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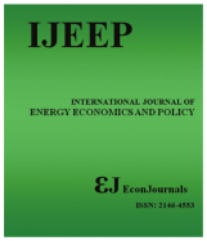

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Perceptions and Determinants of SMEs Consumers' Behaviors for Electricity Saving: Evidence from Indonesia

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ABSTRACT

Consumer's behavior can affect volume and electricity demand profile. Therefore, knowing behavior of users is valuable to manage electricity usage, to design better energy policy and management. This study aims to analyse electricity users for manufacturing small and medium enterprises (SMEs) in Makassar, Indonesia to get information about perceptions and users' behaviors on energy consumption using statistical approach. A questionnaire for survey is firstly designed to obtain required data from respondents. Next, two regression models are proposed to examine determinants of usage behavior and habit of SMEs users towards electricity saving. Explanation variables in the models are user's perception, meteorological, economic, and production technology. Results shown the designed questionnaire is reliable. Perception on energy saving for SMEs' users is generally good enough. The perceptions of consumers are different based on the characteristics of demographic. Other results shown determinants of usage behaviour in SMEs towards electricity saving are user's perception, economic and production technology. Meanwhile determinant for habit of users is perception and production technology. Presented results can give more insight to government or power utility in relation to encourage energy efficiency for industrial sector in Indonesia.

Keywords: Electricity Saving, Perception, Consumers' Behaviors, Small and Medium Enterprises, Indonesia
JEL Classifications: Q40, Q41, Q48, L94

1. INTRODUCTION

Electricity is an essential input for households, business places, and industries. It is used such as for lighting at home, to improve service to customers at business place, and to support production process in industries. As its role is vital for many aspects to human life, therefore, the availability of electricity energy at all times with good quality for consumers is an issue in operation of power systems.

At present, electricity demand continues to increase in many countries including in Indonesia. To handle this, efforts to keep balancing between demand and supply are needed such as through the addition of power plants to increase capability of electric systems in meeting load growth. Increasing efficiency of energy usage or energy saving for sectors which consumed highly electricity such as in SMEs is an interesting option as well. It is caused beside to support security of energy supply, efficient of energy use can reduce operational cost, enhance productivity and also competitiveness (Backlund et al., 2012). However, the success of energy saving practice can be affected by a number of variables and one of them is behavior of consumer. Based on this, it is useful to understand users' behaviors as a basis to reduce electricity consumption. Understanding the characteristics of consumers can increase quality service of utility at the same time. In (Poznaka et al., 2015), knowing pattern and habits of energy usage is an important aspect in analysing factors affecting electricity demand. For this task, one of the approaches that can

be applied to observe consumer's behavior is regression analysis (Park and Lee, 2013). However, performing a study on this area is not easy as required data are not available in many places. It is needed to develop a questionnaire for survey to get behavior data for analysis and this is a challenging work for researcher.

Several studies on consumer's behavior related to energy consumption can be seen in the international literatures. Reference (Poznaka et al., 2015) studies electricity consumers' behaviors for Latvian households. A survey is conducted by the authors to analyze the impact of smart meter utilization at household for energy saving. They conclude that electricity consumption can be reduced 23%. The change of consumption volume is affected by technical and users' psychological factors. Reference (Park and Lee, 2013) conducts survey to analyse perception and electricity user's behavior regarding the usage of compact fluorescent lamps at homes in Michigan as energy-efficient lighting. From the study, it is confirmed that lighting perceptions have relationship with users' behaviors. From socio-demographic perspective, perceptions and behaviors of the users are different. Reference (Yang et al., 2016) investigates further energy saving for households in China by conducting a survey regarding energy curtailment behaviors. Their study confirmed that psychological and socio-demographic variables affect energy saving behavior. The two variables influence higher the indirect energy curtailment behavior than direct behavior. Reference (Arawomo, 2017) applies statistical approach to analyze household occupants' behaviors in using electricity energy for appliances associated with billing system in Ibadan, Nigeria. Resulted information such as electricity saving behavior for metered and pre-paid consumers in using lighting, washing clothes, and ironing are better than unmetered and post-paid consumers. Reference (Bedir and Kara, 2017) studies user's behavior and electricity consumption profile for housing in Netherlands by analyze electricity use for appliances using questionnaire. They confirm that behavioral pattern can be identified based on the actual behavior of consumer in using appliances including lighting. Meanwhile in (Sukarno et al., 2015), the authors analyse the pattern of energy consumption in Padang, Indonesia using cohort model. Four sectors are analysed including commercial and industrial sectors. The study confirmed that urban energy consumption is highly affected by population size, and energy consumption for business and industry is dominantly electricity.

