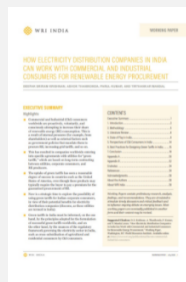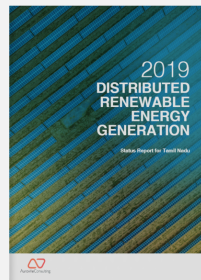# Economic Feasibility of Rooftop Solar for C&I consumers in Tamil Nadu

Date: 27/04/2022
Presented by:
Frano D'Silva
Renewable Energy Analyst
Auroville Consulting

Sustainable Energy Transformation – Tamil Nadu (SET-TN)

SET aims to facilitate higher clean energy deployment in the State by working with stakeholders in order to find sustainable and equitable solutions. SET is a collaborative initiative by Auroville Consulting (AVC), Citizen Consumer and civic Action Group (CAG), the World Resources Institute India (WRI).

For more information, visit our website: https://settn.energy/

Agenda

- Journey of designing an economically feasible system (C&I consumers)

- Intro to Solsavi web tool

- Demo scenario
  - Simulate sample scenario

- Result analysis
  - Review the results and other details generated from Solsavi

- Question & answer
  - Discussion on topics during session

Rooftop Solar
- Solar Capacity
- Performance & lifetime of the system

C&I consumer
- Tariff rate
- Solar regulations

Economic feasibility
- Payback period
- Return on Investment

During the webinar…

- Interactive session

    - Polls and multiple choice questions

    - Polls on Zoom platform will be used

- Please hold your queries until the Q & A session

- This session is recorded for internal use

TN Solar policies & regulations

- Solar Energy Policy, 2019

- Generic Tariff Order for GISS 2021
    - Net Metering for Domestic consumers
    - Net Feed-in for all consumers (incl. HT)
    - Gross Metering for HT consumers (system larger than 150kW)
    - Network charges are introduced
    - Premium charges for export to grid during peak hours
    - Tariff revision for Net Feed-in mechanism

TN Solar policies & regulations

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  - Net Feed-in for all consumers (incl. HT)
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  - Tariff revision for Net Feed-in mechanism

Category (LT)	Net Feed-in	Gross Metering	Net Metering
Domestic	✓	✗	✓
Industrial	✓	✗	✗
Commercial	✓	✗	✗

Category (HT)	Net Feed-in	Gross Metering
Industrial	✓	✗
Commercial	✓	✗
Generators above 150kW	✗	✓

TN Solar policies & regulations

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  – Net Metering for Domestic consumers
  – Net Feed-in for all consumers (incl. HT)
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  – Premium charges for export to grid during peak hours
  – Tariff revision for feed-in mechanism

Compensation rate(INR/kWH)	PV capacity		
	0 – 10kW	11 – 150kW	151 – 999kW
C & I consumers (LT)	3.61	3.37	-
C & I consumers (HT)	3.61	3.37	3.10

Electricity bill

Applicable period

Consumer tariff category

Sanctioned load (kW/kVA)

Units of consumption (kWh)

Tariff rate (INR/kWh)

Total electricity bill (INR)

TamilNadu Generation and Distribution Corporation Ltd.

Villupuram

High Tension Bill (Provisional) for the Month of March 2022

TANGEDCO CIN No: GST No:

HSN : SAC :

**** Electrical Energy & Distribution Services are exempted under GST ****

To:	NAME	Service No.	
		Bill No.	
	ADDRESS	Date of Bill	06-Apr-22
		Due Date	12-Apr-22
		Tariff App. / Bld.	HT IIA / HT IIA
		GST No :	

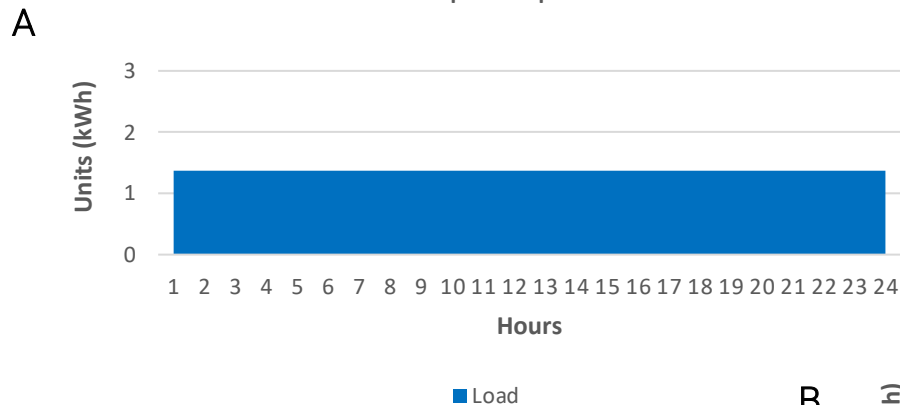| Permitted MD :	600 KVA	Transformer Loss :	0units/0KVA	Tr. CAP.	0 KVA

