



TAMIL NADU ELECTRICITY REGULATORY COMMISSION

Consultative Paper on Generic Tariff order for Grid Interactive Solar Energy generation System (GISS)

(Comments invited by 01-09-2021)

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Consultative Paper on Generic Tariff order to Grid - interactive Solar Energy generation system (GISS)

1.0 Introduction

1.1. The importance of grid connected solar energy generation system

1.1.1. The Tamil Nadu Solar Energy Policy 2019 includes a consumer category solar energy target of 3,600 MW by 2023. As of 31st March 2021, only 9.03 % of this target has been achieved. The Tamil Nadu Solar Energy Policy 2019 introduced two metering mechanisms for rooftop/ ground mounted solar energy systems; net feed-in and gross feed-in, whereby the consumers could opt between the two metering mechanisms.

1.1.2. The Commission had issued Tariff Order No. 3 of 2019 (Order on Rooftop Solar Generation) dated 25-03-2019. The tariff was determined as 75% of: i) pooled cost of power purchase for the respective financial year, or ii) the last feed-in tariff determined by the Commission, or iii) the tariff discovered in latest bidding, whichever is less. For the financial year 2021-2022, this works out to be INR 2.08 per kWh.

1.1.3. Clause 9.2 of the Tamil Nadu Solar Energy Policy states that the Commission “ may introduce time-of-the-day (TOD) solar energy feed-in tariffs to encourage solar energy producers and solar energy storage operators to feed energy into the grid when energy demand is high.” With the declining cost of battery energy storage systems it is expected that prosumers will install consumer category solar energy system coupled with battery storage. These battery energy storage systems at the prosumer level (behind-the-meter) can provide essential grid services such as peak shaving, peak shifting and voltage support.

1.2. Need for the consultative paper

1.2.1. As of 31 March 2021, there is an installed capacity for rooftop solar energy of

325 MW to achieve the target set for 2023 another 3,275 MW will need to be added. Electricity (Rights of Consumers) Amendment Rules 2021 of GoI has furthered avenue for Net metering, gross metering and net billing and contemplates TOD meter in line with Tamil Nadu Solar Policy as follows:

“ The arrangements for net-metering, gross-metering, net-billing or net feed-in shall be in accordance with the regulations made by the State Commission, from time to time:

Provided that where the regulations does not provide for net-metering, net-billing or net feed-in, the Commission may allow net metering to the Prosumer for loads up to five hundred Kilowatt or up to the sanctioned load, whichever is lower and net-billing or net feed-in for other loads:

Provided further that in the case of Prosumers availing net-billing or net feed-in, the Commissions may introduce time-of-the-day tariffs whereby Prosumers are incentivised to install energy storage for utilization of stored solar energy by them or feeding into the grid during peak hours thus helping the grid by participating in demand response of the Discoms:

Provided also that in case of net-metering or net-billing or net feed-in, the distribution licensee may install a solar energy meter to measure the gross solar energy generated from the Grid Interactive rooftop Solar Photovoltaic system for the purpose of renewable energy purchase obligation credit, if any:

Provided also that the Commission may permit gross-metering for Prosumers who would like to sell all the generated solar energy to the distribution licensee instead of availing the net-metering, net-billing or net feed-in facility and the Commission shall decided for this purpose the generic tariff for gross-metering as per tariff Regulations.”

Thus a regulation needs to be enacted on reviewing the existing orders and norms and revising the same in accordance with the Consumer Rules. Also a generic tariff order on charges for net-metering, gross-metering, net-billing needs to be determined as contemplated in the consumer rules besides creating a substantial consumer awareness and information campaigns for the diverse set of consumers to achieve the objective of the solar policy.

As on 31st March 2021, Tamil Nadu has a total installed power generation capacity of 33,695 MW (CEA, Executive Summary on Power Sector, March 2021). The rooftop solar energy capacity installed in Tamil Nadu as of 31st March 2021 represents 0.96% the total installed power capacity and approximately 0.20% of the total energy consumption in the State.

Month and Year	Rooftop solar capacity (MW)	% of 2023 target	Capacity addition required to meet the 2023 target (MW)
March 2019	142.95	3.97	3,457
March 2021	325.06	9.03	3,275

1.2.2. Energy fed into the grid from rooftop solar systems and behind the meter energy storage systems does not require transmission and significantly reduces distribution losses since most of the generated energy is consumed at, or near to the point of generation. This is expected to reduce the Licensee's average cost of supply. Additional benefits include:

- (a) voltage improvements;
- (b) reduction of transmission capacity charges;
- (c) Reduction of stress on lines and equipments;
- (d) generation-consumption matching (during grid outage both generation and consumption stop while in utility category systems generation stops with consumption carrying on elsewhere)
- (e) deferral of infrastructure up gradation.

1.2.3. In order to accelerate the deployment of consumer category solar energy systems and to meet the State's target of 3,600 MW by 2023 a new grid connected solar energy tariff order that applies to all categories of metering mechanisms is proposed. Additionally, the introduction of a ToD (time-of-the-day) feed-in tariff premium aims at promoting the uptake of grid-interactive prosumer energy storage systems.

1.2.4. With the proposed revision of norms of gross metering, net metering and net feed-in mechanism the tariff applicable to the exported energy has been delinked from consumer tariffs.

1.2.5. Consumers may benefit from the self-consumption of solar energy, depending on the consumer retail tariff, the quantity of solar energy self-consumption and the times of the day of self-consumption. Daytime energy demand is different for each consumer and changes throughout the year. Solar energy feed-in tariffs must be based on the cost of distributed solar energy generation and should not be linked to consumer tariffs or perceived or estimated self-consumption benefits. In this regard what matters is the energy transactions that takes place at the common point of service connection where both the energy import from the grid and energy export to the grid take place. Whether the consumer reduces consumption by installing energy efficient equipment, changing lifestyles or using a part of the generated solar energy for own consumption, is not relevant for arriving at a feed-in tariff for the exported solar energy.

1.2.6. Prosumer metering in other countries: In most west-European countries net-metering is still the standard practice. In the USA 38 states have mandatory net-metering rules. Australia and Canada also provide net-metering to its prosumers and is considered a foundation for the promotion of renewable energy systems. Net-metering in these countries makes more sense as there are typically only two consumer tariff rates, one rate for HT consumers and one rate for LT consumers. (Typically, the HT tariff is lower than the LT tariff as the HT consumers are bearing the downstream LT distribution losses). Sometimes net-metering is combined with net feed-in whereby export that does not exceed import on an annual basis is adjusted with import (net-metering) while export in excess of import is paid for (net feed-in); always with a single bidirectional energy meter (with vector summation in the case of three phase meters).

2.0 Technology

2.1.1. Solar photovoltaic technology: Photovoltaic (PV) is the direct method of converting sunlight into electricity through a device known as the “Solar Cell”. Many different solar cell technologies such as mono-crystalline and poly-crystalline silicon, thin films such as amorphous silicon, micro morph, cadmium telluride, copper indium gallium selenide and concentrator-based high-efficiency III-V, etc. are available in the market today. Further, substantial R&D efforts are also underway globally for enhancing efficiencies, developing novel cell technologies that entail reduction of cost of these solar cells.

2.1.2. Energy storage systems: There are multiple battery energy storage technologies such as lithium-ion (Li-ion), lead-acid and advanced lead-acid available. These differ in their capital and operation cost, round-trip efficiency, cycle life, energy-to-power ratio etc. For solar energy systems with battery energy storage

grid interactive hybrid inverters are required.

- 2.2.** Technologies and standards under consideration: Each of these technologies have different cost implications based on their efficiency, reliability, durability and other requirements. The final selection of the technology shall be left to the Prosumer. The minimum technical requirements would be as per the regulations/specifications issued by the Central Electricity Authority, State Regulatory Commission and Ministry of New and Renewable Energy and the Prosumers shall adhere to them.

