Madhav Institute of Technology And Science, Gwalior

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Report Analysis On

Prepaid Energy Meter

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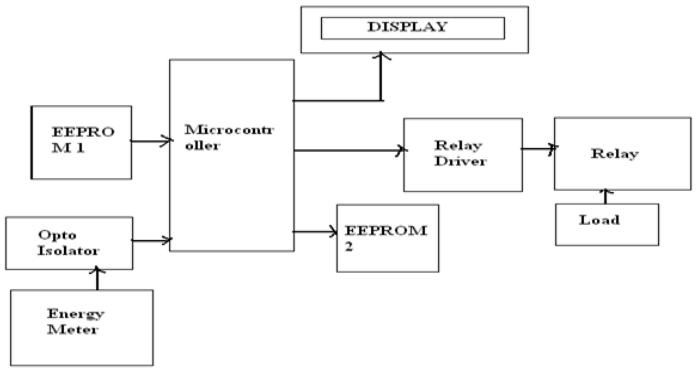
INTRODUCTION

The electromechanical meter consists of an aluminum disc positioned between two electromagnets, one of whose coil is connected to the load and is the current coil and the coil of another electromagnet is connected to the supply voltage. The interaction of the fluxes between the two coils is responsible for providing a torque to the disc, which starts rotating, with the revolutions proportional to the load current. The counter records the number of revolutions and displays them, which indicates the energy consumed.

What is Prepaid Energy Meter

The simplest type of prepaid energy meter consists of 2 EEPROMs interfaced to a microcontroller. One EEPROM contains the recharged balance amount. The microcontroller reads this balance and stores it in the other EEPROM along with the tariff. The energy meter supplies pulses to the microcontroller for every unit of energy consumed. The microcontroller increases the spent energy unit by one and decreases the balance amount in the EEPROM by the fixed tariff. As soon as the balance amount in the EEPROM comes down to zero, the microcontroller sends a signal to the relay driver which in turn switches off the relay, such that the main supply to the load is switched off. An LCD is also interfaced to the microcontroller which displays the amount of energy consumed.



Need for Prepaid Energy Meter

The conventional method of electricity billing involves a person from the distribution unit reading the number of units of electricity consumed in the energy meter, conveying this information to the distribution unit, and then preparing the bill according to the units consumed for a fixed amount of time. This can prove quite tedious as it involves various tasks like reading, then preparing the bill. Still, accuracy cannot be guaranteed as there can be errors in human reading. Even though digital meters are replacing conventional electromechanical meters and provide many accurate readings, still the problem of deliberately making a false reading can exist (political reasons). Despite this, the task of billing for every consumer is a time-consuming job for the distribution grid. Also, the consumer can deliberately consume more amount of power than required and still refrain from paying the bill and nothing can be done to severe the electric power supply.

Pros of Prepaid Energy Meter

- It is highly accurate as of the whole idea of reading the units and then billing manually or any other means is eliminated.

- The consumer cannot escape from paying the electricity bill and the State Electricity Board gets free from debts.

- On the consumer front, the tedious task of paying the bill and waiting anxiously for the bill is eliminated.

- Wastage of energy is diminished as now only the required energy will be consumed as allotted.

- The power grid can monitor the overall energy consumption and any tampering attempts are actually of no use and can be detected if still prevalent.

