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Research Article

Consumer's Willingness To Purchase Energy-Efficient Home Appliances: An Analytical Study In Delhi/Ncr

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ABSTRACT

This research study employs a comprehensive methodology to investigate the awareness, preference, and willingness to pay for energy-efficient appliances [EEA] among consumers in India. The research design utilizes a descriptive and analytical approach, with data collection conducted through a structured questionnaire. simple random sampling is employed to ensure representation by given diversity of the population. The study's findings reveal critical insights into consumer behaviour and perceptions. It examines the awareness levels of EEA, consumer preferences for specific attributes in home appliances, and the extent to which consumers are willing to invest in energy efficiency. Hypotheses are formulated and tested to draw conclusions based on the research objectives. Data analysis techniques, including structural equation modelling were applied to decipher the results, providing valuable insights into consumer behaviour patterns. By elucidating awareness gaps, preference factors, and willingness to invest in energy efficiency, this research strives to foster a more sustainable and energy-conscious consumer landscape in India. Recommendations for further research and policy enhancements are discussed, underscoring the study's potential to shape the future of EEA adoption in India.

KEYWORDS: Energy-efficient appliances, willingness, awareness levels, consumer behaviour, consumer perception.

INTRODUCTION

Energy efficiency gives a competitive edge, mitigates negative environmental repercussions, and contributes to energy sustainability initiatives. Energy efficiency is comprised of three components: energy conservation, fuel substitution, and enhanced energy management. Additionally, it entails the proper exploitation of energy carriers and necessitates their increased efficiency. Controlling useable sources, using energy transporters, and boosting energy efficiency are critical issues. Additionally, it encompasses mitigating adverse environmental consequences. It boosts its acceptance from a social and economic standpoint. It entails community engagement that is affordable in light of the economic climate and manner of life. There are also scientific ways for determining energy efficiency. It contributes to increased energy efficiency. Life cycle analysis may be used to enhance the environment. These have resulted in observable benefits for energy sustainability. This results in a broader societal transformation necessary to attain overall sustainability. Energy proficiency is perceived to mean the usage of energy in the most financially savvy way to do an assembling cycle or offer a support, by which energy squander is limited and the general utilization of essential energy assets is decreased. All in all, energy productive practices or frameworks will look to utilize less energy while leading any energy-subordinate movement: simultaneously, the comparing (negative) natural effects of energy utilization are limited. Different approaches to characterizing energy effectiveness are talked about beneath in box 1. It tends to be valued that energy effectiveness is an expansive term and there are different approaches to involving it in reality. The particular definition relies upon the specific situation and — in the manner it is utilized — it addresses a proportion of result to energy input (or obviously the converse, energy input per characterized yield). A large

portion of energy consumption is attributed to the use of fossil fuels. There is a restricted amount of these available. They are extracted underground. Fossil fuels include coal, oil, tar, oil shale, natural gas, and peat. These are essential components of energy sustainability and are known as energy carriers. These conventional and non-fossil fuel energy options don't deal with environmental issues like climate change. In their most basic form, these energy carriers are not immediately helpful. However, this conversion process has an impact on the environment when they are transformed into fuel that is useful. Any type of energy can be saved by applying the following three ideas: reduce, reuse, and recycle.

RESEARCH OBJECTIVES

The objective for the exploration is to give answers to all questions by the using logical strategies. The primary focus of the examination is to figure out reality which has not been uncovered yet.
RO1: To determine the relationship between environmental knowledge of consumers and consumer attitude towards energy efficient appliances.
RO2: To determine the relationship between consumer attitude towards energy efficient appliances and willingness to purchase energy efficient appliances
RO3: To determine the relationship between environmental knowledge and perceived Behavioral Control.
RO4: To determine the relationship between perceived Behavioral Control and willingness to purchase energy efficient appliances.
RO5: To determine the moderate relationship between consumer attitude towards energy efficient appliances and Behavioral Control.
RO6: To determine the moderate relationship between perceived Behavioral Control and Energy efficient appliances.