3.0 Legal provisions

3.1. Related Provisions of Electricity Act,2003

3.1.1. Section 3(1): *“The Central Government shall, from time to time, prepare the National Electricity Policy and tariff policy, in consultation with the State Governments and the Authority for development of the power system based on optimal utilisation of resources such as coal, natural gas, nuclear substances or materials, hydro and renewable sources of energy”.*

3.1.2. Section 61: *“The Appropriate Commission shall, subject to the provisions of this Act, specify the terms and conditions for the determination of tariff, and in doing so, shall be guided by the following, namely:*

(a) the generation, transmission, distribution and supply of electricity are conducted on commercial principles;

(b) the factors which would encourage competition, efficiency, economical use of the resources, good performance and optimum investments;

(c) Safeguarding of consumers' interest and at the same time, recovery of the cost

(d) the promotion of cogeneration and generation of electricity from renewable sources of energy;

(e) the National Electricity Policy and tariff policy:”

3.1.3. Section 86(1)(e): *“The State Commission shall promote cogeneration and generation of electricity from renewable sources of energy by providing suitable measures for connectivity with the grid and sale of electricity to any person, and also specify, for purchase of electricity from such sources, a percentage of the total consumption of electricity in the area of a distribution licensee;”*

3.2. Relevant provisions of National Electricity Policy are reproduced below:

3.2.1. Section 5.2.20: *“Feasible potential of non-conventional energy resources, mainly small hydro, wind and bio-mass would also need to be exploited fully to create additional*

power generation capacity. With a view to increase the overall share of non-conventional energy sources in the electricity mix, efforts will be made to encourage private sector participation through suitable promotional measures.”

Section 5.12.2:“The Electricity Act 2003 provides that co-generation and generation of electricity from non-conventional sources would be promoted by the SERCs by providing suitable measures for connectivity with grid and sale of electricity to any person and also by specifying, for purchase of electricity from such sources, a percentage of the total consumption of electricity in the area of a distribution licensee. Such percentage for purchase of power from non-conventional sources should be made applicable for the tariffs to be determined by the SERCs at the earliest. Progressively the share of electricity from non-conventional sources would need to be increased as prescribed by State Electricity Regulatory Commissions. Such purchase by distribution companies shall be through competitive bidding process. Considering the fact that it will take some time before non-conventional technologies compete, in terms of cost, with conventional sources, the Commission may determine an appropriate differential in prices to promote these technologies.”

3.3. Relevant sections of the Power Procurement from New and Renewable Sources of Energy Regulation, 2008:

3.3.1. Regulation 4(2): *“While deciding the tariff for power purchase by distribution licensee from new and renewable sources-based generators, the Commission shall, as far as possible, be guided by the principles and methodologies specified by:*

- (a) Central Electricity Regulatory Commission*
- (b) National Electricity Policy*
- (c) Tariff Policy issued by the Government of India*
- (d) Rural Electrification Policy*
- (e) Forum of Regulators (FOR)*
- (f) Central and State Governments”*

3.3.2. Regulation 4 (3): *“The Commission shall, by a general or specific order, determine the tariff for the purchase of power from each kind of new and renewable sources- based generators by the distribution licensee.”*

“Provided where the tariff has been determined by following transparent process of bidding in accordance with the guidelines issued by the Central Government, as provided under section 63 of the Act, the Commission shall adopt such tariff.”

3.3.3. Relevant provisions of the Electricity (Rights of Consumers) Rules 2020, read with the Electricity (Rights of Consumers) Amendment Rules 2021.

3.3.4. Rule 2 (ia): *“‘gross-metering’ means a mechanism whereby the total solar energy*

generated from Grid Interactive rooftop Solar Photovoltaic system of a Prosumer and the total energy consumed by the Prosumer are accounted separately through appropriate metering arrangements and for the billing purpose, the total energy consumed by the Prosumer is accounted at the applicable retail tariff and total solar power generated is accounted for at feed-in tariff determined by the Commission;”

Rule 2 (ja): *“ ‘net-billing or net feed-in’ means a single bidirectional energy meter used for net-billing or net feed- in at the point of supply wherein the energy imported from the Grid and energy exported from Grid Interactive rooftop Solar photovoltaic system of a Prosumer are valued at two different tariffs, where-*

(i) the monetary value of the imported energy is based on the applicable retail tariff;

(ii) the monetary value of the exported solar energy is based on feed-in tariff determined by the Commission;

(iii) the monetary value of the exported energy is deducted from the monetary value of the imported energy to arrive at the net amount to be billed (or credited / carried-over)”;

Rule 2 (jb): *“ ‘net-metering’ means a mechanism whereby solar energy exported to the Grid from Grid Interactive rooftop Solar Photovoltaic system of a Prosumer is deducted from energy imported from the Grid in units (kWh) to arrive at the net imported or exported energy and the net energy import or export is billed or credited or carried-over by the distribution licensee on the basis of the applicable retail tariff by using a single bidirectional energy meter for net-metering at the point of supply;”*

3.3.5. Rule 11, sub-rule 4: *“The arrangements for net-metering, gross-metering, net-billing or net feed-in shall be in accordance with the regulations made by the State Commission, from time to time:*

Provided that where the regulations do not provide for net-metering, net-billing or net feed-in, the Commission may allow net metering to the Prosumer for loads up to five hundred Kilowatt or up to the sanctioned load, whichever is lower and net-billing or net feed-in for other loads:

3.3.6. *Provided further that in the case of Prosumers availing net-billing or net feed-in, the Commissions may introduce time-of-the-day tariffs whereby Prosumers are incentivised to install energy storage for utilization of stored solar energy by them or feeding into the grid during peak hours thus helping the grid by participating in demand response of the Discoms:*

3.3.7. *Provided also that in case of net-metering or net-billing or net feed-in, the distribution licensee may install a solar energy meter to measure the gross solar energy generated from the Grid Interactive rooftop Solar Photovoltaic system for the purpose of renewable energy*

purchase obligation credit, if any:

3.3.8. *Provided also that the Commission may permit gross-metering for Prosumers who would like to sell all the generated solar energy to the distribution licensee instead of availing the net-metering, net-billing or net feed-in facility and the Commission shall decide for this purpose the generic tariff for gross-metering as per tariff regulations:”*

3.3.9. **Rule 13:** *“The solar energy generated by prosumer shall be adjusted against energy consumed and bill amount as per regulations made by the Commission for Grid Interactive rooftop Solar Photovoltaic system.”*

4.0 Tariff determination process

With regard to tariff determination process, the relevant portion of TNERC Regulation 4 of the Power Procurement from New and Renewable Sources of Energy Regulation, 2008 is reproduced below:

“The Commission shall follow the process mentioned below for the determination of tariff for the power from new and renewable sources-based generators, namely;

- a) Initiating the process of fixing the tariff either suo motu or on an application filed by the distribution licensee or by the generator.*
- b) Inviting public response on the suo motu proceedings or on the application filed by the distribution licensee or by the generator.*
- c) Issuing general / specific tariff order for purchase of power from new and renewable sources-based generators.”*

5.0 Tariff pricing and methodology

5.1. Tariff / Pricing Methodology specified in Regulation 4 of the Commission’s Renewable energy 2008 Regulation is reproduced below.

“(2) While deciding the tariff for power purchase by distribution licensee from new and renewable sources-based generators, the Commission shall, as far as possible, be guided by the principles and methodologies specified by:

- a) Central Electricity Regulatory Commission*
- b) National Electricity Policy*
- c) Tariff Policy issued by the Government of India*
- d) Rural Electrification Policy*
- e) Forum of Regulators(FOR)*
- f) Central and State Governments*

(3) The Commission shall, by a general or specific order, determine the tariff for the purchase of power from each kind of new and renewable sources-based generators by the distribution licensee.

(4) While determining the tariff, the Commission may, to the extent possible consider to permit an allowance / disincentive based on technology, fuel, market risk, environmental benefits and social impact etc., of each type of new and renewable source.

(5) While determining the tariff, the Commission shall adopt appropriate financial and operational parameters.

(6) While determining the tariff the Commission may adopt 1[appropriate tariff methodology].”

6.0 Tariff Determination and Components

6.1. Tariff determination, based on a levelized cost of energy calculation is proposed for both the net feed-in and gross feed-in mechanisms for consumer-category solar energy. This is also in line with Regulation 4(6) of “Power Procurement from New and Renewable Sources of Energy Regulations 2008”.

