

KARNATAKA ELECTRICITY REGULATORY COMMISSION

Date: 16th November, 2015

“Discussion paper for determination of tariff for Grid-Interactive Rooftop and Small kilowatt scale solar photovoltaic plants in Karnataka”

1. Preamble:

The Karnataka Electricity Regulatory Commission had issued an Order dated 10th October, 2013 on “Determination of Tariff for grid connected solar photovoltaic, solar thermal and rooftop solar photovoltaic and other small solar power plants”. The tariff determined in this Order is valid for projects entering into Power Purchase Agreement (PPA) on or after 1st April, 2013 and upto 31st March, 2018 but excluding those projects for which the tariff is discovered through bidding process.

Further, the Commission in its Order dated 30th July, 2015, has revised the tariff for grid connected megawatt scale solar photovoltaic and solar thermal power plants duly factoring the decline in capital cost. This has resulted in reduction in tariff from Rs.8.40/unit to Rs.6.51/unit for solar PV plants and from Rs.10.92/unit to Rs. 10.85/unit in respect of solar thermal plants effective from 1st September, 2015.

The Government of India (GoI), vide Resolution dated 1st July, 2015, has revised the National Solar Mission targets from 20,000 MW to 1, 00,000 MW to be achieved by the year 2021-22. This targeted capacity is proposed to be achieved through deployment of 40,000 MW of Rooftop solar projects and 60,000 MW of large and medium-scale solar projects. This proposed capacity addition of rooftop solar power is envisaged under the following categories:

- Institutional sector (hospitals and educational institutions etc.);
- Industrial sector;
- Commercial sector;
- Housing sector;

The year-wise revised targets of rooftop-solar power plants proposed to be achieved under the National Solar Mission to accomplish the scaled-up target of 40,000MW is as under:

Category	Year-wise target (MW)							
	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	Total
Roof-top Solar	200	4,800	5,000	6,000	7,000	8,000	9,000	40,000

The targeted capacity of rooftop-solar power plants proposed to be achieved by Karnataka under the National Solar Mission is as under:

Category	Year-wise target (MW)							
	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	Total
Roof-top Solar	10	275	290	344	403	460	518	2300

Further, the Government of Karnataka (GoK) has notified the Karnataka Solar Policy 2014-2021 on 22nd May, 2014 which envisages achieving a minimum of 400 MW of grid connected solar rooftop plants and 1600 MW of grid connected utility scale solar projects in the State by 2018.

Minimum program targets (MW):

Year	2014-15	2015-16	2016-17	2017-18
Roof-top (grid connected and off-grid)	100	100	100	100

The Ministry of New and Renewable Energy (MNRE) in its guidelines dated 26th June, 2014 on grid connected Rooftop and small Solar Power Plants, has focussed on capacity addition of solar power ranging from 1KWp to 500KWp rooftop and small solar power plants. The guidelines suggest net metering and tariff determination by regulators such that the tariffs are attractive to investors and also do not put too much burden on ESCOMs. The MNRE would provide incentives which includes 15% subsidy for selected categories, accelerated depreciation benefits for industrial and commercial buildings, bank loans at interest rate of housing loan from public sector Banks, Customs Duty concessions and Excise Duty exemptions etc.

2. Need for Mid-course revision:

The Commission in its Order dated 10th October, 2013, has approved the following tariff for rooftop solar PV plants:

Type of rooftop project	Tariff (Rs./unit)
Rooftop project without subsidy	9.56
Rooftop project with 30% capital subsidy	7.20

The Commission has already made midcourse revision of the tariff of megawatt scale solar PV and solar thermal plants. The revision was prompted by consistent reduction in the capital cost which is one of the main factors for determination of tariff. Reduction of capital cost is due to reduction in the price of solar modules that forms the single most major component of solar tariff. Tariff in respect of rooftop and small solar PV plants also needs to similarly reflect their present capital cost. The Commission therefore considers that there is a case for review of the tariff determined for solar rooftop and small kilowatt scale solar PV power plants along with review of the features of net metering approach adopted by the Commission and also a relook of other issues of relevance as discussed in this paper. Hence, this discussion paper is issued to elicit the views of all the stakeholders before taking further decision in the matter.

