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Comparative Analysis the Usage of Prepaid and Postpaid KWH Metre

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Abstract— Prepaid electricity which is using prepaid digital kWh metre is one of the programs of PT PLN to enhance the quality of their services. They make these programs to avoid errors reading the meter, the uncertainty of the Bills, arrears and disconnection. The problems occurred in the consumer side is whether prepaid electricity consumption more efficient than postpaid electricity consumption. In this research we perform the measurement of electric energy consumption using postpaid and prepaid kWh meter with the same load and the same time, so that we able to know which is more efficient. The measurements performed on 1300 VA, R1 customers with 4 types of load (resistive load 500 Watts and 1000 watts, household expenses 407 Watts and 1235 watt), testing was carried out for 6 hours per day, 6 days per week for 1 month. The research result obtained from measurement and calculation of energy consumption. technically at the time and the same loads, prepaid kWh meter more efficiently than postpaid kWh meters. economically, according to TDL 2010, for consumption under 52 kWh kWh Meter prepaid more efficient, whereas for consumption above 52 kWh showed similar results.

Keywords :Pre paid electricity, Post paid electricity, Pre paid kWh meters, Post Paid kWh meters.

I. INTRODUCTION

Electricity has become a fundamental requirement for a wide range of human activities, which are used for a variety of functions in the future. Electricity reliance would make man its existence. PLN was aware of society's reliance on electricity, so continue to conduct various studies to improve the quality of service by offering a variety of service programs. Forms of innovation created by PT. PLN is by issuing prepaid electricity program. The Program has issued prepaid electricity since 2008, prepaid electricity has the advantage that electricity use is more restrained, with no termination penalties, not fines imposed delays, there is no fixed monthly fees and so on. Additionally prepaid electricity created in order to avoid any incident read meter, erratic utility bills, the delinquent accounts, and any disconnection on electricity postpaid. With this program the community invited to better appreciate the existence of electric power and wiser in consuming electricity. Now the question is whether the use of prepaid electricity can be the solution of the existing problems at the moment? Is it true that prepaid electricity more efficient than postpaid

electricity? Therefore the authors conducted a study to analyze the comparative measurement of the electric energy with postpaid and prepaid meters kWh kWh meters with a load and the same time in the laboratory of State Polytechnic of Sriwijaya.

II. THEORY

A. Power^[1]

Electric power is the amount of energy per unit of time, where work is in progress or the work done the Union time. From this definition, then the electrical power (P) can be formulated:

$$P = W / t \quad (1)$$

$$P = V \cdot I \cdot t / t \quad (2)$$

$$P = I^2 \cdot R \quad (3)$$

Whereas Power (P, Watt or Joule/detik), Electrical Energy (W, Joules), time (t, second), voltage (V, Volt), Resistance (R, Ohm).

B. Electrical Energy^[2]

Electrical energy is the ability to generate electricity. Electrical energy is represented by w. Where as the formulation is used to determine the electrical energy is:

$$W = Q \cdot V \quad (4)$$

$$W = (I \cdot t) \cdot V \quad (5)$$

$$W = V \cdot I \cdot t \quad (6)$$

Whereas Electric charge (Q, Coulomb)

C. Current^[3]

Current, depicted with the symbol i (derived from the French word: intensite), defined as the change of velocity with respect to time charge. Or, other sense is the charge flows in a unit of time. So, the current that is actually moving charge. As long as this charge is moving it will pop up the flow, but when the charge is stationary then the flow will also be lost. The charge will move if there's energy out that affected it. The charge is the smallest unit of an atom or a subsection of the atom. In the modern atomic theory, stated that atoms consist of a nucleus of particles (protons are positively charged (+)

and neutrons are neutral) surrounded by loads of electrons (-). So, is normally electrically neutral atoms.

The charge consisted of two types i.e. positive charge and the negative charge. Electric current direction in line with the direction a positive charge and the opposite direction with a flow of electrons. A particle can be a positive charge when it loses an electron, and a negative charge when accepts electrons from other particles.

Coulomb is the basic unit of the International System of Units (SI) is used to measure the electric charge.

Mathematically, the current defined:

$$i = \frac{dq}{dt} \quad (7)$$

Symbol: Q = a constant charge, q = electric charge

D. Voltage^[3]

Voltage or often called potential difference, is the work done for a charge of one coulomb moves from one terminal to another terminal. Or, in other words, if a charge of one coulomb is driven or moved, there is a potential difference on either Terminal.