6.2. The tariff determined in a cost-plus scenario, would depend significantly on the following operating and financial parameters:

1. Capital cost
2. Debt-equity ratio
3. Loan term and interest
4. Capacity Utilisation Factor (CUF)
5. Operation and maintenance cost
6. Insurance
7. Depreciation rate applicable
8. Interest on working capital
9. Economic life of plant and machinery

These parameters are discussed in the section below:

6.2.1. **Capital Investment:** Ministry of New and Renewable Energy has published benchmark costs for rooftop solar PV systems as per table below:

Capacity Range	Benchmark cost (INR per Watt)
1 kW	47
>1 kW 2 kW	43
>2 kW to 3 kW	42
>3 kW to 10 kW	41

>10 kW to 100 kW	38
100 kW to 500 kW	36

The Commission proposes to use three capacity categories and capital costs for the tariff determination.

- (i) System capacities from 1 to 10 kW : INR 41 per Watt
- (ii) System capacities from 11 to 100 kW: INR 38 per Watt
- (iii) System capacities from 101 to 500 kW: INR 36 per Watt
- (iv) System capacities from 501 kW to 999 kW : INR 32 per Watt (in absence of benchmark cost for this category , this cost has been fixed proportionate to the cost applicable to lower capacities below 500 KW)

The Capital cost as proposed shall be inclusive of all equipment costs and labour cost for the design and installation of the solar PV system.

6.2.2. **Debt - equity ratio and return on equity:** The National Tariff Policy lays down a debt equity ratio of 70: 30 for power projects. The Commission has considered 30% equity funding for the net capital cost and proposes a return on equity of 16.96%.

6.2.3. **Term of loan and interest:** In its KUSUM-C order in M.P. No.2 of 2020, dated 10-11-2020, the Commission adopted a loan tenure of 11 years which includes a one-year principal repayment moratorium and an interest rate of 9.50%. The Commission has proposed to adopt the same term of loan an interest rate.

6.2.4. **Capacity utilization factor:** The Commission is of the view that the grid availability for solar PV systems at consumer premises will be lower than for utility scale systems connected to dedicated feeders or sub-feeders at 11KV or higher voltage levels. The Commission proposes to consider a CUF of 19.00% and additionally a grid availability factor of 90.00%.

6.2.5. **Operation and Maintenance Cost:** The Commission proposes to adopt 1.40% of gross capital cost as the O&M cost with an annual increase of 5.72%.

6.2.6. **Insurance:** The Commission considers 0.35% of depreciated gross capital cost as insurance cost.

6.2.7. **Depreciation:** The Commission proposes an annual depreciation rate of 3.60% on the net capital cost, which results in a residual value of 10.00%.

6.2.8. **Interest on Working Capital:** The commission proposes working capital requirements of one month for O&M costs and two months for receivables with a

working capital interest rate of 10.50%.

6.2.9. **Discount Factor:** Commission proposes to adopt a discount factor of 8.67%.

6.2.10. **Life of plant and machinery:** Commission considers an economic life of 25 years as adopted in its earlier orders on rooftop solar generation.

7.0 **Tariff Rate**

7.1. Net feed-in and gross feed-in tariffs

Tariff Components	Values
Capital cost for solar PV system; capacity range: 1 – 10 kW	INR 41,000 per kW
Capital cost for solar PV system; capacity range: 11 – 100 kW	INR 38,000 per kW
Capital cost for solar PV system; capacity range: 101 – 500 kW	INR 36,000 per kW
Capital cost for solar PV system; capacity range: 501kW – 999kW	INR 32,000 per kW
Capacity Utilisation Factor (CUF)	19.00%
Daytime Grid availability factor	90.00%
Operation and maintenance expenses	1.40% of gross capital cost
Operation and maintenance annual cost escalation	5.72%
Insurance	0.35% on depreciated gross capital cost
Debt-Equity ratio	70:30
Life of plant and machinery	25 years
Return on Equity	16.96% (pre-tax)
Term of Loan	10 years with 1 year moratorium period
Interest on loan	9.50%
Depreciation	3.60% per annum
Working Capital components	one month O&M cost and two months receivables
Interest on working capital	10.50%
Discount factor	8.67 %
Levelised cost of energy for solar PV systems; capacity range: 1- 10 kW	INR 3.99 per kWh

Levelised cost of energy for solar PV systems; capacity range: 11- 100 kW	INR 3.70 per kWh
Levelised cost of energy for solar PV systems; capacity range: 101 to 500 kW	INR 3.51 per kWh
Levelised cost of energy for solar PV systems; capacity range : from 501KW to 999kW	INR 3.12 per kWh

The

financial and operational parameters proposed are tabulated below:

7.1.1. The solar energy tariffs computed with the above-mentioned parameters are **INR 3.99** per kWh (25 years fixed) for solar system capacities up to 10 kW , **INR 3.70** per kWh for solar system capacities from 11 to 100 kW , **INR 3.51** per kWh for solar system capacities from 101 to 500 KW and **INR 3.12** per kWh for solar system capacities from 501KW to 999 kW.

7.1.2. The solar energy tariff determined herein will apply to grid connected solar energy systems for all consumer categories of all voltage levels.

7.2. Time of Day tariffs

7.2.1 Clause 9.2 of the Tamil Nadu Solar Energy Policy reads as follows: “9.2 TNERC may introduce time-of-the-day (ToD) solar energy feed-in tariffs to encourage solar energy producers and solar energy storage operators to feed energy into the grid when energy demand is high”. Sub-rule 4 of Electricity (Rights of Consumers) Amendment Rules, 2021 provides that “in the case of Prosumers availing net-billing or net feed-in, the Commission may introduce time-of-the-day tariffs whereby Prosumers are incentivised to install energy storage for utilization of stored solar energy by them or feeding into the grid during peak hours thus helping the grid by participating in demand response of the Discoms”.

7.2.2 The Commission proposes to introduce a time-of-day premium tariff during high demand periods, to promote and incentivise investments in solar energy storage systems. The ToD solar energy feed-in tariffs will be higher than the proposed LCOE (Levellised Cost Of Energy) based tariffs and shall apply for evening peak hours (18:00h – 21:00h) or such other time slots as the Commission may decide.

7.2.3 The ToD feed-in tariff will be determined by adding a percentage premium to the standard solar feed-in tariffs to account for the additional capital investment by the prosumer for the hybrid inverter and the energy storage system. The ToD premium accounts for an additional capital investment for the hybrid inverter and the energy

storage system. The ToD solar feed-in tariff is proposed to be 20% higher than the feed-in tariffs in this order.

7.2.4 This would result in 25-year fixed peak hour ToD feed-in tariffs as follows:

- (i) System capacities up to 10 kW : **INR 4.79** per kWh
- (ii) System capacities from 11 to 100 kW : **INR 4.44** per kWh
- (iii) System capacities from 101 to 500 kW : **INR 4.21** per kWh
- (iv) System capacities from 501 kW to 999 kW : **INR 3.74** per kWh

7.2.5 It is submitted that the proposed peak hour ToD feed-in tariffs are lower than the average cost of supply of TANGEDCO and are therefore a beneficial proposition for all stakeholders. It is expected that with this tariff structure, prosumers will be encouraged to install energy storage systems whereby with the estimated quantum of energy export during peak hours from these systems, their energy storage investment becomes viable.

8 Net work charges:

8.1 Section 61 of the Electricity Act insists that the generation, transmission, distribution and supply of electricity are conducted on commercial principles. Regulation 4 of the Commission's Renewable energy 2008 Regulation stipulates that while determining the tariff, the Commission shall adopt appropriate financial and operational parameters.

- Grid interactive support is the ingredient component of any grid connected solar system, without which the solar generating system would become non-functional.
- While the development of solar has been on the rise in the past decade with isolated investments of individual projects, the supportive Grid on which these solar systems depend for their operation, had been developed with huge investment and being maintained with equally huge recurring expenditure.
- When a dual investment is made for network system and solar system collectively in order to make them to co-exist and complement each other to operate in tandem, the substantial investment pertaining to half portion of the system cannot be ignored.
- Thus the component of the charges pertaining to essential linkage of grid to generate solar power has to be necessarily made a part of charges to be determined holistically for generic solar tariff.