DETAILS	RATE	CONSUMPTION	AMOUNT (Rs.)
1. Industrial Consumption	6.35 per unit	133429	8,47,274.15
2. Peak Hour Consumption	1.27 per unit	0	0.00
3. Night Hour Consumption (5% Rebate)	0.3175 per unit	0 (-)	0.00(-)
4. Quarters Consumption	0 per unit	0	0.00
5. Commercial Consumption	0 per unit	0	0.00
6. Temp. Supply Consumption	0 per unit	0	0.00
7. Total Energy Charges			8,47,274.15
8. Demand Charges	350 per KVA	590.4	2,06,640.00
9. Total Demand and Energy Charges			10,53,914.15

Consumption profile

A

Consumption profile

B
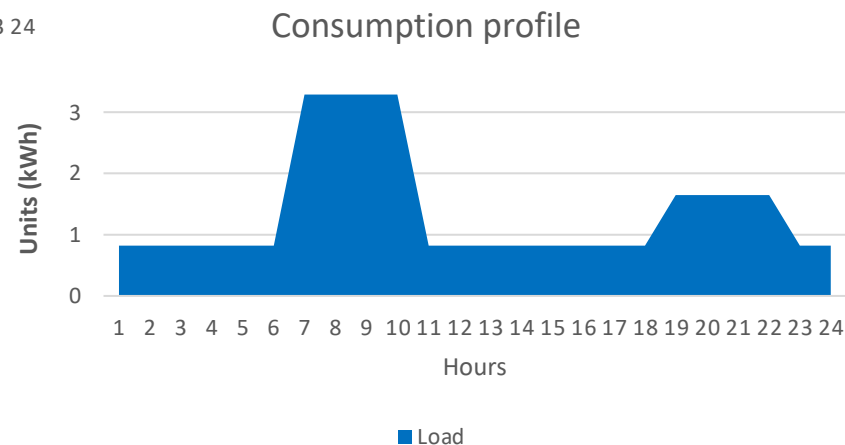
Monthly avg. (kWh)
1000

Daily avg. (kWh)
32.25

Consumption profile

Consumption profile

Monthly avg. (kWh)
1000
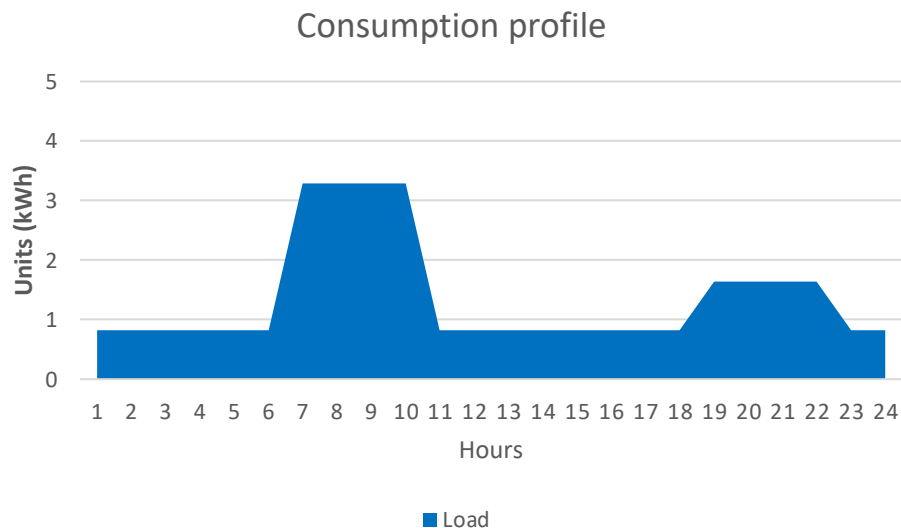
Daily avg. (kWh)
32.25

| Time section (24hrs)	% of consumption
6:00am to 10:00am	40
10:00am to 6:00pm	20
6:00pm to 10:00pm	20
10:00pm to 6:00am	20

Consumption profile

Consumption profile

Legend: Grid to load | Exported to grid | Solar to load | Total solar
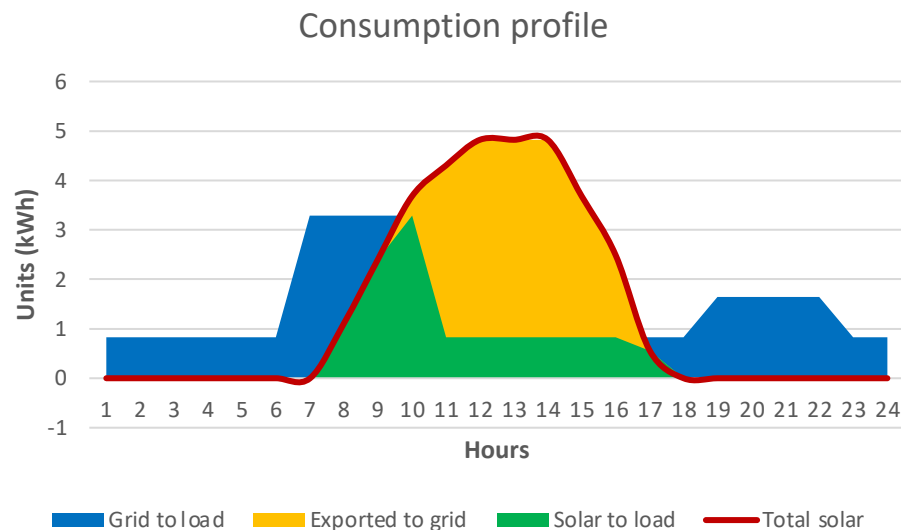
Monthly avg. (kWh)
1000

