

# Briefing Note

## Financial Attractiveness of Rooftop Solar Energy for Domestic Consumers in Tamil Nadu

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### Purpose

The objective of this briefing note is to assess whether the recent General Tariff Order for Grid Interactive PV Solar Energy Generating Systems (GISS) (hereby known as 2021 Tariff Order or TNERC 2021) by the Tamil Nadu Electricity Regulatory Commission has improved the financial attractiveness of rooftop solar energy for the domestic consumer segment in the state.

### Key messages

The 2021 Tariff Order has resulted in a consistently or equally shorter payback period for the simulated average monthly electricity consumption slabs and solar PV capacity ranges (refer to Table 1).

The net feed-in mechanism under the 2021 Tariff Order has proven to give a more attractive or equally attractive payback period across all domestic consumption slabs and the simulated solar energy capacities as compared to the net metering mechanism (refer to Table 2)

Domestic consumers, with average monthly electricity consumption of 350 kWh or higher, will find rooftop solar PV to be an attractive investment opportunity resulting in payback periods of 5 years or less (refer to Table 3).

The removal of the network charges will result in a better payback for consumers in the lower electricity consumption slabs (refer to Table 4).

### Background

The Tamil Nadu Solar Energy Policy 2019, set an overall solar energy target of 9,000 MW. 40 percent of this target, or 3,600 MW, is meant to be met from the consumer category (behind-the-meter) or rooftop solar segment (TEDA 2019). As of 31st March 2021, a cumulative rooftop solar PV capacity of 325 MW has been recorded in the state (TNERC 2021), this represents only 9 percent of the state's rooftop solar target.

The Tamil Nadu Solar Energy Policy 2019 replaced the previous solar net metering mechanism with a solar net feed-in mechanism. Under the net feed-in mechanism, the solar energy is used for self-consumption with the surplus, if any, being exported to the grid. The imported grid energy is debited at the applicable consumer tariff while the exported solar energy is credited on the basis of a solar net feed-in tariff.

The Order for General Tariff and Solar power and related issues (TNERC 2019) introduced a solar net feed-in tariff as the lowest of the following three options:

1. 75% of the pooled cost of power purchase notified by the Commission for the respective financial year in the orders issued on the pooled cost of power purchase under Renewable Energy Power Purchase Obligations, 2010
2. 75% of the last feed-in tariff determined by the Commission.
3. 75% of tariff discovered in latest bidding whichever is less.

For the financial year 2019-2020 this tariff works out to 2.28 INR/kWh and for the financial year 2020-2021 the tariff worked out to 2.08 INR/kWh.

The net-feed in mechanism has been permitted only for LT consumers. HT consumers such as institutional, governmental, industrial, and commercial entities were excluded from any solar metering mechanisms. This excluded a large segment of electricity consumers that has substantial potential in contributing to meeting the rooftop solar energy target of the state.

With the exclusion of all HT consumers from solar net feed-in and with a solar net feed-in tariff, that is below the cost of solar generation, the rooftop solar segment in Tamil Nadu came to a halt. Therefore, the objective of the General Tariff Order for Grid Interactive PV Solar Energy Generating Systems (TNERC 2021) was to “accelerate the deployment of consumer category solar energy systems and to meet the State’s target of 3,600 MW by 2023”.

The 2021 Tariff Order permitted the participation of HT consumers under the net feed-in tariff mechanisms, introduced the choice of domestic consumers to avail either the net metering or the net feed-in mechanism, allowed solar gross metering for solar systems of 150 to 999 kW capacity and set, for the first time, capacity varying solar feed-in tariffs based on a levelized cost of energy (LCOE) calculation (refer to Annexure 1).

Additionally, TNERC introduced network charges, to help DISCOM to better recover its fixed costs. Networks charges are levied on the gross generation of solar energy and therefore apply to both the portion of the solar energy that is self-consumed and the portion that is exported to the grid (refer to Annexure 2). The network charges for the domestic consumer category have been determined 0.25 INR/kWh.

## Considerations

**Payback:** Simple payback is used to assess the financial attractiveness of rooftop solar PV systems.

**Consumption slabs:** 5 different monthly average electricity consumption to cover all existing tariff slabs of the domestic consumer category were used. They include 50, 200, 350, 500, and 600 kWh average monthly electricity consumption.

**Solar Capacities:** A range of 5 solar PV capacities e.g., 1, 3, 5, 7 and 9 kW has been considered for the payback calculations.