This research presents analysis of SMEs' consumers in Makassar in relation to electricity energy usage. The main purpose is to investigate the perception level of SMEs' users and to examine determinants of usage and habit of users on electricity saving using statistical approach. To the best our knowledge, study on analyzing factors affecting consumers' behaviors to improve electricity energy saving in SMEs for Indonesian context is very limited. This work contributes in providing detailed information regarding perception and determinants of SMEs consumers' behaviors towards electricity saving. Besides to fill the gap, the proposed approach can be generally adopted by other areas. Similar case for residential sector is discussed in (Park and Lee, 2013; Akil et al., 2018). Prior studies from several countries which analyzed different issues on SMEs have been published, such as in (Wongsapai et al., 2017) for Thailand, (Kemayel, 2015) for Lebanon, (Chen et al., 2017) for China, (Büyükkeklik et al., 2016) for Turkey, (Amar and Davis, 2015) for Indonesia, (Goto and Wilbur, 2019) for Japan, (Allen and Fullerton, 2019) for USA, (Francisco et al., 2018) for Philippine, and in (Sahoo and Yadav, 2018) for India.

The structure of this paper is as follows. The first part explains background of this study and literature review. In the second part, typical Indonesian industrial consumers are presented. The third part describes questionnaire design, data and method including proposed equation models. Next, results are presented and analyzed. The last part presents the conclusions and future research.

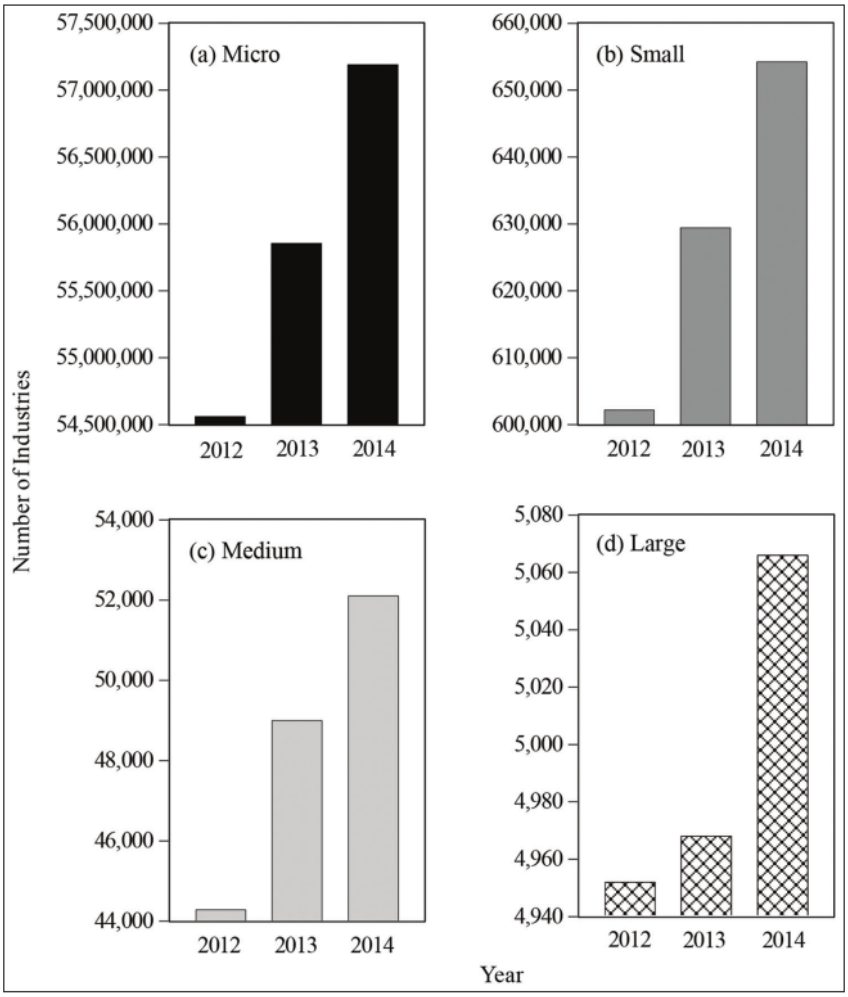
2. TYPICAL INDUSTRIAL CONSUMERS IN INDONESIA

