

DOUBLE BOUNDED CVM FOR ADDITIONAL WTP FOR DECISION IN PHASING OUT WATER HEATER OR PROMOTING ITS GREEN LABEL IN THAILAND

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Abstract: This paper aimed at finding the additional willingness to pay for the green labeled product namely electric shower unit water heater compared to the non-green labeled product. The influence from demographic and non-demographic factors (knowledge, believe, attitude, environmental concern, and emotional value) to the willingness to pay was investigated. The Contingent Valuation Method was used to find out the additional willingness to pay. The double bounded close-ended questions with initial 4 bids (200, 250, 300, and 350 from pretest) were applied to 400 sampled customers represented 500,000 units of sales per year in Thailand (95% confidence level). To interpret the result, the adjusted Probit was used with the disturbance assumed to be log-normal distribution. The result showed that the median and mean is 210.29 and 232.65 Baht respectively (around 7 USD at 30-33 Baht per USD). The most expected activity in opinion of customers for the manufacturer to spend is the forestation. The additional willingness to pay from research reflected around 10 million baht per year to be used for environmental activity which has to be compared with the alternative of phasing out of the electric shower unit water heater and substituted by the ten times energy saving technologies e.g. hot water solar collector or hot water heat pump. Even the new technologies are 6-8 times costing but it would be better for the countries in the long run.

Keyword: Green Label, Electric Shower Unit Water Heater, Additional Willingness to Pay

1. INTRODUCTION TO GREEN LABEL

The response to environmental problem could be done in various ways. One of those is to choose the environmental friendly or green product. This concept pushes the manufacturers or producers to concern the environment together with the business. The green product get better understanding and acceptance from all stakeholders especially when there are the concerns of the global warming. In Europe, customers request the green label from certain products. The World Business Council for Sustainable Development had forecasted that after 2050, there will be only environmental friendly product in the market.

Thailand Business Council for Sustainable Development: TBCSD in 1993 with the secretariat work by Thai Environmental Institute and the Thai Industrial

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Standard had initiated the green label for Thailand (first initiate in Germany in 1977). The name and logo of green label might be different in each country but the objective is the similar. For Thailand, the logo in green global and pigeon as shown in Fig. 1



Figure 1: Green label or eco-label

(Source: Thai Environmental Institute)

To approve the green label for a product, if there is no scheme, the association of that product has to draft and set up the criteria together. When the scheme is available, the manufacturer can comply all requirements. The approved exists 3 years. All products can apply except the food and drug because it is under the responsibility of the Ministry of Public Health (TEI 2013).

1. Factors Influencing the Willingness to Pay

From reviewing various research factors, the factor influencing the additional willingness to pay in decision buying are demographic factor and non-demographic i.e. knowledge, believe, attitude, value and environmental concern (Supapetch & Techato, 2014) as conclusion in table 1 and shown in Fig. 2.

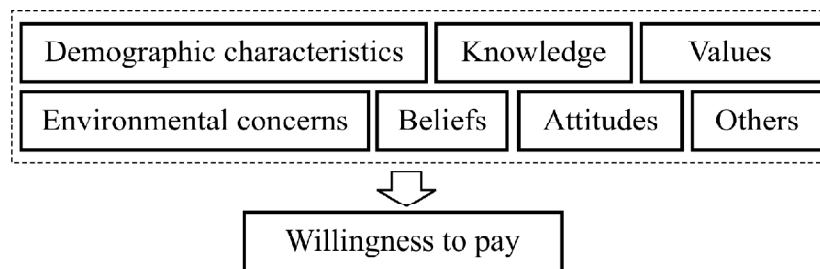


Figure 2: Factors Influencing Willingness to Pay

Table 1
List of research supporting influencing factors to willingness to pay
List of Research and Justification for Inclusion

