

MEDIATING EFFECT OF CONSUMER BEHAVIOR ON THE INTENTION OF SELF GENERATION AND ENERGY CONSERVATION IN SRI LANKA

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ABSTRACT

This paper explores the mediating effect of subjective norms and perceived behavioral control of consumers on running their generators under the self-generation scheme of the Ceylon Electricity Board (CEB). 300 self-generating consumers in Colombo and Kalutara districts were investigated by means of structured questionnaire interviews to ascertain the nature of the issues prevailing with respect to the different incentive schemes introduced by the CEB. The data analysis was carried out using the Structural Equations Modeling technique available in AMOS 25 software package. The findings show that the bulk supply consumers who possess standby and prime power generators were found to be not financially strong to fully operate, the existing equipment too old and having poor performance, lack of fuel storage capacities at sites, environmental issues, lack of firm power to cover entire organization with available resources, high cost of generator spare parts, services and maintenance, lack of trained staff and bad previous experience on given incentive schemes etc. However, 70% of generator owners stated that the financial grant offered by the utility is insufficient to run their own generators whilst 33% of them do not possess the prime power to cater their total demand. 24% of industrial consumers want CEB to hire a generator for them to operate during power outages considering the poor incentive level. At the same time, 47% of consumers expected a financial grant or possible incentive to be paid in advance in order to relieve them from the additional financial burden coming to their core business. 67% of consumers requested a pre-declared self-generation period at least for a couple of months every year as is the common practice in many public utilities on the conservation aspect. Furthermore, the AMOS output shows that there is a significant mediation effect of consumer behavior on financial incentives over the running of their

own generators in the absence of national grid power. However, there is no significant covariance between incentives, tariff regimes and energy savings new technology products. In order to encourage the self-generation scheme introduced by CEB, the presence of mediation power of consumer behavior over the incentive schemes and technology improvements is an essential component which was unearthed in this study. However, it was found that there is no mediating effect of consumer behavior on the tariff regime and the consumer intention on self-generation which is beyond their control. The findings of this research can be utilized for policy and tariff designing and formulating incentive mechanisms in the energy utilities in other emerging economies as well.

Keywords: Electricity, consumer behavior, incentive schemes, power interruptions, self-generation.

1. Background

Electricity is a versatile tool which enhances living standards and brings comfort in day to day activities. It starts and ends the day with hundreds of processes, flows and mechanisms to facilitate human activities. When there is no electricity, people worry and it paralyzes the entire economic system. Ceylon Electricity Board (CEB) mainly depends on hydro power plants with few major thermal generations. Recently one major power plant (Norochcholai) failed and the entire country experienced the discomfort of the loss of generation. At the same time, the failure of timely monsoon rains has also created a mishap and hence, power saving, energy conservation, self-generation, etc. have come into the picture. The motivation and the incentive schemes to conserve electricity play a vital role at this juncture and those have become today's hot topics in many energy forums. Most of the industrial consumers considered in this study possess standby generators and their capacities exceed 250kVA. In the light of the power shortage, CEB has introduced an incentive scheme to encourage those consumers to run their own generators in the absence of grid power. However, many of the generator owners are reluctant to run their own generators due to various reasons. As per the recent incentive mechanism introduced by CEB, Rs.36.00 will be paid for every unit generated by their own generators. However, most industrial consumers are complaining that the offered grant is marginal and insufficient to run their generators even at zero profit. In this context, it is important to explore the different issues prevailing with the use of self-generation for conserving grid power during the non-function of the major power plants in the system.

1.1 Research Questions

- i) What are the issues prevailing with respect to self-generation schemes in Sri Lanka?

- ii) What is the consumer perception on self-generation related incentive mechanisms, tariff regimes, and new technology products and processes available in Sri Lanka?
- iii) What are the important factors which mediate the change in consumer behavior and intention of change in behavior for encouraging self-generation in Sri Lanka?
- iv) What are the policies and guidelines needed to encourage self-generation schemes in Sri Lanka?