Industrial sector in Indonesia is one of main electricity sectors that consumed highly energy. Consumers groups for this sector are devided into micro, small, medium and large industry. Number of employee for micro scale is maximum 4, small scale is between 5 and 19, for medium scale is from 20 to 99, meanwhile for large industry is minimum 100 (Statistics Indonesia, 2019). Typically, majority of the unit comes from micro industry and followed by small, medium, and large sized industry that tends to increase by year. Figures 1 and 2 show number of industries unit for each classification in Indonesia for year 2012 to 2014 and their employees, respectively (Ministry of Cooperatives and SMEs, 2019). From Figure 1, number of industries tends to increase by year for all classifications. The increasing of the units is proportional to the increasing of employee absorption as seen in Figure 2. Particularly for small and medium enterprises (SMEs), employees in year 2012 for small and medium industries are 3.9 million and 2.8 million, respectively. In year2014, the employees increased become 5.5 million for small industries and 3.9 million for medium sized. Similar tendency for industrial consumers also happened in South Sulawesi province where Makassar is located.

The important role of the industry and mainly for SMEs to support economic growth, employment, and poverty reduction which is in line with Indonesian government programs make them increased by year (Irjayanti and Azis, 2012). Comparing characteristics with large industry, the SMEs are not same not only in number of employee but also in some other aspects including organizational structure, human resources, market and customer (Kavak et al., 2015).

Considering the number of existing industry and needed employee are very high, moreover industrial consumers can increase higher based on the trend which proportional to electricity consumption, thus, it is useful to analyse this sector from perspective of users' behaviors to improve energy saving. Here, we focus to observe SMEs particularly for manufacturing industry in one big city in Indonesia, namely Makassar. Besides to reduce operational cost, practicing energy saving can beviewed as an effort to anticipate power shortage. As in (Siyal et al., 2014), the lack of

Figure 1: Typical Indonesian industries for each classification between year 2012 and 2014. (a) Micro, (b) Small, (c)Medium, (d) Large



