Whitepaper

The SUN is definitely rising, but will it shine?

Decoding the trend of falling solar tariffs in India

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Introduction

Solar tariffs in India have continued to fall during the last 2-3 years, almost reaching grid parity levels. Claims of reaching coal-parity in a not-too-distant future are no longer considered impossible. The key question is no longer how low solar tariffs can go but how quickly. Are these falling tariffs sustainable? Will such low tariffs propel growth? Are lenders financing these projects? What are the risks in the industry? These are some of the key questions in the mind of stakeholders who are either present in the Solar Industry or evaluating entry into this industry. In this whitepaper *Rahul Gaba* and *Gurpreet Chugh* from ICF describe the key drivers of solar tariffs, explore how low the tariffs can go, gauge what risks the industry is facing and caution on factors that can de-rail this growth.

Indian Power Sector Growth and Renewable Energy Targets

The total installed power capacity in India stood at 301 GW in Mar 2016, out of which renewables form 14% and solar forms a mere 2%. India's current per capita consumption of electricity is 900 kWh/annum as compared to 2,200-3,500 kWh/annum in Eastern European countries and 5,000-6,500 kWh/annum in Western European countries. The Indian economy is growing and electricity demand is expected to rise significantly over the next two decades as more and more consumers get access to electricity and the standard of living improves.

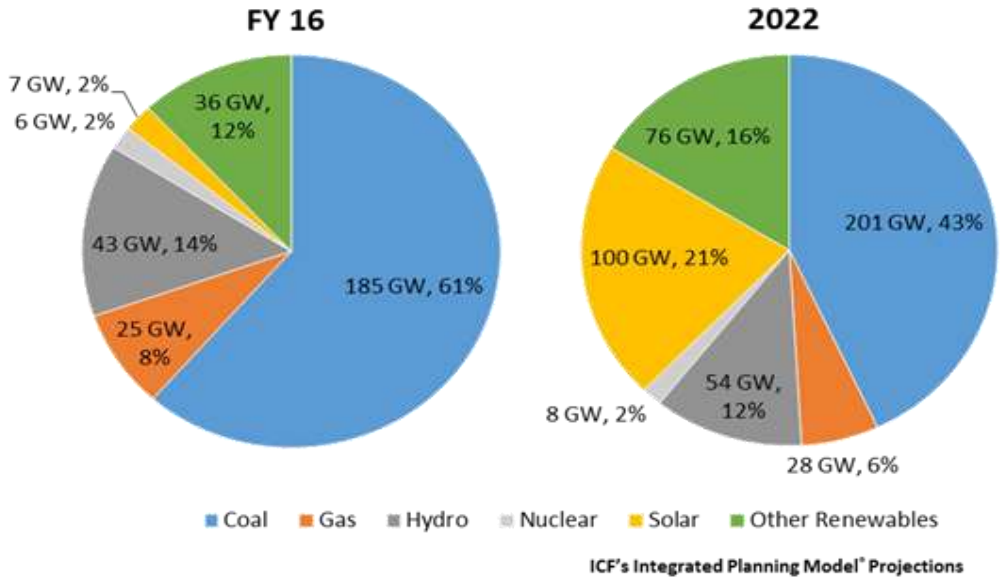

Figure 1 Installed Capacity mix in GW (All-India) in FY 2016 and expected in 2022

While India may still not reach parity with Eastern Europe's per-capita consumption by 2030, nonetheless the increasing demand for electricity will require significant new capacity additions and the total installed capacity is expected to reach 467 GW by 2022 and 730 GW by 2030. To grow sustainably, the Government of India has embarked on a very ambitious renewables fuelled growth strategy with a target of achieving 100 GW installed solar capacity by 2022. If India does deliver on these aggressive RE targets, solar power will comprise 21% of the installed capacity in 2022, as compared to only 2% today (see Figure 1).

Solar Scale-up in India

Such phenomenal growth aspirations are great news for both Indian and global solar community as India is likely to provide the fastest growing market for products and services in the Solar Industry. This is one of the biggest reasons for the rapid drop in solar tariffs in India as more and more global and Indian companies have identified this market potential and want to get in early. Some international companies have also paid entry premiums and bagged projects at low tariffs to enter this sector.

Since the inception of National Solar Mission in 2010, various policy measures such as accelerated depreciation, viability gap funding, renewable purchase obligation, etc., have been adopted by the Indian Government to support solar sector growth. Such measures along with reverse tariff mechanism for bidding led to the rapid fall in tariff bids. Overall, as the installed solar capacity grew eight-fold during the last five years, it was accompanied by 72% drop in tariffs (see Figure 2).