3. Revision of Tariff for kilowatt scale Solar PV rooftop and small Solar power plants:

The Commission proposes the following parameters for revision of tariff of kilowatt scale rooftop and small Solar PV power plants:

i) Life of the Plant:

It is proposed to continue with the currently fixed life of plant which is 25 years for the purpose of determination of tariff.

ii) Term and Tariff design:

Since the life of the plant is being considered as 25 years, in order to ensure certainty of revenue streams to the investors, the Commission proposes to continue with current provision of levelized tariff for a period of 25 years as discussed in the subsequent paras of this discussion paper.

iii) Capacity Utilisation factor:

The Commission in its Tariff Order dated 10th October, 2013 had considered CUF of 19% for solar photovoltaic plants and it proposes to continue with the same levels of CUF for kilowatt scale rooftop and small Solar PV power plants.

iv) Capital Cost:

The Commission in its Tariff Order dated 10th October, 2013 had considered capital cost of Rs.90,000 per KW for kilowatt scale rooftop and small Solar PV power plants. MNRE in its website has indicated a benchmark capital cost of Rs.80000 per KW rooftop solar plants.

The Solar Corporation of India (SECI) in its notification of successful of bidders for allocation of rooftop PV projects under Part-A of Phase IV dated 23rd September, 2014 has allocated 2 MW of rooftop PV projects in Karnataka at module price of Rs.67/Wp. Further, SECI in its notification of successful of bidders for allocation of rooftop PV projects under Part-B of Phase IV dated 3rd

November, 2014 has allocated 2 MW of rooftop PV projects in Karnataka at levelized tariff of Rs.5.97/kWh.

The Commission in its Order dated 30th July, 2015 has considered the solar module cost at Rs.31.20 / Wp and total capital cost of Rs.600 lakhs / MW. Excluding the land cost of Rs.25 lakhs / MW, the capital cost would be Rs.575 lakhs / MW. This works out to Rs.57, 500 / KW.

The Commission notes that though the cost of solar modules used in rooftop and small solar plants would be on par with that used in megawatt scale plants, the cost of power conditioning units and balance of system may not be comparable with megawatt scale plants. Hence, the Commission is of the view that capital cost of Rs.57,500 / KW is not feasible for such plants. The Commission takes note of the recent phenomenon of several players entering into the field of solar rooftop power generation and the competition therein, which is likely to result in significant reduction in capital cost. The revised capital cost should take into account the current cost and also the likely reduction in the days to come.

Considering the above available references of price bids for solar rooftop PV and benchmark cost of MNRE, as discussed in the above paragraphs, the Commission proposes to adopt a capital cost of Rs.75,000 /KW for tariff determination.

v) Debt-Equity Ratio

The Commission proposes to consider a debt equity ratio of 70:30 as currently fixed for the purpose of factoring loan and equity.

vi) Operation & Maintenance Cost:

The operation and maintenance cost consists of employee cost, administrative and general expenses and Repairs & Maintenance expenses. The Commission in its order dated 10th October, 2013 has considered O & M expenses of Rs.1500 / KW (2% of the capital cost) with an annual escalation of 5.72%.

The Commission is of the view that it would be appropriate to consider a percentage of the capital cost as O & M expenses duly providing annual escalation to meet the inflationary costs.

vii) Interest and Tenure of Debt:

Considering the normative tenure of long term debts, the Commission proposes to consider the tenure of debts as 12 years. The Commission in its Order dated 30th July, 2015 on megawatt scale solar PV plants has considered interest on debt at 12.30%. The MNRE has advised Banks to include capital cost of solar rooftop PV plant as part of the home loan. Many Banks have already initiated action and as such loans are available at lower interest rates. The Commission proposes to review the interest allowable on debt based on the prevailing interest rates applicable for solar power projects.

viii) Working Capital:

The Commission in its present tariff order on megawatt scale PV plants has considered two months receivables as working capital. The Commission proposes to fix an appropriate working capital for smaller solar power projects based on the suggestions / comments it receives.

