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Solar Tariffs to Rise by ~21% in the Next 12 Months

Impact of Module Price Volatility and Basic Customs Duty

Executive Summary

India recorded the lowest solar tariff so far of Rs1.99 per kilowatt hour (kWh) (~US$0.03/kWh) in December 2020. Since then, the lowest winning tariffs in utility-scale solar tenders increased by an average of 22% relative to the record-low tariff. This upward movement can be attributed to an increase in project cost and risk.

The main reason for a hike in project cost is the unprecedented surge in commodity prices. Other key factors include the impact of Basic Customs Duty (BCD) and Approved List of Models and Manufacturers (ALMM), a surge in demand for solar power, increased insurance premiums etc.

To understand the effect of this hike on solar tariffs, we performed a tariff analysis through financial modelling considering three different scenarios.

For projects where modules were already procured (by Q1 2022), the base case tariff expected is Rs2.43/kWh (US$0.0323/kWh). For projects where module procurement is expected after Q4 2022, if a developer can procure domestic modules, the tariffs are likely to decline by 7% vis-à-vis the base case scenario.

A substantial chunk of projects that are likely to be commissioned by 2024 would not be able to procure domestic modules due to lack of availability, amid growing demand in all solar segments. For developers who depend on imported modules, the tariffs are expected to increase by about 21% on the base case tariff (mainly due to BCD).

Technology will play a major role in maximising plant output.

Technology will play a major role in maximising plant output. For example, if a developer opts for imported bifacial modules along with a single-axis tracker, about 20% to 22% generation gain can be achieved and this in part can compensate for higher tariffs.

Important underlying risks in future projects – such as supply chain constraint, commodity price volatility, interest rate rises, policy uncertainty etc – will shape solar tariffs.

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1. Solar Tariff Trends (November 2020 - March 2022)

Solar in India became a key sector through the National Solar Mission (NSM) initiated in 2010. Since then, the Indian solar sector has witnessed a boom, recording 55% compound annual growth rate (CAGR) in installation with cumulative solar capacity growing from ~0.3 gigawatt (GW) in 2010 to ~59GW, as of March 2022.[1] The Indian solar market rides on the grid-scale or utility-scale segment, in stark contrast to the general trend observed in other regions.

The deflationary nature of solar tariffs has been the key driver for the development of solar in the price-sensitive Indian market. In 2010, the lowest winning (also known as L1) tariff discovered for utility-scale solar tenders in India was Rs10.95/kWh.

Fast forward to Q4 2020, the Indian market gave rise to two back-to-back record-breaking L1 tariffs – Rs2/kWh (~US$0.027/kWh) in November and (as cited above) Rs1.99/kWh (~US$0.0269/kWh) in December.[2] The latter, breakthrough figure was achieved under a Gujarat Urja Vikas Nigam Limited (GUVNL) tender.

However, since December 2020, the Indian solar tariff trend has been tracing an upward course. A surge in module prices is the most significant factor in this inflation.

A surge in module prices is the most significant factor in India's solar tariff inflation.

From April 2022, the Indian government introduced the BCD on imported cells and modules as well as ALMM for solar modules.

