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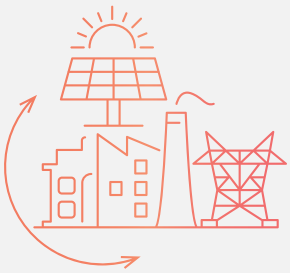

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Briefing Note: Financial attractiveness of Rooftop Solar Energy for HT Commercial and Industrial Consumers in Tamil Nadu

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Purpose

To assess the financial attractiveness of installing grid-interactive rooftop PV solar system for Commercial and Industrial (C&I) consumers under the HT voltage category in Tamil Nadu.

Key messages

- HT C&I consumers get attractive payback if the solar PV system is designed to maximize self-consumption and minimize the export of surplus solar to the grid.
- For HT-industrial consumers, the self-consumption percentage - from gross solar energy generation - required to achieve a 'financially attractive' payback reduced from 60% to 40% with removal of network charges.
- For HT-commercial consumers, the self-consumption percentage - from gross solar energy generation – required to achieve a 'financially attractive' payback reduced from 45% to 35% with removal of network charges.
- Considering the case when network charges are not applied, the payback period reduced by approximately 38% for both HT – Industrial consumers and HT – Commercial consumers.

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Background

In 2022, The Tamil Nadu government set a target to add 20 GW of solar energy capacity by 2030. This capacity addition is expected to be carried out in every district using distributed generation systems (PV Magazine India, 2022). The state has adopted policy and regulatory frameworks - the Tamil Nadu Solar Policy 2019 (TEDA 2019) and the Generic Tariff Order for Grid Interactive PV Solar Energy Generating Systems (GISS) 2021 (TNERC 2021) - to propagate the adoption of grid interactive distributed solar energy.

In Tamil Nadu Solar Policy 2019, a target of 9,000 MW was set. 3,600 MW from this target was meant to be met from consumer category. As of October 2023, Tamil Nadu has 449.22 MW (MNRE, 2023) of rooftop solar installed, which represents 12% of the target set by the state.

In the Generic Tariff Order for Grid Interactive PV Solar Energy Generating Systems (GISS) 2021 (TNERC 2021), feed-in tariffs were revised based on installed solar PV capacity for consumers availing net feed-in solar metering mechanism.

Table 1: Net feed-in tariffs for Industrial and Commercial consumers under HT category

Solar PV capacity(kW)	Feed-in tariff (INR/kWh)
0 – 10	3.61
11 - 150	3.37
151 - 999	3.1

Source: TNERC 2021

In the GISS 2021 order, network charges were introduced and applied for gross generation (sum of self-consumed and exported units) of the grid-interactive solar PV system. In the recent tariff order (TNERC 2023), the network charges for LT and HT category consumers were increased and shown in the table 2.

Table 2: Network charges for FY 2023-24 for LT and HT category

LT (INR/kWh)	HT (INR/kWh)
1.53	1.00

Source: TNERC 2023

In the same tariff order (TNERC 2023), the electricity tariff was revised for all consumer categories, this revision is applicable from 1st July 2023 onwards.

Table 3: Energy charge for Industrial and Commercial consumer under HT category

Consumer category (HT)	Energy charge (INR/kWh)
Industrial	6.90*
Commercial	8.70**

Source: TNERC 2023
* HT-I- tariff category for Industries, Information technology industries
** HT-III - tariff category for Miscellaneous/General purpose

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 funds invested.

Solar PV capacities:
A range of 6 solar PV capacities - e.g. 150, 250, 350, 500, 600 and 750 kW - have been considered for payback calculation.

Average monthly consumption:
6 different average monthly consumption – 20,000, 30,000, 45,000, 65,000, 75,000 and 100,000 units (kWh) - equal to average monthly gross solar generation from each solar PV capacity selected above.

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

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

Results

What is the payback for a HT - C&I consumer in Tamil Nadu?
The analysis is carried out considering the recently updated electricity tariff (TNERC 2023).

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 combination of solar PV capacities (150, 250, 350, 500, 600 & 750 kW) and the assumed monthly average electricity demand (20,000, 30,000, 45,000, 65,000, 75,000 and 100,000 kWh) the simple payback period for each combination is listed below.

The table 4 shows the results of the simulations with 19 selected combinations having a 'financially attractive' payback for a HT – industrial consumers.

From table 5 we observe that combinations having an approximate self-consumption percentage above 60% provided a 'financially attractive' payback for HT-industrial consumers.

Wherein self-consumption is defined as the share of energy from the gross generated solar energy that is directly consumed by the respective entity.