ix) Interest on Working Capital:

The Commission in its recent Order on megawatt scale PV plants has considered interest on working capital at 12.50%. Considering the prevailing base rates and interest rates on short term loans, the Commission proposes to decide suitably, the allowable interest on working capital.

x) Depreciation:

Since the Commission has proposed 70% of the capital cost to be financed by debt component and the tenure of debt at 12 years, the Commission proposes to adopt annual depreciation at 5.83% for the first 12 years to provide

adequate depreciation to meet the loan repayment and an annual depreciation at 1.54% for the balance period of 13 years.

xi) Return on Equity:

The Commission in its present Tariff Order on megawatt scale PV plants has allowed RoE of 16% and the actual tax component as a pass through. The Commission proposes to continue with the same.

xii) Discount Rate:

Since the financing of capital cost is based on 70% debt and 30% equity, the Commission is of the opinion that it would be appropriate to consider weighted average cost of capital (WACC) as the discount factor.

Summary of the parameters adopted by KERC and some of the other States for determination of tariff is indicated in Annexure.

4. Other issues of importance:

i) Sanctioned load Vs installed capacity of solar rooftop PV plant:

The Commission notes that many consumers are intending to install rooftop and other small solar power plants far in excess of their sanctioned load. For example, as per the data furnished by BESCO vide its letter dated 1st August, 2015, an installation with 100 KW sanctioned load and consuming only 637 units/month on an average, is proposing to install 500 KW rooftop/small solar plant and would be exporting 59,363 units / month on net metering basis. Similarly, a consumer with sanctioned load of 1 KW intends to install SRTPV of 100 KW which would result in pumping large quantity of net metered energy into the grid. This disparity between the sanctioned and the installed capacity is resulting in disproportionately large surplus energy being pumped into the grid under the net metering arrangement by consumers installing rooftop solar power plants.

The Commission is of the view that rooftop and small solar power plants are intended to encourage utilising the energy at the point of generation. Rooftop solar generation will also reduce transmission and distribution losses besides savings on creation of transmission and distribution infrastructure.

The Commission is of the view that this trend of consumers installing solar rooftop power plants of capacities far in excess of their sanctioned load should not be encouraged as it is not in the larger interest of the distribution licensees and also the general consumers. There is a need to fix a cap on the generation capacity vis-a-vis the sanctioned load. Even in States where net metering facility is extended to consumers installing rooftop / small solar power plants, there is a cap on the generation capacity of such plants as detailed below:

Name of State	Reference	Allowable Installed Capacity of Solar Rooftop Plant
Tamilnadu	Guidelines for Net-metering issued by TEDA	Not more than Sanctioned/Contracted load
Telangana	TSSPDCL	Less than or equal to Sanctioned/Contracted load
Maharashtra	Draft Net-metering regulations 2015	Not more than contract demand or connected load.
Rajasthan	Net-metering Regulations issued by Rajasthan ERC dated	Not more than 80% of the sanctioned connected load or contract demand.
Punjab	Policy on net-metering for grid interactive Roof-top Solar Photo Voltaic Power Plants dated 05.11.2014 issued by Government of Punjab	Not more than 80% of the sanctioned connected load or contract demand.
Haryana	HERC Rooftop solar grid interactive system based on net-metering Regulations 2014 dated 25.11.2014	Not more than Sanctioned/Contracted load
Gujarat	Gujarat Solar Policy-2015 dated 13.08.2015	Upto a maximum of 50% of the Consumer's sanctioned load

It could be seen from the above table, the allowable installed capacity is not more than the Sanctioned/Contract load in all the above States. Hence, keeping in view the issues of grid stability and the financial health of distribution licensees, the Commission proposes to limit the allowable capacity of SRTPV

and small solar PV plants to the sanctioned load as indicated in the subsequent paras of this paper.

ii) Small Solar Plants mounted on Ground:

The Commission in its Order dated 10th October, 2013 had determined tariff for kilowatt scale small Solar PV plants and Rooftop solar PV plants. The Commission had decided that for solar PV plants of installed capacity of beyond 1MW, the tariff as determined for megawatt scale plants will be applicable. Doubts have been expressed as to whether tariff determined and net metering facility extended to rooftop solar PV plants is also available to small solar PV plants mounted on ground. The MNRE guidelines issued on 26th June, 2014 identifies rooftop and small scale solar power plants with maximum capacity of 500KWp and a minimum of 1KWp.