- 8.2 This network charges shall be applicable to consumers of net-metering and net-billing mechanism for the total units generated by the solar systems. Such charges to be recovered from the prosumers will be covered within the total Aggregate Revenue Requirement as envisaged in the amendment to the Terms and conditions for Tariff Regulation 2005 as notified vide TNERC/TR/5/3 dated 26.05.21.
- 8.3 Net work charges shall not be applicable for consumers of gross metering mechanism as it involves direct sale of the units generated by their solar system to the Licensee.
- 8.4 Net work charges shall be applicable to all existing and new consumers except for consumers who sell the generated units directly to the Licensee under Geoss metering mechanism.
- 8.5 Net work charges shall be applicable to the prosumers categorised under net metering or net billing or net feed in mechanism , as determined by the commission under regulation 70 of TNERC (Terms and conditions for determination of Tariff) Regulations 2005, from time to time.
- 8.6 To encourage the growth of solar power in domestic sector the commission proposed 20% of network charges for domestic consumers of up to 10KW and 75% of network charges for the domestic consumers of above 10KW. 100% net work charges shall be applicable to all other category of consumers.
- 8.7 The total units recorded in the meter to be installed for assessment of generation of solar power shall be reckoned for calculation of network charges.

8.8 Determination of Network charges:

- 8.8.1 As envisaged above, the investment made for 'Distribution Network system' is recoverable from the prosumer for availing the support of network system. In this connection, as regulated under TNERC GISS Regulations 2021, the 'Network charges' is applicable for the units generated by the Solar Rooftop systems categorized under "Net-metering" mechanism and "Net feed-in/Net billing" mechanism.

Under the provisions of Regulation 70 of TNERC (Terms and conditions for Determination of Tariff) Regulations 2005, the Network charges shall be determined based on the accounting records furnished by the Licensee towards the cost of the Distribution Wires Business. TANGEDCO submitted the allocated network cost duly

apportioning the Aggregate Revenue Requirement between Distribution Wire business and Retail supply business based on its Audited Annual accounts for the FY 2019-20 to arrive at the Network charges.

8.8.2 TANGEDCO has considered segregation of network cost into HT and LT levels in the ratio of 70:30. The HT level infrastructure (i.e., 70%) is the network for the ultimate use of both HT & LT level consumers. Hence, the cost of such (70%) common infrastructure is apportioned between HT & LT level sales, based on the ratio of sales to HT & LT category consumers. The remaining portion of the Network cost in HT level as well as the 30% of the segregated cost towards LT level to be appropriated to LT category Sales. Adopting such methodology and after thorough verification of audited accounts furnished by the TANGEDCO, the Commission disallowed certain items and approved the Network cost below:

Sl. no.	Expenses	(Rs. In Crores)	FY 2019-20		Disallowed items	Network cost approved by the TNERC
			Ratio for Wire Business as per Regu.70 of Tariff Regulations	Proportionate expenses for Wire business		
1	Operation and Maintenance expenses	8161.25	65%	5304.81		5304.81
2	Interest on Loan capital & other interest & Finance charges	4402.64	90%	3962.38	1386.83	2575.54
3	Depreciation	1405.7	90%	1265.13		1265.13
4	Interest on Working Capital	63.51	10%	6.35		6.35
5	Return on Equity	491.8	90%	442.62	442.62	0.00
6	Other Debits	32.91	10%	3.29	3.29	0.00
	Total Network Cost	14557.81		10984.58	1832.74	9151.84

The TANGEDCO submitted that it has incurred Rs.10,984.58 Crores towards in Distribution Wire business during the FY 2019-20; out of this, certain expenses found abnormal compared with the true up data for the year 2015-16 and ARR for the year 2018-19 of the Commission's Tariff order dated 11-08-2017.

8.8.3 The Commission considered the Depreciation, Interest on Working capital and O&M expenses are found reasonable comparing with the cost approved for the year 2015-16; and other items are restricted for the reasons stated below:

- (i) **Interest on Loan capital:** According to allocation matrix given under the Tariff Regulations 2005, Rs.3962.38 has been claimed under Interest on Loan capital. At the time of issuing the T.O. for the year 2017-18, in its True up process for the FY 2015-16, the Commission observing the discrepancy in bifurcation of Gross Fixed Assets between the companies, based on certain assumptions restricted the Interest on Loan capital, which was around 65% against its claim. Considering the true up exercise pending for the FY 2016-17 to 2018-19, we are inclined to restrict the Interest on Loan capital upto 65% only.
- (ii) **Return on Equity:** In the T.O. dated 11-08-2017, the Commission had its view that TANGEDCO is mixing the Revenue account with Capital account and the equity approved may again diverged to Revenue Account; the actual borrowings were significantly higher than capital expenditure, hence, the Commission in line with decision taken in Suo motu Order dated 11th December 2014, adopted the same approach while approving the RoE; no RoE was considered in T.O. dt.11-08-2017 too. Therefore in the absence of any justification towards claim of Return on Equity in this petition, the Commission disallowed the same.
- (iii) **Other Debts:** In the absence of any norms for Other Debts and adequate details in the petition, the Commission disallowed the same.

8.8.4 Considering the Network cost arrived at as above, the Commission approved 'Network charges' as shown below.

Sl. No.	Details		HT level	LT level	Total
1	Ratio of Network cost	(a)	70%	30%	100%
2	Apportioned Network cost	(b)	6406.29	2745.55	9151.84
3	Proportionate Network cost for HT @ Sales ratio (Rs.Crores)	$(6406.29) * (14867 / 77391) = (c)$	1230.66		
4	Remaining Network cost belongs to LT	$(9151.84 - 1230.66) = (d)$		7921.18	

5	Energy sent through (in MU)	(e)	14867	62524	77391
6	Network charges / kWh (in Rs.)	HT level=(c)/(e) LT level=(d)/(e)	0.83	1.27	

8.8.5 The Network charges towards the Distribution wire business is chargeable to HT prosumers at 83 Paise / kWh and for LT prosumers at Rs.1.27 / kWh. The above charges is applicable to all existing and new prosumers as specified under respective category until the 'Network charges' is revised by the Commission in the next Tariff Order or in any other special order.

9 Applicability

9.1 **Net- metering** : All domestic consumers are eligible for Net metering mechanism up to the level of sanctioned load/ contracted demand. All categories of consumers irrespective of load, tariff and voltage level are eligible both mechanisms of for Net feed-in and gross feeding according to their option between them.

Domestic consumers who have been provided with the solar net-feed-in facility as per TNERC Order No.3 of 2019 shall have option to migrate to the solar energy net metering mechanism as provided for in this order to avoid discrimination within the same category of consumers.

9.2 **Net billing or net feed-in**: The solar energy net billing or net feed-in mechanism will be available to all electricity consumer categories irrespective of tariff and voltage levels up to the level of sanctioned load/contracted demand.

9.3 **Gross Metering**: The solar energy gross metering mechanism will be available to all existing consumers of all category and tariff as well as new applicants. The minimum size of the Solar System that can be set up under Gross Metering mechanism shall be 1 kW up to a maximum capacity of 999 kW.

9.4. Consumers with pending arrears / outstanding due with the Distribution Licensee shall not be eligible for provisions under this regulation.

9.5 Electricity consumers who have been provided with the solar net-metering facility under the Tamil Nadu Solar Energy Policy 2012 may add additional solar energy capacity and retain the solar energy net-metering facility, provided that the total solar energy capacity shall not exceed the sanctioned load of the service connection as already provided for in the Commission's Order dated 22-12-2020 in M.P. no. 32 of 2020.

- 9.6 Electricity consumers who have been provided with the grid paralleling facility for their solar energy systems have the option to retain the solar energy grid paralleling facility or migrate to the solar energy net feed-in or solar energy gross feed-in mechanism as provided for in this Order. The parallel operation charges shall cease to be applicable upon such migration.
- 9.7 These proposed regulations shall supersede the earlier regulations and statutory orders issued by the Commission so far and for all practical and resolutions of disputes, only these regulations shall prevail without prejudice to all actions taken and orders issued under the earlier orders and regulations.

10. Energy Metering

10.1 Net-metering mechanism and Net feed-in mechanism: At service connection point, a single bidirectional energy meter to record the energy import from the TANGEDCO grid and energy export to the TANGEDCO grid shall be provided. This shall be a digital four quadrant vector summation energy meter configured for bidirectional energy measurement whereby both imported and exported active energy readings and allied parameter are programmed to be displayed. The bidirectional energy meter shall have programmable ToD (time-of-the-day) registers with a minimum of four energy import ToD registers and four energy export ToD registers.

