

ASIA CLEAN ENERGY FORUM (ACEF 2023)

13TH JUNE 2023

Time of Use (ToU) Tariff Design using Regulatory Sandbox Approach for Utility-Led Demand Side Management

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CHAIRMAN - GLOBAL SMART ENERGY FEDERATION

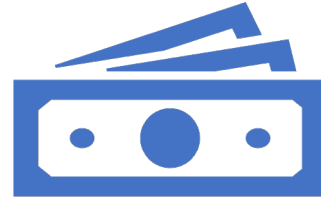




Analyzing the impact of ToU Tariff adoption by a utility to reduce their cost of power purchase as well as the carbon footprint



Real time price signals for participating customers with the help of a messaging application on their mobile phone



Shadow bills for the participating customers for the visibility of potential savings according to ToU price signals



Detailed feasibility analysis, potential impacts and policy recommendations for ToU Tariff in the state of Uttar Pradesh, India



Implementation framework and effective roadmap for the utility to understand the procedure and required infrastructure to implement ToU

Mitigation of peak demand

Avoidance of usage of Diesel Generator (DG) Sets

Avoidance of inverters and lead acid batteries at customer premises

Inclusion of renewable energy (RE) as a base load

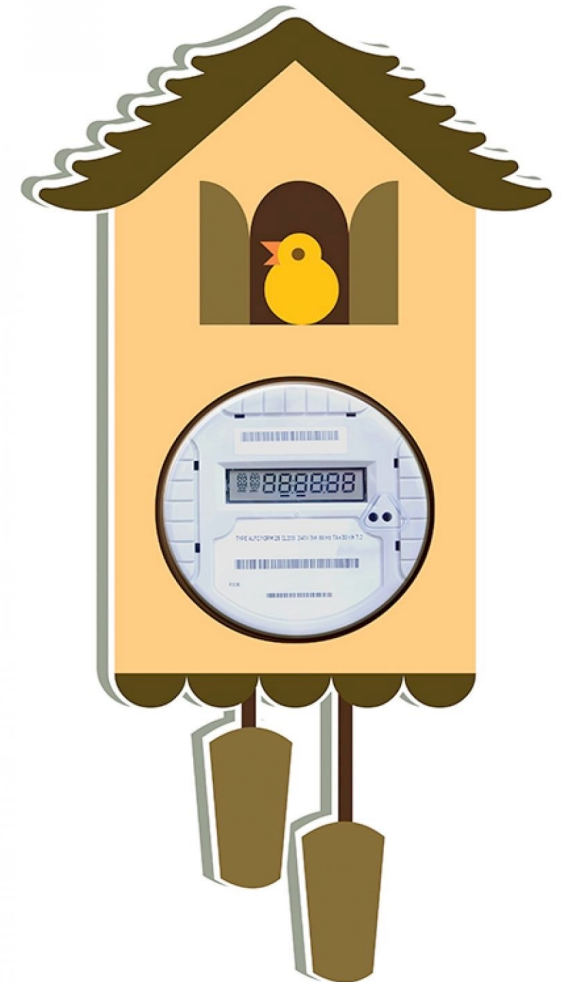
Control electric vehicle (EV) charging pattern

New market opportunities

Cost savings to customers

Reduction in power purchase cost for the Utility

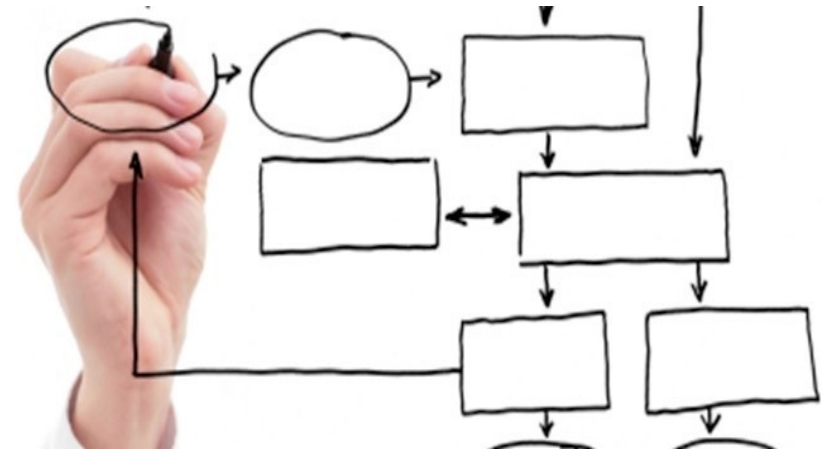
Deferral of transmission and distribution infrastructure upgrades