Cons of Prepaid Energy Meter

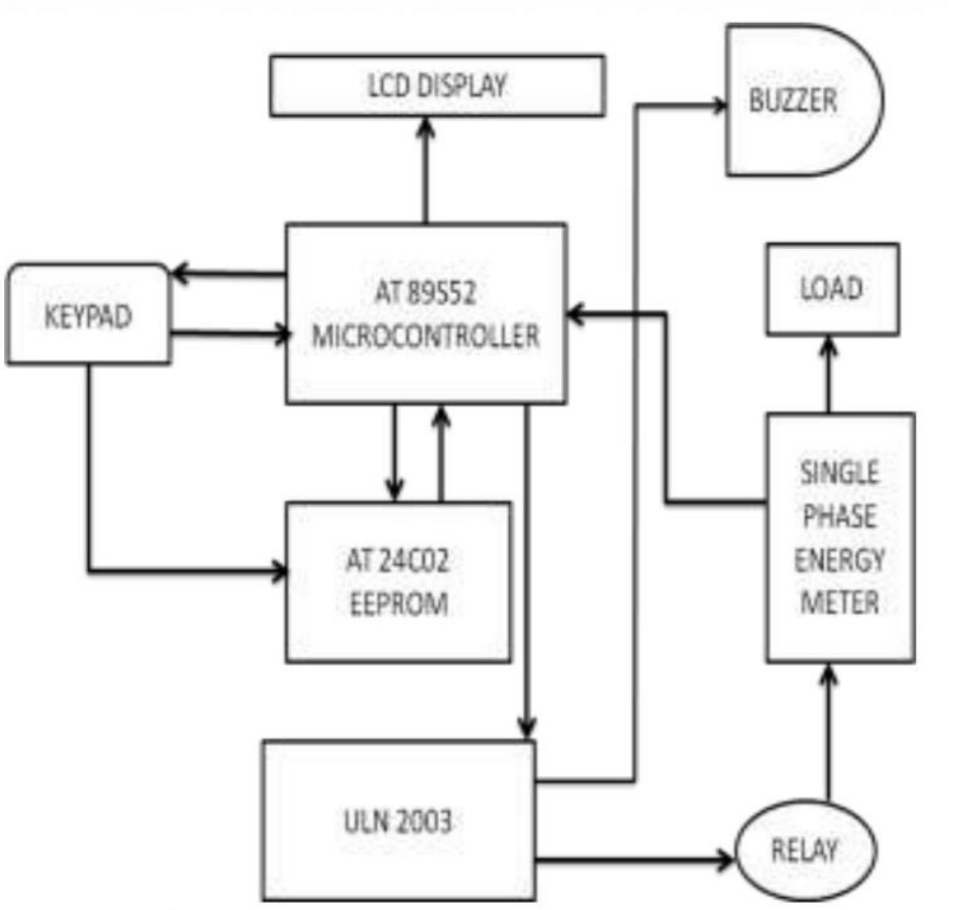
- Prepaid electricity plans are usually more expensive than any other type of fixed or variable plan. As such, you may not be able to access the most inexpensive rates.

- You must maintain your account balance at or above the disconnection balance, otherwise your service may get disconnected.

- When your prepaid electricity account runs out of credit, your service gets turned off.

- Service gets disconnected with very little notice after your account runs out of balance. Prepaid electricity service may be disconnected in as little as one day after you receive a low balance notification.

Circuit Diagram Of Prepaid Energy Meter



Types of Prepaid Energy Meter

ISP ED - Integrated Single Phase STS SABS Prepaid Electric Meter

ITP - Integrated Three Phase STS SABS Prepaid Electric Meter

SSP - Split Single Phase STS SABS Prepaid Electric Meter

SSP PLC - Split Single Phase STS SABS Prepaid Electric Meter

SSP Power Rail - Split Single Phase Din Rail STS SABS Prepaid Electric Meter

SSP PLC Power Rail - Split Single Phase Din Rail PLC STS SABS Prepaid Electric Meter

ISP ED – Integrated Single Phase STS SABS Prepaid Electric Meter

The Integrated Single Phase (ISP ED) meter is a compact, two wire, keypad-based prepayment electricity meter in a housing compatible with the ESKOM standard common base electricity dispenser socket. This meter is most suited to new reticulation and is directly and easily interchangeable with common base prepayment meters from other approved manufacturers using the common base configuration. User interaction with the meter and access to meter information (such as a low credit warning, energy consumption, and load contactor status) are available using the keypad and LCD display.

