a benchmark capital cost norm for biomass power projects, multiple methodologies have been evaluated. These include the Regulatory Capital Cost Approach, the Actual Project Cost Approach, and the Escalation of Capital Cost as sanctioned by the respective State Electricity

Regulatory Commissions (SERC). The subsequent sections provide a comprehensive analysis of these approaches and a summary of the resulting findings.

Regulatory Capital Cost Approach

In the 'Regulatory Capital Cost Approach', the Commission has assessed generic tariff orders for biomass power projects by various SERCs, and the capital cost approvals done by these respective SERCs were sourced. It is worthwhile to mention that most of the states adopted the base capital cost as approved by the Commission in the CERC RE Tariff Regulations, 2020. The Commission observes that most of the SERCs have specified Capital Cost for Biomass Projects in RE Tariff Regulations. MERC, APERC and JSERC have specified Project Specific Tariff determinations for the Capital Cost in their RE Tariff Regulations. The capital cost norms specified by various SERCs for biomass power projects are as follows:

Table 17 Comparison of Capital Cost for Biomass Power Projects by various SERCs (Rs. Cr/MW)

SERC	HERC	UERC	PSERC	MPERC	RERC	BERC
Year of Order/Regulation	2021	2023	2020	2022	2022	2022
Capital Cost (Rs. Cr./MW)	Rs. 5.59 to 6.52 Cr/MW	Rs.5.59 to 6.52 Cr/MW	Rs.5.59 to 6.52 Cr/MW	Rs.5.92 to 6.04 Cr/MW	Rs.5.28 to 5.62 Cr/MW	Rs.5.59 to 6.52 Cr/MW

Based on the analysis of the capital cost considered by various SERCs, the Commission observed that the capital cost approved by SERCs is in marginal variation with the capital cost approved by the Commission in its RE Tariff Regulations, 2020. Given that State-wise capital costs undergo Commission scrutiny and in consideration of the absence of actual data for the past three years, it is proposed to revisit the capital cost norms for biomass power-based projects for the upcoming control period based on the capital cost indexation mechanism.

Escalation of Capital Cost

To establish a trend in capital cost over the years, it is suggested that escalation factors, based on indices like the manufacturing Index, wholesale price index, and infrastructure industry index, be applied to the approved capital cost. This will help normalise and compare the regulated capital costs over the specified period.

In order to comprehensively assess the trajectory of these capital costs, the Commission has undertaken a thorough analysis of the Wholesale Price Index, manufacturing Index and Infrastructure Industry Index for FY 2020-2023. The tabulated data depicts the growth rates of these indices, with an average rate of approximately 14% serving as the adopted escalation factor for the calculation of the revised Capital Cost.

Table 18 Growth in Indexation for Capital Cost

Parameters	FY 2020	FY 2023	Growth % from 2020-2023	Source
Manufacturing Index	129.6	137.1	6%	National Statistical Office (NSO), Govt. of India.
Wholesale Price Index	121.8	152.5	25%	Office of the Economic Adviser, Ministry of Commerce and Industry, Govt. of India
Infrastructure Industry Index	131.6	146.7	11%	Ministry of Commerce and Industry, Govt. of India

Based on the escalation factor in the table above, the capital cost as approved in the 2020 RE Tariff Regulations is escalated to arrive at the capital cost for FY 2024-25. Therefore, the capital cost of biomass based power projects shall be as per the table below for the first year of the Control Period and will remain valid for the entire duration of the control period unless reviewed earlier by the Commission.

Table 19: Proposed Capital Cost for Biomass Power Projects (Rs. Cr./MW)

Biomass Rankine Cycle Projects	Capital Costs (Rs. Lakh/MW)
Project [other than rice straw and juliflora (plantation) based project] with water cooled condenser	638
Project [other than rice straw and juliflora (plantation) based project] with air cooled condenser	685
For rice straw and juliflora (plantation) based project with water cooled condenser	697
For rice straw and juliflora (plantation) based project with air cooled condenser	744

5.3.2. PLANT LOAD FACTOR

The provision for Plant Load Factor for Biomass power projects based on the Rankine cycle, as per the existing RE Tariff Regulations, 2020 is as follows:

“32. Plant Load Factor

For the purpose of determination of tariff, the Plant Load Factor shall be considered as 80%.“

The Plant Load Factor (PLF) stands as a pivotal performance indicator for any power plant, reliant upon various factors including consistent and high-quality fuel supply, plant accessibility, and unimpeded off-take. Reviewing the data of various SERCs concerning biomass power projects, it is observed that the some of the SERCs are following a uniform PLF of 80% for all years of operation without any relaxation during the stabilisation period. Thus, the Commission decides to continue with the current threshold Plant Load Factor for fixed charge determination at the same level.

Table 20: Comparison of PLF for Biomass Power Projects by various SERCs (%)

SERCs		HERC	UERC	PSERC	MPERC	RERC	BERC
Year of Order/Regulation		2021	2023	2020	2022	2022	2022
PLF (%)	During Stabilization	80%	80%	80%	80%	80%	80%
	Remaining period of the first year						
	From 2 nd Year onwards						

5.3.3. AUXILIARY CONSUMPTION

The provision for Auxiliary Consumption for Biomass power projects based on the Rankine cycle as per the existing RE Tariff Regulations, 2020 is as follows:

“33. Auxiliary Consumption

The normative auxiliary consumption shall be as follows: -

a) For project using water cooled condenser: 10%

b) For projects using air cooled condenser: 12%”

The auxiliary consumption factor serves as a pivotal performance metric for power plants, contingent upon the plant's size and configuration. Consequently, to ascertain the Tariff for the Representative Case, after reviewing multiple orders issued by various SERCs, the Commission decides to maintain the previously specified norms of 10% and 12% for Water and Air cooled condenser Auxiliary Consumption, respectively, established in 2020, for determining the tariff applicable to the upcoming control period.

5.3.4. STATION HEAT RATE

The Station Heat Rate for Biomass power projects based on the Rankine cycle, as per the existing provisions in the RE Tariff Regulations, 2020, is as follows:

“34. Station Heat Rate

The Station Heat Rate shall be:

a) For projects using travelling grate boilers: 4200kCal/kWh

b) For projects using AFBC boilers: 4125 kCal/kWh”

The station heat rate of a biomass power plant is contingent upon several factors, including plant capacity, design, configuration, technology employed (such as boiler type and pressure levels), operational and maintenance practices, and the quality of fuel received.

For rankine cycle-based biomass power generation, two primary types of boilers are prevalent: travelling grate and atmospheric fluidized bed combustion (AFBC) . AFBC boilers exhibit higher

efficiency when compared to travelling grate ones, yet their usage is constrained due to limitations imposed by fuel quality and size requirements. Conversely, travelling grate boilers offer greater flexibility as they can accommodate various types and qualities of fuel without requiring significant modifications. As a common industry practice, biomass project developers predominantly opt for travelling grate boilers for biomass-based power generation.

The Station Heat Rate specified by most of the SERCs is the same as that specified by CERC in its Tariff Regulations, 2020. The SHR norms specified by various SERCs for biomass power projects are as follows:

Table 21 Comparison of SHR for Biomass Power Projects by various SERCs (kCal/kWh)

ERC	HERC	UERC	PSERC	MPERC	RERC	BERC
Year of Order/Regulation	2021	2023	2020	2022	2022	2022
SHR (kCal/kWh)	Traveling Grate Boiler - 4200 and AFBC Boiler - 4125	Traveling Grate Boiler - 4200 and AFBC Boiler - 4125	Traveling Grate Boiler - 4200 and AFBC Boiler - 4125	4,200	Traveling Grate Boiler - 4200 and AFBC Boiler - 4125	Traveling Grate Boiler - 4200 and AFBC Boiler - 4125

After conducting a review of the Regulations and orders issued by various SERCs, 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 the RE Tariff Regulations, 2020.

5.3.5. OPERATION & MAINTENANCE EXPENSES

The provision for Operation Maintenance Expenses for Biomass power projects based on Rankine cycle technology as per the existing RE Tariff Regulations, 2020 are as follows:

“35. Operation and Maintenance Expenses

Normative O&M expenses for the first year of the Control period i.e. FY 2024-25 shall be Rs. 55.12 lakhs per MW and shall be escalated at the rate specified in Regulation 19 of these Regulations for the Tariff Period.”

The biomass plants are considerably smaller in comparison to conventional power plants. Despite this, the costs attributed to roles like plant managers, shift operators, and other establishment-related administrative expenses represent a higher proportion of the overall capital cost, differing from conventional power plants. Additionally, unlike bagasse cogeneration projects, biomass-based power projects demand additional manpower and equipment for fuel procurement and handling.

