A Study on the Factors Characterizing Willingness to Conserve Energy Among Urbanites

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Keywords: Energy, Energy Conservation Behaviour, Urbanites, Energy Conservation, Energy-Efficiency, Households.

Abstract: This study attempts to analyse the willingness to conserve electricity among urbanites of Bhopal city in central India. Willingness to conserve electricity is one of the core aspects of adopting a sustainable and energy-efficient lifestyle. Five hundred and fifty (n=550) energy-sufficient households having valid electricity meters were surveyed from different locations in Bhopal city. Data on energy conservation behaviour were analysed using binary logistic regression. Findings suggest that energy conservation willingness was higher among individuals who were educated, had high power and fuel expenditure with larger house space and size, with a high degree of interaction about energy conservation in the neighbourhood, demonstrating higher orientation of individual values, greater belief for energy conversation, higher subjective norms, sharper energy conservation attitude, higher perceived behaviour control and stronger behaviour intention. Psycho-social factors outweigh the socio-economic factors in predicting the willingness to conserve electricity. Policy implications of the findings have been discussed

1 INTRODUCTION

Rapid urbanization has resulted in a sharp rise in electricity consumption even in the hinterlands of India which has drawn the attention of researchers and policymakers toward electricity conservation among urban households to combat several climatic and environmental targets. Household energy conservation has assumed popularity among researchers in recent times against the backdrop of the oil supply shocks of the 1970s. Global warming, climate change and other threats to biodiversity make it necessary to study energy conservation behaviour (Gardner & Stern, 2002). Stern (2008) event goes to argue that home-based behaviour related to energy usage significantly affects our future, sustainability and environment. Therefore, it is imperative to realise a future energy system that is carbon-efficient, safe, and trustworthy. To achieve this goal, we need to give due importance to household as basic unit of assessment as suggested by Hayn, Bertsch, & Fichtner (2014). They have also established the significance of segmentation of household as per the residential electricity loading profile. Scholars have found family size, climate, appliance ownership, lifestyle, physical characteristics of a house and human energy behaviour as main antecedents for energy conservation behavior among urban population. (Baxter et al., 1986; Palmborg, 1986; Mullaly, 1998; Brandon & Lewis, 1999).

Therefore, predicting wiliness to conserve energy at households become crucial to study and we adopt theory of planed behavior framework for doing that as it has been found quite effective in promoting pro-social behaviour (Shepherd, Hartwick & Warshaw, 1988). This provides a basis for trying out a model merging TPB variables with other socio-economic and socio-demographic variables to predict the individual willingness to conserve energy.

In this study we attempt to find what factors directly characterise the willingness of human beings towards energy conservation. The study has operationalized the meaning of energy conservation behaviour in a way that it is limited to power/electricity conservation for the purpose of this research. Thus, household- centric energy conservation behaviour of individuals in Indian context becomes the focal point of this study. This

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Gandhe, R. and Joseph, S.
A Study on the Factors Characterizing Willingness to Conserve Energy Among Urbanites.
DOI: 10.5220/0012502100003792

In *Proceedings of the 1st Pamir Transboundary Conference for Sustainable Societies (PAMIR 2023)*, pages 712-717
ISBN: 978-989-758-687-3

study undertakes this by conducting a large-scale household survey, wherein households are proposed to be selected in a purposive manner. Energy conservation behaviour is function of many factors, i.e., values, beliefs, norms and attitude of individuals, culture, societal norms, socio-economic situation of households, pricing of electricity, consumption patterns or profile of individuals, technological upgradation or adaptation etc. Among all these, this study focuses the psycho-social factors associated with individuals like values, beliefs, norms, attitudes etc in general and attempts to explore their role in determining energy conservation in particular.

Finally, study attempts to ascertain whether people are willing to adopt simple and voluntary steps that contribute towards household electricity conservation? If yes, what factors characterise willingness to conserve energy among urbanites. The focus here is only on willingness to conserve electricity at households.

2 METHOD

2.1 Participants

Data were collected from urban areas of Bhopal. An interview schedule was carried out in outer region of Bhopal city to gauge the willingness of energy conservation behaviour among urbanites. The survey was conducted during daytime from 8AM-6PM.

Those who were available and agreed to participate in the survey were interviewed. Five-hundred and fifty households were surveyed, aged 18 years and above were interviewed.