1.2 Research Objectives

This study is focused on the following objectives;

- i) To find out the motivating forces to encourage self-generation in Sri Lanka.
- ii) To find out the mediating effect of consumer behavior over self-generation and thereby conservation of national grid power in Sri Lanka.
- iii) To derive policies and guidelines to encourage self-generation in the absence of sufficient grid power and thereby conserve electricity in Sri Lanka.

2. Literature Review

In general, incentives create motivation in the human mind and change the intention on behavior (Locke, 2004). There are two types of motivation, namely intrinsic and extrinsic (Frey, 1997). According to Frey (1997), the intrinsic motivation creates an intention to behave within one's own understanding while extrinsic motivation is created by outside antecedents. However, different antecedents on motivation create a positive as well as a negative impact on the performance as per Camerer and Horgath (1999). According to Wright (1993), people will perform only based on the weight of incentives. Condy (2003), explains that incentives have two different forms - monetary and non-monetary. The monetary incentive balances the financial burden on the operation whereas the non-monetary incentive encourages the social and environmental responsibility of the individual. It reduces the burden of the consumer on social commitments and on society. Especially, tax reductions, low-interest loan schemes and social recognition come under the category of non-monetary incentives. Sangeetha et al. (2014) explain that the provision of different incentive schemes has encouraged the Californian electricity sector enormously. The authors further explain that most potential consumers expect tax credits, social recognition, and self-esteem over their contribution on a prevailing national issue or at a time of energy crisis. Therefore, people will tend to use their resources even without expecting any financial incentives if there is heavy social recognition. In the same literature, it has been revealed that consumers are not relying on the duration of the incentive schemes and hence

they are not starting larger projects and do not enjoy economies of scale. However, under the latest trends in supply chain disclosure requirement, many companies are showing their efforts for lesser energy usage and saving to be more socially responsible entities to attract more customers to their products and services irrespective of incentives.

2.1 Why do we encourage self-generation?

Self-generation is the process of running consumer owned generators in the absence of a reliable supply of power from the national grid. However, running a privately-owned generator creates many types of costs such as fuel, labor, maintenance and services, spare parts, and depreciation and, on top of that, needs a sufficient rate of return. In the present context, CEB is offering Rs.36.00 for each unit generated by consumer generators. The total availability of standby/prime power generators within the country is presented in Table 1.

2.2 Research Gap

According to Macovei (2015), a new variable of awareness on the consequences and need to act on the behavior have been added to the theory of planned behavior. It has been validated by a very good model fit and quality indices. During the study, it has been found that the influence of subjective norms and

Table 1: Installed Standby Generator capacities

Organization	Qty	Total Installed Capacity/MW
Food City	380	40
Keels Super	65	8
Hotels	460	10
Industries	4550	650
Water Board	50	35
Harbour	02	16
Sri Lanka Customs	1	4
Central Bank	1	4
Sri Lanka Telecom	40	8
Airport	2	5
Hospitals	500	60
Army Camps	65	18
Universities	15	4
Government offices	160	18
Total Capacity		880 MW

Source: Survey of this research

perceived behavioral control over intention on behavior is very weak due to insufficient sample size. Further, it has not been tested for extreme cases using Mahalanobis test to find outliers. During the present study, the mediating effect of the above two components over the behavior intention is identified as the research gap and tested using the structural equation modeling technique to ascertain the further determinants of consumer behavior and behavior intention on running of own generators under the self-generation scheme during the prevailing power shortage in national grid with enhanced sample size (300).

3. Methodology and Research Design

The research philosophy of this study comprises realism and interpretivism. The existing knowledge with respect to the Theory of Planned Behavior (TPB) and the feedback of electricity consumers are used to derive a new model which explains the mediating effect of two major parameters under the scrutiny. A structured questionnaire was prepared using the operationalization table and a 5-point Likert scale was used to measure different parameters.