**Load curve:** To estimate the solar energy units that can be self-consumed and that will be exported to the grid a single load curve was utilized for all simulations. The load curve has been adapted from System Advisor Model (SAM) software and is listed in Annexure 4.

**Capital subsidy:** In March 2019, MNRE launched its Phase II of the Grid-Connected Rooftop Solar Programme (MNRE 2019a). MNRE provides a capital subsidy for rooftop solar PV systems installed at domestic homes of up to 40% for capacity of up to 3 kW and 20% subsidy for systems of capacity greater than 3 kW and up to 10 kW. TANGEDCO plans to add 5 MW of rooftop solar PV capacity for domestic consumers under Phase II of the national program on rooftop solar.

**Other assumptions:** All the other assumptions included in the financial calculations are given in Annexure 1.

## Results

### Does the 2021 Tariff Order result in a faster payback period for domestic consumers?

One of the key objectives of the 2021 Tariff Order was to accelerate the deployment of rooftop solar PV in the state. Among other things, this would require a better financial return for consumers. A simple payback calculation has been used to assess whether the expected payback on rooftop solar for domestic consumers has shortened and thereby become a more viable option.

Table 1 below indicates whether the simple payback for the selected range of average monthly electricity consumption and different rooftop solar PV capacities has become better with the 2021 Tariff Order as compared to the 2019 Tariff Order. The same table also highlights which of the two available solar metering mechanisms (net metering and net feed-in) is responsible for a shorter payback period.

Overall, it can be inferred that the 2021 Tariff Order promises a shorter payback, especially so for consumers with average monthly electricity consumption of up to 200 kWh and for the higher solar capacity ranges (5 kW and above).

Table 1: Simple payback as per 2021 Tariff Order is shorter as compared to the 2019 Tariff Order

		Consumption(kWh)				
		50	200	350	500	600
Solar Capacity (kW)	1	Yes	Yes	Same	Same	Same
	3	Yes	Yes	Same	Same	Yes
	5	Yes	Yes	Yes	Yes	Yes
	7	Yes	Yes	Yes	Yes	Yes
	9	Yes	Yes	Yes	Yes	Yes

■ Better Payback    ■ Same Payback

Result: Improvements in payback are primarily being seen in the lower average monthly consumption slabs (up to 200 kWh/month) and for the higher solar system capacities (5 kW and above).

### Does the net feed-in mechanism result in the shortest payback periods as compared to the net metering under the 2021 Tariff Order?

With the revised net feed-in tariff of 3.61 INR/kWh (TNERC 2021), the net feed-in mechanism provides in most cases the shortest payback period for all domestic consumer slabs and solar capacities if compared to the net metering mechanism. For two consumption and capacity combinations, net feed-in and net metering were found to result in the same payback period, and in not a single combination was net metering found to provide a shorter payback.

Table 2: Comparison of '2021 tariff order net feed-in with net metering mechanism

		Consumption(kWh)				
		50	200	350	500	600
Solar Capacity (kW)	1	Yes	Yes	Same	Yes	Yes
	3	Yes	Yes	Yes	Same	Yes
	5	Yes	Yes	Yes	Yes	Yes
	7	Yes	Yes	Yes	Yes	Yes
	9	Yes	Yes	Yes	Yes	Yes

■ Better than net metering    ■ Same as net metering

Result: Compared with net metering, the net feed-in mechanism consistently provides a shorter or equally short payback period for domestic consumers.

### Is rooftop solar an attractive investment opportunity for domestic consumers?

'Financial attractiveness' for the purpose of this analysis is defined by a simple payback period of less than or equal to 5 years. The results in table 3 below indicate the expected payback period for various average monthly electricity consumptions slabs and various solar PV capacities. Domestic consumers with average monthly electricity consumption of 350 kWh and more will find an attractive simple payback period for solar systems between 1 and 9 kW under either the net feed-in mechanism or the net metering mechanism.

The average monthly electricity consumption slab of 350 kWh and above rooftop solar PV systems in the range of 1 to 9 kW promises an attractive payback of 5 years or less. The net feed-in mechanism seems to be the one metering mechanism that consistently results in better or equal payback periods than the net metering mechanism. This indicates that the re-introduction of net metering in 2021 did not result in shorter payback periods for consumers.