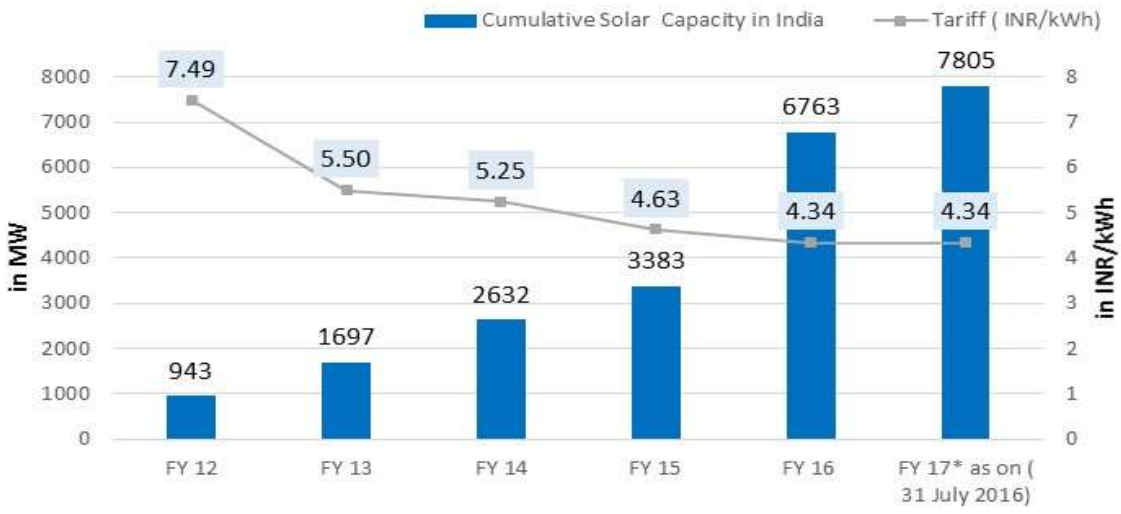

Figure 2 Increasing solar capacity accompanied by reducing tariffs
Source: CEA, MNRE + Business intelligence reports

What this means is that the cost of power from new solar plants in India today is comparable to that from a hydro power plant and lower than that from a LNG based power plant (even when LNG prices are at historical lows) (see Figure 3).

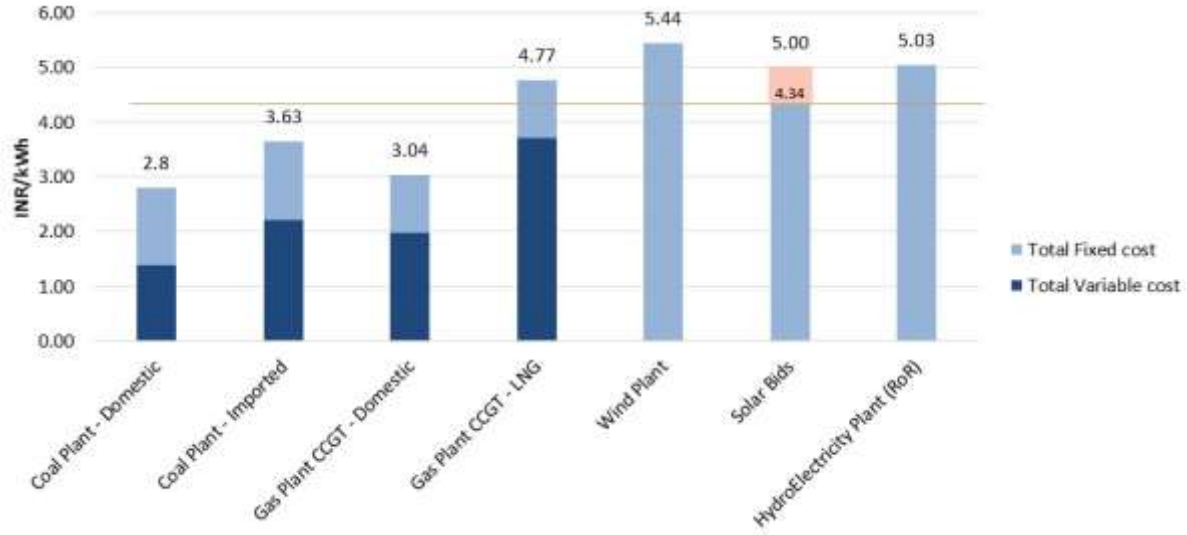

Figure 3 Comparison of cost of power from different sources
Source: ICF analysis

Global Trends

The trend of falling solar tariffs is not unique to India. Low tariffs in reverse auctions are being witnessed all around the world. Tariff benchmarks across North America, Latin America and the Middle-East also witnessed a downward trend when tariffs fell by more than 50% between the global lowest in 2013 (for a project in New Mexico, USA) and the global lowest in 2016 (for a project in Dubai, UAE). Conspicuously, the lowest solar bid in India is still considerably higher than the global lowest –