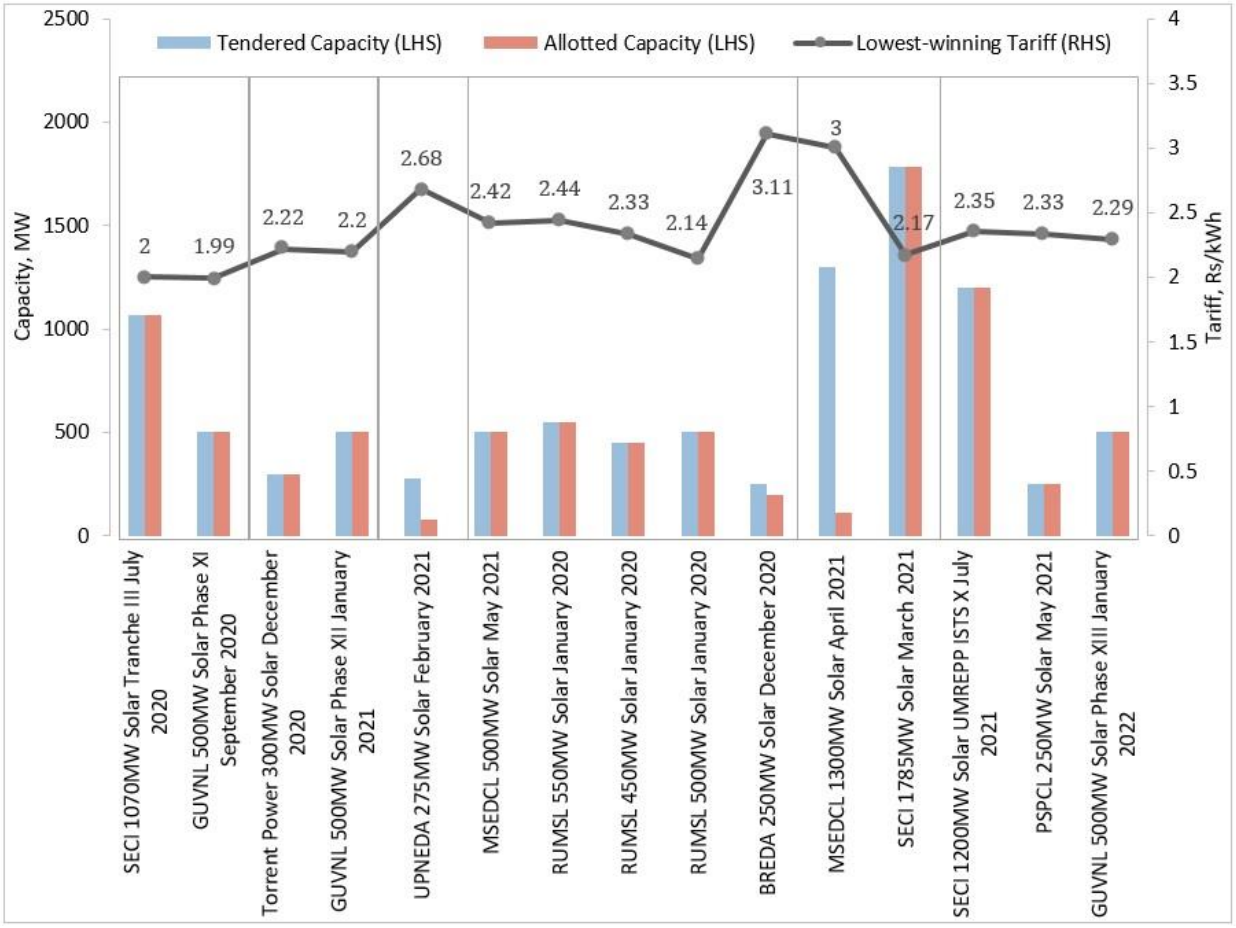
BCD, a tariff barrier against solar PV imports, adds 25% on imported cells and 40% on imported modules. A non-tariff barrier, ALMM is a list of eligible models and manufacturers of solar modules complying with the Bureau of Indian Standards (BIS). As of April 1, only the models and manufacturers that are part of ALMM will be eligible for use in government projects, government-assisted projects and projects under government schemes and programs. So far, ALMM covers only models and makers of domestic solar modules.

In the short term, it is expected that factors such as BCD and ALMM will exacerbate the volatility of domestic module prices, impacting future tariffs.

Observing the tariff trend over the past six quarters, the L1 tariffs discovered in utility-scale solar tenders have increased by an average of 22% above the record-low tariff. This trend can be typically observed in tenders issued by major agencies/tendering authorities such as Solar Energy Corporation of India Limited (SECI), Rewa Ultra Mega Solar Limited (RUMSL) and GUVNL (See figure 1).

[1] JMK Research.
[2] JMK Research.

Figure 1: Results of Major Utility-scale Solar Tenders – India



Source: Relevant Tendering Authorities, JMK Research.

From the onset of recent solar tariff inflation (i.e., from January 2021 to March 2022), the lowest L1 tariff was in August 2021. The associated tender was issued by RUMSL in January 2020, where L1 tariff of Rs2.14/kWh (US$0.029/kWh) was quoted by Tata Power for 170MW capacity. Amid commodity price fluctuation and global supply chain shock, pertinent issues that linger even now, such a low tariff then was a commendable feat.

In India, solar tariffs are also determined by the off-taker's risk profile. Tenders where the off-taker is a central government agency have a lower risk profile than tenders where the off-taker is a state agency. This is mainly because the former category is associated with a greater assurance of payment.