Table 3: Financial attractiveness of rooftop solar under the 2021 Tariff Order

		Consumption(kWh)				
		50	200	350	500	600
Solar Capacity (kW)	1	No	No	Yes	Yes	Yes
	3	No	No	Yes	Yes	Yes
	5	No	No	Yes	Yes	Yes
	7	No	No	Yes	Yes	Yes
	9	No	No	No	Yes	Yes

not attractive    
  Net metering and Net feed-in    
  Net feed-in

Result: Rooftop Solar PV is not yet an attractive investment opportunity for all domestic consumers. Especially consumers with lower and moderate monthly electricity consumption (up to 200 kWh) will not achieve a simple payback period of 5 years or less. However, consumers with average monthly electricity consumption of 350 kWh and more will find rooftop solar to be an attractive opportunity.

### Does the removal of network charges improve the payback on rooftop solar?

Table 4 indicates how many years of lesser payback would be achieved if the network charges of 0.25 INR/kWh solar gross generation were removed. We find that it is primarily the payback period for the lower consumption slabs that improves after the removal of network charges.

Table 4: Improvement of payback on under the 2021 Tariff Order without network charges

		Consumption(kWh)				
		50	200	350	500	600
Solar Capacity (kW)	1	<sup>15</sup> 2 <sub>13</sub>	<sup>8</sup> 1 <sub>7</sub>	<sup>2</sup> 0 <sub>2</sub>	<sup>1</sup> 0 <sub>1</sub>	<sup>1</sup> 0 <sub>1</sub>
	3	<sup>12</sup> 1 <sub>11</sub>	<sup>7</sup> 3 <sub>4</sub>	<sup>3</sup> 1 <sub>2</sub>	<sup>2</sup> 0 <sub>2</sub>	<sup>1</sup> 0 <sub>1</sub>
	5	<sup>11</sup> 2 <sub>9</sub>	<sup>8</sup> 1 <sub>7</sub>	<sup>4</sup> 1 <sub>3</sub>	<sup>3</sup> 0 <sub>3</sub>	<sup>2</sup> 0 <sub>2</sub>
	7	<sup>12</sup> 2 <sub>10</sub>	<sup>9</sup> 1 <sub>8</sub>	<sup>5</sup> 1 <sub>4</sub>	<sup>4</sup> 1 <sub>3</sub>	<sup>3</sup> 0 <sub>3</sub>
	9	<sup>12</sup> 1 <sub>11</sub>	<sup>10</sup> 2 <sub>8</sub>	<sup>6</sup> 1 <sub>5</sub>	<sup>5</sup> 1 <sub>4</sub>	<sup>4</sup> 1 <sub>3</sub>

Better Payback    
  Same Payback

Results: The removal of network charges for the domestic consumer segment results in the improvement of payback, particularly so for the lower consumption slabs (50 kWh, 200 kWh, and 350 kWh).

## Recommendations

With the availability of the capital subsidy under Phase II and the solar net feed-in tariff as per the 2021 Tariff Order, rooftop solar has become a more attractive investment proposition of many domestic consumers, in particular, consumers with monthly average electricity consumption of 350 kWh and more. Electricity tariffs for low-electricity consuming households (below 250 kWh/month) are highly subsidized and cross-subsidized, therefore it is in the interest of the State Government and of TANGEDCO to transition these households to rooftop solar. This will require additional incentives, innovative implementation models, and access to low-cost financing. It is recommended that a dedicated rooftop solar scheme for domestic consumers falling in slab 1 and slab 2 be rolled out, with the objective to reduce the combined subsidy cost to the State Government and TANGEDCO.

Consumers already pay a fixed charge for having a service connection with grid access of a certain capacity and levying of a network charge on solar energy production amounts to the DISCOM collecting network charges multiple times: (i) From consumers / as a fixed charge (the existing fixed or demand charges) and (ii) from consumers with a rooftop solar PV system as a variable charge for solar energy generated. This report found that the removal of network charges will primarily improve the attractiveness of rooftop solar for the lower monthly electricity consumptions slabs. Assuming that most of the low-income households in the state will follow into these lower monthly electricity consumptions slabs, the removal of network charges will make rooftop solar a more attractive opportunity for this domestic consumer group.

As net metering does not provide any shorter or more attractive payback period to domestic consumers in the state and net feed-in mechanism was found to be consistently more or equally attractive the net metering mechanism could potentially be removed and thereby reduce the administrative complexity of having multiple metering mechanism that needs to be managed simultaneously by the DISCOM.