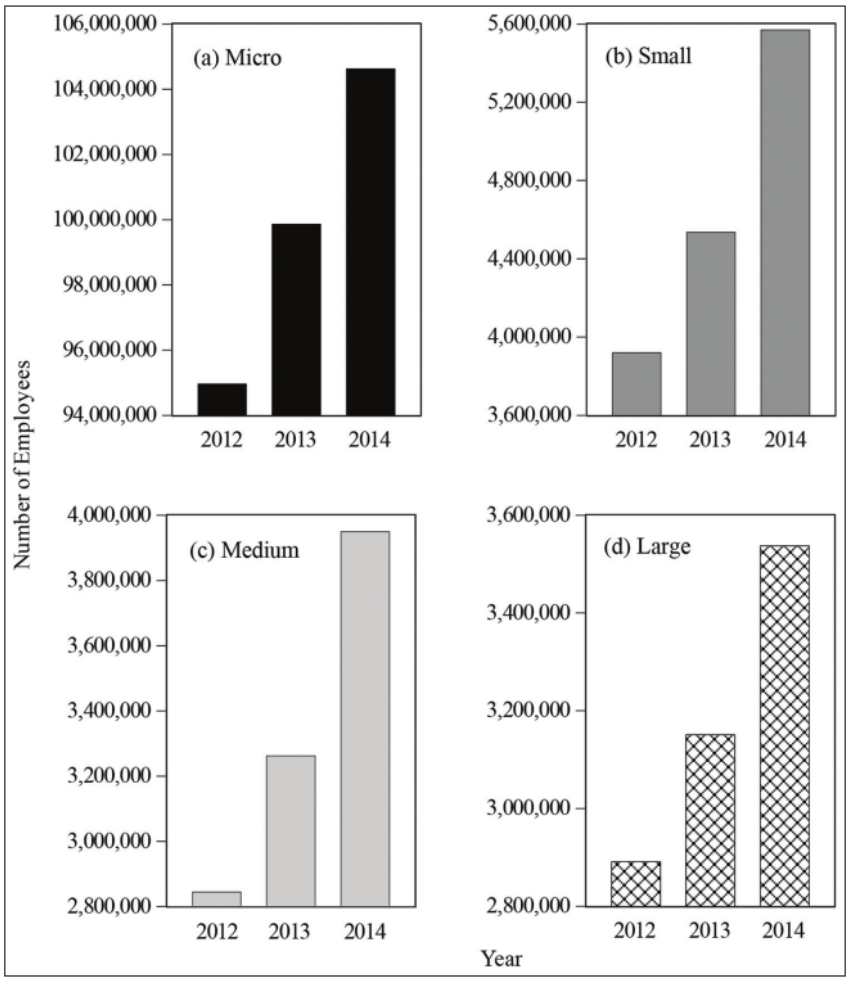
electricity supply for SMEs business can cause losses of financial and customer. Besides that, initiation and encouragement for energy saving should be more intensive as electricity efficiency measurement is not too open for SMEs, and investment allocation for energy efficiency program is relatively small or low priority issue (Khalifa et al., 2019; Thollander and Ottoson, 2010).

3. DATA AND METHODS

To observe consumers' behaviors, questionnaire is commonly used (Guo et al., 2018). Following this, a questionnaire for survey is initially designed to collect data from manufacturing SMEs. It is developed based on the prior studies on users' behaviors in relation to energy consumption in industry and other related works (Park and Lee, 2013; Martinez, 2010), and modifications are done to suit Indonesian environment.

The questionnaire consists of several parts, namely general information (identity) of respondent, perception and other factors in relation to electricity saving, usage behavior and habit of the consumers. For example, general perception asked about gender, age, education, current position in firm, and power capacity at SMEs. For statements of perception and other factors in relation to electricity saving include such as "The usage of energy saving electricity equipments (ESEEs) is vital to support energy saving program for industry," "Implementation of energy saving behaviour can decrease electricity bill in SMEs," "Energy saving behavior can reduce environmental issue," "The usage of ESEEs at work place is affected by weather factor," and "The usage of ESEEs at work place is affected by economic factor (in terms of electricity tariff and maintenance cost)." Meanwhile statements for usage behavior and habit of the consumers include such as "We use ESEEs to support electricity saving program for industry," "We use ESEEs such as low watt lamp due to weather factor (e.g., we need longer lighting during rainy season as sunlight is minimum (darker)," "We use ESEEs because electricity price tends to increase," "Employees always turn off ESEEs after being used as a commitment to support energy saving program for industry," "Although low watt, employees are accustomed to reducing the use of ESEEs when it is not urgent such as not turning on a light when the weather is

Figure 2: Employee absorption for each industry classification. (a) Micro, (b) Small, (c)Medium, (d) Large



bright," and "Employees always turn off ESEEs after being used to reduce electricity consumption considering electricity price." Next, a Likert scale of 7 points ranging from 1 for "strongly disagree" to 7 for "strongly agree" is used to assess items in the questionnaire.

Survey is done in August to September 2019 using purposive sampling technique to select targeted respondents located in Makassar city. Participant or respondent is owner, management level, or employee who knows production process and the usage of electricity energy in related work place. The number of data sample is 100 SMEs' consumers. The collected data represent approximately 19% from total manufacturing SMEs in Makassar for year 2017. For reliability of the questionnaire (40 samples as a pilot survey), it is assessed by using Cronbach's alpha (α) value as expressed in Eq. (1) (Bland and Altman, 1997).

$$\alpha = \frac{k}{k-1}(1-((\sum S_i^2 / S_T^2)) \quad (1)$$

In the above equation, k is number of items (question or statement). Meanwhile variance S_i^2 and S_T^2 are for i^{th} item and for total summing all items, respectively.