- **Lower Electricity Bills for ALL:** ToU tariff gives customers options to save by shifting energy use to the time slots during the day when tariff is lower
- **Freedom of Choice:** Voluntary participation in ToU pilot project with the option to opt-in or opt-out; scheme offers greater freedom to customers in choosing how they want to use and pay for electricity
- **Environmental Benefits:** Primary objective of the ToU tariff is to reduce peak load that could avoid running peaking power plants that are generally run on gas or oil which emits pollutants. ToU tariff will contribute to reduction in emissions

- Selection of the target ToU customers
- Enrolment of customers
- Customer engagement and education
- Design of ToU Tariff and price signals
- Communication of price signals on Whats App group
- Shadow bills to highlight the benefits
- Feedback from customers



Diverse group of 50 voluntary consumers enrolled

Cumulative load represented: 41MW

Commercial customers : 17

Residential customers: 30

Industrial customers: 3

Keen interest and willingness demonstrated by participants to engage in the initiative

SI No	Sanctioned Load (kW)	
Commercial Consumers		
1	Customer 1	1980
2	Customer 2	4279.5
3	Customer 3	1600
4	Customer 4	501
5	Customer 5	660
6	Customer 6	800
7	Customer 7	880
8	Customer 8	2200
9	Customer 9	830
10	Customer 10	350
11	Customer 11	1425
12	Customer 12	383
13	Customer 13	600
14	Customer 14	750
15	Customer 15	889.6
16	Customer 16	1332
17	Customer 17	440
Residential Consumers		
1	Customer 1	5
2	Customer 2	10
3	Customer 3	5
4	Customer 4	2
5	Customer 5	10
6	Customer 6	20
7	Customer 7	3
8	Customer 8	4
9	Customer 9	1
10	Customer 10	10

SI No	Customer	Sanctioned Load (kW)
11	Customer 11	2
12	Customer 12	2
13	Customer 13	2
14	Customer 14	2
15	Customer 15	5
16	Customer 16	13
17	Customer 17	14
18	Customer 18	10
19	Customer 19	8
20	Customer 20	15
21	Customer 21	10
22	Customer 22	8
23	Customer 23	12.5
24	Customer 24	18
25	Customer 25	15
26	Customer 26	15
27	Customer 27	10.4
28	Customer 28	18
29	Customer 29	7.95
30	Customer 30	3
Industrial Consumers		
1	Customer 1	1917
2	Customer 2	144
3	Customer 3	2000



Data Extraction: Extracting pricing data from IEX at every midnight



ToU Price Calculation: Calculating Time of Use prices based on the extracted data



Incentives and Surcharges: Finding incentives and surcharges based on the pricing criteria



Pricing Signal Chart: Preparing a pricing signal chart for 96 blocks



WhatsApp Group Communication: Sending the price signals chart on the WhatsApp group at midnight every day