| | | |
|--------------------|----------------------------------|--|
| Demographic factor | Gender Age, Income, Education | (Hunter <i>et al.</i> , 2004), (McCright, 2010), (Zelezny <i>et al.</i> , 2000), (Mainieria <i>et al.</i> , 1997) (Carlsson & Stenman, 2000), (Boccaletti & Moro, 2000), (Zhang & Wu, 2011), (Song <i>et al.</i> , 2011), (Kostakis & Sardianou, 2011), Ward <i>et al.</i> , 2010), (Shen, 2011), (Gan <i>et al.</i> , 2008) Age, income and education |
| | Knowledge | (Laroche <i>et al.</i> , 2001), (Kaiser <i>et al.</i> , 1999), (Chan & Lau, 2000), (Laroche <i>et al.</i> , 2002), (Andres & Salinas, 2007), (Boccaletti & Morol, 2000), (Farhar, 1999), (Barber <i>et al.</i> , 2009), (Laroche <i>et al.</i> , 1996) |
| | Belief | (Mainieria, 1997), (Aguilar & Vlosky, 2006) |
| | Attitudes | (Roberts,1990), (Andres & Salinas, 2007) |
| | Environmental concern | (Lin & Huang, 2011), (Xu <i>et al.</i> , 2012), (Paladino & Angela, 2005) |
| | Values (Emotional value) | (Lin & Huang, 2011) |

Besides the demographic characteristics, the non-demographic like knowledge, values, environmental concerns, beliefs, attitudes and others are included into the study in order to check if it is sensitive in this case study.

2. Growth of Electric Shower Unit Water Heater

In Thailand, even the location is near the equator but the market of electric shower unit water heater is continuously growth,because of the comfortable feeling, as shown in table 2. The percentage of households use electric shower unit water heater around Thailand has increased from 12% to 14% approximately.

Table 2
Percentage of households installing electric shower unit water heater

| region year | Thailand | Metropolitan | Central | North | North East | South |
|-------------|----------|--------------|---------|--------|------------|-------|
| 2008 | 12.0 % | 21.5 % | 9.2 % | 18.3 % | 8.6 % | 4.1 % |
| 2009 | 12.8 % | 22.6 % | 10 % | 20.3 % | 8.6 % | 5.1 % |
| 2010 | 13.3 % | 22.0 % | 9.3 % | 22.3 % | 9.5 % | 5.3 % |
| 2011 | 14.1 % | 22.9 % | 9.7 % | 23.8 % | 10.5 % | 5.4 % |

Source: National Statistics Office, Thailand 2012

3. Hypothetical Green Market of Electric Shower Unit Water Heater

The electric shower unit water heater is private goods sold in the electric appliances market but the green labeled electric shower unit water heaters do not exist in the

market as the green label had not been completed for this product. The additional willingness to pay for the green label electric shower unit water heater is therefore has to survey from the hypothetical market. The general requirement of green label is to concern 3 issues. The first is to use the renewable resources and the efficiency consumption of nonrenewable resources. The second is the concern of the environmental pollution emission for the whole life cycle e.g. non-heavy metal color or ink is a must for product. The paper or package must be green labeled and non CFCs product. The third is the management of waste in term of reuse and recycle and also the concern of hazardous waste. The component has to have plastic type code to be easily and clearly recycle. The green label for electric shower unit water heater in term of energy efficiency has to receive the label number five which is up to 85% energy efficiency. The green label for electric shower unit water heater is however in process, not yet announced in Thailand.

4. Sampling

The population of the model is 500,000 customers who bought the electric shower unit water heater which is assumed to be the same market as the green label electric shower unit water heater. At 95% confidential limit with the Yamane formula, the number of sample is 400 buyers. The pre-survey 10% equals to 40 customers were used to find out the starting bid. The face to face interview was done. The doubled bounded close-ended questions were applied. One of the questions is to classify the region of sampled in order to follow the cluster sampling as the proportion of real sales as shown in table 1. The sampled in Bangkok and perimeter, central, northern, south-eastern, and southern region is 126, 54, 132, 58, and 30 samples respectively.

From total 400 samples, 53% is female and 47% is male. The marital status is single 55%. The majority of sample 52.75% is in the range of 25-34 years old. The education is mainly 86.75% bachelor degree. The career of sample is mostly in the category of employee for private company. The mean of household income is about 76,000 Baht in the range of 40,000 to 80,000 Baht (see more detail in Fig. 3).

