

GUJARAT ELECTRICITY REGULATORY COMMISSION Ahmedabad

Order No. 1 of 2012

In the matter of: Determination of tariff for Procurement by the Distribution Licensees and others from Solar Energy Projects.

In exercise of the powers conferred under Sections 61 (h), 62 (1) (a), and 86 (1) (e) of the Electricity Act, 2003 (36 of 2003), guidelines of the National Electricity Policy, 2005, Tariff Policy, 2006 and all other powers enabling it on this behalf, the Gujarat Electricity Regulatory Commission (hereinafter referred to as “GERC” or “the Commission”) determines the tariff for procurement of power by Distribution Licensees and others in Gujarat from Solar Energy Projects (the “Tariff Order”).

1. BACKGROUND

- 1.1. Potential for Solar Power
- 1.2. National Action Plan on Climate Change
- 1.3. Government of Gujarat’s Solar Power Policy, 2009
- 1.4. Jawaharlal Nehru National Solar Mission
- 1.5. GERC Solar Tariff Order, 2010
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1.1 Potential for Solar Power

India, especially its western region, receives generous amounts of solar radiation offering an attractive opportunity for generating substantial amounts of electrical energy. Most of Gujarat (“the State”) receives an average solar insolation of greater than 5.2 kWh per square meter per day. In addition, Gujarat also offers an extensive and stable infrastructure in terms of a reliable

and available electric grid network for power evacuation, transmission and distribution; profit-making utility companies with high credit-ratings; expansive road, air and sea port connectivity; extensive water canal network; high economic growth rate backed by a wide range of small and medium-sized manufacturing industries; various initiatives of the State Government to promote solar energy such as the Gujarat Solar Park and the Gandhinagar Photovoltaic Rooftop Programme. All these factors supplement the potential of solar energy in Gujarat.

1.2 National Action Plan on Climate Change

The Prime Minister of India released the country's National Action Plan on Climate Change (NAPCC) on 30 June, 2008. There are Eight National Missions which form the core of the National Action Plan. The NAPCC consists of several targets on climate change issues and addresses the urgent and critical concerns of the country through a directional shift in the development pathway. It outlines measures on climate change related adaptation and mitigation while simultaneously advancing development. The Missions form the core of the Plan, representing multi-pronged, long-term and integrated strategies for achieving goals in the context of climate change. NAPCC set the target of 5% renewable energy purchase for FY 2009-10. Further, NAPCC envisages that such target will increase by 1% annually for the next 10 years. This would mean NAPCC envisages renewable energy to constitute approx 15% of the energy mix of India.

NAPCC is the national strategy of India to achieve a sustainable development path that simultaneously advances economic and environmental objectives. This National Action Plan hinges on the development and use of new technologies. The National Solar Mission is one of the eight national missions which form the core of the National Action Plan. Based on this vision a National Solar Mission was launched.

1.3 Government of Gujarat's Solar Power Policy, 2009

On 6 January, 2009, the Government of Gujarat (GoG) launched the (Gujarat) Solar Power Policy-2009 through the Energy and Petrochemicals Department, GoG, with an objective to respond to the challenges of global warming, strengthen energy security, generate 'green'

employment and accelerate the advent of solar grid-parity. The objectives of the (Gujarat) Solar Power Policy-2009 are:

- Promote generation of green and clean power in the State using solar energy.
- Put in place an appropriate investment climate, that could leverage the Clean Development Mechanism (CDM).
- Productive use of the wastelands, thereby engendering a socio-economic transformation.
- Generate employment and enhance skills of local youth.
- Promote R&D and facilitate technology transfer.
- Establish core technical competence in professionals in the State to initiate and sustain use and effective management of newer applications.
- Promote local manufacturing facilities.
- Create environmental consciousness among citizens.

This policy envisaged an installation of 500 MW in a timeframe of 5 years from megawatt-scale grid-connected solar photovoltaic and solar thermal power projects. The (Gujarat) Solar Power Policy-2009 promotes solar power by defining and facilitating various aspects such as wheeling charges, exemption from payment of electricity duty, exemption from demand cut, high feed-in tariff for a period of 25 years, grid connectivity and evacuation facilities, open-access for third party sale, relaxation from forecasting and scheduling, mandating renewable purchase obligation and assigning of state nodal agencies for ease of implementation.

Since Gujarat's Solar Power Policy-2009, more than 80 national and international companies have signed power purchase agreements (PPA) in two phases, totaling a sizable capacity of 968.5 MW. The megawatt-scale solar photovoltaic plants of 175 MW capacities have already been commissioned, while another 128 MW are ready for commissioning in Gujarat as of 31 December, 2011.

1.4 Jawaharlal Nehru National Solar Mission

The Jawaharlal Nehru National Solar Mission (JNNSM) was announced on 10 January, 2009 by the Government of India through the Ministry of New and Renewable Energy (MNRE). JNNSM aims to promote the development of solar energy for grid connected and off-grid power

generation. The ultimate objective is to make solar power competitive with fossil based applications and install net 20,000 MW of solar power generation units including on rooftops by the year 2022.

In order to encourage rapid scale-up, a scheme is introduced in cooperation with the Ministry of Power, National Thermal Power Corporation Ltd. (NTPC) and Central Electricity Authority (CEA) to off-take solar power and reduce the financial burden on the government. NTPC Vidyut Vyapar Nigam Ltd. (NVVN), a wholly owned subsidiary of NTPC, is chosen as the nodal agency for entering into PPA with Solar Project Developers (the “Developers”).

The Phase I target of achieving an installed solar capacity of 1,000 MW by 2013 is envisioned in the ratio of 50:50 between solar photovoltaic and solar thermal technologies. The allocation of capacities for Phase I is done in two batches: 150 MW of solar photovoltaic capacities and 500 MW of solar thermal capacities were allocated in Batch I of Phase I; while 350 MW of solar photovoltaic capacities in Batch II. Due to an overwhelming response from potential Developers, NVVN has adopted a reverse-bidding process to select Developers, wherein Bidders would offer a discount on the base tariff; the base tariff for solar photovoltaic and solar thermal technologies would be determined by the Central Electricity Regulatory Commission (CERC).

1.5 GERC Solar Tariff Order, 2010

GERC, in its Order No. 2 of 2010 dated 29 January 2010, determined the tariff for procurement of power by the Distribution Licensees and others from solar energy projects for the state of Gujarat. In fact, GERC was the first State Electricity Regulatory Commission (SERC) in the country to issue a comprehensive Tariff Order on solar energy.

The Commission unveiled attractive tariffs levelized at ₹ 12.54 and 9.29 per kWh for solar photovoltaic and solar thermal projects, respectively, for 25 years. GERC further divided these tariffs for two sub-periods for the first 12 and the subsequent 13 years as follows: ₹ 15 per kWh for the first 12 years and ₹ 5 per kWh for the next 13 years for solar photovoltaic projects; and ₹ 11 per kWh for the first 12 years and ₹ 4 for the next 13 years for solar thermal projects.

This tariff is a single-part, generic levelized tariff determined on a cost plus basis. Further, this tariff is applicable only to projects commissioned or to be commissioned up to 28 January, 2012.

1.6 GERC Renewable Purchase Obligation

GERC promoted the sale of power from renewable energy sources through its Notification No. 3 of 2010 titled 'Procurement of Energy from Renewable Sources' dated 17 April, 2010. This Notification is in line with the national targets set by NAPCC.

This renewable purchase obligation (RPO) is applicable to all Distribution Licensees as well as any other person consuming electricity (i) generated from conventional captive generating plant having capacity of 5 MW and above for his own use and/ or (ii) procured from conventional generation through open access and third party sale. Based on this regulation, all applicable entities shall purchase electricity (in kWh) from renewable energy sources at a minimum percentage of the total consumption of its consumers including transmission and distribution (T&D) losses during a year.

This regulation mandates an RPO for solar power of 0.25%, 0.5% and 0.5% for the financial years (FY) 2010-11, 2011-12 and 2012-13, respectively.

1.7 GERC Multi Year Tariff Regulations, 2011

The Commission had notified Regulation No. 1 of 2011 titled "Multi Year Tariff Regulation, 2011" on 22 March, 2011, which is applicable for determination of tariff to all existing and future Generating Companies, Transmission Licensees, Distribution Licensees, and their successors, if any. It is through the framework of this Regulation that the Commission shall determine tariffs for various cases including supply of electricity by a Generating Company to a Distribution Company, intra-state transmission of electricity, intra-state wheeling of electricity, retail supply of electricity, etc. Further, it is within the norms of this Regulation that the tariff for procurement of power from Solar Energy Projects by the Distribution Licensees and others under discussion shall be determined.

1.8 GERC Discussion Paper on Solar Tariff Determination

GERC prepared and made available a Discussion Paper on Determination of Tariff for Procurement of Power by Distribution Licensee and Others from Solar Energy Projects for the State of Gujarat (the “Discussion Paper”) on 1 November, 2011. This Discussion Paper supports the (Gujarat) Solar Power Policy in the methods of promoting solar energy in order to accelerate the advent of grid parity. This Discussion Paper was hosted on the Commission’s website, as well as published as a booklet and circulated among various departments and agencies throughout India for inviting comments and suggestions through affidavits. The last date for submission of comments was 1 December, 2011. Various comments from stakeholders and corresponding responses by the Commission are indicated in this Tariff Order. The list of entities which have communicated their views is given in Annexure I.