Table 1. Sample profile

Variables	DS	Willingness (Yes)	Willingness (No)
Age	M(SD)	38.78(14.77)	38.30(14.61)
Gender: Male	N (%)	206(53.2)	88(54.0)
Female	N (%)	181(46.8)	75(46.0)
CFL LED: Not yet	N (%)	49(12.7)	18(11.0)
: Partially	N (%)	260(67.2)	115(70.6)
: Fully	N (%)	78(20.2)	30(18.4)
House type: Apartment	N (%)	182(47.0)	81(49.7)
Duplex	N (%)	134(34.6)	64(39.3)
Bungalow & Multi-storeyed	N (%)	71(18.3)	18(11.0)
Per capita AMFE	M(SD)	2067.75(1066.34)	1011.66(2118.98)
HH size: Up to 3 members	N (%)	148(38.2)	58(35.6)
more than 3 members	N (%)	239(61.8)	105(64.4)
PEEC: Don't know	N (%)	190(49.1)	64(39.3)
No	N (%)	73(18.9)	39(23.9)
Yes	N (%)	124(32.0)	60(36.8)

Source: Primary data

The interviewee average age was around 38.0 years among both the categories. More than 53.0% of respondent from both the categories were male and around 46.0% were female. Around two-third of respondents from both the categories were partially shifting towards CFL-LED, more than 18.0% were fully shifting whereas more than 11.0% of respondents from both the categories were not shifting towards it. Half of the respondents were living in apartment whereas around one-third were living in duplex and rest were living in bungalow and multi-storeyed. Average monthly fuel expenditure was Rs.2067.75 among willingness categories and almost half, Rs.1011.66 was among non-willingness categories. Almost two-third of the respondents were from both the categories were having more than three members in their houses whereas the rest of the respondents have up to three members in their houses. More than 40.0% of respondents from both the categories were not aware of their expectation of

energy conservation, around 20.0% were having no expectation and the remaining around one-third of respondent have expectation regarding energy conservation (Table1).

2.2 Measures

An interview schedule was developed to assess the willingness of energy conservation behaviour among the residents of Bhopal with different facets of energy conservation behaviour, value orientation of individuals, energy conservation belief, subjective norms, energy conservation attitude, perceived behavioural control and behavioural intention. The interview schedule was preceded by an informed consent form, socio-demographic details of the interviewee and his or her family members.

The item measuring variables were factor analysed, convergent validity and composite reliability were established. For a multi-item variable, the response score of the items were summated and divided by number of items to keep the score within the range of the response scale.

Willingness to reduce your energy consumption was willingness of the respondent to reduce their energy consumption. It was assessed on a two point scale from 1(=Yes) and 0 (=No).

Average monthly power expenditure was power expenditure of the family incurred on power in a month.

Avergae monthly incomeof the households was the monthly icnome of the family from all the sources.

Education was gauged from the respondents as number of years put into formal education. It was assesed as 1(=Non graduate), 2(= Graduate), 3(= Post-graduate or advance) and 4(= Professionally qualified).

Occupational situation was measured on nature of occupation carried out by the respondent. It was assessed as 1(=enterpreneur), 2(=Salaried), 3(=established business).

House space was measured as number of person living in a particular house. It was categorised as 1(= up to 3 member) and 2(= more than 3 member).

Ownership status was gauged from the respondent as the position of the house n which they are living. The response categories agaisnt each item were as 1(=Own) and 2(=Rented).

Neighbourhood interaction on energy conservation was measured on four-point Likert scale from 1(=Never), 2(= Very rarely), 3(=Sometimes), and 4 (= Quite often).

Value orientation of individuals was measured on three dimensions of egoistic (to control and dominate others, strive only for material possession and money in life, absolute rights to lead or command over others, impact on people and events around); altruistic value (Equal opportunity for all, enjoy peace, free of war and conflict, care for the weak and fight injustice in society, engage oneself with working for the welfare of others; bio-spherical value (protect natural resources and conserve energy, respect towards mother earth and its resource and try to live in harmony with other species, lead a life that is in unity with nature and fitting to it, efforts to protect the environment and protect the nature on a nine-point Likert scale from 1(=Not important) to 9(= Very Important).

Energy conservation belief, *Subjective norms*, *Energy conservation attitude, Perceived behavioural control* and *Behavioural intention* was gauged on a nine-point Likert scale with 1 indicting lowest possible scope to 9 indicating highest one.

All the variables and factors reported above had composite reliability (>.70) and convergent validity {Average variance extracted (AVE) >.50 to measure the construct or the factor.

2.3 Data Analysis

The filled in schedules were entered in the spread-sheet for analysis in SPSS-21. The data were analysed using descriptive statistics and binary logistic regression.