5. Willingness to Pay Model

Contingent Valuation Method: CVM, firstly used in 1960 by Robert K. Davis, is the value evaluation by direct interviewing the state preference in term of willingness to pay. It can be used to evaluate either use-value or non-use value (Hanley *et al.* 1997). The open ended question used during the interview is good for the pretesting to find out the starting or initial bid becoming close ended question for the real survey of the willingness to pay. The closed end in form of "take it or leave it", or referendum is good in reducing the variance in real sampling (Mitchell and Carson, 1998). The starting bid should be close to the mean of willingness to pay with Follow-up Bid; Higher Bid and Lower Bid of Median

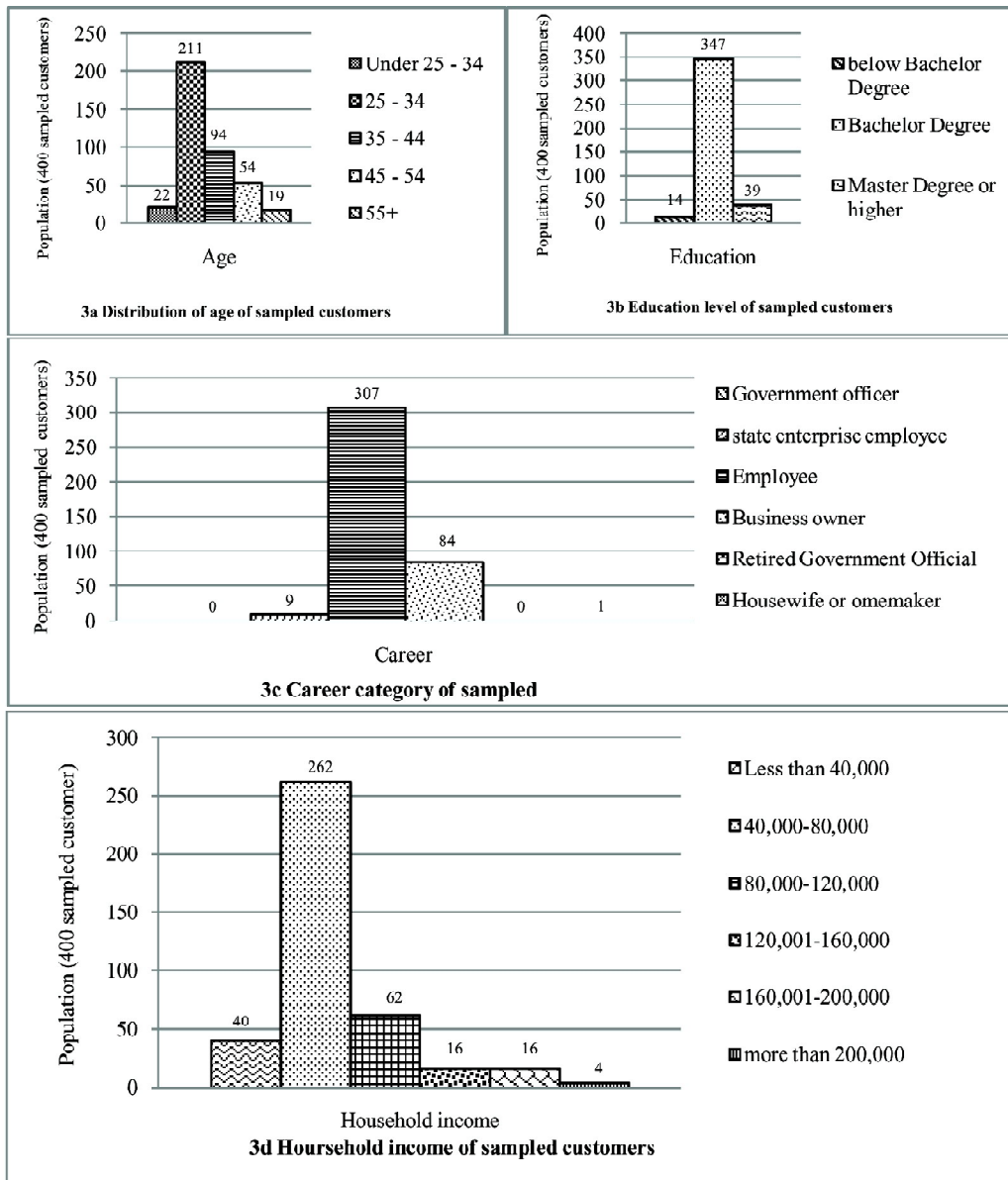


Figure 3a, 3b, 3c, and 3d Demographic of sampled customer

willingness to pay (Alberini and Kahn, 2006; Michell and Carson, 1998, Hanemann and Kanninen, 1996). The triple bounded is not necessary because it gains small efficiency (Hanemann and Kanninen 1998 and Cooper and Hanemann 1995).

The double bounded question leads the answer to dichotomous choice. Double bounded question gives result in Yes-Yes, Yes-No, No-Yes, and No-No (Cameron,

1988). The ordered Probit which is not discrete is therefore not appropriate whereas Tobit model is more complicate but give resemble result (Greene and Hansher, 2009). The willingness to pay could be called continuous random variable. The distribution could be Log-normal, Log-logistic, or Weibull. In this study, the Log-normal was selected because of its maximum likelihood. The goodness of fit is identified by Pseudo R² or Mc Fadden R² (Mc Fadden, 1974) ranging normally 0.2 - 0.4 whereas close to 1 theoretically (Verbeek, 2000; Harper et.al., 1990). The other valuation methods could be in various way but not be used in this