Daily avg. (kWh)
32.25

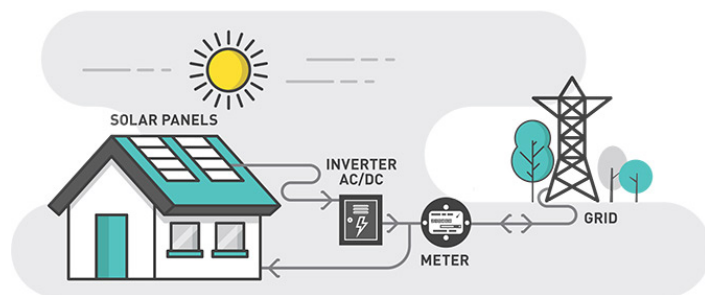| Description	Units (kWh)
Daily avg.	32.25
Grid to load	22.55
System to load	9.7
Exported to grid	9.7

Net Feed-in arrangement

In Net Feed-in arrangement, The net amount to be paid is the difference between amount to be paid for consumption from grid & revenue generated from export to grid?
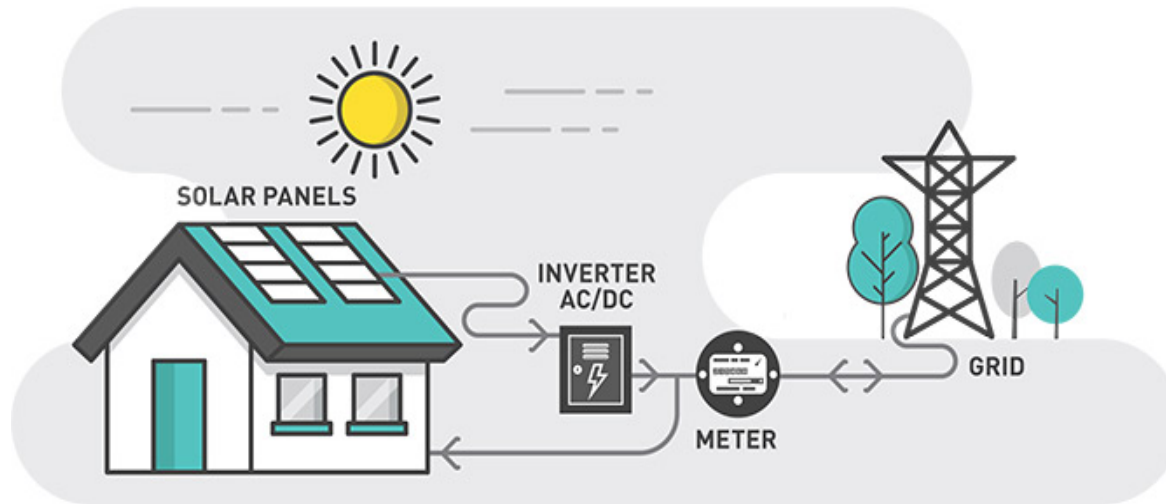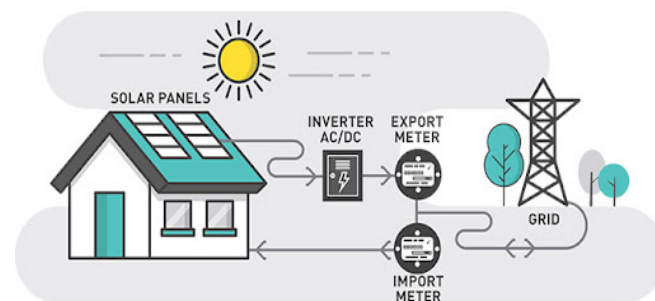