## References

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6. TNERC. 2021. General Tariff Order for Grid Interactive PV Solar Energy Generating Systems (GISS). Order No.8 of 2021. Available at <http://www.tnerc.gov.in/Orders/files/TO-Order%20No%20251020211341.pdf>. (Accessed on: 30th Jan 2022)

## Annexure-1 General Assumptions

Sl. No.	Parameter	Unit	Value
1.	Debt	Percentage	70.00
2.	Equity	Percentage	30.00
3.	Loan period	Number of Years	10.00
4.	Interest rate	Percentage	9.50
5.	Capacity Utilization Factor (C.U.F.)	Percentage	21.00
6.	Operation and Maintenance charges	Percentage of gross capital	1.40
7.	Annual O&M increase	Percentage	5.72
8.	Insurance	Percentage of gross depreciated capital cost	0.35
9.	Depreciation	Percentage of net capital	10.00
10.	Residual rate	Percentage	10.00
11.	Annual AC panel degradation	Percentage	0.75
12.	Life of machinery	Number of Years	25.00
13.	Discount actor	Percentage	8.67
14.	Tilt angle	Degrees	14.00
15.	Array Type	NA	Fixed open rack
16.	Inverter efficiency	Percentage	96.00
17.	System cost-Real discount rate	Percentage	3.48
18.	System cost-Inflation rate	Percentage	5.00
19.	Bench mark cost for 1 to 10 kW capacities (Inclusive of the balance of system charges and the installation labour charges)	INR per kW	44.64
20.	Network charges annual increase	Percentage	3.00
21.	Electricity tariff annual increase	Percentage	5.00
22.	Annual load increase	Percentage	5.00
23.	Network Charges	INR per kWh	0.25

Source: System Advisory Model (SAM)

## Annexure-2 Solar Tariffs

Sl. No.	Capacity Range	Unit	Value
1.	0 to 10 kW	INR per kWh	3.61
2.	11 to 150 kW	INR per kWh	3.37
3.	150 to 999 kW	INR per kWh	3.10