research because of the time for consuming would disturb the one who answers e.g. bidding game or continuous negotiation and payment card of having income in hand (Boccaletti and Nardella, 2000). Besides CVM, there are contingent rating, contingent ranking, or paired comparison which need to show clearly attribute of each choice (Pearce and Ozdemiroglu, 2002).

Hanemann and Kanniene in 1991 had explained Probit model by giving B_i^0 , B_i^l and B_i^u as the starting bid, the lower follow-up bid, and the upper follow-up bid respectively.

Assuming that the log WTP (Willingness to Pay) is linearly dependent on the set of individual characteristics that is;

$$\log(WTP_i) = \mathbf{x}'_i \boldsymbol{\beta} + u_i \dots \tag{1}$$

If \mathbf{x}_i is $K \times 1$ vector of individual characteristics, $\boldsymbol{\beta}$ is a $K \times 1$ vector of parameter, and u_i is a disturbance term ($u_i \sim N(0, \sigma_u^2)$)

$$E(u_i u_j) \begin{cases} 0 & \text{if } i \neq j \\ \sigma_u^2 & \text{if } i = j \dots \end{cases} \tag{2}$$

$$\Pr(y_i = NN) = \Pr(WTP_i < B_i^d) = \Pr(\mathbf{x}'_i \boldsymbol{\beta} + u_i < b_i^d) = F_u(b_i^d - \mathbf{x}'_i \boldsymbol{\beta}) = \Phi\left(\frac{b_i^d - \mathbf{x}'_i \boldsymbol{\beta}}{\sigma_u}\right) = G_i^{NN} \tag{3}$$

$$\Pr(y_i = NY) = \Pr(B_i^d \leq WTP_i < B_i^0) = \Phi\left(\frac{b_i^0 - \mathbf{x}'_i \boldsymbol{\beta}}{\sigma_u}\right) - \Phi\left(\frac{b_i^d - \mathbf{x}'_i \boldsymbol{\beta}}{\sigma_u}\right) = G_i^{NY} \tag{4}$$

$$\Pr(y_i = YN) = \Pr(B_i^0 \leq WTP_i < B_i^u) = \Phi\left(\frac{b_i^u - \mathbf{x}'_i \boldsymbol{\beta}}{\sigma_u}\right) - \Phi\left(\frac{b_i^0 - \mathbf{x}'_i \boldsymbol{\beta}}{\sigma_u}\right) = G_i^{YN} \tag{5}$$

$$\Pr(y_i = YY) = \Pr(WTP_i > B_i^u) = 1 - \Phi\left(\frac{b_i^u - \mathbf{x}'_i \boldsymbol{\beta}}{\sigma_u}\right) = G_i^{YY} \tag{6}$$