Net Feed - in

Solar metering arrangement

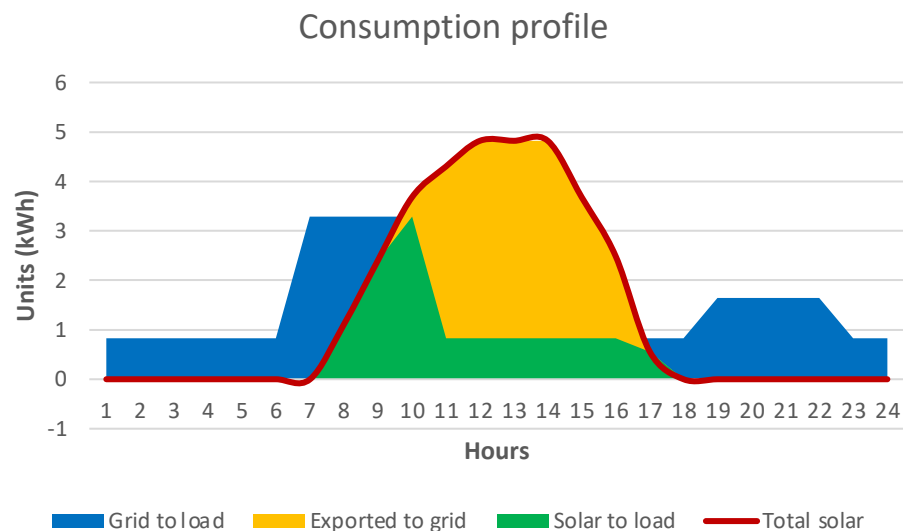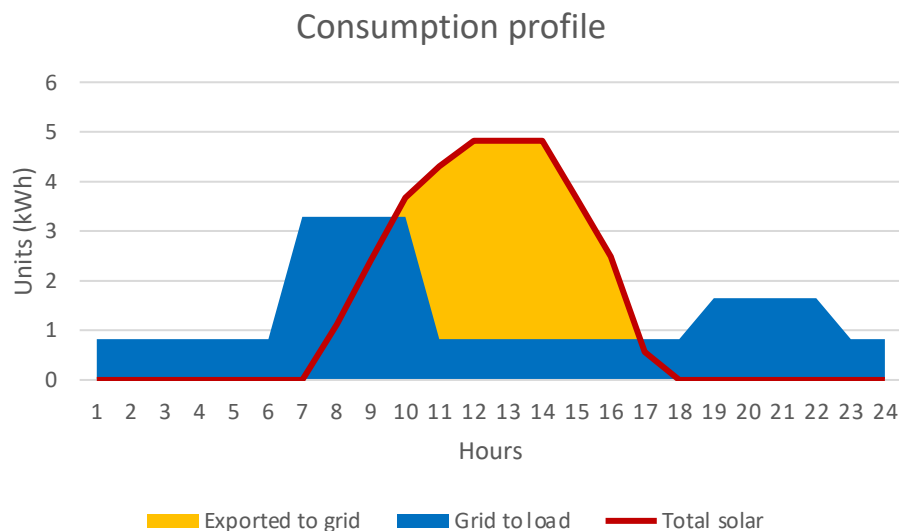| Mechanism	Grid supplied (kWh)	Export to grid (kWh)	Compensation INR/(kWh)	Calculation
Net metering	A	B	Grid tariff	(A − B) * grid tariff
Net feed - in	A	B	Net feed in tariff	(A * grid tariff) − (B * Net feed in tariff)
Gross metering	A	B	Gross feed in tariff	(A * grid tariff) − (B * Gross feed in tariff)

Net metering or Net Feed - in

Gross metering

Net Feed−in mechanism

Consumption profile

Consumption profile chart with Units (kWh) on Y-axis (ranging -1 to 6) and Hours (1 to 24) on X-axis.

Legend:
- Grid to load
- Exported to grid
- Solar to load
- Total solar

Description	Units (kWh)
Monthly avg.	1000
Grid to load	700
System to load	300
Exported to grid	300

Description	Grid tariff (INR/kWh)
Industrial (LT)	6.35

Metering mechanism (C&I consumer)	Calculation	Bill total (INR)
BAU	(grid supplied units * grid tariff)	1000 * 6.35 = 6,350/-
Net Feed-in	(grid supplied units * grid tariff) – (exported units * Net feed in tariff)	(700 * 6.35) – (300 * 3.37) = 3,434/-
Gross Metering	(grid supplied units * grid tariff) – (exported units * Gross feed in tariff)	

Gross Metering

Consumption profile

Legend: Exported to grid | Grid to load | Total solar

X-axis: Hours (1–24), Y-axis: Units (kWh)

Description	Units (kWh)
Monthly avg.	1000
Grid to load	1000
System to load	0
Exported to grid	600

Description	Grid tariff (INR/kWh)
industrial (LT)	6.35

Metering mechanism (C&I consumer)	Calculation	Bill total (INR)
BAU	(grid supplied units * grid tariff)	1000 * 6.35 = **6,350/-**
Net Feed-in	(grid supplied units * grid tariff) – (exported units * Net feed in tariff)	(700 * 6.35) – (300 * 3.37) = **3,434/-**
Gross Metering	(grid supplied units * grid tariff) – (exported units * Gross feed in tariff)	(1000 * 6.35) – (600 * 3.1) = **4,490/-**

Network charges (TN)

The wheeling /network charges stem from the concept of using the electrical network as an indispensable supporting mechanism to generate solar power as well as transmitting the power so generated from generating point to load point destinations.