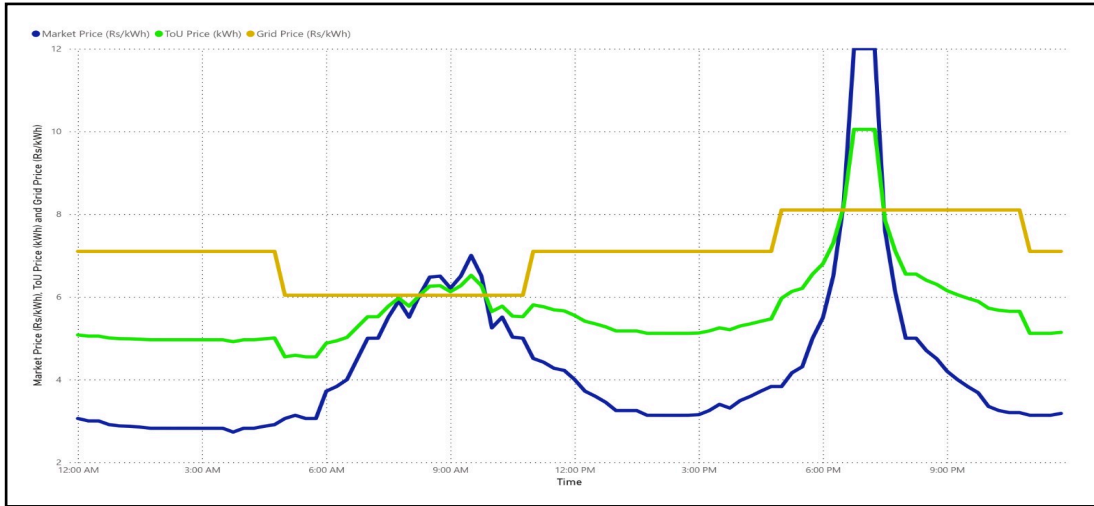


Adjustment Rate Calculation: Calculating adjustment rates separately for commercial, industrial, and residential categories



Shadow Bill Preparation: Prepare monthly shadow bills showing ToU tariff savings compared to the regular utility bills to all customers





- The market price for 96 slots (of 15 minutes) for the following day is fetched from Indian Energy Exchange (IEX)
- The market price is compared with the grid tariff - the regulated price at which the utility is selling power to consumers
- Market Price and Grid Tariff are averaged to figure out a Standard ToU price
- If the grid tariff during a 15 min slot is less than the standard ToU price customer is given rebate in terms of incentive in that slot
- If the grid tariff is more than the standard ToU price customer is imposed penalty in terms of surcharges in that slot
- A portion of the difference of the market price and grid tariff is given to customers in terms of incentives to encourage them to shift their load during low demand periods
- Consumer has to pay as per the market price during high demand periods, it discourage them to use electricity during peak hours
- Though incentives and surcharges are functions of market price; the incentives and surcharges are distributed in such a way to ensure consumers ends up paying less electricity bill at the end of the month