Consequently, the operational and maintenance (O&M) expenses incurred for biomass-based projects tend to be higher when compared with cogeneration projects.

As discussed earlier, the escalation factor for the purpose of normalisation of operation and maintenance expenses is carried out in line with the draft CERC (Terms and Conditions of Tariff) Regulations, 2024. The escalation rate is computed based on the five-year average of WPI for FY 2018-19 to FY 2022-23, which works out to 5.93% per annum, while that of CPI for the same period works out to 5.84% per annum. Considering the 60:40 weightage for WPI and CPI, respectively, the escalation rate works out to 5.89% per annum.

Further, the Commission had continued/extended the FY 2022-23 Tariff Order dated November 7, 2022, for FY 2023-24, and accordingly, various norms for the technology remained the same for FY 2023-24. Therefore, the present base O&M Expense norms for FY 2023-24 are arrived at by escalating FY 2022-23 O&M expense norms by 3.84%, prior to applying the escalating factor for arriving at FY 2024-25 O&M expense norms. Hence, the normative O&M expenses approved for FY 2023-24 have been escalated by 5.89% to arrive at normative O&M expenses for FY 2024-25, which works out to Rs. 55.03 Lakh/MW.

Further, normative O&M expenses, as mentioned above, for FY 2024-25 shall be escalated at the rate of 5.89% per annum for the Tariff Period for the purpose of determination of levelized tariff.

5.3.6. USE OF FOSSIL FUEL

The provision for use of Fossil Fuel for Biomass power projects based on the Rankine cycle technology as per the existing RE Tariff Regulations, 2020, is as follows:

“36. Use of Fossil Fuel

The use of fossil fuels shall not be allowed:

Provided that for biomass power projects based on Rankine cycle technology commissioned on or before 31.03.2017, use of fossil fuels to the extent of 15% in terms of gross calorific value on annual basis, shall be allowed for the Useful Life of the project from the date of commercial operation.”

The Commission has already decided on the issue of usage of fossil fuel in Biomass based power projects in its RE Tariff Regulations, 2020, and the Commission proposes to continue with same provision.

5.3.7. CALORIFIC VALUE

The Gross Calorific Value for Biomass power projects based on the Rankine Cycle, as per the existing provisions in the RE Tariff Regulations, 2020 is as follows:

“37. Calorific Value

The gross calorific value of biomass fuel, for the purpose of determination of tariff, shall be at 3100 kCal/kg.”

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

Table 22 Comparison of Calorific Value for Biomass Power Projects by various SERCs (kCal/kg)

SERC	HERC	UERC	PSERC	MPERC	RERC	BERC
Year of Order/Regulation	2021	2023	2020	2022	2022	2022
GCV (kCal/kg)	3,100	3,100	3,100	3,100	3,400	3,100

In the absence of actual data and a review of the 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, 2020.

5.3.8. FUEL COST

The Commission aims to establish reasonable tariffs by determining the cost of fuel. Most of the SERCs have their own tariffs applicable to the projects in their respective States, that follow the norms set by the CERC. Some of the SERCs also update their norms and fuel costs based on local factors such as fuel availability and accessibility. To establish new norms for fuel costs, the Commission conducted a biomass fuel pricing analysis using data from various sources adopting several methods, as described in the sections below:

The Commission assessed the surplus biomass availability for each crop and state using data from the National Institute for Bio Energy. For the selected crops, the Commission analyzed the latest wholesale prices, Minimum Selling Price (MSP) and Crop Production Costs, and applied the crop-specific crop residue ratio (CRR) to determine the state-specific crop residue prices. However, the Commission encountered difficulties in adopting this method, due to variations in crop residue ratios and calorific values of different crop components (e.g., stem, branches, leaves, etc.), leading to inconsistent fuel prices. The nationalised crop market prices, regular updates, and varying calorific values of different plant species also added complexity to the fuel price determination.

Another method analyzed by the Commission for biomass fuel pricing is Heat Equivalent Value method, which uses the equivalent heat-bearing quality of domestic coal for burning in the plant. The method calculated the average fuel cost based on the average landed cost, Gross Calorific Value (GCV),

Fuel Rate, and the average fuel price per unit of energy of non-coking coal (G14 coal grade). The average fuel cost per Kcal of coal was then applied to the calorific value of biomass to determine the biomass cost.

In addition to above, to facilitate the sustainable supply chain of biomass pellets and expedite their procurement by power utilities, the Ministry of Power issued the '**Modification of Revised Policy for Biomass Utilisation for Power Generation through Co-firing in Coal-based Power Plants**' in June 2023. It is crucial to note that the Government of India has mandated the co-firing of biomass in coal-based thermal stations. While these policy initiatives are anticipated to potentially amplify biomass demand, there is currently insufficient empirical data regarding their specific impact on biomass pricing. However, it is believed that there might be at least a limited influence on biomass pricing. Therefore, the Commission finds it appropriate to consider an additional percentage increase in the price determined by the equivalent heat value method. It is to be noted that the MERC, in its Order in Case No. 1/SM/2022, has also allowed an increase of 10% in biomass price arrived at based on the equivalent heat value method.

The heat equivalent value is a well-known and widely adopted methodology, and factoring in the effects of new policy initiatives will provide an added advantage to power producers. However, the above method had limitations, especially in determining the transportation charges for biomass, a component of the landed fuel cost, which vary across plants and constitute a significant factor, especially for non-pit head plants; Also, the percentage increase in the price of biomass due to new policy initiatives will be difficult to determine.

Furthermore, the Commission has also evaluated a methodology that attributes equal significance to the price derived from the Equivalent Heat Method and the Market Price observed across different States. In this framework, 50% weightage is allocated to the price computed via the equivalent heat method, as well as a 10% increase accounted for over and above the same, due to the effect of biomass co-firing in coal-based thermal stations. Simultaneously, the remaining 50% weightage is accorded to the prevailing market prices of biomass observed across various states.

The Commission had tried to estimate the biomass prices for different states using various methods based on the availability, demand, and transportation costs of biomass. However, the results of these methods were not reliable and realistic for some states, as they showed unrealistic biomass prices that were not feasible for the biomass power projects. The Commission identified the limitations of these methods and decided not to use them for determining biomass prices. Instead, the Commission continued with the same biomass prices that were used in the previous year, as they were more consistent and reasonable.

In the absence of actual data on fuel costs 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, 2020.

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

Hence, in order to take care of the variation in prices for such factors, the Commission is specifying a fuel price indexation formula wherein the various components of the base price of the biomass fuel have been linked to indices, i.e., the average 'Annual Inflation Rate' for domestic coal to be notified by the CERC from time to time, to take care of the fuel cost. Further, 'Wholesale Price Index' and 'Weighted Average Price of High Speed Diesel' have been considered to take care of the fuel handling cost and transportation cost, respectively.

The yearly indices for the last 10 years have been provided below for ready reference:

Table 23 Indexation for Labour Cost, HSD and Fuel Cost

Financial Year	Agriculture Labour Index	HSD Index	Non-Coking Coal Index
2021-22	1,075	128	125
2020-21	1,034	80	124
2019-20	980	94	124
2018-19	907	97	123
2017-18	889	84	127
2016-17	870	74	126
2015-16	835	73	115
2014-15	800	115	115
2013-14	750	126	111
2012-13	672	112	103
2011-12	611	111	101

Based on the above indices, the Commission has normalised the fuel cost escalation by applying the average escalation rate determined for FY 2018-19 to FY 2021-22, which works out to be the Agriculture Index of 5.83%, the HSD Index of 9.70%, and the Fuel Index of 0.57%. Thus, the escalation

rate has been calculated based on the three year average of the aforesaid indices by considering the weightage of 20% Agriculture, 20% HSD, and 60% Fuel Cost, respectively. Hence, the proposed escalation factor for computing fuel costs is 3.45%.

Further, the Commission had continued/extended the FY 2022-23 Tariff Order dated November 7, 2022 for FY 2023-24, and accordingly, various norms for the technology remained the same for FY 2023-24. Therefore, the present base fuel cost norms for FY 2023-24 are arrived at by escalating FY 2022-23 fuel cost norms by 5%, prior to applying the escalating factor for arriving at FY 2024-25 fuel cost norms. Hence, the Biomass fuel cost approved for FY 2023-24 has been escalated by 3.45% to arrive at the fuel cost for FY 2024-25, which works out as shown in the table below. Further, biomass fuel costs, as mentioned below for FY 2024-25, shall be escalated at a rate of 3.45% per annum for the Tariff Period for the purpose of determination of levelized tariff.