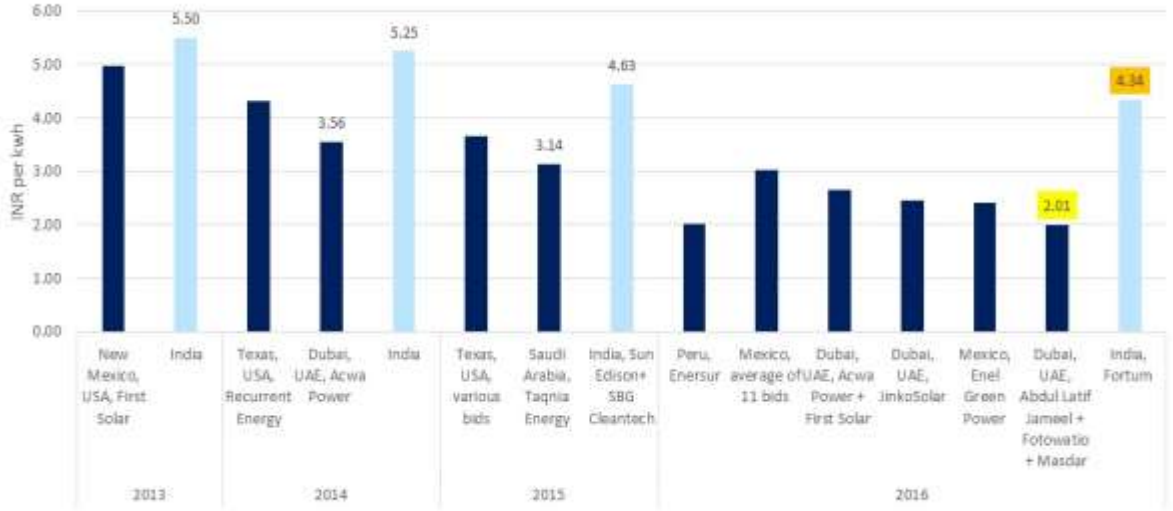

Figure 4 Annual lowest solar bids - Global vs India

Rs 4.34/kWh (Rajasthan 2016) is double of Rs 2.01/kWh (Dubai, 2016) (see Figure 4). These bids cannot (and should not) be compared simply because the key factors such as incentives, land costs, currency hedging, cost of capital and other project risks vary widely from country to country. However, it is important to understand the global wave that the Solar Industry is riding on and assess how this might impact the global risk appetite and also the bidding for projects in India by the same entities that are bidding globally.

Factors Impacting Solar Tariffs

Some of the key factors that impact the solar tariff bids in India include project related technical aspects, financing aspects and overall commercial viability of the deal.

Project Technical Aspects	Costs and Financing Aspects	Overall Commercial Viability
•Solar irradiation •Whether inside the solar park	•Capex and Opex •Debt cost •Equity cost & Expected IRR	•Buyer credit worthiness •Curtailment risk

Figure 5 Key drivers for solar tariffs in India

While all of these factors (and others) are critical to understand for arriving at the tariff, some are more important than the others. For instance, solar radiation is a critical factor as it impacts the project viability and tariffs significantly. A 1% increase in capacity utilization factor (CUF) can lead to a reduction of about 0.20 - 0.25 Rs/ kWh in the tariff. Consequently, states with higher irradiation levels like Rajasthan have seen lower bids on an average when compared to states with lower irradiation levels.

The highest cost item in a PV solar project is the PV module (>50% of the total capex). Given the small scale and high cost of solar PV cell and module manufacturing in India these components have increasingly been sourced from global markets, mainly China and Taiwan. Globally the module prices have fallen drastically over the last few years primarily due to falling polysilicon prices that fell from $475 /kg in 2008 to $17 /kg in 2014. This fall in polysilicon prices coupled with increase in demand for modules and establishment of the global supply chain led to falling module prices. Further, in Asian markets the module prices are significantly lower than in European Union (EU) and North America (NA). This is due to the anti-dumping duty on Chinese modules in EU and NA which has led to a lot of Chinese modules coming to India at very low prices during the last one year. Such low prices for modules had a significant impact on reducing the tariffs being bid for projects.

