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Briefing Note: Financial attractiveness of Rooftop Solar Energy for Domestic Consumers in Tamil Nadu

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Purpose

To assess the financial attractiveness of installing grid-interactive rooftop PV solar systems for domestic consumers in Tamil Nadu.

Key messages

- For monthly consumption below 250 units, net feed-in mechanism showed better payback and for monthly consumption above 250 units, net metering mechanisms showed better payback for combinations of monthly consumption and rooftop solar PV capacities.
- For domestic consumer in Tamil Nadu, 9 combinations for net metering mechanism and 12 combinations for net feed-in mechanism were found to be 'financially attractive'.
- Simple payback period reduced by 10% for both metering mechanisms with removal of network charges.
- Under net feed-in mechanism, with removal of network charges, the 'financially attractive' combinations increase.

Note - 'Financially attractive' payback - Simple payback period of less than or equal to 5 years.

Background

In 2022, the Tamil Nadu government outlined an ambitious goal of achieving 20 GW of solar energy capacity by 2030. This significant expansion is intended to be implemented in all districts through distributed generation systems (PV Magazine India, 2022). Tamil Nadu Solar Policy 2019 (TEDA 2019) and the Generic Tariff Order for Grid Interactive PV Solar Energy Generating Systems (GISS) 2021 (TNERC 2021) were released to encourage the adoption of solar energy in Tamil Nadu.

The Tamil Nadu Solar Policy 2019 established a target of 9,000 MW, with a specific emphasis on 3,600 MW for the consumer category. As of October 2023, Tamil Nadu has successfully installed 449.22 MW of rooftop solar (MNRE, 2023), which accounts for 12% of the state's set target.

Furthermore, the Generic Tariff Order for GISS 2021 (TNERC 2021) introduced revised feed-in tariffs based on the installed solar PV capacity, particularly for consumers utilizing the net feed-in solar metering mechanism.

Table 1: Net feed-in tariffs for Domestic category

Solar PV capacity(kW)	Feed-in tariff (INR/kWh)
0 – 10	3.61
11 - 150	3.37

Source: TNERC 2021

The GISS 2021 order introduced network charges, which were implemented for the gross generation of grid-interactive solar PV systems, encompassing both self-consumed and exported units.

In the recent tariff order (TNERC 2023), network charges for consumers of the LT category were revised to 1.53 INR/kW. In the Generic Tariff Order for GISS 2021 (TNERC 2021), network charges for domestic consumers were defined based on solar PV system capacity. Table 2 details the network charges applicable for domestic consumers based on solar PV system capacity in Tamil Nadu.

Table 2: Network charges for Domestic category in FY2023.

System Size (kW)	LT (INR/kWh)
0-10	0.30
10 & above	1.15

Source: TNERC 2023

Energy tariffs applicable to domestic consumers (LT -1A) in Tamil Nadu are listed in the Table 3 below.

Table 3: Subsidised energy charges payable by Domestic category in 2023.

Consumption slabs (Range in kWh/ month)	Energy Charges payable by consumer (INR/ kWh)
a) For consumers who consume up to 50 units per month	
0-50	Nil
b) For consumers who consume from 51 units to 100 units per month	
0-50	Nil
51-100	2.25
c) For consumers who consume from 101 units to 250 units per month	
0-50	Nil
51-100	2.25
101-200	4.50
201-250	6.00
d) For consumers who consume 251 units and above per month	
0-50	Nil
51-100	4.50
101-200	4.50
201-250	6.00
251-300	8.00
301-400	9.00
401-500	10.00
501 & Above	11.00

Source: TNERC 2023

Considerations

Payback:

Simple payback is used to assess the financial attractiveness of rooftop solar PV systems. The simple payback period disregards the time value of money and is determined by counting the number of years it takes to recover the amount invested.

Solar PV capacities:

A range of 5 solar PV capacities - e.g. 1, 3, 5, 7 & 9 kW - have been considered for payback calculation.

Average monthly consumption:

Six different average monthly electricity consumption – 50, 100, 200, 350, 500 and 600 units (kWh) - to cover all existing tariff slabs of the domestic consumer category were used.

