# DISTRIBUTED GENERATION MODEL TO HARNESS SOLAR POTENTIAL - A SUCCESS STORY OFTELANGANA

## EXECUTIVE SUMMARY

Since inception, Telangana state has been striving to achieve balanced and sustainable energy mix. To achieve this, state has planned massive solar additions up to 6,000 MW by FY 2018-19. In line with the above objective, discoms in Telangana have initiated a tender process to procure 2000 MW of solar power through tariff based competitive bidding route. The current tender encourages distributed generation across different districts and minimizes technical losses by incentivizingpower injected at 33kV voltage level. A transparent and streamlined allocation process is another key feature of the bidding.

The feedback of developers was incorporated while drafting of the Telangana Solar Power Policy 2015. This has led to creation of an environment conducive for solar capacity additions in the state of Telangana.

## INTRODUCTION

The state of Telangana came into existence on 2nd June 2014 as the 29th and youngest state of India, when it was carved out of the north-western hinterland of Andhra Pradesh. Affordable and reliable Power supply is a key enabler for Socio-Economic development of any state. Energy deficit in the state of Telangana was in the range of 4%-12% in the past and energy requirement is expected to significantly increase in the next five years.At the time of bifurcation, the newly formed state of Telangana inherited a power deficit of 5%. The state government has initiated several steps to make the state not only self-sufficient but also to provide reliable and quality power to all consumers in the state in a sustainable manner at an affordable cost.

The need to create a sustainable fuel mix in generation, coupled with technology advancements in solar power leading to reach grid parity in future, has led to solar power been an attractive source to tap clean energy has been identified as a key alternative to conventional mode of power generation.The Telangana region is also endowed with good solar insolation of 5.00 KWh/m2on an average throughout the year,making it an attractive region for development of solar Power. As per MNRE publication, solar potential for Telangana state is 20 GW.

## INITIATIVES BY THE STATE FOR PROMOTING SOLAR ENERGY

With an intent to facilitate adoption of solar Power across all domains, a comprehensive solar policy was notified by the Telangana state government.

The solar policy provides fiscal incentives and more importantly has ease of doing business provisions which substantially address the concerns of investors. Some of the highlights of the Solar Policy are

- Setting up of Single window for expediting the clearances and approvals at various levels. Defining the time limit for various approvals

- Deemed conversion of Land to NALA status on payment of necessary charges
- Providing monetary incentives in terms of, electricity duty exemption, cross subsidy surcharge exemption, concession/reimbursement of VAT and stamp duty registration charges
- Exemption of transmission and distribution charges for wheeling of power, exemption of supervision charges
- Enabling additional incentives by providing Deemed industry status to the solar power projects

These incentives notified prior to the Bid process had resulted in a competitive tariff being quoted by the developer.

## BENEFITS OF DISTRIBUTED GENERATION

### Solar generation for agricultural load

In the current scenario, agricultural demand is rostered and given in multiple spells to different groups based on the demand-supply balance of the grid. Keeping in mind the benefits of day-time power supply to farmers in addition to safety aspects, it is the objective of Government of Telangana (GoTS) to ensure 9 hours day-time to agricultural consumers in the state.

On the supply front, unlike the conventional thermal power plants, whose generation profile is uniform throughout the day, generation from solar projects is during the day time. This results in a spike in generation during day-time.

In the absence of requisite demand during the day-time, there is going to be excess supply in the grid which would lead to backing down of conventional thermal stations, and this would have an adverse impact on cost-economics and reliability of grid operations. In order to avoid such a situation, 9 hours of supply to agricultural load would be given during day-time which will substantially absorb the solar energy generated.

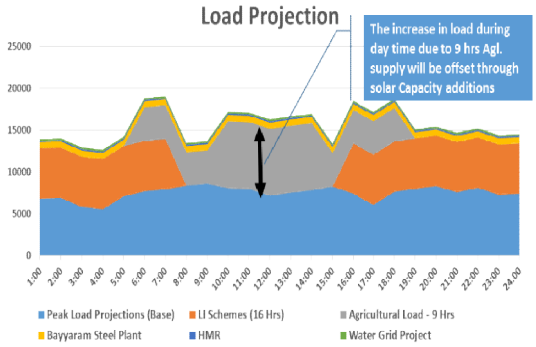


*Figure 1: Load projections for Telangana by 2018-19*

As seen in the figure 1, there would be considerable load during the day time due to 9 hours of agriculture. This load can be addressed from solar based capacity additions which generate power during day-time.