Gross-metering mechanism: An energy meter to record the gross solar energy generation shall be provided. This meter is to be installed immediately after the solar grid inverter. The energy meter shall have programmable ToD (time- of-the-day) registers with a minimum of four energy export ToD registers. The total solar power generated is accounted for feed-in tariff determined by the Commission from time to time. The energy consumed by the prosumer is metered and accounted separately.

10.2 Energy meters shall be of class 1.0 accuracy and shall comply with applicable CEA (Central Electricity Authority) and BIS (Bureau of Indian Standards) standards.

11 Energy Billing and accounting process

11.1 Net metering :

The solar energy exported to the Grid from grid connected solar photovoltaic system is deducted from energy imported from the grid in units to arrive at the net imported or exported energy. The net imported or exported energy is billed or credited or carried over on the basis of the retail tariff.

This process shall continue until the end of the settlement period. At the end of the settlement period, credit i.e the net units of surplus generation available if any shall get lapsed.

Domestic category deserves the facility of net metering where the solar energy generated during the day time does not have scope to be fully consumed in view of the fact that the lighting load predominantly used in domestic usage takes place only in night. Section 5.12.2 of the Electricity Act 2003 emphasises that progressively the share of electricity from non-conventional sources would need to be increased as prescribed by State Electricity Regulatory Commissions. Hence this commission is of the view that in order to accelerate the pace of growth solar system in domestic sector and encourage the potential domestic consumers to widely opt for the solar energy and also to meet the target set by the State Government, the net metering facility shall be made eligible for all domestic category consumers to the limit of individual sanctioned load.

11.2 Net billing or Net feed-in:

The monetary value of the imported energy is debited based on the applicable retail tariff; The monetary value of the exported energy is credited based on the feed-in tariff determined by the Commission. The monetary value of the exported energy is deducted from the monetary value of imported energy to arrive at the net amount to be billed. If the cumulative credit amount exceeds the debit amount during any billing cycle, the net credit is carried over to the next billing cycle. At the end of a 12-month settlement period, the consumer has the option to receive payment of the net credit balance (if any) or have such credit balance carried-over to the next settlement period. The solar energy net feed-in mechanism will be available to all electricity consumer categories of all tariff and voltage levels.

11.3 Gross-metering:

Gross metering is permitted for prosumers who opts to sell all generated solar energy to the distribution licensee instead of availing the net- metering or net feed-in facility. The exported solar energy is credited at the feed in tariff determined by the Commission. The amount is credited in the operators/consumers electricity bill for every billing cycle.

12 Standards and Technical Requirements

- 12.1 The solar PV system and the interconnection with the TANGEDCO grid shall comply with all applicable regulations and standards of the Central Electricity Authority (CEA), Grid Codes and the Tamil Nadu Electricity Distribution Code with latest amendments.

- 12.2 The solar plant capacity under both metering mechanisms, net feed-in and gross feed-in, shall not exceed the sanctioned load of the service connection.
- 12.3 The total capacity of solar PV systems connected to a distribution transformer shall not exceed 100% of the distribution transformer capacity.
- 12.4 Distribution licensees shall update the status of the cumulative solar energy system capacity connected and solar energy generated by each system at each distribution transformers on their website every month.
- 12.5 Where ever separate meter measuring the gross solar generation is not available at present in existing grid connected solar system, Licensee shall take prompt action to install them as mandated.
- 12.6 For all grid connected solar energy systems under the distribution licensee shall make use of the existing distribution network to the maximum extent possible so that utilisation of such infrastructure is optimized.
- 12.7 The solar power generator and equipments shall meet the requirement specified in the CEA's (Technical Standards for connectivity of the Distributed Generation Resources) Regulations 2013 and as amended from time to time. The responsibility of operation and maintenance of the solar power generator including all accessories and apparatus lies with the solar power generators. The design and installation of the roof top Solar Photo Voltaic (SPV) should be equipped with appropriately rated protective devices to sense any abnormality in the system and carryout automatic isolation of the SPV from the grid. The inverters used should meet the necessary quality requirements. The protection logics should be tested before commissioning of the plant. Safety certificates for the installation should be obtained from the appropriate authorities.
- 12.8 The automatic isolation of the SPV should be ensured for no grid supply and low or over voltage conditions and within the required response time. Adequate rated fuses and fast acting circuit breakers on input and output side of the inverters and disconnect/Isolating switches to isolate DC and AC system for maintenance shall be provided. The consumer should provide for all internal safety and protective mechanism for earthing, surge, DC ground fault, transients etc. as per the CEA regulation/standards.
- 12.9 The inverter should be a sine wave inverter suitable for synchronizing with the distribution licensee's grid.
- 12.10 Grid interactive solar PV system with battery backup is not under the purview of this order. Any battery backup shall be restricted to the consumer's network and the consumer shall be responsible to take adequate safety measures to prevent

battery power/Diesel Generator(DG) power/backup power extending to distribution licensee's LT grid on failure of distribution licensee's grid supply.

- 12.11 To prevent back feeding and possible accidents when maintenance works are carried out by distribution licensee's personnel in his network, suitable isolator/ isolating disconnect switches which can be locked by distribution licensee personnel should be provided. This is in addition to automatic sensing and isolating on grid supply failure etc and in addition to internal disconnect switches. In the event of distribution licensee LT supply failure, the SPG has to ensure that there will not be any solar power being fed to the LT grid of distribution licensee. The consumer is solely responsible for any accident to human being/animals whatsoever (fatal/non-fatal/departmental/non departmental) that may occur due to back feeding from the SPG plant when the grid supply is off. The distribution licensee reserves the right to disconnect the consumer installation at any time in the event of such exigencies to prevent accident or damage to men and material.
- 12.12 The consumer shall abide by all the codes and regulations issued by the CEA/Commission to the extent applicable and in force from time to time. The consumer shall comply with CEA/TNERC/CEIG/ distribution licensee's requirements to the extent it is applicable with respect to safe, secure and reliable function of the SPG plant and the grid. The power injected into the grid shall be of the required quality in respect of wave shape, frequency, absence of DC components etc.
- 12.13 The SPG shall restrict the harmonic generation, flicker within the limit specified in the relevant regulations issued by the Central Electricity Authority.
- 12.14 The inverter should be a sine wave inverter suitable for synchronizing with the distribution licensee's grid.
- 12.15 Any battery backup shall be restricted to the consumer's network and the consumer shall be responsible to take adequate safety measures to prevent battery power/Diesel Generator(DG) power/backup power extending to distribution licensee's LT grid on failure of distribution licensee's grid supply.

13.0 Grid-interconnection application process

- 13.1 For commissioning of consumer category solar PV systems of capacity higher than 10 kW the issuance of safety certificate by the Chief Electrical Inspectorate (CEIG) is presently required which may be amended from time to time.
- 13.2 Application for Solar Power connectivity shall be in Form-1 and shall be submitted to the respective section officer/designated officer of the distribution licensee

along with a registration fee of Rs. 100 (Rupees One hundred only). The licensee shall acknowledge the receipt of the application.

- 13.3 Both the parties shall sign an agreement in Form-2, Annexed.
- 13.4 The Distribution licensee will install the required energy meters and commission the solar metering facility within three weeks from the date of application by the consumer.
- 13.5 The distribution licensee will enhance and update its metering and billing system in line with the requirement of above mandates such that relevant parameters pertaining to solar energy gross feed-in and net feed-in are assessed and furnished clearly in the electricity consumers' bills. Distribution licensees will make available online all of the above billing data for each consumer, along with a sample bill explaining the various billing components.
- 13.6 The distribution licensee shall implement online applications for all categories of Grid interactive solar generation scheme. The status of all applications received online or offline shall be displayed. The licensee shall maintain section wise data base of applications received, approval status, installation and commissioning details.
- 13.7 Wherever the meter for measuring the gross generation of solar units is not available at present, the same shall be installed. Till such time the units recorded in the inverter will be accounted for the purpose.
- 13.8 For all new solar systems the applicant shall install the meter to measure the gross generation along with installation of solar system at his cost.

14.0 Operative Control Period

This order shall come into force from the date of its issue. The tariffs determined shall be applicable for all consumer categories and is applicable for a control period up to 31.03.23 or till such time the Commission may extend.