- Networks charges are levied on the gross generation of solar energy
    - Applies to both portion
        - Self consumption
        - Exported to grid

- Network charges is applicable for the units generated by the GISS, categorized under "Net-Metering" mechanism and "Net Feed-in" mechanism
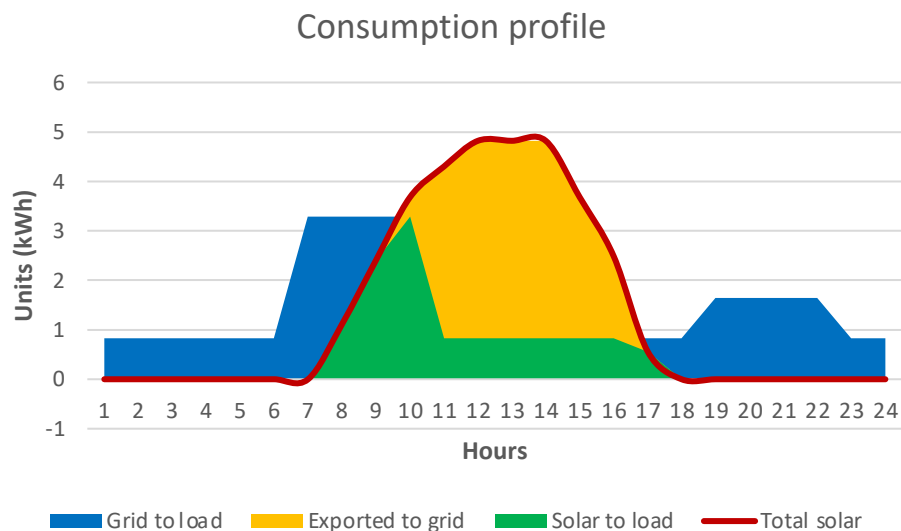
Network charges (TN)

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- Network charges is applicable for the units generated by the GISS, categorized under "Net-Metering" mechanism and "Net Feed-in" mechanism

C & I consumers	Network charges (INR/kWh)	
Metering mechanism	LT	HT
Net Feed-in	1.27	0.83
Gross Metering	-	0

Net Feed-in mechanism

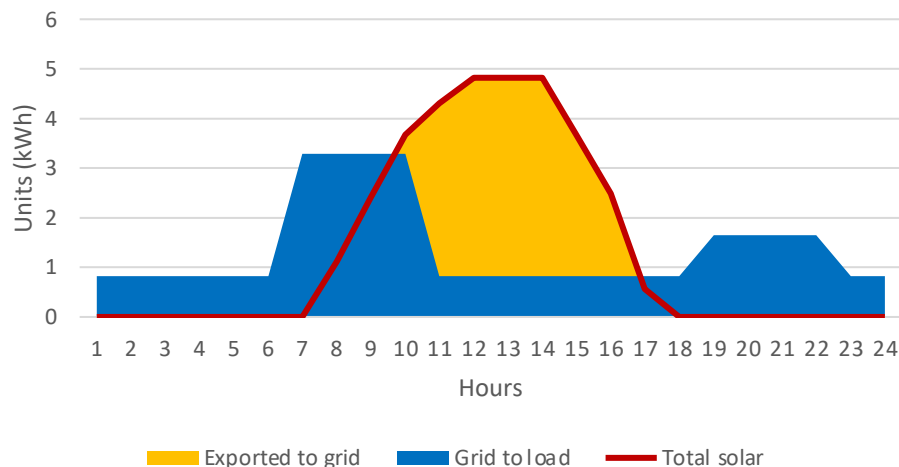| C & I consumers	Network charges (INR/kWh)	
Metering mechanism	LT	HT
Net Feed-in	1.27	0.83
Gross Metering	-	0

Consumption profile

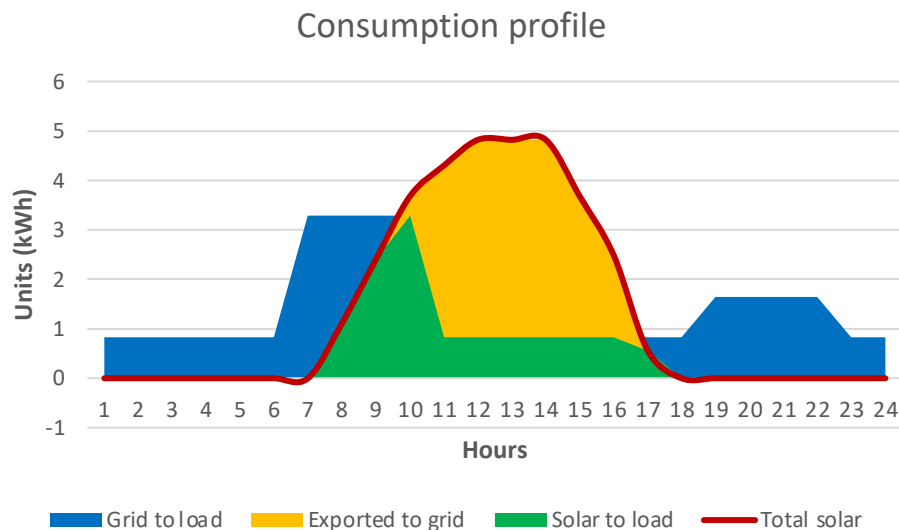| Description	Grid tariff (INR/kWh)	
Industrial (LT)	6.35	
Metering mechanism (C&I consumer)	Calculation	Bill total (INR)
BAU	(grid supplied units * grid tariff)	6,350/-
Net Feed-in	(grid supplied units * grid tariff) – (exported units * Net feed in tariff)	3434 + (600 * 1.27) = 4,196/-
Gross Metering	(grid supplied units * grid tariff) – (exported units * Gross feed in tariff)	