E. Measurement^[4]

The measurement is determination of quantity, dimensions, or capacity, usually against a standard or unit of measurement. In the study of measurement known a few terms, among other things:

- The instrument is measuring instrument for determining the value of a quantity or quantities or variables.
- Precision is a price closest to a reading of an instrument approach the true value of the measured variable.
- Precision is a measure of the ability to measure results that are similar.
- Sensitivity is a comparison between the output signal or instrument responses to changes in input or variables that are measured.
- Resolution is the change in the value of the smallest measured which instruments will give a response or a response.
- Error is the deviation of the measured variable price (value) which is actually

Measurement of electrical quantities no one produces perfect precision. Need to know the actual cause of the sensitivity and the occurrence of errors of measurement Errors in measurement can be classified into three types, namely: Error –common mistakes, Systematic error mistakes Random Errors Are Not Intentional.

III. METHODOLOGY

The measurement of electric energy in kWh meters postpaid and prepaid using a measuring instrument of Power and Harmonics Analyzer. The measurement was carried out in

the laboratory of electrical engineering State Polytechnic Sriwijaya Palembang. The comparative testing of electrical energy in both postpaid and prepaid kWh meter is done with 4 different types of loads for 1 month and each load test performed within 6 hours per day for 6 days. Testing process performed with 4 different types of loads each week, namely:

1. The first week, the resistive load 5 incandescent lamps with a total power of 500 Watt.
2. The second week, the resistive load 10 pieces of incandescent lamps with a total power of 1000 Watts.
3. The third week, the load of household consisting of energy-efficient lighting, TV, fan, refrigerator, and water pumps with a total power of 407 Watts.
4. The fourth week, the load of household consisting of incandescent bulbs, television, fan, fridge, and water pump with a total power of 1235 Watts.

A. Measurement Equipment

Power and Harmonics Analyzer

Power Harmonics Analyzer is a combination of several functions measurement of electrical such as voltage, current, active power, reactive power, power factor, frequency, all power, and the other harmonics in one device. Power Harmonic Analyzer 6830 used to measure the current (total, phase motors and metal), voltage (total, ph-ph and ph-neutral), frequency, power factor (total and per phase), power/phase (active, reactive and apparent), total power (active, reactive and apparent), energy (active, reactive and apparent), THD (currents and voltages).

Analogue KWH Meter (Postpaid)^[6]

kWh meter PLN postpaid used to calculate the power consumption of consumer kWh meter is analogous to the power of 1300 VA. This tool works using magnetic induction method in which a magnetic field to move the dish is made of aluminum. The rotation will move counter shows the number of digits as his kWh. The disc rotation will move counter shows the number of digits as his kWh

Kwh meter is a device used to measure the large power consumption by consumers. This tool is very common in the community. The main part of a kWh meter is, the coil voltage, the coil current, aluminum disc, fixed magnet whose task of induction aluminum disc to neutralize the magnetic field and mechanical gear that records the amount of rotation of the aluminum disc.

This tool works by using method of induction of the magnetic field in which the magnetic field moving the aluminum disc. The disc rotation will move the counter digits as the number of kWh display

Digital KWH Meter (Prepaid) 2R^[7]

Prepaid kWh meters type of Star 2S-2R DDSY23S with a power of 1300 VA is the latest service from PLN with a range

of advantages in regulating the use of electric energy through the Prepaid Meters (CDM).

The electricity will be streamed to households (load), it first flowed through the MCB who serves as the current delimiter is at once in case of short circuit protection. Then streamed into kWh Meters which functions to calculate the energy used. This prepaid system using a special Meters kWh with keypad and have sensors to detect electrical energy used with impulse output of the lights flicker.

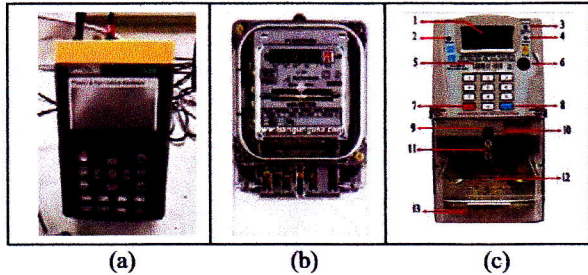


Figure 1. (a) Power and Harmonics Analyzer 6830, (b) analogue kWh meter, (c) Digital kWh Meter

B. Load Measurement

Comparison of measurement of power on postpaid and prepaid meters kWh using a simulated series of module 1 simple phase consisting of load incandescent lighting (purely resistive), energy saving lights, water pump, TV, refrigerator and fan.