Perception level is measured by using mean score analysis. Next, to reveal more information, two regression equation models for behaviors of SMEs' consumers are proposed to examine relationship between observed variables. Formulation and considered variables in the models are given in the Eqs. (2) and (3).

$$USMEs = \hat{\psi}_0 + \hat{\psi}_1 CoP + \hat{\psi}_2 MeV + \hat{\psi}_3 EcV + \hat{\psi}_4 PtV + u_t \quad (2)$$

$$HSMEs = \hat{\xi}_0 + \hat{\xi}_1 CoP + \hat{\xi}_2 MeV + \hat{\xi}_3 EcV + \hat{\xi}_4 PtV + u_t \quad (3)$$

where *USMEs* and *HSMEs* are usage behavior and habit of consumers for conserving energy, respectively. Variable *CoP* is consumers' perceptions, *MeV* is meteorological variable, *EcV* is economic variable, and *PtV* is production technology variable. Meanwhile $\hat{\psi}_0$ and $\hat{\xi}_0$ are intercept values of models, other values of $\hat{\psi}$ and $\hat{\xi}$ are regression coefficients, and u_t is a residual for each model. Common autoregressive structure is applied in the SMEs models to dealing with autocorrelation.

$$u_t = \rho_1 u_{t-1} + \rho_2 u_{t-2} + \mathrm{L} + \rho_p u_{t-p} + \varepsilon_t \quad (4)$$

where ρ_p is constant, p is autoregressive order, and ε_t is a white noise. Each model is tested until second order autoregressive, and then assessed by using Akaike Information Criterion. The smaller of AIC value, the better of model.

4. RESULTS AND ANALYSIS

4.1. Reliability Assessment and Validity

Table 1 shows the results for reliability measurement of the questionnaire. As seen in Table 1, obtained Cronbach's alpha (α) values for all dimensions are greater than threshold value for reliability (0.60). This confirmed that all questionnaire's items in each dimension have internal consistency or reliable. Therefore, the designed questionnaire can be used for main survey and further analysis. For validity, expert judge approach is adopted in this study.

4.2. Demographic Analysis

Table 2 shows descriptive results of all manufacturing SMEs under study. Several important information about general background of the respondents can be seen from Table 2. For example, major portion of respondents is male (73%) as compared to female (27%). Position in firm is dominantly owner (63%), followed by employee (27%) and management level (10%). Among of the responding SMEs, 90% is small industry and 10% is medium industry. Installed electric capacity (IEC) is categorized into three categories, where majority of the respondents has IEC in their work places is 2,200 VA to 6,600 VA (67%).

Table 1: Reliability test result

No.	Dimension	α value
1	Consumer's perception	0.845
2	Meteorological variable	0.858
3	Economic variable	0.843
4	Production technology variable	0.860
5	Usage behavior	0.835
6	Habit of consumer	0.882

Table 2: Descriptive statistic

Category	Item	Frequency (N)	Percentage	Total (%)
Gender	Male	73	73	100
	Female	27	27	
Educational level	High school	70	70	100
	Graduate	27	27	
	Post graduate	1	1	
	Others	2	2	
Age	<20 years	6	6	100
	21-30 years	26	26	
	31-40 years	28	28	
	>41 years	40	40	
Position in firm	Owner	63	63	100
	Management level	10	10	
	Employee	27	27	
Size of Industry	Small	90	90	100
	Medium	10	10	
IEC	<2,200 VA	29	29	
	2,200-6,600 VA	67	67	100
	>6,600 VA	4	4	

4.3. Perception of Consumers towards Electricity Saving

From analysis for all participants, general perception of SMEs' users on energy saving in Makassar is good enough. It is shown by obtained average mean value 5.7 out of 7 point Likert scale. To observe further, perceptions level is analysed from aspect of demographic characteristic. Based on the size of industries, consumers of small industries have more positive perception on electricity saving (M = 5.71; SD = 1.03) than consumers for medium sized (M = 5.70, SD = 1.25). Next, based on the IEC, it is found that consumers with IEC in the 2,200 to 6,600 VA range have higher positive perception (M = 5.82; SD = 0.94) than consumers for IEC <2,200VA (M = 5.58, SD = 1.126) and above 6,600 VA (M = 4.75, SD = 1.88).

