IMPACT OF PEER SUPPORT AND PERFORMANCE FEEDBACK ON TRANSFER OF TRAINING FOR ENERGY CONSERVATION

A Thesis submitted to the

University of Petroleum and Energy Studies

For the award of

Doctor of Philosophy

In

Management

BY

Shaikh Shamser Ali

July 2020

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Department of Energy

School of Business

University of Petroleum and Energy Studies

Dehradun – 248007: Uttarakhand

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DECLARATION

I declare that the thesis entitled "Impact of Peer Support and Performance Feedback on Transfer of Training for Energy Conservation" has been prepared by me under the guidance of Dr. Ruchi Tyagi, Associate Professor, Department of General Management, University of Petroleum and Energy Studies, Dehradun, Dr. Ragini, Assistant Professor Department of General Management, University of Petroleum and Energy Studies, Dehradun, and Dr. Vijaykumar Kunche, Managing Director, First ESCO, Hyderabad. No part of this thesis has formed the basis for the award of any degree or fellowship previously.

Shaikh Shamser Ali
July, 24, 2020

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CERTIFICATE

I certify that Shaikh Shamser Ali has prepared his thesis entitled "Impact of Peer Support and Performance Feedback on Transfer of Training for Energy Conservation", for the award of PhD degree of the University of Petroleum and Energy Studies, under my guidance. He has carried out the work at the Department of Energy, University of Petroleum and Energy Studies.

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ABSTRACT

The researcher undertook this research work to evaluate the effect of Peer Support and Performance Feedback on Transfer of Training for Low-Cost Energy Conservation Measures that will translate into Energy Conservation with a minimal budgetary requirement for any organization. A total of 317 works of literature were studied to understand the concept, justify the business problem, draw a framework to undertake the study, and analyze the findings with the appropriate software. The funnel approach was adopted to identify six keywords and based on these keywords three themes were identified. Research Gap was derived from three thematic gaps and theoretical premise gap to formalize the research problem. Accordingly, three research questions, three research objectives, and three hypothesize were finalized to validate the conceptual model that was envisaged.

Since the study was to measure the impact it was necessary to collect the field data at two-time intervals. Therefore, the study is mixed longitudinal. LCECM training was adopted from IAEMP and was imparted by IAEMP experts. Sampling method was convenience sampling with a sufficient sample size justified by three methods and feedback from the participants was collected through a tested and verified questionnaire. Similarly, actual field energy consumption data were measured for 90 working days in a year interval at two different sites before and after the training data. Measured data were analyzed for energy conservation according to IPMVP Protocol – A and further t-Tested on the outcome of the IPMVP Protocol – A output. Participants' feedback was tested by ANOVA and t-Test using SPSS software. The conceptual model was tested by PLS-SEM using R Version 3.5.1 for path analysis.

The conceptual model envisaged that Peer Support and Performance Feedback will have a positive effect on the Transfer of Training and Transfer of Training will have a positive effect on Energy Conservation. Impact of Transfer of

Training on Energy Conservation was validated by participants' feedback and also by actual field energy consumption measurement to rule out any slip between the intension and implementation. The same was also suggested by earlier studies on similar applications.

Findings based on participant's feedback data analysis were as follows:

(i) **Peer Support** positively influence **Transfer of Training (H1 = 0.38).**

(ii) **Performance Feedback** positively influence **Transfer of Training (H_2 = 0.42).**

(iii) **Transfer of Training** has positive impact on **Energy Conservation (H_3=0.18).**

(iv) The impact of the **Transfer of Training** on **Energy Conservation** is **highly significant**.

(v) **Peer Support** and **Performance Feedback** did not have any direct influence on **Energy Conservation** (0.03 and 0.04) without the **Transfer of Training**.

Findings based on field energy consumption reading analysis were as follows:

(i) In meter reading 1 energy conservation was between **17.1% to 21.7%** by reducing the Air-Conditioning running time by 30 minutes and increasing the Air-Conditioner set temperature by 1-degree centigrade.

(ii) In meter reading 2 energy conservation was between **20.4% to 21.3%** by reducing the Air-Conditioning running time by 20 minutes and increasing the Air-Conditioner set temperature by 2 degrees centigrade. Before the training reading, 10 ceiling fans were not in use as per the facility's standard operating practice, but after the training 10 ceiling fans were Switched-On that helped to increase the set temperature by 2 degrees centigrade.

(iii) A t- Test on the IPMVP-A analysis result is highly significant. **Transfer of Training** has direct impact on **Energy Conservation (H_3=0**) in both cases.

Based on the above findings the following inferences can be made.

(i) Peer support has a constructive impact on Transfer of Training.

(ii) Performance Feedback helps individuals for making the Transfer of Training more effective.

(iii) The Transfer of Training on LCECM has a constructive influence on Energy Conservation.

(iv) Impacts on Energy Conservation are measurable both directly by Energy Meter readings and indirectly by Feedbacks from the building occupants.

(v) Direct Meter reading shows 17.1 – 21.7 % monthly energy savings in the air-conditioning application simply by increasing the air-conditioner set temperature by 1°C and reducing the air-conditioner switch "ON" duration by 30 minutes without any compromise with the comfort level of the building occupants.

(vi) LCECM has huge potential to save energy daily which costs a very negligible amount of money if engaged external expert and nil if done by in-house training.

(vii) Strongly recommended implementing such hands-on LCECM training by any organization.

The conceptual model holds good as the final model that Peer Support and Performance Feedback has a straight effect on the Transfer of Training and Transfer of Training has a positive impact on Energy Conservation. The study was conducted with many restrictions from the participating organizations and such obstacles can be easily overcome with the support from the competent authorities. Similar studies should be encouraged in other applications like industries, transportation, and domestic sectors. Also, a study can be undertaken to create modular training models for energy conservation in different sectors.

ACKNOWLEDGEMENTS

The research study is much more than what I perceived it to be. Firstly, I want like to recognize the mental backing of my main guide Dr. Ruchi Tyagi to make me believe that I can walk the finishing line at the age of sixty. She went beyond supervision to make me understand the nuances of the academic way of writing. I want to extend my earnest gratefulness to all my guides Dr. Ruchi Tyagi, Dr. Ragini, and Dr. Vijaykumar Kunche for their constant support in my Ph.D. study and allied research, for their endurance, inspiration, and vast knowledge. They unswervingly allowed their experience to enrich my knowledge and work and continuously coxswained me in the correct path as and when they believed I required it. I was fortunate to get such dedicated professionals as advisors and mentors for my Ph.D. education.

Besides my guides, I want to admit the inputs from the Faculty Research Committee for improving the quality of my study. I also want to outspread my honest thankfulness to all HODs of the School of Business for sparing their time to listen to me in my endeavor for knowledge. Their insightful comments, advice, encouragement, and motivation assisted me to expand my study from numerous viewpoints.

My sincere thanks to my friends and colleague from the industry for helping me with relevant case studies, papers, and reports at various stages of my research work. I must also acknowledge the unconditional support of Dr. Viswanathan from Presidency College in Chennai for tutoring me data analysis using PLS-SEM, and how to present the findings in academic parlance.

A distinct gratitude to my spouse and children for their sustenance and inspiration to complete the research study.

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LIST OF SYMBOLS

$	US Dollar
Bn	Billion
Tn	Trillion
%	Percentage
Rs.	Indian Rupees
+	Addition
-	Subtraction
=	Equal to
>	Greater than
<	Less than
β	Beta Coefficient
@	At the rate of

LIST OF ABBREVIATIONS

Word	ABBREVIATION
BEE	Bureau of Energy Efficiency
BRPL	The Bongaigaon Refinery & Petrochemicals Ltd.
CBEC	Central Board of Exercise and Custom
DERT	Disaster and Emergency Response Team
DSM	Demand Side Management
EC	Energy Conservation
ECBC	Energy Conservation Building Code
EEA	Energy Efficiency Assessment
GDP	Gross Domestic Production
GOI	Govt. of India
GRIHA	Green Rating for Integrated Habitat Assessment
IAEMP	Indian Association of Energy Management Professional
IEA	International Energy Agency
IFMA	International Facility Management Association
IPEEC	International Partnership for Energy Efficiency Cooperation
IPMVP	International Performance and Measurement Verification Protocol
KSA	Knowledge, Skills, and Abilities
LCECM	Low-Cost Energy Conservation Measures
Mtoe	Million Tons of Oil Equivalent
NPC	National Productivity Council
PAT	Perform, Achieve & Trade
PCRA	Petroleum Conservation Research Association
PF	Performance Feedback
PLS	Partial Least Square
POSOCO	Power System Operation Corporation Limited
PS	Peer Support

PWC	Price Waterhouse Coopers
SEM	Structural Equation Modeling
TERI	The Energy Resources Institute
TOT	Transfer of Training

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Chapter 1

Background and Introduction

1.1 Background

Fossil fuel reserve in the world is gradually getting depleted and various studies are going on in different countries to find means and ways to prolong the availability of fossil fuel besides finding alternative fuel sources. It all started in the mid-nineteen seventies when the first fuel crises were felt in developed countries due to the industrial revolution leading to a shortage of power. Researchers and the industry experts came up with Demand Side Management (DSM) as a possible solution to the shortage of power by enhancing the utilization capacity at the consumer end with the help of technological excellence. The researcher tried to explore if the usage of energy particularly fossil fuel can be influenced by human behavior.

1.2 The Motivation Behind the Study

The current fossil fuel reserve of the world is limited and expected to get exhausted in another hundred years or so. The living human population in the world should make a combined effort to preserve that fossil fuel reserve as much as they can instead of coming up with action plans for filling the difference between demand and supply by accelerating fossil fuel usage. Studies in the past suggested that there is a huge energy conservation opportunity by simple actions like administrative corrective measures, i.e. Low-Cost Energy Conservation Measures (LCECM), in India. Some of the recent newspaper articles also suggest the same as highlighted below:

Energy efficiency drive: Tamil Nadu fourth among industrial states

TNN | Aug 4, 2018, 10:58 IST

A- A+

Representative image

CHENNAI: Tamil Nadu is ranked fourth among industrialised states in pursuing energy efficiency initiatives. According to the first edition of the survey released by Niti Aayog on Thursday, the state lags in energy efficiency programmes for buildings. The state could start tracking the effectiveness and impact of energy efficiency programmes using quantitative indicators such as energy intensity and penetration of energy efficient technologies in demand sector. Rajasthan, Karnataka and Maharashtra are ranked above Tamil Nadu in the same grouping.

Figure 1.1: Energy Efficiency initiatives in Tamil Nadu

Source: Times of India, Aug. 4, 2018

This article in figure 1.1 suggests an energy efficiency program be implemented in commercial buildings in Tamil Nadu. This initiative is in addition to various DSM programs that are in practice being a leading industrial state in India.

New building code for energy efficiency

Plan To Reduce Pollution And Save Power

TIMES NEWS NETWORK

Vijayawada: The state government will soon come out with new building code for energy efficiency. Andhra Pradesh was the first state to frame Energy Conservation Building Code (APEECBC) 2017 and now new guidelines on building constructions and energy utilisation will be announced.

According to officials, the new code will help reduce pollution and save power. Chief secretary Anil Chandra Punetha on Sunday reviewed the proposed energy conservation guidelines with senior officials.

Punetha has directed the officials to focus on energy security and help achieve 20 to 22% energy savings through energy conservation building code-complied buildings. "All commercial buildings in the capital region should comply with APEECBC 2017 norms," Punetha said.

According to an official statement, the state government has set a target of saving 13,000 to 15,000 million units (MU) energy.

With the development of new capital, commercial building growth has been envisaged as 10% in the state resulting in a large number of commercial buildings in the next five years. " Punetha said. "In fact, the buildings consume more than 31% of the total electricity demand in the country and this will increase by 2030. The AP government has already set a target of achieving 13,000 to 15,000 MU energy savings which is around 25% savings out of the total energy requirement of 52,000 MU per annum. Implementation of energy efficiency measures, including implementation of ECBC will help achieve this target and successfully implement the prestigious 24x7 power supply scheme," he said.

TOWARDS A POWER SHIFT

- AP sets a target of saving 13,000 million units (MU) to 15,000 MU energy
- Energy conservation building code-compiled buildings will achieve 20 to 22% energy savings
- With the new capital, there will be a 10% commercial building growth in the next five years
- Buildings consume more than 31% of the total electricity demand in the country
- Bureau of Energy Efficiency (BEE) helping the AP government in the implementation of Energy Conservation Building Code (ECBC)
- ECBC compliance is mandatory for any commercial building or complex with 1,000 square meters or built-up area of 2,000 square meters

Figure 1.2: Energy Conservation Building Code initiatives in India

Source: New Indian Express, Jan.21, 2019

This article in figure 1.2 advocates the operationalization of ECBC (Energy Conservation Building Code) as propagated by BEE (Bureau of Energy Efficiency) for energy conservation in India as envisaged within the framework of Energy Conservation Act. 2001 that was further modified in 2007 and 2017 for effective implementation.

TIMES REGION

Power demand high, TN seeks more coal

'72k Tonnes Required Daily'

The request was conveyed to the centre as Tamil Nadu power minister's speech was presented at a conference of discoms convened by Union power ministry in New Delhi on Wednesday

Figure 1.3: Shortage of Coal in Tamil Nadu's Thermal Power Plant

Source: Times of India, Mar. 1, 2019

This article in figure 1.3 highlights the short supply of coal to the thermal power plants in Tamil Nadu justifying the shortage of availability of coal. Coal is a common fossil fuel that is generally used in Indian thermal power plants across the board as it is locally available and the initial designs of power plants were coal-based.

Govt could consider 'minimum indoor temp settings' for commercial buildings

Releases Action Plan Recommending Ways & Means To Reduce Cooling Demand

Vishwa.Mohan
@timesgroup.com

A COOL IDEA

Figure1.4: Energy saving by A/C temperature Control in Commercial Building

Source: Times of India, Mar.9, 2019

This article in figure 1.4 highlights the need for low-cost energy conservation measures in the application of air-conditioners used in the Indian commercial building sector through ECBC that is under the Energy Conservation Act 2001. The Indian Government and industry both are exploring all possible means for increasing the efficacy in energy consumption at the user end for operational

excellence through the modified Energy conservation Act 2001 and Electricity Act 2003. These are mostly related to technology which faces a major challenge in India for budgetary allocation as many of the industries in India operate under severe budgetary constraints.

1.2.1 Choice of Topic: Impact of Peer Support and Performance Feedback on Transfer of Training for Energy Conservation

The understanding and necessity to conserve energy came into practice in the world scenario in the mid-nineteen seventies when the shortage of fuel was experienced for the first time. Demand Side Management was propagated for the first time as a possible solution to overcome the challenge (Lutzenhiser, 1992). Researches were undertaken mainly to discover the possibilities to expand the efficacy in the technologies available then. Further research suggested that the buildings in domestic and commercial sectors have the potential of conserving energy to the extent of 72 % (Xiaoqi Xu, 2013). The government of India undertook the study to analyze the energy consumption in domestic sectors and extended the study to identify the opportunities for implementation. One such study identified the need for changing human behavior by providing the training on proper usage of energy (Prayas – Energy Group report, 2016). Biswas et. al. in 2008 came out with a finding based on their in-house study in an educational institute that giving energy conservation training to the building occupants a sizable volume of energy is possible to be conserved. IAEMP (Indian Association of Energy Management Professional) energy audit reports very often suggest the implementation of energy usage behavioral training for energy conservation. Studies have been done in multi-stories residential buildings, independent residential buildings, and educational institutes to assess the impact of instructions in the form of Dos and Don'ts by the building occupants for energy conservation. Results were encouraging and all studies recommended more research with a situation-specific structured training program (Ishak et al., 2016; Mahamadi et al., 2016; Bhatti et al., 2013). The topic is an attempt to understand how the predictors will have any influence on the transfer of training for changing the behavior of consumers for energy conservation.

1.2.2 Choice of Context

Transfer of Training is well-defined as the ranking of grade that learners successfully use the information, attitude, and skills added in the training program to the workplace (Baldwin and Ford, 1988). The literature review suggests that the effectiveness of the transfer of training is manipulated by features like designing of training, training environment, organizational motivation, peer support, feedback, etc. Some of the relevant points are listed below:

- More studies should be carried out to assess the effect of peer support on the transfer of training in energy conservation applications.
- There is a necessity for a all-inclusive energy conservation policy to address the necessity of preserving Fossil Fuel.
- Indian energy policy for energy conservation hinges on technological excellence and incentivizing energy saving by different tariff methods and subsidies.
- There is a need for more studies in India to measure the influence of a structured training applicable to all sectors for energy conservation by addressing the people's energy usage behavior.
- The report suggests the need for more studies on the patterns of energy usage by the consumers for analyzing the effect of energy conservation training.
- The report suggests the need for more studies to check whether the post-training feedback system on the energy conservation program will make any positive impact.

The relevant studies can be summarized as shown in table 1.1.

Table 1.1: Relevant Studies on Motivation to take Present Study

Year	**Author**	**Justifications**
2020	Ali et al.	The scarcity of information to justify energy conservation can be influenced by training.
2020	Dang et al.	Per capita increase in global GDP between 1990 to 2016 witnessed a proportional increase in air pollution in terms of PM 2.5.
2019	Woodrow W. Clark II	Policies needed to address Energy Conservation by all means to preserve Fossil Fuel.
2018	Gill and Lang	Need more studies to see the impact of training on energy conservation.
2018	Halawi and Haydar	Need more studies on performance feedback to justify the effect of training.
2018	Kueh Hua Ng	Need more studies on peer support for understanding the influence of training.

Carrico and Riemer in 2011 conducted a study related to motivation for energy conservation in the workplace through instructions like Dos and Don'ts. The assumption was that the peer education and feedback influence the energy usage behavior of building occupants. The study concluded that peer education and feedback are highly influential motivating factors when it comes to energy usage in workplaces.

It is seen that Peer Support (PS) and Performance Feedback (PF) has more impact, compared to other factors, on Transfer of Training (TOT) but not in Energy Conservation (EC) training applications. There is also a scarcity of literature to suggest that PS and PF have a positive influence on TOT that in turn converts into EC. The impact of TOT on EC is more complex to determine than the impact of PS and PF on TOT because there can always be a slip between intention and action. Considering these factors and the constraints in fund and time the researcher decided to take PS and PF as antecedents of TOT and TOT

as antecedents of EC for determining whether energy conservation training can help the users in changing their energy usage behavior that will lead to energy conservation.

1.3 Need for Research

Need for an increased generation: Energy demand in India is increasing at a quicker proportion than earlier and overtook the demand growth globally in 2018. Almost 70% of the rise in global demand for energy is from China, the USA, and India. An article titled "India's energy demand outpaced global growth" by IEA was published on March 26, 2019, in Business Line. According to this report, India's primary energy demand increased by 4% or over 35 Mtoe (Million Tons of Oil Equivalent) , which is 11 % of the global demand growth. Accordingly, emission increased by 4.8% or 105 million tons. This emission is mostly from power plants using coal as the primary fuel. The net increase in emission in China, India, and the USA due to increased use of fossil fuel is 85% of the net increase in emission in the world.

The Economic Times on September 10, 2019, quoted the Indian Oil Minister as "The projected energy demand growth is 4.2 percent per annum up to 2035. This makes India's energy demand growing faster than all major economies of the world. We are preparing for such a growth path of energy demand in the country". The growth in Indian power generation from 2009-10 to 2018-19 is tabulated in Table 1.2. There is a steady increase in generation from 771.551 Billion Unit (BU) in 2009-10 to 1249.337 BU in 2018-19 and it is mainly due to the growth in the Indian economy.

Table 1.2: Growth of Power Generation in India during (2009-19)

Year	Power Generation through Regular Sources (BU)	Growth %
2009-10	771.551	6.6
2010-11	811.143	5.56
2011-12	876.887	8.11
2012-13	912.056	4.01
2013-14	967.150	6.04
2014-15	1048.673	8.43
2015-16	1107.822	5.64
2016-17	1160.141	4.72
2017-18	1206.306	3.98
2018-19	1249.337	3.57

Source : https://powermin.nic.in/en/content/power-sector-glance-all-india

Growing Demand for Electrical Power and Shortages: Even with the increase in a generation there was still difference between supply and demand for regular demand. Data available in the CEA report indicates there is always a deficit in regular power demand though the gap is gradually decreasing from 10.1% in 2009-10 to 0.6% in 2018-19. The Power supply and shortage in demand in India during 2009-10 to 2018-19 are summarised in Table 1.3.

Table1.3 Power Supply (Energy Demand) in India (2009-19)

Year	Energy Demand			
	Requirement of Power	Availability of Power	Surplus(+)/Deficits(-) of Power	Percentage of Difference
	(MU)	(MU)	(MU)	(%)
2009-10	8,30,594	7,46,644	-83,950	-10.1
2010-11	8,61,591	7,88,355	-73,236	-8.5
2011-12	9,37,199	8,57,886	-79,313	-8.5
2012-13	9,95,557	9,08,652	-86,905	-8.7
2013-14	10,02,257	9,59,829	-42,428	-4.2
2014-15	10,68,923	10,30,785	-38,138	-3.6
2015-16	11,14,408	10,90,850	-23,558	-2.1
2016-17	11,42,929	11,35,334	-7,595	-0.7
2017-18	12,13,326	12,04,697	-8,629	-0.7
2018-19	12,74,595	12,67,526	-7,070	-0.6

Source : https://powermin.nic.in/en/content/power-sector-glance-all-india

Growing Need of Peak Demand and Shortages: Even with the increase in a generation there was still a gap between demand and supply for peak demand requirements. Data available in the CEA report indicates there is always a deficit in peak demand though the gap is gradually decreasing from 12.7% in 2009-10 to 0.8 % in 2018-19. The Power supply and shortage in peak demand in India during 2009-10 to 2018-19 are summarised in Table 1.4.

Table1.4: Power Supply (Peak Demand) in India (2009-19)

Year	Peak Demand			
	Requirement of Power	Availability of Power	Surplus(+)/Deficits(-) of Power	Percentage of Difference
	(MW)	(MW)	(MW)	(%)
2009-10	1,19,166	1,04,009	-15,157	-12.7
2010-11	1,22,287	1,10,256	-12,031	-9.8
2011-12	1,30,006	1,16,191	-13,815	-10.6
2012-13	1,35,453	1,23,294	-12,159	-9.0
2013-14	1,35,918	1,29,815	-6,103	-4.5
2014-15	1,48,166	1,41,160	-7,006	-4.7
2015-16	1,53,366	1,48,463	-4,903	-3.2
2016-17	1,59,542	1,56,934	-2,608	-1.6
2017-18	1,64,066	1,60,752	-3,314	-2.0
2018-19	1,77,022	1,75,528	-1,494	-0.8

Source : https://powermin.nic.in/en/content/power-sector-glance-all-india

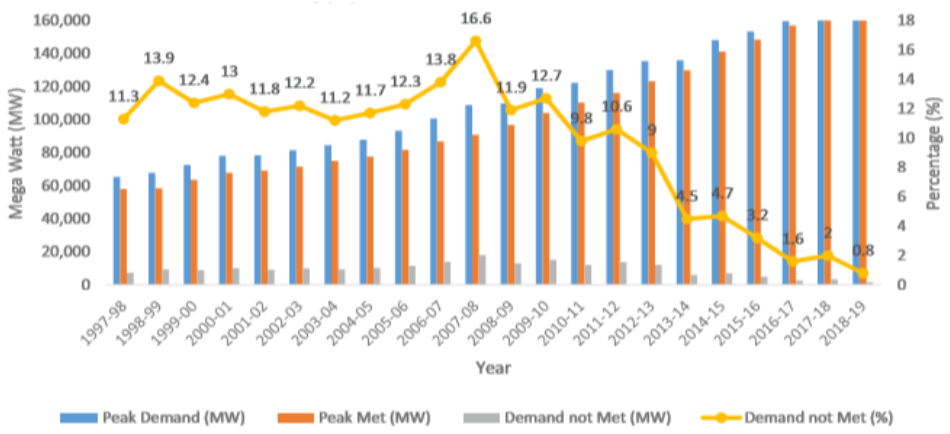

Figure1.5: Comparison between Demand and Supply since 1997 in India

Source: http://www.cea.nic.in/reports/annual/annualreports/annual_report-2019.pdf

Figure 1.5 illustrates how the difference between supply and demand had been reduced gradually over the time and in 2018-19 it stood at 0.8% compared to 16.6% in 2007-08 but could not surpass the demand despite ramping up the generation from time to time.

Projection of future power requirements: As deliberated above there is a steady rise in electrical power requirement in India in recent past and it is anticipated to grow in the same trajectory. The technological development prospect has indicated the demand for electrical power in India from two different sources. These sources are the Central Electricity Authority (CEA) and Energy Technology Perspectives (ETP) (Remme et al., 2011). Figure 1.5 highlights the growth pattern. Point to note is that there is a significant change in projected demands between "CEA with energy efficiency" and "CEA without energy efficiency". There is a reduction in demand elasticity from 0.95 to 0.5 overtime and the graph is projected till 2050.