Gross Metering

Consumption profile

Units (kWh) vs Hours (1–24)

Legend: Exported to grid / Grid to load / Total solar

C & I consumers	Network charges (INR/kWh)	
Metering mechanism	LT	HT
Net Feed-in	1.27	0.83
Gross Metering	-	0

Description	Grid tariff (INR/kWh)	
Industrial (LT)	6.35	
Metering mechanism (C&I consumer)	**Calculation**	**Bill total (INR)**
BAU	(grid supplied units * grid tariff)	6,350/-
Net Feed-in	(grid supplied units * grid tariff) – (exported units * Net feed in tariff)	3434 + (600 * 1.27) = 4,196/-
Gross Metering	(grid supplied units * grid tariff) – (exported units * Gross feed in tariff)	4490 + (600 * 0) = 4490/-

Optimization criteria

Consumption profile

Units (kWh) vs **Hours**

Legend: Grid to load | Exported to grid | Solar to load | Total solar
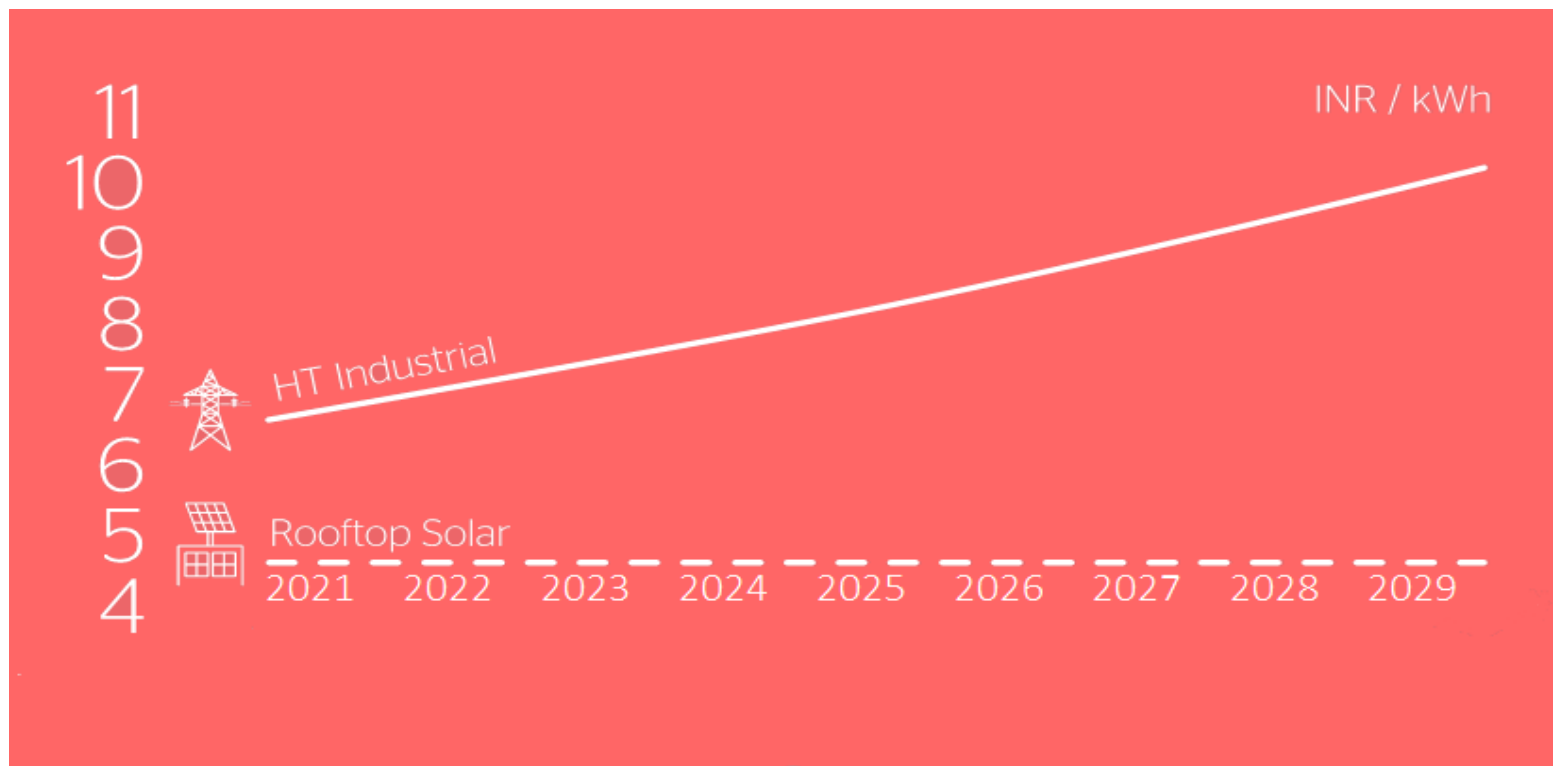
- Optimised solution criteria
  - Maximise avoided cost
  - Maximise savings
  - Minimise payback