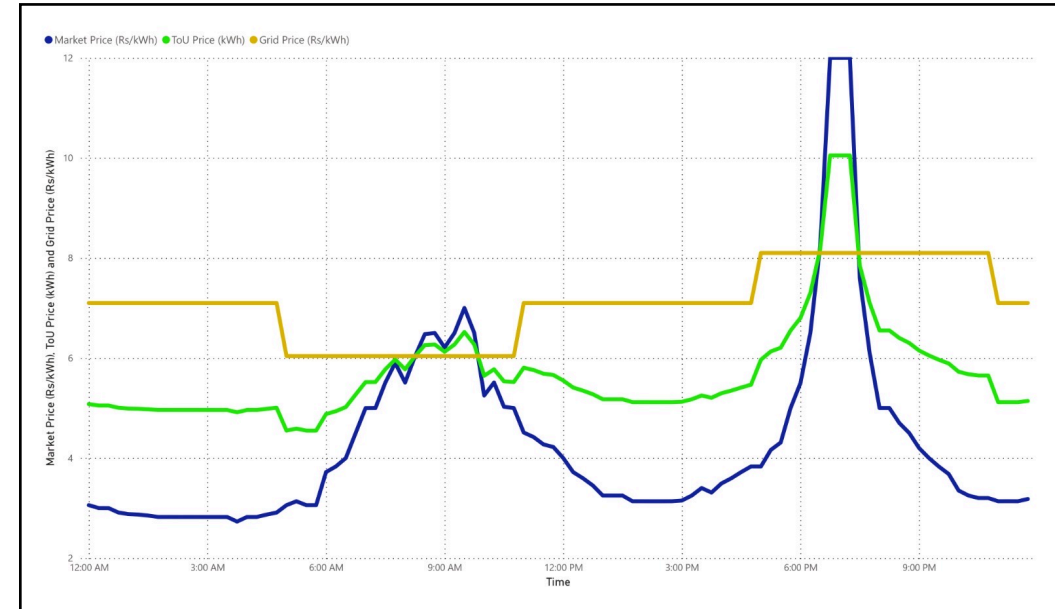
02 Dec 2022															
Slot No.	Time Slot	Incentive	Surcharge	Slot No.	Time Slot	Incentive	Surcharge	Slot No.	Time Slot	Incentive	Surcharge	Slot No.	Time Slot	Incentive	Surcharge
1	00:00 - 00:15	2		25	06:00 - 06:15			49	12:00 - 12:15	1		73	18:00 - 18:15		
2	00:15 - 00:30	2		26	06:15 - 06:30			50	12:15 - 12:30	1		74	18:15 - 18:30		
3	00:30 - 00:45	2		27	06:30 - 06:45			51	12:30 - 12:45	1		75	18:30 - 18:45		2
4	00:45 - 01:00	2		28	06:45 - 07:00			52	12:45 - 13:00	1		76	18:45 - 19:00		1
5	01:00 - 01:15	2		29	07:00 - 07:15			53	13:00 - 13:15	1		77	19:00 - 19:15		
6	01:15 - 01:30	2		30	07:15 - 07:30			54	13:15 - 13:30	1		78	19:15 - 19:30		
7	01:30 - 01:45	2		31	07:30 - 07:45			55	13:30 - 13:45	1		79	19:30 - 19:45		
8	01:45 - 02:00	2		32	07:45 - 08:00		1	56	13:45 - 14:00	1		80	19:45 - 20:00	1	
9	02:00 - 02:15	2		33	08:00 - 08:15		1	57	14:00 - 14:15	1		81	20:00 - 20:15	1	
10	02:15 - 02:30	2		34	08:15 - 08:30		1	58	14:15 - 14:30	1		82	20:15 - 20:30	1	
11	02:30 - 02:45	2		35	08:30 - 08:45			59	14:30 - 14:45	1		83	20:30 - 20:45	1	
12	02:45 - 03:00	2		36	08:45 - 09:00			60	14:45 - 15:00	1		84	20:45 - 21:00	1	
13	03:00 - 03:15	2		37	09:00 - 09:15			61	15:00 - 15:15	1		85	21:00 - 21:15	1	
14	03:15 - 03:30	2		38	09:15 - 09:30			62	15:15 - 15:30	1		86	21:15 - 21:30	1	
15	03:30 - 03:45	2		39	09:30 - 09:45			63	15:30 - 15:45	1		87	21:30 - 21:45	2	
16	03:45 - 04:00	2		40	09:45 - 10:00			64	15:45 - 16:00			88	21:45 - 22:00	2	
17	04:00 - 04:15	2		41	10:00 - 10:15			65	16:00 - 16:15			89	22:00 - 22:15	2	
18	04:15 - 04:30	2		42	10:15 - 10:30			66	16:15 - 16:30	1		90	22:15 - 22:30	2	
19	04:30 - 04:45	2		43	10:30 - 10:45			67	16:30 - 16:45	1		91	22:30 - 22:45	2	
20	04:45 - 05:00	2		44	10:45 - 11:00			68	16:45 - 17:00	1		92	22:45 - 23:00	2	
21	05:00 - 05:15	1		45	11:00 - 11:15			69	17:00 - 17:15			93	23:00 - 23:15	1	
22	05:15 - 05:30	1		46	11:15 - 11:30			70	17:15 - 17:30			94	23:15 - 23:30	1	
23	05:30 - 05:45	1		47	11:30 - 11:45	1		71	17:30 - 17:45	1		95	23:30 - 23:45	1	
24	05:45 - 06:00	1		48	11:45 - 12:00			72	17:45 - 18:00			96	23:45 - 24:00	1	