Table 24: Proposed Biomass Price for FY 2024-25

States	Biomass Price for FY2024-25 (Rs/ MT)
Andhra Pradesh	3,983
Haryana	4,534
Maharashtra	4,637
Punjab	4,742
Rajasthan	3,958
Tamil Nadu	3,918
Telangana	3,983
Uttar Pradesh	4,053
Other States	4,260

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

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 Non-Fossil Fuel based Co-generation projects have been discussed.

5.4.1. CAPITAL COST

The existing provision regarding Capital Costs for Non-Fossil Fuel based Co-generation projects in the RE Tariff Regulations, 2020 is as follows:

“39. Capital Cost

Normative capital cost for the non-fossil fuel based co-generation projects shall be Rs. 492 Lakhs/MW for the first year of the Control Period i.e. financial year 2020-21 and will remain valid for the entire duration of the Control Period unless reviewed earlier by the Commission.

To establish a benchmark capital cost norm for non-fossil fuel based co-generation power projects, multiple methodologies have been evaluated. These include the Regulatory Capital Cost Approach, the Actual Project Cost Approach, and the Escalation of Capital Cost as sanctioned by the respective SERCs. The subsequent sections provide a comprehensive analysis of these approaches and a summary of the findings.

Regulatory Capital Cost Approach

In the 'Regulatory Capital Cost Approach', we have assessed generic tariff orders for non-fossil fuel based co-generation power projects issued by various SERCs, and the capital costs approved by the respective SERCs were sourced. It is worthwhile to mention that most of the states adopted the base capital costs as approved by the Commission in the CERC RE Tariff Regulations, 2020. The Commission observes that most of the SERCs have specified capital cost for non-fossil fuel based co-generation projects in RE Tariff Regulations. MERC, APERC, 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 as follows:

Table 25 Comparison of Capital Cost for Non-Fossil Fuel based Co-generation Power Projects by various SERCs (Rs. Cr/MW)

Year of Order/Regulation	2021	2020	2021	2020	2022	2023
Capital Cost (Rs. Cr./MW)	Rs. 4.925 Cr/MW	Rs. 4.92 Cr/MW	Rs. 4.66 Cr/MW	Rs. 4.92 Cr/MW	Rs. 4.92 Cr/MW	Rs. 4.92 Cr/MW

Based on the analysis of the capital cost considered by various SERCs, the Commission observed that the capital cost approved by SERCs is in marginal variation with the capital cost approved by the Commission in its RE Tariff Regulations, 2020. Given that State-wise capital costs undergo the Commission's scrutiny and in the absence of actual data for the past three years, it is proposed to revisit the capital cost norms for non-fossil fuel based co-generation based power projects for the upcoming control period based on the capital cost indexation mechanism.

Escalation of Capital Cost

To establish a trend in capital cost over the years, it is suggested that escalation factors, based on indices like the manufacturing Index, the wholesale price index, and infrastructure industry index, be applied to the approved capital cost. This will help to normalise and compare the regulated capital cost over the specified period.

In order to comprehensively assess the trajectory of these capital costs, the Commission has undertaken a thorough analysis of the Wholesale Price Index, manufacturing Index and Infrastructure

Industry Index for FY 2020-2023. The tabulated data depicts the growth rates of these indices, with an average rate of approximately 14% serving as the adopted escalation factor for the calculation of the revised Capital Cost.

Table 26 Growth in Indexation for Capital Cost

Parameters	FY 2020	FY 2023	Growth % from 2020-2023	Source
Manufacturing Index	129.6	137.1	6%	National Statistical Office (NSO), Govt. of India.
Wholesale Price Index	121.8	152.5	25%	Office of the Economic Adviser, Ministry of Commerce and Industry, Govt. of India
Infrastructure Industry Index	131.6	146.7	11%	Ministry of Commerce and Industry, Govt. of India

Based on the escalation factor in the table above, the capital cost as approved in the 2020 RE Tariff Regulations is escalated to arrive at the capital cost for FY 2024-25. Therefore, the Commission proposes to revise the capital cost of non-fossil fuel based co-generation based power projects to Rs. 562 Lakh/MW as specified in RE Draft Tariff Regulations, 2024, for the first year of the Control Period and will remain valid for the entire duration of the control period unless reviewed earlier by the Commission.

5.4.2. PLANT LOAD FACTOR

The existing provisions regarding Plant Load Factor for non-fossil fuel based co-generation power projects, as per the existing provisions in the RE Tariff Regulations, 2020, are as follows:

“40. Plant Load Factor

The plant load factor for different States shall be as follows:

State	Plant Load Factor (%)
Uttar Pradesh and Andhra Pradesh	45%
Tamil Nadu and Maharashtra	60%
Other States	53%

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

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

SERC	HERC	UERC	PSERC	MPERC	RERC	BERC
Year of Order/Regulation	2021	2023	2020	2021	2020	2022
Plant Load Factor (%)	53%	45%	53%	53%	53%	53%

The Plant Load Factor (PLF) stands as a pivotal performance indicator for any power plant setup, reliant upon various factors including consistent and high-quality fuel supply, plant accessibility, and unimpeded off-take.

It is noted that PLF for non-fossil fuel based co-generation projects is computed on the basis of plant availability for the number of operating days considering operations during crushing season and off-season and a 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 was computed as 45%, i.e., $(180/365) * 92\%$. Similarly, for 240 days and 210 days as operating days, PLF was computed as 60% (i.e., $240/365 * 92\%$), and 53% (i.e., $210/365 * 92\%$), respectively.

In the absence of actual data and a review of PLF notified by various SERCs, the Commission proposes to retain the PLF as specified in the RE Tariff Regulations, 2020.

5.4.3. AUXILIARY CONSUMPTION

The existing provision regarding Auxiliary Consumption for non-fossil fuel based cogeneration projects in the RE Tariff Regulations, 2020 is as follows:

“41. Auxiliary Consumption

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

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

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

SERC	HERC	UERC	PSERC	MPERC	RERC	BERC
Year of Order/Notification	2021	2023	2020	2021	2020	2022
Aux. Consumption (%)	8.50%	8.50%	8.50%	8.50%	8.50%	8.50%

The Commission while framing the RE Tariff Regulations, 2020 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 SERCs, the Commission proposes to retain the same norm for Auxiliary Consumption for non-fossil fuel based co-generation projects as specified in the RE Tariff Regulations, 2020.

5.4.4. STATION HEAT RATE

The existing provision regarding Station Heat Rate for non-fossil fuel based cogeneration projects in the RE Tariff Regulations, 2020 is as follows:

“42. Station Heat Rate

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

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

Table 29 Comparison of SHR for Non-fossil fuel based Co-generation projects by various SERCs (kCal/kWh)

SERC	HERC	UERC	PSERC	MPERC	RERC	BERC
Year of Order/Regulation	2021	2023	2020	2021	2020	2022
Station Heat Rate (kCal/kWh)	3,600	3,600	3,600	3,600	3,600	3,600

The Station Heat Rate specified by most of the SERCs is the same as that specified by CERC in its RE Tariff Regulations, 2020. 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 the RE Tariff Regulations, 2020.

5.4.5. CALORIFIC VALUE

The existing provision regarding Gross Calorific Value for non-fossil fuel based cogeneration projects in the RE Tariff Regulations, 2020 is as follows:

“43. Gross Calorific Value

The gross calorific value for bagasse shall be considered as 2250 kCal/kg. For the use of biomass fuels other than bagasse, gross calorific value as specified under Regulation 37 shall be applicable.”

The Commission has reviewed the 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 Cogeneration Projects by various SERCs (kCal/kg)

SERC	HERC	UERC	PSERC	MPERC	RERC	BERC
Year of	2021	2023	2020	2021	2020	2022

SERC	HERC	UERC	PSERC	MPERC	RERC	BERC
Order/Notification						
GCV (kCal/kg)	2,250	2,250	2,250	2,250	2,250	2,250

The Commission observed that the calorific value of bagasse considered by most SERCs is the same as that specified by CERC in its RE Tariff Regulations, 2020, i.e. 2250 kCal/kg. Based on a review of the GCV adopted by different SERCs, the Commission proposes to retain the Gross Calorific Value of 2250 kcal/kg as specified in the RE Tariff Regulations, 2020.

5.4.6. FUEL COST

The existing provision regarding Fuel Cost for Non-Fossil Fuel based Cogeneration projects in the RE Tariff Regulations, 2020, is mentioned below;

“44. Fuel Cost

(1) The price of bagasse for the first year of the Control Period i.e., financial year 2020-21 shall be as specified in the table below and shall be escalated at 5% to arrive at the base price for subsequent years of the Control Period, unless specifically reviewed by Commission. For the purpose of determining levellised tariff, a normative escalation of 5% per annum shall be applicable on bagasse price.”