The b_i^0 , b_i^d and b_i^u represent the natural log form of B_i^0 , B_i^l , and B_i^u respectively. Gathering all the terms above, the likelihood function can be written as;

$$L(\beta|X) = \prod_{i=1}^n \prod_{j \in J} (G_i^j)^{I_i^j} \tag{7}$$

Giving X is the matrix of individual with characteristic of $J = \{NN, NY, YN, YY\}$ namely the set of possible responses. The I_i^j is the indicator function taking value as follows;

$$I_i^j = \begin{cases} 1 & \text{if } y_i = j \\ 0 & \text{otherwise} \end{cases} \tag{8}$$

The parameters can be estimated by maximizing the likelihood function - $L(\beta|X)$, with respect to β .

$$\hat{\beta} = \underset{\beta}{\operatorname{argmax}} L(\beta|X) \tag{9}$$

The fitted value and the marginal effect can be calculated as follows, respectively:

$$\widehat{WTP}_i = e^{x_i' \hat{\beta}} \tag{10}$$

$$\frac{\partial WTP_i}{\partial x_{ik}} = (\hat{\beta}_k) e^{x_i' \hat{\beta}} \tag{11}$$

For Goodness of Fit, McFadden's pseudo R-squared can be used and for hypothesis testing, the likelihood ratio test can be used.

7. RESULT AND DISCUSSION

From 400 samples in figure 4, most of them, 168 samples have knowledge about the green product. The samples of 78 persons have belief in green label and 49 samples has food attitude in environment. The least group are 31 samples have emotional value in choosing green label product. For the additional willingness to pay to the green labeled electric shower unit water heater compared to the normal electric shower unit water heater, the doubled bound close-end showed the result that the increasing of bid causes the increasing of the group NN (refuse the willingness to pay two times even the second time the bid is only a half of the first proposed bid) likewise NY (refuse to pay for the proposed bid of the willingness to pay but accept when reduce to the half of the first bid). On the other hand, the trend of YY (say yes to pay the willingness to pay for the first proposed bid and still agree to pay even the bid is raised double) group is decreased likewise YN (accept the proposed bid but refuse when the bid is raised double). The result showed that the median and mean is 210.29 and 232.65 Baht respectively as in figure 5.

For the additional money paid to green label electric shower unit water heater, most of customer expected that the manufacturer would spend it for the reforestation as first order, environmental knowledge dissemination as second order, and support the research and development of the manufacturer as the third order. The number of each order is not different from one another i.e. 259, 214, and, 203 samples as in figure 6 respectively.