1.9 Public Hearing

A public hearing was held on 27 December, 2011 wherein participants expressed their views on the Discussion Paper. Various comments from stakeholders were heard at the hearing, and the corresponding responses by the Commission are indicated in this Tariff Order. The list of participants at the hearing is given in Annexure II.

NOW, the Commission determines the tariffs, for the second control period, for procurement of power by Distribution Licensees and others from solar photovoltaic (PV) and concentrated solar thermal (CST) technologies for the State of Gujarat. The tariffs are determined as a single-part, generic and levelized, derived on a cost-plus basis.

2. DETERMINATION OF TARIFF FOR PROCUREMENT OF POWER FROM SOLAR PHOTOVOLTAIC POWER PROJECTS

2.1 Solar Photovoltaic Technology

Photovoltaics (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, micromorph, 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 and reducing costs of these solar cells, as well as developing novel cell technologies.

The Commission has decided that the final selection of the technology shall be left to the solar photovoltaic Project Developers, and hence, adopted an approach of generic tariff determination.

Further, as each of these technologies have different cost implications based on their efficiency, reliability, mounting, tracking, land, water and other requirements, the Commission shall determine the tariff for photovoltaic projects based on the poly-crystalline silicon technology, which currently dominates the global market share.

In any case, the photovoltaic modules shall comply with the following standards developed by the International Electrotechnical Commission (IEC) that qualify the photovoltaic modules for design as well as safety:

Design qualification and type approval:	IEC 61215 for Crystalline and Multi-Crystalline Silicon Terrestrial PV Modules, OR IEC 61646 for Thin-Film Terrestrial PV Modules, OR IEC 62108 for Concentrated Photovoltaic Modules & Assemblies.
Safety qualification:	IEC 61730 for Photovoltaic Modules (General)

Further, as per current industry practices, photovoltaic modules shall carry a performance warranty of more than 90% of their rated power during the first 10 years of operation, and more than 80% of their rated power during the subsequent 15 years.

2.2 Cost of Photovoltaic Systems

2.2.1 Capital Cost

The cost of the photovoltaic modules account for more than half the cost of the entire photovoltaic power plant, and hence, have a substantial impact on the resultant Levelized Cost of

Electricity (LCOE). However, the photovoltaic module prices, irrespective of module technology, have been steadily declining owing to research and development, industry adaptation and economies of scale. The module prices have declined by more than half over the last decade, and are expected to drop at the same rate in the near future.

All components of a photovoltaic power plant except the photovoltaic modules are collectively termed as the Balance of System (BoS), which include:

- Photovoltaic inverters,
- Transformers,
- Module mounting structures,
- Combiner/ junction boxes,
- DC and AC power cables, communication cables, and
- Engineering, civil works and labour.

Photovoltaic inverters are rated for their power handling capacity, and inverters ranging from less than 1 kW and more than 1 MW capacity are commercially available. Inverters for photovoltaic power projects are classified based on their capacity and operational philosophy, which also has an implication on its cost and performance. Similar to photovoltaic modules, the cost of inverters is also gradually decreasing with advancing research and development as well as economies of scales.

The land requirement for crystalline silicon solar photovoltaic power plant is considered at approximately 5 acres per megawatt (MW) of installed capacity. This land requirement increases for photovoltaic projects utilizing either lower efficiency technologies or solar tracking; however, in such instances, the cost of land as well as balance of system are compensated either due to a lower cost of photovoltaic modules or higher capacity utilization factors (CUF), respectively.

The Solar Power Policy, 2009 of the Government of Gujarat provides that the transmission line from the switchyard of the substation of the megawatt-scale solar power plant to the GETCO substation shall be laid by GETCO. For smaller photovoltaic systems such as rooftop systems

which are connected to the distribution grid at 11kV or below, the infrastructure typically exists as the solar power Generator is also the Consumer of the Distribution Utility. However, in case the existing infrastructure is not sufficient for evacuation of solar power, such infrastructure shall be developed or upgraded by the relevant Distribution Company.

With this briefly described background, the Commission considered systems of two scales, megawatt-scale and kilowatt-scale, both grid-connected without battery backup, to independently determine their tariffs. The Commission had proposed, in its Discussion Paper, a net capital cost ₹ 11.00 crore per megawatt for megawatt-scale photovoltaic power plants, and ₹ 1.3 lacs per kilowatt (kW) for kilowatt-scale photovoltaic systems.

Suggestions of the Objectors:

Various Project Developers have suggested a higher capital cost for solar photovoltaic power projects in the range of ₹ 12 to 14.5 crore per megawatt owing to factors such as higher cost of land in Gujarat, and high civil, engineering and administrative expenses. It is pointed out by some Developers that the cost of land is around ₹ 8 to 10 lacs per acre, which amounts to as much as ₹ 50 lacs per megawatt. Certain Developers have also pointed out that the reduction in prices of photovoltaic modules and balance of systems is only temporary due to a situation of oversupply in the market. Further, some Developers have indicated that various cost components are actually higher than that indicated in the Commission's Discussion Paper. It was also brought to the Commission's attention that cost of mounting structures, transformers, copper for wires, fuel, and recent devaluation of the Indian Rupee has resulted in a higher capital cost for solar projects in general. One of the Developers indicated that additional allowance of ₹ 35 lacs per megawatt should be provided in the capital cost to cover charges including (a) debt syndication charge, (b) upfront fee to banks, (c) other fees including lender's independent engineer, lender's legal counsel, security trustee, lender's insurance adviser, (d) owner's engineer, (e) other costs including stamp duty, supervision charges to GETCO, compliance fees, CDM consultant and process, environmental impact assessment, energy yield study, and travel. There is a suggestion from two developers to consider the interest during construction (IDC) into the capital cost, one of whom indicated a value of ₹ 30 lacs per megawatt.

To counter the suggestions from Developers for increasing the capital cost, it is argued on behalf of the Distribution Companies to consider the capital cost proposed recently by the Central Electricity Regulatory Commission (CERC) at ₹ 10 crore per megawatt. This decrease in capital cost is further supported by a decreasing trend of solar equipment prices on account of aspects like (a) economies of scale, (b) optimization of production in industry, (c) reduced company margins due to competition, and (d) level of multiple R&D activities. Further, they indicated that the capital cost of ₹ 11 crore proposed by the Commission seemed to be on the higher side considering the unexpected low bids discovered during the recent Jawaharlal Nehru National Solar Mission (JNNSM) Phase-I Batch-II bidding.

Commission's Ruling:

Considering the various aspects presented by the Developers and Utilities, the cost trends of the technology through independent surveys, and recent results of the Jawaharlal Nehru National Solar Mission (JNNSM) bidding, the Commission decides to adopt a capital cost of megawatt-scale solar photovoltaic power projects at ₹ 10 crore per megawatt, and that of kilowatt-scale solar photovoltaic power projects at ₹ 1.2 lacs per kilowatt. This capital cost shall include the cost of land and it is up to the Developers to identify the most appropriate land based on solar insolation and cost. Further, the evacuation line infrastructure shall be developed or upgraded by the relevant Distribution Company/ State Transmission Utility (STU).

2.2.2 Operation and Maintenance Cost and its Escalation

Photovoltaic power plants are characterized by their simple and low-cost operation and maintenance (O&M). The operation and maintenance of a photovoltaic power plant mainly involves cleaning of the photovoltaic modules at a regular interval. Additional operation and maintenance activities include regular checking of electrical connections, oil in transformers, minor replacement of electronic components, etc. In addition to cleaning staff, the photovoltaic power plants typically require security staff and site engineers or supervisors. Performance monitoring of such plants are typically done remotely, and an engineer may be deployed onsite only during troubleshooting of issues.

Earlier tariff orders of CERC and several State Electricity Regulatory Commissions (SERCs) have considered the operation and maintenance cost of 0.5% of the plant capital cost. However, due to the decrease in capital cost and increase in other costs, the Commission, in its Discussion Paper, had considered an operation and maintenance cost of 0.75% of the capital cost. Further, as most of this cost is human resource-related, the annual escalation of the operation and maintenance cost was considered to be 5%.

Suggestions of the Objectors:

Many Developers have suggested that the operation and maintenance cost for the first year should be at least 1% of the capital cost or in the range of ₹ 11 to 13 lacs per megawatt, which was primarily driven by the rising cost of manpower lately.

One of the Developers suggested that the operation and maintenance cost of rooftop photovoltaic systems should be considered around 1.5 to 2% of the capital cost due to the requirement of a higher maintenance workforce.

Regarding the escalation in the cost of operation and maintenance, some of the Developers suggested that the escalation should be in lines with the CERC guidelines at 5.72% annually. Some also suggested that this escalation should be around 8% annually considering the present annual inflation rate at 8%.

Commission's Ruling:

The Commission decides to maintain the first year operation and maintenance cost for photovoltaic power plants at 0.75% of the capital cost. This cost will also be applicable to the kilowatt-scale photovoltaic systems as the Commission envisions that such smaller system will be maintained by individuals or organizations who would maintain the systems domestically at a much lower cost.