Three independent variables (IV), namely incentives, tariff regimes, and technology are considered as antecedents for changing consumer perceptions on running their generators under the self-generation scheme introduced by the utility. Since the IVs are measured as perceptions, they become latent variables. The consumer attitude and awareness of different antecedents introduced by the utility were identified as mediating variables (MV) and measured as latent factors. The behavior intention, which is a strong decision reached in the consumer's mind and is positively related to the final behavioral action as explained by the TPB introduced by Ajzen (1991), was identified as the dependent variable (DV) and measured using a 5-point Likert scale.

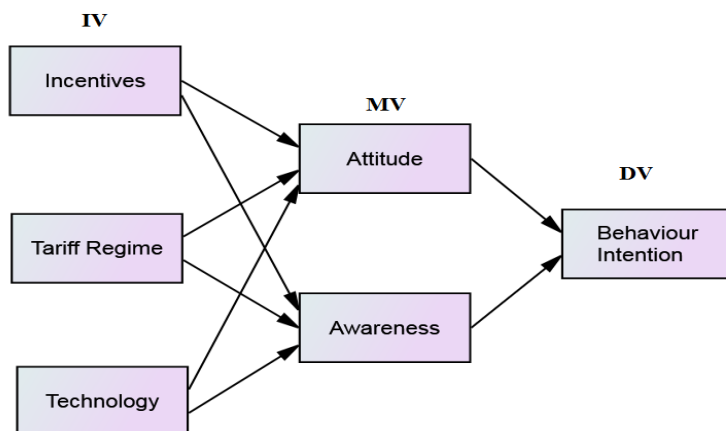


Figure 1: Conceptual Model

AMOS 25th Version Structural Equation Model for the above conceptual framework is given in Figure 2.

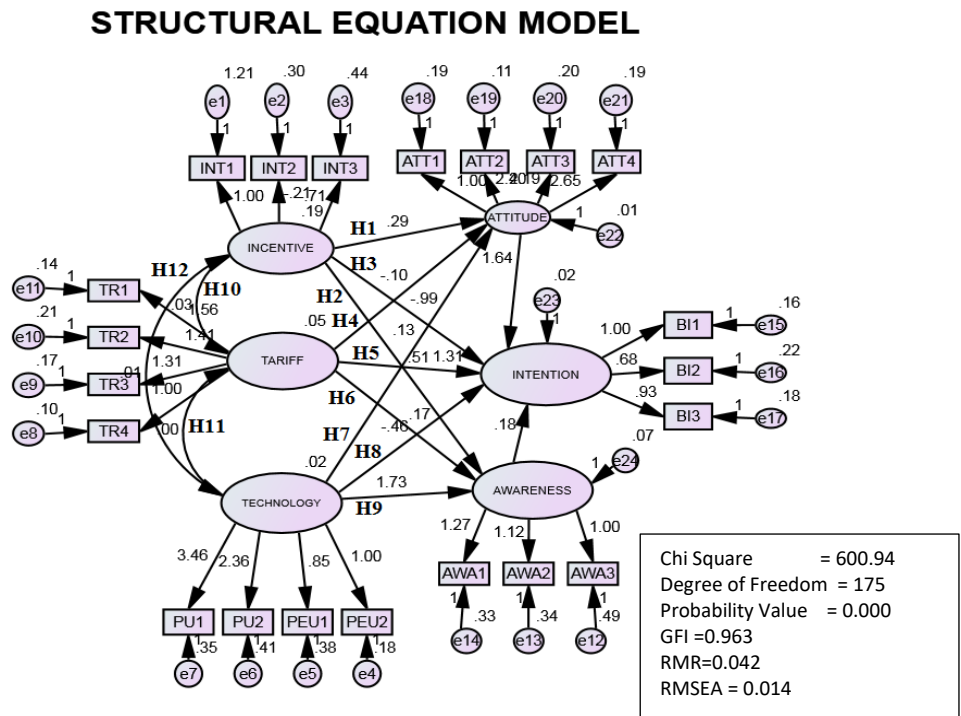


Figure 2: Structural Equation Model

3.1 Hypothesis

Using the structural equation modeling technique, 18 hypotheses are derived as given below;