### Proximity of Generation to load centres

In Telangana State, as can be seen in figure 2, only a few places such as Mahabubnagardistrict and adjoining areas have a higher solar insolation compared to the rest of Telangana. This coupled with better availability of land has resulted in those becoming the most preferred areas by solar project developers'vis-à-vis other districts in Telangana.

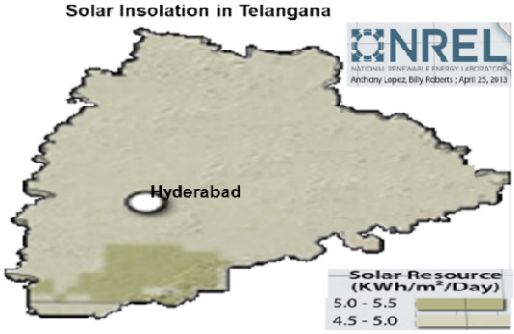


*Figure 2: Direct normal irradiation in the state of Telangana- Source: India Solar Resource Map of National Renewable Energy Laboratory dated 25th April 2013*

From an overall perspective of utilization of network and reduction of technical losses at a state level, it is pertinent to have generation closer to the demand centers. In order to achieve this objective, district-wise ceiling for injection of solar capacities were introduced. As agricultural consumption has a key bearing on the load incident on the system in any district, the ceiling for solar generation was set based on the quantum of agricultural demand in that particular district. In the solar tender, district limits as depicted in figure 3 were introduced to encourage developers to generate solar power in all the districts across the state.

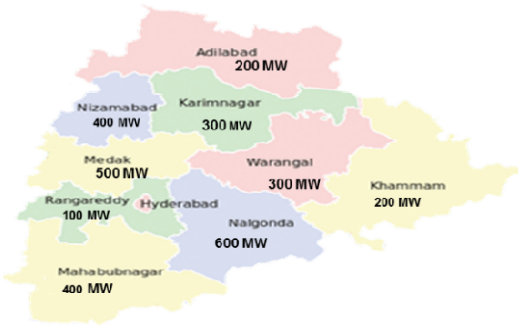


*Figure 3: Telangana Districts with district capacity limits*

| District Name | Agriculture demand in each spell (MW) | Current district limits (MW) |
|---|---|---|
| Mahbubnagar | 500 | 400 |
| Medak | 500 | 500 |
| Nalgonda | 600 | 600 |
| RR South | 150 | 100 |
| Warangal | 351 | 300 |
| Karimnagar | 455 | 300 |
| Khammam | 190 | 200 |
| Nizamabad | 412 | 400 |
| Adilabad | 197 | 200 |

*Table 1: District limits in line with agricultural load*

The district limits has been arrived based on the quantum of agricultural load in a given district to the overall agricultural load in the State.

**Transmission Losses avoided**

As the solar injection at 33 KV voltage would be absorbed by the local downstream demand, transmission losses can be avoided and this would also result in avoidance of upstream strengthening of the transmission network. Estimated financial benefits of avoiding transmission losses is shown in table 2 below.

| Particulars | Units | Value |
|---|---|---|
| Solar ceiling tariff at 33kV level | | 6.45 |
| Transmission Losses avoided | % | 4.02% |
| Impact of Transmission losses avoided on a per unit basis | Rs/kWh | 0.26 |

*Table 2: Financial implication of transmission loss avoidance by injecting power at 33 kV voltage level*

**Estimates: Additional transmission investments averted**

If 500 MW of solar were to come up at 33 kV voltage, it would also lead to reduced need for strengthening of the upstream transmission infrastructure. Additional investments which would be averted due to this approach is about 98 crores at 220/132 KV level and 510 crores at 132/33 KV level and this is shown in Figure 4:

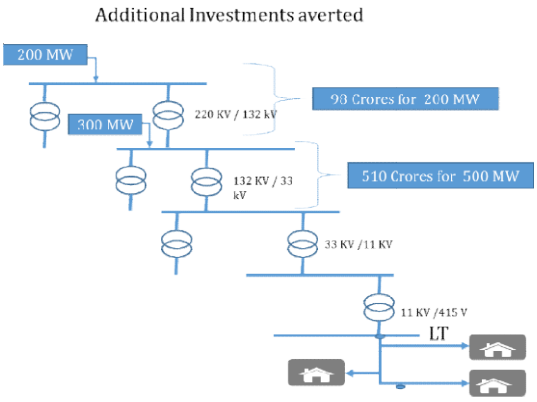


*Figure 4: Additional transmission investment for network enhancement averted at higher voltages*

## SOLAR TENDER PROCESS

The benefits of distributed generation as well the utilization of solar energy during daytime has been explained in the previous section. The challenge now was to structure and to float a tender to realise the above objectives as well as to make it attractive for the bidders to participate in the tender. The following sections give a snapshot on structuring and criteria followed for shortlisting bidders.

The Solar Tenders was floated in 2014 and 2015, for procuring 500 MW and 2,000 MW through tariff based competitive bidding.

The 2,000 MW was splitinto Group-1 and Group-2 with different ceiling tariff for each group as mentioned in table 3.

| Category | Interconnection Voltage | Requisitioned Capacity | Ceiling Tariff | Project Timeline |
|---|---|---|---|---|
| Group 1 | Injection at 33 KV level | 500 MW | Rs 6.4500/kWh | 12 months |
| Group 2 | Injection at 132 kV level, 220kV Level | 1500 MW | Rs 6.3200/kWh | 15 months |

*Table 3: Differential tariff for Group 1 and Group 2*

Further, to ensure distributed generation, the district limits were introduced as mentioned in table 1.

The bidders were also given the list of substations with capacity available in each substation. Each bidder were given a choice of 5 sub-stations to choose from and the tariff quoted by them would be applicable at the respective interconnection sub-station.

## ALLOCATION PROCESS

The Bidders were ranked in the order of quoted tariff. The bidders are allotted substation as per their preference list. If substation capacity is reached or district capacity reached, then the next preferred substation will be allotted.

If either district capacity is reached or none of the preferences of the bidder is available, Bidder is moved to second round for the capacity not allotted and a similar allocation process is followed with the balance capacity available in substation and district.Discretion rests with the discom in deciding the appropriate cut-off for capacity allocation which it deems fit.

## SALIENT FEATURES OF THE PROCESS

### Reverse Bidding

Ceiling tariff of Rs 6.45/kWh for group-1 has been determined based on the lowest tariff from previous bid process of 515 MW. Since, power injected at EHT voltages would be incurring transmission losses, ceiling tariff for group-2 has been set atRs 6.32/kWh. The bidder whoever quotes the lowest would be allotted their preferred interconnection substation.

By adopting this approach, the onus was clearly on project developers to choose the right technology along with mechanisms for maximizing energy generation (through tracking systems).

### Substation Capacity

A list of available capacity in each substation was prepared taking into account the load in each station and the capacity that can be injected. Moreover as a contingency measure, since most of 33kV feeders are radial, the solar power injection at 33kV is reduced at the 132 kV level to facilitate flow of power to upstream network in case of in-adequate consumption at 33 KV and downstream.

The upfront declaration of capacities available at different sub-stations for injection has led to the project developer in making an informed choice based on the project-economics of a particular substation location. This step has resulted in cutting-down on the time required for finalization of the project site.

**Optimal utilization of bays**

To ensure that bays in each voltage levels are used optimally, minimum and maximum capacity at each voltage and interconnection substation is defined in the tender as per table.4. As an example, a 6 MWproject was allowed to inject at 33 KV voltage, not at 33 KV side of 132/33 KV SS as the 132/33 KV SS is capable of handling injectionsupto 15 MW.

| Interfacing/grid substation | Injection Voltage level (AC) | Injection capacity at Substation (MW) |
|---|---|---|
| 33/11 kV | 33 kV | 2 to 8 |
| 132/33 kV | 33 kV | 9 to 15 |
| 132/33 kV | 132 kV | 16 to 50 |
| 220/132 kV | 132 kV | 16 to 50 |
| 220/132 kV | 220 kV | 41 to 100 |
| 400/220 kV | 220 kV | 51 to 150 |

*Table 4: Minimum-Maximum MW at each voltage level*

**Eligibility including Individuals & Partnerships**

One of the key aspects of the bid was the eligibility criteria. It opened doors for all interested parties with sufficient technical and financial capability. Bidders could be from any of the following categories- Companies, Partnerships, Individuals, and Consortiums of Companies, Foreign companies/ partnerships/ individuals/ consortiums of foreign companies.