Also, it is highly likely that the developers concerned for such a project would have sourced the modules by Q1 2022, before implementation of BCD. This is a major contributing factor in achieving such a low tariff.

Further, for projects expected to be commissioned by 2022, modules may have been sourced by Q1 2022, to safeguard them from the effects of BCD.

Table 1 lists tenders that act as important milestones in the solar tariff trend starting December 2020.

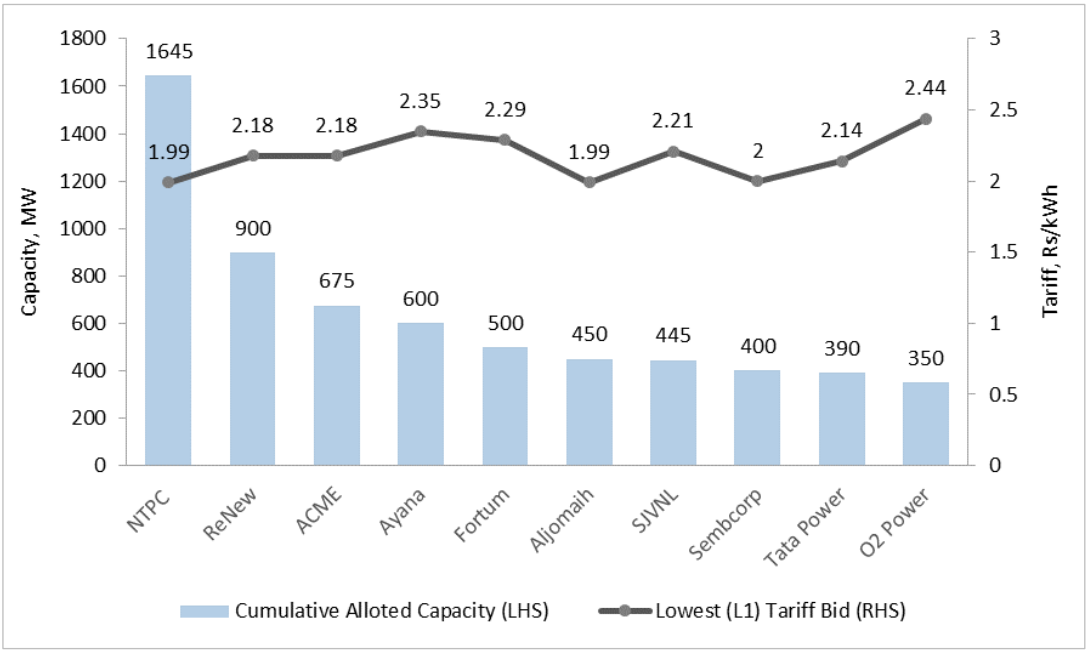
Table 1: Milestone Utility-scale Solar Tenders – December 2020-March 2022

Tender Highlight	Tender Name	Capacity (MW)	L1 Tariff (Rs/kWh)	Result Announced Date	Scheduled Commercial Operation Date (SCOD)	Winner Details
Lowest-ever Discovered Tariff	GUVNL 500MW Solar Phase XI September 2020	500	1.99	December 2020	September 2022	• NTPC - 200MW • Torrent Power - 100MW • Aljomaih Energy and Water Co. - 80MW • Aditya Birla Renewables - 120MW
Lowest L1 Tariff of FY 2022	RUMSL 500MW Solar Neemuch January 2020	500	2.14	August 2021	November 2023	• Tata Power - 160MW (INR 2.15/kWh) • Tata Power - 170MW • Aljomaih Energy and Water Co. - 170MW
Highest Discovered Tariff	Bihar Renewable Energy Development Agency (BREDA) 250MW Solar December 2020	250	3.11	August 2021	May 2023	• Satluj Jal Vidyut Nigam Ltd. (SJVNL) - 200MW
Largest Tendered Capacity	SECI 1785MW Solar March 2021	1785	2.17	December 2021	September 2023	• NTPC – 500MW • ReNew – 600MW • ACME – 375MW • Sprng Energy – 200MW • UPC Renewables – 90MW • Metka EGN – 20MW
Latest Result	GUVNL 500MW Solar Phase XIII January 2022	500	2.29	March 2022	September 2023	• Fortum - 200MW • Hinduja Renewables - 120MW • SJVN – 100MW • UPC Renewables – 80MW

Source: JMK Research.