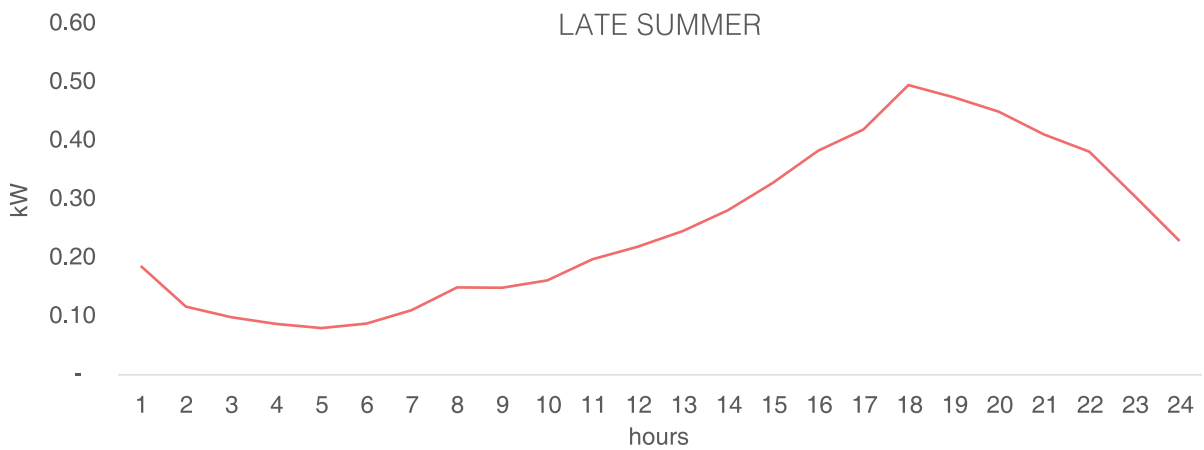
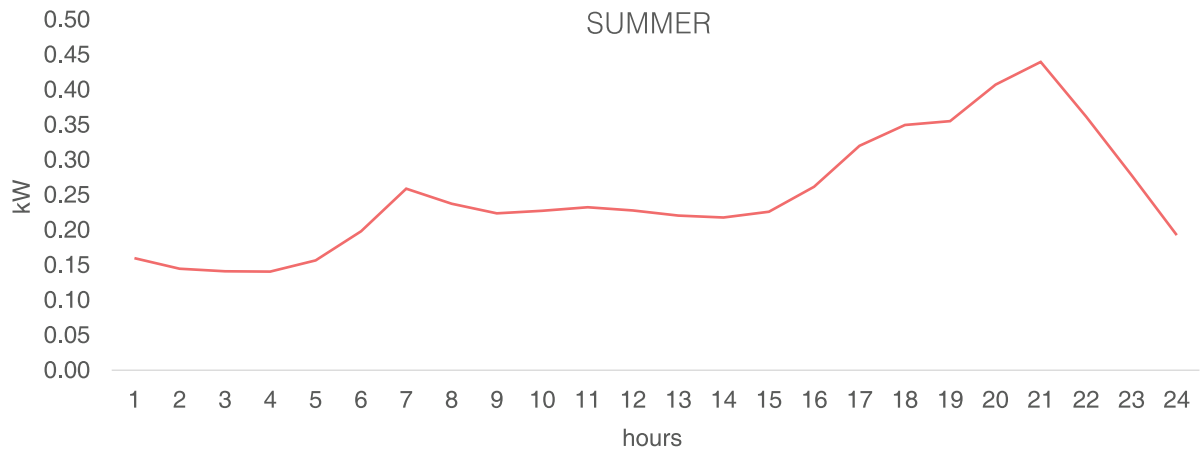
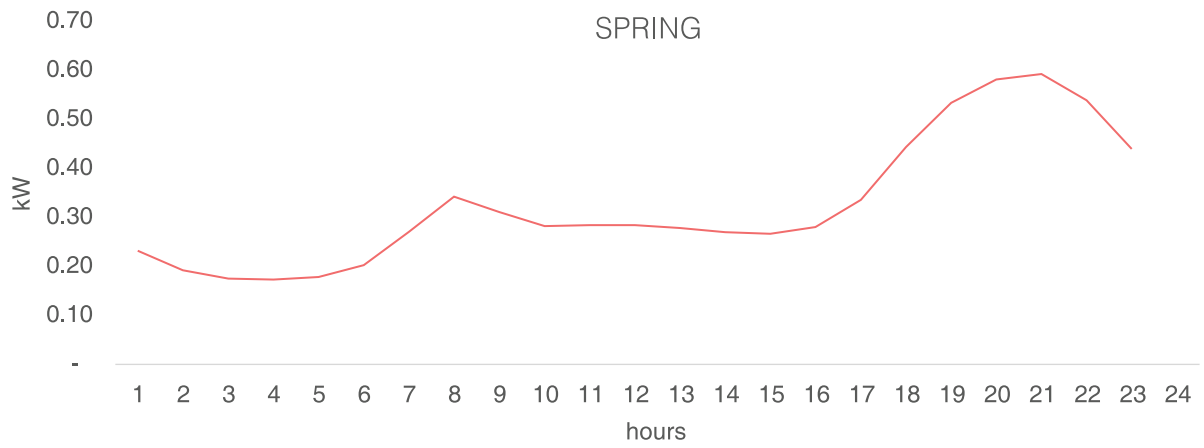
Source: TNERC 2021