Considering the concerns of the Developers regarding the high inflation rate, and in lines with the CERC guidelines as well as GERC Multi Year Tariff Regulation, 2011, the Commission decides to adopt an annual escalation in operation and maintenance cost of 5.72%.

2.2.2 Inverter Replacement Cost

The Commission had, in its Discussion Paper, considered an inverter replacement event during the 13th year of operation. Further, it was estimated that the cost of the inverter was around 15% of the capital cost, and its price was declining steadily at the rate of 10% annually.

Suggestions of the Objectors:

Some Developers have indicated that the projected cost of inverter replacement was too low, and that it should be considered at least 5 to 6% of the capital cost.

Commission's Ruling:

Considering the rate of decrease in cost of electronics and current cost trends of photovoltaic inverters, the Commission decides to consider an annual decline in the cost of inverters at 10%. Hence, an inverter replacement cost equivalent to 3.81% of the capital cost shall be considered in the 13th year.

2.3 Performance Parameters of Photovoltaic Power Plants

2.3.1 Plant Capacity

The capacity of a solar photovoltaic power plant shall be defined as the cumulative rated capacity of the photovoltaic modules at Standard Testing Condition (STC) used in that power plant. Further, as it may not be practical to achieve the exactly desired plant capacity due to design constraints, a tolerance of $\pm 2\%$ is allowed.

Additionally, during the supply of photovoltaic modules, the actual power output of the module at STC may be different from the rated module power due to the nature of its manufacturing. The net allowable module tolerance between the module rating and actual performance in a photovoltaic power plant is considered at $\pm 3\%$.

Suggestions of Objectors:

One of the Developers has suggested that the tolerance in plant capacity may be allowed up to $\pm 5\%$ as $\pm 2\%$ might not be practical.

Commission's Ruling:

The Commission retains the tolerance of $\pm 2\%$ on the plant capacity as it comfortably incorporates all typical design tolerances related to photovoltaic modules, string sizes, mounting structures and inverters.

2.3.2 Capacity Utilization Factor

The Commission had taken into account the performance ratios of photovoltaic power plants, irradiance data for various locations in Gujarat from various sources, calculated the capacity utilization factors (CUF) for various locations in Gujarat, as well as received feedback from existing photovoltaic power plants in Gujarat on their capacity utilization factors. Based on these data, the Commission had indicated a uniform capacity utilization factor of 18.5% for photovoltaic power plants in Gujarat.

Suggestions from Objectors:

Certain Developers have suggested that the capacity utilization factor should be reduced in the range of 17 to 18% attributing to the insufficiency of available insolation data, and taking into account the tolerances of the photovoltaic modules along with their output guarantees.

Some Distribution Companies have requested a higher capacity utilization factor around 19 to 20% quoting the high insolation available in Gujarat, discussions with Developers, and the CERC study conducted for India.

Commission's Ruling:

Based on various suggestions from Developers, consecutive calculations, reliable weather data and experiences from best practices, the Commission decides to reduce the capacity utilization factor to 18% for all photovoltaic power plants.

2.3.3 Annual Degradation in Performance

A performance warranty for 25 years on photovoltaic modules is an industry standard today. Typical warranties guarantee a performance of more than 90% for the first 10 years, and a performance of more than 80% for the next 15 years, adding to a total of 25 years. This implies an annual degradation rate of 0.9% for the photovoltaic modules. No substantial degradation is expected in the performance of the balance of system.

Hence, the Commission decides to consider the annual degradation in the performance of photovoltaic systems at 1%.

2.3.4 Auxiliary Energy Consumption

A photovoltaic power plant consumes minimal energy for auxiliary purposes. Auxiliary power may be required for air-conditioning in inverter and control rooms, cleaning water softening and pumping system, security night lighting and general office lights and fans. Hence, the Commission, in its Discussion Paper, had considered an auxiliary consumption of 0.25% of the gross photovoltaic energy generation.

Suggestions from Objectors:

Some Developers have suggested auxiliary consumptions ranging from 0.5 to 2% of the gross photovoltaic energy generation. They have attributed this high auxiliary consumption to high-power equipments such as air-conditioners in inverter rooms and water pumps for cleaning of photovoltaic modules.

Commission's Ruling:

It is seen from existing photovoltaic power plants that the use of air-conditioners is from minimal to nil, and many inverters have their own cooling systems and do not require cooling the entire inverter room.

Hence, the Commission retains the auxiliary consumption for photovoltaic power plants at 0.25% of the gross energy generation.

2.3.5 Useful Life

The standard warranty of photovoltaic modules, which account for more than half of the cost of the entire plant, is for a period of 25 years. However, the photovoltaic power plant including the modules is expected to last substantially beyond this period. The Commission as well as CERC, in their existing and previous orders and regulations have defined the useful life of solar photovoltaic power projects at 25 years.

Hence, the Commission shall consider the useful life of photovoltaic power projects at 25 years.

2.4 Finance-Related Parameters for Photovoltaic Power Plants

2.4.1 Debt-Equity Ratio

The Multi Year Tariff Regulation, 2011, notified by GERC provide a normative debt-equity ratio of 70:30 for Generating Companies/ Licensees. Further, Clause 5.3 (b) of the Tariff Policy, 2006, notified by the Ministry of Power, GOI, stipulates a debt –equity ratio of 70:30 for financing of power projects. Further, the GERC, in its current Solar Tariff Order dated 29 January, 2010 in Order No. 2 of 2010 has stipulated the same debt-equity ratio.

Hence, the Commission shall consider a debt-equity ratio of 70:30 for financing photovoltaic power projects.

2.4.2 Loan Tenure

The GERC Multi Year Tariff Regulation, 2011, notified by the Commission provides for a loan tenure of 10 years. Further, GERC in its last Solar Tariff Order has stipulated the same loan tenure.

Hence, the loan tenure of 10 years was considered in the Commission’s Discussion Paper.

Suggestions from Objectors:

One of the Developers as well as a Distribution Company suggested higher loan tenures in the range of 12 to 15 years considering the maturity of renewable energy technologies and high project life of 25 years.

Commission's Ruling:

Considering the novelty of photovoltaic technologies especially for financial institutions, the Commission has decided to retain the loan tenure of 10 years.

2.4.3 Interest Rate on Loan

Considering the recent volatility and substantially increasing interest rates by the State Bank of India (SBI) and other banks, the Commission had indicated in its Discussion Paper that the method of determining interest rates based on the weighted average over the past period did not represent a realistic interest rate achievable by Developers. Hence, the interest rate on loan was considered based on the existing interest rate at the time of the Discussion Paper. Thus, the interest rate was considered at 12%, which was arrived at by adding 200 basis points to the then existing SBI base rate of 10%.

Suggestions of Objectors:

There have been substantial comments from the Developers to consider interest rates in the range of 13 to 14.5%. Such a high interest rate is suggested by the Developers owing to the rising interest rates with expectations that they may rise further soon, quoting examples of loans for renewable energy projects between 13.5 and 14.5 %, due to reluctance of banks to finance solar projects due to their nascent stage in terms of experience, as well as indicating the draft CERC regulation wherein the CERC has indicated an interest rate at 300 basis points over the average SBI rate.

Commission's Ruling:

Considering the nascent stage for deployment of solar technologies in the country with the reluctance of banks to finance such projects, and volatility of the interest rates, the Commission has decided to consider the annual interest rate on debt for solar power projects at 13%.

2.4.4 Insurance Cost

The Commission shall consider an insurance cost at the rate of 0.35% of the net assets, which is considered annually over and above the operation and maintenance cost and in lines of the Commission's last Solar Tariff Order No. 2 of 2010.

2.4.5 Working Capital

The Commission, in its Discussion Paper, had considered a working capital as the sum of (i) one month's expense on operation and maintenance expenses, and (ii) receivables equivalent to one month's energy charges for sale of electricity calculated on a normative CUF, based on its Multi Year Tariff Regulation Notification 1 of 2011.

Suggestions from Objectors:

One of the Developers suggested consideration of two month's receivables for energy charges through sale of electricity calculated on a normative CUF. Further, a Developer also requested for adding 15% of the total operation and maintenance charges into the working capital as per the CERC guidelines.

Commission's Ruling:

The Commission has considered one month's receivable for energy charges for the working capital considering the prompt payments made by Distribution Companies in Gujarat and delay penalties for payment included in the PPA. Moreover, the cost related to operation and maintenance is already covered through other provisions for tariff determination.

Hence, the Commission shall retain the working capital as the sum of (i) one month's expense on operation and maintenance expenses, and (ii) receivables equivalent to one month's energy charges for sale of electricity calculated on a normative CUF.

2.4.6 Interest Rate on Working Capital

As the interest rates on working capital are found to be lower than long-term interest rates for power project over the last ten years, the Commission had considered, in its Discussion Paper, this interest rate at 11.25% per annum.