The latest utility-scale solar tender concluded in March 2022. For this tender, GUVNL was the tendering authority, and the winning tariff was Rs2.29/kWh (US$0.030/kWh). This tariff is ~15% more than the L1 tariff discovered in December 2020 under the 500MW tender issued by the same authority (GUVNL). Higher tariffs can be attributed to increased project costs and risks.

Figure 2: Leading Developers in Utility-scale Solar Auctions (November 2020-March 2022)



Source: Relevant Tendering Authorities, JMK Research.

NTPC has been the most active developer in utility-scale solar over the past few quarters. The company has won the highest cumulative capacity (1645MW), with highly aggressive tariff bids. ReNew Power, ACME Solar and Ayana also have been prominent developers in this period.

2. Factors Leading to Rise in Project Cost

The cost of utility-scale solar projects in India have risen since 2020, primarily due to an unprecedented surge in equipment costs. The following are the major factors. (Section 3 analyses the effect on tariffs.)

- **Impact of BCD & ALMM**

  Anticipating an upsurge in the demand for domestically manufactured solar modules due to BCD and ALMM, leading domestic solar manufacturers increased their prices by US¢3-4/Wp between February and March 2022.[3]

- **Commodity Price Hike**

  Globally, the price of solar monocrystalline passivated-emitter-and-rear-contact (Mono PERC) modules increased by about 38% from August 2020 to March 2022.[4] A surge in the price of polysilicon (due to the combined effects

[3] JMK Research.
[4] JMK Research.

of geopolitical tension and the COVID-19 pandemic) has been the strongest driver of rising module prices.

Other key factors include commodity price hikes (glass and metals including copper, silver, aluminium), a surge in freight charges (due to shortage of shipping containers) etc. These have also added to balance-of-system (BOS) costs, including inverters, module mounting structures etc.

Commodity price hikes and a surge in freight charges have also added to balance-of-system costs.

- **Augmentation of Demand**

  Supply-demand mismatch is another major contributor to solar module price increases. Over the past two years, demand and acceptance for solar has risen worldwide. The demand for cheaper and cleaner sources of energy, with corporates globally setting up decarbonising and Net Zero goals, is further driving the demand for solar. Commodity prices increase when demand outstrips supply.

- **Increase in Goods and Services Tax (GST)**

  On October 1, 2021, the Indian government increased GST on solar cells, modules and inverters from 5% to 12%. This will increase the capital expenditure (capex) of solar projects by 4.5%, effectively raising solar tariffs by Rs0.1/kWh (US$0.013/kWh).[5]

- **Insurance Premiums**

  With the rise in risk pertaining to climate change, insurance premiums for solar projects are also becoming expensive.

- **Others**

  During September-November 2021, several countries, including China, faced severe power shortages, chiefly due to surging demand for power and shortage of coal. The solar manufacturing industry, still highly concentrated in China, was affected by the rolling blackouts caused by lack of power supply. This crisis compounded an already difficult situation and further contributed to an increase in module prices in late 2021.

  Supply chain restrictions due to the Russia-Ukraine conflict led to the price of solar modules increasing by ~8-9% in March 2022.[6]

[5] Mint. Higher GST from today likely to affect solar power rates. October 2021.
[6] ET Now. Solar panels cost spike 8%-9% due to Russia-Ukraine conflict. April 2022.

3. Tariff Analysis – Utility-scale Solar Project

The cost dynamics of utility-scale solar projects have changed substantially since 2020, with the next major transition likely to occur in projects employing BCD-imposed modules. We carried out a tariff analysis through financial modelling, considering a hypothetical system with a 500MW Alternating Current (AC) capacity. With the AC capacity as constant, three scenarios were built on the basis of origin of module and project timeline.

The cost dynamics of utility-scale solar projects have changed substantially since 2020.

- The first scenario, considered as the base case for the modelling, is assumed to use **540Wp mono-facial imported module**. The scheduled commercial operation date (SCOD) is assumed to be December 2023. It is assumed further that imported modules were stockpiled by **Q1 2022** (i.e., before implementation of BCD).

- The second scenario considers **540Wp mono-facial domestic module**. The SCOD is in December 2024 and module procurement is assumed to be completed in **Q1 2023**.

- The third scenario considers **540Wp mono-facial imported module**. The SCOD is in December 2024 and module procurement is assumed to be completed in **Q1 2023**.

Table 2 details further considerations.