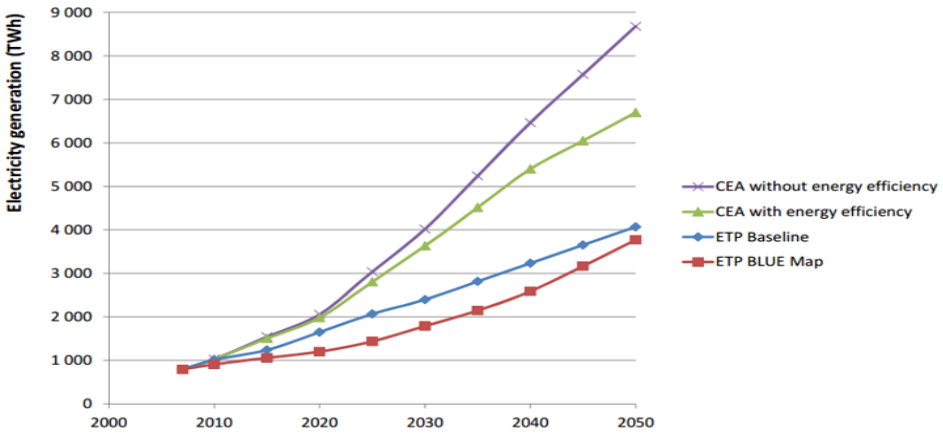

Fig. 1.6: Electrical Power Demand Projections for India (2007-50)

Source: www.iea.org

The relation between Economic Growth (EG) and Energy Consumption (EC) in India: Findings based on literature in the relation between EG and EC in India is inconclusive (Shahbaz et al. 2017). The study found EG is an outcome of EC (Yang and Zhao 2014) and there is a unidirectional relation between EC and activities related to economy (Ghosh and Kanjilal 2014). The study found that there was a feedback effect in the Indian agricultural sector from 1972 – 2008 between electrical power consumption and GDP in India (Abbas and Choudhury 2013). Sherawat et al. (2015) found an unbiased connection between EC and EG in India for the duration between 1971–2011. A study on oil and electricity by Malik (2009) also found that EG results in higher EC resulting in higher oil consumption. This had a unidirectional impact

for a period between 1970 – 2005. From the prevailing works on the connection between EC and EG in India, it is evident that there are divergent results as summarized in Table 1.5 for the duration between 1950s to 2014.

Table1.5: Energy Consumption and Economic Growth of India

EC has an impact on EG	**EG has an impact on EC**	**EG and EC have an impact on each other**	**EG and EC do not have an impact on each other**
Ghosh and Kanjilal (2010), (1971-2008)	Shahbaz et al. (2016), (1971-2012)	Ahmed et al. (2016), (1971-2014)	Sherawat et al. (2015), (1971-2011)
Gupta and Sahu (2009), (1960–2009)	Malik (2009), (1970-2005)	Abbas and Choudhary (2013), (1972 -2008)	Alam et al. (2011), (1971-2006)

Source: Amalgamated by the researcher

Note: The study period is indicated in the second set of parentheses.

The relation between Energy Consumption (EC) and financial development (FD: There are many studies on the relation between EC and FD as a yardstick to measure the growth in economic for any country. Studies in India and other countries found divergent results on the subject. Rashid and Yousaf (2015) found FD is having a positive and significant link with EC. Contrary to that, Sherawat et al. (2015) found an unbiased relation amongst FD and EC in India for the duration between 1971 to 2011, while Shahbaz et al. (2016) suggested that FD will lead to reduction in EC. In all these studies FD is determined by the variables from the stock market. From the available literature on the association amongst EC and FD, it is evident that there are divergent results as summarised in Table 1.6 over various periods from the 1970s to 2010s.

Table 1.6: Energy Consumption and Financial Development in India

FD has a Positive effect on EC	FD has a Negative effect on EC	FD and EC affect on each other	FD and EC do not affect on each other
Rashid and Yousaf (2015), (1980-2011)	Shahbaz et al. (2016) (1971– 2012)	Shahbaz et al. (2016) (1971–2012)	Sehrawat et al. (2015) (1971–2011)
Boutabba (2014) (1971–2008)	Mahalik and Mallick (2014) (1971–2009)	Shahbaz (2015) (1972–2012)	

Source: Amalgamated by the researcher

Note: The study period is indicated in the second set of parentheses.

The opportunity of Energy Conservation: Studies and reports suggest that industries and building sectors are the two major energy consumers. Studies also suggest that these two sectors can help in conserving a considerable amount of energy provided the consumers take a different economic approach for energy conservation. They need to look at it as an investment and not expenditure (Ali and Tyagi, 2019).

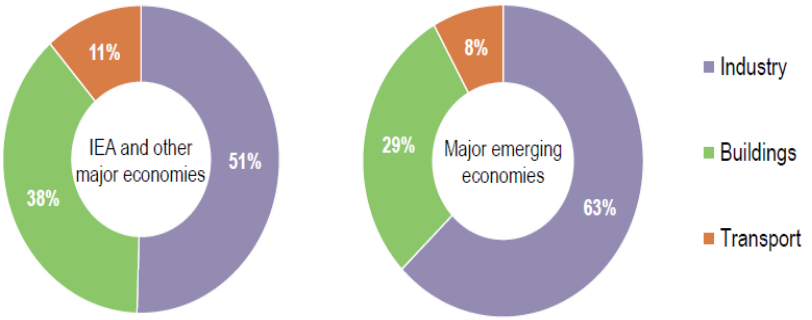

Figure 1.7: IEA Report statistics on Energy savings improving energy efficiency
Source: www.iea.org

Note: “Other major economies” are India, China, Indonesia, Brazil, South Africa, Russia, and Argentina. “Major emerging economies” are China, Brazil, Indonesia, India, South Africa, and Mexico.

The building sector has made the second-largest contribution to historical efficiency gains globally after that of industry. These two sectors contribute

maximum towards the financial development at this point as highlighted in Figure 1.8.

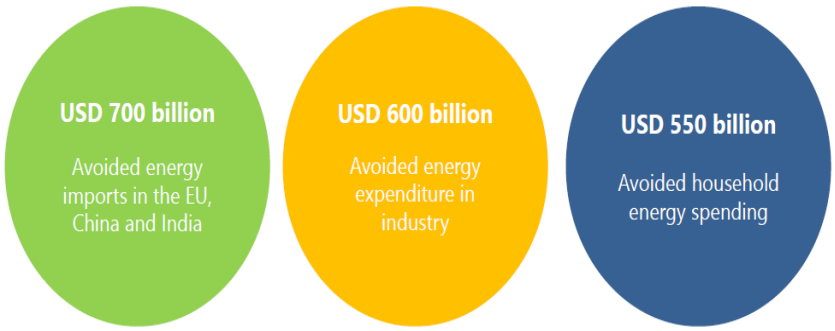

Figure 1.8: IEA Report statistics on Energy Efficiency Benefits
Source: www.iea.org

UN Sustainable Development Goals target is 7.3 and this can be achieved by the Efficient World Scenario. The household sector has the potential of saving USD 550 billion while the same for the industry is USD 600 billion as shown in Figure 1.8. Cost for energy conservation projects should be seen as an investment and not expenditure (Ali and Tyagi, 2019). Figure 1.9 illustrates this same fact. On average, one dollar invested in any energy efficiency project will pay back three times from energy saving over the lifetime of the equipment. The building sector comes second to the industry in payback for the investment. In terms of financial development, it is a good return on investment.

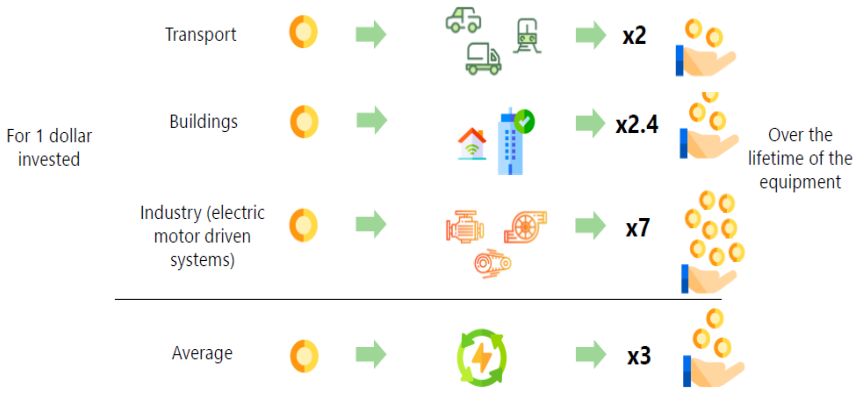

Figure 1.9: IEA Report statistics on Investment payback scenario over equipment lifetime
Source: www.iea.org

Need for any research can arise for many reasons, be it academic demand, industrial requirement or solution to a pressing problem, etc. and can be initiated by government, industry, or educational institutes. The necessity for undertaking this research work is summarized as below:

a. With the increase in industrialization and improvement in living standards need for power is increasing gradually since the nineteen sixties in India so is the power generation. It is anticipated to rise more in the forthcoming future at a considerable quicker rate of development. Mostly fossil fuel, namely coal, and oil, is used in India to meet the fuel need at the power plants as the main source of energy. The report suggests the gradual depletion of world-known fossil fuel reserves. The report also suggests that there is a pressing necessity to discovery substitute fuel sources while restricting the usage of fossil fuel so that the world gets a long time to find reliable solutions.
b. Demand Side Management is an accepted and practiced norm in the world today to optimize energy usage but it needs more effort to find a permanent solution. Technological excellence has come into the practice to increase the efficiency of machines and trial continues to do so in machines and systems. Some studies in the recent past have suggested a huge scope of energy conservation in building sectors by educating the occupants for judicious usage of energy. This opportunity got misplaced in the past due to the minuscule use of energy in each building compared to many industries.
c. IAEMP (Indian Association of Energy Management Professional) is a practicing energy conservation professional body operating in India for several years and has the consumer level hands-on experience about operations, end users' attitudes, awareness, and opportunities to conserve energy at various applications. This professional body suggests the need for training to the end-users about the judicious usage of energy to tap the low hanging fruits in energy conservation at no-cost particularly in the building sectors.
d. The government of India passed the new Energy Conservation Act in 2001 with a vision of energy independence by 2020. This was followed

by enacting a revised Energy Act in 2003 to bring accountability, transparency, and improved operational practices. It further led to the introduction of Energy Conservation Building Code (ECBC) that is modified and further improved upon to bring into practice in 2018 especially to support the energy conservation initiatives in Indian building sectors.

The relevant studies can be summarized as shown in table 1.7.

Table 1.7: Relevant Studies on Need for Research

Year	**Author**	**Justifications**
2018	Ohueri et. al.	Studies on educational buildings in India have concluded that giving energy conservation training to the building occupants a sizable amount of energy can be saved.
2018	Antonio Paone and Jean-Philippe Bacher	Human energy usage attitude is capable of having a positive influence on energy consumption with a saving potential of 72% in domestic and commercial sectors.
2016	Prayas – Energy Group report	Periodical investigative study on residential energy consumption in India can exhibit opportunities for energy conservation.

Source: Amalgamated by the researcher

The relevant reports can be summarized as shown in table 1.8.

Table 1.8: Relevant reports on need for research

Year	Author	Justifications
2018	International Energy Agency (IEA)	The world-known fossil fuel reserve is gradually getting exhausted.
2017	The Economic Times	Indian energy consumption is anticipated to raise by 50 % from the level of 2008 to the level of 2035.
2017	Govt. of India Report	Power generation in India has increased from 771 BU to 1160 BU between 2010 and 2017.
2017	IAEMP	Indian Association of Energy Management Professional (IAEMP) suggests the implementation of behavioral training for energy conservation.
2016	IAEMP	Experience from over 50 commercial building's energy audit in Chennai by IAEMP members strongly suggest that the behavioral energy conservation training can result in energy savings.

Source: Amalgamated by the researcher

The relevant regulations can be summarized as shown in table 1.9.

Table 1.9: Relevant regulations on need for research

Year	Regulation	Justifications
2019	Bureau of Energy Efficiency (BEE)	DSM (Demand Side Management) propagate maximum utilization of low-cost energy conservation measures.
2017	Energy Conservation Building Code (ECBC)	ECBC 2017 is a guideline to make Indian buildings more energy efficient.
2001	Energy Conservation Act 2001	Energy Conservation Act suggests implementing energy conservation policies and guidelines.

Source: Amalgamated by the researcher

1.4 Business Problem

The scholar derived at the business problem after the literature review, due diligence, and years of experience in energy conservation practice. The business problem is stated as; **"The impact of low-cost energy conservation measure (LCECM) training is not much explored for saving power consumption in the Indian commercial building sector leading to the opportunity loss".**

1.5 Significance of the Study

Fossil fuel consumption in the world is much higher than non-fossil fuel at this point. Availability of known world fossil fuel reserves will get exhausted unless new sources of fossil fuel are discovered. Gail Tverberg, (2012) found in his study that the world fossil fuel consumption mainly for power generation will reach its peak before the end of this century. After that, if new resources of fossil fuel are not discovered or alternative sources of energy are not found then there will be a huge shortage of energy. He predicts that by the year 2015 the availability of total energy will fall to its half level compared to what it was in 2010. Alternative energy sources are non-fossil fuels. These can be renewable energy or even a decrease in energy consumption. Decrease in energy consumption will also help the world by providing a longer time to find alternative solutions.

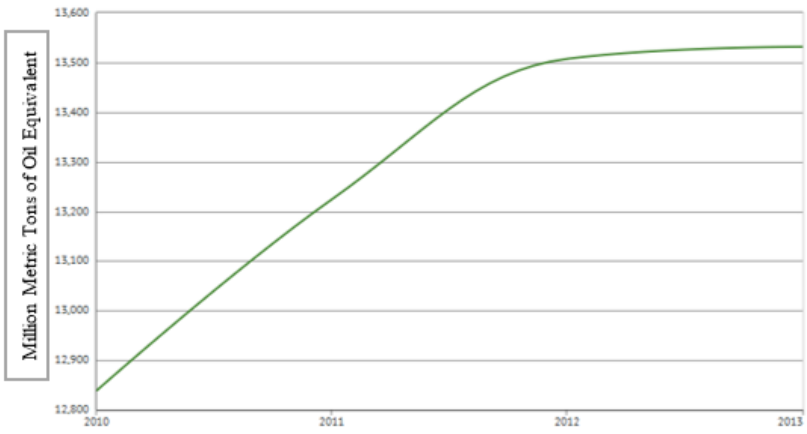

Figure 1.10: World Total Primary Energy Production (Mtoe)

Source: https://knoema.com/EIAINTL2018May/international-energy-data-monthly-update

Figure 1.10 shows the world total primary energy production increased from 12,838.64 Mtoe in 2010 to 13,531.21 Mtoe in 2013. This is an annual average increment of 1.77%

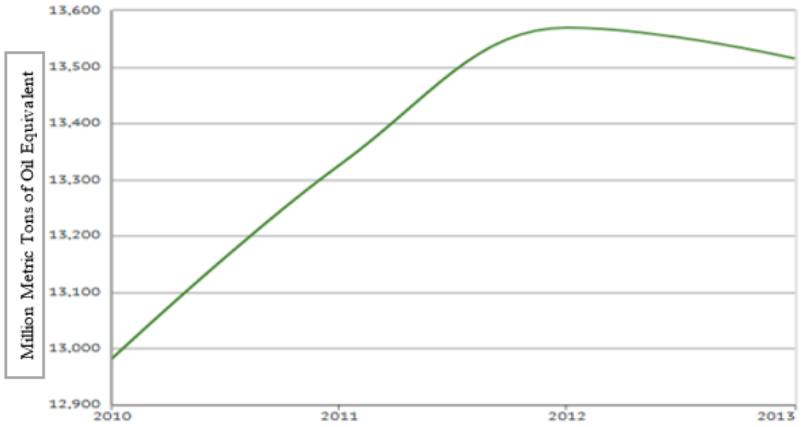

Figure 1.11: World Total Primary Energy Consumption (Mtoe)
Source: https://knoema.com/EIAINTL2018May/international-energy-data-monthly-update

Figure 1.11 highlights the rise of the Total Primary Energy Consumption in the world from 12,982.07 Mtoe in 2010 to 13,514.38 Mtoe in 2013. It corresponds to 1.36% of average annual growth. This is high time that the world community comes together to curb this growing demand and consumption of prime energy.

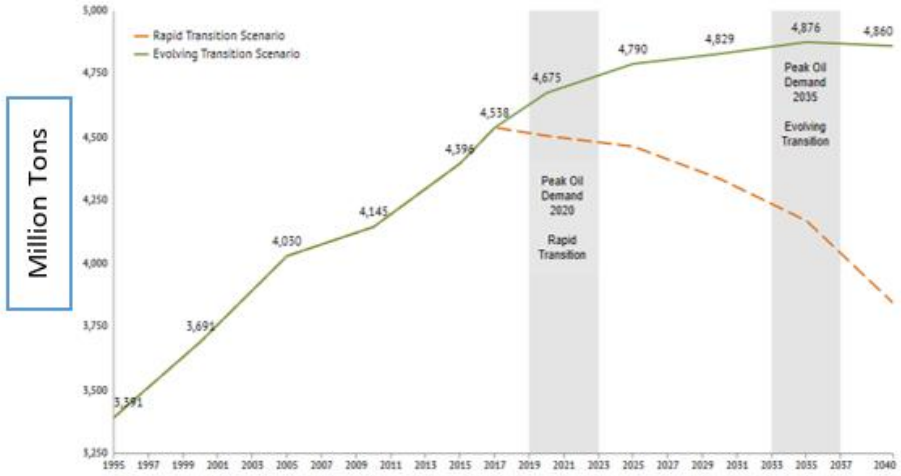

Figure 1.12: World Oil Consumption (Million Tons)

Source: https://knoema.com/qswiazc/the-consequences-of-peak-demand-and-the-low-carbon-transition

Figure 1.12 illustrates a very gloomy picture of the world oil consumption in terms of Rapid Transition Scenario vs Evolving Transition Scenario after 2017.

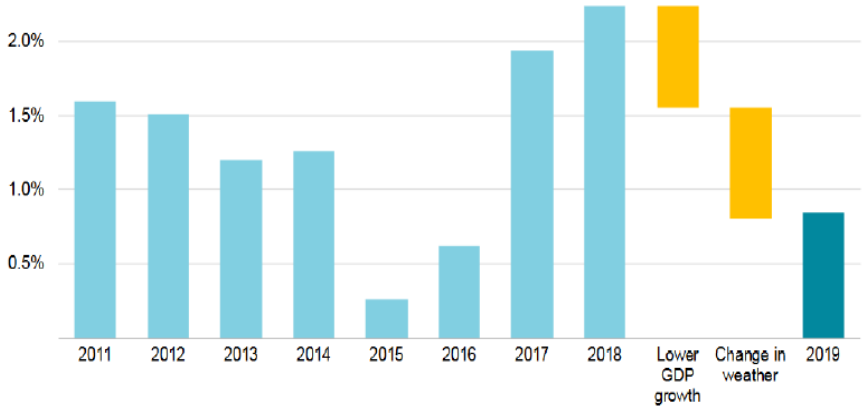

Figure 1.13: Global primary energy demand 2011-2019
Source: www.iea.org

Total primary energy demand globally rose by 0.9% in 2019 which is less than that of 2018 rate mainly because of lower economic growth and milder weather as shown in Figure 1.13. Covid -19 may have a further influence on the primary energy demand globally but that will be only temporary as shown in Figure 1.14 corresponding to similar incidents in the last 100 years.

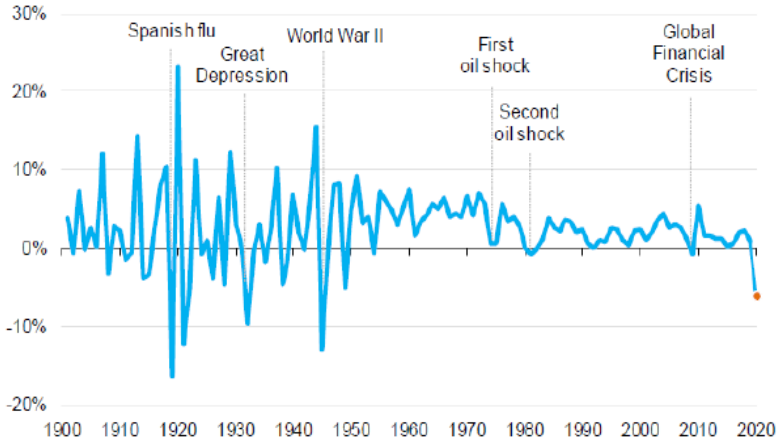

Figure 1.14: IEA Report statistics on primary energy demand globally (1900-2020)

Source: www.iea.org

Global energy demand reduced by 3.8% in 2020 during the first quarter due to Covid-19 which is 150 Mtoe (Million Tons of Oil Equivalent) compared to that of the first quarter in 2019. It is an unusual situation since most of the countries

have gone into lockdown mode to fight Covid-19 and that led to a near standstill condition for almost every economy in the world. Once the Covid-19 lockdown is reversed business activities will gradually pick up in every country leading to a global upsurge in demand for the fossil fuel. As a consequence the first oil crises in 1970s DSM was considered to be the technological solution against the contentious rising of global energy demand.

Therefore, if we need to maintain the same energy consumption level as on date then substitute resources for energy need to be found to meet at least half of that demand by the end of this century. Abd-el Hakim Mohamed Izran, (2015) suggested that these alternative sources of energy could be solar, biomass, hydro, or nuclear, besides taking necessary steps to reduce energy consumption. According to his study coal, oil and natural gas will get exhausted by the end of this century from the known sources as on date. He predicts solar, wind, geothermal, and biomass have huge potentials to bridge the gap falling due to the non-availability of fossil fuel by the end of this century. Therefore, he suggests more work on these areas to find alternative energy solutions. The crux of the suggestion is to expedite the hunt for substitute resources for energy before the known fossil fuel sources are depleted so that as the fossil fuel usage reduces the use of alternative fuel will gradually increase without any significant impact on any economy in the world.

The Indian power sector has been growing steadily since 1960 mainly due to the growth in industrialization, transportation, and human living standards. Govt. of India report, (CEA report 2019) illustrates the growth of the Indian Power Sector since 1947. Govt. of India planned this growth in a phased manner for five years block starting with the first plan ending on 31 March 1956. There was not much growth in installed capacity till the end of the fourth plan in 1974. Industrialization started to pick up so was an increase in demand calling for the growth in installed capacity. From the fifth plan till the end of the tenth plan in 2007 the demand for more energy increased steadily calling for increasing the installed capacity. It is after this period India witnessed a huge jump in energy demand in each planning phase mainly due to diversification in business

activities mainly increase in manufacturing, IT business, transportation, and improvements in living standards in India. The installed power generation capacity in India is 3,56,100 MW as of 31 March 2019. This growth pattern is anticipated to increase along the same trajectory owing to a further growth in manufacturing, commercial, domestic, and transportation sectors beyond 2019.

All India Electricity Generation

With the increase in installed generating capacity as shown in Figure 1.15, the power generation has been to its maximum possible capacity to reduce the difference between the demand and supply that is ever growing. Govt. of India report, (CEA report 2019) shows about 78% of the fuel needs were met by fossil fuel during 2019. The majority of Indian power plants use coal, natural gas, furnace oil, and diesel as the main source of fuel. Fuel wise gross electricity generation in India during 2018-19 was 13,71,817 GWh and coal constituted for 74.52% (10,22,265 GWh), Gas 3.63% (49,834 GWh) and diesel 0.02% (212 GWh), (CEA report 2019). The same is graphically represented as is shown in Figure 1.16.

