CERC's analysis on Benchmark Capital Cost for Solar PV Power Projects and Solar Thermal Power Projects

ENERGETICA INDIA

The article revisits the costs breakup from CERC to arrive an benchmark capital cost for solar pv and solar thermal projects in India.

BENCHMARK CAPITAL COST NORM FOR SOLAR PV POWER PROJECTS FOR THE FY 2013-14

BackGround

CERC had noted that the solar PV industry had seen significant cost reductions over the last three years showing a declining trend of over 20-22% on annual basis.

It was pointed out that the cost of solar PV crystalline module cost was in the range of 0.6-0.65 USD/Wp; at the time of CERC report. This remarkable reduction in module prices was due to a combination of factors like economies of scale, technological advances and manufacturing process advances, and over production vis-a-vis demand.

CERC noted a similar declining trend in terms of the price of balance of system (BoS) due to the reduction in the power electronics, inverters, streamlined installation technologies and processes.

The combined reduction in prices and low cost financing has contributed to the low cost solar electricity sale price in the recent bids in India.

India has seen the following price bids under JNNSM:

- In batch I, the bid range varied from 10.95/kWh to 12.76/kWh with an average bid price of Rs. 12.12/kWh.
- The winning bids for solar PV under batch II of JNNSM phase I varied from 7.49/kWh to 9.44/kWh with an average bid price of Rs. 8.77/kWh

Module Cost

The analysis of CERC; with inputs from leading databases and consulting companies, indicated that the current thin film module price per Wp varies in the range of $0.4 to $1.0 and crystalline module price varies in the range of $0.50 to 1.0.

Also most of the international studies showed that the prices are expected to decline in future.

Considering the above reasons, the Commission proposed to consider base module cost at $0.65/Wp (CIF) i.e. cost, insurance, freight and taxes, for the determination of benchmark capital cost for solar PV projects for FY2013-14. With the exchange rate of Rs. 53/US$, the module cost works out to Rs. 344.5 Lakh/ MW for the FY 2013-14 for determination of benchmark cost for Solar PV projects for FY 2013-14.

Non-Module Cost Component

The non-module cost components comprise cost towards land, civil & general works, ground mounting structures, power conditioning unit, cabling & transformer/ switchgears and preliminary/pre-operating expenses & financing costs.

Land:

The land requirement for Solar PV based power project depends upon the technology employed i.e. Crystalline or Thin film, conversion efficiency and solar radiation incident in respective area.

The Commission, while determining the benchmark capital cost for Solar PV projects for the year 2012-13, had considered land requirement of 5 Acre/MW for crystalline PV project and its cost was considered as Rs. 16 Lakh / MW. The Commission proposed to escalate the normative land cost of FY2012-13 at 5% and proposes the land cost at Rs. 16.80 Lakh/ MW for the determination of benchmark capital cost of Solar PV projects for FY2013-14.

Civil and General Works:

The cost associated with civil works includes testing of soil, preparation of soil/ ground with all necessary works like earthmoving, digging holes for the foundations/pilings and leveling, fencing of the land, development of approach road, cable trenches, water supply arrangement in solar farm, control room etc.

The General works include security of solar farm, setting up of power back-up generator; yard lighting, Earthling Kits, etc.

The Commission, while determining the benchmark capital cost for Solar PV projects for the year 2012-13, had considered the civil and general works together as Rs. 90.00 Lakh /MW.

After allowing cost escalation of 5% over the last year's cost the Commission proposed to consider 94.50 lakh/MW as the cost for Civil and General work for benchmark capital cost of Solar PV projects for FY2013-14.

Ground Mounting Structures:

This expenditure includes cost associated with manufacturing, delivery, installation and calibration of either hot galvanized steel or aluminium structures including all necessary material, works and installation on prepared foundations/pilings.

The Commission, while determining the benchmark capital cost for Solar PV projects for the year 2012-13, had considered the cost of ground mounting structure as Rs. 100.00 Lakh/MW. After allowing cost escalation of 5% over the last year's cost the Commission proposed to consider Rs. 105.00 Lakh/MW towards the cost for Ground Mounting Structures for benchmark capital cost of Solar PV projects for FY2013-14.

Breakup for Capital Cost Projection

Particular	Capital Cost Norm for Solar PV Project	% of Total Cost
	Rs. Lakhs/MW	
PV Modules	344.50	42.8%
Land Cost	16.80	2.1%
Civil & General Works	94.50	11.7%
Mounting Structure	105.00	13.0%
Power Conditioning Unit	60.00	7.4%
Evacuation Cost upto Inter-Connection Point (Cables & Transformers)	105.00	13.0%
Preliminary & Pre-Operative Expenses including IDC and contingency	80.00	9.9%
Total Capital Cost	**805.80**	**100.0%**

Table 1.

Power Conditioning Unit (Inverter):

Power conditioning equipment is an important component of the balance-of-system. Power conditioners process the DC power produced by a photovoltaic system to AC power and match the same with utility's power.

While specifying the benchmark capital cost for solar PV projects in 2012-13, the Commission had considered 98 Lakh/MW as cost towards Power conditioning unit. Considering the reduction of inverter prices globally and in India it was proposed that expenditure towards Power conditioning unit to be considered as Rs. 60.00 Lakh/MW.

Cables and Transformers:

This expenditure includes EPC cost towards DC cabels between Solar PV panels & Inverters including junction boxes, AC cabling between Inverter & substation, Earthling arrangements and Transformer. The transformer cost includes the EPC cost of a step up outdoor type transformer, breaker, Current Transformers, Potential Transformers, Isolators, LAs, protection relay and TOD meter.