ITP – Integrated Three Phase STS SABS Prepaid Energy Meter

The Integrated Three Phase (ISP) meter is a four-wire 100 Amp per phase, keypad-based prepayment meter in a compact BS housing. The meter is suitable for residential, commercial and light industrial environments. The meter also features a dedicated diagnostic indicator which shows the status of communication to the optional remote customer interface unit (CIU). This valuable visual aid assists the field technician to validate the installation and determine probable fault types. The meter boasts a large custom display and also features a host of standard Meter Mate software features including the ability to operate as a prepayment meter or in credit metering mode.

SSP Split Single Phase STS SABS Prepaid Energy Meter

The Split Single Phase (SSP) meter is a compact, two wire, keypad-based prepayment electricity meter which comprises two parts, the Energy Management Unit (EMU) and the Customer Interface Unit (CIU). User interaction with the meter and access to meter information (such as a low credit warning, energy consumption, and load contactor status) are available using the keypad and LCD display on the CIU

Energy Management Unit (EMU)

Customer Interface Unit (CIU)

SSP PLC - Split Single Phase STS SABS Prepaid Energy Meter

The new generation Cash power Gemini PLC meter is a compact, single-phase, keypad based, 80 Amp split prepayment meter in a BS 5685 standard housing. Communication between the meter and the customer interface unit is by means of Power Line Carrier technology. (PLC)

Gemini PLC Prepayment Meter (above)

PLC Customer Interface Unit (above)

SSP Power Rail - Split Single Phase STS SABS Prepaid Energy Meter

The Split Single Phase (SSP) Power Rail meter is a compact, two wire, keypad-based prepayment electricity din rail mounted meter which comprises two parts, the Energy Management Unit (EMU) and the Customer Interface Unit (CIU). User interaction with the meter and access to meter information (such as a low credit warning, energy consumption, and load contactor status) are available using the keypad and LCD display on the CIU.

Customer Interface Unit (CIU)

Power-Rail Energy Management Unit (EMU)

SSP PLC - Power Rail - Split Single Phase STS SABS Prepaid Energy Meter

The Power-Rail PLC is a single-phase 80Amp keypad based, split prepayment meter in a DIN rail-mount housing, using PLC communications between the meter and the customer interface unit. The meter uses the standard PLC customer interface unit which is common to the Single Phase SSP PLC and Three Phase PLC products. The meter is typically installed in a pole-top enclosure or secure street kiosk and the small size of the product means a smaller street kiosk can be used. As with the SSP PLC and Three Phase PLC, the meter can be accessed remotely using the PLC Remote Access Terminal

PLC Customer Interface Unit (above)

Power-Rail Energy Management Unit (EMU)

Prepaid Meter at a Glance

In all the utilities where the pre-paid metering study was undertaken, the features of the meters were found to be largely similar. Based on the age of the meters, there were certain variations too in the features; however such variations were limited and have been explained in detail in subsequent sections.

A pre-paid single phase as well as three phase meter records all the parameters like MDI, instantaneous load, consumption in kWh and kVAh, power factor, current etc. Owing to the feature of auto disconnection upon exhaustion of recharge amount, the pre-paid meter is also provided with switches which are signalled by a PLC (Programmable Logic Controller), which switches the supply to 'ON' or 'OFF' based on the input signals received by it from recharge of the meter.

Features Of Prepaid Energy Meter

Recharge

Recharge in all of the pre-paid meters surveyed during the study is done through a recharge coupon which is issued by the utility by accessing software that is maintained and provided by the meter supplier. The recharge coupon is generated using the consumer account number and the intended amount of recharge. The recharge coupon is a numeric code designed to have details like the amount of recharge, applicable tariff schedule, sanctioned load and category of consumer.

Features Of Prepaid Energy Meter

Connect/Disconnect

the modern pre-paid meters are provided with the facility of connecting and disconnecting the supply based on the credit amount available in the meter. The meters are provided with switches for connecting and disconnecting the supply. These switches are the biggest contributor to the cost of the pre-paid meters1 and are the main reason for pre-paid meters coming at significantly higher costs compared to normal post-paid type energy meters.