- Important parameters
  - Self consumption
  - Export to grid
  - Import from grid

Avoided costs represent the 'costs' that are avoided with installation of rooftop solar

Optimization criteria

Benchmark costs & technology

- Benchmark cost (MNRE)
  - Taken from Order dated 27th Oct 2021

- Solar only system
  - Benchmark costs include inverter and other balance of system costs

- Solar + Battery system
  - Hybrid inverter required
  - Battery cost estimation

PV range (kW)	Costs(INR/kW)
< 1	46,923
> 1 & < 2	43,140
> 2 & <3	42,020
> 3 & < 10	40,991
> 10 & < 100	38,236
> 100 & < 500	35,886

Components	Costs (INR/kW)	
	Ad. Lead acid	Lithium Ion
Hybrid Inverter	18,000	18,000
Battery system	8,359	18,310

Why rooftop solar ?

– Legal
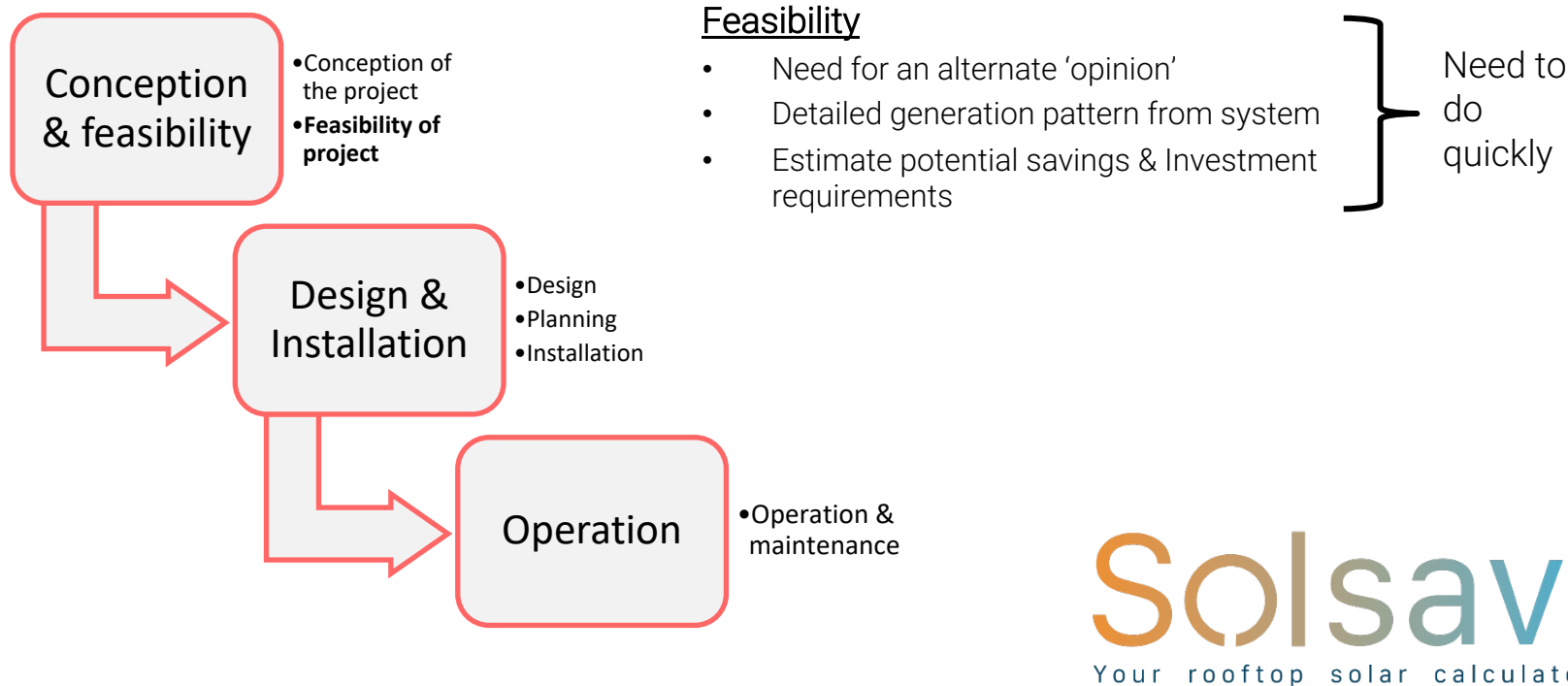 - Building code regulation
    – TNCDB rules, 2019 requires mandatory installation of solar energy system in High rise and non-High rise buildings exceeding 16 dwelling units and 300 sq.m of commercial building.

– Environmental
  - Lower emission due to generation from renewable source

– Financial
  - Savings (long-term)
  - Increase in property value
  - 'Sustainability' adds to selling value

Decision making process

Conception & feasibility

- Conception of the project
- **Feasibility of project**

Design & Installation

- Design
- Planning
- Installation

Operation

- Operation & maintenance

Feasibility

- Need for an alternate 'opinion'
- Detailed generation pattern from system
- Estimate potential savings & Investment requirements

Need to do quickly

Solsavi

Your rooftop solar calculator

How Solsavi can help?