The Commission is of the view that solar power generation in a consumers premises needs to be encouraged irrespective of whether it is on rooftop or ground mounted. The Commission therefore proposes to allow rooftop and small ground mounted solar power plants with installed capacities ranging from 1KW to maximum of 500 KW in a premises based on net-metering concept. In case the installed capacity of a solar plant exceeds 500KW, then the tariff determined for the megawatt scale will be applicable to such plants.

iii) Net-metering & Gross metering:

The Commission in its Order dated 10th October, 2013 had allowed power purchase by the distribution licensees from rooftop solar plants including small solar power plants by introducing the concept of net metering arrangement/scheme. In net metering the consumer is paid for the net energy i.e., the difference of energy generated from solar rooftop plant and energy consumed in his/her installation. This concept allows only surplus energy to be injected into the grid by the consumer. The Commission proposes to continue with net-metering concept for all consumers other than domestic consumers.

In case of domestic consumers, the Commission proposes to adopt gross metering concept wherein the entire energy generated by the solar rooftop plant including small solar power plants is allowed to be injected into the grid without reckoning the consumption by the domestic consumer's installation. This would allow sale of entire energy generated at the tariff to be fixed by the Commission.

iv) Grid Connectivity:

The Commission in its Order dated 10th October, 2013 had decided that, the evacuation from 1 kW upto 5 kW installed capacity of solar rooftop PV shall be at single phase 230 volts, the evacuation from 5 kW upto 50 kW installed capacity shall be at 3 phase 415 volts level. Further, it was decided that the solar rooftop PV systems with installed capacity of 50 kW and above shall be connected at 11 kV distribution systems. The maximum installed capacity of solar rooftop PV plant at any single location was limited upto 1 MW, for the purpose of applying the solar rooftop PV tariff.

The grid connectivity shall have to be arranged by the distribution licensee in accordance with the prevailing CEA (Technical Standards for Connectivity to the Grid) Regulations, 2007 and CEA (Technical Standards for Connectivity to the Grid) Amendment Regulations, 2013 and KERC Grid Code as amended from time to time.

The Commission proposes to adopt following grid connectivity in compliance with the above said Regulations / Code:

Installed Capacity of solar installation	Voltage Level
From 1 KWp and upto 5 KWp	240 volts
Above 5 KWp and upto 50 KWp	415 volts
Above 50 KWp and upto 500 KWp	11 KV HT / 415 volts LT

v) Metering:

As per the current Order in force, metering shall be in compliance with the CEA (Installation and Operation of Meters) Regulations 2006 as amended from time to time.

In the case of solar rooftop PV systems including small solar power plants connected to LT grid of a distribution company, the concept of gross or net metering will be adopted and the energy pumped into the grid will be billed accordingly. However, if site specific issues are observed by ESCOMs, the ESCOMs should adopt such metering arrangement wherein the solar injection and consumer's self-consumption are metered separately and gross or net metered component is computed and billed as per the Commission's Orders in force.

5. Tariff for the Small Kilowatt scale and Rooftop Solar PV Plants:

The Commission had considered fixing a separate feed-in-tariff for rooftop and small solar power plants and extending net metering facility for measuring the surplus energy injected to distribution licensee's grid, in order to harness the large potential for generating power using solar energy with plants being installed on un-utilised rooftops and vacant lands around buildings by grid connected consumers. This was to facilitate the consumers to get their return on their investments in a shorter period and encourage more consumers to invest in such solar power plants, which would be in the larger interest of the State. The surplus generation capacity was envisaged to be within reasonable limits.