States	Bagasse Price for FY2020-21 (Rs/ MT)
Andhra Pradesh	1,878
Haryana	2,671
Maharashtra	2,632
Punjab	2,351
Tamil Nadu	2,023
Telangana	1,877
Uttar Pradesh	2,095
Other States	2,274

(2) For use of biomass other than bagasse in non-fossil fuel based co-generation projects, the biomass prices as specified under Regulation 38 shall be applicable.”

The Commission aims to establish reasonable tariffs by determining the cost of fuel. Most of the SERCs have their own tariffs applicable to the projects in their respective States, that follow the norms set by the CERC. Some of the SERCs also update their norms and fuel costs based on local factors such as fuel availability and accessibility. To establish new norms for fuel costs, the Commission conducted a bagasse fuel pricing analysis using data from various sources adopting several methods, as described in the sections below:

The Commission assessed the surplus bagasse availability for the state using data from the National Institute for Bio Energy. For bagasse, the latest State Advisory Prices (SAP), Fair Remunerative Price (FRP), and Crop Production Costs, and applied the crop-specific crop residue ratios (CRR) were

analyzed to determine the state-specific crop residue prices. However, the Commission encountered difficulty in adopting this method, as only four states, namely, Haryana, Punjab, Uttar Pradesh, and Uttarakhand, used notified Sugarcane State Advisory Prices (SAP), leading to inconsistent fuel prices. The nationalised fair remunerative prices, regular updates, and limited availability of SAP prices for each state also added complexity to the fuel price determination.

Another method analyzed by the Commission for bagasse fuel pricing is Heat Equivalent Value method, which uses the equivalent heat-bearing quality of domestic coal for burning in the plant. The method calculated the average fuel cost based on the average landed cost, Gross Calorific Value (GCV), Fuel Rate, and the average fuel price per unit of energy of non-coking coal (G17 coal grade). The average fuel cost per Kcal of the coal was then applied to the calorific value of bagasse to determine the bagasse cost.

The heat equivalent value is a well-known and widely adopted methodology; however, the above method had limitations, especially in determining the transportation charges for bagasse, a component of the landed fuel cost, which vary across plants and constitute a significant factor, especially for non-pit head plants.

Furthermore, the Commission has also evaluated a methodology that attributes equal significance to the price derived from the Equivalent Heat Method and the nationalised Fair Remunerative Prices (FRP). In this framework, 50% weightage is allocated to the price computed via the equivalent heat method, and the remaining 50% weightage is accorded to the prevailing FRP prices of bagasse.

The Commission had tried to estimate the bagasse prices using various methods based on the availability, demand, and transportation cost of bagasse. However, the results of these methods were not reliable and realistic, as they showed unrealistic bagasse prices that were not feasible for the bagasse power projects. The Commission noted the limitations of these methods and decided not to use them for determining bagasse prices. Instead, the Commission continued with the same bagasse prices that were used in the previous year, as they were more consistent and reasonable.

Furthermore, several associations, including the UP Sugarcane Association, have presented data concerning the pricing of bagasse, relying on actual procurement prices within the state of Uttar Pradesh. According to the data shared by the association, bagasse prices have been ranging from Rs 1710 / MT to Rs 3130 /MT, with the average bagasse price coming around Rs 2490 /MT. In the absence of actual data on fuel costs 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, 2020.

The Commission notes that, the price of bagasse fuel depends on various components, such as remuneration to farmers, costs related to collection and storage, transportation, loading and

unloading costs, agent commissions, etc. Fuel procurement and transportation are handled by the highly unorganised sector, and prices are influenced by local factors.

Hence, in order to take care of variation in prices for such factors, the Commission is specifying a fuel price indexation formula wherein the various components of the base price of the bagasse fuel have been linked to indices, i.e., the average 'Annual Inflation Rate' for domestic coal to be notified by the CERC from time to time, to take care of the fuel cost. Further, 'Wholesale Price Index' and 'Weighted Average Price of High Speed Diesel' have been considered to take care of the fuel handling cost and transportation cost, respectively.

The yearly indices for the last 10 years have been provided below for ready reference:

Table 31 Indexation for Labour Cost, HSD and Fuel Cost

Financial Year	Agriculture Labour Index	HSD Index	Non-Coking Coal Index
2021-22	1,075	128	125
2020-21	1,034	80	124
2019-20	980	94	124
2018-19	907	97	123
2017-18	889	84	127
2016-17	870	74	126
2015-16	835	73	115
2014-15	800	115	115
2013-14	750	126	111
2012-13	672	112	103
2011-12	611	111	101

Based on the above indices, the Commission has normalised the fuel cost escalation by applying average escalation rate determined for FY 2018-19 to FY 2021-22, which works out to be an Agriculture Index of 5.83%, an HSD Index of 9.70%, and a Fuel Index of 0.57%. Thus, the escalation rate has been calculated based on the three-year average of the aforesaid indices by considering the weightage of 20% Agriculture, 20% HSD, and 60% Fuel Cost, respectively. Hence, the proposed escalation factor for computing fuel costs is 3.45%.

Further, the Commission had continued/extended the FY 2022-23 Tariff Order dated November 7, 2022 for FY 2023-24, and accordingly, various norms for the technology remained the same for FY 2023-24. Therefore, the present base fuel cost norms for FY 2023-24 are arrived at by escalating FY 2022-23 fuel cost norms by 5% prior to applying the escalating factor for arriving at FY 2024-25 fuel

cost norms. Hence, the Bagasse fuel cost approved for FY 2023-24 has been escalated by 3.45% to arrive at the fuel cost for FY 2024-25, which works out as shown in the table below. Further, bagasse fuel costs, as mentioned below, for FY 2024-25 shall be escalated at a rate of 3.45% per annum for the Tariff Period for the purpose of determination of levelized tariff.

Table 32 Proposed Bagasse Price for FY 2024-25

States	Bagasse Price for FY2024-25 (Rs/ MT)
Andhra Pradesh	2,249
Haryana	3,199
Maharashtra	3,152
Punjab	2,815
Tamil Nadu	2,423
Telangana	2,248
Uttar Pradesh	2,509
Other States	2,723

5.4.7. OPERATION & MAINTENANCE EXPENSES

The provision for Operation and Maintenance Expenses for non-fossil fuel based cogeneration projects as per the existing RE Tariff Regulations, 2020, is as follows:

“45. Operation and Maintenance Expenses

Normative O&M expenses during first year of the Control period i.e. financial year 2020-21, shall be Rs. 24.52 Lakh per MW and shall be escalated at the rate specified in Regulation 19 of these Regulations for Tariff Period.”

As discussed earlier, the escalation rate has been calculated based on the five years’ average CPI and WPI indices by considering the weightage of 60:40 for WPI and CPI, respectively.. Hence, the proposed escalation factor for computing O&M expenses is 5.89%.

Further, the Commission had continued/extended the FY 2022-23 Tariff Order dated November 7, 2022 for FY 2023-24, and accordingly, various norms for the technology remained the same for FY 2023-24. Therefore, the present base O&M Expense norms for FY 2023-24 is arrived at by escalating FY 2022-23 O&M expense norms by 3.84%, prior to applying the escalating factor for arriving at FY 2024-25 O&M expense norms. Hence, the normative O&M expenses approved for FY 2023-24 have been escalated with 5.89% to arrive at normative O&M expenses for FY 2024-25 which works out to Rs. 29.07 Lakh/MW.

Further, normative O&M expenses, as mentioned above, for FY 2024-25 shall be escalated at a rate of 5.89% per annum for the Tariff Period for the purpose of determination of levelized tariff.

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

The Commission, in Draft CERC RE Tariff Regulations, 2024, has specified combined parameters for the Solar PV project, the Solar Thermal Power Project and the Floating Solar Project. Under this section, parameters such as the Capital Cost Norm, Capacity Utilisation Factor, Auxiliary Consumption, and O&M Expenses for these projects have been discussed.

5.5.1. CAPITAL COST

The existing provisions regarding parameters for solar power projects in the RE Tariff Regulations, 2020 are as follows:

“46. Capital Cost

The Commission shall determine only project specific capital cost considering the prevailing market trends.”

Solar PV Project:

The Commission analysed the actual capital cost of solar PV power projects funded during the last three years, as given in the Table below:

Table 33: Comparison of Actual Capital Cost of Solar Power PV Projects

S. No.	Size	No. of Projects	Capital Cost (Rs. Cr./MW)
1	Up to 10 MW	6	3.52-7.27
2	11-50 MW	3	4.08-6.16
3	51-100 MW	2	4.89-6.61
4	100-500 MW	8	4.77-6.61
5	Above 500 MW	3	3.84-5.93

Based on the actual capital cost data, the Commission observed that per MW cost of solar projects varies based on the location, size of the plant etc. Therefore, based on the prevailing market information and as most of the Solar Power projects are coming under the competitive bidding route, the Commission proposes to determine only the Project Specific Capital Cost for Solar PV Power Projects for the next Control Period.