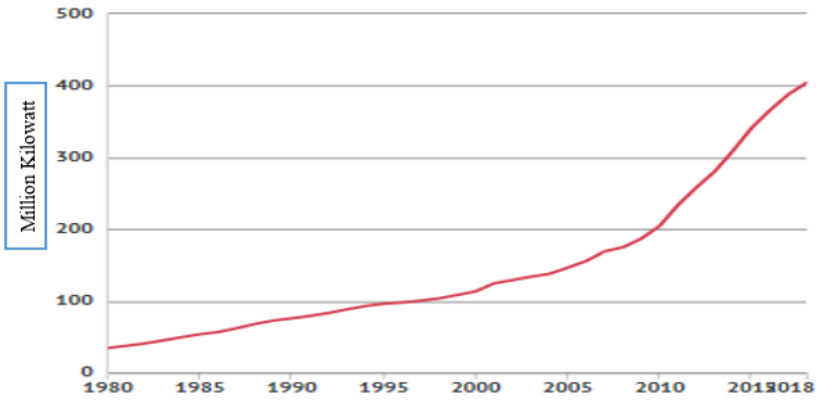

Figure 1.15: Total Electricity Installed Capacity in India (Million Kilowatt)

Source: https://knoema.com/titogsd/energy-overview?Region=India

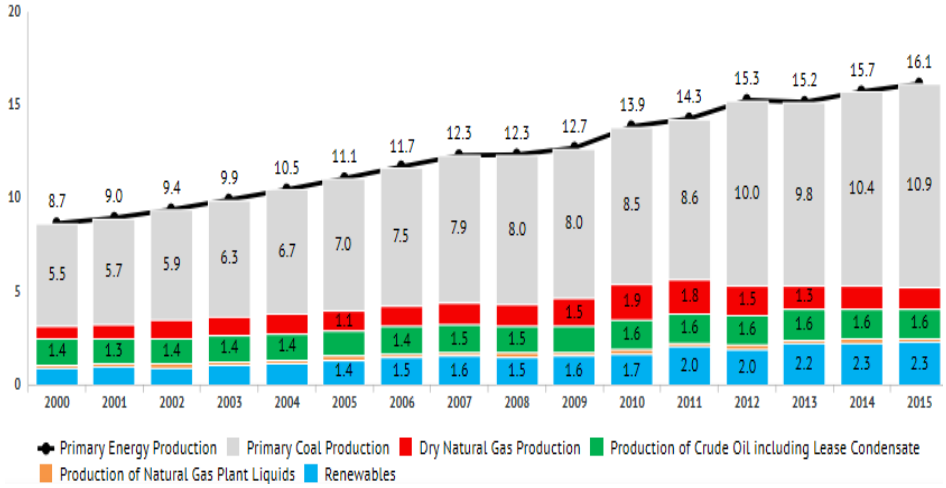

Figure 1.16: Energy Production by Fuel Source type in India (Quadrillion BTU)

Source: https://knoema.com/titogsd/energy-overview?Region=India

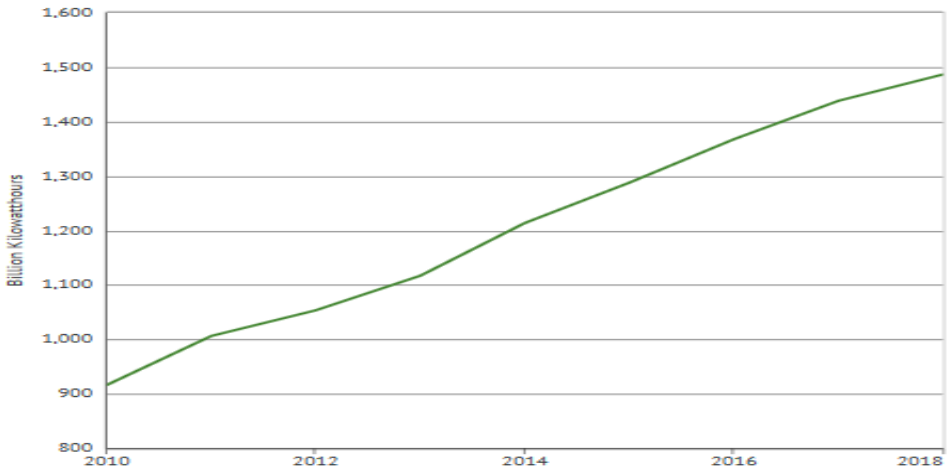

Figure 1.17: Total Net Electricity Generation in India (Billion Kilowatt-hours) (2010-2018)

Source: https://knoema.com/EIAINTL2018May/international-energy-data-monthly-update

Total electricity net generation in India increased from 1,053.41 Billion kilowatt-hours in 2012 to 1,486.54 Billion kilowatt-hours in 2018, and the average annual growth rate is 5.92% as highlighted in Figure 1.17. It is not in isolation but in line with the worldwide growing demand for more power as highlighted in Figure 1.18.

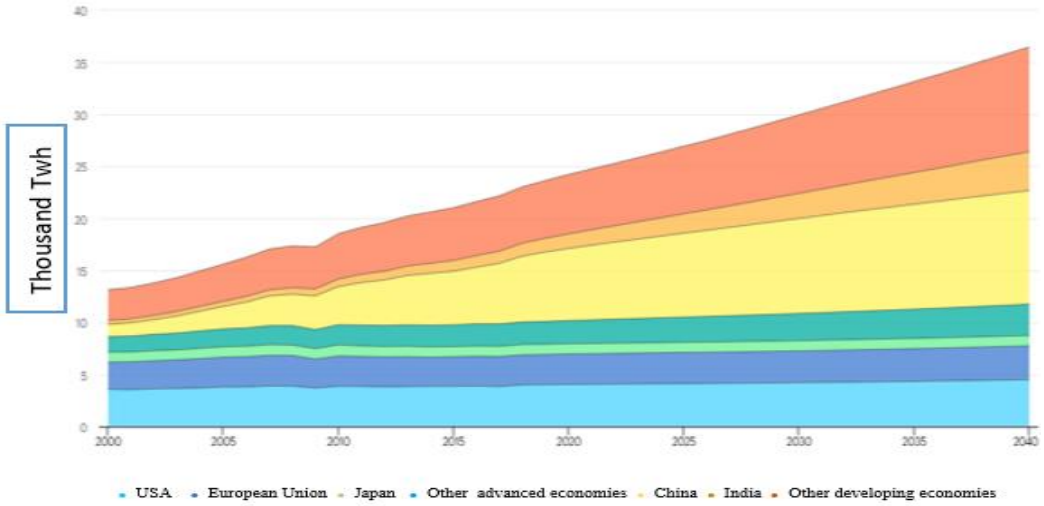

Figure 1.18: Global Electricity Demand by Region between 2000-40 (Thousand Twh)

Source: https://www.iea.org/data-and-statistics/charts/global-electricity-demand-by-region-in-the-stated-policies-scenario-2000-2040

All India Electrical Power Consumption

Electrical Power is the primary energy source used in India particularly in buildings, be it for residential or business purposes. Domestic and commercial sectors in India consumed 33 % of generated power as per the Govt. of India report 2019. This is mainly due to the improvement in living standards. In the last decade, this percentage of increase in the usage of electrical power is seen to be contentious. As per the Govt. of India report, (CEA report 2019), total power consumption in India during 2018-19 was 11,96,309 GWh. Industrial, domestic, and agricultural sectors consumed the maximum power during this time. Industrial consumption was 41.16% (4,92,361GWh), while domestic was 24.76% (2,96,219 GWh), commercial was 8.24% (1,98,622 GWh) and agricultural was 17.69% (2,11,609 GWh). Consumption in these four sectors is expected to rise gradually mainly due to an upsurge in requirement for new constructions, manufacturing capacity, and the need for increased food sustainability. To meet this growing demand for electrical power, primary energy (Fossil fuel) usage in India is gradually increasing as shown in Figure 1.19, and in that coal and fuel oil portion is more and on the increasing path.

Electrical power consumption has also increased rapidly since 2000 as highlighted in Figure 1.20.

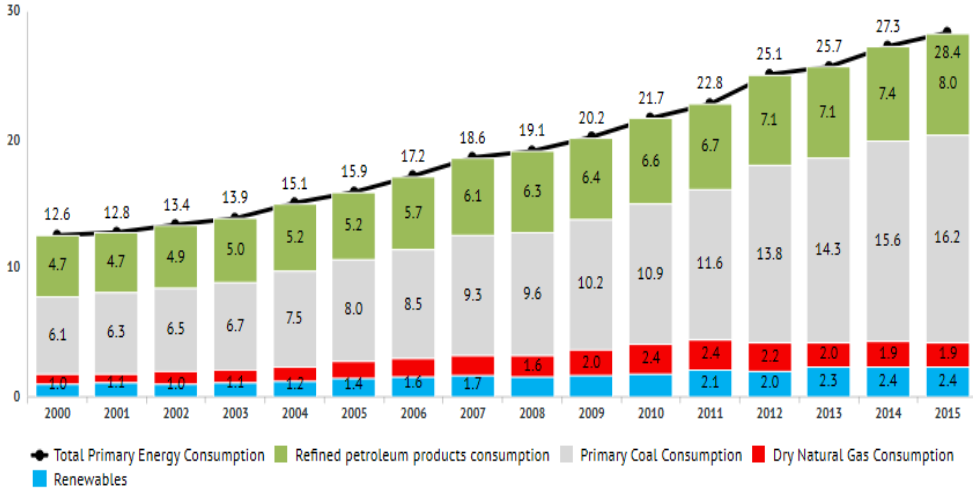

Figure 1.19: Energy Consumption by Fuel Source type in India (Quadrillion BTU)

Source: https://knoema.com/titogsd/energy-overview?Region=India

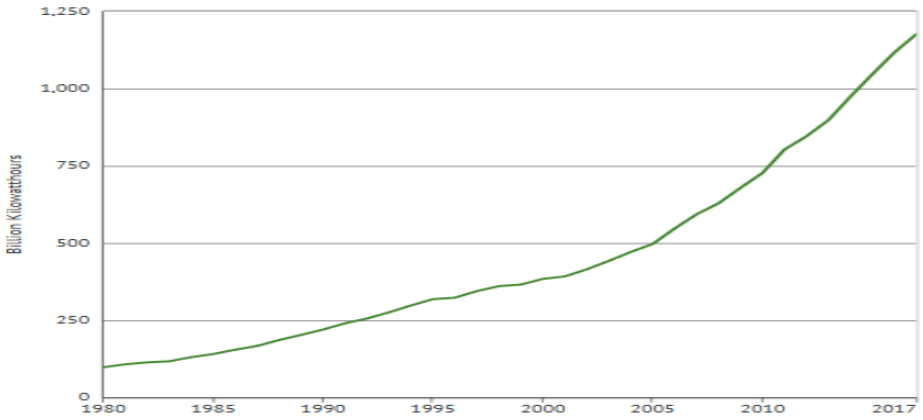

Figure 1.20: Total Electricity Net Consumption in India (Billion Kilowatt-hours)

Source: https://knoema.com/EIAINTL2018May/international-energy-data-monthly-update

Between 1998 and 2017 total electricity net consumption of India grew substantially from 360.5 Billion Kilowatt-hours to 1.176.75 Billion Kilowatt-hours. This rise in annual growth rate is contentious and reached at a maximum of 10.41% in 2011 and then gradually reduced to 5.33% in 2017.

Due to the constant increase in demand, the deficit between supply and demand of electricity is always there and it is an operational challenge to optimize the utilization. The gap is steadily reducing by increasing the generation but very difficult to meet the full demand at all times. It becomes more critical due to two major peaks, i.e. morning and evening which is mainly because of domestic and commercial sectors. Because of these two peaks reserve capacity of the higher generation becomes a problem for both Capex and Opex. There is always a shortage of power to meet the demand and it becomes critical during peak hours. Govt. of India report (CEA, 2019) shows peak demand deficit was more during the 1990s and the energy demand deficit was more in 2000s for the period between 1984-85 to 2018-19. To bridge these gaps between demand and supply generation capacity was increased and also the power generation as discussed in the earlier section. As of 2018 -19 the energy demand deficit is 0.58% and peak demand deficit is 0.84%. Peak demand in India is mainly in the morning and the evening. POSOCO (Power System Operation Corporation Limited) report 2016 suggests that the load in India starts increasing from morning 4 AM which is the night lean demand and reaches the morning peak around 9 AM mainly because people start getting ready at home to go to their respective works. The demand for power gradually reduces and settles during the day. Lean demand is around 1.30 PM mainly due to the lunch break time. Again the demand gradually increases and reaches the evening peak demand at 7 PM as the people return home from their respective works and starts household chores of the day. Thereafter the demand for power gradually reduces at night.

Martin Nicholson, (2012) discussed various load demands to explain the peak demand. Baseload demand is more or less constant during the 24 hours. It is an intermediate load demand that starts increasing from around 5 AM and settles around 7 AM to remain at the same level until around 10 PM. Intermediate load demand is above the baseload demand and starts gradually reducing after 10 PM to baseload demand level at night. As the manufacturing starts in the morning, commercial and Govt. offices start operating there is an increase of another demand in load which he terms as peak demand load. It starts around 7

AM, gradually peaks in the afternoon, and reduces to intermediate load demand level by 10 PM. Therefore, During the peak load demand utility needs to meet the baseload demand, intermediate load demand, and peak load demand.

The demand for energy in India continues to grow due to an increase in industrialization and improvement in lifestyle and business operations. This demand is met mostly by increasing the generation capacity utilizing fossil fuel to its maximum. The world primary energy source, i.e. fossil fuel reserve, is gradually depleting and anticipated to get exhausted by the next century if further fossil fuel reserved is not discovered. It is a main reason of apprehension for the world community. Under this scenario, energy conservation by every possible means can contribute to prolonging the usage of world-known fossil fuel reserves which in other words will give more time to mankind to find an alternative source of energy or some other solutions.

1.6 Rationale of the Study

Energy Conservation Act 2001 was introduced in India for providing a legal context to encourage energy conservation in India and subsequently BEE (Bureau of Energy Efficiency) was made operationalized under the Electricity Act 2003 with the objectives as described below.

- Formulate and roll out Energy Conservation Building Coad (ECBC) for initiating energy conservation activities in the building sectors with a chalked out action plan and road map.
- Standard and Labeling (S and L) of products and equipment mostly used in domestic and commercial sectors for daily work purposes with an easy identification plan. Subsequently, star ratings were introduced to indicate the energy efficiency levels of the products.
- Demand Side Management (DSM) to be incorporated not only by technological means but also with tariff incentives to enhance the energy utilization at the consumer end for better management of both the peak demands (morning and evening) and improvement of the utilization efficiency.

- Introduction of Bachat Lamp Yojana (BLY) in Indian homes to improve the energy efficiency in lighting load by way of replacing old inefficient lights with new energy-efficient lights.
- Promoting energy conservation through increased efficiency in Small and Medium Enterprises (SMEs) through handholding by technological and commercial support and introduce innovative projects to sustain the initiatives.
- Identify the Designated Consumers (DC) for the introduction of energy conservation plans identified by BEE for their respective premises and operations and also to publish their respective Energy Conservation Vision.
- Certification of Energy Managers (EM) and Energy Auditors (EA) through a centralized examination process to set the standard for energy conservation activities across India. One of the important activities of these EMs and EAs is to propagate energy conservation at the consumer level and also to train the end-users for proper and efficient utilization of energy.

Power consumption in the Indian buildings is approximately 35% of the total power generation. These are commercial buildings, residential buildings in domestic usage, and various other types of buildings used for various other purposes. As per the Govt. of India report (CEA, 2019) during 2017-18 commercial buildings consume 9 % and domestic buildings consume 24 % of the total of 35 % power consumed by all buildings in India. Building sector comes next to manufacturing sector in power-consumption in India.

India is a big country with five different climatic conditions such as hot, cold, composite, humid, and moderate (ECBC, 2017) spanning from all four directions. As per the climatic conditions loads connected in any building are light, air-conditioner, fan, water heater, fridge, washing machine, microwave oven, various receptacle mount loads used in daily domestic or commercial purposes, etc. However, the primary loads of domestic and commercial buildings are mainly lighting and air-condition loads and consume 59 % and 31

% respectively as per the Govt. of India report (CEA, 2019). Other loads consume only 10% of the demand.

Construction in the Indian building sector is growing steadily as the economy and business activities are growing. There is a surge in migration of educated young professionals from rural to urban locations due to the economic growth and career opportunities. Construction of new buildings is the reality to keep pace with the increasing demand from residential and commercial sectors. It is estimated that the existing buildings in India will grow to 2.2 billion m^2 in 2037 from 1.4 billion m^2 in 2017as per the AEEE report in 2017. According to this report of 2.2 billion m^2 in 2037, only 61% of buildings are in existence. That calls for the construction of another 39% of the buildings by 2037. The average yearly electricity consumption growth rate in Indian commercial buildings is 9-10% from 2006-07 to 2015-16 (CEA, 2017). It is projected to grow further as the estimated 39% of the future demands in the building is constructed and occupied by 2037 (AEEE, 2017).

Therefore, there is a need to ensure that the future buildings in India are made energy efficient. Air-conditioning systems, lights, water heating systems, receptacle mount loads, etc. used in the building should be energy efficient. On-site, electricity generation either from solar or wind or bio-fuel should have the priority. The usage of natural light should be given priority while ensuring the thermal integrity of the building by an efficient building design to maintain the highest standard for the building envelope. Water is becoming a scarce commodity in many cities in India and therefore, water recycling and water harvesting must be a key feature in every new building construction. Features of such energy-efficient buildings should have zero wastage, be self-sustainable, and high inefficiency. AEEE Conference Presentation in 2018 suggests on-site generation should be given priority by using wind, solar, and biomass as much as possible to reduce the grid power dependency. Building design should consider all factors to keep the building envelop within the limit by utilizing daylight as much as possible and restricting the heat ingress to the maximum level. Lights used in the buildings should be of high efficiency and

with better control options. The HVAC system should be having energy-efficient equipment and heat recovery options as much and wherever possible. Occupancy load particularly in IT-related buildings should have the option for remote control from the facilities management control desk. Water harvesting must be taken on priority and reuse as much as possible.

The Indian Government passed the Energy Conservation Act 2001 to promote energy conservation in India. Subsequently, ECBC (Energy Conservation Building Coad) was introduced in 2007 to implement energy conservation in building sectors in India. The Indian Government mandated improved energy-efficient design and buildings construction through ECBC for the future infrastructures. The code also recommends two additional categories of design for buildings namely ECBC+ and Super ECBC to achieve higher levels of energy efficiency. However, these two categories are not obligatory and go beyond the minimum requirements.

Therefore, the present study aligns with the Indian Government's energy conservation action plan and its implementation through the Energy Conservation Act 2001 and subsequently supported by introducing the new Electricity Act 2003.

ECBC Implementation Roadmap: The road map as explained in Figure 1.21 is for a smooth implementation, while the policies and guidelines are from the central government and implementation is by the state governments through their respective Urban Local Bodies (ULBs). It can also be said that the ECBC implementation is by three levels. Centre at the national level will be in an advisory role, states will be in coordination role and ULBs will be in implementation role at the local level.

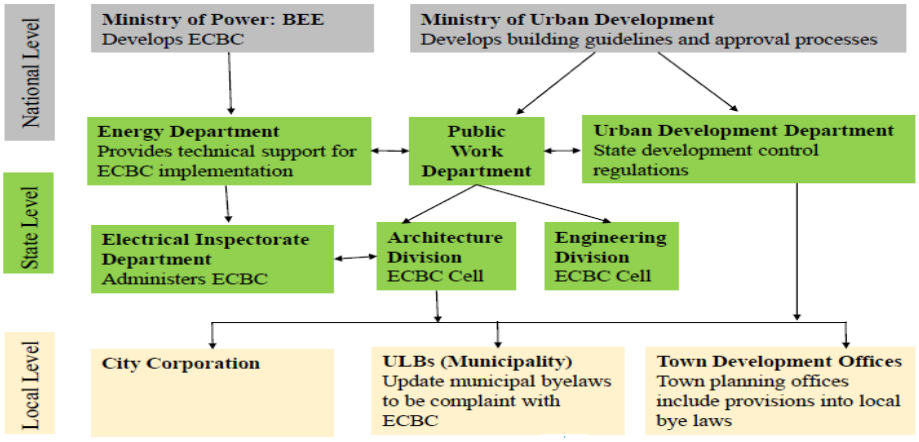

Figure 1.21: Energy Conservation Building Code (ECBC) Implementation Road Map
Source: https://www.aeee.in/

1.7 Organization of the Thesis

The present study is prepared into seven chapters for exploration and the presentation. The first chapter, 'Background and Introduction' constitutes the business problem and its scope. The second chapter describes the Indian energy scenario and energy conservation. The third chapter explains a structured review of the literature. Chapter Four includes hypothesis generation and model development. Chapter Five describes the research methodology. Chapter Six includes data analysis and findings, followed by operationalization and conclusions in Chapter Seven.

The first chapter narrates the background. Also, introduction constitutes the motivation for the study, business problem, and its need. Significance and the rationale of the research are also discussed.

The second chapter summarises the present status of Indian Energy Conservation reforms undertaken by the Government of India followed by various aspects of energy conservation measures undertaken by the main study at Guindy Industrial Estate in Chennai.

The third chapter critically analyses the research gaps identified in the theme-based structured literature review. Research problem, research questions, and research objectives are also covered.

The fourth chapter includes the need for low-cost energy conservation measures training and its antecedents. Describes the operating definitions of terms used for developing the conceptual model and related hypotheses considered to test the model.

The fifth chapter includes the methodological and procedural presentation of researching the problem under investigation. The chapter gives the details of the pilot study. The questionnaire with organizational, personal, and task items, was used after establishing their reliability and validity. The research flow chart highlights the complete research process. The chapter also include the limitations of research.

In the sixth chapter, a detailed analysis of collected data through the PLS-SEM method is included. Also gives the details of actual energy conservation that was measured at two different locations and analyzed using IPMVP – A protocol.

The seventh chapter consists of discussion, implications, and contribution to the research objectives. The chapter concludes with future scope of research.

1.8 Summary

a) Various newspaper reports in the recent past suggest the need for initiating energy conservation practices in Indian homes and commercial buildings in a more proactive manner involving not only the government agencies and industries but also the consumers.
b) Demand Side Management (DSM) was believed to be the answer to overcome the difference between supply and demand in energy during the nineteen seventies in developed countries. This initiative was particularly to preserve fossil fuel namely coal and oil which were the main source of fuel then. Subsequently, innovations and developments took place to improve performance efficiency by improving technology.
c) During the last decade, researchers found that human behavior influences energy consumption and the measures to influence human

behavior do not cost much money while these measures have good potentials of saving energy.

d) Low-cost energy conservation measure (LCECM) training is identified as the business problem which is not much explored in the industries due to the mindset of a biased approach to see it as an expenditure rather than an investment.

e) Energy conservation by every means is the need of the hour as the world's known fossil fuel reserve is gradually depleting in one hand and another demand for additional energy is growing steadily all over the world. Urgent need to meet the gap between demand and supply should not divert our attention from diminishing fossil fuel reserves.

f) Energy Conservation Act 2001 and Electricity Act 2003 were implemented to encourage energy conservation in India in all segments through all possible means. Energy Conservation through LCECM training is one area that needs to be explored further which has the potential to increase the energy utilization efficacy at the consumer end.

Chapter 2

Energy Conservation Regulations in India

2.1 Introduction

In order to understand the energy conservation regulation in India, it is important to understand various reforms the Indian power sector has gone through. Some major changes were done to bring transparency and accountability in the Indian power sector's operations over the years. Some of the relevant studies are summarized in Table 2.1 highlighting the need for such changes.

Table 2.1: Energy Conservation Reforms in Indian Power Sector

Year	Source	Findings
2020	Garg V.	Due to subsidy burden and commercial losses in operations, it became a necessity to reform the Indian power sector.
2019	Mishra P.	The decentralization of operations has brought transparency and improvement in operations.
2019	Niti Aayog	State Electricity Boards could not sustain the attempt of increasing the capacity and calls for disassembling the same for operational excellence.
2018	Srivastava S.	Public sector enterprises understudy proves to be inefficient and privatization can bring efficiency in the operations.
2018	Estrin and Pelletier	The economic performance of the public sector will improve by privatization through wide share ownership.

Source: Amalgamated by the Researcher

The hydro-electric power plant at Darjeeling in 1897 was the beginning of Indian power generation. The sector has gradually grown over the years to come to the present status. Immediately after India's independence the combined

thermal and hydropower plant capacity in India was 1392 MW. Subsequently, Indian Electricity Act 1910 was revised and Electricity (Supply) Act 1959 was passed by the parliament. It is the Indian Electricity Act 2003 which was introduced in the parliament in 2001 along with the Energy Conservation Act 2001 laid the ground for Energy Conservation Regulation.

Research shows human intervention to use the equipment/system judiciously requires a paradigm shift in attitude towards energy usage from "If not me, to why not me?". Perhaps that is how human psychology works and accepted by the majority as the norms. With the advancement in automation in lifestyle, human intervention for better management seems to be the things of the past and forgotten. ECBC 2017 is a good policy towards bringing energy efficiency in building sectors which otherwise is not the priority area to the business community as it is seen as an expenditure towards operations (Ali and Tyagi, 2019). If the human intervention is mandated as an obligatory factor under ECBC 2017 by the Urban Local Bodies (ULBs) it will not only make the buildings more energy-efficient but will also bring a socio-cultural change about the way energy is being used and also the consequences of abuse/misuse of energy which is the greatest gift to the mankind by the mother nature.

2.2 Brief Genesis and Present Status of Energy Conservation Reforms

The State Electricity Boards (SEBs) were dismantled into private entities like Distribution, Transmission, and Generation companies respectively to increase operational effectiveness. Table 2.2 summarizes the evolution of structural reforms in the Indian Power Sector.