The tariff of solar power is declining year on year. This is mainly due to reduction in module price, market competition and economies of scale over a period of time. In the recent reverse bidding held in Madhya Pradesh, developers have offered to install solar rooftop PV plants and supply power generated at a rate of Rs.5.00 per unit. The latest tariffs discovered on 4th November, 2015 in the

NTPC Tender for setting up of 500MW Solar plant in Andhra Pradesh is as low as Rs.4.63 per unit. This indicates that the cost of generation from solar power plants is on the decline. The tariff allowed in other States on net metering basis is indicated in the Annexure for reference.

The Commission proposes to determine tariff duly considering all components of expenditure like capital cost, interest on loan, depreciation, interest on working capital and return on equity which have been discussed in the above paragraphs.

6. Implementation of scheme of SRTPV Plants:

Based on the above discussions, considering the present retail tariff for different categories of consumers in the State, the Commission proposes the following approach for implementation of the scheme of SRTPV and small Solar Plants:

Category of Consumers	Allowable Installed Capacity of rooftop and small solar PV plants	Billing
NET-METERING (Applicable to Industrial, Commercial and all categories of consumers other than Domestic category)		
HT Consumers (other than Residential)	Equivalent to Contract Demand/Sanctioned Load subject to a maximum of 500KW (HT Power supply beyond 50KW).	50% of energy generated has to be consumed by the consumer. Balance 50% energy is to be billed at tariff determined by the Commission.
LT Consumers (other than Domestic)	Equivalent to Sanctioned Load subject to a maximum of 5KW on single phase supply and for above 5KW upto 50KW on three phase supply.	In case the self-consumption is less than 50%, such shortfall in energy consumption shall be billed at Average Pooled Power Purchase cost notified by the Commission from time to time.

		In case of installed capacity in excess of allowable capacity, the energy injected in excess of the allowable installed capacity shall be billed at Average Pooled Power Purchase cost notified by the Commission from time to time.
GROSS METERING (Applicable to only Domestic Consumers)		
Domestic Consumers	<p>HT Residential Consumers (HT-4): Equivalent to Contract Demand/Sanctioned Load subject to a maximum of 500KW (HT Power supply beyond 50KW).</p> <p>LT Domestic Consumers (LT2(a)): Equivalent to Sanctioned Load subject to a maximum of 5KW on single phase supply and for above 5KW upto 50KW on three phase supply.</p>	<p>Gross energy generated by the Solar Rooftop plant will be allowed to be injected into the grid payable at the tariff to be fixed by the Commission based on the parameters discussed in this paper.</p> <p>The Consumer shall continue to pay his energy bills for the energy consumed at the prevailing applicable retail supply tariff.</p> <p>In case of installed capacity in excess of allowable capacity, the energy injected in excess of the allowable installed capacity shall be billed at Average Pooled Power Purchase cost notified by the Commission from time to time.</p>

7. Applicability of the revised tariff:

The revised tariff to be determined is proposed to be made applicable to all the new rooftop solar and small solar PV plants of stipulated capacity entering into power purchase agreement from 1st January, 2016 onwards and on or before 31st March, 2018.

8. Suggestions/Comments/Views:

As per the above discussions, the Commission proposes to determine tariff for rooftop and kilowatt scale small solar power plants.

The Commission requests all stakeholders and the general public to furnish their views/suggestions/comments before 16th December, 2015. The stakeholders are requested to furnish any documents or material as may be available in support of their proposals / views so as to enable determination of tariff in a reasonable manner.

Summary of tariff parameters considered in some of the other SERCs in comparison with KERC