Features Of Prepaid Energy Meter

Tariff Revision

Tariff revision in case of all the meters can be effected through the same recharge voucher which the consumers purchase from the outlets of the utility. Whenever there is a tariff revision in any month, the meter supplier or the professionals of the utility update the same in the token generating software of the meters. So the next token that a consumer purchases has an in-built coding which when punched into the meter would automatically update the meter with the latest tariff schedule. Thereon, the deductions in amount in the meter shall be made based on the revised tariff.

Features Of Prepaid Energy Meter

Cost

The main contributors to the cost of prepaid meters are the switches provided in the meter for connecting and disconnecting the supply. The pre-paid meter is provided with far greater tamper features as compared to the normal post-paid type meters (like magnetic influence withstanding ability etc.) further increasing the cost of the meters. However, in case prepaid meters are implemented on a large scale, the cost would get distributed over a large consumer base and would register significant reduction.

Features Of Prepaid Energy Meter

Inhouse Display Unit

In addition to the display screen at the metering unit, the pre-payment type meters are also provided with an additional display unit and punch pad/ Key Pad which can be installed inside the consumer premises so as to enable the consumers to access their meter information at any hour. Through the display unit and punch pad, the consumers can also recharge the meter, check their balance, consumption, instantaneous and maximum recorded load etc.

Analysis Of Prepaid Energy Meter

Tariff Structure Of Various States

Andhra Pradesh

Bihar

Gujarat

Delhi

Assam

Madhya Pradesh

Karnataka

Himachal Pradesh

Goa

Chattisgarh

Andhra Pradesh

Single-phase connection up to 5 kW load and three-phase above it.
A consumer having more than 500 units can opt for smart meter having a rebate of Re.1/- during 10 AM to 12 Noon.
The tariff is in three groups namely Group A (up to 75 units), B (between 225 units) and C (above 225units).

CATEGORY-I (A): DOMESTIC – LT (TELESCOPIC)	Energy Charges ₹/kWh
Group A: Consumption ≤75 Units during the billingmonth	
0-50	1.45
51-75	2.60
Group B: Consumption (>75 and ≤225 units) during the billing month	
0-50	2.60
51-100	2.60
101-200	3.60
201-225	6.90
Group C: Consumption >225 units during the billing month	
0-50	2.65
51-100	3.35
101-200	5.40
201-300	7.10
301-400	7.95
401-500	8.50
Above 500 units	9.95

Bihar

Single-phase up to 7 kW and three-phase above 5 kW, an option to consumer to choose between 5 to 7 kW
Billing demand shall be the max. demand recorded during the month or 75% of the contract demand whichever is higher. If in any month the recorded maximum demand exceeds 110% of contract demand, the excess demand shall be billed at twice the normal charges.

DS-I (Rural)	Metered: Rs.20 /kW or part/month	0-50	2.55
		51-100	2.80
		101-200	3.05
		>200	3.40
DS-II Demand-based	Rs.40 /kW or part/month up to 70 kW	0-100	4.22
		101-200	5.02
		201-300	5.87
		>300	6.67

Gujarat

The charges specified are on a monthly basis. Distribution Licensee may decide the period of billing and adjust the tariff rate accordingly.
Except in cases where the supply is used for purposes for which a lower tariff is provided in the tariff schedule, the power supplied to any consumer shall be utilized only for the purpose for which supply is taken and as provided for in the tariff.

RGP: 1-phase 6 kW 3-phase above 6kW			
Load	Fixed Charge	Units Slab	Energy Charge
2kW	15/month	0-50	Rs. 3.05
2-4 kW	25/month	51-100	Rs. 3.5
4-6 kW	45/month	101-250	Rs. 4.15
>6 kW	70/month	>250	Rs. 5.2

Delhi

Delhi State has announced a subsidy of Nil energy charge up to 200 units and a half from 200-400 units.
Power Purchase Cost Adjustment (PPAC) is levied to adjust the power purchase cost from NTPC, Delhi Genco, Delhi Transco etc. It is levied on fixed and energy charges.