3 RESULTS

Per capita average monthly power expenditure and average monthly income of the household was more among non-willingness than willingness. Compared to willingness, non-graduate was slightly more than non-willingness family whereas there were more graduate, post-graduate, and professionally qualified among willingness than non-willingness, more entrepreneur, salaried, and established businessman, having little higher house space, more respondent having their own houses and rented, having neighbourhood interaction from different categories of never, very rarely, sometimes, quite often, slightly more from all the psychological variables like value orientation of individual, energy conservation belief, subjective norms, energy conservation attitude, perceived behavioural control, and behavioural intention.

The above factors described the awareness of people towards energy conservation but it did not disclose which factors characterises the awareness and non-awareness people regarding energy conservation.

Because of binary nature of outcome (1= awareness vs. 0= non-awareness), binary logistic regression was applied. Sixteen variables that were supposed to characterize the willingness vs. non-willingness were entered as explanatory variables— value orientation of individual, energy conservation belief, subjective norms, attitude, perceived behavioural control, behaviour intention, average monthly power expenditure, average monthly income expenditure, education from non-graduate, graduate, and professionally qualified, occupational situation, house space, neighbourhood interaction of energy conservation, and ownership status. Those were either coded as dummy variables or were continuous variables, shown in Table 2.

In logistic regression, values of odds ratios (ORs) with 95 per cent confidence interval were used to estimate logistic coefficients. ORs greater than 1 indicate an increased chance with probability > .50 of willingness against non-willingness. The logistic model significantly separated between willingness and non-willingness, χ^2 (8) = 15.49, p<.05. The model explains the 8.7% (Nagelkerke R^2) of the variance of willingness status and correctly classified 72.0% of cases. The variances of willingness were impressive with 87% correct prediction and of non-willingness were 50.3%.

The people who were willingness for energy conservation were more educated but the variance does not differentiate between willingness and non-willingness. When its affect was controlled occupational situation, neighborhood interaction, and ownership status did not differentiate between willingness and non-willingness. The silent characteristics associated with willingness as compared to non-willingness was higher value orientation of individuals, energy conservation beliefs, subjective norms, energy conservation attitude, perceived behavioral control, behaviour intention, average monthly power expenditure, average monthly income of households, occupational situation, and house space because the 95% confidence interval of ORs of these indicators did not contain a value less than one (Table 2).

Table 2. Variable predicting willingness for energy conservation

Variables in the equation	β	SE	df	Sig.	Odds ratio	95% CI for Exp. (β)	
						Lower	Upper
AMPE	.00	.00	1	.37	1.00	1.00	1.00
AMIH	.00	.00	1	.18	1.00	1.00	1.00
Education: NG	-.30	.35	1	.39	.74	.37	1.47
: Graduate	-.51	.26	1	.04	.60	.36	.99
: PQ	-.40	.28	1	.16	.67	.39	1.17
Occupational Situation: EB	.00	.24	1	1.00	1.00	.62	1.60
: Entrepreneur	.01	.37	1	.98	1.01	.49	2.10
House space	.00	.00	1	.47	1.00	1.00	1.00
NIEC: N	-.29	.10	1	.00	.75	.62	.90
Ownership status: Owned	-.82	.28	1	.00	.44	.25	.76
VOI	-.00	.01	1	.90	.99	.99	1.01
ECB	.01	.00	1	.07	1.01	1.00	1.02
SN	.00	.01	1	.97	1.00	.99	1.01
ECA	.01	.00	1	.20	1.01	1.00	1.01
PBC	.00	.01	1	.49	1.00	.99	1.01
BI	.01	.01	1	.43	1.01	.99	1.02
Constant	.17	.77	1	.82	1.19		

4 DISCUSSION

This study investigates the factor characterizing the willingness of people towards energy conservation behavior and binary logistic regression was performed using data collected from 550 households for identifying factors. Here only one from of household energy i.e., electricity has been considered. Energy is a challenging issue across the world, which leads its inclusion into sustainable development goals (UNDP, 2015).

Average Monthly Income of the Household (AMIH) and Average Monthly Power Expenditure (AMPE) were the two major socio-economic factors responsible to explain their willingness to conserve energy. Households with large income normally occupy houses with large spaces which enhance their power expenditure making them conscious towards energy bills. As electricity units consumed over & above a certain limit, they are charged with higher tariff. House-space therefore also emerges as a factor that influence the energy conservation decision of the households. Occupational situation also emerged as a major factor that characterize energy conservation behavior. In our data, respondents were either entrepreneur, salaried or had established business in our sample. Entrepreneurs and people with established business were found to be more concerned towards energy conservation as opposed to salaried people which is quite logical as entrepreneur and established businessman are more concerned about saving energy because of low input cost in their business which is ultimately going to increase their profit. The ownership status was also found to contribute towards reducing their electricity bills more so in case of house being occupied by the home owners. Households with rented accommodation did not show same level of interest in saving energy.