Partnerships, individuals, consortiums and foreign bidders must form Indian SPV for implementing project before PPA execution.

This has enabled all the interested parties to participate in the tender subject to their meeting technical and financial eligibility to execute the project. This has led to greater competition.

**Early commissioning incentives**

In order to encourage expeditious addition of capacity a one-time early commissioning incentive was offered to developers as mentioned in table 6.

| CoD | One time incentive |
|---|---|
| 30- 59 days before scheduled CoD | INR 2 Lakhs/MW of contracted capacity |
| 60- 89 days before scheduled CoD | INR 3 Lakhs/MW of contracted capacity |
| 90 or more days before scheduled CoD | INR 5 Lakhs/MW of contracted capacity |

*Table 5: Early commissioning Incentives*

## OUTCOME OF THE 2,000MW BID

Solar bid process for procuring 2,000 MW has seen a commendable participation resulting in total offered capacity of 4,988 MW. The technically and financially qualified bids amounts to 4,623 MW.

*Table 6: Tender Results*

| Category | Total Capacity Offered (MW) | Lowest (Rs./kWh) | Highest (Rs./kWh) | Weighted average tariff Rs./kWh) |
|---|---|---|---|---|
| Group-I 33 KV Injection | 1181 | 5.4991 | 6.4500 | 6.0582 |
| Group-2 EHT Injection | 3442 | 5.1729 | 6.3190 | 5.9072 |
| **Total:** | **4623** | | | **5.9458** |

As seen in the table 6, among the qualified bidders, lowest tariff in group-1 was Rs.5.4991/kWh and for group-2 Rs.5.1729/kWh. The overall weighted tariff of the 4623 MW is less than INR 6/ kWh

## KEY BENEFITS DERIVED

At the inception of the State of Telangana in June 2014, the installed capacity of solar was a mere 32 MW and the current capacity stands at ~ 2.7 GW and it is expected to reach to ~3.8 GW by Mid of FY2018-19 from the projects (under construction) which have been already awarded through tender process.

Adoption of distributed generation model resulted in the following

- District-wise solar capacity cap was fixed based on agricultural demand. This has resulted in absorption of solar power by the agricultural and other loads locally.
- Avoidance of upstream transmission investments and losses due to local generation and absorption.As per preliminary estimates, it is expected that savings due to avoidance of transmission losses due to injection at 33 KV level is about INR 40 crores on an annual basis.
- As per preliminary estimates, it is expected that additional investments which would be averted due to avoidance of strengthening of transmission system is in excess of INR 500 crores.
- Also the distributed model is expected to offer significant benefits from a grid management perspective as well. A rainy day or a momentary cloud cover will have a minimal impact on the overall solar generation due to wide spread distribution of solar power when compared to a concentrated generation of power at a single place.
- Upfront declaration of capacities enabled the investors in selecting the SS of their choice for solar power injection thereby reducing the time for commissioning.

In addition to the above direct benefits offered by the above model, the distributed model of solar generation is also expected to bring in socio-economic benefits due its spread across remote parts of the state.

The newly formed state of Telangana has taken lot of steps to provide 24x7 power for all and one of main steps to achieve it has been to encourage solar power generation.

- 24 hour power supply to agricultural consumers is being implemented in Medak and Nalgonda districts since July'2017
- On trial basis, 24 hour power supply to agricultural consumers for the rest of the districts (Mahbubnagar, Rangareddy) is being implemented from 06th Nov 2017
- TSSPDCL has been implementing 24 hour power supply successfully to all the agricultural consumers duly completing all the related works.