Interest rates on working capital are found to be lower than long-term interest rates for power project over the last ten years. This gap between the long-term loan and working capital loan rate is typically between 50 and 100 basis points. Accordingly, the Commission, in its Discussion Paper, had considered the interest rate on working capital at 11.25% per annum, which is 75 basis points lower than the long term interest rate of 12% considered in the same Discussion Paper.

Suggestions from Objectors:

A few Developers have suggested that short term loans are available at a higher interest rate by 50 to 75 basis points compared to the long term loans, and hence, the interest on working capital should be higher than the interest on loan. There have been suggestions to increase the interest on working capital in the range of 12.79 to 14.75% based on various reasons. One of the Developers quoted the draft CERC regulation wherein the interest rate on working capital is calculated as 350 basis points over the weighted average SBI rate during the first six months, which results to 12.79%. One of the Developers quoted the Commission's previous interest rate for solar tariff based on Order No. 2 of 2010 at 11.75%, and hence suggested that the current interest rate should be higher than that.

Commission's Ruling:

The Commission has considered a high interest rate on long-term capital debt considering the recent volatility of the interest rates and nascent stage of the solar technology in India. However, the same logic may not be applied to the interest rate on working capital as it is decided based on different parameters, and hence, should be lower than the interest rate on long-term capital debt. Considering the current market parameters, the Commission decides to increase the interest rate on working capital to 12%.

2.4.7 Rate of Depreciation

The Commission, in the Discussion Paper based on its Multi Year Tariff Regulation Notification No. 1 of 2011, had indicated that the value base for the purpose of depreciation shall be the capital cost of the asset; salvage value of the asset at 10% and depreciation be allowed up to a

maximum of 90% of the capital cost. Depreciation per annum shall be based on ‘Differential Depreciation Approach’ over loan tenure and the period beyond loan tenure over useful life computed on ‘Straight Line Method’. Depreciation shall be chargeable from the first year of commercial operation. In case of commercial operation of the asset for part of the year, the depreciation shall be charged on *pro rata* basis.

As a promotional measure, the Commission considered a high rate of depreciation during the loan tenure of 10 years at 6% per annum, thereafter spreading the remaining depreciation over the remaining useful life at 2% per annum.

Suggestion from Objectors:

Some Developers have suggested that the rate of depreciation should be at 7% per annum for the first 10 years in line with the CERC guidelines, which will also provide the requisite comfort level to financial institutions.

One of the Distribution Companies requested to reduce the rate of depreciation to 5.83%, arrived at assuming spreading 70% depreciation over a loan tenure of 12 years.

Commission’s Ruling:

Considering the long life of the solar power plant of more than 25 years and a gradual expected degradation, the Commission decides to retain the rate of depreciation suggested in the Discussion Paper at 6% of the project cost annually for the initial 10 years, and 2% of the project cost annually for the subsequent 15 years.

2.4.8 Return on Equity

The Commission has provided in the Multi Year Tariff Regulation, 2011 Notification No. 1 of 2011 as well as indicated in the Discussion Paper the return on equity as 14% per annum. The Commission has also allowed Income Tax at 20.008% (18.5% MAT + 5% Surcharge + 3% Education Cess) per annum for 10 years, and Corporate Tax at 32.445% per annum from 11th year onwards. Any further enhancement in the return on equity will burden the Consumers.

Suggestions from Objectors:

Many Developers have suggested the post-tax return on equity to be increased in the range of 15.5% to 16% in lines with CERC considerations. There have also been some independent suggestions of increasing the same to 17% and 20% in order to promote solar energy as such projects require a risk premium and are environmentally friendly. One of the objectors indicated that the return of equity of 14% is vulnerable, and can reduce easily to 7% in case of a fluctuating interest rate, and hence, should be increased.

Commission's Ruling:

The Commission has provided in the Multi Year Tariff Regulation, 2011 Notification No. 1 of 2011, indicated in the Discussion Paper, as well as considers the return on equity for all projects, renewable and non-renewable, at 14% per annum. Hence, the Commission shall retain the return on equity at 14% per annum.

2.4.9 Discount Rate for Levelized Tariff Calculation

The Commission, in its Discussion Paper, had calculated the annual levelized tariff based on the discount rate of 10.74% over the 25 year life of the solar power project.

Suggestions from Objectors:

While one Developer has requested the basis of calculating the discount rate, another Developer has requested a discount rate of 12.6% to be considered for calculating the levelized tariff for a period of 25 years, which is justified as the weighted average of the rates of interest on the loan and return on equity.

Commission's Ruling:

The discount rate for calculating the levelized tariff is computed based on the time series for latest twelve calendar years, and is based upon weighted average cost of capital (WACC). The discount rate due to cost of debt is calculated based on market interest rate and corporate tax rate, while the discount rate due to equity is calculated based on the risk free rate, *beta*, and equity market risk premium. Here, *beta* indicates the degree to which the stock's return moves with that of the overall market and is computed on the data on Bombay Stock Exchange (BSE)

Indices for power sector and Sensex for the year 2010. Further, this methodology is also adopted by the CERC for calculating discount rates.

Hence, the Commission shall retain the annual discount rate of 10.74% to calculate the levelized tariff over the 25 year life of the solar project.

2.5 Tariff for Photovoltaic Power Projects

2.5.1 Photovoltaic System Classification

Based on the basic differences in capital cost and implementation of megawatt-scale ground-mounted photovoltaic systems, and kilowatt-scale rooftop photovoltaic systems, Commission, in its Discussion Paper, had categorized all photovoltaic systems into two general scales for tariff applicability. In general, it was indicated that the kilowatt-scale tariff would be applicable to systems of capacities ranging from 1 to 100 kilowatt, while the megawatt-scale tariff would be applicable to systems of capacities more than 100 kilowatt.

Suggestions from Objectors:

One Developer and also a City Municipal Corporation have suggested that systems of capacities ranging from 100 kilowatt to 1 megawatt should also be considered for kilowatt-scale tariff because of comparatively high evacuation cost which includes a 11 kV transformer, switchyards, additional earthing requirements, etc.

One of the Distribution Companies suggested that the range of rooftop photovoltaic installation capacity should be increased from 1 to 5 kilowatt to a wider range of 1 to 6 kilowatt for feeding into the distribution grid at 230 V, 1 ϕ .

Commission's Ruling:

Considering the costs related to evacuation using a 11 kV transformer, switchyard, and auxiliary equipment, the Commission has decided that the kilowatt-scale tariff shall also be applicable to photovoltaic systems of capacity ranging from 100 kilowatt to 1 megawatt. Hence, the tariff

applicability and evacuation specification for photovoltaic systems based on installed capacities shall be as follows:

Table: Tariff applicability and other evacuation specification for photovoltaic systems based on installed capacities.

System Capacity	System Type	Evacuation Specification	Applicable Tariff
1 kW – 6 kW	Rooftop	230 V, 1 ϕ , 50 Hz	Kilowatt-scale Photovoltaic Tariff
6 kW – 100 kW	Rooftop	415 V, 3 ϕ , 50 Hz	
100 kW – 1MW	Rooftop OR Ground-mounted	11 kV, 3 ϕ , 50 Hz	
1 MW – 4 MW	Ground-mounted	11 kV, 3 ϕ , 50 Hz	Megawatt-scale Photovoltaic Tariff
> 4 MW	Ground-mounted	66 kV, 3 ϕ , 50 Hz	

2.5.2 Tariff for Photovoltaic Power Projects

Based on the various parameters laid out in the Discussion Paper, the Commission had indicated a levelized tariff for megawatt-scale photovoltaic projects of ₹ 10.27 per kilowatt-hour (kWh) for 25 years for projects availing accelerated depreciation, which was further distributed as ₹ 10.50 per kWh for the first 12 years, and ₹ 6.30 per kWh for the subsequent 13 years. Similarly, the Commission had indicated a levelized tariff for megawatt-scale photovoltaic projects of ₹ 10.81 per kilowatt-hour (kWh) for 25 years for projects availing accelerated depreciation, which was further distributed as ₹ 12.04 per kWh for the first 12 years, and ₹ 6.84 per kWh for the next consecutive 13 years. For the kilowatt-scale photovoltaic power projects, the Commission had indicated a levelized tariff of ₹ 12.49 per kWh for 25 years for projects availing accelerated depreciation, and ₹ 13.14 per kWh for 25 years for projects not availing accelerated depreciation.

Suggestions from Objectors:

One of the Developers suggested that the levelized tariff for energy generated through photovoltaic power plants should be ₹ 11.66 per kWh, and justified it as a 7% drop over the previous tariff. Another Developer suggested that the debt coverage ratio should be increased, i.e. the tariff during the first 12 years should be kept higher, in order to make the tariff more

lender-friendly. While one Developer supported the concept of the two-phase tariff, another Developer indicated that a single levelized tariff for straight 25 years was better in order to maintain continued interest of the Developer in the plant.

Regarding the kilowatt-scale photovoltaic tariff, one of the Developers requested to consider an additional component ‘Roof Incentive’ in ₹ per kWh to motivate rooftop owners to install such systems. The Developer quoted the Gandhinagar Photovoltaic Rooftop Programme, where a provision for rooftop incentive of ₹ 3 per kWh is made to incentivize roof owners to lend their roofs. A City Municipal Corporation suggested a levelized rooftop solar photovoltaic tariff of ₹ 15 per kWh for 25 years considering a rooftop incentive of ₹ 1 per kWh.