Table 2.2: Key Structural Reforms in Indian Power Sector (1879-2020)

Year	Development
Pre-reform phase changes in Indian power sector	
1879	Introduction of electricity usage in Calcutta
1897	India's first hydro power plant of 130 kW capacity at Darjeeling
1899	India's first major hydroelectric Sivasmudram power project of 4.5 MW capacity
1951	Introduction of CEA (Central Electricity Authority) and SEBs (State Electricity Boards).
1980	Introduction of private sector participation proposal.
1981	NPTC (National Power Grid and National Power Transmission Corporation) was introduced.
1986	PFC (Power Finance Corporation) came into existence to support all power plants.
Reform phase changes in Indian power sector	
1991	IPPs (Introduction of Independent Power Producers)
1996	Restructuring of Indian power sector initiated.
Post-reform phase changes in Indian power sector	
2001	Introduction of Energy Conservation Act
2003	Introduction of revised Electricity act
2007	Introduction of ECBC (Energy Conservation Building Code)
2018	Implementation of ECBC 2017
2020	Introduction of amendments to EA 2003

Source: Amalgamated by the Researcher

Operational reforms in the Indian power sector came into existence in 1991 through power distribution companies, known as 'DISCOMs'. More than 20 states in India have implemented 17 new and advanced technologies to increase the efficacy of their respective DISCOMs (Khurana and Banerjee, 2015). The comparative assessment of operational and technical parameters of the post-reform phase is summarized in Table 2.3 for an easy understanding of the impact of reforms.

Table 2.3: Percentage Losses in GDP (1993-2003)

Particulars	The early 1990s	The early 2000s
Deficit in Energy (%)	7.7	7.5
Deficit in Peak (%)	18.8	14
Consumption Per Capita (kWh)	268	355
Losses in Transmission and Distribution (%)	22.8	27.8
Power sector's percentage share in total national plan outlay (%)	18.9	12.2
Recovery of Cost (%)	79.4	68.6
Monetary Losses (Rs. billion)	40	250
Percentage Losses of GDP (%)	0.7	1.5

Source: Khurana and Banerjee, 2015

Operational efficiencies and challenges in the Indian power sector did not see much significant improvement. Table 2.3 indicates an energy deficit of 7.5%, transmission and distribution losses of 27.8%, and cost recovery of 68.6% in the early 2000s, which indicates inefficiencies in the Indian power sector.

Table 2.4: Relevant Studies on Key Structural Reforms related to Energy Conservation in Indian Power Sector

Year	Source	Findings
2000	Kannan et al.	Poor efficiency of SEBs is mainly due to lack of accountability.
2002	Kannan et al.	Inefficiencies in technical, financial and organizational management call for efficiency improvement program.
2010	Yadav et al.	Indian power sector distribution management has deficiencies in operation and financial performance.
2013	Mohanty et al.	Entry of private players has brought positive changes in efficiency of distribution and production activities.
2014	Pargal et al.	The operational efficiency in terms of technical and financial performance deteriorated by 1994 in India power sector.

Source: Amalgamated by the Researcher

Studies revealed deficiencies like operational, managerial and technical inefficiencies coupled with high debt on government, increase losses, lack of

accountability in the absence of consistent policy taking the potential investors away from supporting the reforms (Rao, 2004; Shukla et al, 2011; Kumar et al, 2012) calling for revisiting the existing regulations in the Indian power sector. Table 2.5 gives an insight into the evolution of reforms in Indian power sector regulations.

Table 2.5: Relevant studies on Energy Conservation Reforms in Indian

Year	Development
Pre-reform phase changes in Indian power sector	
1910	Electricity Act,1910
1948	Electricity (Supply) Act, 1948
Reform phase changes in Indian power sector	
1998	Electricity Regulatory Commissions Act, 1998
Post-reform phase changes in Indian power sector	
2001	Energy Conservation Act 2001
2003	Electricity Act 2003
2007	Introduction of ECBC
2018	Implementation of ECBC
2020	Introduction of amendment to EA 2003

Source: Amalgamated by the Researcher

The world today is moving away from fossil fuels. The global energy policy is increasing focus on the environment and sustainability. The pressing concern for many regions around the world is affordable access to energy and stable infrastructure (Iftikhar Fatima et al., 2015). The developed countries have ensured affordable energy access today and also taken steps to meet the future energy demands (Ahuja and Tatsutani, 2009). The Government of India also has introduced a two-way tactic to meet the energy mandate while safeguarding a minimum increase in CO_2 emissions. First, encouraging more use of alternate energy mainly through wind power and or solar energy on the generation side. At the same time replacing the old technology with the new and energy-efficient technology in power plants using fossil. Second, the efficient utilization of energy in DSM application as the opportunities provided in the Energy Conservation Act 2001. BEE came into existence in 2002 under the ambit of Ministry of Power to operate as a statutory body. The purpose was to implement the Energy Conservation Act 2001. It was in line with the national energy vision

given by the Indian president Dr. APJ Abdul Kalam as “Energy independence by 2020”. Studies as summarized in Table 2.6 and 2.7 suggest the necessity for regulatory restructurings in the Indian power sector.

Table 2.6: Relevant studies on Regulatory Reforms in Indian Power Sector

Year	Author	Justification
2018	Tongia and Gupta	The electricity Act of 2003 has made significant legal and institutional changes to meet the industry's requirements.
2017	Mukherjee et al.	The Electricity Act 2003 promised to remove the maladies of the Indian Power Sector at a time ridden with difficulties.
2017	Buckley and Shah	Electricity Act 2003 has brought 5.6% annual generation growth in the Indian power sector leading to technological progress.

Source: Amalgamated by the Researcher

Table 2.7: Relevant reports on Regulatory Reforms in Indian Power Sector

Year	Source	Justification
2020	International Energy Agency	An integrated approach that can ensure reliable and affordable electricity needs to redefine the objectives and methodologies.
2019	World Energy Council	Indian power sector policy appears to have locked itself into adverse situations that may cause favorable institutions and unfavorable institutions.
2019	Energy World	Though the power sector reforms received a thrust in the reform plan of the state budgets some states have opted to do the same through different measures.
2016	Asian Power	Regulatory reforms intend to bring competition and increase operational efficiency.
2015	Indian Energy Exchange	The Electricity Act 2003 on one side opens possibilities of increased competition but on the other side opens a new area of policy risk that is supposed to mitigate.

Source: Amalgamated by the Researcher

ECBC is a game-changing policy initiative (ECBC, 2017; Yu and Evans 2014). ECBC spells out the minimum requirements of design as standards and accordingly, construction of private and public buildings in India. It promotes the energy-efficient design or retrofitting of the buildings without affecting their functions, comfort, health, and productivity (Rawal et al., 2018).

Energy Conservation Building Code (ECBC): The Indian Government introduced ECBC in 2007 for the construction of new buildings. It was constituted as part the Energy Conservation Act 2001 for strengthening BEE for implementing the Act successfully. The purpose of ECBC is to make the Indian domestic and commercial sector buildings energy efficient. The Indian building sector consumes about 35 % of the generated power of which commercial buildings consume 9 %, residential buildings consume 24 % and other buildings consume 2 % (CEA). ECBC compliant buildings are expected to consume 40 % - 60 % less energy compared to any conventional buildings based on a computer simulation model. It is estimated that nationwide approximately 1.7 billion kWh of power savings is possible annually if ECBC implementation is made mandatory (CEA). The introduction of ECBC was the beginning of a series of actions for promoting energy conservation in Indian commercial and domestic sector buildings. One such action is the introduction of Eco-Niwas Samhita in 2018.

While ECBC was introduced at the Central level but the responsibility for implementation lies with the States Ministry of Urban Development. Central Government or State Governments can give necessary suggestions to Urban Development Authorities (UDA) for implementing ECBC for optimal utilization and conservation of energy. Main features of revised ECBC 2017 are:

i) To set a long term vision for Indian building sector energy conservation.
ii) To ensure all existing and new buildings are under the preview of the act.
iii) To ensure energy-efficient building design for reducing energy usage.

iv) To establish a baseline of energy consumption for comparison and endorse buildings that surpass the minimum requirements of the code.

v) To ensure the ease of submission and implementation of the code.

The building sector consumes 35 % of the total electrical power in India. In that domestic buildings consumes 24 % while commercial buildings account for 9 %. Lighting (59 %) and Air-conditioning (31 %) are the biggest power-consuming loads in Indian commercial buildings as shown in Figure 2.1. Successful implementation of ECBC is expected to reduce electricity consumption by 25 % -30 % in Indian commercial and residential building sectors (Tsuda et al., 2016).

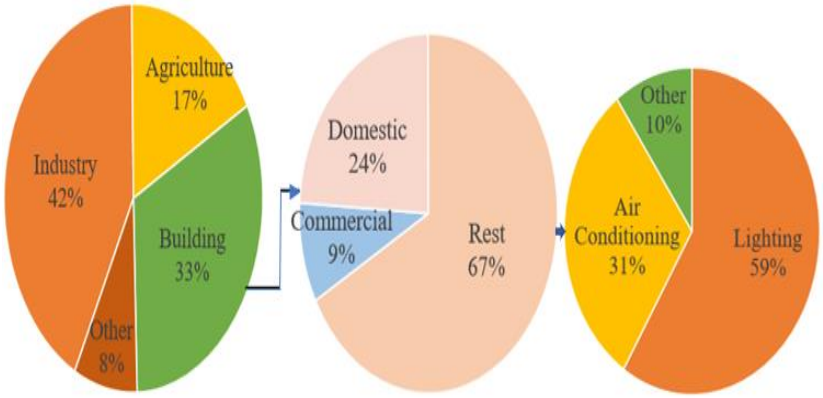

Figure 2.1: Break-up of Electricity Consumption in India

Source: https://www.aeee.in/

The expected outcome of ECBC: ECBC was created under the Energy Conservation Act to strengthen BEE to drive energy independence initiatives across India and to teach the public in general regarding the effective usage of power. Initially drafted CEBC had the following key features for energy conservation in building sectors in India.

i) Applicable only to new commercial buildings that will have 100 kW and more as connected load or 120 kVA or more as contract demand.

ii) Daylight harvesting and shading provisions were introduced as passive design features of the new buildings.
iii) Introduction of installing all possible renewable energy systems.
iv) Implementation of energy-efficient building design.
v) Encouraging energy-efficient design to modify the existing buildings.
vi) Target to reach a milestone of near-zero energy buildings.

This ECBC was further modified in approach and expanded in reach during 2017 with better clarity and redefined target as highlighted in Figure 2.2. It is estimated that 50 % of energy savings which in monetary terms will be about Indian Rs. 35,000 Crore (350 Billion Rupees) is possible by the year 2030. And if that happens then it will mean a 15 GW reduction in peak demand and abatement of 250 Mt CO2e of GHG.

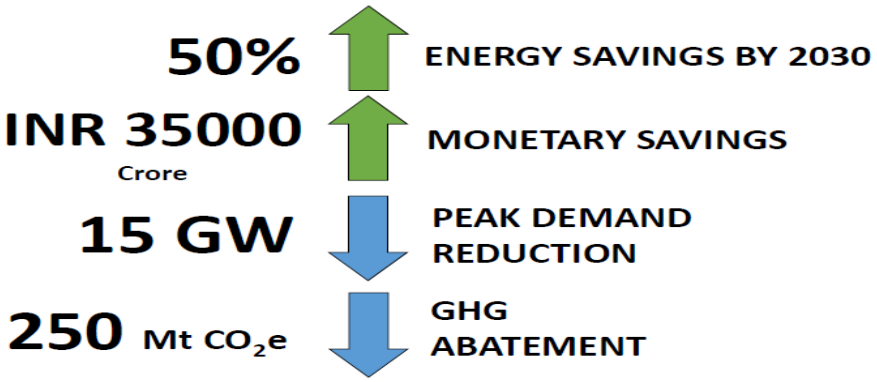

Figure 2.2: Potential National Impact of ECBC 2017
Source: Government of India report on ECBC, 2017

BEE forecasted the impact of an effectively implemented ECBC across the country and all five climatic conditions will translate into an overall energy conservation in the range of 20 – 25 % as shown in Figure 2.3. It will be possible because human behavior has a positive impact on energy consumption by any equipment/machines used in buildings daily (Khan et al., 2016).

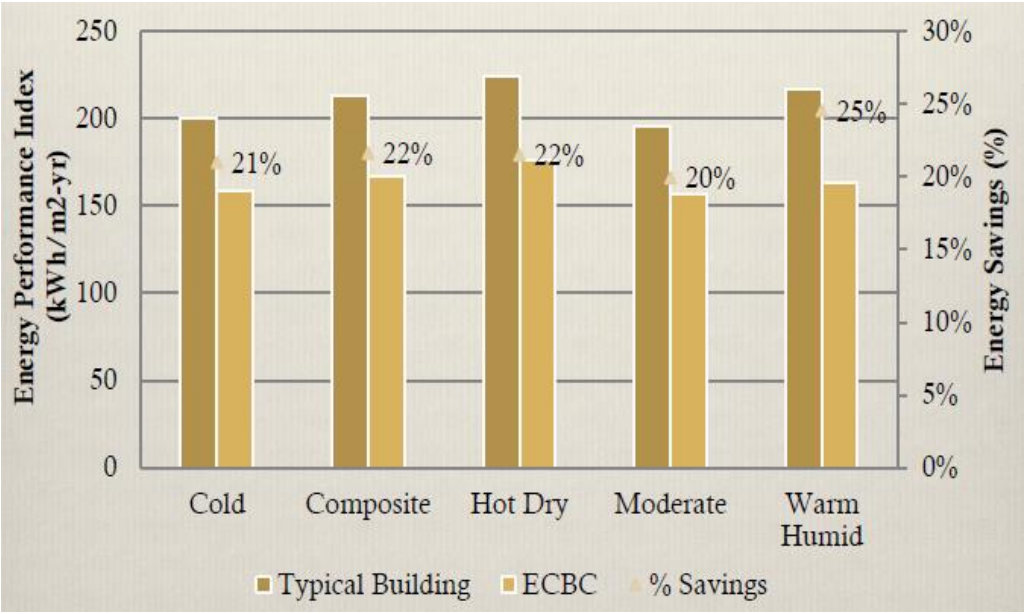

Figure 2.3: BEE Report Statistics on Expected Impact of ECBC

Source: https://beeindia.gov.in/

2.3 Energy Conservation Measures

ECBC 2017 gives clear policy guidelines with regards to the building envelope which is an energy intensity parameter consisting of building design, construction, and machine/equipment/appliances that will be in use within the building premises. It is the Energy Conservation Measures (ECM) that can help the building envelop to be within the accepted limits. ECM can be corrective action in the daily operation, administrative advice for the people, better technology, equipment/machine with higher efficiency, modification in the plant operations or any such actions that will result into reducing the energy consumption while performing the same work without compromising with the final output or comfort level. The government of India has initiated many energy conservation projects using ECMs, particularly in the building sector. Lighting is one such project which is a huge success in India to replace the inefficient lights with energy-efficient lights. Bachat Lamp Yojana (BYL) is one such project under XI plan to distribute about 29 million energy-efficient Compact Fluorescent Lamps (CFL) leading to an avoided generation capacity of 415 MW (BEE, 2019). However, such measures remain a voluntary exercise towards energy conservation in India. ECM options can be categorized as per their

respective features and cost implications for implementation. In general, ECMs are categorized into three groups (IAEMP) as summarized below:

Table 2.8: Energy Conservation and Efficiency Measures Pay Back Period

Options	**Features**	**Cost**	**Tentative Payback**
High Cost	Technology Change	High	More than 5 years
Mid Cost	Addition and Alteration	Moderate	1 to 3 years
Low Cost	Administrative Corrective Actions	Less	Less than 1 year

Source: Amalgamated by the researcher

Generally, Mid Cost and Low-Cost options are opted by the industries since the implementation is easy, the payback period is reasonable and the fund is not a constraint. The high-Cost option is proposed mainly when the organization is looking for modernization or expansion of the operations. Low-Cost Energy Conservation Measures (LCECM) are most favored in the industry due to short payback and ease of implementation (Janos, 2011).

2.3.1 Low-Cost Energy Conservation Measures (LCECM)

An energy conservation activity that may be training, administrative corrective actions, modifications in operational procedures, fine-tuning the controls of equipment, and usage of building's energy management software for air-conditioning, ventilation, lighting, heating, and business-related activities effectively for optimal utilization of energy that will lead to energy conservation (IAEMP). LCECM has benefits like ease of implementation with a short payback period, mostly administrative and corrective actions which include training. It will also have an impact on Demand Side Management (DSM) particularly on morning and evening peaks and on load curve (Worrell et al., 2003; Janos, 2011; Biswas et al., 2013).

2.4 Need for Low-Cost Energy Conservation Measures (LCECM) Training in India

The government of India initiated a nationwide survey of power consumption pattern and the opportunities to improve the energy usage in Indian homes by Prayas – Energy Group in 2014. After a detailed study in 21 states, the group presented its findings in 2016 with many suggestions. One such suggestion was that behavioral training on low-cost energy conservation measures to the dwellers of a commercial infrastructure can play a part in bridging the difference between supply and demand (Prayas – Energy Group report, 2016). This report had a significant impact on ECBC 2017 which was implemented in 2018. Govt. policies mostly emphasize energy conservation by advancement in technology that needs training (Electricity Act 2003). Studies in industrialized nations have shown huge opportunities in energy conservation, particularly in domestic and commercial building sectors through human interventions. These were mostly done to modify the energy usage habits through some Dos and Don'ts, simple instructions, and better utilization of Building Management System (BMS). The outcome of these initiatives was further enhanced by providing performance feedback to the participants to encourage more participation. Some of the relevant findings are listed below:

- Administrative and Corrective Measures have huge energy saving potential (PCRA, 2008).
- The success of PAT (Perform, Achieve, and Trade) Scheme I by BEE (Bureau of Energy Efficiency, 2012).
- Reduction in Transmission and Distribution losses (Hledik et al., 2015).
- Saving is daily at the consumer's end (Hledik et al., 2016).

Potential for energy conservation through LCECM and other options are highlighted in the IEA 2016 report as illustrated in Figure 2.4. India has huge scope to reduce the energy intensity with an energy conservation potential of 15 % leading to an approximately 4 years payback period. By the year 2040 energy intensity in India will be far better than South Africa, China, Indonesia, Mexico, and Brazil. This opportunity covers all energy conservation options including LCECM. Figure 2.5 summarizes an energy conservation plan in stages in

various sectors like SMEs, commercial buildings, street lights, municipal pumping and agricultural pumping in India that is estimated to have a potential of 15 % savings corresponding to 75 billion units of power. It will also create an opportunity of rupees 150,000 crores of investment with an estimated payback period of 4 years.

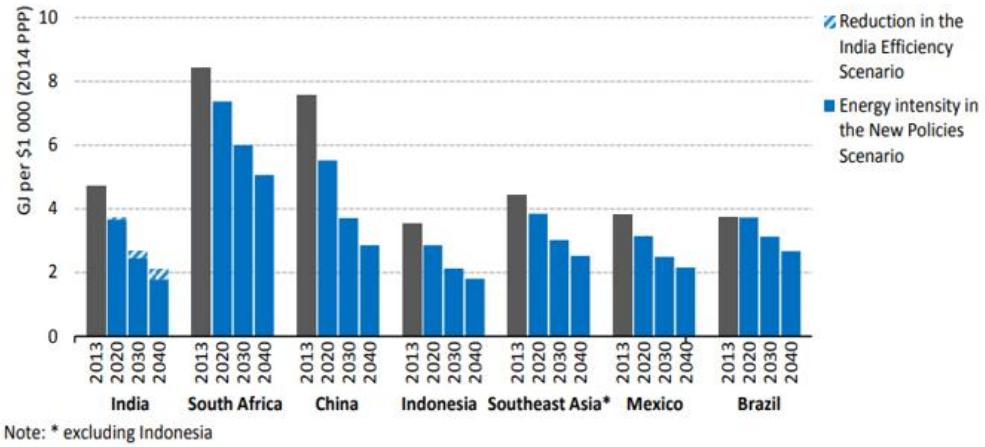

Figure 2.4: Energy Efficiency Outlook of India vs Intensity of Total Primary Energy

Source: https://www.eea.europa.eu/data-and-maps/indicators/total-primary-energy-intensity-4/assessment-1

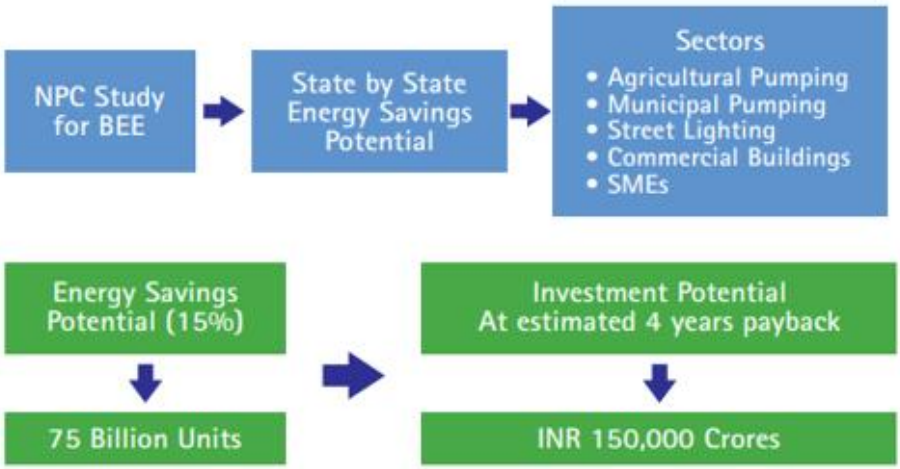

Figure 2.5: Energy Saving and Investment Pay Back

Source: https://webstore.iea.org/energy-efficiency-market-report-2014

Training plays a significant part in LCECM application when we talk about walking the last miles in energy conservation practices. Some of the studies are summarized below to justify that argument.

- Sustainability of energy conservation by training and its assessment (Prayas Energy Group Report, 2016).
- Behavioral training on low-cost energy conservation measures to the dwellers of a commercial infrastructure can play a part in bridging the differences between supply and demand (Prayas – Energy Group report, 2016).
- Studies on educational buildings in India have concluded that giving energy conservation training to the building occupants a sizable amount of energy can be saved (Biswas et. al., 2008).
- Recommended increasing energy efficiency training by 20 percent (PWC Report, 2012).
- Certification of Energy Auditors and Energy Managers by BEE (Energy Act, 2003).
- Lack of project funding due to higher initial cost is a main blockade to implement energy conservation projects (Training Manual, Bureau of Energy Efficiency, 2015).
- GRIHA (Green Rating for Integrated Habitat Assessment) program propagates the need for behavioral training launched by TERI (The Energy Resources Institute).
- Star Rating scheme of BEE targeting commercial buildings propagates behavioral training though voluntary (IEA, 2016).

Technological excellence alone cannot achieve optimal energy utilization and unlikely to be sustainable in the longer run. Energy management will have the biggest influence when behavioral training is addressed i.e. behavior of persons in the organization that influence energy usage. Figure 2.6 justifies behavioral impact is equally important like technical and organizational impacts when we talk about sustainable energy conservation.

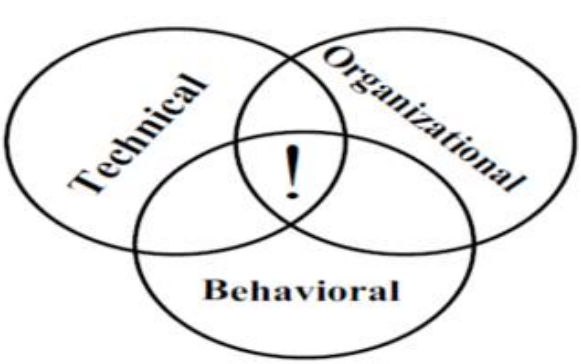

Figure 2.6: Energy Management Dimensions

Source: www.energy.gov.za/EEE/Projects/IndustrialEnergyManagement

2.4.1 Why Guindy Industrial Estate for the Present Study

Guindy was developed as one of the first MSME sectors in independent India way back in the 1950s and rightly played its part towards the industrial progress particularly in Tamil Nadu. Presently BEE is executing an energy conservation project with the funding from world bank applicable for the companies registered as SME in the Chennai area under Electricity Act 2003. The project is executed by one of the BEE empaneled ESCO and the targeted ECMs are Low-cost and Mid-cost. Guindy cluster also falls under the preview of ECBC 2017 with regards to building envelope for energy conservation.

Past energy audits by IAEMP members in various SMEs in and around Chennai city highlighted the lack of training in technology to the employees working in these clusters. Poor knowledge about the proper utilization of energy added to the operational cost. Imparting energy conservation training was identified in these audits as low hanging fruit most appropriate for these clusters. It had the potential to reduce the operational cost with very minimal expenditure that can be recovered in a few months through a reduction in energy consumption. Due to tough competition in business and IT revolution in Chennai few of these clusters were eventually closed and taken over by IT giants. Guindy being inside the city and still having many business units operational is not located in the areas where the IT sector is growing leaps and bound. Ambattur is another area where small business units are still located but many are not operational and

awaiting conversion into IT buildings as it is the fastest IT sector growth area at present. Table 2.9 summaries various aspects of selecting Guindy for the present study. Figure 2.7 gives the geographical location of Guindy Industrial Estate and some reports on its present operating conditions besides opportunities to conserve energy by implementing LCECMs through ECBC.