Solar Thermal Projects:

The Commission has observed that most of the SERCs have opted for project specific capital costs for solar thermal power projects, except UERC and MPERC. Therefore, the Commission proposes to determine only project specific capital costs for solar thermal power projects for the next Control Period.

Floating Solar Project:

The Commission proposes to determine only project specific capital costs for Floating Solar Power Projects for the next Control Period.

5.5.2. CAPACITY UTILISATION FACTOR

Solar PV Project:

The existing provisions regarding parameters for solar PV power projects in the RE Tariff Regulations, 2020 are as follows:

“The Commission shall only approve capacity utilisation factor for project specific tariff:

Provided that the minimum capacity utilization factor for solar PV power projects shall be 21%:”

The Commission has analysed the Capacity Utilisation Factor for the projects funded during last 3 years and it was observed that the CUF is in the range of 19% - 26%. Commission has analysed the norms of various SERCs and it was observed that the CUF notified is in the range of 19%-28%. In view of the above, the Commission proposes the minimum CUF norm for Solar PV power project as 21%.

Solar Thermal Projects:

The existing provisions regarding parameters for solar thermal power projects in the RE Tariff Regulations, 2020 are as follows:

“The Commission shall only approve capacity utilisation factor for project specific tariff:

Provided further that the minimum capacity utilization factor for solar thermal power projects shall be 23%:”

The Commission observes that most SERCs are following the approach followed by CERC.

Table 34: Comparison of the CUF of Solar Thermal Power Projects notified by SERCs

SERC	CSERC	HERC	UERC	MERC	RERC
Notified Year	2022	2021	2023	2019	2020
Capacity Utilisation Factor (%)	23%	23%	23%	23%	23%

In view of the above, the Commission proposes the minimum CUF norm for Solar Thermal power project as 23%.

Floating Solar Project:

The existing provisions regarding parameters for floating solar power projects in the RE Tariff Regulations, 2020 are as follows:

“The Commission shall only approve capacity utilisation factor for project specific tariff:

Provided also that the minimum capacity utilisation factor for floating solar projects shall be 19%.”

In the absence of actual data, the Commission proposes the minimum CUF norm for Floating Solar power projects as 19%.

5.5.3. OPERATION & MAINTENANCE EXPENSES

The existing provisions regarding parameters for solar power projects in the RE Tariff Regulations, 2020 are as follows:

“The Commission shall determine only project specific O&M expenses considering the prevailing market trends.”

Solar PV Project:

The Commission has analysed the O&M Expenses for the projects funded during the last 3 years and it was observed that the O&M Expenses are in the range of Rs. 2.5 Lakh/MW to Rs. 7.5 Lakh/MW. The Commission has analysed the norms of various SERCs, and it was observed that the O&M Expenses are in the range of Rs. 6 Lakh/MW to Rs. 16.24 Lakh/MW.

Therefore, based on the prevailing market information and as most of the Solar Power projects are coming under the competitive bidding route, the Commission proposes to determine only the project specific O&M Expenses for Solar PV Power Projects for the next Control Period.

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.

Floating Solar PV Project:

The Commission proposes to continue to determine only project specific O&M expenses for Floating Solar PV Projects for the next Control Period.

5.5.4. AUXILIARY CONSUMPTION

Solar PV Project:

The existing provisions regarding parameters for solar PV power projects in the RE Tariff Regulations, 2020, are as follows:

“The Commission shall only approve auxiliary consumption for project specific tariff:

Provided that the maximum auxiliary consumption for solar PV power projects shall be 0.75%,”

The Commission observes that for grid connected projects, auxiliary consumption also includes the losses of transformers, apart from auxiliary consumption such as solar trackers, lighting, module cleaning, etc. Therefore, the Commission proposes the maximum auxiliary consumption norm for the Solar PV project as 0.75%.

Solar Thermal Projects:

The existing provisions regarding parameters for solar thermal power projects in the RE Tariff Regulations, 2020 are as follows:

“The Commission shall only approve auxiliary consumption for project specific tariff:

Provided further that the maximum auxiliary consumption for solar thermal power projects shall be 10%,”

The Commission has reviewed the norms for Auxiliary Consumption considered by various SERCs and observed that most of the SERCs are following the approach followed by CERC.

Table 35: Comparison of Auxiliary Consumption of Solar Thermal Power Projects notified by SERCs

SERC	CSERC	UERC	MERC	RERC
Year of Order/Regulation	2022	2023	2019	2020
Auxiliary Consumption (%)	10%	10%	10%	10%

In view of the above, the commission proposes a maximum auxiliary consumption norm for solar thermal power project of 10%.

Floating Solar Project:

The existing provisions regarding parameters for floating solar power projects in the RE Tariff Regulations, 2020 are as follows:

“The Commission shall only approve auxiliary consumption for project specific tariff:

Provided also that the maximum auxiliary consumption for floating solar projects shall be 0.75%.”

Solar modules are used in Floating Solar Plants. Therefore, it is proposed to keep the auxiliary consumption of Floating Solar power plant the 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 provision for Capital Costs for Biomass Gasifier power projects as per the existing RE Tariff Regulations, 2020, is as follows:

“50. Capital Cost

Normative capital cost for biomass gasifier based power projects shall be Rs.593 lakhs/MW during first year of Control Period i.e. financial year 2020-21 and will remain valid for the entire duration of the Control Period unless reviewed earlier by the Commission.”

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

Table 36 Comparison of Capital Cost of Biomass Gasifier notified by SERCs

SERC	PSERC	RERC	JSERC	BERC	HERC	UERC
Year of Order/Regulation	2020	2022	2016	2022	2021	2023
Capital Cost (Rs. Lakhs/MW) – without Capital Subsidy	593	593.49	593	593	593	Pine leaves based Biomass Gasifier projects - 625.00 Other Biomass Gasifier Projects - 592

Based on the analysis of the capital cost considered by various SERCs, the Commission observed that the capital cost approved by SERCs is in marginal variation with the Capital Cost approved by the Commission in its RE Tariff Regulations, 2020. Given that State-wise capital costs undergo the Commission’s scrutiny and in the absence of actual data for the past three years, it is proposed to revisit the capital cost norms for biomass gasifier power-based projects for the upcoming control period based on the capital cost indexation mechanism.

Escalation of Capital Cost

To establish a trend in capital cost over the years, it is suggested that escalation factors, based on indices like the manufacturing Index, wholesale price index and infrastructure industry index, be applied to the approved capital cost. This will help normalise and compare the regulated capital costs over the specified period.

In order to comprehensively assess the trajectory of these capital costs, the Commission has undertaken a thorough analysis of the wholesale price index, manufacturing Index, and Infrastructure Industry Index for FY 2020-2023. The tabulated data depicts the growth rates of these indices, with an average rate of approximately 14% serving as the adopted escalation factor for the calculation of the revised Capital Cost.

Table 37 Growth in Indexation for Capital Cost

Parameters	FY 2020	FY 2023	Growth % from 2020-2023	Source
Manufacturing Index	129.6	137.1	6%	National Statistical Office (NSO), Govt. of India.
Wholesale Price Index	121.8	152.5	25%	Office of the Economic Adviser, Ministry of Commerce and Industry, Govt. of India
Infrastructure Industry Index	131.6	146.7	11%	Ministry of Commerce and Industry, Govt. of India

Based on the escalation factor in the table above, the capital cost as approved in the 2020 RE Tariff Regulations is escalated to arrive at the capital cost for FY 2024-25. Therefore, the Commission proposes to revise the capital cost of biomass gasifier based power projects to Rs. 677 Lakh/MW for the first year of the Control Period, which will remain valid for the entire duration of the control period unless reviewed earlier by the Commission.

5.6.2. PLANT LOAD FACTOR

The provision for Plant Load Factor for Biomass Gasifier power projects as per the existing RE Tariff Regulations, 2020, is as follows:

“51. Plant Load Factor

Plant load factor for determination of tariff shall be considered as 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 of Biomass Gasifier notified by SERCs

SERC	PSERC	RERC	JSERC	BERC	HERC	UERC
Year of Order/Regulation	2020	2022	2016	2022	2021	2023
Plant Load Factor (%)	85%	85%	85%	85%	85%	85%

In the absence of actual data for Biomass Gasifier Projects and based on a review of norms adopted by SERCs, the Commission proposes to retain the Plant Load Factor as specified in the RE Tariff Regulations, 2020.