Incentive in ₹
Surcharge in ₹


02 Dec 2022															
Slot No.	Time Slot	Incentive	Surcharge	Slot No.	Time Slot	Incentive	Surcharge	Slot No.	Time Slot	Incentive	Surcharge	Slot No.	Time Slot	Incentive	Surcharge
1	00:00 - 00:15	2		25	06:00 - 06:15			49	12:00 - 12:15	1		73	18:00 - 18:15		
2	00:15 - 00:30	2		26	06:15 - 06:30			50	12:15 - 12:30	1		74	18:15 - 18:30		
3	00:30 - 00:45	2		27	06:30 - 06:45			51	12:30 - 12:45	1		75	18:30 - 18:45		2
4	00:45 - 01:00	2		28	06:45 - 07:00			52	12:45 - 13:00	1		76	18:45 - 19:00		1
5	01:00 - 01:15	2		29	07:00 - 07:15			53	13:00 - 13:15	1		77	19:00 - 19:15		
6	01:15 - 01:30	2		30	07:15 - 07:30			54	13:15 - 13:30	1		78	19:15 - 19:30		
7	01:30 - 01:45	2		31	07:30 - 07:45			55	13:30 - 13:45	1		79	19:30 - 19:45		
8	01:45 - 02:00	2		32	07:45 - 08:00		1	56	13:45 - 14:00	1		80	19:45 - 20:00	1	
9	02:00 - 02:15	2		33	08:00 - 08:15		1	57	14:00 - 14:15	1		81	20:00 - 20:15	1	
10	02:15 - 02:30	2		34	08:15 - 08:30		1	58	14:15 - 14:30	1		82	20:15 - 20:30	1	
11	02:30 - 02:45	2		35	08:30 - 08:45			59	14:30 - 14:45	1		83	20:30 - 20:45	1	
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15	03:30 - 03:45	2		39	09:30 - 09:45			63	15:30 - 15:45			87	21:30 - 21:45	2	
16	03:45 - 04:00	2		40	09:45 - 10:00			64	15:45 - 16:00			88	21:45 - 22:00	2	
17	04:00 - 04:15	2		41	10:00 - 10:15			65	16:00 - 16:15			89	22:00 - 22:15	2	
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24	05:45 - 06:00	1		48	11:45 - 12:00			72	17:45 - 18:00			96	23:45 - 24:00	1	

	Incentive in ₹
	Surcharge in ₹


ToU Price Signal Chart



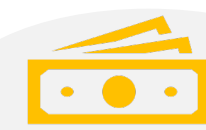
ToU Chart Showing Grid Price, Market Price and ToU Rate



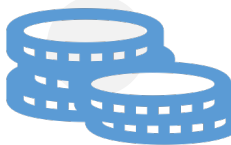
Understanding of customer responses and participation to real-time price signals and its impact on the grid




Understand the concerns of customers with ToU implementation and the challenges




Test the revenue impact of the Utility and the savings in power purchase cost




Calculation of the CO₂ reduction potential of ToU tariff



Consultations with different stakeholders on adoption of ToU Tariff



Presentation of the results to Uttar Pradesh Electricity Regulatory Commission (UPERC) and Energy Department, UP



ToU implementation Roadmap for Uttar Pradesh

MADHYANCHAL VIDYUT VITRAN NIGAM LIMITED
 मध्यंचल विद्युत वितरण निगम लि०

For Assistance Dial 1912
 For Bill SMS BILL <Account No> **5616195**
 WhatsApp No: **8010924203**
 Pay your bill on < www.upenergy.in >

Electricity Bill

Account No. 8641052534		Division EUDD_CHINHAT(DIV362626)	
Name M/S B.B.D. EDUCATIONAL SOCIETY		Subdivision SDO3626261	
Father/Husband name NA		Sanctioned Load 2000 KVA	
Address FAIZABAD ROAD CHINHAT, Lucknow, UP-226010, IND		Meter S.No 559421	
Mobile No xxxxxx9722		Tariff HV1	
Email bxxxxxxxx@gmail.com		Supply Type H12	
Connection Date 27-NOV-2014		Security Deposit 2400000.1	

Bill No 864102142408	Bill Basis OK	Due Date 15-OCT-2022
Bill Date 01-OCT-2022	Billed Demand 1500.00	Due Date Rebate 0
Bill Month OCT-2022	Progressive Subsidy Amount	Payable By Due Date 5139409
Net Billed Unit 325650	Inoperative Amount 0	Discon. Date 22-OCT-2022

This bill will be construed as final notice under section 171 of Supply Code 2005. Supply can be disconnected at any date on non-payment of old dues.