Table 2.9: Summarizing why Guindy is chosen for the Study over other Industrial Areas

Industrial Area	Types of Industry	Present Status	Reason for Closer	Why Guindy
Guindy	SME	Safety is an issue at Guindy (The Hindu, 11 Jan 2019.		Inside the city and yet struggling.
Perungudi		Perungudi is taken over by IT industries	Lack of business (Citizen matters, Nov. 6, 2018).	Non-IT commercial buildings are coming up.
Taramani		As per master plan for CMA - 2026 Taramani does not exist	Financial difficulties (S Kumaraswami, 2002).	Few energy audits by IAEMP members suggest availability of electrical power was an issue in the past. (IAEMP, 2016).
Ambatur		Only 7 active members at Ambatur as per AIEMA AGM 2018.	Lobbing for IT infrastructure (Development Commissioner MSME report, 2019).	

Source: Compiled by researcher

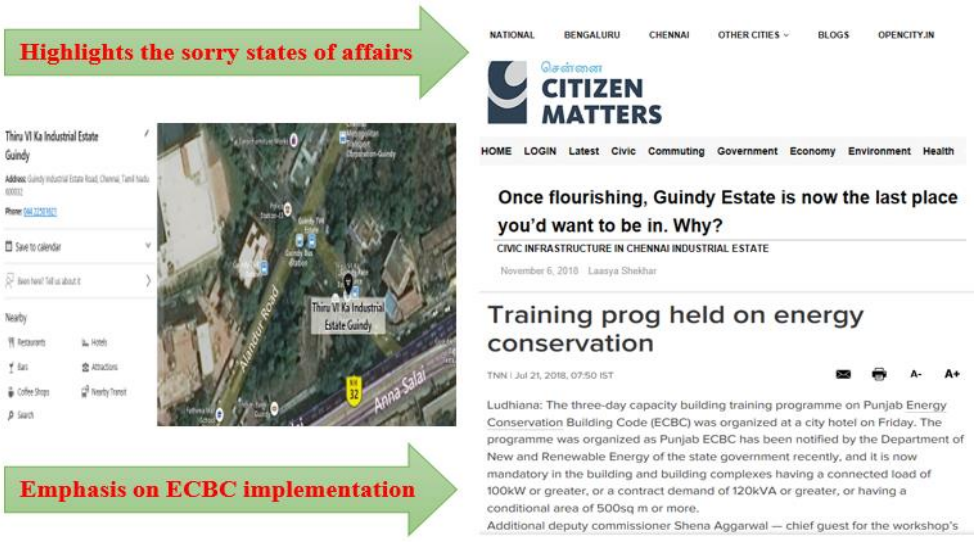

Figure 2.7: The Guindy Industrial Area Under Study

Source: Amalgamated by researcher

2.5 Summary

a) The Indian power sector has gone through major changes in the operating environment through structural reforms.

b) Energy Conservation Act, 2001 along with the Electricity Act, 2003 was the first move to accomplish energy independence by 2020 by the Indian Government.

c) The Indian Power Sector had undergone another regulatory reform by the introduction of ECBC in 2007 for implementing energy conservation in the building sector in totality.

d) ECBC is a game-changing regulatory reform in India for implementing energy conservation practices in the building sector with clear cut policies and guidelines for both central and local authorities.

e) ECMs are part and parcel of any effective energy conservation mechanism. LCECM training as ECM in commercial buildings has promising potential for energy conservation with minimal financial impact to the operations.

f) Guindy industrial area is suitable for the present study as it comes under both ECBC and ongoing energy conservation projects for SMEs by BEE.

Chapter 3

Structured Literature Review

3.1 Introduction

The beginning point of the review of literature is the keywords derived from the study title and the business problem. These keywords are Energy Conservation, Transfer of Training, Peer Support, Performance Feedback, Commercial Building, Low-Cost Energy Conservation Measures (LCECM). Based on the review three themes are identified. The identified themes are justified in relevance to the present study. The derived thematic gap is further refined. Consecutively the underpinning theory is identified from the review of the literature and theoretical premise gap is derived. The researcher reached the consolidated research gap from the thematic gap and theoretical premise gap. The consolidated research gap pointed to the research problem. The research questions are stated in accordance with the research problem. Research Questions are 3 and the searcher made 3 Research Questions addressing three Research Objectives.

3.2 Designing the Review

Structured literature review is done according to the keywords concluded from the study title and business problem. These keywords are Energy Conservation, Transfer of Training, Peer Support, Performance Feedback, Commercial Building, Low-Cost Energy Conservation Measures (LCECM). The theoretical premise is also identified based on the applicability of the study. Thematic gaps and theoretical premise gaps are derived through the three themes and theoretical premise respectively to finalize the consolidated research gap. Subsequently, research problem, research questions, and research objectives are derived through the structured review of literature. The structured literature review also covers the applicability of data study software. Table 3.1 is the summarization of the broader topics reviewed in the literature based on the keywords. It summarizes and reflects broader prospects of the topics covered for the literature review for this study.

Table 3.1: Overview of Literature Review on Key Words and During Research Process

Sl. No	Key Word	Overview	No. of Literature
1	Energy Conservation	Impact of energy-efficient building design for energy conservation.	57
		Impact of energy conservation on peak demand and Demand Side Management (DSM).	
		Market barriers for investment in energy conservation projects.	
		Incentives for energy conservation through Govt. policies.	
		Peak demand and DSM through varied Tariffs to encourage energy conservation.	
2	Transfer of Training	Behavioral Change of employees for knowledge enhancement by transfer of training.	41
		Energy conservation initiatives because of energy conservation training.	
3	Peer Support	Supervisors' encouragement for energy conservation practices.	36
		Co-workers support in energy conservation initiatives.	
4	Performance Feedback	Feedbacks from the organization on initiatives taken for energy conservation.	32
		Feedbacks from the experts on energy conservation initiatives.	
5	Commercial Building	Energy conservation in public and private buildings in various countries.	39
		Energy conservation in Industries and commercial buildings in various countries.	
		Report on energy conservation by Govt. sectors and private sectors.	
		Country specific report on sustainable energy conservation.	
6	Low-Cost Energy Conservation Measures (LCECM)	Dos and Don'ts for energy conservation in daily activities.	31
		Administrative corrective actions for energy conservation.	
		Fine Tuning in operating procedures for energy conservation.	
		Alertness to arrest pilferages and wastages of energy.	
7	Literature Review on Underpinning Theory	Review of studies on Theory of Transfer of Training	38
		Review of the researches on the Theory of Planned Behavior	
		Review of studies on A-B-C Theory	

8	Literature Review for identifying Research Methodology after Research Question formulation	Review of research papers on various model-based studies	35
		Review of thesis on similar studies	

The structured literature review is done based on the funnel approach propagated by Margret R Rollers (2015) for the literature review as shown in Figure 3.1. Based on the keywords themes are identified. From the identified themes thematic gaps are derived. The theoretical premise of the research is derived from the reviewed literature and accordingly the theoretical premise gap is derived. A consolidated research gap is then derived from the thematic and theoretical premise gap that leads to a research problem.

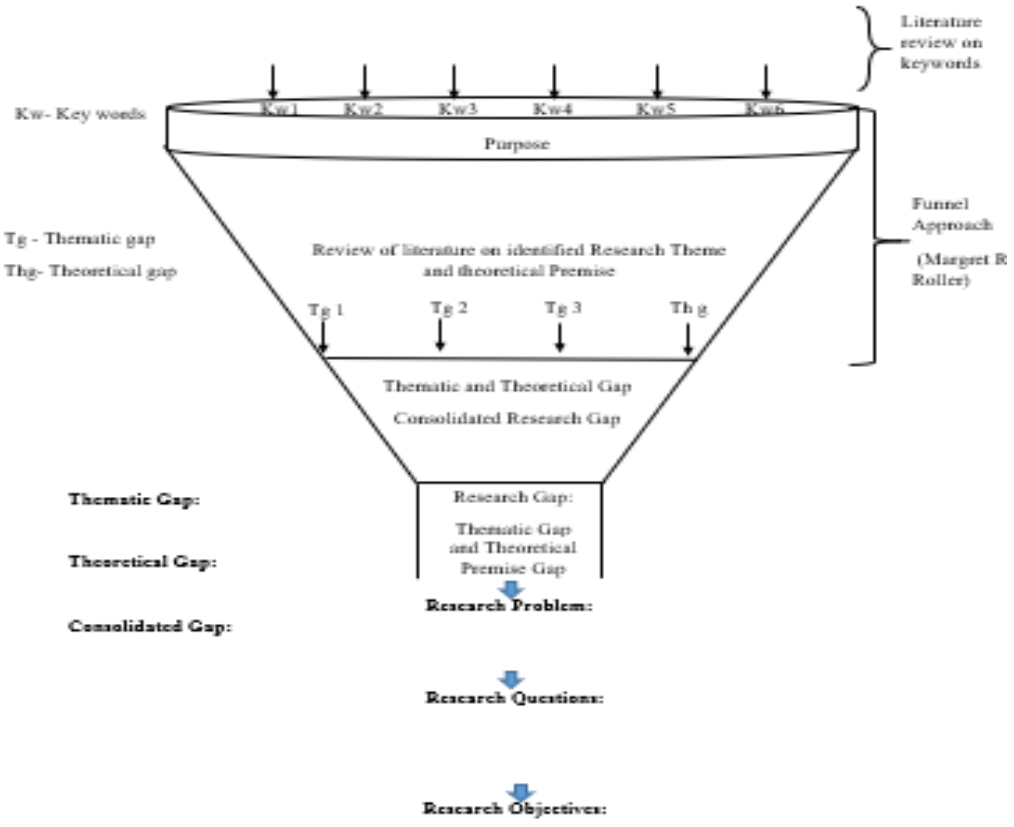

Figure 3.1: Literature Review Funnel Approach

Key Words are finalized based on the title of the study and the business problem to identify the related papers, past works, and other documents for further reviews. A total of 236 works of literature are studied and relevant points are recorded in a structured manner for all the literature as shown in Table 3.2 for identifying the themes and gaps from the reviewed literature.

Table 3.2: Glimpse of Literature Review Record Sheet

Title	Author	Year	publication type	Reference & URL
Energy efficiency through tenant engagement: A Pilot Behavioural Program for Multifamily Buildings	Lauren Ross and Ariel Drehobl	2016	ACEEE white paper	American Council for an Energy-Efficient Economy, 529 14th Street NW, Suite 600, Washington, DC 20045, http://aceee.org/white-paper/takoma-park-pilot

Objectives	Variables	Theory	Tools Used - Theory /Model	Tools used - Statistical	Research Methodology
To test behavioural strategies for promoting energy efficiency and distribution of energy saving devices among low to moderate income multifamily housing	Energy efficiency, Human behaviour.	Tenant Engagement around energy-efficient behaviours.	Introduction through various campaign / communication tenant engagement.	Utility Bills	Qualitative Methodology using observation method on 366 units forming control groups.

Finding	Themes	Consolidated Theme	Gap
1. The energy-saving interventions lead to opportunities and challenges for tenant engagement around energy-efficient behaviours justified by billing cycle. 2. The key areas of focus were- fostering tenant engagement, building relationships with building managers, involving trusted community influencers, and catering to the diversity of the community.	Behavioural intervention programs for low- to moderate-income communities have impact on efficient usage of energy .	Changes in human behaviour can help in saving energy in public and private buildings.	Feedback on level of satisfaction with energy saving information and devices was not taken.

3.2.1 Selection Criteria

The research work is for energy conservation in commercial premises involving the people working there. These people are from different social, cultural, and economic backgrounds having varied prospects of lifestyle. Their attitude and behavior also vary accordingly. Therefore, it is significant to list out the keywords those are most appropriate to select the related literatures for reviewing purposes. The funnel approach as suggested by Margret R Roller is used to review the identified literature with the help of six keywords to identify the Themes. Thematic Gap and Theoretical Premise Gap identification is done accordingly following the same approach.

3.3 Identifying the Research Themes

A review of the literature was recorded in a spreadsheet in an objectified manner to derive the key highlights as shown in Table 3.3. It is a step by step process to consolidate the relevant points from the initial records of 158 works of literature to identify three Themes as highlighted in Table 3.2.

Table 3.3: Glimpse of Literature Review Record Sheet to Identify Research Theme

Keyword	Author	Year	Variables	Tools		Findings	Recommendations	Inference	Theme	Consolidated Theme
				Theory/Model	Statistical					
Energy efficiency, Human behaviour, Residential Housing.	Lauren Ross and Ariel Drehobl	2016	Energy efficiency, Human behaviour.	Introduction through various campaign / communication tenant engagement.	Utility Bills	The energy-saving interventions lead to opportunities and challenges for tenant engagement around energy-efficient behaviours justified by billing cycle.	Recommendations for determining the best engagement strategies for targeted communities, utilizing relationships with building managers.	Energy saving through human behaviour change in low to moderate income group residential buildings in Maryland, USA.	Behavioural intervention programs for low- to moderate-income communities have impact on efficient usage of energy .	Energy Conservation in Indian Commercial Sector.

The most relevant studies from the spreadsheet are summarized in Table 3.4 according to identified three themes

Table 3.4: List of Few Studies reviewed to Identify Research Themes

Research Theme	Review of Study
Policy related to Energy Conservation in India.	ECBC 2017; Ministry of Power, GOI, 2017; CEA, GOI, 2015; Graham, 2015; U.S. Energy Information Administration 2014; Ghosh et al., 2013. Energy Act, 2003; Energy Conservation Act 2001.
Energy Conservation in the Commercial Building Sector.	Trombley et al., 2017; Ross et al., 2016; Staddon et al., 2016; Podgornik et al., 2016; Tsuda et al., 2016; Sutherland, 2016; Eto et al., 2016; Khan et al., 2016; Stefanie et al., 2016; Thondhlana et al., 2016; Dorena et al., 2016; Vinea et al., 2016; Dixon et al., 2015; Bull et al., 2015; Marta et al., 2015; Senick, 2015; Streimikiene, 2015; Carlson, 2015; Azara et al., 2015; Farley et al., 2014; Heracleous et al., 2014; Bedwell et al., 2014; Agha-Hossein et al., 2014; Wolfe et al., 2014; Doleschal et al., 2014; Azizi et al., 2014; Kriström et al., 2014; Heracleous et al., 2014; Farley et al., 2014; Stommen et al., 2014; Young et al., 2013; Chen, 2013; Barbu et al.; 2013, Jamaludin et al., 2013; Huebner et al., 2012; Yun et al., 2011; Oliveria et al., 2010; Attari et al., 2010.
Training on Energy Usage for Energy Conservation.	Staddon et al., 2016; Ishak et al., 2016; Suryawanshi et al., 2016; Ross et al., 2016; D'Oca, 2016; Sutherland, 2016; Podgornik et al., 2016; Sam et al., 2016; Abrahamse et al., 2016;Hossein et al.,2015; Young et al., 2015; Farley et al., 2014; Heracleous et al., 2014; Chen, 2013; Bhatti et al., 2013; Joshi et al., 2012; Mahamadi et al., Wang, 2011; Wang et al., 2011; Grossman et al., 2011; Oliveira et al., 2010; Leimbach, 2010; Marans et al., 2009; Eddie et al., 2008; Abrahamse, 2007; Jakob 2007; Patil et al., 2007; Choong et al., 2006; Poortinga et al., 2003.

Source: Amalgamated by the researcher

Literature Review on Identified Themes

Three themes are identified using the funnel approach and the topics reviewed in the literature are summarized below.

- Energy-saving by residents attitude change towards energy usage in low to the moderate-income group in multifamily housing building and independent houses.
- Energy-saving by a change in end user's energy usage pattern from a psychological, socio-demographic, social, cultural perspective, and feedback mechanism.
- Energy-saving by human attitude change through specific models like TPB, Stochastic Modelling, or Bond Graph Modelling or specific analysis, etc.
- Energy-saving by end user's behavior change in a public building.
- Energy-saving by students behavior change in educational institute buildings in the US, Europe, and Asia.
- Energy-saving by employees behavior change in industrial workplaces, commercial buildings in the US, Europe, Asia, and Australia.
- Energy conservation Policies in different countries by different Governments.
- Energy conservation and its environmental impact through human behavior change.
- Energy-saving by user-friendly building design having low energy and carbon footprint and better land utilization.
- Energy-saving by human behavior change and its impact on peak demand and demand-side management.
- Establishment of energy management tools for energy saving through technological innovation and human behavior change in tropical and non-tropical regions.
- Energy efficiency improvement programs in US airports through technological innovation and human behavior change.
- Government and private sector report on energy.

- Country specific studies on sustainable energy conservation programs.
- Market Barriers to investments for energy conservation through increased efficiency.
- Government policies mandated energy conservation programs through various incentives in the Indian Commercial and Industrial Sectors.

3.3.1 Justification on Identified Research themes

Three themes are derived from the structured literature review and these are as follows:

a) Policy related to Energy Conservation in India.
b) Energy Conservation in the Commercial Building Sector.
c) Training on Energy Usage for Energy Conservation.

Themes are derived, by using keywords relevant to the research study, from the structured literature review. Justifications for each identified themes are summarized from the spreadsheet. Summarization of theme-wise justifications is tabulated in Table 3.6.

Table 3.6: Justification to Identified Research Themes

Research Theme	Justification
Policy related to Energy Conservation in India.	• Most of the policies on energy conservation are centered on technological excellence (Energy Act, 2001). • Energy Conservation Building Codes 2017 is voluntary in nature (Ali and Tyagi, 2019). • Govt. policy to influence consumer behavior for energy conservation need to be implemented (Graham, 2015). • Govt. of India energy conservation policy should also address energy consumer's training needs on energy usage (Ghosh et al., 2013).
Energy Conservation in the Commercial Building Sector.	• Most of the studies are done in the U.S and Europe on low and middle-income groups, individual and multi-family housings. (Stommen et al., 2014). • Impact on savings by Dos and Don'ts is studied in non-Indian conditions (Podgornik et al., 2016). • Studies suggest for ECMs in commercial building sectors for energy conservation (Huebner et al., 2012).
Training on Energy Usage for Energy Conservation.	• The impact of training on energy conservation is tested for an educational institute (Wang, 2011). • Sustainability of energy conservation training needs more tests (Poortinga et al., 2003). • Peer's influence on the training transfer for energy conservation should be tested further (Abrahamse, 2007).

Source: Amalgamated by the researcher

3.4 Research Theme 1

Research Theme 1: Policy related to Energy Conservation in India.

Energy conservation became a matter of concern for the developed countries ever since the first energy crises were felt in the mid-nineteen seventies. Respective countries across the world came out with energy policies concerning generation, transmission, and distribution of power for better management. Energy conservation in India was taken on priority at the beginning of this century and the actions were initiated by two individuals at the helm of running the country then. While the Indian president Dr. A P J Abdul Kalam pronounced the energy vision statement for the country as "Energy independence by 2020", action to enact the Energy Conservation Act, 2001 and Electricity Act, 2003 was initiated by then PM of India Mr. A B Bajpayee. The existing energy policy was completely changed mainly by decentralizing the operations and creating a private organization like entities for better management and accountability to utilize the resources better by increasing the operational efficiency. Further revisions were done in Electricity Act, 2003 in due course of time. Similarly, the Energy Conservation Act, 2001 was also revised a few times to bring better clarity and broaden the horizon of the Act in due course of time. One such initiative was to operationalize ECBC (Energy Conservation Building Code) in 2018 for implementing and practicing energy conservation in building sectors through various innovative ideas to create awareness about energy conservation which also included training to the consumers about the proper utilization of energy.

3.4.1 Research Gap from Theme 1

The first thematic research gap is derived from the first theme in a step by step manner. Reviewed literature for relevant findings is recorded in the spreadsheet for all reviewed literature as shown in Table 3.7 to derive the first thematic gap.

Table 3.7: Glimpse of Literature Review Record Sheet to Identify Research Gap

Theme	Details	Year	Objective of the study	Variables	Tools	
					Theory/ Model	Statistical
Stochastic modelling coupled with disaggregation and feedback have impact on Energy efficient behaviour.	Stochastic modelling & disaggregation of energy consumption behaviour.	2014	To suggest ways to modify human behaviour activities in order to conserve energy by optimising the use of energy.	Energy consumption, human behaviour, energy disaggregation.	Literature Review	Stochastic modelling & energy disaggregation.

Findings	Recommendations	Inference	Gap
Stochastic modelling coupled with disaggregation based on conditional random fields could identify energy usage activities with high degree (81.4%) of accuracy.	Disaggregation of energy usage activities using a method based on CRFs will give high degree of accuracy.	Energy saving through stochastic modelling and energy disaggregation based on conditional random field (CRF)using real world energy consumption data.	Impact of behavioural pattern in actual application of different usage of energy & premises was not tested.

Based on the above process first thematic gap is identified as follows:

Scarcity of Literature emphasizing conservation through Energy Conservation Training as most of the reviewed literature focuses on Technological Excellence.

3.4.2 Justification of Research Gap from Theme 1

The Indian government first introduced the Energy Conservation Act 2001 and then Electricity Act 2003 for mainly two reasons. First to implement energy conservation in India as a Government initiated the process and second to revamp the operational process of various electricity boards in a more professional and accountable manner. Subsequently, ECBC (Energy Conservation Building Codes) was introduced by the Indian Government which was revised and finally implemented in 2018 as per the 2017 revision. Government of India energy conservation policies mostly emphasize excellence in technology (Energy Act 2003) which will always have an impact on funding as the energy conservation project funding is still considered as an expenditure in India and not investment (Ali and Tyagi, 2019). Applicability of ECBC in the Indian commercial building sector is also voluntary in nature for practicing energy conservation. Energy conservation in India prior to 2001 was

encouraged by incentivizing the efforts by the consumers. One of these incentives is the flexible tariff method. Policy exists to incentivize energy saving by different tariff method but needs more proactive actions for energy conservation in India (Pricewaterhouse Coopers, 2010). Energy conservation through technological excellence is not enough to harvest all energy conservation opportunities in India. There are many ways to conserve energy though it might appear to be insignificant as these conservations may be minuscule. Policies should encourage to tap every opportunity of energy conservation. Policies need to address Energy Conservation by all means to preserve Fossil Fuel (Gosh et al., 2013).

3.5 Research Theme 2

Research Theme 2: Energy Conservation in the Commercial Building Sector

With the implementation of ECBC in 2018, which was initiated in 2007 after the first revision of the Energy Conservation Act 2001, domestic and commercial building sectors became an essential element of the energy conservation campaign in India. Various energy conservation schemes were launched by the Indian Government to help the Urban Local Bodies (ULB) responsible for initiating actions at the ground level. Star labeling of products to indicate the quantum of energy consumption to educate the consumers was another such initiative by the Government of India. Some studies and surveys also indicate a substantial quantity of energy-saving is possible in the Indian building sectors but needs to be studied further (Podgornik et al., 2016 and Ghosh et al., 2013). Most of the initiatives for energy conservation programs in the Indian building sector are focused on lighting and small air-conditioning applications.

3.5.1 Research Gap from Theme 2

The second thematic research gap is derived from the second theme in a step by step manner. Reviewed works of literature for relevant findings are recorded in the spreadsheet as shown in Table 3.7 to derive the second thematic gap.

The second thematic gap based on the above process is identified as follows:

Lack of Scholarly attention on the transfer of Training for Energy conservation.

3.5.2 Justification of Research Gap from Theme 2

Training for energy conservation can be two types. One type of training, that is commonly in practice in India, is the technical training to keep abreast with the latest in technology to ensure the operations are up to date so the efficiency of machines/equipment is maintained at the highest level resulting in improved energy intensity. This is an expensive affair for any organization and needs advanced fund planning with all due diligence. Another training, that is mostly ignored due to ignorance and negligence, is the training to the end-users and machine operators about the correct operating procedures with the right attitudes towards judicious utilization of energy. Since the potentials to conserve energy with these small corrective steps are negligible the importance of such training seldom gets the priority in the agenda of the decision-makers. Till 2007 efforts towards energy conservation centered around Demand Side Management (DSM) and such small initiatives by the individuals were not on priority due to lack of supporting information. The scarcity of information to justify energy conservation can be influenced by training (Aguinis et al. 2009). Scholars started to explore the opportunities to conserve energy where the end users can make correct decisions to optimize energy utilization by enhancing the end users' knowledge through appropriate energy conservation training. These kinds of training are less expensive and easy to impart that can even be done inhouse. Studies done on energy conservation opportunities in India suggest the need for more studies to see the impact of training on energy conservation (World Bank report, 2008).