5.6.3. AUXILIARY CONSUMPTION

The provision for Auxiliary Consumption for biomass gasifier power projects as per the existing RE Tariff Regulations, 2020 is as follows:

“52. Auxiliary consumption

The auxiliary consumption shall be considered as 10% for the determination of tariff.”

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

Table 39 Comparison of Auxiliary Consumption of Biomass Gasifier notified by SERCs

SERC	PSERC	RERC	JSERC	BERC	HERC	UERC
Year of Order/Regulation	2020	2022	2016	2022	2021	2023
Auxiliary Consumption (%)	10%	10%	10%	10%	10%	10%

Based on a review of norms adopted by SERCs, the Commission proposes to retain the existing Auxiliary Consumption norms as specified in the RE Tariff Regulations, 2020.

5.6.4. SPECIFIC FUEL CONSUMPTION

The provision for Specific Fuel Consumption for Biomass Gasifier power projects as per the existing RE Tariff Regulations, 2020 is as follows:

“53. Specific fuel consumption

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

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

Table 40: Comparison of Specific Fuel Consumption of Biomass Gasifier notified by SERCs

SERC	PSERC	RERC	JSERC	BERC	HERC	UERC
Year of Order/Regulation	2020	2022	2016	2022	2021	2023
Specific Fuel Consumption (kg per kWh)	1.25	1.25	1.25	1.25	1.25	Pine leaves based Biomass Gasifier projects - 1.50 Other Biomass Gasifier Projects - 1.25

In the absence of actual data for Biomass Gasifier Projects and based on a review of norms adopted by SERCs, the Commission proposes to retain the Specific Fuel Consumption as specified in the RE Tariff Regulations, 2020.

5.6.5. OPERATION AND MAINTENANCE EXPENSES

The provision for Operation and Maintenance expenses for biomass gasifier power projects as per the existing RE Tariff Regulations, 2020, is as follows:

“54. Operation and Maintenance expenses

Normative O&M expenses for the first year of the Control period i.e. financial year 2020-21 shall be Rs. 61.31 lakhs per MW and shall be escalated at the rate specified in Regulation 19 of these Regulations for Tariff Period.”

As discussed earlier, the escalation rate has been calculated based on the five years' average CPI and WPI indices by considering the weightage of 60:40 for WPI and CPI, respectively. Hence, the proposed escalation factor for computing O&M expenses is 5.89%.

Further, the Commission had continued/extended the FY 2022-23 Tariff Order dated November 7, 2022 for FY 2023-24, and accordingly, various norms for the technology remained the same for FY 2023-24. Therefore, the present base O&M Expense norms for FY 2023-24 are arrived at by escalating FY 2022-23 O&M expense norms by 3.84%, prior to applying the escalating factor for arriving for FY 2024-25 O&M expense norms. Hence, the normative O&M expenses approved for FY 2023-24 have been escalated by 5.89% to arrive at normative O&M expenses for FY 2024-25, which works out to Rs. 72.69 Lakh/MW.

Further, normative O&M expenses, as mentioned above, for FY 2024-25 shall be escalated at a rate of 5.89% per annum for the Tariff Period for the purpose of determination of levelized 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 provision for Capital Costs for Biogas power projects as per the existing RE Tariff Regulations, 2020, is as follows:

“56. Capital Cost

Normative capital cost for biogas based power projects shall be Rs.1186 lakhs/MW for first year of the Control Period i.e. financial year 2020-21 and shall remain valid for the entire duration of the Control Period unless reviewed earlier by the Commission.”

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

Table 41 Comparison of Capital Cost of Biogas notified by SERCs

SERC	CSERC	PSERC	MPERC	RERC	HERC	UERC
Year of Order/Regulation	2023	2020	2021	2022	2021	2023
Capital Cost (Rs. Lakhs/MW)	1186	1186	1162	1156.7	1186	1185

Based on the analysis of the capital cost considered by various SERCs, the Commission observed that the capital cost approved by SERCs is in marginal variation with the capital cost approved by the Commission in its RE Tariff Regulations, 2020. Given that State-wise capital costs undergo the Commission's scrutiny and in the absence of actual data for the past three years, it is proposed to revisit the capital cost norms for biogas power-based projects for the upcoming control period based on the capital cost indexation mechanism.

Escalation of Capital Cost

To establish a trend in capital cost over the years, it is suggested that escalation factors, based on indices like the manufacturing Index, wholesale price index, and infrastructure industry index, be applied to the approved capital cost. This will help normalise and compare the regulated capital costs over the specified period.

In order to comprehensively assess the trajectory of these capital costs, the Commission has undertaken a thorough analysis of the Wholesale Price Index, manufacturing Index, and Infrastructure Industry Index for the FY 2020- 2023. The tabulated data depicts the growth rates of these indices, with an average rate of approximately 14% serving as the adopted escalation factor for the calculation of the revised Capital Cost.

Table 42 Growth in Indexation for Capital Cost

Parameters	FY 2020	FY 2023	Growth % from 2020-2023	Source
Manufacturing Index	129.6	137.1	6%	National Statistical Office (NSO), Govt. of India.
Wholesale Price Index	121.8	152.5	25%	Office of the Economic Adviser, Ministry of Commerce and Industry, Govt. of India
Infrastructure Industry Index	131.6	146.7	11%	Ministry of Commerce and Industry, Govt. of India

Based on the escalation factor in the table above, the capital cost as approved in the 2020 RE Tariff Regulations is escalated to arrive at the capital cost for FY 2024-25. Therefore, the Commission proposes to revise the Capital Cost of Biogas based power projects to Rs. 1,354 Lakh/MW as specified in the RE Draft Tariff Regulations, 2024, for the first year of the 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 provision for Plant Load Factor for Biogas power projects as per the existing RE Tariff Regulations, 2020 is as follows:

“57. Plant Load Factor

Plant load factor shall be considered as 90% for determination of tariff.”

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

Table 43 Comparison of PLF of Biogas notified by SERCs

SERC	CSERC	PSERC	MPERC	RERC	HERC	UERC
Year of Order/ Regulation	2023	2020	2021	2022	2021	2023
Plant Load Factor (%)	90%	90%	90%	90%	90%	90%

In the absence of actual data for Biogas Projects and based on a review of norms adopted by SERCs, the Commission proposes to retain the Plant Load Factor as specified in the RE Tariff Regulations, 2020.

5.7.3. AUXILIARY CONSUMPTION

The provision for Auxiliary Consumption for Biogas power projects as per the existing RE Tariff Regulations, 2020 is as follows:

“58. Auxiliary Consumption

The auxiliary consumption shall be considered as 12% for determination of tariff.”

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

Table 44 Comparison of Auxiliary Consumption of Biogas notified by SERCs

SERC	CSERC	PSERC	MPERC	RERC	HERC	UERC
Year of Order/ Regulation	2023	2020	2021	2022	2021	2023
Auxiliary Consumption (%)	12%	12%	10%	12%	12%	12%

Based on a review of norms adopted by SERCs, the Commission proposes to retain the existing Auxiliary Consumption norms as specified in the RE Tariff Regulations, 2020.

5.7.4. OPERATION & MAINTENANCE EXPENSES

The provision for Operation and Maintenance expenses for Biogas power projects as per the existing RE Tariff Regulations, 2020, is as follows:

“59. Operation and Maintenance Expenses

Normative O&M expenses for the first year of the Control Period i.e. financial year 2020-21 shall be Rs. 61.31 lakhs per MW and shall be escalated at the rate specified in Regulation 19 of these Regulations for the Tariff Period.”

As discussed earlier, the escalation rate has been calculated based on the five years average CPI and WPI indices as 5.89%.

Further, the Commission had continued/extended the FY 2022-23 Tariff Order dated November 7, 2022 for FY 2023-24, and accordingly, various norms for the technology remained the same for FY 2023-24. Therefore, the present base O&M Expense norms for FY 2023-24 are arrived at by escalating FY 2022-23 O&M expense norms by 3.84%, prior to applying the escalating factor for arriving for FY 2024-25 O&M expense norms. Hence, the normative O&M expenses approved for FY 2023-24 have been escalated by 5.89% to arrive at normative O&M expenses for FY 2024-25, which work out to Rs. 72.69 Lakh/MW.

Further, normative O&M expenses, as mentioned above, for FY 2024-25 shall be escalated at a rate of 5.89% per annum for the Tariff Period for the purpose of determination of levelized tariff.