(By order of the Tamil Nadu Electricity Regulatory Commission)

**(S.Chinnarajalu)
Secretary**

Solar net feed-in (net-billing) tariff calculator

LCOE Calculations

Assumptions		Unit	1	2	3	4
			1-10 kW	11-100 kW	101-500 kW	501 kW-1MW
1	Solar PV system capacity	kW	1.00	1.00	1.00	1.00
2	MNRE benchmark cost	INR / kW	-	-	-	-
3	Gross capital cost before subsidies	INR / kW	41,000	38,000	36,000	32,000
4	MNRE subsidy	%	0.00%	0.00%	0.00%	0.00%
5	Government of Tamil Nadu subsidy	%	0.00%	0.00%	0.00%	0.00%
6	Equity (% of net capital cost after subsidies)	%	30.00%	30.00%	30.00%	30.00%
7	Return on equity	%	16.96%	16.96%	16.96%	16.96%
8	Interest on loan	%	9.50%	9.50%	9.50%	9.50%
9	Loan tenure	Year	11	11	11	11
10	Loan moratorium	Year	1	1	1	1
11	Solar PV system CUF	%	19.00%	19.00%	19.00%	19.00%
12	Daytime grid availability	%	90.00%	90.00%	90.00%	90.00%
13	Average annual solar panel degradation	%	0.00%	0.00%	0.00%	0.00%
14	O&M (percentage of capital cost)	%	1.40%	1.40%	1.40%	1.40%
15	O&M annual increase	%	5.72%	5.72%	5.72%	5.72%
16	Insurance (% of depreciated asset value)	%	0.35%	0.35%	0.35%	0.35%
17	Annual depreciation	%	3.60%	3.60%	3.60%	3.60%
18	Depreciation on <i>net</i> capital cost after subsidies?	Y/N	Y	Y	Y	Y
19	Working Capital - O&M	Month	1	1	1	1
20	Working Capital - receivables	Months	2	2	2	2
21	Interest on Working Capital	%	10.50%	10.50%	10.50%	10.50%
22	Discount factor	%	8.67%	8.67%	8.67%	8.67%
23	Economic life of system	Years	25	25	25	25
LCOE		INR / kWh	3.99	3.70	3.51	3.12

lar net feed-in (net-billing) tariff calculator

IE Calculations
hout energy storage

Assumptions / Inputs		Unit
Solar PV system capacity	1.00	kW
MNRE benchmark cost	-	INR / kW
Gross capital cost before subsidies	38,000	INR / kW
MNRE subsidy	0.00%	%
Government of Tamil Nadu subsidy	0.00%	%
Equity (% of net capital cost after subsidies)	30.00%	%
Return on equity	16.96%	%
Interest on loan	9.50%	%
Loan tenure	11	Year
Loan moratorium	1	Year
Solar PV system CUF	19.00%	%
Daytime grid availability	90.00%	%
Average annual solar panel degradation	0.00%	%
O&M (percentage of capital cost)	1.40%	%
O&M annual increase	5.72%	%
Insurance (% of depreciated asset value)	0.35%	%
Annual depreciation	3.60%	%
Depreciation on net capital cost after subsidies?	Y	Y/N
Working Capital - O&M	1	Month
Working Capital - receivables	2	Months
Interest on Working Capital	10.50%	%
Discount factor	8.67%	%
Economic life of system	25	Years

ults / Outputs

Funding	
MNRE benchmark cost for installed capacity	- INR
Gross capital cost before subsidy	38,000 INR
Capital cost eligible for subsidy	- INR
MNRE subsidy (INR)	- INR
Capital cost after MNRE subsidy	38,000 INR
Government of Tamil Nadu subsidy	- INR
Capital cost after MNRE subsidy and GoTN subsidy	38,000 INR
Equity	11,400 INR
Loan	26,600 INR

Total Funding Check - % of Gross Capital Cost	
MNRE contribution	0.00% %
Tamil Nadu Government contribution	0.00% %
Equity	30.00% %
Loan funding	70.00% %
Total Funding (% of gross capital cost)	100.00% %

Total Funding Check - % of Net Capital Cost	
Equity	30.00% %
Loan funding	70.00% %
Total Funding (% of net capital cost)	100.00% %

Solar Energy Generation	Year-->																									Total
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	
Solar energy generation (kWh)	1,498	1,498	1,498	1,498	1,498	1,498	1,498	1,498	1,498	1,498	1,498	1,498	1,498	1,498	1,498	1,498	1,498	1,498	1,498	1,498	1,498	1,498	1,498	1,498	1,498	37,449

Cost of Solar Energy Generation																										Total
Return on equity	1,933	1,933	1,933	1,933	1,933	1,933	1,933	1,933	1,933	1,933	1,933	1,933	1,933	1,933	1,933	1,933	1,933	1,933	1,933	1,933	1,933	1,933	1,933	1,933	1,933	48,336
Interest on Loan	2,527	2,527	2,274	2,022	1,769	1,516	1,264	1,011	758	505	253	-	-	-	-	-	-	-	-	-	-	-	-	-	-	16,426
Operation and Maintenance (O&M)	532	562	595	629	665	703	743	785	830	878	928	981	1,037	1,096	1,159	1,225	1,295	1,370	1,448	1,531	1,618	1,711	1,809	1,912	2,022	28,063
Insurance	133	138	143	148	154	160	166	172	178	185	192	199	206	213	220	228	235	243	251	259	267	275	283	291	299	3,690
Depreciation	1,368	1,368	1,368	1,368	1,368	1,368	1,368	1,368	1,368	1,368	1,368	1,368	1,368	1,368	1,368	1,368	1,368	1,368	1,368	1,368	1,368	1,368	1,368	1,368	1,368	34,200
Interest on O&M Working Capital	5	5	5	6	6	6	7	7	8	8	9	9	10	10	11	11	12	13	13	14	15	16	17	18	19	246
Sub-total	6,498	6,524	6,299	6,076	5,855	5,635	5,418	5,204	4,992	4,782	4,575	4,371	4,169	3,970	3,774	3,581	3,391	3,204	3,020	2,839	2,661	2,487	2,317	2,151	1,989	129,158
Interest on Receivables Working Capital	114	114	110	106	102	99	95	91	87	84	80	76	72	68	64	60	56	52	48	44	40	36	32	28	24	2,260
Total cost	6,612	6,638	6,409	6,182	5,957	5,734	5,513	5,295	5,079	4,866	4,655	4,448	4,241	4,037	3,836	3,637	3,441	3,248	3,058	2,871	2,687	2,506	2,328	2,153	1,981	131,418
Total cost per kWh	4.41	4.43	4.28	4.13	3.98	3.83	3.68	3.53	3.39	3.25	3.11	2.97	2.83	2.69	2.55	2.41	2.27	2.13	2.00	1.87	1.74	1.61	1.48	1.35	1.22	87.73

Levelised cost of Energy																										Total
Discount Factor	1.00	0.92	0.85	0.78	0.72	0.66	0.61	0.56	0.51	0.47	0.44	0.40	0.37	0.34	0.31	0.29	0.26	0.24	0.22	0.21	0.19	0.17	0.16	0.15	0.14	0.44
Present Value	4.41	4.08	3.62	3.22	2.85	2.53	2.23	1.98	1.74	1.54	1.35	1.19	1.11	1.03	0.96	0.90	0.84	0.78	0.73	0.68	0.64	0.60	0.56	0.53	0.49	1.62

lar net feed-in (net-billing) tariff calculator

IE Calculations
[Description]

Assumptions / Inputs	Value	Unit
Solar PV system capacity	1.00	kW
MNRE benchmark cost	-	INR / kW
Gross capital cost before subsidies	36,000	INR / kW
MNRE subsidy	0.00%	%
Government of Tamil Nadu subsidy	0.00%	%
Equity (% of net capital cost after subsidies)	30.00%	%
Return on equity	16.96%	%
Interest on loan	9.50%	%
Loan tenure	11	Year
Loan moratorium	1	Year
Solar PV system CUF	19.00%	%
Daytime grid availability	90.00%	%
Average annual solar panel degradation	0.00%	%
O&M (percentage of capital cost)	1.40%	%
O&M annual increase	5.72%	%
Insurance (% of depreciated asset value)	0.35%	%
Annual depreciation	3.60%	%
Depreciation on net capital cost after subsidies?	Y	Y/N
Working Capital - O&M	1	Month
Working Capital - receivables	2	Months
Interest on Working Capital	10.50%	%
Discount factor	8.67%	%
Economic life of system	25	Years