TABLE I. LIST OF LOAD

No.	Type of Load	Specification	Cos ϕ	Number	Power
1.	Incandescent lighting	100W/220V	1	10 pcs	1000W
2.	Energy Efficient lighting	18W/220V	0,64	4 pcs	72 W
2.	Water pumps	125W/220V	0,46	1 pcs	125W
3.	TV	70W/220V	0,53	1 pcs	70 W
4.	Refrigerator	90W/220V	0,81	1 pcs	90 W
5.	Fan	50W/220V	1	1 pcs	50 W

IV. DISCUSSION

A. Comparative Analysis of Measurement Results and Calculations

Comparison of the test results of electrical energy on average per hour within 6 hours for 6 days for each load on postpaid and prepaid kWh meter, obtained electric energy comparison on average for 6 days as follows :

TABLE II. COMPARING THE RESULTS OF MEASUREMENTS AND CALCULATIONS OF ELECTRICAL ENERGY PER HOUR

Type of Load	Type of Metre	Energy Used
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		Measurement Result	Calculation Result
500 Watt (a pure resistive load)	Pospaid	0,446 kWh	0,4488 kWh
	Prepaid	0,443 kWh	0,4461 kWh
	Difference	0,003 kWh	0,0027 kWh
1000 Watt (a pure resistive load)	Pospaid	0,874 kWh	0,8758 kWh
	Prepaid	0,871 kWh	0,8723 kWh
	Difference	0,003 kWh	0,0035 kWh
407 Watt (Load of household)	Pospaid	0,380 kWh	0,4699 kWh
	Prepaid	0,376 kWh	0,4668 kWh
	Difference	0,004 kWh	0,0031 kWh
1235 Watt (Load of household)	Pospaid	1,101 kWh	1,1351 kWh
	Prepaid	1,088 kWh	1,1327 kWh
	Difference	0,013 kWh	0,0024 kWh

Technically, the use of electrical energy in kWh meter postpaid and prepaid using the same load and the same time, energy consumption electricity kWh meter postpaid larger or faster than electrical energy consumption spent electric energy in prepaid kWh meter. Each of kWh Meter have different working principles, where in principle work on postpaid kWh meters have a coil inductance, which had resulted in consequential kWh meters more quickly heat so it's more quickly spend electrical energy. whereas Prepaid kWh meters just an electronic device with keypad keys which has sensors to detect electrical energy used with impulse output of the lights flicker. Thus in technical measurements prepaid kWh meters more efficient than postpaid kWh meter.

B. Economic Analysis

From the results of calculations performed in accordance TDL 2010, Rp 790 for 1300 VA. Then can be calculated economically postpaid and prepaid electricity.

TABLE III. THE ECONOMICAL CALCULATION RESULTS OF PREPAID AND POSTPAID ELECTRICITY

Usage (kWh)	Amount of Postpaid Electricity bills	Amount of Prepaid Electricity Bills
49	Rp 41,080	Rp 38,710
50	Rp 41,080	Rp 39,500
51	Rp 41,080	Rp 40,290
52	Rp 41,080	Rp 41,080
53	Rp 41,870	Rp 41,870
54	Rp 42,660	Rp 42,660
55	Rp 43,450	Rp 43,450

Customers of R1 1300 VA according to TDL 2010, total electricity bill for prepaid than postpaid more efficient for use of <52 kWh and it is same for the use of ≥ 52 kWh. For calculation of postpaid tariff, electric energy consumption limits enforced minimum is 40 hours. When taking electrical energy under 40 hours, for the calculation of the rates will still be counted 40 hours of usage. While prepaid tariffs, electrical energy consumption is calculated according to the amount consumed, do not impose minimum limit the consumption of electrical energy. postpaid Bill for not including VAT and the

use of street lighting. While the bills for prepaid is already included VAT and the use of street lighting.

CONCLUSION

From the results of measurements and calculations for R1 customers 1300 VA technically, electric energy consumption in postpaid and prepaid kWh meter with the same and the same time, prepaid kWh meters are more efficient than postpaid kWh meters. While economically, for the consumption of electrical energy under 52 kWh prepaid kWh meter more efficient than postpaid kWh meters. for usage above 52 kWh will both alike.

The advantages and disadvantages of Prepaid Electricity and Postpaid Electricity are as follows.

- Prepaid Electricity, has advantages over the postpaid electricity, energy prices: kWh "ALONE" (without the cost burden), no minimum account limit, the registrar meter no need to record the number of usage, there is no potential for arrears, and most importantly, the customer able to manage and control the use of electricity to be more efficient in a month. The disadvantage if the usage limit is over then the power turns off immediately no matter the time of day or night, you are using electricity or not it is being considered by the consumer to change the way electricity consumption by using electricity vouchers.
- Postpaid Electric, Has the disadvantage compared to prepaid ie, price of energy: additional kWh cost burden (power 450 and 900 VA), is limited to the "minimum bill" (40 hours minimum), need to recording kWh rate, potential delinquent "big enough". While the advantages are electrical disconnection the connection manually.

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