5.7.5. SPECIFIC FUEL CONSUMPTION

The provision for specific fuel consumption for biogas power projects as per the existing RE Tariff Regulations, 2020 is as follows:

“60. Specific Fuel Consumption

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

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

Table 45 Comparison of Specific Fuel Consumption of Biogas notified by SERCs

SERC	CSERC	PSERC	MPERC	RERC	HERC	UERC
Year of Order/Regulation	2023	2020	2021	2022	2021	2023
Specific Fuel Consumption (kg per kWh)	3	3	2.61	3	3	3

In the absence of actual data for Biogas Projects and based on a review of norms adopted by SERCs, the Commission proposes to retain the Specific Fuel Consumption as specified in RE Tariff Regulations, 2020.

5.7.6. FUEL COST (FEED STOCK PRICE)

The provision for Fuel Price for Biogas power projects as per the existing RE Tariff Regulations, 2020 is as follows:

“61. Fuel Cost (Feed stock Price)

Feed stock price during first year of the Control Period i.e. financial year 2020-21 shall be Rs. 1422/MT and shall be escalated at the rate of 5% per annum to arrive at the base price for subsequent years of the Control Period, unless specifically reviewed by Commission. For the purpose of determining levelized tariff, a normative escalation factor of 5% per annum shall be applicable.”

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

Table 46 Comparison of Fuel Cost of Biogas notified by SERCs

SERC	CSERC	PSERC	MPERC	RERC	HERC	UERC
Year of Order/ Regulation	2023	2020	2021	2022	2021	2023
Fuel Cost (Rs. /MT)	2000	1422	1088	1348.8	685	1693

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, 2020.

However, as discussed earlier, the price of the biogas fuel depends on various components, such as remuneration to farmers, costs related to collection and storage, transportation, loading and unloading costs, agent’s commissions, etc. Fuel procurement and transportation are handled by the highly unorganised sector and prices are influenced by local factors.

Hence, in order to take care of variation in prices for such factors, the Commission is specifying a fuel price indexation formula wherein the various components of the base price of the biogas fuel have been linked to indices, i.e., the average ‘Annual Inflation Rate’ for domestic coal to be notified by the CERC from time to time, to take care of the fuel cost. Further, ‘Wholesale Price Index’ and ‘Weighted

Average Price of High Speed Diesel' have been considered to take care of the fuel handling cost and transportation cost, respectively.

The yearly indices for the last 10 years have been provided below for ready reference:

Table 47 Indexation for Labour Cost, HSD and Fuel Cost

Financial Year	Agriculture Labour Index	HSD Index	Non-Coking Coal Index
2021-22	1,075	128	125
2020-21	1,034	80	124
2019-20	980	94	124
2018-19	907	97	123
2017-18	889	84	127
2016-17	870	74	126
2015-16	835	73	115
2014-15	800	115	115
2013-14	750	126	111
2012-13	672	112	103
2011-12	611	111	101

Based on the above indices, the Commission has normalised the fuel cost escalation by applying the average escalation rate determined for FY 2018-19 to FY 2021-22, which works out to be the Agriculture Index of 5.83%, the HSD Index of 9.70%, and the Fuel Index of 0.57%. Thus, the escalation rate has been calculated based on the three-year average of the aforesaid indices by considering the weightage of 20% Agriculture, 20% HSD, and 60% Fuel Cost, respectively. Hence, the proposed escalation factor for computing fuel costs is 3.45%.

Further, the Commission had continued/extended the FY 2022-23 Tariff Order dated November 7, 2022 for FY 2023-24, and accordingly, various norms for the technology remained the same for FY 2023-24. Therefore, the present base fuel cost norms for FY 2023-24 are arrived at by escalating FY 2022-23 fuel cost norms by 5%, prior to applying the escalating factor for arriving at FY 2024-25 fuel cost norms. Hence, the Bagasse fuel cost approved for FY 2023-24 has been escalated by 3.45% to arrive at the fuel cost for FY 2024-25, which works out to 1,702/MT. Further, biogas fuel cost as mentioned for FY 2024-25, shall be escalated at a rate of 3.45% per annum for the Tariff Period for the purpose of determination of levelized tariff.

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, and O&M Expenses for MSW/RDF power projects have been discussed.

The National Electricity Policy highlights the importance of setting up Municipal Solid Waste Energy projects in urban areas with a view to reducing environmental pollution apart from generating additional energy. Promoting MSW based projects is equally important given the scarcity of urban land in the State.

The Commission notes that mass incineration/ refuse derived fuel based technologies are emerging as preferred options for managing the growing problem of waste in the country. Both of the above technologies are part of the incineration process by which electricity generation from Municipal Solid Waste (MSW) is carried out in the power plant. The purpose of the aforesaid technology deployed by the generators is that the minimum discharge of Municipal Solid Waste (MSW) remains available after the process, which will be dumped in landfill sites by the corporation of Urban Development Authorities, so that the burden of waste required to be dumped in landfill sites shall be minimal .

In mass incineration projects, the Municipal Solid Waste received from the Municipal Corporation or Urban Development Authority or Panchayat as the case may be, directly uses as fuel in the generating plant without undergoing any waste processing at the power plant.

In the case of the RDF based plant, the Municipal Solid Waste provided at the doorstep/power plant by the Municipal Corporation/Urban Development Authority at NIL cost is processed by the project developer/generator and converted into Refuse Derived Fuel (RDF). Such processed MSW (RDF) is utilised in the power plant as fuel. Thus, the processing of MSW received at the power plant by the project developer at NIL cost shall require to incur expenditure (cost) towards the installation of equipment/plant for processing MSW, the deployment of manpower for such processes, and also the consumption of energy in the processing unit installed at the generating plant (MSW based power project). It is therefore necessary to factor the processing cost of the MSW received at zero cost at the power plant as per the concession agreement with the corporation by the project developer (generator) by way of the additional cost of process equipment as part of the capital cost. The costs linked to deploying manpower for MSW processing, along with its repair and maintenance, form a part of the project's O&M expenses. Similarly, the consumption of energy in the process equipment also needs to be factored into the auxiliary consumption of the power plant.

The main cost components of MSW to energy projects can be broadly classified into six important categories, i.e., (i) plant and machinery (including pre-processing equipment), (ii) land cost, (iii) civil works, (iv) evacuation infrastructure, (v) associated miscellaneous expenses, and (vi) cost towards

restricting the emissions from the plant within the permissible limits specified in the Solid Waste Management Rules, 2016 (in the case of incineration technology).

The Commission notes that the Concessional Agreement signed by the MSW developers with the Municipal Authorities provides for doorstep delivery of the MSW collected in the city, implying that the developers have to process the incoming raw MSW in the form of processed fuel and use it for power generation in the case of an RDF based power plant.

In view of the above, the Commission decides not to allow any fuel costs in the case of MSW based projects on RDF; instead, the Commission prefers to include the cost of fuel preparation (process equipment) in the overall capital cost of the project, which will address both Capacity Charge and Fuel preparation costs and other incidentals. Hence, the related norms like Station Heat Rate, Fuel cost escalation, Gross Calorific Value, etc. are not applicable to them.

5.8.1. CAPITAL COST

The provision for capital cost for MSW/RDF technology as per the existing RE Tariff Regulations, 2020 is as follows:

“62. Capital Cost

The Commission shall determine only project specific capital cost considering the prevailing market trends.”

The Commission has reviewed capital cost norms specified by various SERCs for MSW/RDF power projects, which are as follows:

Table 48 Comparison of Capital Cost of MSW/RDF based Projects notified by SERCs

SERC	TNERC	MPERC	MERC	KSERC	HERC	UERC
Year of Order/Regulation	2019	2021	2021	2018	2021	2023
Capital Cost (Rs. Lakhs/MW)	17.00	18.50	20.98	16.52	15.00	MSW - 15.00 RDF – 9.00

In addition to the above, the Commission has also analysed the actual project specific capital cost for three plants as received from IREDA, which is as follows:

Projects	Capital Cost (Rs. Crore/MW)
GOODWATTS WTE JAMNAGAR PRIVATE LIMITED	15.79
JINDAL URBAN WASTE MANAGEMENT (GUNTUR) LTD	18.08
JINDAL URBAN WASTE MANAGEMENT (VISAKHAPATNAM) LTD	23.92

Based on the analysis of the capital cost considered by various SERCs, actual data received from IREDA, and consultation with MOHUA, the Commission observed that the capital cost for MSW/RDF based

technology varies significantly within the range of Rs. 15 Crore/MW to Rs. 23.92 Crore/MW. The variation in the capital cost depends on the location and size of the project.

In view of the above, the Commission proposes the capital cost for MSW and RDF as Rs. 1800 Lakh/MW and Rs. 2100 Lakh/MW respectively.