HYPOTHESIS OF THE RESEARCH

Ha1: There is a significant relationship between environmental knowledge and consumer attitude towards energy efficient appliances
Ha2: There is a significant relationship between consumer attitude towards energy efficient appliances and willingness to purchase energy efficient appliances.
Ha3: There is a significant relationship between environmental knowledge and perceived Behavioral Control.
Ha4: There is a significant relationship between perceived Behavioral Control and willingness to purchase energy efficient appliances.
Ha5: consumer attitude towards energy efficient appliances moderately affects the perceived Behavioral Control.
Ha6: Perceived Behavioural Control moderately affects consumer attitude towards energy efficient appliances.

SCOPE OF THE STUDY

❖ Functional Scope

Functional scope of the study is to analyze and evaluate the consumer's willingness to purchase energy-efficient appliances: an empirical study.

❖ Geographical Scope

The study conducted in India on consumer behaviour and preferences regarding energy-efficient home appliances in India. This study aims to investigate the level of awareness among consumers about energy-efficient appliances, their preferences for such appliances, and their willingness to pay a premium for energy-efficient features. Delhi/NCR is the region for this research study. The study covered the area – delhi, noida, gurgaon, Ghaziabad, Faridabad.

Figure : Delhi/NCR Map

TARGET POPULATION

The target population includes the consumers who are using energy efficient appliances in DELHI/NCR.

SAMPLE SIZE

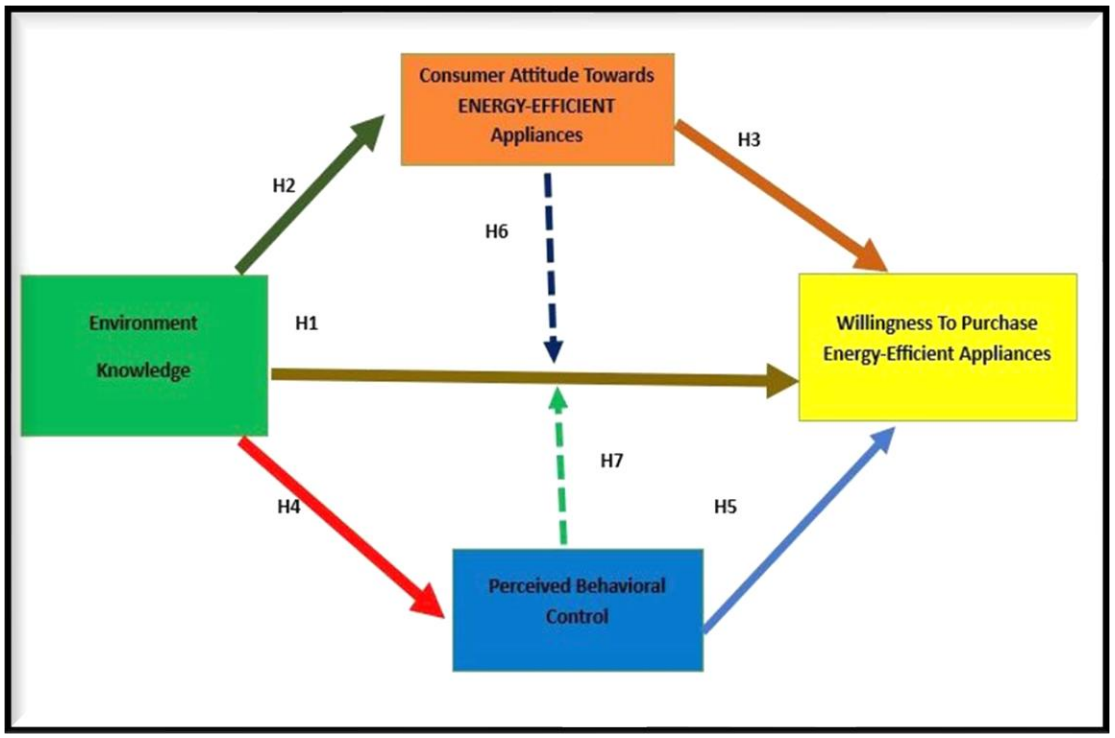
Sample size of 586 was drawn for this research study.