Inputs / Outputs

Funding	
MNRE benchmark cost for installed capacity	- INR
Gross capital cost before subsidy	36,000 INR
Capital cost eligible for subsidy	- INR
MNRE subsidy (INR)	- INR
Capital cost after MNRE subsidy	36,000 INR
Government of Tamil Nadu subsidy	- INR
Capital cost after MNRE subsidy and GoTN subsidy	36,000 INR
Equity	10,800 INR
Loan	25,200 INR

Total Funding Check - % of Gross Capital Cost	
MNRE contribution	0.00%
Tamil Nadu Government contribution	0.00%
Equity	30.00%
Loan funding	70.00%
Total Funding (% of gross capital cost)	100.00%

Total Funding Check - % of Net Capital Cost	
Equity	30.00%
Loan funding	70.00%
Total Funding (% of net capital cost)	100.00%

Solar Energy Generation	Year-->																									Total
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	
Solar energy generation (kWh)	1,498	1,498	1,498	1,498	1,498	1,498	1,498	1,498	1,498	1,498	1,498	1,498	1,498	1,498	1,498	1,498	1,498	1,498	1,498	1,498	1,498	1,498	1,498	1,498	1,498	37,449

Cost of Solar Energy Generation																										
Return on equity	1,832	1,832	1,832	1,832	1,832	1,832	1,832	1,832	1,832	1,832	1,832	1,832	1,832	1,832	1,832	1,832	1,832	1,832	1,832	1,832	1,832	1,832	1,832	1,832	1,832	45,792
Interest on Loan	2,394	2,394	2,155	1,915	1,676	1,436	1,197	958	718	479	239	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15,561
Operation and Maintenance (O&M)	504	533	563	596	630	666	704	744	786	831	879	929	982	1,039	1,098	1,161	1,227	1,297	1,372	1,450	1,533	1,621	1,714	1,812	1,915	26,586
Insurance	1,257	1,217	1,177	1,137	1,098	1,058	1,019	980	941	902	863	824	785	746	707	668	629	590	551	512	473	434	395	356	317	1,798
Depreciation	1,296	1,296	1,296	1,296	1,296	1,296	1,296	1,296	1,296	1,296	1,296	1,296	1,296	1,296	1,296	1,296	1,296	1,296	1,296	1,296	1,296	1,296	1,296	1,296	1,296	32,400
Interest on O&M Working Capital	41	5	5	5	6	6	7	7	7	8	8	9	9	10	10	11	11	12	13	14	15	16	17	18	19	233
Sub-total	6,156	6,181	5,967	5,756	5,546	5,339	5,133	4,930	4,729	4,530	4,334	4,141	3,950	3,761	3,574	3,390	3,209	3,031	2,856	2,684	2,515	2,349	2,186	2,026	1,868	122,360
Interest on Receivables Working Capital	108	108	104	101	97	93	90	86	83	79	76	72	72	74	75	76	77	78	80	81	82	84	85	87	89	2,141
Total cost	6,264	6,289	6,072	5,857	5,643	5,432	5,223	5,016	4,812	4,610	4,410	4,214	4,024	3,837	3,653	3,471	3,291	3,114	2,940	2,769	2,601	2,436	2,274	2,115	1,959	124,502
Total cost per kWh	4.18	4.20	4.05	3.91	3.77	3.63	3.49	3.35	3.21	3.08	2.94	2.81	2.68	2.55	2.42	2.29	2.16	2.03	1.90	1.77	1.64	1.51	1.38	1.25	1.12	83.11

Levelised cost of Energy																										
Discount Factor	1.00	0.92	0.85	0.78	0.72	0.66	0.61	0.56	0.51	0.47	0.44	0.40	0.37	0.34	0.31	0.29	0.26	0.24	0.22	0.21	0.19	0.17	0.16	0.15	0.14	0.44
Present Value	4.18	3.86	3.43	3.05	2.70	2.39	2.12	1.87	1.65	1.46	1.28	1.13	1.05	0.98	0.91	0.85	0.79	0.74	0.69	0.65	0.61	0.57	0.53	0.50	0.47	1.54

Solar net feed-in (net-billing) tariff calculator

LCOE Calculations
[description]

Assumptions / Inputs	Unit
1 Solar PV system capacity	1.00 kW
2 MNRE benchmark cost	- INR / kW
3 Gross capital cost before subsidies	32,000 INR / kW
4 MNRE subsidy	0.00% %
5 Government of Tamil Nadu subsidy	0.00% %
6 Equity % of net capital cost after subsidies	30.00% %
7 Return on equity	16.96% %
8 Interest on loan	9.50% %
9 Loan tenure	11 Year
10 Loan moratorium	1 Year
11 Solar PV system CUF	19.00% %
12 Daytime grid availability	90.00% %
13 Average annual solar panel degradation	0.00% %
14 O&M (percentage of capital cost)	1.40% %
15 O&M annual increase	5.72% %
16 Insurance (% of depreciated asset value)	0.35% %
17 Annual depreciation	3.60% %
18 Depreciation on net capital cost after subsidies?	Y Y/N
19 Working Capital - O&M	1 Month
20 Working Capital - receivables	2 Months
21 Interest on Working Capital	10.50% %
22 Discount factor	8.67% %
23 Economic life of system	25 Years

Results / Outputs

Funding	
MNRE benchmark cost for installed capacity	- INR
Gross capital cost before subsidy	32,000 INR
Capital cost eligible for subsidy	- INR
MNRE subsidy (INR)	- INR
Capital cost after MNRE subsidy	32,000 INR
Government of Tamil Nadu subsidy	- INR
Capital cost after MNRE subsidy and GoTN subsidy	32,000 INR
Equity	9,600 INR
Loan	22,400 INR

Total Funding Check - % of Gross Capital Cost	
MNRE contribution	0.00% %
Tamil Nadu Government contribution	0.00% %
Equity	30.00% %
Loan funding	70.00% %
Total Funding (% of gross capital cost)	100.00% %

Total Funding Check - % of Net Capital Cost	
Equity	30.00% %
Loan funding	70.00% %
Total Funding (% of net capital cost)	100.00% %

Solar Energy Generation	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	Total
Solar energy generation (kWh)	1,498	1,498	1,498	1,498	1,498	1,498	1,498	1,498	1,498	1,498	1,498	1,498	1,498	1,498	1,498	1,498	1,498	1,498	1,498	1,498	1,498	1,498	1,498	1,498	1,498	37,449
Cost of Solar Energy Generation																										
Return on equity	1,628	1,628	1,628	1,628	1,628	1,628	1,628	1,628	1,628	1,628	1,628	1,628	1,628	1,628	1,628	1,628	1,628	1,628	1,628	1,628	1,628	1,628	1,628	1,628	1,628	40,704
Interest on Loan	2,128	2,128	1,915	1,702	1,490	1,277	1,064	851	638	426	213	-	-	-	-	-	-	-	-	-	-	-	-	-	-	13,832
Operation and Maintenance (O&M)	448	474	501	529	560	592	625	661	699	739	781	826	873	923	976	1,032	1,091	1,153	1,219	1,289	1,363	1,441	1,523	1,610	1,702	23,632
Depreciation	1,152	1,152	1,152	1,152	1,152	1,152	1,152	1,152	1,152	1,152	1,152	1,152	1,152	1,152	1,152	1,152	1,152	1,152	1,152	1,152	1,152	1,152	1,152	1,152	1,152	28,800
Interest on O&M Working Capital	4	4	4	5	5	5	5	6	6	6	7	7	8	8	9	9	10	10	11	11	12	13	14	15	15	207
Sub-total	5,472	5,494	5,304	5,116	4,930	4,746	4,563	4,382	4,204	4,027	3,853	3,681	3,725	3,771	3,820	3,873	3,928	3,987	4,050	4,116	4,186	4,261	4,340	4,424	4,513	108,765
Interest on Receivables Working Capital	96	96	93	90	86	83	80	77	74	70	67	64	65	66	67	68	69	70	71	72	73	75	76	77	79	1,903
Total cost	5,568	5,590	5,397	5,206	5,016	4,829	4,643	4,459	4,277	4,097	3,920	3,746	3,790	3,837	3,887	3,940	3,997	4,057	4,120	4,188	4,259	4,335	4,416	4,501	4,592	110,668
Total cost per kWh	3.72	3.73	3.60	3.48	3.35	3.22	3.10	2.98	2.86	2.74	2.62	2.50	2.53	2.56	2.59	2.63	2.67	2.71	2.75	2.80	2.84	2.89	2.95	3.00	3.07	73.88