5.8.2. PLANT LOAD FACTOR

The provision for Plant Load Factor for MSW/RDF as per the existing RE Tariff Regulations, 2020 is as follows:

“63. Plant Load Factor

(1) Plant load factor for determining tariff for municipal solid waste based power projects and refuse derived fuel based power projects shall be:

S. No.	Plant Load Factor	MSW	RDF
a)	During Stabilisation Period	65%	65%
b)	During the remaining period of the first year (after stabilisation period)	65%	65%
c)	2 nd Year onwards	75%	80%

(2) The stabilisation period shall not be more than 6 months from the date of commercial operation of the project.”

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

In the absence of actual data for MSW/RDF Projects and based on a review of norms adopted by SERCs, the Commission proposes to retain the Plant Load Factor as specified in the RE Tariff Regulations, 2020.

5.8.3. AUXILIARY CONSUMPTION

The provision for Auxiliary Consumption for MSW/RDF power projects as per the existing RE Tariff Regulations, 2020 is as follows:

“64. Auxiliary consumption

The auxiliary consumption for determination of tariff shall be considered as 15%.”

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

Table 49 Comparison of Auxiliary Consumption of MSW/RDF notified by SERCs

SERCs	TNERC	MPERC	MERC	KSERC	HERC	UERC
Year of Order/Regulation	2019	2021	2021	2018	2021	2023
Aux. Consumption	15%	15%	1 st year - 16.57% 2 nd year – 18.67%	15%	15%	15%

Based on the above analysis, the Commission observes that most of the SERCs are following the approach adopted by CERC.

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

Based on a review of norms adopted by SERCs, and as auxiliary consumption is one of the controllable factors, the Commission proposes to retain the existing Auxiliary Consumption norms as specified in RE Tariff Regulations, 2020.

5.8.4. OPERATION AND MAINTENANCE EXPENSES

The provision for Operation and Maintenance expenses for MSW/RDF based power projects as per the existing RE Tariff Regulations, 2020 is as follows:

“66. Operation and Maintenance expenses

The Commission shall determine only project specific O&M expenses considering the prevailing market trends.”

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 O&M expenses for MSW/RDF projects vary significantly. In view of the above, the Commission proposes the O&M expenses of MSW and RDF technology as 6.5% and 8.5% of the Capital cost, respectively.

5.9. PARAMETERS FOR RENEWABLE HYBRID ENERGY PROJECT

India is actively advancing towards a sustainable and diversified energy future by implementing hybrid renewable energy projects. These initiatives seamlessly integrate multiple renewable sources, such as solar, wind, and occasionally biomass or hydropower, with the aim of optimizing power generation and bolstering grid reliability.

The concept of hybrid renewable energy projects in India epitomises a strategic approach to harnessing the complementary attributes of diverse renewable sources. Notably, solar and wind energy exhibit distinct peak generation periods, and their combination in a hybrid setup ensures a

more consistent and reliable power output. This collaborative synergy effectively addresses the intermittency challenges inherent in individual renewable sources.

Numerous hybrid projects have been launched nationwide, underscoring a dedicated commitment to cleaner and more sustainable energy practices. The incorporation of cutting-edge technologies, including energy storage solutions, further elevates the efficacy of these projects. This integration enables the storage of excess energy during peak generation, facilitating its utilization during periods of lower renewable energy output.

I As stipulated by the MNRE, in a hybrid plant, one resource's rated power capacity should be at least 33% of the rated power capacity of the other resource. In light of this criterion, the Commission suggests that RE projects should be categorized as Hybrid Projects only when the rated capacity of one renewable energy technology constitutes at least 33% of the rated capacity of other renewable energy technologies, and they operate at the same point of interconnection.

5.9.1. Capital Cost

The existing provisions regarding Capital Cost for Renewable hybrid energy projects in RE Tariff Regulations, 2020 are as follows:

“69. Capital Cost

The capital cost shall be determined on project specific basis considering the prevailing market trends.”

The Commission analysed the actual capital cost of renewable hybrid energy projects funded during last three years as given in the Table below:

Table 50: Comparison of Actual Capital Cost of Renewable hybrid energy projects

S. No.	Size	No. of Projects	Capital Cost (Rs. Cr./MW)
1	Upto 150 MW	5	5.6-12.5
2	151 - 300 MW	1	10.7
3	301 - 450 MW	4	5.9-6.5
4	Above 450 MW	1	6.2

Source: Data received from SECI and IREDA

Based on actual Capital Cost data, the Commission observed that per MW cost of Renewable hybrid energy projects varies based on the location, size of the plant, etc. Therefore, based on the prevailing market information, the Commission proposes to determine only the project specific capital cost for renewable hybrid energy projects for the next Control Period.

5.9.2. Capacity Utilisation Factor

The existing provisions regarding Capacity Utilisation Factor for Renewable hybrid energy projects in the RE Tariff Regulations, 2020 are as follows:

“70. Capacity Utilisation Factor

(1) The Commission shall determine only project specific capacity utilisation factor in respect of renewable hybrid energy projects taking into consideration the proportion of rated capacity of each renewable energy source, as the case may be, and applicable capacity utilisation factor for such renewable energy source, as the case may be:

Provided that the minimum capacity utilization factor for renewable hybrid energy project shall be 30% when measured at the inter-connection point, where the energy is injected into the grid.”

In the absence of actual data, the Commission proposes to retain the Capacity Utilisation Factor of renewable hybrid energy projects as specified in the RE Tariff Regulations, 2020.

5.9.3. Operation and Maintenance Expenses

The existing provisions regarding O&M expenses for Renewable hybrid energy projects in the RE Tariff Regulations, 2020 are as follows:

“71. Operation and Maintenance expenses

The Commission shall determine only project specific O&M expenses considering the prevailing market trends.”

The Commission proposes to continue to determine only Project Specific O&M Expenses for Renewable hybrid energy Projects for the next Control Period.

5.10. PARAMETERS FOR RENEWABLE ENERGY WITH STORAGE PROJECT

India has been actively embracing renewable energy sources, and the integration of energy storage systems is gaining prominence in its sustainable energy landscape. Various initiatives are underway to implement renewable energy storage projects. These endeavours aim to enhance grid stability, reduce dependency on conventional power sources, and promote a cleaner and more sustainable energy mix. The storage component enables the capture and storage of excess energy generated during peak times, which can then be released during periods of low renewable energy generation.

The deployment of renewable energy with storage projects is crucial for India's energy transition goals, aligning with the government's commitment to increasing the share of renewable energy in the overall energy mix. These projects contribute to mitigating the challenges posed by the variability of renewable sources, making them a more reliable and resilient part of the energy infrastructure. As

India continues to advance its renewable energy agenda, the integration of energy storage technologies represents a significant step forward in achieving a greener and more sustainable energy future for India.

5.10.1. Capital Cost:

The capital cost of RE with storage project includes the capital cost of the RE project, the capital cost of Storage and other common infrastructure. The existing provisions regarding capital costs for renewable energy with storage projects in the RE Tariff Regulations, 2020 are as follows:

“73. Capital Cost

The Commission shall determine only project specific capital cost for renewable energy with storage project considering the prevailing market trends”

As the renewable energy with storage project is in the nascent phase of development, establishing a standardised benchmark for the capital cost of energy storage remains a challenging endeavour. Moreover, the configuration of storage systems is intricately tied to the variations of renewable energy technologies and their diverse applications. Hence, it is proposed to determine the cost of RE with storage projects on a project specific basis. The capital cost of the RE with Storage project shall be determined considering the prevailing market trends.

5.10.2. Storage Efficiency:

The existing provisions regarding storage efficiency for renewable energy with storage projects in the RE Tariff Regulations, 2020 are as follows:

“74. Storage Efficiency

(1) The Commission shall approve the storage efficiency only for project specific tariff:

Provided that the minimum efficiency for storage based on technology of solid state batteries shall be 80%:

Provided further that the minimum efficiency for storage based on technology of pumped storage shall be 75%:

(2) Efficiency of storage component of renewable energy 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 the absence of actual data, the Commission proposes to retain the Storage Efficiency of renewable energy with storage projects as specified in RE Tariff Regulations, 2020.

5.10.3. Operation and Maintenance expenses:

The existing provisions regarding Operation and Maintenance expenses for Renewable energy with storage projects in the RE Tariff Regulations, 2020 are as follows:

“75. Operation and Maintenance expenses

The Commission shall determine only project specific O&M expenses considering the prevailing market trends.”

As the renewable energy with storage project is in the nascent phase of development, establishing a standardised benchmark for the O&M expenses of energy storage remains a challenging endeavour. Moreover, the configuration of storage systems is intricately tied to the variations of renewable energy technologies and their diverse applications. Hence, it is proposed to determine the cost of RE with storage projects on a project specific basis. The O&M expenses of the RE with Storage project shall be determined considering the prevailing market trends.