COMPOSITION OF THE SAMPLE

S.No	Name of Store	Location	Number of Consumers
1	Samsung Electronics	Gurgaon	18
2	LG Electronics	Noida	58
3	Bosch	Delhi	46
4	Whirlpool	Gurgaon	26
5	Panasonic	NOIDA	58
6	Godrej	Ghaziabad	41
7	Haier	Delhi	26
8	Hitachi	Faridabad	36
9	Voltas	Faridabad	35
10	Philips	NOIDA	45
11	Havells	Delhi	26
12	Usha	Noida	56
13	Bajaj	Ghaziabad	44
14	Lifelong	Gurgaon	26
15	IFB	Noida	45
	Total=15	**Total=15**	**Total =586**

CONCEPTUAL FRAMEWORK

A Conceptual framework is a visual representation that helps to illustrate the expected relationship between cause and effect.



HYPOTHESIS TESTING

For analyzing hypothesis from 1-6, analysis was performed by identifying factors and confirming these factors by applying CFA and EFA "confirmatory factor analysis is used to test whether measures of a construct are consistent with a researcher's understanding of the nature of that construct.

"KMO and Bartlett's Test"		
"Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.746
Bartlett's Test of Sphericity	Approx. Chi- Square	7632.47
	df	625
	Sig."	0

EFA: EXPLORATRY FACTOR ANALYSIS

Exploratory Factor Analysis (EFA) is a statistical method used to uncover the underlying structure of a relatively large set of variables. EFA is a technique within factor analysis whose overarching goal is to identify the underlying relationships between measured variables. It is commonly used by researchers when developing a scale (a *scale* is a collection of questions used to measure a particular research topic) and serves to identify a set of latent constructs underlying a battery of measured variables. "As a prerequisite, the KMO and Bartlett's test of sphericity was run to check data suitability for EFA. It is seen that Bartlett's test of sphericity was significant (χ 2 (625) = 7632.47, p<.05". "Kaiser-Meyer-Olkin Measure of Sampling Adequacy–This measure varies between 0 and 1, and Kaiser-Meyer-Olkin Measure of Sampling Adequacy value is .746 which is closer to 1 which is good so Kaiser-Meyer-Olkin Measure of Sampling Adequacy is good".

CONSTRUCT LOADINGS

	Consumer Attitude towards energy efficient appliances	willingness to purchase energy efficient appliances.	Environmental knowledge of consumer	perceived Behavioral Control
CA1	0.806			
CA2	0.843			
CA3	0.842			
CA4	0.765			
CA5	0.678			

WP1		0.716		
WP2		0.871		
WP3		0.875		
WP4		0.804		
WP5		0.678		
EK1			0.880	
EK2			0.875	
EK3			0.801	
EK4			0.791	
EK5			0.681	
PBC1				0.869
PBC2				0.901
PBC3				0.854
PBC4				0.871
PBC5				0.789

CFA: CONFIRMATORY FACTOR ANALYSIS

It is a theory driven confirmatory statistical technique (Schreiber, Stage and King, 2006). It used to verify the factor structure of a set of observed variables and test the hypotheses to test the relationship between observed variables and their underlying latent constructs (Suhr, 2006). Theoretical knowledge or empirical research or both are applied together to postulate prior relationship patterns in a research model and then tests the hypotheses statistically. The independent variables are unobserved constructs, also known as factors, dimensions or latent variables. CFA is a way to specify which variables load onto which factors (Jonathan, 2011). Unlike exploratory factor analysis (EFA), the researcher must specify all the aspects of the CFA model in advance (Brown, 2006). In addition to its greater emphasis on theory and hypotheses testing, it provides many other analytic possibilities that are not available in EFA. The hypothesized measurement model tests model fit through investigation of model specification, model identification, model estimation, model evaluation and identification. Thus, for the purpose of evaluating the research model on the basis of CFA and SEM, it was decided to report the following goodness of fit indices: chi square and the degrees of freedom, normed chi-square, RMSEA, SRMR, GFI, AGFI, CGI, NNFI . The first run of the PLS was used to check that the outer loadings of the indicators were above the threshold of β=0.7

Model Fit Measures	
"Measure	**Estimate"**
RMSEA	2619.423
DF	646
SRMR	2.342
CGI	0.71
SRMR	0.278
NNFI	0.04
AGFI	0.05