State	Haryana	Gujarat	KERC	
Date of issue	13.08.2014	17.08.2015	10.10.2013	As proposed in this discussion paper
Draft/Final	Final Order	Final Order	Final Order	Draft Oder
Applicability	Plants to be commissioned between FY 2014-15 and FY 2015-16	Plants to be commissioned during 1 st July, 2015 to 31 st March, 2018	Plants to be commissioned between FY 14 and FY18	Plants to be commissioned during 1 st January,2016 and upto 31 st March, FY18
Capital cost	Rs.6.80 Crores/MW	Rs. 80,000/kW	Rs. 90,000/kW	Rs. 75000/kW
CUF	19%	19%	19%	19%
Operation and maintenance expenses	Rs.1124 /kW with an annual escalation of 5.72%	Rs, 1090/kW with an escalation of 5.72%	2% of Capital cost i.e Rs.1800/kW with an annual escalation of 5.72%	Rs.1500 / KW (2% of the capital cost) with an annual escalation of 5.72%
Life of plant and machinery	25 years	25 years	25 years	25 years
Term of Loan	10 years	10 years	10 years	12 years
Interest on loan	13.75%	12.70%	12.50%	12.30%
Working Capital components	a) O&M for one month; (b) Receivables equivalent to 2 months of energy charges for sale of electricity calculated on the normative CUF; (c) Maintenance spare @ 15% of operation and maintenance expenses.	a) O&M expense for one month; (b) One month energy charge at normative CUF;	2 months receivables	2 months receivables

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Interest on working capital	14.00%	11.85%	13%	12.50%
Return on equity	16% on normative equity (MAT / Corporate Tax shall be separately allowed in the tariff)	14%	16%	16%
Debt-equity ratio	70 : 30	70:30	70:30	70:30
Depreciation rate	7% for first 10 years up to maximum of 90%	6% for first 10 years then 2% for the next 15 years	Depreciation rate for the first 10 years=7% and the next 15 years=1.33%	Depreciation rate for the first 12 years=5.83% and the next 13 years=1.54%
Discount factor	14.42%	10.647%	13.41%	WACC
Tariff (Without Accelerated Depreciation)	7.19/kWh	Rs.8.42/Unit during 1 st July,2015 to 31 st March, 2016 Rs.7.83/Unit during 1 st April, 2016 to 31 st March, 2017 Rs.7.28/Unit during 1 st April,2017 to 31 st March, 2018	9.56/kWh without subsidy 7.20/kWh with subsidy	To be determined

The tariff allowed in other States on net metering basis for SRTPV

Name of State	Reference	Allowable tariff for Solar Rooftop Plant
Tamil Nadu	TEDA Guidelines for implementation of LT connectivity/Net-Metering	Injection upto 90% of the consumption annually will be adjusted at applicable retail supply tariff. Excess beyond 90% will go as lapsed.
Andhra Pradesh	Andhra Pradesh Solar Power Policy-2015 dated 12.02.2015	Net-metering OR Gross metering allowed at tariff equal to the average cost to serve determined by APERC every year. For FY14, it is Rs.5.25/Unit.
Telangana	Telangana Solar Policy 2015	Net-metering OR Gross metering is allowed. Under gross metering the power would be sold at average cost of service of the DISCOM. The tariff applicable for units under net metering would be at average pooled power purchase cost.
Maharashtra	Net-metering Regulations 2015	Net energy at the end of each Financial year shall be purchased by the DISCOM at approved Average Cost of Power Purchase for that year.

Rajasthan	Net-metering Regulations issued by Rajasthan ERC dated 26.02.2015 & RERC Solar Tariff Order dated 19.06.2015.	Excess energy of 50units or more in month is paid at RERC determined tariff. In case it is less than 50 units in a month, the same is carried forward till the cumulative excess reaches 50 Units. At present RERC tariff is Rs.6.74/Unit.
Punjab	Policy on net-metering for grid interactive Rooftop Solar Photo Voltaic Power Plants dated 05.11.2014 issued by Government of Punjab	Injection upto 90% of the consumption annually will be adjusted at applicable retail supply tariff. Excess beyond 90% will go as lapsed.
Haryana	HERC Rooftop solar grid interactive system based on net-metering Regulations 2014 dated 25.11.2014	Injection upto 90% of the consumption annually will be adjusted at applicable retail supply tariff. Excess beyond 90% will go as lapsed.
Delhi	DERC Guidelines on Net-metering Regulations-2014	Excess generation is paid at Average Pooled Power Purchase Cost to be settled at the end of the year
Gujarat	Gujarat Solar Policy-2015 dated 13.08.2015	Surplus energy will be paid at Average Pooled Power Purchase rate of the year in which the plant is commissioned.