Table 2: Utility-scale Solar Project – Cost Analysis (for Three Scenarios)

S. No	Item	Units	Description		
			Scenario 1 Imported Modules. Module Procurement by Q1 2022	Scenario 2 Domestic Modules. Module Procurement by Q1 2023	Scenario 3 Imported Modules. Module Procurement by Q1 2023
1	AC Capacity	MW	500		
2	Direct Current (DC)/AC Ratio	-	1.5		
3	Project Capacity (DC)	MW	750		
4	DC Capacity Utilisation Factor (CUF) – 1st year	%	20%		
5	Degradation Factor	%	1.5% for 1st year; 0.6% for subsequent years		
6	Interest Rate	%	8.5%		
7	Return on Equity	%	13%		
8	Loan Tenor	Years	18		
9	Debt/Equity Ratio	-	75:25		
10	Project Location	-	Rajasthan		
11	BCD Application	-	No		Yes (40% BCD)
12	DC Project Cost	Rs Crore/ MW	2.94	2.71	3.62
		US$m/ MW	0.39	0.36	0.48
13	**Tariff Discovered**	**Rs/kWh**	**2.43**	**2.26**	**2.95**
		US¢/kWh	**3.23**	**3.01**	**3.93**

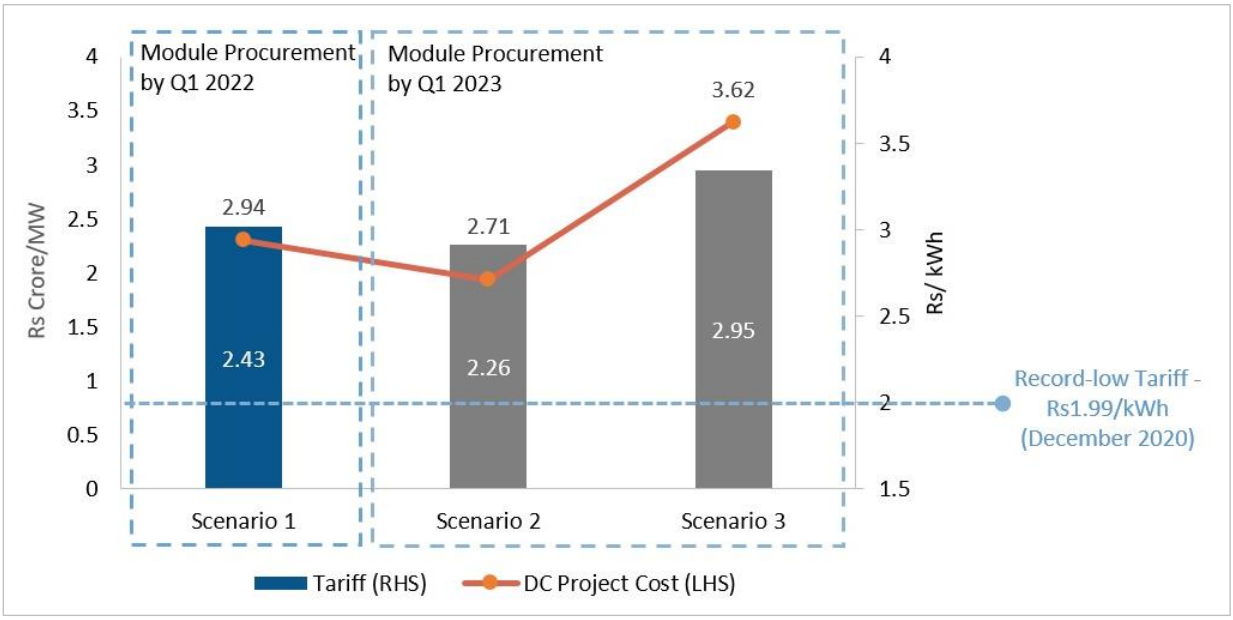
Source: JMK Research.
Note: 1) Average conversion rate taken is US$1= Rs75.
2) Module price is assumed to fall by 7% by Q1 2023.

In scenario 1, key project costs include module (65%) and BOS (22%). Other costs including land, pre-operative, contingency and interest expenses during construction (IDC) make up the balance of 13% of the total project cost of Rs29m/MW (US$390,000/MW) of DC capacity. The levelised tariff discovered with all the considerations is Rs2.43/kWh (US$0.0323/kWh).