Central financial assistance (CFA):

CFA is applied for each system size considered in this study. Please find more details in the Annexure.

Load curve:

The load curve was customised by defining a typical weekday and weekend consumption for the domestic category using the Solsavi tool (Auroville Consulting, 2023). Please find more details in the Annexure.

Other assumptions:

All the other assumptions included in the financial calculations are given in Annexure.

Results:

Does the net feed-in mechanism result in the shorter payback periods as compared to the net metering?

For most of the combinations net feed-in mechanism gives faster payback than net metering (refer to Table 4). However, we also find combinations where the net metering mechanism provides a faster payback with few combinations having a similar payback for both solar metering mechanisms.

Table 4: Comparison if net feed-in mechanism results in faster payback period as compared to the net metering

System sizes (kW)	Monthly consumption(kWh)					
	50	100	200	350	500	600
1	Yes	Yes	No	No	No	Same
3	Yes	Yes	Yes	Same	No	No
5	Yes	Yes	Yes	Yes	Same	No
7	Yes	Yes	Yes	Yes	Yes	Same
9	Yes	Yes	Yes	Yes	Yes	Yes

■ Faster payback ■ Same Payback

Is rooftop solar an attractive investment opportunity for domestic consumers?

For this note, we define the 'financial attractiveness' of a grid-interactive rooftop PV solar system as a system that achieves a simple payback period of less than or equal to 5 years.

Considering the combinations of solar PV capacities (1, 3, 5, 7 and 9 kW) and the assumed monthly average electricity consumption (50, 100, 200, 350, 500 & 600 kWh) the simple payback period for each combination is detailed in table 5.

9 combinations in net metering mechanism and 12 combinations in net feed-in mechanism were found to be 'financially attractive' for a domestic consumer in Tamil Nadu.

Table 5: Simple payback period for domestic consumers for selected combinations of PV solar system sizes and average monthly consumption for both solar metering mechanism

Simple payback (yrs)						
System sizes (kW)	Monthly average (units)					
	50	100	200	350	500	600
1	No	No	No	Yes	Yes	Yes
3	No	No	No	Yes	Yes	Yes
5	No	No	No	Yes	Yes	Yes
7	No	No	No	No	Yes	Yes
9	No	No	No	No	No	Yes

■ Financially attractive for both metering mechanism
■ Financially attractive' for Net Feed-In

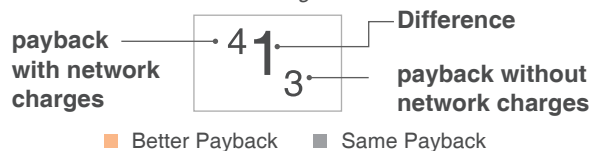
Does the removal of network charges improve the payback on rooftop solar?

The DISCOM collects network charges for gross generation from grid-interactive PV solar systems, in addition to the fixed charges for having a service connection and grid access.

The simulations were carried out to determine payback period for a domestic consumer without considering the network charges that are applied on gross generation from the grid-interactive rooftop PV solar system.

As shown in figure 1, the value in the cell is the difference between the payback with network charges (expressed as superscript) and payback without network charges (expressed as subscript). The legends represent if the difference in payback is either the same or better as compared to scenario when network charges are considered.

Figure 1: Example representation of difference in payback with and without network charges



For domestic consumers under the net metering and net feed-in mechanism, there was 1 combination that resulted in 'financially attractive' payback when network charges were not applied.

However, for domestic consumers under net feed-in mechanism, removal of network charges provided better payback in most of the combinations. Table 6 details the results for payback with and without network charges under net feed-in mechanism.