3.6 Research Theme 3

Research Theme 3: Training on Energy Usage for Energy Conservation

While the training is part of ECBC and BEE (Bureau of Energy Efficiency), the nodal agency of the Indian Government responsible for implementing the Energy Conservation Act 2001, has already examined and qualified over fifteen

thousand Energy Managers and Energy Auditors but the initiatives to train the consumers are yet to take up. Studies had been done in developed countries mostly in an educational institute and various residential buildings with certain Dos and Don'ts as a set of instructions to evaluate the impact on energy conservation initiatives. Transfer of training impact is a proven fact on many applications but not on energy conservation applications. There is a dearth of literature in this application and has a huge scope for further studies. Some of the studies in this application are listed below.

- The impact of training for energy conservation is tested at an educational institute with Dos and Don'ts and needs to be tested with proper training (Wang, 2011).
- The sustainability of behavioral training needs more tests (Poortinga et al., 2003).
- Peer's influence on the training transfer for energy conservation should be tested further (Abrahamse, 2007).

3.6.1 Research Gap from Theme 3

The third thematic research gap is derived from the third theme in a step by step manner. Reviewed works of literature for relevant findings are recorded in the spreadsheet as shown in Table 3.7 to derive the third thematic gap.

The third thematic gap based on the above process is identified as follows:

The dearth of Scholarly Literature addressing Predictors of Transfer of Training related to Energy Conserving Behavior.

3.6.2 Justification of Research Gap from Theme 3

Studies related to training on energy conservation are mostly done in educational institutes in the form of instructions related to a set of Dos and Don'ts for a particular application. No formal training was given as such but some improvisations for energy conservations. Most of these studies were done in non-Indian applications. Energy conservation initiatives in India are still in the process of implementation and technological upgradations have the priority. ECBC 2017 was implemented in 2018 and the impact is yet to be conclusively

derived due to various reasons. Energy Conservation Training for commercial buildings applications is still in its infancy in India (IAEMP). There are many studies on the transfer of training for different applications. However, there is a scarcity of literature on energy conservation training where the training is designed and imparted based on the actual requirements. Therefore, predictors of transfer of training is also a distant possibility in energy conservation applications. The study suggests that there is a need for more studies on peer support to understand the impact of training on energy conservation (Bhatti et al. 2013). There is a need to be established the fact that both peer support and performance feedback influence the transfer of training significantly in energy conservation applications though the same is proven in various other applications. The same is also suggested as the need for more studies on performance feedback to justify the effects of training on energy conservation (World Bank report, 2008).

3.7 Identifying the Underpinning Theory

There are many studies on the training transfer as the base premise on various applications and many theories are built on this base premise. Prominent amongst these studies is Baldwin and Ford (1988) which describe the transfer of training as a measure of level to which individuals can successfully apply the learned knowledge to their respective works. The knowledge is gained through enhanced information, skills up-gradation, and improvement in attitudes added in the training background. Grasping the new job-related competencies by a trainee is the startinf of the training transfer process (Velada et al., 2007). By grasping, it denotes to a comparatively stable variation in information, competence, and performances of individual. Baldwin and Ford's (1988) model suggests that the output of a training will be in accordance with the input of the training at a given condition for transfer. Training inputs are mainly the training design, work situation, and the learner's aptitude to grasp the training content. It is significant to acknowledge inputs like (i) what kind of organizational work atmosphere will be supportive of the knowledge transfer, and (ii) why people desire to enhance their work output after successfully completing the training session (Siriporn Yamnill et al., 2001). Baldwin and Ford (1988) suggest that

there are four important hurdles on the transfer of training. These are namely (1) The difficulty of how to measure the training transfer and when to do so, (2) The simplification of outcomes from training design evaluation studies, (3) Selection of the appropriate learner characteristic for its influence on training transfer for evaluation and (4) The conjecturing and the organization environment that can influence transfer of training.

TPB (Theory of Planned Behavior) by Ajzen (1991) is another philosophy and based on TPB studies are done mostly in various residential buildings in energy conservation applications. TPB assumes that the action of any human is directed by three types of beliefs which are specific to situation. These are (i) beliefs around the possible outcomes of his or her conduct (behavioral beliefs), (ii) beliefs around the normative prospects of others (normative beliefs), and (iii) beliefs around the existence of influences that may supplement or hamper the performance of the individual (control beliefs). In their individual totals, behavioral beliefs produce a satisfactory or disapproving tendency to the conduct in query. Normative beliefs translate in apparent societal burden or individual standard to accomplish that particular conduct. Control beliefs trigger increase to supposed behavioral control, the supposed comfort or inability of executing that specific conduct.

Energy conservation in any application is mainly by two approaches and these are technological excellence and behavioral approach (Wong, 1997; Mohan et.al, 1983). Facility managers and plant managers are generally skeptical about the behavioral approach for energy conservation due to a lack of substantiating proof of it and its true probability (Geller, Richard, and Peter, 1982). Awareness through appropriate training can certainly remove that barrier of lack of understanding. Awareness of Energy conservation is an important feature of any energy conservation program (Vesma, 2002, Wong, 1997, Mohamed El Halimi et al., 2000). Williams (1993) suggested LCECM training on energy conservation to be one of the effective ways for motivating employees for energy conservation. Studies have shown anything between 5 to 10 % of energy conservation is achievable in building sector applications by correct energy

usage behavior of the occupants (Loozen and Moosdijk, 2001). Yik et al. (2002) suggested a deficiency in knowledge to be the primary hurdle to any energy conservation initiatives. Wexley and Latham (1991) found that learning is a comparatively enduring modification in behavior which can happen through the repetition of the application of that knowledge. Barker (1997) suggested that knowledge brings an enduring change in behavior resulting from individual experiences from a situation. Energy conservation awareness should be followed by behavioral changes (Wai et al., 2006). People usually have brief memories of any learnings and can simply revert to old habits of doing business when it comes to energy conservation practices (Dick-Larkam, 1977). It is comparatively problematic to transform people's behavior towards energy conservation (Smith, 1978).

"Antecedents-Behaviour-Consequences" is a contingency theory that was conceived by the renowned behavioral expert, B. F. Skinner (Maag, 2004). This model was developed to evaluate human and animal conduct through experiments. The conduct was divided into three main segments such as inducement, operant response, and reinforcement/penalty. It is also known as the three-term contingency theory and being functional in training to monitor school children's behavior. The theory of learning suggests that any individual will alter his or her behavior because of his or her experiences with the surroundings. Antecedents-Behaviour-Consequences theory is explained in Figure 3.2.

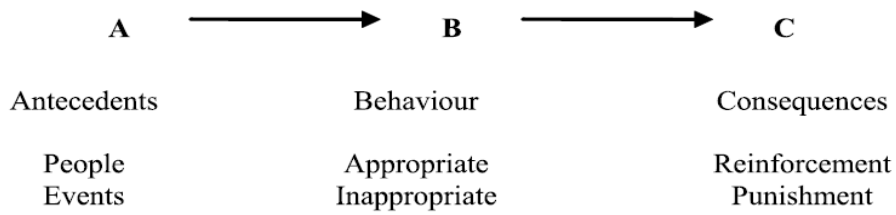

Figure 3.2: Antecedents-Behaviour-Consequences (ABC) Model
Sources: Maag (2004)

Antecedents are the situations that will be present in the environment prior to the behavior is displayed (Maag, 2004). Behavior is voluntary in nature and functions in the situation to produce required consequences (Kahn, 1999).

Consequences change future behavior by helping to either rise, reduce, or continue as it was (Maag, 2004). Wai et al., (2006) determined through their energy conservation study that there are three main stages for developing awareness and these are environment, mind, and behavior. The environment is input, behavior is output while the mind is the people. People can be encouraged to lend their support to any energy conservation program through information like (i) amount of energy is being used, (ii) money spent, (iii) importance of energy on their job, (iv) energy consumption for per units of output, (v) significance of energy problem and its impact on the economy (Williams, 1993). A conceptual outline for the energy conservation development procedure was projected by Wai et al., (2006) based on the Antecedents-Behaviour-Consequences theory. This conceptual outline comprises of nine steps within the three main stages as environment, mind, and behavior. Steps to create awareness for energy conservation can be divided into two groups. These are (i) steps influenced by the trainer or the transferor and (ii) steps influenced by the employee or the receiver. While the environment will be dominated by the transferor, the mind will be dominated by the receiver. The behavior will influence both the transferor and the receiver.

The researcher has reviewed 79 papers on theoretical premise. Based on the above discussions Antecedents-Behaviour-Consequences theory is considered to be the theoretical premise of this study.

3.7.1 Theoretical Research Gap

The researcher has used a funnel approach to review 79 works of literature for identifying the theoretical premise of the study and then the theoretical premise gap. Details from the review were summarized and recorded into the spreadsheet as shown in Table 3.8. The previous section describes how the theoretical premise was determined. The next section describes how the theoretical premise gap was derived. The theoretical premise gap for the study is determined as - Theory of Training Transfer specifically addressing Peer Support and Performance Feedback.

Table 3.8: Glimpse of Literature Review Record Sheet to Identify Theoretical Research Gap

Segment	Author	Findings	Inference	Theoretical Premise	Theoretical Premise Gap
Theoretical Premise	Choong Weng Wai, Abdul Hakim Mohammed, and Baung Alias (2006).	The energy-saving interventions lead to energy-efficient behaviors.	Energy-saving by human behavior change in low to moderate-income group residential buildings.	Antecedents-Behaviour-Consequences Theory	Theory of Training Transfer specifically addressing Peer Support and Performance Feedback.

3.7.2 Justification of Theoretical Research Gap

As discussed earlier energy conservation is based on technological excellence and the human behavioral approach. The behavioral approach is the area of this study. A wood process plant in South Island initiated and energy conservation drives through some administrative actions to encourage employees to join the switch-initiatives at the time of the break periods and as and when the working zones are freed. It was found to be very effective and resulted in energy conservation (Wedge, 2003). Loozen and Moosdijk in 2001 found it is possible to conserve anything between 5 to 10 % energy in domestic applications by correct energy usage behavior. Some of the related researches are listed below where energy usage behavior change was initiated through antecedents for energy conservations.

- The focus area of the study was to develop the tenant engagement, strengthening relationships with building managers, connecting trusted community influencers, and catering to the diversity of the community for energy conservation in a multifamily residential building (Lauren Ross and Ariel Drehobl, 2016).
- The research shows electricity savings between 22% - 27% is achievable if energy consumption feedback is introduced specifically in the

awareness campaign for energy conservation in the building sector (Podgornik et al., 2016).

- The study result highlighted that dynamic pricing or information feedback can be used as demand control initiatives either for shifting the peak load or reducing the electricity consumption (Tsuda et al., 2016).
- Only an energy efficiency campaign to conserve energy in residential buildings will not give the desired result. Behavior changing program through training is also to be run in parallel because all stakeholders will not have the same priorities and interest (Kate Farley and Susan Mazur-Stommen, 2014).
- Training design plays a significant part in changing behavior for conserving energy but combining factors like happiness, user interest, and cultural interest can have a better psychological impact (Zhenwei et al., 2013).
- Behavioral interferences related to social dimension amongst the peers will help in bringing a lasting behavior change for energy conservation in office buildings (Douglas Jesse Miller, Jr., 2013).
- The study shows daily energy consumption feedback influencing the residents for more active participation to conserve energy (Chao Chen, 2013).
- Sheila Sheridan, chairman of IFMA (International Facility Management Association) discussed the importance of energy conservation by facility managers during an interview with Druckman in 2004. According to her facility management specialists have greater accountability and responsibility with human resources as it is significant to consider human behavior factors in energy conservation.
- According to associated research findings behavioral method is key to any energy conservation program and considered such model to be an important element for any energy management project to be successful (Dahle and Neumayer, 2001).

Therefore, the theoretical premise research gap identified as "Theory of Training Transfer specifically addressing Peer Support and Performance

Feedback" is justified.

3.8 Consolidated Research Gap

The researcher has used the funnel approach as suggested by Margret R Roller for a structured literature review to derive at the thematic research gaps. The thematic research gaps identified from the thematic review of works of literature are:

i) Scarcity of Literature emphasizing conservation through Energy Conservation Training as most of the reviewed literature focuses on Technological Excellence.
ii) Lack of Scholarly attention on the Transfer of Training for Energy Conservation.
iii) A dearth of Scholarly Literature addressing Predictors of Transfer of Training related to Energy Conserving Behavior.

The theoretical premise gap according to the review of literature is Antecedents-Behaviour-Consequences Theory. This is also known as Three Term Contingency Theory.

The research gap is derived from the thematic and theoretical premise gaps as a consolidated research gap as stated below:

A comprehensive study could not be found which includes predictors to Transfer of Training (Low-Cost Energy Conservation Measures).

Pictorial representation of the literature review process is sketched in figure 3.3.

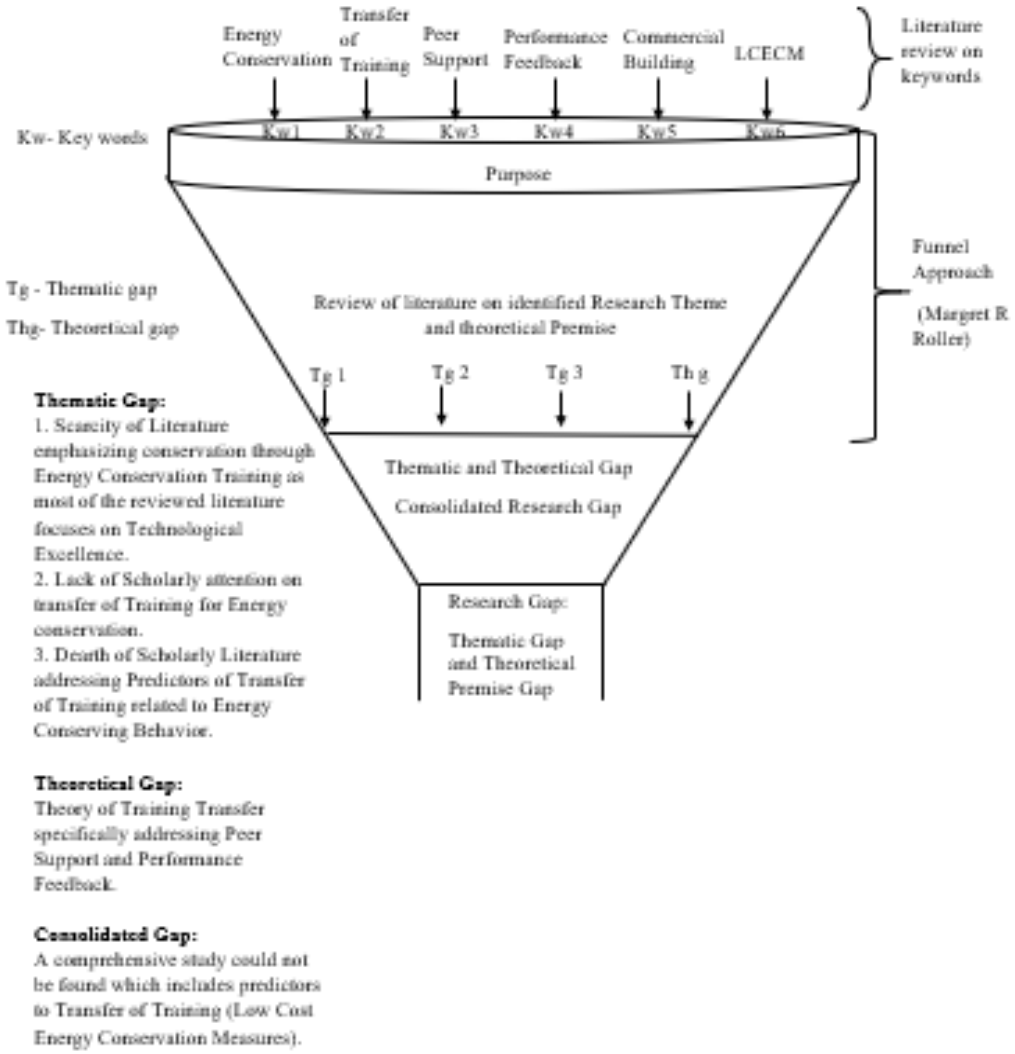

Figure 3.3: Research Gap Identification and Funnel Approach

3.8.1 Critical Analysis of Research Gap

The literature review evaluates the output indicators of the Indian power sector and in particular power consumption in the Indian commercial building sector. The Indian power sector is growing at a respectable rate since the last few decades but the rising measure of inefficient operations is noticeably troubling the sector. Technical and commercial losses, negative profits, and consumer dissatisfaction are some of the growing concerns in the Indian Power Distribution Sector and thus adversely affecting the entire operations. Though the Indian Government tried to overcome these issues through Energy Conservation Act, 2001 and Electricity Act, 2003 but the satisfactory success could be debatable.

The literature review also demonstrates that the reforms in the Indian power sector is inclusive of new technologies and practices. These reforms in new technologies and practices are at operational levels as well as services level. The restructurings in the Indian power sector have also stressed that the power distribution companies should take initiatives for the customer-oriented marketable method for energy conservation programs through several initiatives taken by the Indian Government within the purview of Energy Conservation Act, 2001. The review of literature identified the need for future research on energy conservation in building sectors by incorporating LCECM training to consumers. Subsequent to the research gaps derived from the review of literatures, it is very important to find out whether and how much impact the LCECM training transfer will have on energy consumption. The literature review identified the potential of LCECM training and the significant part it can play in energy conservation initiatives in India under the Energy Conservation Act of, 2001. Therefore, it is a theoretical need to study further for evaluating and stablishing the effect of LCECM training on energy conservation in the Indian building sector.

3.9 Research Problem

Critical analysis of research gap leads to the research problem as stated below;

Impact of peer support and performance feedback to Transfer of low-cost energy conservation measures (LCECM) training for energy conservation.

The research problem is justified as follows:

- Premise occupants are given awareness training to highlight the neglected behaviors that cause energy loss or unjustified usage of energy. Time and money are spent on such training but the outcome of that training process is not evaluated, (Dorena et al., 2016).
- It is important to know whether the training is accepted by the participant and further inculcated in his/her energy usage behavior besides sharing the learning with peers. Therefore, it is important to

know whether the training that is being imparted is accepted and inculcated for practical applications. Hence, there is a need for verification and evaluation of such training for measuring the influence, (Xiaoqi Xu, 2013).

- There is a need to work on what can be done to enhance the application of the provided training to the occupants. From the literature review it is found that, after the training is completed, trainees are not applying learned KSAs (Knowledge, Skills, and Abilities) taught during the training program, (Carrico et al., 2011).

The USTDA (US Trade and Development Agency) has granted $1 million aid to power Discom BRPL (The Bongaigaon Refinery and Petrochemicals Ltd.) to develop and implement India's first energy efficiency program containing behavioral aspect. (Times of India, March 7, 2018).

3.10 Research Questions

Three research questions are framed in accordance with the research problem and stated as follows:

i) "What is the impact of Peer Support on Transfer of Training (LCECM)"?
ii) "What is the impact of Performance Feedback on Transfer of Training (LCECM)"?
iii) "What is the impact of the Transfer of Training on Energy Conservation"?

3.11 Research Objectives

Three research objectives are framed in accordance with three research questions and stated as follows:

i) "To study the impact of Peer Support on Transfer of Training (LCECM)".
ii) "To study the impact of Performance Feedback on Transfer of Training (LCECM)".

iii) "To study the impact of Transfer of Training on Energy Conservation".

Pictorial representation of the process of Research Gap leading to Research Problem, Research Questions and Research Objectives is sketched in figure 3.4.

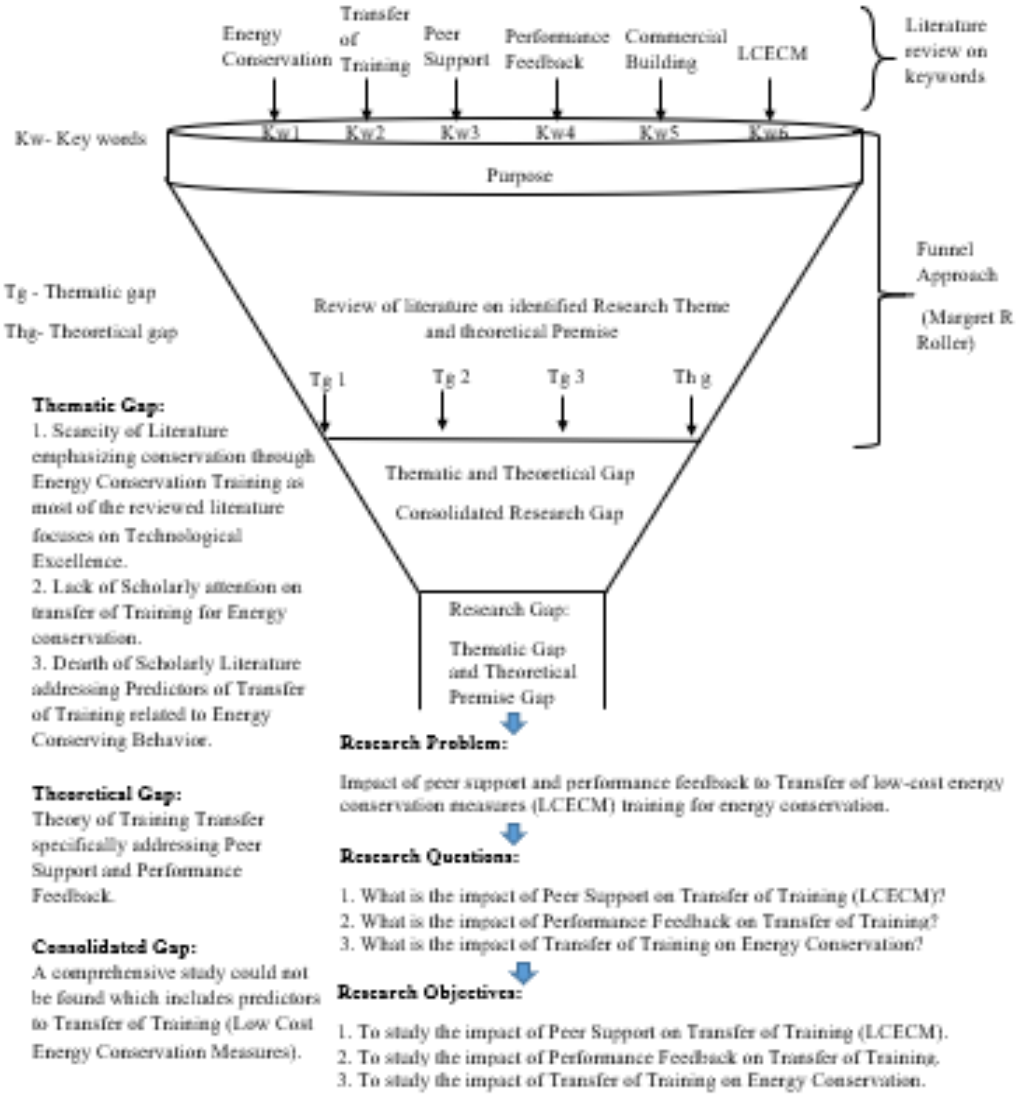

Figure 3.4: Research Gap leading to RP, RQs and ROs in Research Process Flow Chart

3.12 Summary

a) To explore the suitable answer to the identified business problem the researcher adopted the funnel approach as suggested by Margret R Roller for literature review.

b) Six keywords are identified and based on these key words three themes are (i) “Policy related to Energy Conservation in India”, (ii) “Energy Conservation in Commercial Building Sector”, and (iii) “Training on Energy Usage for Energy Conservation”.
c) Three thematic gaps are identified as (i) “Scarcity of Literature emphasizing conservation through Energy Conservation Training as most of the reviewed literature focuses on Technological Excellence”, (ii) “Lack of Scholarly attention on the transfer of Training for Energy conservation”, and (iii) “Dearth of Scholarly Literature addressing Predictors of Transfer of Training related to Energy Conserving Behavior”.
d) The theoretical premise is identified as “Antecedents-Behaviour-Consequences Theory”, and theoretical premise gaps are; “Theory of Training Transfer specifically addressing Peer Support and Performance Feedback”.
e) Consolidated research gap is; “A comprehensive study could not be found which includes predictors to Transfer of Training (Low-Cost Energy Conservation Measures)”.
f) The identified research problem is; “Impact of peer support and performance feedback to Transfer Low-Cost Energy Conservation Measures (LCECM) training for energy conservation”.
g) Three research questions are; (i) “What is the impact of Peer Support on Transfer of Training (LCECM)”? (ii) “What is the impact of Performance Feedback on Transfer of Training (LCECM)”?, and (iii) “What is the impact of the Transfer of Training on Energy Conservation”?
h) Three research objectives are; (i) “To study the impact of Peer Support on Transfer of Training (LCECM)”, (ii) “To study the impact of Performance Feedback on Transfer of Training (LCECM)”, and (iii) “To study the impact of Transfer of Training on Energy Conservation”.