Levelised cost of Energy	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	Total
Discount Factor	1.00	0.92	0.85	0.78	0.72	0.66	0.61	0.56	0.51	0.47	0.44	0.40	0.37	0.34	0.31	0.29	0.26	0.24	0.22	0.21	0.19	0.17	0.16	0.15	0.14	0.44
Present Value	3.72	3.43	3.05	2.71	2.40	2.13	1.88	1.66	1.47	1.29	1.14	1.00	0.93	0.87	0.81	0.76	0.71	0.66	0.62	0.58	0.54	0.50	0.47	0.44	0.42	1.37

Levelised cost of energy	INR	3.12	per kWh
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Depreciation calculation	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	Total
Depreciation on gross capital cost	1,152	1,152	1,152	1,152	1,152	1,152	1,152	1,152	1,152	1,152	1,152	1,152	1,152	1,152	1,152	1,152	1,152	1,152	1,152	1,152	1,152	1,152	1,152	1,152	1,152	28,800
Depreciation on gross capital cost - cumulative	1,152	2,304	3,456	4,608	5,760	6,912	8,064	9,216	10,368	11,520	12,672	13,824	14,976	16,128	17,280	18,432	19,584	20,736	21,888	23,040	24,192	25,344	26,496	27,648	28,800	28,800
Depreciation on net capital cost after subsidies	1,152	1,152	1,152	1,152	1,152	1,152	1,152	1,152	1,152	1,152	1,152	1,152	1,152	1,152	1,152	1,152	1,152	1,152	1,152	1,152	1,152	1,152	1,152	1,152	1,152	28,800
Depreciation on net capital cost after subsidies - cumulative	1,152	2,304	3,456	4,608	5,760	6,912	8,064	9,216	10,368	11,520	12,672	13,824	14,976	16,128	17,280	18,432	19,584	20,736	21,888	23,040	24,192	25,344	26,496	27,648	28,800	28,800

Solar net feed-in (net-billing) tariff calculator

LCOE Calculations
[description]

Assumptions / Inputs	Unit
1 Solar PV system capacity	1.00 kW
2 MNRE benchmark cost	- INR / kW
3 Gross capital cost before subsidies	41,000 INR / kW
4 MNRE subsidy	0.00% %
5 Government of Tamil Nadu subsidy	0.00% %
6 Equity % of net capital cost after subsidies	30.00% %
7 Return on equity	16.96% %
8 Interest on loan	9.50% %
9 Loan tenure	11 Year
10 Loan moratorium	1 Year
11 Solar PV system CUF	19.00% %
12 Daytime grid availability	90.00% %
13 Average annual solar panel degradation	0.00% %
14 O&M (percentage of capital cost)	1.40% %
15 O&M annual increase	5.72% %
16 Insurance (% of depreciated asset value)	0.35% %
17 Annual depreciation	3.60% %
18 Depreciation on net capital cost after subsidies?	Y Y/N
19 Working Capital - O&M	1 Month
20 Working Capital - receivables	2 Months
21 Interest on Working Capital	10.50% %
22 Discount factor	8.67% %
23 Economic life of system	25 Years

Results / Outputs

Funding	
MNRE benchmark cost for installed capacity	- INR
Gross capital cost before subsidy	41,000 INR
Capital cost eligible for subsidy	- INR
MNRE subsidy (INR)	- INR
Capital cost after MNRE subsidy	41,000 INR
Government of Tamil Nadu subsidy	- INR
Capital cost after MNRE subsidy and GoTN subsidy	41,000 INR
Equity	12,300 INR
Loan	28,700 INR

Total Funding Check - % of Gross Capital Cost	
MNRE contribution	0.00% %
Tamil Nadu Government contribution	0.00% %
Equity	30.00% %
Loan funding	70.00% %
Total Funding (% of gross capital cost)	100.00% %

Total Funding Check - % of Net Capital Cost	
Equity	30.00% %
Loan funding	70.00% %
Total Funding (% of net capital cost)	100.00% %

Solar Energy Generation	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	Total
Solar energy generation (kWh)	1,498	1,498	1,498	1,498	1,498	1,498	1,498	1,498	1,498	1,498	1,498	1,498	1,498	1,498	1,498	1,498	1,498	1,498	1,498	1,498	1,498	1,498	1,498	1,498	1,498	37,449
Cost of Solar Energy Generation																										
Return on equity	2,086	2,086	2,086	2,086	2,086	2,086	2,086	2,086	2,086	2,086	2,086	2,086	2,086	2,086	2,086	2,086	2,086	2,086	2,086	2,086	2,086	2,086	2,086	2,086	2,086	52,152
Interest on Loan	2,727	2,727	2,454	2,181	1,909	1,636	1,363	1,091	818	545	273	-	-	-	-	-	-	-	-	-	-	-	-	-	-	17,722
Operation and Maintenance (O&M)	574	607	642	678	717	758	801	847	896	947	1,001	1,058	1,119	1,183	1,251	1,322	1,398	1,478	1,562	1,652	1,746	1,846	1,952	2,063	2,181	30,278
Insurance	184	198	213	228	243	258	273	288	303	318	333	348	363	378	393	408	423	438	453	468	483	498	513	528	543	13,915
Depreciation	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	36,900
Interest on O&M Working Capital	5	5	6	6	6	7	7	7	8	8	9	9	10	10	11	12	12	13	14	15	16	17	18	19	20	265
Sub-total	7,011	7,039	6,796	6,555	6,317	6,080	5,846	5,615	5,386	5,160	4,936	4,716	4,772	4,832	4,895	4,962	5,033	5,108	5,188	5,273	5,364	5,459	5,561	5,668	5,782	139,355
Interest on Receivables Working Capital	123	119	115	111	106	102	98	94	90	86	83	84	85	86	87	88	89	91	92	94	96	97	99	101	103	2,439
Total cost	7,134	7,162	6,915	6,670	6,427	6,187	5,949	5,713	5,480	5,250	5,023	4,799	4,856	4,916	4,980	5,049	5,121	5,198	5,279	5,366	5,457	5,555	5,658	5,767	5,883	141,794
Total cost per kWh	4.76	4.78	4.62	4.45	4.29	4.13	3.97	3.81	3.66	3.50	3.35	3.20	3.24	3.28	3.32	3.37	3.42	3.47	3.52	3.58	3.64	3.71	3.78	3.85	3.93	94.66

Levelised cost of Energy	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	Total
Discount Factor	1.00	0.92	0.85	0.78	0.72	0.66	0.61	0.56	0.51	0.47	0.44	0.40	0.37	0.34	0.31	0.29	0.26	0.24	0.22	0.21	0.19	0.17	0.16	0.15	0.14	0.44
Present Value	4.76	4.40	3.91	3.47	3.08	2.73	2.41	2.13	1.88	1.66	1.46	1.28	1.20	1.11	1.04	0.97	0.90	0.84	0.79	0.74	0.69	0.65	0.61	0.57	0.53	1.75

Levelised cost of energy	INR	3.99	per kWh
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Depreciation calculation	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	Total
Depreciation on gross capital cost	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	36,900
Depreciation on gross capital cost - cumulative	1,476	2,952	4,428	5,904	7,380	8,856	10,332	11,808	13,284	14,760	16,236	17,712	19,188	20,664	22,140	23,616	25,092	26,568	28,044	29,520	30,996	32,472	33,948	35,424	36,900	36,900
Depreciation on net capital cost after subsidies	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	1,476	36,900
Depreciation on net capital cost after subsidies - cumulative	1,476	2,952	4,428	5,904	7,380	8,856	10,332	11,808	13,284	14,760	16,236	17,712	19,188	20,664	22,140	23,616	25,092	26,568	28,044	29,520	30,996	32,472	33,948	35,424	36,900	36,900