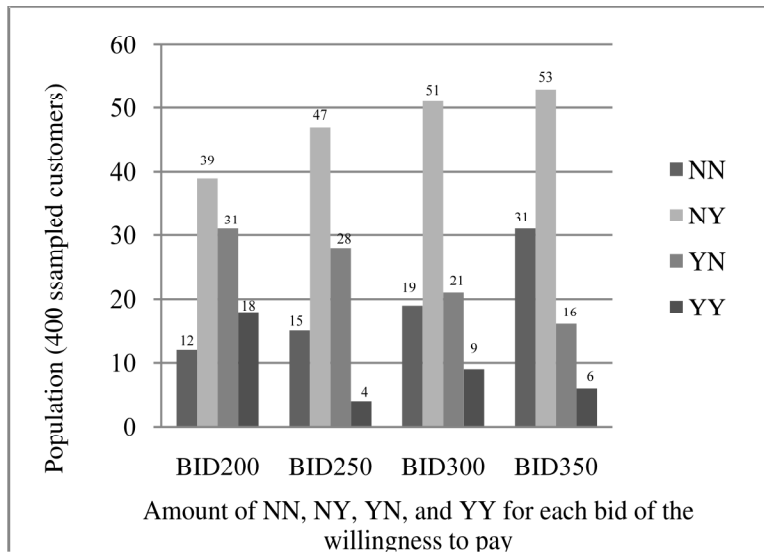


Figure 4: Amount of NN, NY, YN, and YY

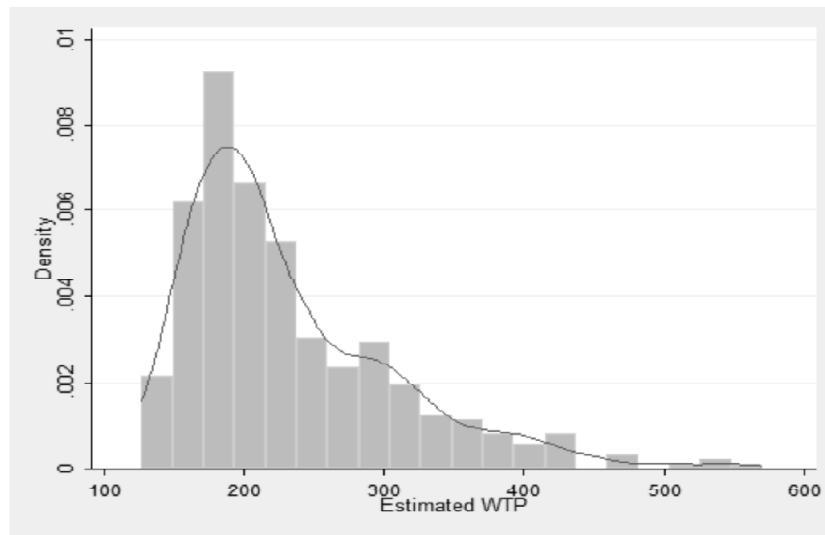


Figure 5: The estimated willingness to pay

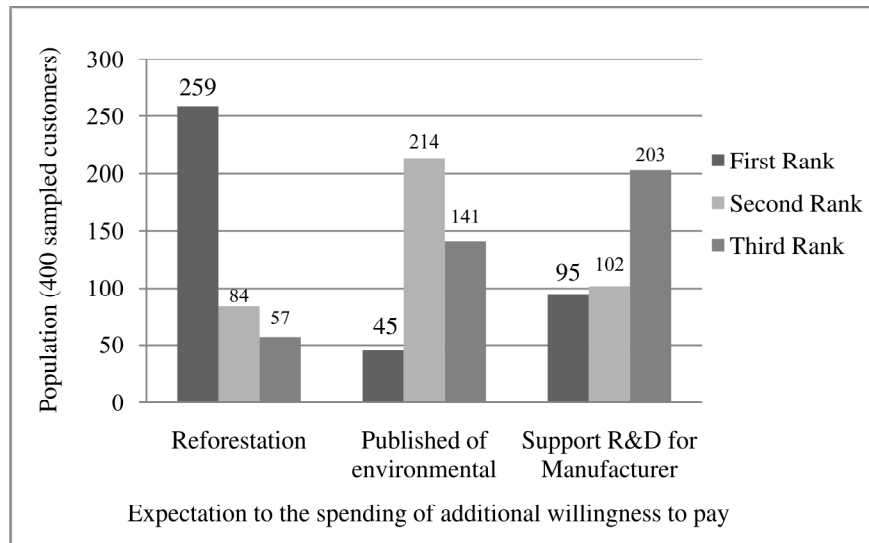


Figure 6: Expectation from samples to the spending additional willingness to pay

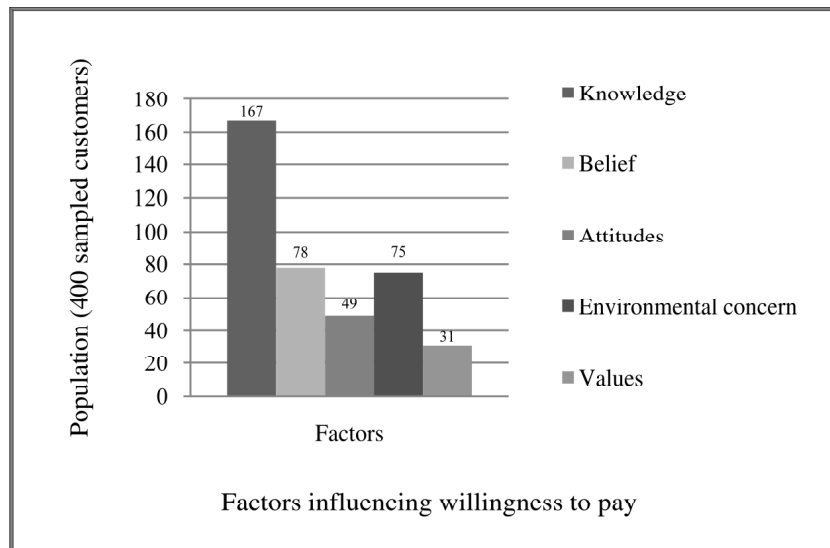


Figure 7: Factors influencing additional willingness to pay

To judge if the sample has knowledge of green label, the correct answers 3 from 4 questions was used as criteria which is enough as the information is too specific. For beliefs, attitudes, environmental concerns, and emotional values, the score of up to 3 from 4 marks in average was used as criteria. The result is shown in figure 7.

Putting the surveyed data both demographic factors and non-demographic factors the beta and its standard error is shown in table 3.

Table 3
Beta value of each independent variable in equation 1
 (Standard errors in parentheses and *** p<0.01, ** p<0.05, * p<0.1)

| | <i>Set 1</i> | <i>Set 2</i> |
|------------------------|-------------------------|------------------------|
| | Beta | Beta |
| Region C | | 0.127 (0.0946) |
| Region N | | 0.0271 (0.0715) |
| Region NE | | -0.144 (0.0913) |
| Region S | | -0.219* (0.120) |
| Female | -0.0478 (-0.0606) | -0.0504 (0.0623) |
| Married | 0.125 (-0.0806) | 0.110 (0.0792) |
| Age | 0.0172*** (-0.00482) | 0.0154*** (0.00498) |
| Bachelor | -0.359** (-0.157) | -0.303* (0.158) |
| Master or higher | -0.161 (-0.182) | -0.165 (0.184) |
| Log (Household income) | 0.180** (-0.0716) | 0.135* (0.0709) |
| Knowledge | | 0.0714** (0.0364) |
| Believe | | -0.0517** (0.0245) |
| Attitude | | -0.0181 (0.0197) |
| Environmental concern | | 0.0131 (0.0207) |
| Emotional value | | 0.0490** (0.0226) |
| Constant | 3.081*** (-0.752) | 3.913*** (0.840) |
| Sigma | 0.531*** (-0.0252) | 0.514*** (0.0245) |
| Observations | 400 | 400 |