The Commission, while determining the benchmark capital cost for Solar PV projects for the year 2012-13, had considered the cost of cables and transformers and other associated equipments as Rs. 100.00 Lakh/MW.

After allowing cost escalation of 5% over the last year's cost, the Commission proposed that Rs. 105 Lakh/ MW may be considered as expenditure towards cables and transformers for solar PV projects.

Preliminary/Pre-operating expenses and Financing Costs:

The preliminary/pre-operating expenses include transportation of equipment, storage of equipment at site, insurance, contingency, taxes and duties, IDC and finance charges etc. Detailed breakup of Preliminary and Pre-operative expenses and financing cost, lump sum in percentage of total capital cost is proposed as under:

a. Insurance Cost: 0.5%
b. Contingency: 0.5%
c. Interest during Construction (IDC): 5%
d. Financing cost: 1%
e. Project management cost: 1%
f. Pre-operative Cost: 1.0%

Preliminary/Pre-operating expenses and Financing Cost contribute to above 10% of total capital cost on average basis. In past years, while determining the benchmark capital cost for solar PV projects, the Commission had considered 10% of total capital cost as preliminary /Pre-operating expenses and Financing cost.

Accordingly, Rs. 80.00 Lakh/MW was proposed to be considered as preliminary / Preoperating expenses and Financing cost.

Considering data in table 1 the total cost of Solar Photo voltaic power projects for the FY2013-14 was proposed to be considered at Rs. 800.00 lakh/MW as benchmark project cost of Solar PV projects.

BENCHMARK CAPITAL COST FOR SOLAR THERMAL POWER PROJECTS

As per first proviso under Regulation 5 of the RE Tariff Regulations, 2012, the benchmark capital cost for Solar thermal power projects is reviewed annually. The normative capital cost for Solar Thermal Power Projects in past are shown in table 2.

Under the National Solar Mission (NSM), the total aggregated capacity 500

Year	FY 09-10	FY 10-11	FY 11-12	FY 12-13
Capital Cost (Rupees Lakh/MW)	1300	1530	1500	1300

Table 2.

Name of Bidder	Discount Offered (Paisa)	State	MW	Tariff Quoted Rs./kWh
Lanco Infratech	482	Rajasthan	100	10.49
KVK Energy Ventures	411	Rajasthan	100	11.2
Megha Engineering & Infrastructure	400	Andhra Pradesh	50	11.31
Rajashthan Sun Technique Energy	334	Rajasthan	100	11.97
Aurum Renewable Energy	312	Gujarat	20	12.19
Godawari Power & Ispat	311	Rajasthan	50	12.2
Corporate Ispat Alloys	307	Rajasthan	50	12.24
		Weighted Average	470	11.48

Table 3.

MW of grid connected Solar thermal Projects in Phase 1 was to be developed.

Seven Solar Thermal power projects (470 MW) were selected through the bidding process under JNNSM Phase–I and the discount offered on CERC determined tariff of Rs. 15.31/kWh was as seen in table 3.

Developers of solar thermal projects in India are reported to be facing some problems especially in terms of lack of availability of solar irradiation data which is essential for planning and optimizing a solar thermal power project. Due to much lower DNI vis a vis initial estimate, solar field re-engineering is reported to have been carried out by some of the developers. Generation of revised technical specifications and modification of relevant orders placed on various suppliers may cause the delay on the commissioning of the projects.

Lack of authentic solar irradiation data and lack of data on project costs of projects under commissioning in India, electricity generation potential of typical sites and knowledge of performance of technology in India, and possible impact of rupee depreciation on project cost were the issues considered by the Commission

while determining the benchmark capital cost of the solar thermal project.

The International renewable energy Agency (IRENA) has in its report on Renewable energy technologies: Cost analysis series – Concentrating Solar Power (June 2012) mentioned that the estimated cost of CSP plants varies significantly, depending on the capacity factor, which in turn depends on the quality of the solar resources, thermal energy storage levels and the technical characteristics of CSP plant.

The said report also states that based on the data analysis, for parabolic trough plants without thermal storage, cost could be as low as USD 4600/kW with capacity factor in the range of 20-25%. Report also estimated possible cost reduction by 2015 (table 4).

However the Commission considered the total installed cost in India to be lower compared to Europe and US.

Though there are opportunities for cost reductions for CSP plant, the fact remains that the commercial deployment of CSP is still in its infancy in India. As experience is gained, R&D advances, mass production of components occurs and increased competition in technology providers develops, costs will come down.

However, significant investment in further R&D and deployment will be required to realize these cost reductions.

Considering the expected reduction in cost of thermal power projects globally as well as the tariff quoted by the bidders selected under JNNSM, the Commission proposed the benchmark capital cost of solar thermal project as 1200 Lakh/MW for FY 2013-14.

	2011		2015	
	2010 USD/kW	Capacity Factor (%)	2010 USD/kW	Capacity Factor (%)
Parabolic trough				
No Storage	4600	20 to 25	3900 to 4100	20 to 25
6 hrs Storage	7100 to 9800	40 to 53	6300 to 8300	40 to 53
Solar Tower				
6-7.5 hrs Storage	6300 to 7500	40 to 45	5700 to 6400	40 to 53
12-15 hrs Storage	9000 to 10500	65 to 80	8100 to 9000	65 to 80

Table 4.