These findings are consistent with previous findings where home ownership along with high income of the household, social context and household energy conservation practices are the factors responsible for energy conservation behaviour to be executed. Home owners and high-income households are more likely to invest and therefore more willing to invest in conserving energy than renters and low-income households. Factors associated with house space & building characteristics and income too, are among most dominant influencers towards household energy usage. Abdullah et al. (2019). Energy conservation technology adoption is the manifestation of willingness to conserve energy. It is normally the owner of the house who is takes the decision to invest / adopt in new technologies that lead to energy conservation. Recently, Zedan S & Miller W (2017) also suggest that owner occupied housing cases are more prone to conserve energy in urban households in their study using social network analysis.

All the six psychometric variables—(i) value orientation of individuals (ii) energy conservation belief (iii) subjective norms (iv) energy conservation attitude (v) perceived behavioural control and (vi) behaviour intention, all were contributing to individual perception of willingness for energy conservation. These findings are consistent with this widely established understanding that psycho-social aspects thus predict the willingness, and intent to conserve energy or any such pro-social behaviour. In last one decade, studies using Norm Activation Model (NAM), Value Beliefs and Norm (VBN) theory and Theory of Planned Behaviour (TPB) have argued emphatically the role of factors associated with *Values, Beliefs, Norms, Attitudes*, *Perceived Behavioral Control* and *Behaviour Intention* (Abrahamse, W., & Steg, L., 2011; Zhang Y. et al, 2013; Werff Ellen van der & Steg L. 2015).

5 CONCLUSION AND POLICY IMPLICATIONS

Each of these findings have critical policy implications. First, regardless of the socio-economic and socio-demographic realities, energy conservation willingness can still greatly be influenced and shaped by psycho-social factors, therefore interventions and programmes that promote appropriate values, beliefs, develop certain normative behavioural standards, shapes & builds right attitudes, and are potentially capable of inducing intention to promote energy conservation in society any form, must be encouraged. Second, the technology-based approach of employing green and energy efficient equipment has its limitations so far as energy conservation for household is concerned as *rebound effect* will always be at play, nonetheless it doesn't suggest that ways & means other than those associated with influencing human psyche are not be pursued for energy conservation (Lorna A. et al 2000; Ouyang J. et al, 2010).

Among the psycho-social factors, beliefs, norms attitudes can be influenced directly therefore social campaigns and different socio-economic interventions can be planned for influencing them towards improving the will and intent of the individuals to conserve energy. Some suggestions could be 1) role of the housing associations can be

revisited to influence factors like attitudes greatly adopting feedback of peer organizations and feedback from authorities as suggested by Egmond et al (2005), 2) electricity provider companies can send regular feedback reports which can do wonders by inducing, subjective, personal and injunctive norms. In this context case of OPOWER presented by Allcott, (2011) can be a good example. Similar non-price interventions can be thought in India to promote energy efficient behaviour. Effective social campaigns with cogent communication strategies can help change the beliefs of common urbanite pertaining to urgency of energy conservation. Finally, price-based interventions like offering subsidy on energy bill if the consumption remains to a certain limits and other innovative experiments can be planned to achieve the targets for energy conservation in any form.

So far as pricing strategy is concerned, one such scheme is already being implemented in the state of Madhya Pradesh, where residents under *Atal Grih Jyoti Yojana* are charged for all units consume only if they consume more than 150 units of electricity. If the consumption remains within a limit of 150 units, then the bill per unit is waived off. This scheme has been very effective in making many households willing to keep their electricity usage within 150 units in Urban areas of the state of Madhya Pradesh, India.

One more interesting policy implication is the combined effect of monthly income & expenditure along with occupational situation. All of three aspects significantly influence the willingness to conserve energy (see result: Table 02), which indicates that entrepreneurs are more willing to conserve electricity. A country like India which is one of the youngest nations and has immense potential for start-ups, chances are bright that more and more population will be willing to conserve energy when we combine it with the fact that new start-ups can't spent enormously and have to be more disciplined with their expenditure on any aspects including power. When more households would be self-dependent on their new enterprise, energy conservation specially in terms of electricity will then gain the momentum in India.

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