Table: Summary of Cronbach's alpha, Composite Reliability and Average Variance Extracted (AVE)

Variables	Cronbach's Alpha	Composite Reliability	Average Variance Extracted(AVE)
environmental knowledge	0.852	0.895	0.631
consumer attitude towards energy efficient appliances.	0.924	0.939	0.660
willingness to purchase energy efficient appliances	0.932	0.945	0.711
perceived Behavioral Control	0.867	0.908	0.669

			Regression Weights				Standardized Regression Weights
			Estimate	**S.E.**	**C.R.**	**P**	**Estimate**
CA1	<---	CA	1				0.34
CA2	<---	CA	0.72	0.12	6.67	***	0.67
CA3	<---	CA	0.67	0.13	4.67	***	0.87
7CA4	<---	CA	1.05	0.18	8.54	***	0.45
CA5	<---	CA	1.23	0.19	7.48	***	0.23
EK1	<---	EK	1.78	0.11	9.54	***	0.53
EK2	<---	EK	1.58	0.5	7.4	***	0.76
EK3	<---	EK	3.16	0.34	10.03	***	0.67
EK4	←-	EK	1.00	0.33	8.98	***	0.72
EK5	←-	EK	0.687	0.06	7.65	***	0.68
WTP1	<---	WTP	0.7	0.04	13.37	***	0.87
WTP2	<---	WTP	0.53	0.05	12.23	***	0.75
WTP3	<---	WTP	0.79	0.04	13.5	***	0.67
WTP4	<---	WTP	0/891	0.03	14.01	***	0.54
WTP5	<---	WTP	0.78	0.03	11.23		0.88
PBC1	<---	PBC	0.892	0.09	12.785	***	0.73
PBC2	<---	PBC	0.74	0.02	11.43	***	0.62
PBC3	<---	PBC	1.08	0.04	15.38		0.77
PBC4	<---	PBC	1.14	0.02	14.54	***	0.75
PBC5	<---	PBC	1.12	0.3	13.65	***	0.58

STRUCTURAL EQUATION MODELLING

Structural Equation Modelling (SEM) is a methodology for representing, estimating, and testing a network of relationships between variables (measured variables and latent constructs). (Hair, Anderson, Tatham and Black, 1998; Suhr, 2006). SEM tests hypothesized patterns of directional and non-directional relationships among a set of observed (measured) and unobserved (latent) variables. It helps in understanding the patterns of correlation/covariance among a set of variables and also explains as much of their variance as possible with the model specified (Kline, 1998). SEM determines whether any relationship exists between the variables and along with CFA,it enables to accept or reject a hypothesis framed in accordance with the proposed research model (Sharif, 2013).

PATH ANALYSIS AND HYPOTHESES TESTING

The values of the standardized coefficients of the structural relationships (SEM), and the respective levels of significance of their associated t-statistic, it should be noted that 6hypotheses could not be rejected. The effect of energy efficient appliances on their consumer satisfaction level turned out to be significant; we could not reject, Ha1 There is a strong relationship between environmental knowledge and consumer attitude towards energy efficient appliances. There is a strong relationship between consumer attitude towards energy efficient appliances and willingness to purchase energy efficient appliances, we could not reject Ha2. Also, there is a strong relationship between environmental knowledge and perceived Behavioral Control, we could not reject Ha3. The result of the present study confirms that there is a strong relationship between perceived Behavioral Control and willingness to purchase energy efficient appliances. The study confirms that the consumer attitude towards energy efficient appliances moderately affects the perceived Behavioral Control, we could not reject Ha4. Also, it is confirmed that perceived Behavioural Control moderately affects consumer attitude towards energy efficient appliances, we could not reject Ha5. perceived Behavioral Control moderately affects consumer attitude towards energy efficient appliances , we could not reject H6.