A public interest group suggested to the Commission that the tariff should be determined through reverse bidding as this process ensures the best price without too much burden on the consumer, the net installation capacity can easily be ‘capped’ through reverse bidding, and any inaccuracy in determining the tariff can be mitigated. A Distribution Company suggested to the Commission to adopt the minimum tariffs determined through the latest Jawaharlal Nehru National Solar Mission bidding.

Commission’s Ruling:

A summary of the various parameters discussed and decided upon is provided as follows:

Table: Summary of parameters for determining tariff for solar photovoltaic power projects.

PARAMETER	VALUE		
Plant Cost			
Capital Cost	₹	1000	Lacs per MW for megawatt-scale system
	₹	1.2	Lacs per kW for kilowatt-scale system
O&M Cost		0.75%	of Capital Cost
Escalation in O&M Cost		5.72%	Annually
Inverter Replacement Year		13th	Year
Inverter Cost during Replacement		3.81%	of Capital Cost

Performance Parameters			
Capacity Utilization Factor		18%	
Performance Degradation		1%	Annually
Auxiliary Consumption		0.25%	of Energy Generation
Useful Life		25	Years
Financial Parameters			
Debt : Equity Ratio		70 : 30	
Loan Tenure		10	Years
Interest Rate on Loan		13.00%	
Insurance Cost		0.35%	Annually
Interest on Working Capital		12.00%	Annually
Working Capital	Sum	1	Month's O&M Expense
	of:	1	Months' Energy Charges at normative CUF
Rate of Depreciation		6%	Annually for the first...
		10	Years
		2%	Annually for the next...
		15	Years
Minimum Alternate Tax Rate		20.008%	Annually for the first...
		10	Years
Corporate Tax Rate		32.445%	Annually
Return on Equity		14%	Annually
Discount Factor		10.74%	Annually

Based on these technical and financial parameters, the levelized tariff including return on equity for megawatt-scale solar photovoltaic power projects availing accelerated depreciation is calculated to be **₹ 9.28 per kWh**, while the tariff for similar projects not availing accelerated depreciation is calculated to be **₹ 10.37 per kWh**. The Commission also decides to determine the tariff for two sub-periods. For megawatt-scale photovoltaic projects availing accelerated depreciation, the tariff for the first 12 years shall be **₹ 9.98 per kWh** and for the subsequent 13 years shall be **₹ 7 per kWh**. Similarly, for megawatt-scale photovoltaic projects not availing accelerated depreciation, the tariff for the first 12 years shall be **₹ 11.25 per kWh** and for the subsequent 13 years shall be **₹ 7.50 per kWh**.

Similarly, the levelized tariff including return on equity for kilowatt-scale solar photovoltaic power projects availing accelerated depreciation is calculated and finalized at **₹ 11.14 per kWh**, while the tariff for similar projects not availing accelerated depreciation is calculated and finalized at **₹ 12.44 per kWh**. The Commission has decided that there shall be a flat levelized tariff for 25 years for the kilowatt-scale photovoltaic power projects.

2.5.3 Successive Revisions to Tariff

Due to the steadily decreasing cost of solar technology, reducing the burden on the end user of electricity, and ensuring timely commissioning of projects, the Commission, in its Discussion Paper, had indicated a year-on-year reduction for the 25-year applicable tariff. Hence, the Commission had considered a conservative decline in the tariff for both megawatt-scale and kilowatt-scale photovoltaic projects at 7% decline for 1 April, 2013 to 31 March, 2014, and a further 7% decline for 1 April, 2014 to 31 March, 2015.

Suggestions from Objectors:

Some Developers suggested that as CERC and Rajasthan Electricity Regulatory Commission (RERC) have provided 15 months for setting up 10-20 megawatt-sized photovoltaic power plants, the Commission should in the same lines also provide 15 months for the new tariff before declining it by 7%; further, it requires longer time due to limited availability of equipment and service providers, as well as it takes more time in Gujarat to acquire land for solar projects. One of the Developers indicated that the 7% decline was very steep, and should be about 4% after 31 March, 2014 due to uncertainty in decreasing cost trends of photovoltaic modules and balance of system. Some Developers requested the Commission to reconsider the entire proposal of successive revision in the tariff as it was too premature and preemptive, and that the market forces as well as rupee value have been greatly fluctuating.

Certain Developers and a Distribution Company suggested reviewing the rate of revision of the tariff each year before finalizing it. One of the Distribution Companies requested the Commission to consider a higher rate of decline in tariff as the decrease in capital cost of

photovoltaic power projects since the Commission's last tariff order has annually been around 15%.

Commission's Ruling:

The commission has considered an annual reduction of 7% in the tariff for solar photovoltaic power projects considering various factors including the capital and financial costs of such projects, as well as to encourage projects coming up and being commissioned at a regular pace. Removal of the provision for year-on-year decrease in the tariff and resultantly keeping a fixed tariff up to 31 March, 2015 may cause most of the projects to be commissioned very close to the end of this period leaving a void in deployment of photovoltaic power plants. Leaving the year-on-year rate of revision open-ended in the current order would create uncertainty for the solar and related industries for the long term, and hence, should be fixed.

Hence, the Commission has decided to retain the decline in the applicable tariff for both megawatt-scale and kilowatt-scale photovoltaic projects at 7% decline for 1 April, 2013 to 31 March, 2014, and a further 7% decline for 1 April, 2014 to 31 March, 2015 as follows:

Table: Summary of tariffs for solar photovoltaic power plants commissioned between 29 January, 2012 and 31 March, 2015.

Period →	29 Jan. '12 to 31 Mar. '13	1 Apr. '13 to 31 Mar. '14	1 Apr. '14 to 31 Mar. '15
<i>For megawatt-scale photovoltaic projects availing accelerated depreciation</i>			
Levelized Tariff for 25 years	₹ 9.28 per kWh	₹ 8.63 per kWh	₹ 8.03 per kWh
For first 12 years	₹ 9.98 per kWh	₹ 9.13 per kWh	₹ 8.35 per kWh
For subsequent 13 years	₹ 7.00 per kWh	₹ 7.00 per kWh	₹ 7.00 per kWh
<i>For megawatt-scale photovoltaic projects not availing accelerated depreciation</i>			
Levelized Tariff for 25 years	₹ 10.37 per kWh	₹ 9.64 per kWh	₹ 8.97 per kWh
For first 12 years	₹ 11.25 per kWh	₹ 10.30 per kWh	₹ 9.42 per kWh
For subsequent 13 years	₹ 7.50 per kWh	₹ 7.50 per kWh	₹ 7.50 per kWh
<i>For kilowatt-scale photovoltaic projects availing accelerated depreciation</i>			

Levelized Tariff for 25 years	₹ 11.14 per kWh	₹ 10.36 per kWh	₹ 9.63 per kWh
<i>For kilowatt-scale photovoltaic projects not availing accelerated depreciation</i>			
Levelized Tariff for 25 years	₹ 12.44 per kWh	₹ 11.57 per kWh	₹ 10.76 per kWh

[Note for clarification: The applicable tariff gets fixed at the time of commissioning of the plants. For example, if a megawatt-scale solar photovoltaic power plant gets commissioned between 29 January, 2012 and 31 March, 2013, then the applicable tariff shall be ₹9.98 for the first 12 years shall and ₹ 7.00 per kWh for the subsequent 13 years. Similarly, if another megawatt-scale photovoltaic power plant gets commissioned between 1 April, 2013 and 31 March, 2014, then the applicable tariff shall be ₹9.13 per kWh for the first 12 years and ₹ 7.00 for the subsequent 13 years.]

3. DETERMINATION OF TARIFF FOR PROCUREMENT OF POWER FROM SOLAR THERMAL POWER PROJECTS

3.1. Solar Thermal Technology

Solar thermal technologies, also known as concentrated solar thermal (CST) technologies, typically concentrate the direct component of sunlight or the direct normal incidence (DNI) to attain high temperatures and consequently generate electricity. The concentration is achieved typically through various reflection methodologies, which define these technologies. There are four primary solar thermal technologies, which include (i) parabolic trough, (ii) linear Fresnel, (iii) central receiver, and (iv) parabolic dish technologies. In addition to different construction of reflectors, these technologies also differ based on reliability, maturity, and economics.

One of the advantages of solar thermal technologies is that they can be designed to perform for longer hours even after sunset by incorporating storage of heat energy and hence enhancing the capacity utilization factor. Further, conventional power plants can be hybridized with solar thermal technologies to utilize the solar energy and yield higher outputs at lower conventional fuel consumptions.

The Commission has decided that the final selection of the technology shall be left to the solar thermal Project Developers, and hence, adopted an approach of generic tariff determination.

Further, as each of these technologies have different cost implications based on their efficiency, reliability, mounting, tracking, land, water and other requirements, the Commission shall determine the tariff for solar thermal projects based on the parabolic trough technology, which currently is the most mature of all solar thermal technologies and dominates the global market share.