Normally, perception can affect the decision to buy or to use something. Based on this, the observed consumers with more positive perceptions are relatively easy to use ESEEs (main and supporting equipment for production process) in their work places and even inform or promote it to others. With regards to this, Tables 3 and 4 show percentage distribution of owned ESEEs by consumers according to the size and IEC category, respectively. From Table 3, around 31.1% of respondents for small industry have been using energy saving equipment both for main and supporting equipment, meanwhile for medium sized is around 30%. Next in Table 4, respondents with IEC 2,200-6,600 VA have used energy saving equipment around 32.8% both for main and supporting equipment (it is greater than other two categories) as seen in the Table 4.

4.4. Determinants of Consumers' Behaviors

Regression results for USMEs model are given in Table 5. The model is well validated with R^2_{adj} value is around 55.23%. The probability of F-statistic is 0 indicated that at least of the explanation variables affect the dependent variable. From Table 5, consumer's perception (CoP), economic (EcV), and production technology factor (PtV) have significance in the model at 10% level with expected coefficient signs. The significance of variable is shown by P-values for CoP, EcV, and PtV factor below 0.1. Another factor, namely meteorological (MeV) has no significance. For meteorological condition such as temperature in Makassar, its variation (changing of temperature) is not too high throughout

Table 3: Owned ESEEs according to size of industry

Size (N)	Energy saving equipment (%)				
	Main and supporting	Main	Supporting	None	MR*
Small (90)	31.1	8.9	57.8	1.1	1.1
Medium (10)	30	30	40	-	-

*Missing response

Table 4: Owned ESEEs according to IEC

IEC (N)	Energy saving equipment (%)				
	Main and supporting	Main	Supporting	None	MR*
<2,200 VA (29)	27.5	10.3	62	-	-
2,200-6,60 VA (67)	32.8	10.4	53.7	1.5	1.5
>6,600 VA (4)	25	25	50	-	-

the year. This can be related to insignificance of meteorological variable on the usage of ESEEs. For significance variables, this confirmed that perception, economic, and production technology have highly impacts or as determinants for SMEs' consumers in using ESEEs at work places to support energy saving. The more positive of perception, the higher desire of consumer to use ESEEs as perception can affect decision of consumer in buying goods. Similar for economic variable (electricity tariff and maintenance cost), the higher of tariff or the lower of maintenance budget for SMEs, the higher desire of consumers to use ESEEs. Meanwhile for production technology such as applied energy sources, electricity for SMEs is generally supplied from PT. PLN (a power utility). This may encourage consumers to use ESEEs to reduce bill. Comparing between variables, perception of consumer (CoP) give highest influence on usage behavior as indicated by regression coefficient value for CoP (0.3828) is bigger than EcV (0.1376) or PtV variable (0.1274).

For HSMEs model, the regression results are presented in Table 6. The behavior model has R^2_{adj} value around 32.33%. By applying the same significance level (10%), perception (CoP) and production technology variable (PtV) are significant in the model. Meanwhile other variables (meteorological, and economic factors) have no significance. Elimination of the non-significance variables in the models gives almost the same output. From results, perception and production technology are important variables for habit of SMEs' consumers in practicing energy saving at work places. In this sense, employees in organization have habit to turning off equipment after being used to reduce electricity consumption or operational cost. Besides that, the habit is encouraged to support the smooth production process and or to prioritize the electricity needs of main equipment in manufacturing SMEs. Earlier studies in (Martinez, 2010; Siyal et al., 2014) are also confirmed the important role of behavior and production technology in reducing energy consumption in industries. Comparing between the models, considered variables can explain the usage behavior (USMEs model) better than habitual behavior (HSMEs model). The two types of behavior for SMEs' consumers in Makassar in terms of usage and habitual behaviors for electricity saving are almost have the same success factors.