Scenario 2 demonstrates a substantial decrease in tariff, guided by the assumption that domestic module prices would undergo deflation by US$0.01.5-0.2/kWh relative to scenario 1. This delivers the lowest tariff among the scenarios at Rs2.26/kWh (US$0.031/kWh). This is due to the expectation that domestic module capacity increases substantially in 2023, leading to a reduction in module prices.

Scenario 3 generates the highest tariff at Rs2.95/kWh (US$0.0393/kWh), primarily on account of 40% BCD on imported modules.

Figure 3: DC Project Cost v/s Tariff for Three Scenarios



Source: JMK Research.

Scenario 1, which replicates the current practice, shows a 22% increase over the record-low tariff of Rs1.99/kWh (~US$0.03/kWh). Also, in the short term (less than a year), solar project auctions are expected to witness a similar tariff hike over record-low tariff on account of availability of massive stock of BCD-free imported modules.

A major chunk of cumulative capacity of projects that are likely to be commissioned by 2024 would not be able to procure domestic modules amid surging demand across all solar segments (rooftop, open access, utility-scale). In this case, the tariffs would be about Rs2.95/kWh (as in scenario 3), which is about 21% higher than scenario 1 (base case) tariff. Unless the prices of imported modules decline substantially, it will be difficult to match this tariff with the scenario 2 tariff.

Technology will play a major role in maximising plant output. If a developer opts for imported bifacial modules along with single-axis tracker, ~4%-5% capacity utilisation factor (CUF) gain can be achieved, compensating for the higher project cost.[7]

4. Sensitivity Analysis

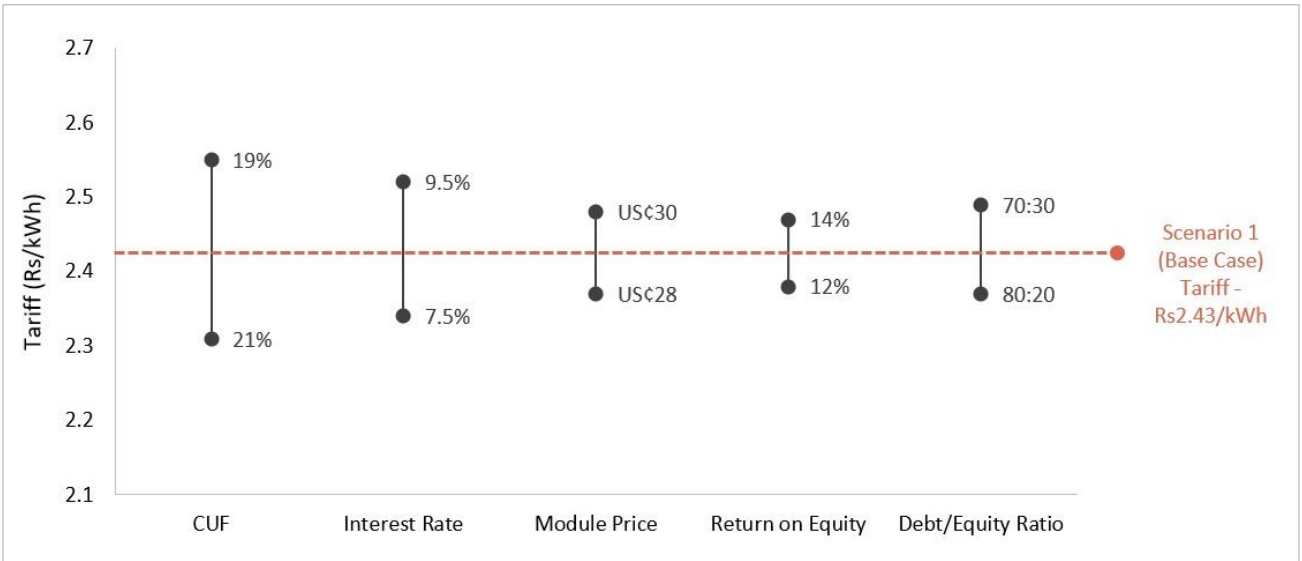
As discussed above, for projects where modules were already procured (by Q1 2022), the base case tariff expected is Rs2.43/kWh. For projects where a developer

[7] JMK Research.

procures domestic modules after Q4 2022, the tariffs are likely to decline by 7%. For developers who depend on imported modules, the tariffs are expected to increase by 21% (mainly due to BCD).