Chapter 4
Hypothesis Generation and Model Development

4.1 Introduction

Starting this chapter with a broader outline of Low-Cost Energy Conservation Measures (LCECM), its training for energy conservation, antecedents in energy conservation training transfer, and impacts of energy conservation training. Explains the conceptualization and operationalization of LCECM. It includes the underpinning theory of transfer of training for energy conservation. Further explains the details of antecedents to transfer of training for energy conservation and in what way these antecedents impact the transfer of training. The conceptual model is framed in accordance with the underpinning theory. It further leads to identifying the hypothesis in each step of the conceptual model. The conceptual model is derived according to the conceptualization of LCECM in literature. Operating definitions of the variables and items in line with the conceptual model are explained towards the end of this chapter.

4.2 Conceptualization of LCECM (Low-Cost Energy Conservation Measures) in Literature

The development of research theory depends on research and research leads to a new theory (Fawcett et al., 1986). Theories play a key role in research to identify, explain, and predict new ideas. Theories are challenged and pushed to increase the knowledge base within their limit of prospects on many occasions. The theoretical premise identifies and explains the appropriate theory that explains the research problem under the study area (Abend G, 2008). All research studies need a theoretical context for examination and explanation. Theories need to be continuously revised and updated by research learnings. The conclusion of any research endorses the literature part and also the theory on which the research is carried out is acknowledged.

A literature review was done to find the most appropriate theoretical premise of

the present study, as per the identified research gaps specified in the earlier chapter. The perception of predictors impacting the transfer of training is being focused on for energy conservation. In this study the research area is related to the effect of PS and PF on the TOT for EC.

For the success of any study, suitable actions are required. At times varied difficulties may stop the easy development and that may disturb the performance of an individual. Inspiration can help in overcoming such difficulties. Inspiration is a group of variables that can regulate the behavior, which is different from learning. The new suggestion is aimed with the help of learning variables, that has the potential for intended behavior. With the help of suitable inspiration, the above-stated possibility can be changed into a behavioral pattern. Intrinsic motivation and extrinsic motivation are the two types motivation. The intrinsic motivation is the natural human tendency to learn and practice for attaining inherent accomplishment, while extrinsic motivation is the after-effects of some external inspirations (Ryan RM and Deci EL, 2000). Many researchers studied the idea of inspiration over the years and recognized a few theories. Transfer of Training is one of the largely followed theories amongst them. As this proposed study intend to examine the impact of PS and PF on TOT, Antecedents-Behaviour-Consequences Theory is found to be an appropriate base theory as discussed in the previous chapter.

4.2.1 LCECM in Energy Conservation

An energy conservation activity can be training, administrative corrective actions, modifications in operational procedures, fine-tuning the controls of equipment, and the use of any software for managing/controlling the energy usage in any building. This may be applicable to machines/equipment like air conditioning, ventilation, lighting, heating, and any business-related activities. This is done to optimize the utilization of energy which will lead to energy conservation. LCECM has benefits like ease of implementation with a short payback period, mostly administrative and corrective actions which include training. It will also have an impact on Demand Side Management (DSM)

particularly on morning and evening peaks and on load curve (Worrell et al., 2003; Janos, 2011; Biswas et al., 2013). The summary of literature review suggesting the need for energy conservation through transfer of training is given in Table 4.1.

Table 4.1: List of Few Studies reviewed on Energy Conservation Training Transfer

Year	**Source**	**Justification for Training Transfer to Conserve Energy**
2013	Bhatti et al.	Need more studies on peer support to understand the impact of training.
2013	Ghosh et al.	Policies need to address Energy Conservation by all means to preserve Fossil Fuel.
2010	Price Waterhouse Cooper	Policy exists to incentivize energy saving by different tariff methods.
2009	Aguinis et al.	The scarcity of information to justify energy conservation can be influenced by training.
2008	World Bank Report	More studies are required to see the impact of training on energy conservation.
2008	World Bank Report	More studies are required on performance feedback to justify the effect of training.
2003	Electricity Act 2003	Govt. policies mostly emphasize energy conservation by advancement in technology that needs training.

Source: Amalgamated by the researcher

4.3 Operationalization of LCECM Training Transfer in Literature

Studies in the developed countries have shown huge opportunities in energy conservation, particularly in domestic and commercial building sectors by changing the user's habit through training. These were mostly done through some Dos and Don'ts, simple instructions, and better utilization of Building Management System (BMS). The outcome of these initiatives improved further

when feedback was given to the participants. Some of the relevant findings are listed below:

- Administrative and Corrective Measures have huge energy saving potential (PCRA, 2008).
- The success of PAT (Perform, Achieve, and Trade) Scheme I (BEE Report, 2012).
- Reduction in Transmission and Distribution losses (Hledik et al., 2015).
- Saving is daily at the consumer's end (Hledik et al., 2016).

IEA report 2016 highlights the potential for energy conservation through various energy conservation measures including LCECM in countries like India, South Africa, China, Southeast Asia, Mexico, and Brazil. According to this report, India has huge potential for reducing the energy intensity with an estimated energy conservation potential of 15 % leading to an approximately 4 years payback period. This opportunity covers all energy conservation options including LCECM. IEA also proposed a step by step methods for energy conservation projects in India in sectors like SMEs, Commercial Buildings, Municipality Street Lights, Municipality water distribution Pumps and Agricultural Pumps. National Productivity Council (NCP) is responsible to conduct the energy audits in each state for BEE. The project has the potentials of an estimated overall energy savings of 15% that translates into 75 Billion Units of Power. It will also create an opportunity for investing rupees 150,000 crores in the energy conservation projects with an estimated 4 years payback period. Training is an integral part of this energy conservation project initiative. Training plays a significant part in LCECM application when we talk about walking the last mile in energy conservation. Some of the studies are summarized below to justify that argument.

Table 4.2: Few Studies reviewed on Need for LCECM Training

Year	Source	Justifications
2017	The Energy Research Institute (TERI)	GRIHA (Green Rating for Integrated Habitat Assessment) program propagates the need for behavioral training.
2016	Prayas Group Report	Sustainability of energy conservation by training and its assessment.
2016	Prayas Group Report	The gap between supply and demand of electrical power can be minimized by low-cost energy conservation measure training to the occupants of any commercial building.
2016	International Energy Agency (IEA)	Star Rating scheme of BEE targeting commercial buildings propagates behavioral training through voluntary.
2015	BEE Training Manual	Lack of project funding due to higher initial cost is the main hurdle to implement any energy efficiency projects.
2012	Price Waterhouse Coopers	Recommended increasing energy efficiency training by 20 percent (Emerging opportunities and challenges - India Energy Congress).
2008	Biswas et al.	Studies on educational buildings in India have concluded that by giving energy conservation training to the building occupants 20% of energy can be saved.
2003	Energy Act.	Certification of Energy Auditors and Energy Managers by BEE.

Source: Amalgamated by the researcher

Energy conservation through efficient technology will always have room for improvement due to the missing link of human interventions. Energy management will have the biggest impact when energy conservation training is addressed in its totality i.e. behavior of individuals in the organization also impacts directly on energy usage. DOE report 2019, suggests that behavioral

impact is equally important like technical and organizational impacts when we talk about sustainable energy conservation.

The energy conservation approach in any application is two-directional and these are technological excellence and behavioral approach (Wong, 1997). LCECM training is one of the simple means to motivate employees for energy conservation (Williams, 1993). Lack of knowledge leads to mind blocks for energy conservation initiatives resulting in hurdles (Yik et al. 2002). Repetition of any application based on the learning from energy conservation training will result in an enduring changed behavior (Wexley and Latham, 1991). Barker (1997) found knowledge brings an enduring change in behavior resulting from individual experiences in a particular situation. That is the reason Wai et al., (2006) suggested energy conservation awareness should be followed by behavioral changes and came out with a model based on Antecedents-Behaviour-Consequences (A-B-C) contingency theory. This theory was conceived by the renowned behavioral expert, B. F. Skinner to examine human and animal behavior through experiments (Maag, 2004). Antecedents are the stimulus that triggers to create an environment leading to a voluntary Behavioral action resulting in a Consequences that brings an outcome that can be measured and verified.

4.3.1 LCECM Training for Energy Conservation

Wai et al., (2006) identified three main stages of energy conservation awareness process based on Antecedents-Behaviour-Consequences Theory as shown in Figure 4.1. Antecedents in the situations or environment, Behaviour is voluntary in nature of the employee and Consequences are the change in the future behavior of the employee after the awareness training.

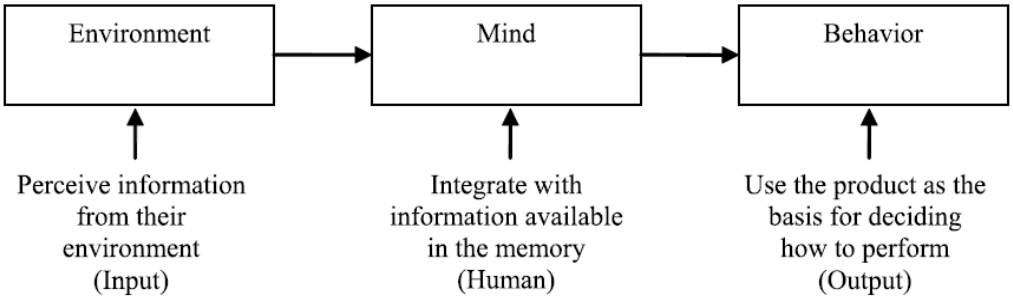

Figure 4.1: Environment-Mind-Behaviour (EMB) Model
Source: Wai et al., (2006)

Transfer of training in different applications was studied by various researchers and various models for successful transfer of training were suggested in the past. Low-Cost Energy Conservation Measures are completely different application areas in different contexts. These are the means and ways to reduce energy consumption with minimal monetary constraints without compromising with the operational outputs (Staddon et al., 2016). Studies had been done in educational institutes and residential buildings to evaluate the impact of certain operating instructions through some Dos and Don'ts, instructions, and graphic representations to understand the impact of such actions from the monthly energy bills (Aunis et al., 2009). It was also assessed in some cases by giving feedback to the occupants of the premises to evaluate whether the feedback had any positive impact (Stommen et al., 2014). There is a scarcity of literature suggesting low-cost energy conservation measures training is a cost-effective way to conserve energy. Formal training on energy conservation by practicing low-cost energy conservation measures was never part of such studies to assess the impact on energy conservation through such training transfer (Podgornik et al., 2016). In order to assess the impact of TOT on EC the researcher decided to incorporate LCECM training in this research work.

4.3.2 Transfer of LCECM Training for Energy Conservation

Procedures or tools that could efficiently transfer the motivation to the receiver or the employee from the transferor or the trainer is the method of knowledge transfer. Based on this understanding and at the backdrop of Antecedents-

Behaviour-Consequences Theory, Wai et al., (2006) developed the Energy Awareness Process framework for energy conservation application as sketched in Figure 4.2.

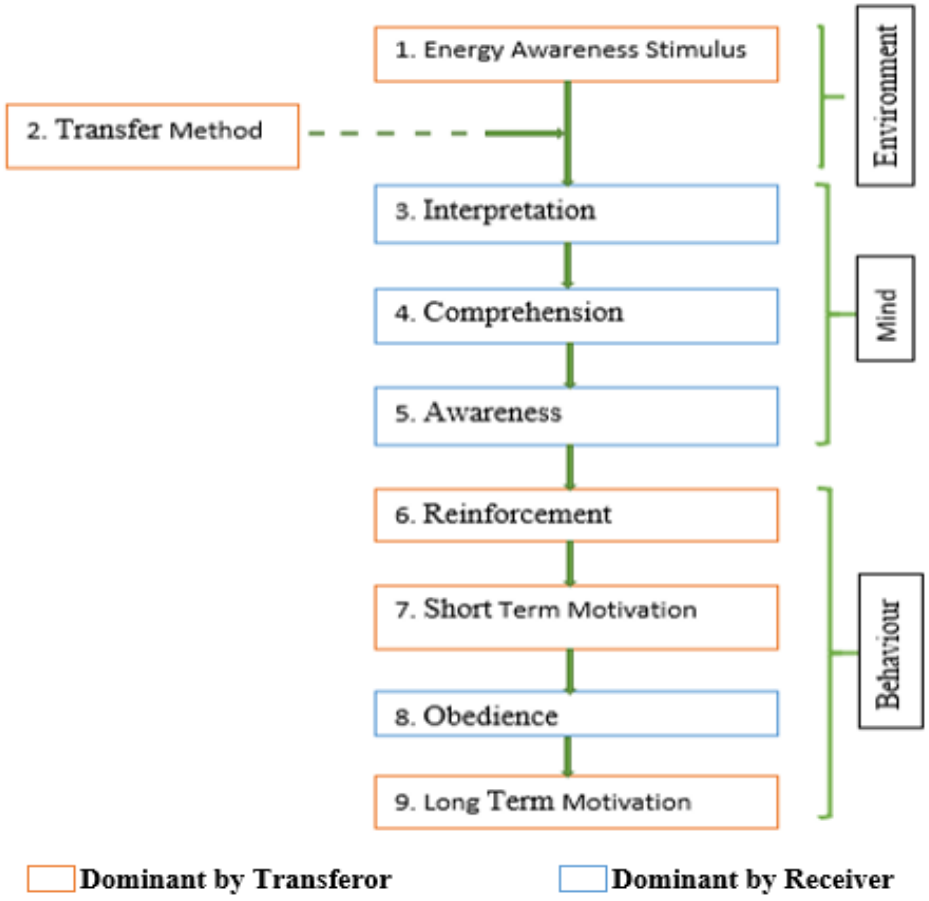

Figure 4.2: EMB Model and Energy Conservation Training
Source: Wai et al., (2006)

Gao et al.; (2017) used TPB theory in their energy conservation study in educational building and found peer support and performance feedback are effective in influencing the students to follow the Dos and Don'ts. Yamnill et al., (2001) found in their study, which was on non-energy conservation application, that both peer support and performance feedback influence training transfer. Wai et al., (2006) used both peer support and performance feedback indirectly in their energy conservation study to develop a framework on the energy conservation awareness process.

Experience shows energy conservation training in terms of proper utilization of energy through practical means has an important part to play in the TOT for EC application when it comes to walking the last mile connectivity (IAEMP, 2016). Some of the studies are summarized below to justify that argument.

- LCECM training to the commercial building's occupants can play an important role for bridging the gap between supply and demand in electrical power consumption (Prayas Energy Group Report, 2016).
- Sustainability of energy preservation by training and its regular evaluation is required in India (Prayas – Energy Group report, 2016).
- Studies on educational buildings in India have concluded that giving energy conservation training to the building occupants a sizable amount of energy can be saved (Biswas et. al., 2008).
- Recommended increasing energy efficiency training by 20 percent (PWC Report, 2012).
- Certification of Energy Auditors and Energy Managers by BEE to implement energy conservation at the ground level (Energy Act, 2003).
- Lack of project funding due to higher initial cost is main hurdle to implement energy conservation projects. Energy-saving by no-cost measures like inhouse training can substantiate project funding (Training Manual, Bureau of Energy Efficiency, 2015).
- GRIHA (Green Rating for Integrated Habitat Assessment) program launched by TERI (The Energy Resources Institute) propagates the need for behavioral training.
- Star Rating scheme of BEE targeting commercial buildings propagates behavioral training though voluntary initiatives (IEA, 2016).

Technological excellence alone cannot achieve optimal energy utilization and is unlikely to be sustainable in the longer run. Energy conservation will have the major influence when energy conservation training addresses the real practical issues faced by the end-users on day to day basis that usually goes unnoticed in any training on technology.

4.4 Antecedents of LCECM Training Transfer

A framework to develop Energy Awareness Process is created by Wai et al., (2006) based on Antecedents-Behaviour-Consequences (A-B-C) theory that was conceived by the renowned behavioral expert, B. F. Skinner (Maag, 2004). According to this framework, energy awareness stimulus is the first phase in the environment stage and dominated by the trainer or transferor. This stimulus is the antecedent as highlighted in Table 4.3.

Table 4.3 : Antecedents-Behaviour-Consequences (ABC) model

(A) Antecedent	(B) Behavior	(C) Consequence
• Stimulus or Trigger points that act as an external environment to create a situation for behaviors to change.	• Cognitive or thinking in nature voluntary actions that lead us to choose whether to do or not to do. • Respondent or physical in nature leading to psychological changes in our body. • Operant or acting in nature voluntary actions lead us to choose whether to do or not to do.	• An external event that will occur after a particular covert or operant behavior.

Source: Wai et al., (2006)

Previous research shows there can be several antecedents to transfer of training in different applications for different purposes. These antecedents can be both dependent variables as well as independent variables. Ross et al., (2016) found when the multi-storied residential building tenants were asked to share their individual experiences with fellow tenants of the building it resulted in more energy conservation. It is considered to be peer support. Abrahamse et al., (2016) found when the individual residential buildings owners were updated on daily basis through email about their daily energy consumption resulted in more energy conservation compared to when this information was not shared. This is considered to be performance feedback. Ishak et al., (2016) found that the students in the campus could enable in dropping the energy consumption when the daily energy consumption data was displayed on the main notice board for all to see leading to more interactions amongst the students resulting in energy conservation. This is an example of peer support and performance feedback. Therefore, peer support and performance feedback can be good antecedents of LCECM training transfer.

4.4.1 Identifying LCECM Training Transfer Antecedents

There is a scarcity of scholarly literature addressing the TOT through PS and PF on EC application. Training Transfer needs to be not only verified from the feedback obtained through a set of appropriately phrased questionnaires from the participants but also to be measured in actual application because research shows there can be a gap between intension and action when we talk about conserving energy by engaging the people (Staddon et al. 2016). TOT and its antecedents are discussed in the previous sections. Based on this discussion the researcher has considered PS and PF as the antecedents to LCECM transfer of training for the current study. Limited antecedents are considered for the study due to constraints of time and resources. Further studies in the future on Energy Conservation applications can include other antecedents to evaluate further impacts.

4.4.2 Justification of PS, and PF as Antecedents of LCECM Training Transfer

A total of seventy-nine works of literature on the theoretical premise were reviewed. Many antecedents could influence the Transfer of Training. A detailed analysis found that Peer Support and Performance Feedback had the maximum influence as predictors for the Transfer of Training but in different applications. Since there is a scarcity of scholarly literature addressing the Transfer of Training through Peer Support and Performance Feedback on Energy Conservation application a line was required to be drawn to conclude the findings of the present study convincingly. After detailed discussions and deliberations with twelve practicing Energy Conservation professionals of IAEMP, it was unanimously decided to consider PS and PF to be the antecedents of TOT in this present study for evaluating the impact on EC. The reasons for this conclusion are summarized as bellow.

a) There can be more than two antecedents of transfer of training. The choice was whether to consider all the antecedents in this study or take part in the antecedents. Including all antecedents could have made the study more lengthy and complex. Given the constraints in resources and approach, it is advisable to tackle the subject in a step by step manner, so that full justification can be done in progressive studies. Carrico et al., in 2011; Vandenberg et. al., in 2008; and Wilson et. al., in 2007; adopted similar method in their respective studies in the past.
b) Many researchers have contended that the central rudiments needed in a fruitful intercession contain evidence around in what way to modify conduct, response, and a helpful societal atmosphere (Staats et al., 2004; Geller, 2002; De Young, 1996).
c) Carrico et al., in 2011 have advocated peer support and performance feedback as predictors for transfer of training.
d) There is a possibility that PS and PF might target diverse paths for appealing in activities to preserve energy. Scholars have claimed that there are twin paths for involvement in societal activities. The initial path involves a coherently believed procedure in which individuals consider the price and benefits of collaboration. The another path

comprises a want for endorsement and association from the cluster (Simon et al., 1998; Sturmer and Simon, 2004; Sturmer, Simon, Loewy, and Jorger, 2003). If the feedback and peer education interferences scrutinized here differentially target consequence expectation views and apparent societal customs, the mixture of the two might endorse conduct modification amongst a larger numeral of people who otherwise would be inspired by solitary one or the other. Therefore, an intrusion that comprises both PS and PF will lead to a larger decrease in energy usage than either PS or PF can do alone (Carrico et al., 2011).

e) Besides providing proofs for performance feedback and peer support as interference apparatuses, the study also talk about the role of enticements in endorsing conduct modification. The fact that these things were fashioned at the backdrop in which there was nil monetary recompense for persons who adapted their conduct opposes old-style commercial investigation of this matter (Wilson and Dowlatabadi, 2007).

Thus for the present study researcher has included both PS and PF as antecedents to TOT. Therefore, the justification of PS and PF as antecedents of LCECM Transfer of Training (LCECMTT) is summed-up in Table 4.4.

Table 4.4: Justification of LCECM Training Transfer antecedents

Year	Source	Justification of Predictors as antecedents of LCECM Transfer of Training
2013	Bhatti et al.	Need more studies on peer support to understand the impact of training.
2013	Ghosh et al.	Policies need to address Energy Conservation by all means to preserve Fossil Fuel.
2010	Price Waterhouse Cooper	Policy exists to incentivize energy saving by different tariff methods.
2009	Aguinis et al.	The scarcity of information to justify energy conservation can be influenced by training.
2008	World Bank Report	Establishing the impact of training on energy conservation need more studies.
2008	World Bank Report	Justification on the impact of training by performance feedback for energy conservation need more studies.
2003	Energy Act 2003	Govt. policies mostly emphasize energy conservation through advanced technology.

Source: Amalgamated by the researcher

4.5 Peer Support (PS), and LCECM Training Transfer

It is important to understand the meaning of “Peer Support” as an antecedent of “Transfer of Training”. Some of the definitions by various researchers are listed below.

- Bates et al. (2007) define “Peer Support” as "The extent to which a trainee's peers reinforce and support the use of learning on-the-job" (p. 205).
- Kirwan and Birchall (2006) describe this form of support as "Amount of help in applying new learning from peers" (p. 265).
- Peer support
  i) "Setting goals together" (Russ-Eft, 2002; Hawley and Barnard, 2005).
  ii) Giving trainees concrete assistance.

iii) "Sharing ideas about course content" (Martin, 2010; Hawley and Barnard, 2005).

LCECM training is required to be tailored made solutions based training for better participation by the end-users. It should not be a common approach for all applications because energy consumption has two dimensions such as technology (Machines and Systems) and humans (Operators with diverse attitudes). Two identical machines performing similar work for similar purposes at two different locations and operated by two different sets of people will not consume the same amount of energy for the same net output because human intervention in operating the machine will not be the same due to different attitudes (IAEMP). It is seen in the earlier sections that peer support helps in making positive changes when we talk about giving instructions and guidelines to follow the best practices in energy conservation.

4.5.1 Influence of Peer Support on LCECM Training Transfer

Studies in the past are done on many applications considering the transfer of training to ne a dependent variable and peer support to be an independent variable. Training in energy conservation is usually done on the machines or systems by the manufacturers to train the operators about the correct operations of the machines or the systems and these are mostly training to upgrade the technological know-how. Studies in the past also found that human intervention for proper utilization of the machines or systems can also optimize energy utilization leading to energy conservation. That is the reason the Indian Government incorporated ECBC (Energy Conservation Building Codes) within the Energy Conservation Act, 2001 which is under implementation in Indian building sectors from 2018. Training on LCECM under ECBC 2017 is voluntary in nature and that creates rooms for missing low hanging fruits in energy conservation. A suitably designed tailor-made LCECM training for energy conservation having PS as an independent variable and TOT as a dependent variable can give a better result. Past research shows there are direct, indirect, and also nil effect of PS on TOT. Table 4.5 summarizes the relevant studies.

Table 4.5: Few relevant studies on Peer Support, and Training Transfer

Finding	Studies
Direct	Bates et al., 2000; Cromwell and Kolb, 2000; Holton et al.,1997
Indirect	Kirwan and Birchall, 2006; Nijman et al., 2006; Chiaburu and Tekleab, 2005; Ruona et al., 2002; Seyler et al., 1998; Noe, 1986
None	Van der Klink et al., 2001

Source: Amalgamated by the researcher

4.5.2 Deriving Hypothesis Statement 1

As stated in the previous section that PS as an independent variable and TOT as a dependent variable in applications other than LCECM training is a proven fact. Bates et al., (2000) concluded PS has a positive effect on TOT while Nijman et al., (2006) concluded the effect to be indirect. Studies in the multi-storied residential building found where the residents shared information and experience with fellow residents resulted in more energy saving compared to buildings where it was not the same. Based on the researcher's personal experience in energy conservation for more than 15 years and the experiences shared in the literature from similar studies it is assumed that PS will have a positive effect on TOT for LCECM training. It is similar to the first and second stages of the A-B-C theory as shown in Figure 4.3.

Figure 4.3: Antecedent 1 and Behaviour stages of A-B-C Model

If we draw a parallel between the A-B-C theory and the present study then PS is the first antecedent and TOT is the Behaviour as shown in Figure 4.4.