Another important factor leading to low tariff bids has been the reducing balance of systems (BoS) costs in India which have dropped significantly during the last few years. According to Central Electricity Regulatory Commission (CERC) annual estimates contained in the benchmark tariff orders (see Figure 6) BoS costs have fallen by 50% during the last 4 years. Overall, falling capex has played a significant role in reducing the tariffs being bid for projects during the last few years.

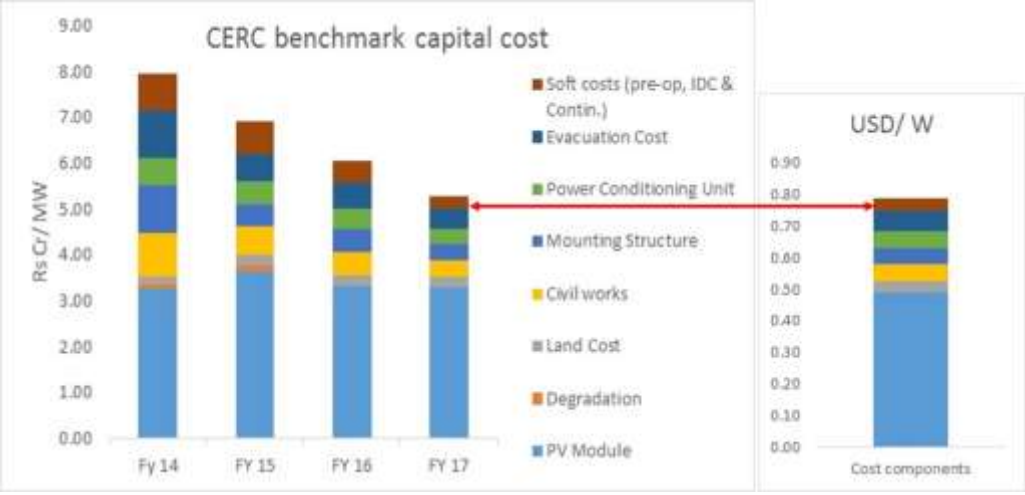

Figure 6 CERC benchmark solar project capital cost FY 17

To illustrate how developers look at tariffs while bidding, we will take the CERC capital cost benchmarks and suitable O&M costs for a 100 MW solar project in a state, say Jharkhand, where 19% CUF is possible. We assume 70:30 debt:equity financing with debt cost at 11.50% and cost of equity at 15%. With these assumptions, the project can be viable at a tariff of Rs 5.25 – 5.35/kWh over the project life of 25 years. With this base tariff, we further evaluate the impact of optimizing different elements.

The first parameter is the capital cost. While the CERC benchmark cost assumes modules available at $0.50/W, there have been deals where project developers have been able to source Tier 1 modules at lower costs of $0.45/W and even at $0.40/W. A reduction of 10 cents in module prices can lead to a tariff reduction of Rs 0.55 – 0.60/ kWh.

In case the project is in a state with higher radiation that can lead to 20% CUF (say Telangana or Rajasthan) the tariff can be reduced by Rs 0.20 -0.25/ kWh. Next, with a strong project promoter balance sheet, the debt may be available at lower rates and 10.5% interest rate is a possibility with refinancing on project completion. This can further lead to a tariff reduction by 0.15 - 0.20/ kWh. Figure 7 below shows how some of these optimizations further impact the base tariff as a cascade of reductions.