Fixed Charge (in kW/month)				
≤2 kW	2-5 kW	5-15 kW	15-25 kW	> 25 kW
Rs. 20	Rs. 50	Rs. 100	Rs. 200	Rs. 250
Energy Charges (Rs./unit)				
0-200	201-400	401-800	801-1200	>1200
Rs. 3	Rs. 4.5	Rs. 6.5	Rs. 7	Rs. 8

Assam

If any unit consumed for commercial, then the category will change to commercial.
The Tariff does not include any tax or duty, etc., on electrical energy that may be payable at any time in accordance with any law/State Government Rule in force. Such charges, if any, shall be payable by the consumers in addition to the tariff.

Consumption	Energy Charge	Fixed Charge
For consumption up to 30 kWh per month.	Rs. 4.25/kWh	Rs. 20 per connection per month

Consumption	Energy Charge	Fixed Charge
First 120 kWh per month	Rs. 5.10/kWh	Rs. 50/kW/ month
From 121 – 240 kWh per Month	Rs. 6.35/kWh	
Balance kWh	Rs. 7.35/kWh	

	Energy Charge	Fixed Charge
For all consumption.	Rs 6.95/kWh	Rs. 50/kW/month

Madhya Pradesh

Fixed Charges calculated based on the unit consumed during the month i.e. 0.1 kW for every 15 units or part consumed. For consumption of 125 units, the assessed load will be 0.9 kW and fixed charges for the urban area will be Rs. 9×23=207.
A minimum charge of Rs. 70 per connection as minimum charge towards energy charge is applicable for the below category.

Slab	Unit (in Rs.)	Monthly fixed charge	
		Urban	Rural
01- 50	Rs. 4.05	Rs. 60/con	Rs. 45/con
51-150	Rs. 4.95	Rs. 100/con	Rs. 80/con
151-300	Rs. 6.3	Rs. 23/0.1kW	Rs. 20/0.1kW
300-above	Rs. 6.5	Rs. 25/0.1kW	Rs. 23/0.1kW

Karnataka

There are five distribution company namely BESCOM, GESCOM, MESCOM, HESCOM and CESC and the tariff order for all the companies is same.
The tariff for BJ/KJ consumer is completely subsidized by the GOK. In case, the subsidy is not released by the GOK, then the applicable tariff is Rs. 7.02/unit subject to a monthly minimum charge of Rs. 45 per month. If the consumption exceeds 40 units per month or any BJK installation is found to have more than one out let.

Domestic Urban LT2 a (i)		
Fixed Charges	**Slab**	**Unit Charges**
First kW: Rs.60 Lifeline	0-30	Rs. 3.75
Addl. Rs. 70/kw	31-100	Rs. 5.2
	101-200	Rs. 6.75
	Above 200	Rs. 7.8

Himachal Pradesh

Lifeline consumers max. limit of 60 units applicable and if the consumption exceeds than normal tariff applicable.
The subsidy given by GoHP for the second slab i.e. 126-300 kWh shall apply to prepaid meter consumers .
Prepaid meter consumer shall be charged energy charges only with no fixed charges, meter rent and service charges.

Particulars	Units/month	Approved Tariff for FY21 (Rs/kWh)	Govt. of HP Subsidy for FY21 (Rs./kWh)	Effective Tariff after subsidy (Rs/kWh)
Lifeline consumers	0-60	3.30	2.30	1.00
Other consumers	0-125	3.95	2.40	1.55
	126-300	4.85	1.90	2.95
	Above 300	5.45	1.05	4.40
	Prepaid consumers	4.85	1.90	2.95

Goa

Low Income Group (LIG) apply to a consumer having sanctioned load of 0.1 kW (2 points with 2×40 watts) and consumes up to 30 units per month.

