Comparison: Various PPA structures

Sl	Particulars	Deemed generation (take or pay)	Two-part tariff	Capacity based Fixed Charge	Time of Day (ToD)
1	Structure Description	• The off-taker to pay for the entire generation ("Available Energy"), including the period of curtailment at the PPA tariff; effectively pay for deemed generation	• The PPA tariff consists of fixed capacity charges (INR/ MW/ year), and an energy charge (INR/ kWh) towards delivered energy. • The RFP specifies the maximum possible curtailment (for e.g. 20% of annual energy) and the minimum Availability required (for e.g. 95%)	• The PPA tariff is fixed capacity charges (INR/ MW/ year) • Off-taker (or SLDC) shall have right to operate plant as per grid requirement and shall become active asset manager • The RFP will specify the minimum required availability (for e.g. 95%)	• This structure values the delivered energy as per time of generation • Off-taker shall prescribe a 24 hour "Multiplier Curve". The Effective tariff will be Quoted tariff multiplied by the multiplier for that hour as per the "Multiplier Curve" • The "Multiplier Curve" may be different for each month

	Tariff basis	• Single tariff based on energy	• Two-part tariff structure
			  • Capacity (INR/MW/year);
			  • Energy charges (INR/kWh)
				• Single fixed tariff based on Capacity	• Single bid tariff
					• But the Effective tariff will be as per the "Multiplier Curve" specified in the RFP

	Curtailment Risk	• Curtailment risk is with the off-taker entirely	• Curtailment risk is shared between the off-taker and the developer, as bidders may make different assumptions on the level of curtailment (within the cap)	• Curtailment risk is with the off-taker entirely	• To be operated Must Run Status – no curtailment risk
	Bid Evaluation Criteria	• Lowest tariff bidder (similar to the current PPA)	• Off-taker shall specify the capacity charge in RFP, and bidders shall be asked to quote/bid on energy charge (It is suggested that capacity charges not to be more than 50%[1] of expected total tariff) • The bidder with the lowest energy charge will be the winner	• Bidders to quote a Capacity charge and Minimum Guaranteed Energy for each of the 25 years • **COE = Quoted Capacity charges/ Minimum Guaranteed Energy** for the year • Bidder with the lowest LCOE over the PPA tenure will be the winner	• Lowest tariff bidder

[1] Higher fixed capacity charges will encourage bidders to go for lower DC:AC ratio as well as discourage them to use advanced technology (high capex) as bidders will not get compensated for the same. Further, higher capacity charges will put weather risk, to an extent, to off-taker's account.
At the same time, lower fixed capacity charges will not compensate developers adequately on account of curtailment risk. Also, having lower capacity charges may force bidders to assume higher curtailment risk (result into higher tariff)

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	Performance Requirement and Liquidated Damages	• Similar to the current PPA structures the "Available Energy" should meet the specified minimum threshold
		• The Developer should demonstrate Availability during curtailment period to be eligible for deemed generation payment
			• Ensure minimum annual guaranteed Plant availability (for e.g.95%)
			• The Developer to Declare Availability on Day Ahead basis and then may be allowed to modify a fixed number of times during the day (15 minute schedule)
			• Availability shall be calculated on monthly basis at the inverter level and shall exclude :
			  • low irradiance period (< 200W/m2)
			  • Force majeure period (but capacity payment to be paid)
			• If the Declared Availability is not met on an annual basis, the Capacity charge to be reduced on the proportionate basis
			• If the plant doesn't generate the maximum possible output (for the irradiance) as per the Declared Availability the LD will be levied
			
			• Developer shall be entitled for energy payment for the shortfall, in case actual annual curtailment exceeds limit specified in PPA
				• Developer has to ensure:
				a. Guaranteed Plant availability
				b. Guaranteed annual generation
				
				• The Developer to Declare Availability on Day Ahead basis and then may be allowed to modify a fixed number of times during the day (15 minute schedule)
				• Availability shall be calculated on monthly basis at the inverter level and shall exclude :
				a. low irradiance period (< 200W/m2)
				b. Force majeure period (but capacity payment to be paid)
				
				Three Tier LD
				• **Availability LD**: If the Declared Availability is not met on an annual basis, LD will be levied
				• **Power LD**: If the plant doesn't generate the maximum possible output (for the existing irradiance) as per the Declared Availability the LD to be levied at a higher rate
				• **Generation LD:** In case of annual generation (delivered energy + curtailed energy) is lower than Minimum Guaranteed Energy, then the developer is liable to LD for the shortfall
				• To avoid double accounting of penalty, Generation LD shall be applicable if actual availability is
					• Ensure minimum annual energy commitment.
					• LD to be paid in case the minimum energy is not met on an annual basis

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				equal to or greater than 95% and Availability LD shall be applicable if plant availability is less than 95%.	
8	Compensation for performance[2] -Frequency regulation/ reactive power -Voltage regulation -Active power	• Developer to be compensated at energy tariff for the active power loss for providing these ancillary services	• Developer to be compensated at energy tariff for the active power loss for providing these ancillary services	• No compensation applicable as developers paid for capacity to provide such performance	• Not applicable as the primary purpose would be to provide for time shifting the energy
9	Challenges	• Establishment of expected generation (generation loss) at the time of curtailment • There may be a time gap between receipt of curtailment communication and implementation by developer, unless it is communicated digitally	• Measuring and monitoring that the required Availability was maintained may be a challenge • Establishment of expected generation may be point of contention between developer and off-taker • Lenders would want bidders to assume max curtailment to avoid revenue loss resulting into higher tariff	• Ensuring that the required Availability was maintained may be a challenge • Establishment of expected generation may be point of contention between developer and off-taker • Discourages generation optimization on account of tracker, higher DC:AC ratios, lower degradation, higher yield technology • Higher possibility of gaming by the developer in declaring Availability	• The "Multiplier Curve" may be difficult to arrive it for the Discoms • Further, the "Multiple Curve" (peak load duration and time periods) may change over the 25 year PPA duration. Providing for such a change, while keep the developer revenue neutral may be a challenge • Need to provide adequate provisions for compensating the developer if the energy is curtailed
10	Implementation	• This structure is the closest to the current PPA structure	• The Discom officers would need to be trained for the ensuring the	• Structure more suitable for assets meant to act like spinning reserve	• The structure is more suitable for time shifting

[2] Specific performance requirement from project as per instruction from utility. It shall be captured in plant SCADA system as well as SLDC

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		with minimum changes; hence relatively easy to implement • Can be even implemented even in legacy projects by modifying the PPAs to provide for deemed generation	requirements of the PPA, lest they result in invoice disputes	and/or provide ancillary services. Psychologically, Discoms may not be willing to pay for it, currently	application. • Will inherently encourage storage technologies

Common Requirements/ Assumptions

- **All power plants to have a PPC for receiving AGC and signals from the grid operator**
- **PPC should be able to record the time for active power curtailment either through signals or setting setpoints from the SCADA (and not the clipping losses)**
- **The Availability will be measured at an inverter level for the sake of the Capacity calculation**
- **Soiling losses will not be factored in the calculation of the Curtailed Energy for the purpose of the Deemed Generation**