From table 3, even the sampling is cluster type but for regional analysis the number of sampling in each region is not appropriate to analyze separately. The whole country analysis showed that, there are two sets of beta to compare the case of having all factors and only. The results for two cases are not significant different. The asterisk means the significant factors with its standard error in bracket.

This research studied the willingness to pay by using STATA software with the source code of Alejandro Lopez-Feldman for DoubleBoundedClose-Ended. The result showed that the people in southern has negative willingness to pay 21.9%. This would be the effect of hot and humid climate which can be seen also the least growth of sales in the south. The higher of age for one year increase the willingness to pay. This might be the reason of higher concern in health. The bachelor education reduces the willingness to pay 30.3%. The knowledge from studying may not be relevant to the willingness to pay causes the reluctant. The person who has income has positive willingness to pay 13.5% as the reason of affordable. The increase of knowledge, believe and emotional value, increase the willingness to pay 7.14%, 5.17% and 4.9% respectively as they are the factors supporting the green concept.

CONCLUSION

The adjusted double bounded close ended Probitmodel was used for finding the additional willingness to pay with the assumption of the Log-normal distribution of the disturbance. The mean additional willingness to pay is 210 Baht or approximately 105 million Baht per year for the total market in Thailand. The additional willingness to pay was expected by customer to be used in the reforestation activity. The additional willingness to pay from research reflected around 10 million baht per year to be used for environmental activity which has to be compared with the alternative of phasing out of the electric shower unit water heater and substituted by the ten times energy saving technologies e.g. hot water solar collector or hot water heat pump. To promote the green label would be appropriate for the short term of energy planning for the country but not as good as the hot water solar collector or heat pump in the long run.

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