Table 4: Simple payback period for HT – Industrial consumers for selected combinations of PV solar system sizes and average monthly consumption

Simple payback (yrs.)						
System sizes (kW)	Monthly consumption(kWh)					
	500	1,000	2,000	4,000	8,000	10,000
150	Yes	Yes	Yes	Yes	Yes	Yes
250	No	No	Yes	Yes	Yes	Yes
350	No	No	Yes	Yes	Yes	Yes
500	No	No	No	Yes	Yes	Yes
600	No	No	No	No	No	Yes
750	No	No	No	No	No	Yes

Financially attractive

Table 5: Percentage of self-consumption from gross solar generation for HT-Industrial consumer

% of self-consumption						
System sizes (kW)	Monthly consumption(kWh)					
	20,000	3,0000	45,000	65,000	75,000	100,000
150	52%	71%	87%	93%	96%	99%
250	34%	48%	66%	83%	87%	92%
350	25%	36%	51%	67%	74%	86%
500	18%	26%	38%	51%	58%	71%
600	15%	22%	32%	44%	50%	62%
750	12%	18%	26%	36%	41%	52%

Financially attractive

The table 6 shows the results for a HT – commercial consumer. A total of 26 combinations were found to be 'financially attractive.

From table 7 we can observe that combinations with an approximate self-consumption percentage above 45% provided a 'financially attractive' payback for HT-commercial consumers.

Table 6: Simple payback period for HT – Commercial consumers for selected combinations of PV solar system sizes and average monthly consumption

Simple payback (yrs.)						
System sizes (kW)	Monthly consumption(kWh)					
	20,000	3,0000	45,000	65,000	75,000	100,000
150	Yes	Yes	Yes	Yes	Yes	Yes
250	No	Yes	Yes	Yes	Yes	Yes
350	No	Yes	Yes	Yes	Yes	Yes
500	No	No	Yes	Yes	Yes	Yes
600	No	No	No	Yes	Yes	Yes
750	No	No	No	Yes	Yes	Yes

Financially attractive

Table 7: Percentage of self-consumption from gross solar generation for HT-Commercial consumer

% of self-consumption						
System sizes (kW)	Monthly consumption(kWh)					
	20,000	3,0000	45,000	65,000	75,000	100,000
4	56%	75%	90%	95%	96%	99%
8	36%	51%	70%	86%	90%	94%
16	27%	38%	54%	71%	78%	89%
32	19%	28%	40%	54%	61%	75%
64	16%	24%	34%	47%	53%	66%
80	13%	19%	28%	39%	44%	56%

Financially attractive

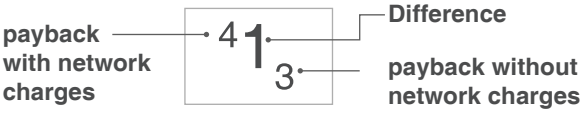
What is the payback for a HT C&I consumer in Tamil Nadu without considering network charges?
The DISCOM collects network charges for gross generation from grid-interactive PV solar system, in addition to the fixed charges for having a service connection and grid access.

The simulations were carried out to determine the payback years for a C&I consumer without considering the network charges that is applied on gross generation from the grid-interactive rooftop PV solar system.

The table 8 shows the difference in the payback period for a HT – industrial consumer.

As shown in figure 1, the value in the cell is the difference of 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



Better Payback Same Payback

Table 8: Difference in payback for HT – Industrial consumer with and without network charges

Change in simple payback (yrs.)						
System sizes (kW)	Monthly consumption(kWh)					
	20,000	3,0000	45,000	65,000	75,000	100,000
150	$^{5}2_{3}$	$^{3}1_{2}$	$^{3}1_{2}$	$^{3}1_{2}$	$^{2}0_{2}$	$^{2}0_{2}$
250	$^{10}5_{5}$	$^{6}2_{4}$	$^{3}1_{2}$	$^{3}1_{2}$	$^{3}1_{2}$	$^{3}1_{2}$
350	$^{13}6_{7}$	$^{9}4_{5}$	$^{5}2_{3}$	$^{3}1_{2}$	$^{3}1_{2}$	$^{3}1_{2}$
500	$^{15}4_{11}$	$^{13}6_{7}$	$^{9}5_{4}$	$^{5}2_{3}$	$^{4}1_{3}$	$^{3}1_{2}$
600	$^{17}5_{12}$	$^{14}5_{9}$	$^{11}6_{5}$	$^{6}2_{4}$	$^{5}2_{3}$	$^{3}1_{2}$
750	$^{18}4_{14}$	$^{15}4_{11}$	$^{13}6_{7}$	$^{9}4_{5}$	$^{7}3_{4}$	$^{4}1_{3}$

Better payback Same payback

Out of the selected combinations, only 2 combinations resulted in having the same payback and the remaining combinations resulted in better payback for HT – Industrial consumer, when network charges were not applied.

The results for HT – Commercial consumer, comparing the scenarios for payback with and without network charges are shown in table 9.