3.2. Cost of Solar Thermal Technology

3.2.1. Capital Cost

The Commission, in its last Solar Tariff Order dated 29 January, 2010 in Order No. 2 of 2010 has considered a capital cost of ₹ 13 crore per megawatt. However, these capital costs have been low for Developers considering the large scale, technological uncertainties and hence, perceived risks. The CERC, in its order dated 26th February, 2010 in suo motu Petition No. 53 of 2010 on *Terms and Conditions for Tariff determination from Renewable Energy Sources* has considered a capital cost of solar thermal technologies at ₹ 15.3 crore per megawatt; however, this capital cost might not be effective as the Developers have bid for substantial discounts during the JNNSM Phase I bidding. Till date, no utility scale solar thermal power project has been commissioned in India. Further, there have been a wide range of reports on the capital costs of various solar thermal technologies.

Upon reviewing the current state of technology and associated costs, and in order to support the development of solar thermal technology, the Commission, in its Discussion Paper, had suggested a capital cost of ₹ 14.5 crore per megawatt, which also includes the cost of land.

Suggestions of the Objectors:

One of the Project Developers has suggested a capital cost of ₹ 16.39 per megawatt quoting that most of the components of a solar thermal power plant are imported and the fluctuations in dollar and euro exchange rates add a further burden of 10 to 12% on the capital cost, importing adds

additional expenditure in form of freight to the tune of 7 to 10%, there is not much clarity on the customs duty structure for imports as per MNRE notification, there are exorbitant taxes on locally procured items, and the cost of water infrastructure can add a cost of up to ₹ 50 lacs per megawatt.

A public interest group has suggested to the Commission that the indicated capital cost for solar thermal power plants seems to be on the higher side and requested the Commission to reduce it. One of the Distribution Companies requested the Commission to consider this capital cost at ₹ 13 crore per megawatt as recently proposed by CERC. They further indicated that there is a decreasing trend of solar equipment prices on account of aspects like (i) economies of scale, (ii) optimization of production in industry, (iii) reduced company margins due to competition and economic crisis, (iv) level of multiple R&D activities.

Commission's Ruling:

The Commission acknowledges that as there are no commissioned utility-scale solar thermal power plants in India, the capital cost is derived based on global examples. Further, the costs involved in the first projects for a particular technology are typically on the higher side. Hence, in order to support the development and deployment of the solar thermal technology, the Commission decides to fix the capital cost of ₹ 14 crore per megawatt.

3.2.2. Operation and Maintenance Cost and its Escalation

The operation and maintenance costs of solar thermal power plants are higher than solar photovoltaic power plants. In addition to the cost of operating staff, solar thermal power plants also utilize fuels such as diesel for its auxiliary processes, water for cooling, and heat transfer fluids, which have a limited life.

After due consideration, the Commission had indicated the operation and maintenance cost of solar thermal power plants at 1.5% of the capital cost in its Discussion Paper. Further, the annual escalation of the operation and maintenance cost was considered to be 5%.

Suggestions from Objectors:

One of the Distribution Companies suggested considering an operation and maintenance cost of ₹ 15 lacs per megawatt for the first year, and thereafter an annual escalation of 5.72% as per the recent CERC norms.

Commission's Ruling:

Based on the nascent stage of the solar thermal technology and lack of indigenous data, the Commission decides to retain the operation and maintenance cost at 1.5% of the capital cost, and thereafter an annual escalation of 5.72%.

3.3. Performance Parameters of Solar Thermal Power Plants

3.3.1. Capacity Utilization Factor

Taking into account the direct normal irradiance in Gujarat, the Commission shall considered a capacity utilization factor of 23% for solar thermal power plants.

3.3.2. Annual Degradation in Performance

Considering the nature of the solar thermal power plants, there are many components which may be subject to degradation. Based on learnings from working solar thermal power plants, the net degradation due to degradation in the heat transfer fluid, reflector assembly, thermal storage system, power block, etc. is in the range of 0.25-0.5% annually.

Hence, the Commission shall consider the annual degradation in performance of solar thermal power plants at 0.25%.

3.3.3. Auxiliary Consumption

The Commission had considered the auxiliary consumption for solar thermal power plants in lines with its last Solar Tariff Order dated 29 January, 2010 in Order No. 2 of 2010 at 10%. CERC, in its order dated 26 February, 2010 in suo motu Petition No. 53 of 2010 on *Terms and Conditions for Tariff Determination from Renewable Energy Sources* as well as the *Draft Terms and Conditions for Tariff Determination from Renewable Energy Sources* dated 18 November, 2011 has considered an auxiliary consumption of 10%.

Suggestions from Objectors:

One of the Developers has requested to consider the auxiliary consumption at 18 to 20% based on their experience with one of their own projects.

Commission's Ruling:

The Commission feels that the example cited may not be a representative of the typical auxiliary consumption; moreover, there was no substantial data available to prove the auxiliary consumption at a higher level.

Hence, the Commission shall retain the auxiliary consumption of solar thermal power plants at 10%.

3.3.4. Useful Life

The useful life for solar thermal power plants is estimated between 20 and 25 years based on the technology. Both GERC, in its last Solar Tariff Order dated 29 January, 2010 in Order No. 2 of 2010, and CERC, in its order dated 26th February, 2010 in suo motu Petition No. 53 of 2010 on *Terms and Conditions for Tariff determination from Renewable Energy Sources* as well as *Draft Terms and Conditions for Tariff Determination from Renewable Energy Sources* dated 18 November, 2011 have considered the useful life for solar thermal power plants as 25 years.

Hence, the Commission shall consider the useful life of solar thermal power plants for tariff determination at 25 years.

3.4. Finance-Related Parameters for Solar Thermal Power Plants

The Commission had considered the same finance-related parameters for solar thermal power plants as that for solar photovoltaic power plants. These parameters include:

- 3.4.1. Debt-Equity Ratio
- 3.4.2. Loan Tenure
- 3.4.3. Interest Rate on Loan

- 3.4.4. Insurance Cost
- 3.4.5. Working Capital
- 3.4.6. Interest Rate on Working Capital
- 3.4.7. Rate of Depreciation
- 3.4.8. Return on Equity
- 3.4.9. Discount Rate on Levelized Tariff

While there were not many direct suggestions on finance-related parameters by the Objectors, their suggestions that were received for photovoltaic power plants can be extended to solar thermal power plants. Further, the Commission's ruling on such finance-related suggestions shall also apply to solar thermal power plants.

3.5. Tariff for Solar Thermal Power Projects

3.5.1. Tariff for Solar Thermal Power Projects Without Storage

The Commission, based on the various parameters laid out in its Discussion Paper, had indicated a levelized tariff for solar thermal power project availing accelerated depreciation benefit at ₹ 12.32 per kWh for 25 years; this tariff was further distributed as ₹ 14.00 per kWh for the first 12 years, and ₹ 7.00 per kWh for the subsequent 13 years. Also, the levelized tariff for solar thermal power projects not availing accelerated depreciation benefit was indicated at ₹ 13.00 per kWh for 25 years; this tariff was further distributed as ₹ 14.68 per kWh for the first 12 years, and ₹ 7.68 per kWh for the next 13 years.

Suggestion from Objectors:

One of the Project Developers suggested considering a levelized tariff of ₹ 15.31 per kWh as the Developer was not able to achieve financial closure for its solar thermal power project after having worked on the same for 11 months, additional number of approvals and related costs including studies such as Coastal Relief Zone approval, Marine EIA, etc. which happens at a central level, costs associated with careful selection of land in the shape of a quadrilateral and water source.

One of the Distribution Companies requested the Commission to consider a levelized tariff of less than ₹ 10.49 per kWh benchmarked by the Jawaharlal Nehru National Solar Mission Phase I bidding.

Commission's Ruling:

A summary of the various parameters discussed and decided upon is provided as follows:

Table: Summary of parameters for determining tariff for solar photovoltaic power projects.

PARAMETER	VALUE		
Plant Cost			
Capital Cost	Rs.	1400	Lacs per MW
O&M Cost		1.5%	of Capital Cost
Escalation in O&M Cost		5.72%	Annually
Performance Parameters			
Capacity Utilization Factor		23%	
Performance Degradation		0.25%	Annually
Auxiliary Consumption		10%	of Energy Generation
Useful Life		25	Years
Financial Parameters			
Debt : Equity Ratio		70 : 30	
Loan Tenure		10	Years
Interest Rate on Loan		13.00%	
Insurance Cost		0.35%	Annually
Interest on Working Capital		12.00%	Annually
Working Capital	Sum	1	Month's O&M Expense
	of:	1	Months' Energy Charges at normative CUF
Rate of Depreciation		6%	Annually for the first...
		10	Years
		2%	Annually for the next...
		15	Years
Minimum Alternate Tax Rate		20.008%	Annually for the first...

	10	Years
Corporate Tax Rate	32.445%	Annually
Return on Equity	14%	Annually
Discount Factor	10.74%	Annually

Based on these technical and financial parameters, the levelized tariff including return on equity for solar thermal power projects availing accelerated depreciation is calculated to be **₹ 11.55 per kWh**, while the tariff for similar projects not availing accelerated depreciation is calculated to be **₹ 12.91 per kWh**.