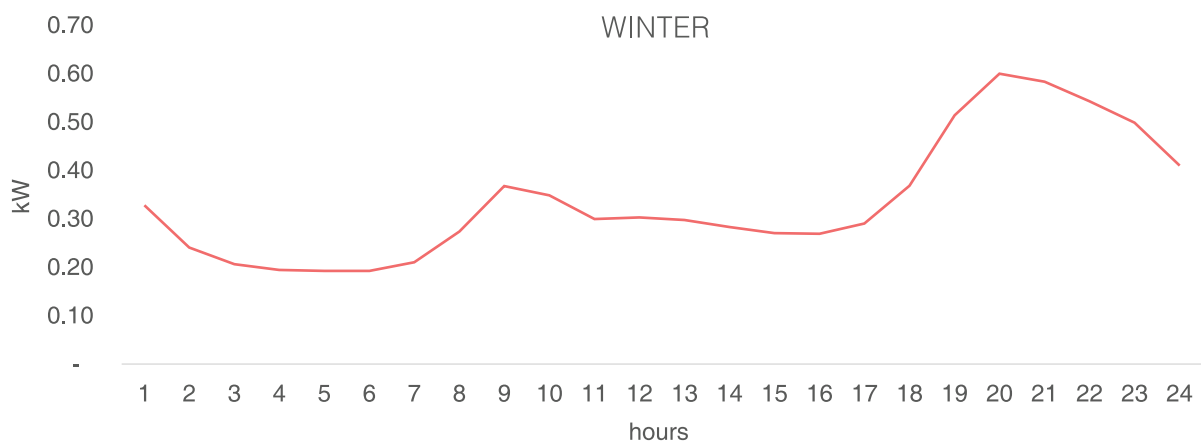
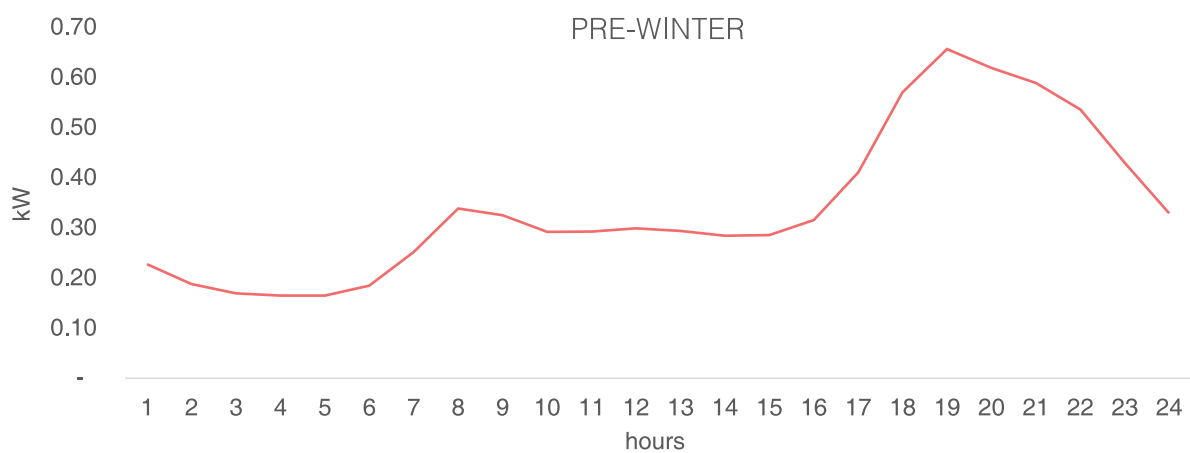
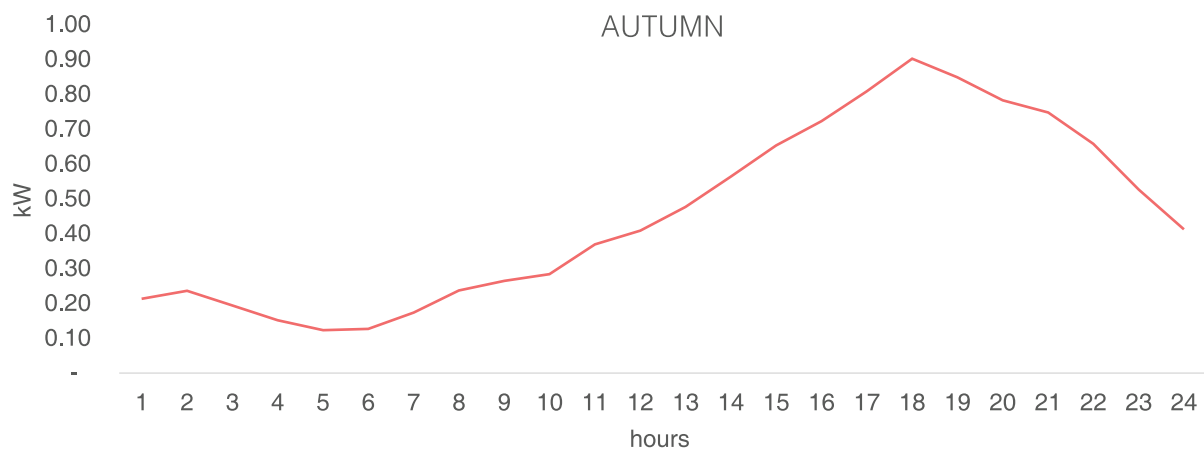
## Annexure-3 Network charges

Sl. No.	Category	Unit	Value
1.	High Tension	INR/kWh	0.83
2.	Low Tension	INR/kWh	1.27 *
			*it is further subsidised for the domestic category as follows: 20% of 1.27 (equals 0.25) for capacities 1 kW to 10 kW and 75% (or 0.95) for capacities above 10 kW

Source: TNERC 2021

### Annexure-4 Domestic load profile by season





Source: System Advisor Model (SAM)

## Annexure-5 MNRE Subsidy

Solar system capacity (kW)	Subsidy
1	40%
3	40%
5	32%
7	29%
9	27%

Source: MNRE 2019(a)