Table 6: Difference in payback for domestic consumer with and without network charges under net feed-in mechanism

Change in simple payback (yrs.) under net feed-in mechanism						
System sizes (kW)	Monthly consumption(kWh)					
	50	100	200	350	500	600
1	¹⁷ 2 ₁₅	¹⁶ 1 ₁₄	¹¹ 4 ₇	¹ 0 ₁	¹ 0 ₁	¹ 0 ₁
3	¹⁶ 2 ₁₄	¹⁶ 2 ₁₄	¹⁴ 3 ₁₁	² 0 ₂	² 0 ₂	¹ 0 ₁
5	¹⁷ 2 ₁₅	¹⁷ 2 ₁₅	¹⁵ 2 ₁₃	⁵ 1 ₄	⁴ 1 ₃	² 0 ₂
7	¹⁷ 2 ₁₅	¹⁷ 2 ₁₅	¹⁶ 2 ₁₄	¹⁰ 4 ₆	⁵ 1 ₄	⁴ 1 ₃
9	¹⁸ 2 ₁₆	¹⁷ 2 ₁₅	¹⁷ 2 ₁₅	¹² 3 ₉	⁷ 2 ₅	⁵ 1 ₄

■ Better Payback ■ Same Payback

Recommendation:

- Domestic consumers may request consumer advocacy and protection groups to approach the government and request to review the current network charges.
- Request your solar installer to carefully size your rooftop solar system to maximize self-consumption of solar energy and minimize export of surplus solar energy to the grid.
- Net metering mechanism is recommended for domestic consumers having an average monthly electricity consumption above 250 units.
- Net feed-in mechanism is recommended for domestic consumers having an average monthly electricity consumption below 250 units.

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Annexure

Figure 2 - Average hourly load profile for a weekday and a weekend day - Domestic category

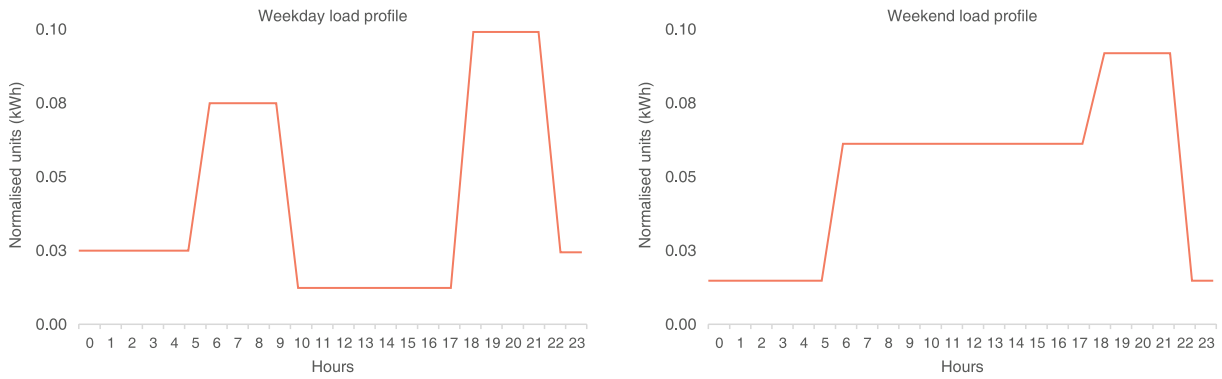


Table 7 Key assumptions

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	9.00
5.	Operation and Maintenance charges	INR Per kW	500
6.	Annual O&M increase	Percentage	5.00
7.	Annual AC panel degradation	Percentage	1.00
8.	Life of machinery	Number of Years	25.00
9.	Discount factor	Percentage	8.61
10.	Tariff escalation	Percentage	5.00
11.	Annual load increase	Percentage	2.00
12.	Inverter replacement year	Year	14.00

Table 8: Assumed Capital cost – Calculated from quotations received for solar PV system in FY 22-23 and FY 23-24

Sl. No.	Size(kW)	Capital cost(INR/kW)
1.	1	63,800
2.	1 - 2	58,700
3.	2 - 3	57,150
4.	3 - 10	55,750
5.	10 - 100	52,000
6.	100 - 500	48,800
7.	500 - above	48,800

Table 9: Total subsidy based on updated rates on CFA, 2023.

System Size (kW)	Total Subsidy (INR)
1	14588
3	43764
5	58352
7	72940
9	87528