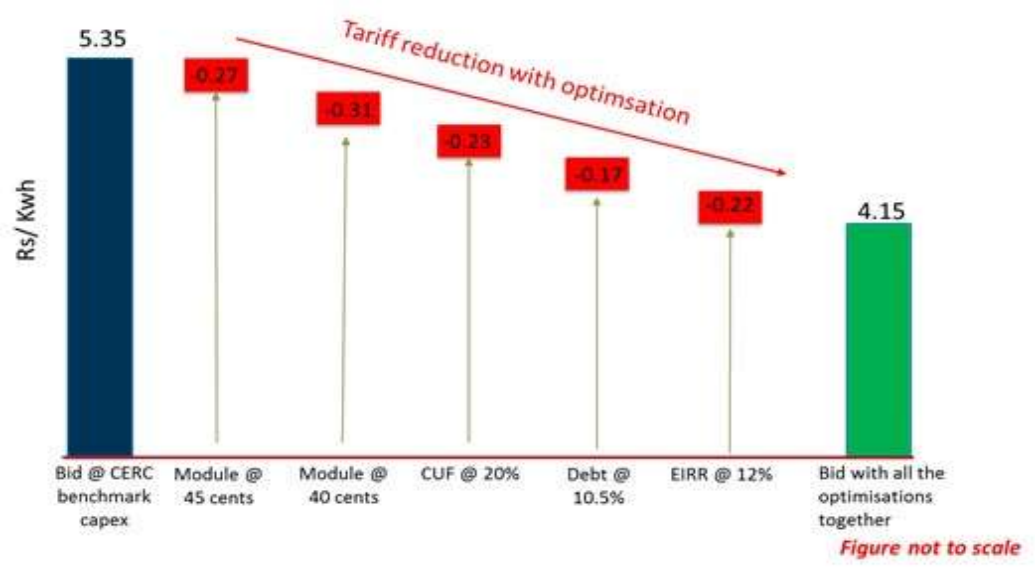

Figure 7 Tariff bid optimization cascade
Source: ICF analysis using ICF-SBM (Solar Bid Model)

In addition, innovative financing structures are being experimented such as long-term equipment financing, parent company support, SPV financing and others.

These structures are enabling bidders to further optimise their cash flows by reducing upfront cash outflow, thereby, increasing return on equity and providing further opportunity to bidders to reduce Day 1 tariff bids. Similarly, strategic tie-ups between module suppliers and developers can offer symbiotic relationships to be leveraged.

In addition, alternate tariff models by bid inviting authorities such as providing annual escalation clauses can present additional routes for day 1 tariff reduction.

So What Could Eclipse the Solar Growth?

As solar capacity builds up and more and more projects are developed, it will result in injection of a significant amount of variable solar power into the grid. Incase India is indeed able to install 100 GW of solar by 2022, it will require ramp up and ramp down requirement of 15-18 GW per hour to balance solar alone. Under such circumstances it will become critical to ensure that balancing power is made available through variable generation sources such as - pumped hydro, open cycle gas or other energy storage solutions. There is a need for very detailed hourly modelling to understand the requirement of such variable power at state level and undertake advance planning. Such planning would require coordinated response on policy, market, infrastructure and investments in variable generation assets.

The second critical risk will be buyer creditworthiness. Ensuring financeable PPA terms and enhancing creditworthiness of ailing DISCOMS through innovative payment security mechanisms will be essential to ensure that the RE capacity addition does not falter midway. A strong step has been taken with Ujwal DISCOM Assurance Yojana (UDAY) but it will be equally important to ensure implementation of the measures identified in UDAY especially on loss reduction, energy efficiency and tariff filing.

In conclusion, there is a strong potential for growth of solar power in India and this presents an exciting opportunity for domestic and international investors. Many investors have already entered or are close to entering the solar value chain and have aggressive plans for a ramp up. Capital will be available from both domestic and international sources. Likewise, technology and human capital too can be quickly ramped up to support this growth. The only factor determining how much of this promised growth materializes will be the ability and willingness of DISCOMs to buy this clean power and integrate the variable nature of this power into the grid.

About the Authors

Gurpreet Chugh is currently Consulting Director, Energy at ICF International. He joined ICF in 2013. Prior to joining ICF, Mr. Chugh was Director, Natural Resources in CRISIL Infrastructure Advisory. He has close to 15 years of experience in the global Energy sector and has worked on identifying, evaluating and structuring private M&A deals in E&P in West Africa, Russia, Indonesia and India. In his professional career as a consultant, he has worked on consulting engagements for International energy majors and provided advisory services on issues across the gas value chain. He has worked in India, UK, Russia and West Africa. Gurpreet is a Chartered Financial Analyst (CFA®), has received an MBA in finance from Management Development Institute, Gurgaon and has a Bachelor's degree in Engineering from DIT, University of Delhi.

Rahul Gaba is a Senior Associate with ICF in New Delhi office and has over 7 years' of experience in advising multilateral agencies (ADB, The World Bank, UNDP), government bodies (Govt. of India, UK and USA) and private sector clients in clean energy markets. Rahul has led clean energy assignments involving research & analysis, market assessment, policy and regulatory study and feasibility analysis of new technologies. Prior to joining ICF, Rahul worked as Consultant with Emergent Ventures India (EVI) an integrated Climate Change Management and Renewable Energy firm funded by IDFC Private Equity. In his role with EVI, he supported developers on clean energy market study, renewable resource assessment, bid price analysis and project development. Rahul holds a Bachelor's degree in Engineering from DCE, University of Delhi.

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- Net back price estimation