The solar tender of 2000 MW has been one of its kind with the scale of solar generation which has been never attempted so far across India. As discussed in the preceding sections, a combination of policy steps, structuring of the tender from a technical and economic standpoint which takes into account the unique aspects of solar power generation has enabled the electricity distribution companies in the state of Telangana to successfully tap solar energy at an optimal cost.

Innovative steps taken by the utilities andGoTS such as the present 2,000 MW tender, would go a long way in realizing the objective of making the state of Telangana self-sufficient in power and also in having a sustainable fuel mix.

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## "Distributed Generation Model - A Success Story of Telangana"

# Introduction to the power sector – Telangana State

## Introduction to Power Sector – Telangana State

Telangana is one of the highest power-intensive states in India, with a per capita power consumption in 2015-16 of 1,394 units, which is higher than all India average. *(All India average – 1,075 units in FY 2015-16, as per CEA )*

In the current year Telangana state has successfully met peak demand of 9,500 MW recorded in October 2017 which is 310 MW higher than 9,191 MW that was recorded in the previous financial year.

There is no load shedding in the State of Telangana since November 2014. Discoms have contracted additional power for providing 24X7 reliable and quality power to all consumers at an affordable cost.

# Key highlights of Telangana State Solar Policy 2015

## Ease of doing business Provisions

- Expeditious clearance of all approvals by the 'Single Window Desk'
- Deemed conversion to Non-agricultural land status
- Exemption from Land ceiling Act
- Approval by Gram Panchayat within 14 days
- Open Access application will be processed in 21 days
- SPPs will be registered as factories under the Factories Act within 7 days

## Fiscal and Operational Incentives

- Exemption of Cross Subsidy Surcharge for sale within the state
- 100% refund of VAT/SGST for all inputs for SPPs for a period of 5 years
- Exemption of Electricity Duty for sale within the state
- Banking of 100% energy permitted for sale within the state
- 100% refund of Stamp Duty for land purchase
- Exemption of wheeling and transmission charges for captive use within the state

**Dedicated SOLAR POLICY CELL (SPC) for expedited clearances/approvals and co-ordination**

**Project Monitoring Committee (PMC) for monitoring implementation progress**

# Salient features of Distribution Generation Model adopted by Telangana

Distributed generation model was adopted by Telangana.

01 **Fixing of district-wise caps on solar generation**

02 **Up-front declaration of sub-station capacities**

03 **Declaration of maximum and minimum capacity for injection at each voltage and substation interconnection point.**

04 **District-wise solar capacity was fixed based on the quantum of agricultural demand.**

05 **Offering of early commissioning incentives**

- ***Tenders were floated and competitive bidding was conducted for 500 MW and 2,000 MW in 2014 and 2015 respectively.***
- ***A capacity of 4,988 MW was offered from bidders in the last tender of 2,000 MW.***

# Salient features of Distribution Generation Model adopted by Telangana

- District-wise ceiling for injection of solar capacities was introduced.
- Ceiling for solar generation was set based on the quantum of agricultural demand in that particular district
- To optimally utilise bays at each voltage level, minimum and maximum capacity that can be injected at each voltage level and interconnection substation was specified

***The increase in load during day time due to 9 hours agricultural supply was to be met through solar capacity additions***

| District Name | Agriculture demand in each spell (MW) | Current district limits (MW) |
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| Mahbubnagar | 500 | 400 |
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# Solar Capacity Additions in Telangana State – Success Story

Following benefits were derived on account of adopting distributed generation model

**District-wise solar capacity cap**

- Local generation and absorption of solar power by the agricultural and other loads locally

**Avoidance of Tr. Losses & Investments**

- Savings : ~ INR 40 Crs/ Yr due to injection at 33 KV level is
- Avoided investments in strengthening of Tr. System: INR 500 Crs

**Upfront declaration of capacities**

- Developers have selected the SS of their choice for solar power injection
- Reduction of time for CoD

**Better grid management**

- Minimal impact on the overall solar generation (Momentary cloud cover) due to wide spread distribution of solar power vis-à-vis concentrated generation of power at a single place.

At the inception of the State of Telangana in June 2014, the installed capacity of solar was a mere 32 MW and the current capacity stands at ~ 2.7 GW and it is expected to reach to ~3.8 GW by Mid of FY2018-19

***Thank You***