To illustrate the influence of key factors on utility-scale solar tariff, we performed a sensitivity analysis on the basis of tariff discovered in scenario 1.

Figure 4: Sensitivity Analysis re Scenario 1 Solar Model



Source: JMK Research.

- **Capacity Utilisation Factor (CUF)**

  A 1 percentage point change in CUF leads to (+/-) 5% or Rs0.12/kWh (US$0.016/kWh) change in the tariff. To broaden the thin margins provided to developers by India's conventional solar projects, an assurance of higher CUF has become very critical for high-output modules. Few domestic module manufacturers – among them Adani Solar, Waaree, Vikram Solar, Jakson, Premier Energies – produce high-wattage modules with a capacity of 540Wp. These modules have an efficiency of ~20%-21%.

  Due to the ALMM restriction, availability of imported higher-wattage modules (greater than 600Wp series) will be a challenge for developers. This will make it difficult for them to sustain aggressive tariff bids.

- **Interest Rate**

  A 100 basis point (bp) increase/decrease of 8.5% causes a rise/fall of 4% or Rs0.09/kWh (US$0.012/kWh) in the base case tariff (refer figure 4 above). Availability of debt at a low cost is a challenge in India. However, of late, banks and financial institutions (FI) have lowered interest rates in the post-COVID era from 10%-12% to ~ 8.5%-10%.

  Central and state public sector undertakings (PSUs) such as National

Thermal Power Corporation Limited (NTPC) and Satluj Jal Vidyut Nigam (SJVN) have access to capital at less than 8%. One method of raising debt is through issuance of a non-convertible debenture (NCD), which helps to raise long-term finance and to accumulate asset appreciation. Recently, NTPC decided to raise Rs1500 crore (US$200 million) through issuance of an unsecured NCD at a coupon rate of 5.78%.[8]

The ability to raise debt at competitive rates provides a huge advantage to project developers. Several large renewable energy (RE) developers have access to low-cost international capital, enabling aggressive tariff bids. ReNew Power, Adani Green Energy and Greenko, among others, have a strong presence in the overseas green bond market. Debt financing through green bonds is relatively cheaper (typical interest rate, 4%-6%).[9]

The ability to raise debt at competitive rates provides a huge advantage to project developers.

When solar projects become operational, developers have the option of refinancing loans at a lower cost.

Green bonds play an important role in refinancing of debt from institutional lenders. Loan refinancing with green bonds not only lowers the interest burden on developers but also allows higher a debt-to-equity ratio. Furthermore, it allows non-amortisation period[10] of three to five, providing higher returns in the initial years of the loan tenor.

- **Module Price**

  Solar modules, the most significant component in the overall project cost, have a high degree of influence over the project tariff. A change of US$0.01/Wp in module price affects the tariff by (+/-) 2% or Rs0.06/kWh (US¢0.08/kWh).

  There is a substantial lag – eight to 12 months – between bidding and module procurement for a large-scale solar project. Any rise in module prices during this time might significantly reduce developers' returns.

- **Return on Equity (RoE)**

  Equity investors' expectation on returns from utility-scale solar projects has been ~ 12%-13% in recent times. If a developer is aggressive and desperate to build the project pipeline, then the RoE expectation is also low. Even large

[8] Economic Times. NTPC to raise Rs 1,500 crore via NCDs. April 2022.
[9] CEEW-CEF. Financing India's Energy Transition Through International Bond Markets. August 2021.
[10] Non-amortisation period - The period during which a borrower only pays for accrued interest on the loan.

national and international project developers with access to low-cost financing (both debt and equity) have lower RoE expectations than Indian investors.

Bond refinancing or sale to infrastructure investment trusts (InvITs) also assist the developer in improving returns and enabling aggressive bidding.

In the base case model, a one percentage point change in RoE can reduce or increase the tariff by 2%, leading to minuscule adjustment per kWh of Rs0.05 (US¢0.07).

- **Debt/Equity (D/E) Ratio**

  The base case ratio is three to one (75:25). With ratios of 80:20 and 70:30, the tariff varies between Rs2.37/kWh (US$0.0316/kWh) and Rs2.49/kWh (US$0.0332/kWh) (i.e., variation of 2% up or down on base case tariff).