Table 5: Results for SMEs usage model (Eq. 2)

Variable	Dependent variable: Usage behavior			
	Coef.	P-value	SE	t-statistic
$\hat{\psi}_0$	1.8859	0.0000	0.3330	5.6631
CoP	0.3828	0.0000[a]	0.0758	5.0469
MeV	−0.0063	0.9298[ns]	0.0717	−0.0883
EcV	0.1376	0.0357[a]	0.0646	2.1305
PtV	0.1274	0.0254[a]	0.0561	2.2716
R^2	0.5704			
$R^2_{adj.}$	0.5523			
Prob. (F-Stat.)	0.0000			
Durbin-Watson Stat.	1.7700			
Akaike information Crit.	1.7626			

[a]Significant at 5% level; [ns]non significance variable

Table 6: Results for SMEs habit model (Eq. 3)

Variable	Dependent variable: Habit of consumers			
	Coef.	P-value	SE	t-statistic
$\hat{\xi}_0$	3.3819	0.0000	0.4420	7.6512
CoP	0.1847	0.0583	0.0963	1.9174
MeV	−0.0462	0.5896[ns]	0.0854	−0.5412
EcV	0.0247	0.7608[ns]	0.0810	0.3053
PtV	0.1876	0.0137[a]	0.0746	2.5126
AR(1)	0.2687	0.0115	0.1042	2.5785
AR(2)	0.2056	0.0606	0.1082	1.9001
R^2	0.3651			
$R^2_{adj.}$	0.3233			
Prob. (F-Stat.)	0.0000			
Durbin-Watson Stat.	1.9627			
Akaike Information Crit.	2.2602			

[a]Significant at 5% level; [ns]non significance variable

There are some implications from this study. To stimulate SMEs consumers effectively, determining more realistic strategies in promoting energy saving practice is important. As perception variable has significance influence to the usage behavior and habit of consumers, therefore giving priority according to level perception of users as a strategy is meaningful. For example based on the size of industry, respondent of medium industry shows lower perception than small industry. Or based on the installed electric capacity (IEC), consumers with IEC above 6,600 VA has lower perception on energy saving than SMEs consumers with IEC <2,200VA, or 2,200 to 6,600 VA range. More focus should be given to consumers with low perception. In addition, besides priority approach, more media and intensive campaign from government or power utility regarding benefit of energy saving is urgent to be done for consumers such as through television, social media, newspaper, and etcetera. The more information users have regarding a low watt product and benefit of energy saving, the more easily they are buying it and practicing energy saving lifestyle in their workplaces. Next, similar approach can be used in designing strategy for other success factors of saving energy practice in SMEs. Providing more suitable strategies or programs can help to minimize obstacles to energy efficiency including insufficient information and low technical skills (Thollander and Dotzauer, 2010; Sweeny et al., 2013; Prukvilailert and Wangskarn, 2011).

Energy saving can be seen as a part to enhance SMEs performance which is in line with concern of Indonesian government on energy conservation program. Furthermore under global competition, the usage of electricity energy in industries in all levels should more efficient to increase productivity and competitiveness.

5. CONCLUSIONS

This study presents analysis regarding perception and SMEs consumers' behaviors towards energy saving in Makassar. A questionnaire is developed for survey and obtained data are analysed using statistical approach including regression analysis. It is concluded from results that perception of SMEs users toward electricity energy saving is good enough. Variables affect the usage behavior of energy-efficient electric equipment at work places are user's perception, economic, and production technology. Meanwhile for habit of users is affected mainly by perception and production technology.

Industrial sector is commonly known as central interest in conservation as it consumes highly electricity energy. Therefore, the presented information give more insight in relation to increase electricity saving for manufacturing SMEs in Makassar and as a reference in designing energy policy. This work contributes in providing detailed information regarding perception and determinants of SMEs consumer's behavior. Other variables will be analyzed in future research to find completely main factors of energy consumption behavior for Indonesian SMEs including determining of suitable intervention strategy.

6. ACKNOWLEDGMENTS

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