The Commission decides to retain only a levelized tariff for solar thermal power projects, and not to further distribute the levelized tariffs into two sub-periods. The Commission takes this approach as the tariff for solar thermal power projects in the current Tariff Order has increased compared to the previous order. Moreover, the levelized tariff determined herein is greater than the tariff determined for the first 12 years in the previous order, and hence, the financial viability of the solar thermal power projects will continue to remain intact.

Further, this tariff shall apply to solar thermal power projects without storage commissioned between 29 January, 2012 and 31 March, 2015.

Table: Summary of tariffs for solar thermal power plants without storage commissioned between 29 January, 2012 and 31 March, 2015.

<i>Levelized Tariff for Solar Thermal Projects</i>	
With accelerated depreciation benefit:	₹ 11.55 per kWh for 25 years
Without accelerated depreciation benefit:	₹ 12.91 per kWh for 25 years

The tariff determined above is for solar thermal power plants without any storage facilities or hybridization with any other, conventional or non-conventional power technologies. Further, it

is clarified that solar power projects may not utilize any kind of fuel or energy other than solar energy for processes involved in generation of electricity. In case any solar power project is found to be utilizing any other kind of fuel or energy other than solar energy, necessary action as per law including withdrawal of preferential tariff shall be taken.

3.5.2. Tariff for Variants of Solar Thermal Plant (Variants Including Storage and Hybrid)

Storage and hybrid technologies, both have an implication on various costs associated with capital, operation and maintenance, auxiliary power consumption, etc. as well as may increase the capacity utilization factor.

In case a Developer chooses to develop the system with thermal storage or as a hybrid, the tariff determination for such system shall be taken up on case-to-case basis by the Commission under 'project specific' tariff determination route. Provided that the financial norms as specified in this order, except for capital cost, shall be ceiling norms while determining the project specific tariff.

4. OTHER CONSIDERATIONS

4.1. Plant and Machinery

Solar power projects established with only new Plants and Machinery shall be eligible for the benefit of tariff determined within the scope of this Tariff Order.

4.2. Auxiliary Power Supply

The State Transmission Utility or the Distribution Licensee shall provide auxiliary power from the same point of connectivity, i.e. a common point for injection as well as for drawl of energy for the solar generator under kWh to kWh adjustment basis.

4.3. Reactive Energy Charges

The Reactive Power Charges as approved by the Commission in tariff orders for the Gujarat Energy Transmission Corporation Ltd. (GETCO) from time to time shall be applicable to such projects.

4.4. Evacuation Facilities

Interfacing line of appropriate capacity and voltage as per the Central Electricity Authority (CEA) (Technical Standard for connectivity to the grid) Regulations, 2007 shall be provided by the STU or the Distribution Licensee at their cost. The intending generator shall apply to the STU or the Distribution Licensee concerned well in advance.

Switchyard equipment, metering and protection arrangement and Remote Terminal Units (RTU) at generator end shall be provided by the owners of solar generators/ solar Project Developers at their own cost. The interconnection voltage at generator switchyard will depend on the quantum of power to be evacuated and as per the connectivity granted by the STU or the Distribution Company in line with the State Grid Code.

The transmission line from the switchyard of generator to the Gujarat Energy Transmission Corporation Ltd. (GETCO) substation shall be laid by GETCO.

Suggestions from Objectors:

Some Developers stressed that the laying of evacuation lines and infrastructure should be within GETCO's scope. Some Developers also requested that if the STU passes the obligation of construction of evacuation lines to the Developer, or if there is any delay in construction of the evacuation lines, then such projects should not be penalized for late commissioning of the plant.

The State Transmission Utility has requested to the Commission that the responsibility of laying the transmission lines should be within the scope of the solar Project Developer because (i) many solar projects are established at remote locations and they should be incentivized to establish their projects at convenient locations near the GETCO substations, which would also decrease the transmission losses, and (ii) it is difficult to manage installation for such a high volume of transmission lines especially as Developers are not providing enough time for the State Transmission Utility to set up the transmission line infrastructure.

One of the Distribution Companies suggested that the Developer should pay 15% per annum the cost of the infrastructure for laying the transmission infrastructure.

Commission's Ruling:

One of the advantages of solar technology is the ability to utilize non-fertile and non-productive land under harsh conditions, which are often found at remote locations and hence, may be far from the STU substations. The utilization of such land should not be discouraged. The STU is the best-suited agency with the expertise to carry out the work of laying transmission lines throughout the state. Further, the Solar Power Policy, 2009 of the Government of Gujarat provides that the transmission line from the switchyard of the substation of the megawatt-scale solar power plant to the GETCO substation shall be laid by GETCO.

Hence, the Commission retains that the transmission lines from the switchyard of generator to the GETCO substation shall be laid by GETCO. The cost for the same shall also be borne by GETCO.

4.5. Transmission and Wheeling Charge

Whenever the power is sold to a Distribution licensee, the generator shall supply the power at the interconnection point of the generator-STU i.e. generator bus-bar. Thereafter, the transmission/wheeling charges shall be borne by the distribution licensee.

Suggestion from Objectors:

One of the Developers has requested the Commission to introduce free wheeling of solar-generated power on the STU and Distribution Licensees in the state both for intra-state and interstate delivery. He has reasoned that Gujarat, being a leading state in solar energy, has the opportunity to wheel and export solar power to other states, and hence, free wheeling can be of strategic importance. He further indicated that CERC has announced free wheeling of solar power on the Central Transmission Utility (CTU) for solar project until 2013, and Rajasthan has announced concessionary wheeling charges. Another Developer suggested that the wheeling charges and losses should be considered on the direction of net flow of power as the flow of solar power can either increase or even decrease the STU losses.

One of the Distribution Companies has suggested that the transmission loss applicable to consumers wheeling power at the 66 kV and above voltage level shall be estimated by SLDC, whereas for a consumer wheeling power below 66 kV should be normal transmission losses (estimated by SLDC) plus 10% distribution losses.

Commission's Ruling:

Regarding transmission /wheeling charges for self use (captive use) or third-party sale, the following is decided by the Commission:

4.5.1. Wheeling at 66 kV and Above

As per the scope of this Tariff Order, this clause shall be applicable to solar plants of capacity greater than 4 MW.

For wheeling of power to consumption site at 66 kV voltage level and above, the wheeling of electricity generated from the Solar Power Generators to the desired location(s) within the State shall be allowed on payment of transmission charges and transmission losses applicable to normal Open-Access Consumer. Inter-state sale of power shall also be on the same principles.

For wheeling of power to consumption site at a voltage below 66 KV, the wheeling of electricity generated from the solar power Generators to the desired location(s) within the State shall be allowed on payment of transmission charges as applicable to normal open-access customers and transmission and wheeling loss @ 7% of the energy fed into the grid. This loss shall be shared between the transmission and distribution licensees in the ratio of 4:3.

4.5.2. Wheeling at 11 kV or Above and Below 66 kV

As per the scope of the current Tariff Order, this clause shall be applicable to ground-mounted or rooftop solar plant of capacity between 100 kW and 1 MW, and ground-mounted solar plants of capacity between 1 MW and 4 MW.

The wheeling of power generated by such generators to the desired location(s) within the area of same distribution licensee shall be allowed on payment (in kind) of distribution loss @ 3% of the energy fed in to the grid.

The wheeling of power generated by such generator to the desired location(s) within the State but in the area of a different distribution licensee shall be allowed on payment of transmission charges as applicable to normal Open-Access Customers and transmission and distribution loss @ 10% of the energy fed in to the grid. These losses shall be shared among the transmission licensee and two distribution licensees involved in the ratio of 4:3:3.

4.5.3. Wheeling at 415 V or below

As per the scope of the current Tariff Order, this clause shall be applicable to rooftop solar installations of capacity between 1 kW and 5 kW feeding at 220 V, 1 ϕ ; and rooftop solar installations of capacity between 5 kW and 100 kW feeding at 415 V, 3 ϕ .

No wheeling charges shall apply for wheeling of power generated by such projects, to the desired locations(s), as such projects decrease the transmission and distribution losses for the utility, and increase the efficiency of the grid.

4.5.4. Wheeling at Two or More Locations

If a Solar Power Generator owner desires to wheel electricity to more than two locations, he shall pay ₹ 0.05 per unit on energy fed in the grid to Distribution Company in whose area power is consumed in addition to the abovementioned transmission charges and losses, as applicable.

4.6. Cross-Subsidy Surcharge

As a promotional measure for solar power, which is still in its nascent stage, no cross-subsidy surcharges shall be levied in case of third-party sale. However, normal open-access charges as specified in the Section titled “Transmission/ Wheeling Charges” shall be levied from Consumers/ Users.

No banking shall be allowed in case of third party sale. The energy wheeled is required to be consumed in the same time block. Any unutilized energy is to be considered as sale to the utility and for the same the distribution licensee should pay 85% of the tariff determined by the Commission.

4.7. Applicability of Intra-State ABT

In its Discussion Paper, the Commission had suggested that intra-state availability-based tariff (ABT) order should not be applicable to solar power generation projects.

Suggestions of Objectors:

One of the Distribution Companies suggested to the Commission to include solar projects for applicability for intra-state ABT based on the Indian Grid Code notified by CERC for solar and wind projects.