Details	Amount		Details	Amount
	Gross Amt	Subsidy		
Energy Charges	2644278.00	0.00	Interest on Security	0.00
Fixed/Demand Charges	600000.00	0.00	Due Security	0
Min Charge	0.00	0.00	TDS Amount	0
Electricity Duty		243320.85	TCS Amount	35112.34
Excess Demand Penalty	0.00		CGST	0
Low P.F. Surcharge	0.00		SGST	0
Provisional Adjustment	0.00		Current LPSC	23635.47
Tariff Adjustments	0.00		Net Current Bill	3546346.66
Credit	0.00		Prev. Due Date Rebate Adj.	0
Debit	0		Arrear Amount	1560504.18
Misc Charges	0		Prev. Arrear LPSC	32558.53
Rebate	0			
Compensation Amt			Payable Amount	5139409
Installation	0.00		In Words : Fifty One Lakh Thirty Nine Thousand Four Hundred Nine Rupees Only	
Dishonor Cheque	0			
Dishonor Charge	0			

Pay your bill online on < www.upenergy.in >
Pay DD/Cheque in favour of : EXECUTIVE ENGINEER-EUDD_CHINHAT

Meter Badge Number	Meter Status	Recorded DMD	Previous Date	Previous Read	Current Date	Current Read	Diff	MF	Meter Unit	Period Months	Meter Rmrk
559421PS0186	A		01-SEP-22	403062.7	01-OCT-22	409447.2	6384.5	50	319225 KWH	1	OK
559421PS0186	A		01-SEP-22	415027.4	01-OCT-22	421540.4	6513	50	325650 KVAH	1	OK
559421PS0186	A	25.06						50	1253 KVA	1	OK

Assessed Unit	Opening Surplus Solar Units 0.00	Closing Surplus Solar Units 0.00	Meter Units 325650
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Energy Saved is Energy Produced
To get electricity related various services on whatsapp give a missed call on 8010924203

EC Calculation				Current Payment Details	
Unit	Rates	Amount	Subsidy Rate	Subsidy Amount	Net Energy Charge

Last Paid Amount **307856.00**
 Last Paid Date **15-SEP-2022**

Paid Amount **3578905**
 Paid Date **15-OCT-22**
 Payment Mode **CHEQUE**
 Receipt No **864105234847**

Printed By : NMISHRA1 As On Date: 16-Nov-22 10:06 AM EXECUTIVE ENGINEER - EUDD_CHINHAT

SHADOW BILL WITH TIME OF USE (ToU) TARIFF

Electricity Bill

Account No. 8641052534		Division EUDD_CHINHAT(DIV362626)	
Name M/S B.B.D. EDUCATIONAL SOCIETY		Subdivision SDO3626261	
Father/Husband name NA		Sanctioned Load 2000 KVA	
Address FAIZABAD ROAD CHINHAT, Lucknow, UP-226010, IND		Meter S.No 559421	
Mobile No xxxxxx9722		Tariff HV1	
Email bxxxxxxxx@gmail.com		Supply Type H12	
Connection Date 27-Nov-14		Security Deposit 2400000.1	

Bill No 864102142408	Bill Basis OK	Due Date 15-Oct-22
Bill Date 01-Oct-22	Billed Demand 1500	Due Date Rebate
Bill Month Oct-22	Progressive Subsidy Amount	Payable By Due Date 5139409
Net Billed Unit 325650	Inoperative Amount	Discon. Date 22-Oct-22

This bill will be construed as final notice under section 171 of Supply Code 2005. Supply can be disconnected at any date on non-payment of old dues.

Details	Amount		Details	Amount
	Gross Amt	Subsidy		
Energy Charges	2644278.00	0	Interest on Security	0.00
Fixed/Demand Charges	600000	0	Due Security	
Min Charge	0	0	TDS Amount	
Electricity Duty		243320.85	TCS Amount	
Excess Demand Penalty	0		CGST	0.00
Low P.F. Surcharge	0		SGST	0.00
Provisional Adjustment	0		Current LPSC	23635.47
Tariff Adjustments	0		Net Current Bill	3546346.66
Credit	0		Prev. Due Date Rebate Adj.	0.00
Debit	0		Arrear Amount	
Misc Charges	0		Prev. Arrear LPSC	32558.53
Rebate	0			
Compensation Amt			Payable Amount	5139409.00
Installation	0		Total ToU Saving*	94438.50
Dishonor Cheque	0		Net Bill Amount after ToU Saving	5044970.50
Dishonor Charge	0			

Pay your bill online on < www.upenergy.in >
Pay DD/Cheque in favour of : EXECUTIVE ENGINEER-EUDD_GOMTINAGAR