5. Risk Factors – Indian Utility-scale Solar

The overall risk factored into solar projects in India has magnified in the past two years. The key risk factors for large-scale solar projects are as follows:

- **Commodity Price Volatility**

  China is a prime hub in the global supply chain. With COVID-19 cases surging in China since March 2022, the Chinese government has imposed strict lockdowns in several major provinces, so fluctuating commodity prices are expected to continue in the near-term.

  Developers who typically procured modules six months before project commissioning have been extending the procurement timeline due to the price volatility. This has led to considerable delays in commissioning of many projects.

- **Interest Rate Hike**

  Most independent power producers (IPPs) now source debt from a mix of capital at fixed and floating rates, split between foreign and domestic lenders. Any change in the Reserve Bank of India (RBI) guidelines affects the floating interest rate. The recent surge in commodity prices has fuelled inflation and domestic lenders are likely to raise their interest rates, in turn shrinking market liquidity and increasing the cost of capital.

- **Approved List of Models and Manufacturers (ALMM)**

  The latest version of the ALMM was released on 6 April 2022, listing 55 manufacturers and a cumulative capacity of ~14GW. However, capacity linked to quality high-wattage domestic modules (more than 500Wp and CUF above 20%) is limited.

Given the paucity of supply of high-output domestic modules, ALMM implementation may aggravate the ongoing supply-side crisis.

- **Currency Fluctuation**

  The focus on enhancing domestic solar manufacturing capability has improved lately but the Indian market remains import-driven. In 2021, imports accounted for about 72% of the total solar modules procured.[11] Depreciation of the Indian rupee would have a negative impact on project costs. Additionally, a stable currency helps to lower the currency hedging cost/premium when raising overseas debt.

- **Policy Uncertainty**

  India's lack of clear and consistent policies clouds the long-term vision of investors and developers. Even though BCD was announced about a year ago, there is still no clarity on the timeline of its imposition and no certainty that the effective BCD rates would stay the same.

  In October 2021, the central finance ministry raised the GST on solar modules and other RE equipment from 5% to 12%. Any future increase in GST on solar equipment can severely handicap the bankability of new projects.

Any future increase in GST on solar equipment can severely handicap the bankability of new projects.

  Uncertainty surrounding tariff and non-tariff barriers pushed solar developers to import/stockpile modules by FY2022 to meet their short- to medium-term requirements. As a result, in FY2022, solar imports in India are expected to rise to ~US$4.1billion (year-on-year increase of 618%).[12]

6. Conclusion

Despite a significant surge in module prices in the past year, tariffs quoted by project developers in the latest auction are still very aggressive due to various reasons – interest of new entrants, availability of low-cost funding to PSUs and international developers, and possible adoption of new technology (bifacial modules with trackers, robotic cleaning, advance O&M practices) – for increasing energy generation.

However, the trend in auctions in the second half of 2022 is likely to be upward. With imported modules, the tariffs are likely to be up by 21% over base case

[11] JMK Research.
[12] Ministry of Commerce and Industry, Government of India.

(scenario 1) tariff of Rs 2.43/kWh (US$0.0323/kWh); if a developer can procure domestic modules, the tariffs would decline by 7%.

The abiding major concern is that most developers will not be able to secure supply of domestic modules due to the huge demand across segments, including rooftop solar, open access, utility scale as well as the off-grid market. In this case, developers will have to import modules that will attract 40% BCD. Even if domestic modules are considered, lack of availability of high-wattage modules and bifacial modules will be a critical challenge, limiting the enhancement of CUF.

The abiding major concern is that most developers will not be able to secure supply of domestic modules.

Prices of domestic modules are also volatile and may surge significantly in the near-term, mainly because of the demand-supply mismatch, an increase in global polysilicon prices, 25% BCD on solar cells etc. To reduce dependency on imported equipment and raw materials, the Indian government, as part of its production-linked incentive (PLI) scheme, has allotted Rs24,000 crore (US$3.2 billion) capital subsidy to set up vertically integrated domestic solar manufacturing facilities, which are likely to start production by mid-2023 at the earliest. Even for domestic modules, prices until then are likely to see an upward trend.

There can only be limited control over external factors that drive the cost of a solar project. Nevertheless, it is imperative that central and state government regulators make a joint effort to streamline and bring clarity and certainty to ongoing policy-related hurdles, especially regarding BCD imposition and ALMM-related issues. This would avoid delays in project commissioning caused by the short-term surge in module prices. This, in turn, will be critical to achieve India's near-term goal of adding 100GW solar by December 2022 and 300GW by 2030.

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