Commission's Ruling:

Considering the nascent stage of the solar technology, and in order to reduce the uncertainty, the Commission retains that that intra-state ABT order shall not be applicable to solar power generation projects.

4.8. Energy Accounting

Solar-based energy generation projects shall be out of the purview of the intra-state ABT. However, for the purpose of energy accounting, such projects shall have to provide ABT compliant meters at the interface points. Interface metering shall conform to the Central Electricity Authority (Installation and Operation Meters) Regulations, 2006. The electricity generated from the Solar Power Generators shall be metered and readings shall be taken jointly by the solar power project Developer with the Gujarat Energy Development Agency (GEDA), Gujarat Energy Transmission Company Ltd. (GETCO) or Distribution Company at the interconnection point of the generator bus-bar with the transmission or distribution system concerned, as the case may be.

In case of solar rooftop power projects, a separate metering system shall be provided at the output terminal of solar roof-top power project to measure gross energy generation from such project.

Suggestions from Objectors:

One of the Distribution Companies has suggested that meter reading can be taken at SLDC or its representatives or by Distribution Companies, which can be final and binding.

Commission's Ruling:

As GEDA is the nodal agency for all solar power projects in Gujarat, their participation for meter reading is necessary in addition to the Project Developer. Hence, the electricity generated from the Solar Power Generators shall be metered and readings shall be taken jointly by the solar power project Developer with the Gujarat Energy Development Agency (GEDA), Gujarat Energy Transmission Company Ltd. (GETCO) or Distribution Company at the interconnection point of the generator bus-bar with the transmission or distribution system concerned, as the case may be.

4.9. Non-Applicability of Merit Order

Considering the nature of solar energy, all solar energy power plants shall be considered as 'must-run' facilities, and the power generated from such power plants shall be kept out from the merit order dispatch principles.

4.10. Power Purchase Agreement

The term of the power purchase agreement that the solar Developer signs with the Distribution Licensee will be 25 years. The Distribution Licensee will sign the PPA at the earliest from the date of submission of the application with all relevant details by the solar generators and get it approved from the Commission.

Suggestions from Objectors:

One of the Distribution Companies has suggested to the Commission that specific approvals for signing PPAs may not be required from the Commission as they have already signed many PPAs.

The same Distribution Company has also requested the Commission to include a provision for submission of Bank Guarantee/ Security Deposit of Rs. 50 lacs /MW for Developers at the time of signing of PPA as this provision was present in the Commission's previous solar tariff order. Further, they have cited two examples where in absence of provisions related to collection of security deposits they are finding difficulties in recovering liquidated damages from Developers.

Commission's Ruling:

The Commission retains that term of the power purchase agreement that the solar Developer signs with the Distribution Licensee will be 25 years. The Distribution Licensee will sign the PPA at the earliest from the date of submission of the application with all relevant details by the solar generators and get it approved from the Commission.

Further, the Commission decides that the Project Developer shall submit a Bank Guarantee/ Security Deposit of ₹ 50 lacs /MW to the Distribution Licensee at the time of signing of PPA.

4.11. Sharing of Clean Development Mechanism (CDM) Benefit

The Commission had considered sharing of CDM benefits as per the recommendation made by the Working Group for Renewable Energy Generation constituted by the Forum of Regulators and as per the CERC, in Clause 21 of its Renewable Energy Regulation No. L-7/186(201)/2009-CERC dated 16 September, 2009:

“100% of the gross proceeds on account of CDM benefit to be retained by the project Developer in the first year after the date of commercial operation of the generating station. In the second year, the share of the Beneficiaries shall be 10% which shall be progressively increased by 10% every year till it reaches 50%, whereafter the proceeds shall be shared in equal proportion, by the Generating Company and the Beneficiaries.”

Suggestions from Objectors:

One of the Developers suggested that the CDM sharing should be based on net proceeds and not gross proceeds due to the high initial cost of registration of the project for such benefits and income tax to be paid on such benefits. An equipment supplier suggested that the Developer should retain 100% of the CDM one year after the registration of the project before starting to share it with the Beneficiaries. This provision is to incentivize the Developer to file for CDM benefit; otherwise because it takes 2-3 years to register a CDM project, the Developer would never be able to realize benefit of 100% of the CDM benefit.

Commission's Ruling:

Considering the high initial cost of registering CDM projects, application of taxes on CDM benefits and long time to realize the CDM benefits, the Commission decides that 100% of the net proceeds on account of CDM benefit to be retained by the project Developer in the first year after the date of commercial operation of the generating station. In the second year, the share of the Beneficiaries shall be 10% which shall be progressively increased by 10% every year till it reaches 50%, whereafter the proceeds shall be shared in equal proportion, by the Generating Company and the Beneficiaries

4.12. Control Period

The control period proposed for the Commission's Discussion Paper is from 29 January, 2012 to 31 March, 2015.

Suggestions from Objectors:

One of the Developers suggested that the control period should be up to 31 March, 2016. Another Developer suggested the Commission to consider delayed projects for the same tariff till commissioning is achieved with 12 months of new control period commencement date.

Commission's Ruling:

The control period for this Tariff Order shall be from 29 January, 2012 to 31 March, 2015.

The tariff for procurement of solar photovoltaic power shall be revised year-on-year during this control period. These tariffs have already been mentioned in previous clauses of this Tariff Order. For solar thermal technologies, considering the lead time of such power projects, the tariff shall be constant during the control period.

COMMISSION'S ORDER

The Commission approves the tariff for Procurement by the Distribution Licensees and others from Solar Energy Projects for the Control Period from 29 January, 2012 to 31 March, 2015 as outlined in the table below:

Period →	29 Jan. '12 to 31 Mar. '13	1 Apr. '13 to 31 Mar. '14	1 Apr. '14 to 31 Mar. '15
<i>For megawatt-scale photovoltaic projects availing accelerated depreciation</i>			
Levelized Tariff for 25 years	₹ 9.28 per kWh	₹ 8.63 per kWh	₹ 8.03 per kWh
For first 12 years	₹ 9.98 per kWh	₹ 9.13 per kWh	₹ 8.35 per kWh
For subsequent 13 years	₹ 7.00 per kWh	₹ 7.00 per kWh	₹ 7.00 per kWh
<i>For kilowatt-scale photovoltaic projects availing accelerated depreciation</i>			
Levelized Tariff for 25 years	₹ 11.14 per kWh	₹ 10.36 per kWh	₹ 9.63 per kWh

<i>Levelized Tariff for Solar Thermal Projects</i>	
With accelerated depreciation benefit:	₹ 11.55 per kWh for 25 years

Sd/-	Sd/-	Sd/-
Dr. M. K. Iyer	Shri Pravinbhai Patel	Dr. P. K. Mishra
Member	Member	Chairman

Place: Ahmedabad

Date: 27th January, 2012

Annexure I: List of Entities that have communicated their views on the Discussion Paper on Determination of Tariff for Procurement of Power by distribution Licensees and Others from Solar Energy Projects for the State of Gujarat made public by the Gujarat Electricity Regulatory Commission on 1 November, 2011.

	Name
1	Abellon Clean Energy Limited
2	ACME Tele Power Limited
3	Adani Power Limited
4	Applied Material India Private Limited
5	Astonfield Solar (Gujarat) Private Limited
6	Cargo Solar Power (Gujarat) Private Limited
7	Dakshin Gujarat Vij Company Limited
8	EMCO Limited
9	ENAM Holdings Private Limited
10	Essar Power Limited
11	Gujarat Urja Vikas Nigam Limited
12	Jahind Projects Limited
13	Kalidas Patel & Atul Kumar
14	Kiran Energy Solar Power Limited
15	Lanco Solar Energy Private Limited
16	Moser Baer Clean Energy Limited
17	Prayas Energy Group
18	Rajkot Municipal Corporation
19	Rudraksh Energy
20	Shri Vagmin Buch
21	Solarfield Energy Private Limited
22	SunEdison - Energy India Private Limited
23	Torrent Power Limited
24	Welspun Renewable Energy Limited
25	Yantra eSolar India Private Limited

Annexure II: List of Entities that have participated in the public hearing on the Determination of Tariff for Procurement of Power by distribution Licensees and Others from Solar Energy Projects for the State of Gujarat at the Gujarat Electricity Regulatory Commission on 27 December, 2011.

	Name
1	Abellon Clean Energy Limited
2	ACME Tele Power Limited
3	AES Solar Energy Gujarat Private Limited
4	Applied Material India Private Limited
5	Astonfield Solar (Gujarat) Private Limited
6	Cargo Solar Power (Gujarat) Private Limited
7	EMCO Limited
8	ENAM Holdings Private Limited
9	Essar Power Limited
10	Gujarat Energy Transmission Corporation Limited
11	Gujarat Urja Vikas Nigam Limited
12	Kiran Energy Solar Power Limited
13	Lanco Solar Energy Private Limited
14	Moser Baer Clean Energy Limited
15	Parimal Power
16	Rudraksh Energy
17	State Load Dispatch Centre
18	SunEdison - Energy India Private Limited
19	Surat Municipal Corporation
20	Torrent Power Limited