- H1: There is a positive relationship between attitude and incentive
- H2: There is a positive relationship between awareness and incentive
- H3: There is a positive relationship between incentive and self-generation intention
- H4: There is a positive relationship between tariff regime and consumer attitude
- H5: There is a positive relationship between tariff and self-generation intention
- H6: There is a significant relationship between tariff and consumer awareness
- H7: There is a positive relationship between technology and consumer attitude

- H8: There is a positive relationship between technology and self-generation intention
- H9: There is a positive relationship between technology and consumer awareness
- H10: There is a positive correlation between incentive and tariff regime
- H11: There is a positive covariance between tariff and technology
- H12: There is a positive covariance between incentive and technology
- H13: There is a mediating effect of consumer attitude on the intention of self-generation and incentive granted by the utility
- H14: There is a mediating effect of consumer awareness on the intention of self-generation and incentive granted by the utility
- H15: There is a mediating effect of consumer attitude on tariff and intention on self-generation
- H16: There is a mediating effect of consumer awareness on tariff and intention on self-generation
- H17: There is a mediating effect of consumer attitude on technology and consumer intention on self-generation
- H18: There is a mediating effect of consumer awareness on technology and consumer intention on self-generation

3.2 Data Collection and Questionnaire

A structured questionnaire was designed to cover the actual responses on different indicators of identified constructs as given in Table 2. Accordingly, 21 questions were asked via telephone conversation from 300 industrial consumers in Colombo and Kalutara Districts.

Table 2: Operationalization Table

Indicator	Variable		Question	Measurement	
	Identifier	Measure		Scale	Reference
Attitude	ATT1	Adequate on action	Q(1.1)	Likert	Vanden Berg (2007) Dasanayaka (2012) Clement, Henings and Osboldiston (2014) Ajzen (1991) Dasanayaka (2011), Dasanayaka
	ATT2	Wise on action	Q(1.2)	Likert	
	ATT3	Useful on action	Q(1.3)	Likert	
	ATT4	Must on action	Q(1.4)	Likert	
Awareness and Need	AWA1	I am aware of the action	Q(2.1)		Clement, Henings and Osboldiston (2014)
	AWA2	I am aware of the need	Q(2.2)	Likert	
	AWA3	I am aware of the consequences	Q(2.3)	Likert	
Tariff Regime	TR1	Existing tariffs encourage me to run my generator	Q(3.1)	Likert	

					and Jayarathne (2012) Wright (1994)
	TR2	The tariff structure is reasonable	Q(3.2)	Likert	Macovei (2015) Osboldiston (2014) Cotton (1988) Jaworski (1981)
	TR3	The tariff structure is not evenly designed	Q(3.3)	Likert	
	TR4	It is not customer oriented	Q(3.4)	Likert	
Incentive	INT1	Financial incentive level is insufficient	Q(4.1)	Likert	
	INT2	Payment of incentive in advance encourages me to run my generator	Q(4.2)		
	INT3	The offered incentive is not well designed to suit the prevailing costs	Q(4.3)	Likert	
Technology	PU1	It is useful but my capacity is insufficient	Q(5.1)	Likert	Authors defined
	PU2	It is user-friendly but I have no fuel storage	Q(5.2)	Likert	Authors defined
	PEU1	Continuous running is impossible due to environmental issues	Q(5.3)	Likert	Macovei (2015)
	PEU2	Starting loads cannot be accommodated	Q(5.4)		
Behavior Intention	BI1	Definitely, I will run my generator	Q(6.1)	Likert	Authors defined
	BI2	It is my obligation to conserve electricity	Q(6.2)	Likert	
	BI3	Due to financial benefit I intend to run my generator	Q(6.3)	Likert	Authors defined

4. Data Analysis

Six latent constructs were measured using 21 observable indicators which were measured using 5 points Likert scale in order to find out the influence of each parameter on self-generation scheme introduced by CEB. The measured data were tabulated using SPSS and analyzed with AMOS version 25. The AMOS techniques were further used to identify the mediating effect of consumer attitudes and behavior awareness on financial incentives, tariff regimes and existing technologies introduced by CEB to encourage the self-generation scheme and thereby conserve electricity. Accordingly, AMOS output is given in Table 3. Only the significant parameters (p value < 0.001) are tabulated given the space limitation.