Table 9: Difference in payback for LT – Commercial consumer with and without network charges

Change in simple payback (yrs.)						
System sizes (kW)	**Monthly consumption(kWh)**					
	20,000	3,0000	45,000	65,000	75,000	100,000
150	$^{3}1_{2}$	$^{2}0_{2}$	$^{1}0_{1}$	$^{1}0_{1}$	$^{1}0_{1}$	$^{1}0_{1}$
250	$^{6}3_{3}$	$^{3}1_{2}$	$^{2}0_{2}$	$^{1}0_{1}$	$^{1}0_{1}$	$^{1}0_{1}$
350	$^{9}4_{5}$	$^{5}2_{3}$	$^{3}1_{2}$	$^{2}0_{2}$	$^{2}0_{2}$	$^{1}0_{1}$
500	$^{13}6_{7}$	$^{9}5_{4}$	$^{5}2_{3}$	$^{3}1_{2}$	$^{2}1_{1}$	$^{1}0_{1}$
600	$^{14}5_{9}$	$^{11}5_{6}$	$^{6}3_{3}$	$^{4}2_{2}$	$^{3}1_{2}$	$^{2}1_{1}$
750	$^{16}5_{11}$	$^{13}6_{7}$	$^{9}5_{4}$	$^{5}2_{3}$	$^{4}2_{2}$	$^{3}1_{2}$

Better Payback Same Payback

Recommendations

- HT C&I consumers are advised to select their solar PV system size with the objective to maximise solar energy self-consumption and minimise the surplus solar units exported to the grid.
- HT C&I consumers may request their chambers and industrial associations to approach the government and request to review the current network charges.
- HT C&I consumers could shift their load during solar generation hours facilitating faster payback for the selected solar PV system.
- HT C&I consumers in Tamil Nadu could adopt Battery energy Storage Systems (BESS) to replace the supply during peak hours or as back-up.
- HT C&I consumers in Tamil Nadu are facing regular power outages. Diesel generators are primarily used to provide power back-up. Installation of rooftop solar in combination with existing diesel generator could result in substantial savings on fuel expenses.

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Annexure

Figure 2 Average hourly load profile for a weekday and a weekend day - HT industry

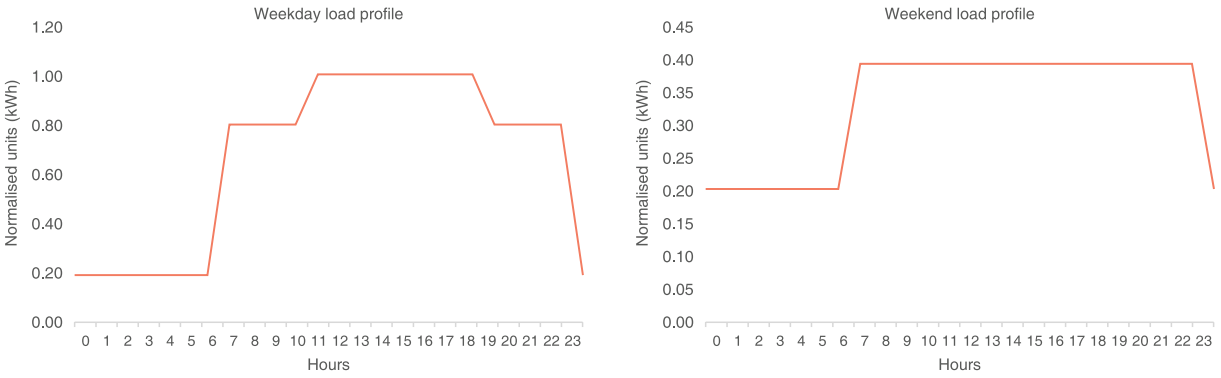

Figure 3 Average hourly load profile for a weekday and weekend day - HT commercial

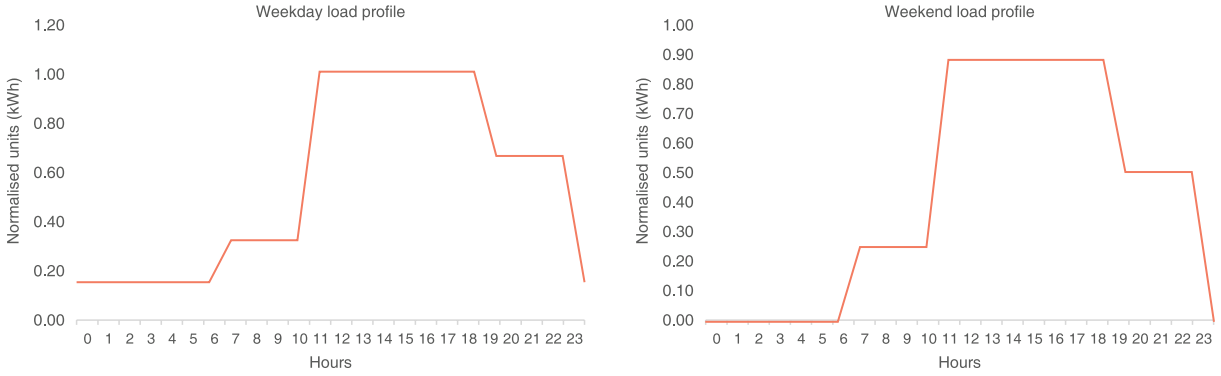

Table 10: Key assumptions

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 11: Assumed Capital cost – Calculated from quotations received for solar PV system in FY22-23 and FY23-24

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