Solsavi

Your rooftop solar calculator

Need for the tool

- Existing tools lack state specific tariff rate and policy details

- Only domestic tool to include battery storage

- Most of the online tools are developed by solar developers – conflict of interest

- Optimisation of system capability on economic feasibility

Features

- Updated tariffs

- Detailed consumption pattern

- Includes battery storage

- Option to optimize or customize

- Financial output: Potential savings, payback, ROI

- 25 year analysis for the system

Demo Scenarios

Scenario #1 (Industrial) - HT
An industrial warehouse with a sanctioned load of 120kW and a solar plus battery only system connected to grid under net feed-in mechanism

Scenario #2 (Commercial building) - LT
A commercial building with a sanctioned load of 55kW and a solar only system connected to grid under net feed-in mechanism

Demo Scenarios

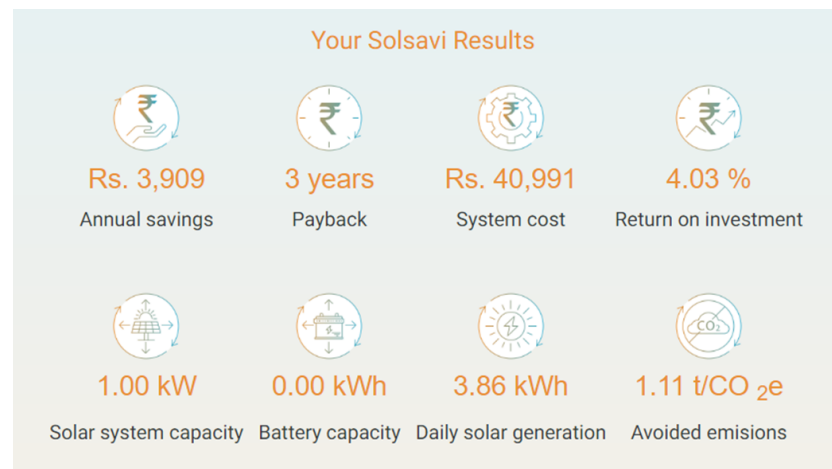| Description				
Pin code	600001			
Voltage type	HT			
Sanctioned load (kW)	120			
Average monthly consumption (kWh)	20,000			
Load consumption	6AM – 10AM	10AM – 6PM	6PM – 10PM	10PM – 6AM
	20	40	30	10
Battery Technology	Lithium Ion			
Run	Optimize			

Scenario #1 (Industrial)

- An industrial warehouse with a sanctioned load of 120kW and a solar plus battery system connected to grid under Net Feed-in mechanism

Result Analysis

- Financial
  - Annual savings
    - Savings for the 1st year of operation
  - Payback
    - How long to recover the investment
  - System cost
    - Total investment for the installation
  - Return on investment
    - Annualized for 25years – positive value is indicator of good investment

- Technical
  - Solar & Battery capacities
    - Selected or Optimized system sizes for the analysis
  - Solar generation
    - Hourly details of solar generation from the system
  - Avoided emissions
    - Emissions saved from installation of the system

Your Solsavi Results

Rs. 3,909	3 years	Rs. 40,991	4.03 %
Annual savings	Payback	System cost	Return on investment

1.00 kW	0.00 kWh	3.86 kWh	1.11 t/CO$_2$e
Solar system capacity	Battery capacity	Daily solar generation	Avoided emisions

Demo Scenarios

Go to https://www.solsavi.in/

Demo Scenarios

Description				
Pin code	600001			
Voltage type	LT			
Sanctioned load (kW)	55			
Average monthly consumption (kWh)	8,000			
Load consumption	6AM – 10AM	10AM – 6PM	6PM – 10PM	10PM – 6AM
	20	40	30	10
Run	Customise			

Scenario #2 (Commercial building)

- A commercial building with a sanctioned load of 55kW and a solar only system connected to grid under Net Feed-in mechanism

Q&A

- Learnings from the webinar

- Is the tool user friendly?

- Will you make use of the web tool?

- Further enhancements
  - Continual update of tariff and policy
  - Include database of other states

Supplementary material

- Solar Energy Policy – 2019

  - *https://teda.in/wp-content/uploads/2019/02/SOLARPOLICY2019.pdf*

- Generic Tariff Order for GISS

  - *http://www.tnerc.gov.in/Orders/files/TO-Order%20No%20251020211341.pdf*

Frano DSilva

T: 0 413 262 2571 | **M:** +91-9880501287
E: frano@aurovilleconsulting.com | www.aurovilleconsulting.com
Kalpana, Crown Road, | Auroville, Tamil Nadu, 605101

Radhika Sri Paravastu

T: 0413-2622571 | **M:** +91-6300148046
E: radhika@aurovilleconsulting.com | www.aurovilleconsulting.com/
Auroville Consulting, Kalpana Crown Road | Auroville, Tamil Nadu- 605 101 | India

Auroville Consulting

Kalpana Community, Crown Road, Auroville, TN - 605101, India.

www.aurovilleconsulting.com