Domestic LT-D	Fixed Charges	Energy Charge
0-100 units	Single Phase: Rs.25/con/month Three Phase: Rs.65/con/month	1.50
101-200 units		2.25
201-300 units		2.85
301-400 units		3.65
Above 400 units		4.25
Domestic LT-LIG	Rs. 50/con/month	

Chattisgarh

Fixed Charges and Energy Charges are telescopic. For example, if consumption in any month is 150 units, then for the first 100 units, rate of slab 0-100 shall be applicable and for the remaining 50 units, rate of slab 101-200 shall be applicable.
The domestic consumer is eligible for State Govt. Subsidy.

Category of Consumers	Units Slab	Fixed Charge (Rupees per kWh)	Energy Charge (Rs. per kWh)	Minimum Fixed Charge
LV-1: Domestic				
Domestic including BPL Consumers	0 -100 units	2.40	1.00	Single Phase Rs. 40/- per month
	101-200 units	2.50	1.10	
	201 - 400 units	3.20	1.70	Three Phase Rs. 120/- per month
	401 – 600 units	3.50	2.00	
	601 and above units	4.85	2.45	

Cost Benefits

Prepayment meters have a higher cost than standard credit meters, with the difference between the cost of a prepayment meter and a standard credit meter in the range of Rs. 3300 per meter, considering an average cost of Rs. 1200 for a standard meter and Rs. 4500 for a prepayment meter.

Prepayment meters have the potential to allow discom to avoid meter reading costs completely, given no bills are required to be sent to customers. However, it has been assumed that reading prepayment meters and bills dispatch to the consumers will continue to be necessary to meet the requirements of the regulatory provisions.

Benefits due to elimination of outstanding dues beyond the due date: Under the present post payment system there are several cases of defaults in payment of electricity bills by consumers beyond the due dates given in electricity bills being served to consumers. Such cases of delayed/ non-payment of bills are quantified in terms of debtors in days for sale of power and also collection efficiency levels.

Comparison Between Prepaid And Post-paid Energy Meter

Parameter	LT Commercial	LT Domestic
Connected Load for Sample Calculation	2 KW	2 KW
Load Factor	50% Load in use for 12 Hrs in a Day	40% Load in use for 8 Hrs in a Day
Per Consumer Avg. Annual Consumption (kWh)	4380	2336
Average Tariff (Rs./ kWh), at Rates notified by DERC for FY12, excluding ED	8.24	3.39*
Billing Cycle	Bimonthly/ 60 Days (upto 10kW Load)	Bimonthly/ 60 Days
Meter Reading to Billing Date (Days)	10	10
Billing to Due Date (Days	15	15
Vending Cost per Recharge in Prepaid (INR)	16	16
Number of prepaid recharges per consumer/ per month	0.63	0.63
Cost per manual meter reading (INR)	7	7
Cost of Bill Printing (INR)	0.64	0.64
Bill Distribution/ Dispatch (with acknowledgement), (INR)	2.42	2.42
Bill Distribution/ Dispatch (without acknowledgement) for PPM, (INR)	1.65	1.65
Disconnection/ Reconnection expenses, per case, (INR)	85	85
Bill Correction Charges per case, (INR)	50	50
Faulty Billing Cases, (INR)	1.67%	1.67%
No. of Disconnections (average), (INR)	0.7%	0.7%
Interest Rate (As per State Bank PLR)	11%	11%

Future Scope of Prepaid Energy Meter

The customer can easily pay the bill through various online modes which ultimately saves a lot of time for the customers.

There are a very few chances of mistakes compared to post-paid energy meter.

Since the customers need to follow the social distancing and various rules due to Covid-19, this method is really helpful as it saves people from waiting in long queue to pay the their electricity bill.

Conclusion

In conclusion, we had found that the majority of people who are using the prepaid electricity meter are satisfied with the system as they are more alert and well informed of their electric usage; thus encourage them to be more preserved in their energy as well as financial practice. They would also encourage other people to adopt the prepaid electric meter into their homes as it may prevent outstanding debts to the government.

The users are not bound to pay excess amount of money, they have to pay according to their requirements.

It is more reliable and friendly.

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