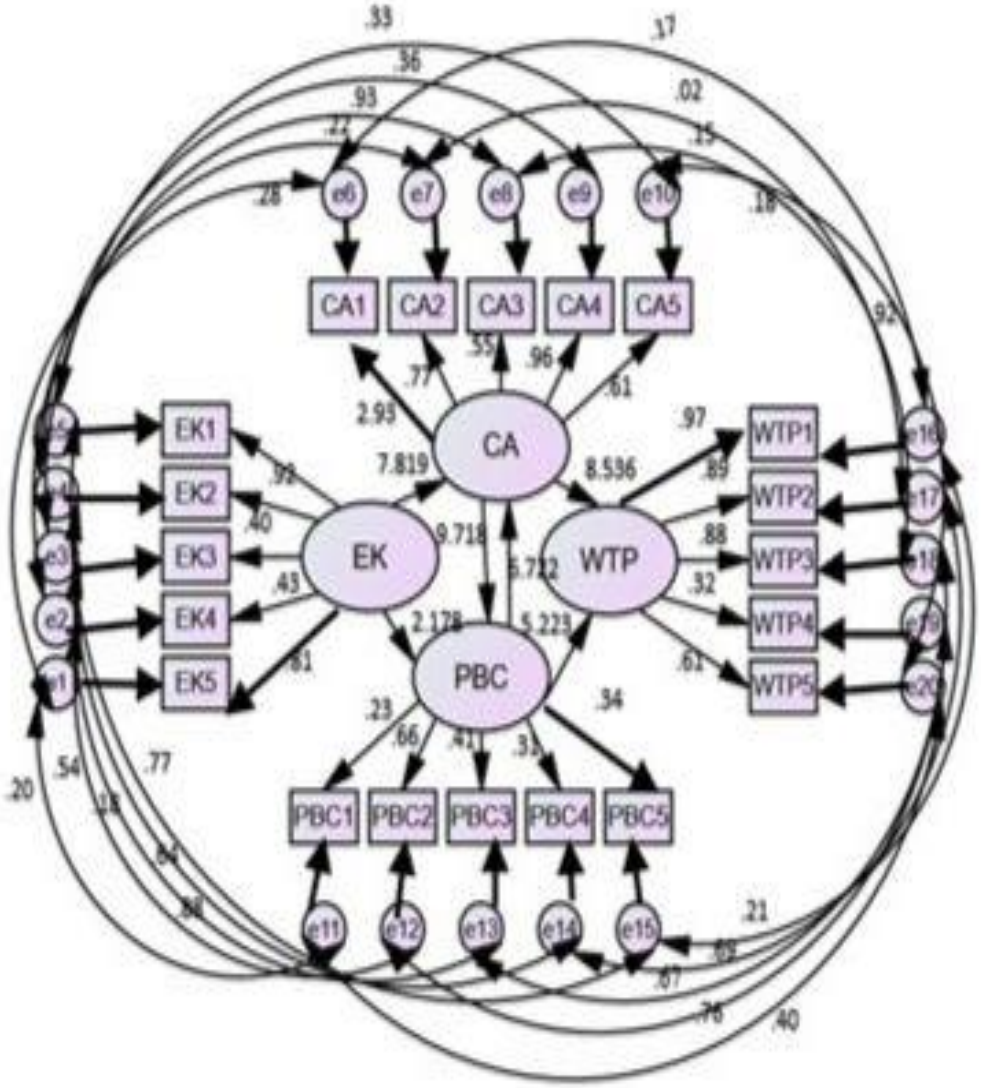


Figure: Structural Equation Modelling (SEM)-model measurement &Conceptual model estimation

Table: Summary of SEM Results and Hypotheses Testing

Hypotheses	Structural relation	Path coefficient	Standarddeviation	t-static	P	Contrast
H2	EK → CA	0.639	0.214	7.819	0.000	Supported
H3	CA → WP	0.423	0.312	8.536	0.000	Supported
H4	EK → PBC	0.793	0.248	2.718	0.000	Supported
H5	PBC → WP	0.775	0.464	5.223	0.000	Supported
H6	CA → PBC	0.879	0.381	9.718	0.000	Supported
H7	PBC → CA	0.541	0.336	5.722	0.000	Supported
Notes: R^2(EK) = 0.70; R^2(CA) = 0.540; R^2(WTP) = 0.524; R^2(PBC) = 0.718						