4.1 Discussion

By observing the results, it is found that Cronbach's Alpha for 21 variables for a standard estimate is 0.648 (> 0.6 as per Nunnally, 1970) which can be considered as a reliable data set. The value of RMR=0.042 (< 0.10), GFI =0.963 (> 0.95), RMSEA=0.014 (< 0.05) indicates perfect model fit in the adjusted model. Most consumers are not aware of the existing incentive schemes on self-generation and it is shown in the results as $\beta=0.515$, Standard Error (SE) = 0.155, Critical Ratio (CR) =3.325, p -Value < 0.001 . As shown in AMOS output, consumer's perception of the given incentive mechanism is negative $\beta=-0.99$ and it indicates their unwillingness to run their generators due to the inadequate return on investment. Further, the consumer attitude on the present tariff structure is also negative ($\beta=-0.10$) and shows that consumers worry about the present tariff system. Further, consumers reject many of the offered incentive mechanisms due to their unrealistic nature. Consumers worry about the poor technical support given by the utility on self-generation mechanism. Many industries have their own generators, but the utility has not made a sufficient effort to get them connected to the system due to poor publicity and awareness campaigns conducted by them ($\beta= -0.46$).

Accordingly, the hypotheses H1, H2, H5, H6, H9, H10, H13, H14, H17, H18 are found to be true whereas the hypotheses H3, H4, H7, H8, H11, H12, H15 and H16 are found to be false. The results on the mediating effect of consumer behavior and their awareness on the three major components of incentives, tariff regimes and technology are tabulated in Table 4.

Table 3: Estimates (Group number 1 - Default model)
Maximum Likelihood Estimates
Regression Weights: (Group number 1 - Default model)

			Estimate	S.E.	C.R.	P
AWARENESS	<---	INCENTIVE	0.515	0.155	3.325	***
INT3	<---	INCENTIVE	-0.713	0.172	-4.146	***
PU2	<---	TECHNOLOGY	2.355	0.706	3.337	***
PU1	<---	TECHNOLOGY	3.463	1.032	3.356	***
TR3	<---	TARIFF	1.309	0.188	6.964	***
TR2	<---	TARIFF	1.414	0.204	6.933	***
TR1	<---	TARIFF	1.563	0.207	7.549	***
AWA2	<---	AWARENESS	1.123	0.186	6.027	***
AWA1	<---	AWARENESS	1.268	0.208	6.099	***
BI2	<---	INTENTION	0.679	0.123	5.517	***
BI3	<---	INTENTION	0.931	0.145	6.407	***
ATT2	<---	ATTITUDE	2.396	0.51	4.7	***
ATT3	<---	ATTITUDE	2.192	0.483	4.539	***
ATT4	<---	ATTITUDE	2.651	0.569	4.662	***

Co-variances: (Group number 1 - Default model)

			Estimate	S.E.	C.R.	P
INCENTIVE	<-->	TARIFF	0.029	0.014	2.117	0.034
INCENTIVE	<-->	TECHNOLOGY	-0.014	0.01	-1.404	0.16
TECHNOLOGY	<-->	TARIFF	0.001	0.003	0.458	0.647

Variances: (Group number 1 - Default model)