Meter Badge Number	Meter Status	Recorded DMD	Previous Date	Previous Read	Current Date	Current Read	Diff	MF	Meter Unit	Period Months	Meter Rmrk
559421PS0186	A		01-09-2022	403062.7	01-10-2022	409447.2	6384.5	50	319225 KWH	1	OK

Units considered for ToU Adjustment	Adjustment Rates	Amount Saved Under ToU Tariff
325650	0.29	94438.50

* ToU savings is the rebate for electricity consumption during the periods when rebates on existing tariffs was offered through Pricing Signals by ISGF everyday morning
As on date

Utility Bill

Shadow Bill

Sr No	Customer Category	Connected Load (kW)	Cumulative Utility Bill from Sept 2022 to Feb 2023 – 6 months (INR)	Shadow Bills as per ToU Rates for the 6 months period from Sept 2022 to Feb 2023 (INR)	% Savings
1	Commercial -1	1120	11950035	10891696.2	8.856365693
2	Commercial -2	1980	16526477	15333893.7	7.216197983
3	Commercial -3	383	1070606	980965.9	8.37283744
4	Commercial -4	501	3005854	2675861.5	10.97832762
5	Commercial -5	750	5867903	5333706.6	9.103701953
6	Commercial -6	1112	7527224	7055364.3	6.268708092
7	Commercial -7	550	3162585	2856651.6	9.673523399
8	Commercial -8	2000	15456863	14055217.9	9.068108451
9	Commercial -9	4279.5	47124748	43780598.9	7.09637556
10	Commercial -10	700	13261650.8	11791930.4	11.08248454
11	Commercial -11	2200	9661697	9178058.72	5.005728083
12	Commercial -12	600	9921729	9454760.17	4.706526756
13	Commercial -13	1425	11436062	10392410.6	9.125968362
14	Commercial -14	350	1792342	1593196	11.11093753
15	Commercial -15	1665	2505663	2328416.72	7.073827566
16	Commercial -16	990	2177020	2036136.18	6.471406785
17	Commercial -17	800	7259180	5952680.81	17.99788943
18	Industrial -1	2000	2368938	2068832	12.66837714
19	Industrial -2	2000	177481	155616	12.31962858
20	Residential -1	18	136664	131470.84	3.799947316
21	Residential -2	13	310152	301154.4	2.901029173
22	Residential -3	10	426593	425543.99	0.245904176
23	Residential -4	5	14362	13921.5	3.067121571
24	Residential -5	2	11404	10744.5	5.783058576
25	Residential -6	2	9444	8963.83	5.084392207
26	Residential -7	15	284646	274816.08	3.453384204
27	Residential -8	15	36103	31991.23	11.38899814
28	Residential -9	20	117243	110714.17	5.568630963
29	Residential -10	10	47017	45070.51	4.139970649
30	Residential -11	2	18745	18199.95	2.907708722
31	Residential -12	2	10721	10269.01	4.21593135
32	Residential -13	5	21399	20208.42	5.563717931
33	Residential -14	2	57042	53493.65	6.220591845
34	Residential -15	1	8644	8455.31	2.182901435
35	Residential -16	4	17087	16178.37	5.317668403
36	Residential -17	2	86382	81106.14	6.107591859
37	Residential -18	3	47739	46582.66	2.422212447
38	Residential -19	10	42352	40803.48	3.656309029
39	Residential -20	2	6175	5841.88	5.39465587
40	Residential -21	17	87445	83345.24	4.688386986
41	Residential -22	16	298656	295959.33	0.902935149
42	Residential -23	5	13366	12657.18	5.303157265
43	Residential -24	10.67	52847	50793.18	3.886351165
44	Residential -25	10	14439	13702.51	5.100699494
45	Residential -26	3	6860	6481.53	5.517055394
46	Residential -27	5	13051	12968.25	0.634051031
47	Residential -28	15	175596	169167.46	3.660983166

Sept 2022 to Feb 2023 (6 months)

- Total Savings: INR 1,44,09,633
- Commercial Category Savings: 9.16%
- Industrial Category Savings: 3.35%
- Residential Category Savings: 4.32%
- Top Saving Category: Commercial
- Highest Individual Savings: 18% (Commercial-17)

THANK YOU

For discussions/suggestions/queries email:

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