DISCUSSIONS OF STRUCTURAL EQUATION MODELLING (SEM) RESULTS

For the present study structural equation modelling fitted the best among other models because all variables significantly and positively supported other variables. The p value in every case is found to be less than 0.05, when testing the hypothesis for the regression coefficient which means that above hypothesis is accepted. The structural relation was established between environmental knowledge and consumer attitude and it was found that there is significant relation between environmental knowledge and consumer attitude. The structural relation between consumer attitude to wars energy efficient appliances and willingness to pay found significant as it shows what consumer thinks and how much they prefer energy efficient appliances. By applying structural relation between environmental knowledge and perceived consumer behaviour which shows that consumer

awareness and advertisement and other information of the appliances all impacts the consumer behaviour. There is a significant relation between perceived consumer behaviour and willingness to pay by observing structural relation it was found that, it depends in the consumer willingness that how much they want to use energy efficient appliances. By structural relation analysis it was found that consumer attitude towards energy efficient appliance's moderately affects perceived consumer behaviour and same has been found in last hypothesis that perceived consumer behaviour moderately affects consumer attitude towards energy efficient appliances. . One key insight is the need for targeted education and awareness campaigns to address any existing misconceptions or gaps in knowledge regarding EEA. By providing clear and accessible information about the benefits and features of energy-efficient appliances, consumers can make more informed decisions about their purchases. Moreover, emphasizing the long-term cost savings and environmental impact of EEA could further motivate consumers to choose energy-efficient options. The study underscores the significance of implementing comprehensive education campaigns, targeted marketing strategies, and supportive government and industry initiatives to promote energy-efficient appliances [EEA].

HYPOTHESES RESULT

S.NO	HYPOTHESIS	RESULT
Ha1:	There is a significant relationship between environmental knowledge and consumer attitude towards energy efficient appliances	Accepted
Ha2:	There is a significant relationship between consumer attitude towards energy efficient appliances and willingness to purchase energy efficient appliances.	Accepted
Ha3:	There is a significant relationship between environmental knowledge and perceived Behavioral Control.	Accepted
Ha4:	There is a significant relationship between perceived Behavioral Control and willingness to purchase energy efficient appliances.	Accepted
Ha5:	consumer attitude towards energy efficient appliances moderately affects the perceived Behavioral Control.	Accepted
Ha6:	perceived Behavioral Control moderately affects consumer attitude towards energy efficient appliances.	Accepted

CONCLUSION

The findings from the above analysis depicts that be the energy saver for the earth favour. Energy saved; energy gained. People utilize electric energy for a variety of reasons in a modern majority population living around the world. Numerous innovative energy generation and energy efficiency initiatives are underway worldwide. Efforts are being made to maximize the efficiency of energy generation, storage, transmission, and utilization. Simultaneously, the demand for electric energy has expanded significantly. It is projected that in the next years, the annual electricity consumption will be many times that of the prior few decades. In our country, India, the majority of electric energy is now generated by the combustion of fossil fuel; coal. Additionally, it is projected that fossil fuels will deplete dramatically in coming decades. Electric energy is also squandered in transit, which adds to the waste load. The current situation indicates that there is widespread consensus at all levels that there is a genuine need to save available electric energy through improving energy efficiency and, ultimately, energy sustainability. The primary reason for conducting research in this field is to make attempts to identify ways to try to achieve energy efficiency to the extent possible when it is used through electrical home appliances. Such type of efforts also helps to conserve natural resources and protect environment from adverse effects to some extent possible, while it is used through electrical home appliances. A general rule is to consume it in such a manner that it does not have a negative impact on the environment while also savings in expenses on energy consumption so that it may be used by future generations without feeling its scarcity. Thus, sustainability entails reducing carbon emissions, protecting the environment, transitioning to renewable energy sources, and maintaining a stable environment. As a result, when efforts are made, ecology is protected. Additionally, it promotes fresh discoveries that avoid having a detrimental influence on the society. Sustainability also takes into account the preservation of human civilization and the efforts to make natural resources more sustainable.

. As a result, conserving energy becomes critical. Economic advances are resulting in an improvement in people's quality of life and a reduction in their financial load. Social developments contribute to raising public understanding of regulation and public health protection against pollution and other negative consequences of business. Additionally, it maintains access to essential natural resources without impairing living standards. Sustainability literacy teaches about environmental conservation and the dangers that might occur if issues are not handled in a timely manner.

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