	Estimate	S.E.	C.R.	P
TARIFF	0.051	0.011	4.632	***
e1	1.214	0.11	11.027	***
e2	0.3	0.025	12.058	***
e3	0.438	0.042	10.371	***
e4	0.183	0.016	11.215	***
e5	0.377	0.032	11.879	***
e6	0.412	0.043	9.534	***
e7	0.346	0.061	5.689	***
e8	0.102	0.01	9.979	***
e9	0.174	0.018	9.966	***
e10	0.208	0.021	10.017	***
e11	0.142	0.017	8.264	***
e12	0.489	0.048	10.244	***
e13	0.339	0.04	8.487	***

e14	0.332	0.045	7.423	***
e15	0.159	0.021	7.411	***
e16	0.218	0.02	10.663	***
e17	0.185	0.021	8.609	***
e18	0.194	0.017	11.742	***
e19	0.113	0.016	7.159	***
e20	0.201	0.02	9.874	***
e21	0.188	0.022	8.427	***

Table 4: Testing of Mediating effect

Hypothesis	Indirect Effect	Direct Effect	Result on Hypothesis
H13	Incentive * Attitude $0.29 \times 1.64 = 0.47$	Incentive → Intention -0.99	An indirect effect is greater than the direct effect. Hence, mediation exists between incentive and consumer attitude
H14	Incentive * Awareness $0.13 \times 0.51 = 0.0663$	Incentive → Intention -0.99	An indirect effect is greater than the direct effect. Hence, mediation exists between incentive and awareness
H15	Tariff * Attitude $-0.10 \times 1.64 = -0.164$	Tariff → Intention 1.31	An indirect effect is less than the direct effect. Hence mediation does not exist between tariff and the consumer attitude
H16	Tariff * Awareness $0.17 \times 0.18 = 0.0306$	Tariff → Intention =1.31	An indirect effect is less than the direct effect. Hence mediation does not exist between tariff and consumer awareness
H17	Technology * Attitude $= 0.13 \times 1.64 = 0.2132$	Technology → Intention =-0.46	An indirect effect is greater than the direct effect. Hence mediation exists between technology and the consumer attitude
H18	Technology * Awareness $= 1.73 \times 0.18 = 0.3114$	Technology → Intention =-0.46	An indirect effect is greater than the direct effect. Hence mediation exists between technology and consumer awareness

5. Conclusion and Policy Recommendations

From the analysis, it is found that there is a significant mediating effect of consumer behavior which is composed of consumer attitude and consumer awareness on the intention of running of their generators during the power outage period. However, the financial value of the offered incentive highly influenced the decision on the running of generators. Furthermore, consumer behavior is not mediating the tariff regime and the intention of self-generation. This is because the consumer has no positive impression over the existing tariff structure which is totally beyond their control. However, there is a significant mediation effect of consumer behavior on the intention of self-generation with the available incentives and technology. Therefore, in order to encourage the consumers to run their generators during a period of power shortage, there should be an adequate financial incentive as well as technical support to the consumer. At the same time, the consumer should be aware of the available tariff structures and technologies to make the most out of the grant. In Sri Lanka, there are more than 850MW of private generators. But, still, the utility has failed to achieve even 50% of it as per the findings of this study. This is due to lack of consumer awareness, inadequate tariff structure, insufficient incentive level, etc. Therefore, it is necessary to change the consumer attitude and awareness on electricity saving and encourage use of their own generators efficiently and effectively by means of proper incentives and suitable technological support. The utility must try to offer more financial incentives and sustainable non-financial incentives to change consumer behavior on self-generation. Further, the utility must introduce new technologies to enhance the efficiency of consumer generators. Specifically, many consumers expect payment in advance in order to run their generators. This mechanism also encourages the addition of all the available capacities to the national grid. Even if some advance payments are granted, in the long run, the already paid money can be recovered by the excess units they will be adding to the system. Since this study covered only the Colombo and Kalutara districts, other districts are to be covered in future research. It is identified as a limitation of this research. Future research is also suggested on developing a scientific model which will explain the proportional contribution of each component on the incentive schemes, tariff regimes, and new technology products and processes to energy savings.

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