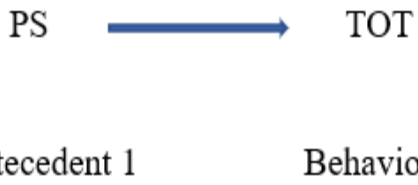

Figure 4.4: PS and TOT corresponding to first and second stages of the A-B-C Model

PS as an antecedent and independent variable is expected to influence the TOT as a dependent variable in energy conservation application. Accordingly, the first hypothesis based on the first research objective is determined.

Hypothesis$_1$ is "Peer support positively influence the transfer of training".

4.6 Performance Feedback (PF), and LCECM Training Transfer

It is vital to appreciate the connotation of Performance Feedback as an antecedent of Transfer of Training. Some of the definitions by various researchers are quoted below.

- Ishak et al., (2016) define as "Consumer energy behavior can be understood at its fundamental level by examining the interactions between cognitive norms, material culture, and energy practice".
- Oliveira et al,. (2011) define as "Transform the behavior of users of public buildings regarding Energy Efficiency".
- Ross et al., (2016) define as "Energy-efficient behaviors are shaped by factors such as price, awareness, trust, and a sense of moral obligation to the community".
- Carrico et al., (2011) define as "Information disseminated through block leaders is more effective than traditional routes of public education".
- Young et al., (2015) define as "The attitudes of staff, especially as a result of the value placed on the environment and job satisfaction".

LCECM training is required to be tailored made solutions based training for better participation by the end-users. It should not be a common approach for all applications because energy consumption has two dimensions such as

technology (Machines and Systems) and humans (Operators with diverse attitudes). Two identical machines performing similar work for similar purposes at two different locations and operated by two different sets of people will not consume the same amount of energy for the same net output because human intervention in operating the machine will not be the same due to different attitudes (IAEMP). It is seen in the previous sections that performance feedback helps in making positive changes when we talk about giving instructions and guidelines to follow the best practices in energy conservation.

4.6.1 Influence of Performance Feedback on LCECM Training Transfer

Studies in the past are done on many applications and TOT is considered as a dependent variable while PF is considered to be an independent variable. Training in energy conservation is usually done on the machines or systems by the manufacturers to train the operators about the correct operations of the machines or the systems and these are mostly training to upgrade the technological know-how. Studies in the past also found that human intervention for proper utilization of the machines or systems can also optimize energy utilization leading to energy conservation. That is the reason the Indian Government incorporated ECBC (Energy Conservation Building Codes) under the Energy Act 2001 which is under implementation in Indian building sectors from 2018. Training on LCECM under ECBC 2017 is voluntary in nature and that creates rooms for missing low hanging fruits in energy conservation. A suitably designed tailor-made LCECM training for Energy Conservation having PF as independent variable and TOT as a dependent variable can give a better result. Past research highlights the effects of PF on TOT on various applications but Energy Conservation. Table 4.6 highlights some quotes from the relevant studies.

Table 4.6: Few relevant studies on Performance Feedback and Training Transfer

Finding	Studies
"Performance feedback is significantly related to transfer of training".	Velada et al. (2007)
"Performance feedback influences transfer of training".	Oliveira et al. (2010)
"Performance feedback is a key factor to the transfer of training".	Staddon et al. (2016)
"Performance feedback helps to transfer of training".	Amanda et al. (2010)

Source: Amalgamated by the researcher

4.6.2 Deriving Hypothesis Statement 2

As stated in the previous section that PF as an independent variable and TOT as a dependent variable in applications other than LCECM training is a proven fact. Staddon et al. (2016), and Oliveira et al. (2010) concluded PF has a direct impact on TOT. Studies in the multi-storied residential building found where the residents were given feedback on a daily and weekly basis through various means resulted in more energy saving compared to buildings where the feedback was not given. Based on the researcher's personal experience in energy conservation for more than 15 years and the experiences shared in the literature from similar studies it is assumed that PF will have a positive effect on TOT for LCECM training. It is similar to the first and second stages of the A-B-C theory as shown in Figure 4.5.

Figure 4.5: Antecedent 2 and Behaviour stages of A-B-C Model

If we draw a parallel between the A-B-C theory and the present study then PF is the second antecedent and TOT is the Behaviour as shown in Figure 4.6.

Figure 4.6: PF and TOT corresponding to first and second stages of the A-B-C Model

PF as an antecedent and independent variable is expected to influence the TOT as a dependent variable in energy conservation application. Accordingly, the second hypothesis based on the second research objective is determined.

Hypothesis$_2$ is "Performance Feedback positively influences the transfer of training".

4.7 LCECM Transfer of Training, Peer Support, and Performance Feedback

Previous studies in residential and commercial buildings suggested that low-cost energy conservation measures implemented through some instructions like Dos and Don'ts in the form of guidelines resulted in energy conservation (Trombley et al., 2017). Though there was no formal training given still the building occupants could follow the instructions and take the actions as was intended to be. Differences in the outcome were observed where the building occupants shared their experience with other occupants to encourage each other for more active participation (Tsuda et al., 2016). The same was also observed when arrangements were made to give the building occupants feedback on daily basis based on their efforts to reduce energy consumption (Ross et al., 2016). It is evident that if certain instructions coupled with a feedback mechanism and encouragement to support each other can give substantial energy saving then formal training based on LCECM and designed for peer support and performance feedback will give far better results in energy conservation initiative. That is why the researcher decided to incorporate low-cost energy conservation measures training with PS and PF as antecedents in the study to evaluate the effect of the TOT on Energy Conservation application.

4.7.1 LCECM Training Transfer and Energy Conservation

Studies in the past are done on many applications where TOT is an independent variable. Dependent variable is the area of application where the impact of TOT is expected to be validated. These studies were done in non-energy conservation applications. Most of these impacts were measured by obtaining the feedback through a set of questionnaires suitably drafted to capture the intent of the participants. There is always a slip between the intent and the act. An intent to do certain actions immediately after the training may not be the same after some time and the actions may not be needed to be done immediately after the training in real-life applications. That means the learnings from the training need to be embedded into the personality of the individual so that he or she applies the learning without being told as and when needed. That can be ascertained only if the impact is measured in actual applications in addition to feedback from the participants. In this study, energy conservation is the final goal that needs to be proved through LCECM training with the help of certain independent and dependent variables.

4.7.2 Deriving Hypothesis Statement 3

As stated in the previous section TOT is considered to be an independent variable and EC is considered as a dependent variable. Energy conservation is the final goal in this study that needs to be proven beyond any reasonable doubt so that a conclusion can be drawn. That is the reason it is important to prove this hypothesis not only based on feedback from the participants but also by actual measurement of the consumed energy in actual applications. This will prove the fact that the intent to act after the LCECM training is embedded into the personality to act at a later time when it was needed. It is similar to the second and third stages of the A-B-C theory as shown in Figure 4.7.

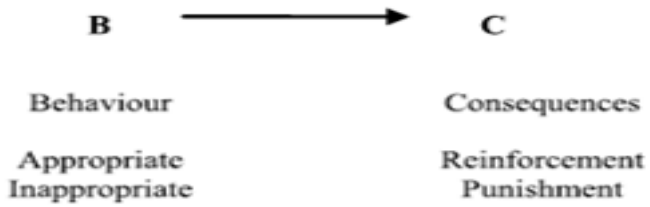

Figure 4.7: Behaviour and Consequence stages of A-B-C Model

If we draw a parallel between the A-B-C theory and the present study then TOT is the Behavior and EC is the Consequences as shown in Figure 4.8.

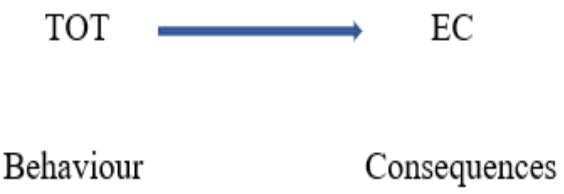

Figure 4.8: TOT and EC corresponding to second and third stages of the A-B-C Model

Transfer of Training as an antecedent and independent variable will influence Energy Conservation as a dependent variable for energy conservation as a consequence. Accordingly, the third hypothesis based on the third research objective is determined.

Hypothesis$_3$ is "Transfer of Training has a positive impact on energy conservation".

4.8 Conceptual Model

The discussion in the previous sections were for hypothesis identification and at the backdrop of that discussion a conceptual model is developed for the present study. It is an adopted low-cost energy conservation measurement training from IAEMP and imparted by the practicing energy conservation practicing professional to the targeted audience. From the work environment, PS and PF are considered to be the antecedents of the TOT. Training output is considered to be the volume of unique learning which takes place at the time of the training program and retention of that same after the training program is completed to practice on work during the future times. Circumstances under which the training transfer takes place and the retention of that learning over a period of time and its application on work are also conceived in the projected conceptual model as sketched in Figure 4.9.

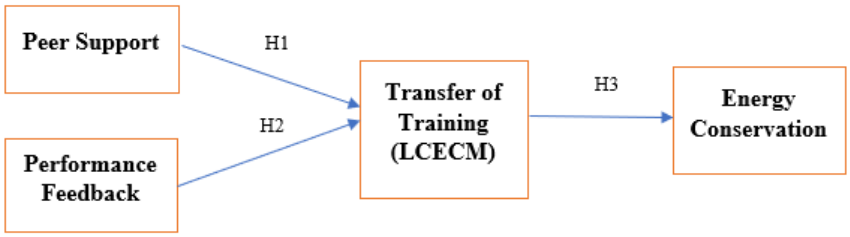

Figure 4.9: Conceptual Model for Present Study

In the current study based on the conceptualization of the model, it is projected that Peer Support and Performance Feedback definitely effect the Transfer of Training. This implies, if peers are supporting then there are chances that transfer of training will be high. Similarly, if learners are given regular feedback on their performance then they will be motivated to apply energy conservation measures in their offices/workplaces. “Peer Support (PS) positively influence Transfer of Training (TOT)” is H_1. “Performance Feedback (PF) positively influences Transfer of Training (TOT)” is H_2. “Transfer of Training (TOT) has positive impact on Energy Conservation (EC)” is H_3. While H_1, H_2, and H_3 will be tested by the feedbacks obtained through a set of questionnaires from the participants, H_3 will also be tested additionally by actual measurements of energy consumption at two sites in real-life applications besides feedback.

4.8.1 Operating Definition

Low-cost energy conservation measures training: It is self-disciplining to optimize the usage of energy without compromising with the comfort level or output. This can be done by training to enhance the knowledge, upgrade the skills, and change the attitude towards energy usage such that it leads to a reduction of energy consumption. The low-cost energy conservation training includes corrective measures or administration of some actions of energy users which in turn will reduce energy consumption to do the same work. Since it deals with the modification in the learner's behavior towards energy usage this type of training is also known as behavioral change training for Low-Cost Energy Conservation Measures. The same is defined by others as follows:

"Train consumers on optimal utilization of energy using Low-Cost Energy Efficiency Measures" (PCRA Reference Manual, 2008).

"Energy Efficiency Assessment refers to measuring and analyzing energy use and energy losses in a process, facility or activity area to identify, investigate, evaluate, make the business case for and report on energy use and energy efficiency opportunities in energy using entity over time" (DERT, 2010).

Training: Training is teaching or developing any skills to gain any knowledge that enhances the ability to advance one's competence, capacity, efficiency, and performance.

Transfer of Training: It means the newly acquired skills by the trainees learned from an energy conservation training program is understood, accepted, and inculcated into their character for applying the same on their works in future times without being asked to do so. If that happens then it leads to enhancement of their individual performance (IAEMP).

Measuring Training: Measuring Training is the assessment of the effect and efficacy of the training at Response, Knowledge and Conduct level of the trainee so that the training output can be measured and corrective activities can be initiated for further enhancements.

Feedback on Training: A spoken or written mechanism to help the trainer to advance the training procedure and content so that the trainees get the best out of any training program. Similarly, assessing by the trainer to the trainees about their grasp of the subject acquired from the training.

Commercial Building: The Commercial building is a premise which is used for commercial activities like office, shops, hotels, hospitals, warehouse or premise for public celebrations, etc.

Performance Feedback: Feedback of performance after obtaining the training to evaluate the effectiveness of the training transfer. Velada et., al. (2007) defined performance feedback as: "Feedback on the transfer of training that translates into actual measurable output."

Peer Support: It is the help, encouragement, and support of the co-workers, supervisors, and managers to implement the learned skills of energy conservation into work. Bates et. al., (2007) define Peer Support as "The extent to which a trainee's peers reinforce and support the use of learning on-the-job." Kirwan and Birchall (2006) describe this form of support as the "Amount of help in applying new learning from peers."

Energy Conservation: Energy saving by altering human behavior without compromising with the comfort level (IAEMP).

4.8.2 Hypothesis

There are three hypotheses based on the research objectives and stated as follows:

H_1- "Peer support positively influences the transfer of training".

H_2- "Performance Feedback positively influences the transfer of training".

H_3- "Transfer of Training has a positive impact on energy conservation".

4.9 Summary

a) LCECMs are easy to apply and cost-effective means to conserve energy especially in the building sector.
b) Study shows there can be many antecedents to TOT. For LCECM application PS and PF found to be suitable to study the impact on TOT.
c) The conceptual model is made founded on the supposition that PS and PF as antecedents will have a direct influence on TOT while TOT as antecedent will have a direct impact on EC.
d) Operating definitions of various terms used are explained in this chapter.
e) Three hypotheses are (i) "Peer support positively influences the transfer of training", (ii) "Performance Feedback positively influences the transfer of training", and (iii) "Transfer of Training has a positive impact on energy conservation".

Research methodology is a systematic process of resolving a research problem and that is discussed in the next chapter.

Chapter 5

Research Methodology

5.1 Introduction

Methodology undertaken to develop a model for the transfer of training with two predictors for energy conservation is described in this chapter. It also explains the method and design to undertake the research. The chapter completes the research process flow chart.

The research methodology is systematically finding an answer for a research problem braced with an appropriate reason. The research methodology can modify depending upon the nature of the problem. Quantitative, qualitative, and mixed methodologies are the types of research methodologies generally followed for research work. The most appropriate research methodology is selected based on the nature of the research work. Quantitative methodology is created on the severe analysis of quantifiable data collected during the study. Qualitative methodology is associated with the subjective assessment of different features. The mixed methodology is a combination of both. The selection of the methodology is carried out during the research design phase of this study as described further.

5.2 Research Design

A master plan that highlights the techniques used and processes followed for gathering the data and analyzing the same in a research study are called research design. The ultimate reason for a research process is to formulate the research objectives that will guide to designing the research process appropriately (Singh K, 2007).

5.2.1 Research Approach

The study is a Mixed Longitudinal approach. Regression analysis is a method of forecasting a consequence variable from a single forecaster variable (Simple

Regression) or numerous forecaster variables (Multiple Regressions). Here, we are finding cause and effect. A similar approach was taken in previous studies by Huebner, 20113; Sanquist et.al., 2011; Ishak et.al., 2016; Wokje, 2007; and Hossein et.al., 2004. Because both the dependent and independent variables are matric variables and hence regression may be opted for finding reason and result relationships.

5.3 Population and Sampling Frame

The Industrial Estate at Guindy is known as Thiru-Vi-Ka Industrial Estate and was set up in 1958. The total land of this Industrial Estate is 404 acres. To encourage small and tiny entrepreneurs 123 plots were developed and 110 tiny works shed with a ready to use area of 200 Sq. Ft. and 400 Sq. Ft. was built at the beginning. As per the Industrial Estate Manufacturer's Association Directors 2005 (Not revised after that), total work sheds are 148, and SIDCO sheds are 60. However, the Industrial Estate has gone through massive structural changes after 2005 mainly due to the influx of IT Industries and non-functioning of many small units engaged in manufacturing activities leading to the changes in the original development plan of the Estate.

The Industrial Estate is located between Adyar River on North, Mount Road on South, Inner Ring Road on West, and Alandur Road on East. For this study, only the offices, workshops, and sheds are considered which are engaged in the back office, warehouse, and manufacturing activities. Garment complex is not considered as it is on the other side of Inner Ring Road and an extension of the Estate. Small and tiny units located in Ekkatuhangal area are not considered as most of these units are either operating from the residential area or got closed/converted into commercial outlets after the Chennai Metro Rail project started. Over the years many of these units were either shut down or moved to other locations.

The required data for this research work is gathered through an organized questionnaire one month after giving the LCECM training to the participants. Convenience sampling method is followed to collect feedback data. A total of

26 organizations took part in the process. One representative from each organization was selected to help the researcher collecting the feedback through the questionnaire.

5.3.1 Sampling Method and Sample Size

Convenient Sampling is used for the targeted area. As per SIDCO Office, the Chennai report of 2008 there were 318 operating units. However, IAEMP surveyed in 2016 and found only 79 units are in daily operations. The researcher visited all 79 units for the study. A total of 27 companies agreed for the study. The researcher further verified with the Manufacturing Association President about the true representation of the cluster by these units in terms of size, workforce, operations, turnover, and years of operations. It was confirmed to be so by the Association President. Therefore, there were 26 companies for the study and one company was for a pilot study. Representatives of 26 companies attended the LCECM training given by the trainers from IAEMP. LCECM training was given in 6 random groups on 6 different days to the representatives from 26 companies. Each training session was for 2 hours duration. Feedback was collected through the structured questionnaire after one month of the training.

Out of 318 listed companies, only 79 companies were operating daily. A total of 27 companies out of these 79 daily basis operating companies agreed to be part of the study. One company was selected for the pilot test and the remaining 26 companies with a combined strength of 1070 workforce participated in this study. A total of 398 participants attended the training in 6 sessions and 363 participants gave the feedback which was collected one month after giving the training. Missing participants were either away from the station or left the organizations. A total of 348 feedbacks were found to be complete and considered for further analysis. This 348 feedback constitutes 247 Male and 101 Female.

Statics Hand Book by S Deviant suggests using a sample size from a similar study. "Role and Impact of Reward and Accountability on Training Transfer"

by Ahmed et. al., (2015) had a sample size of 200 with valid feedback of 117. Using Cochran formula for sample size calculation with 95% confidence and 5 % plus or minus precision the sample size should be 283 for a 1070 population. The formula used is;

$$n = \frac{n_0}{1 + \frac{(n_0 - 1)}{N}}$$

Also, researchers in the past on similar subject have done studies with less than 500 population (Carrico, 2011; Pruitt et. al., 2012; Webb et. al., 2014; Merakou et. al., 2006; Lam, 2006; Benders, 2006; Abrahamse et. al., 2007).

5.4 Exploratory Stage of Scale development

Literature review of more than 200 journal articles and research papers revealed that Likert 5 – point scale was used by all researchers in similar applications. The same was followed for this study as well.

Likert Scale: 5-point (1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree)

5.5 Data Collection Tool

The survey questionnaire was prepared for collecting the data in the form of feedback one month after imparting the LCECM training to the participants. The questionnaire had six sections. The first two sections are for the demographic details of the organization and participants respectively. The next four sections are for Peer Support, Performance Feedback, Transfer of Training, and Energy Conservation respectively. The questionnaire was tested for correctness and completeness through the reliability and validity tests. Necessary corrections were made to finalize the questionnaires and the feedback was collected by using the same. After the feedback data was collected a pre-processing was done for the organization and participant demography data using SPSS software for checking the consistency and correctness of the collected data for final PLS path modeling analysis.

Impact of LCECM Training measures 4 factors namely Peer Support and Performance Feedback being an independent variable while Transfer of Training and Energy Conservation being a dependent variable. These factors are relevant to Holton's and Tesluk's model of training transfer (Holton et.al., 2003, 2000 and Tesluk et. al., 1995). The instrument is categorized into six construct areas namely Organization Details (OD), Participant Details (PD), Transfer of Training (TOT), Performance Feedback (PF), Peer Support (PS), and Energy Conservation (EC). Organization Details contains ten items measuring five constructs. Participant Details contain twenty-four items measuring nine constructs. The transfer of Training contains fifty-five items measuring eleven constructs. Performance Feedback comprises forty-five items computing nine constructs. Peer Support comprises forty-five items computing nine constructs. Energy Conservation comprises forty-five items computing nine constructs.

5.5.1 Harkness Method

Harkness Method was followed by the researcher along with seven practicing energy management professionals from Chennai to discuss and debate about the feedback and data collection methodology to be adopted and the pros and cons of that methodology. Necessary corrections were made in that approach while finalizing the questionnaires.

5.5.2 Reliability

Reliability denotes the uniformity or constancy of test scores. The reliability is verified by two ways such as Cronbach's alpha method and Guttman Split – Half method. This analysis was done by using SPSS as a scale reliability test.

Instrument Reliability (**Cronbach Alpha**):

Reliability refers to the uniformity or constancy of test scores. The reliability is being verified by means of Cronbach's alpha method. This analysis will be done by using SPSS as a scale reliability test. Generally acceptable value of Cronbach's alpha is varies between 0.70 to 0.95 (Tavalok, Dennick, 2011). The reliability of the data is critical in the survey process of feedback data collection.

This signifies whether or not an interpretation can be done from the collected feedback data. The reliability is verified by using both Cronbach's alpha method and the Guttman Split-Half method. This analysis is done by using SPSS as a scale reliability test, and the overall value of Cronbach's alpha is found to be 0.73, and Guttman split-half is 0.863 which can be interpreted as "reliable". The details are as follows:

Table 5.1: Cronbach's Alpha Reliability Report

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.723	**.730**	42

Instrument Reliability (**Guttman Split-Half**):

The reliability coefficient in case of Guttman Split-Half Reliability is just the association amongst the scores gained by the same individuals on the two executions of the test. This is carried out by using the Pearson Product-Moment Correlation Coefficient (r). The value of "r" is always remains between –1 to +1. The range of 0.71 - 0.90 is High correlation and strong relationship (Guilford, 1956).

Table 5.2: Guttman Split-Half Reliability Report

Cronbach's Alpha	Part 1	Value	.319
		N of Items	21[a]
	Part 2	Value	.578
		N of Items	21[b]
	Total N of Items		42
Correlation Between Forms			.851
Spearman-Brown Coefficient	Equal Length		.919
	Unequal Length		.919
Guttman Split-Half Coefficient			**.863**

5.5.3 Dimensionality

The entire spectrum of the study is captured using four dimensions – Peer Support, Performance Feedback, Transfer of Training, and Energy Conservation. The much higher dimension of reality was reduced to four dimensions, with the proper methodology adopted, after discussions with subject matter experts in the concerned areas.

5.5.4 Validity

The face and content validity were carried out for different components of the questionnaire, and whose consolidated outcomes are provided in Table 5.5, Table 5.12, and Table 5.13. The validity of the information is very important when the feedback data are collected through a survey process. This represents whether an inference can be drawn from the collected data or not. Face validity, a measure of an indicator "makes sense" as a means to judge the questions by the scientific community, was carried out during the pilot testing stage itself. Content validity, a measure representing all aspects of the conceptual definition of a construct, was also ensured with the help of experts who were part of the pilot study. A content validity ratio was calculated based on the suggestions given by the experts.

Face Validity: Face validity is related to whether a panel of experts on the topic agrees that the statements relate to what are supposed to be measured. The instrument will have face validity if there is an agreement. A test will have face validity if an examination of the items conclude that the items are measuring that are proposed to be measured. Therefore, asking people, who are experts and have authority in the related field, about their opinion on the test is face validity. Face validity is the simplest process of validation but at the same time it is considered to be the weakest form of validity. It assesses the presence of the questionnaire in relations to likelihood, readability, uniformity of style and configuring, and the unambiguousness of the language used in framing the questionnaire (DeVon et al., 2007; Trochim, 2001; Haladyna 1999). Therefore,

face validity is a form of usableness rather than reliability (Parsian and Dunning, 2009).

Face validity in this study was established to indicate whether the survey questionnaire appeared to be suitable for the study and its content. To establish the face validity of the survey questionnaire, an assessment form (Table 5.3) was established to assist respondents evaluate the parameters as below.

- There is unambiguity in the wordings of the questions.
- The probability of answering the questions correctly by the targeted respondents.
- The design and elegance of the questionnaire.

Twelve experts from the Indian Association of Energy Management Professionals (IAEMP) were randomly selected to respond to the evaluation form evaluate the face validity using Likert scale of 4, 1 = Strongly Agree, 2 = Agree, 3 = Disagree, and 4 = Strongly Disagree. Face validity was still valuable in providing significant information for operationalization of the survey questionnaire by the experts in spite of being the lowest form of validation.

Table 5.3: Face Validity Evaluation Form

S. No.	Criterion	Strongly agree	Agree	Disagree	Strongly disagree
1	There is unambiguity in the wordings of the questions.				
2	The probability of answering the questions correctly by the targeted respondents.				
3	The design and elegance of the questionnaire.				

Result on face validity for Questionnaire: Responses of 12 IAEMP experts were collected on the evaluation form for the questionnaire. Disseminations of responses are shown in Table 5.4.

Table 5.4: Response on Face Validity Evaluation Form

S. No.	Criterion	Strongly agree	Agree	Disagree	Strongly disagree
1	There is unambiguity in the wordings of the questions.	12			
2	The probability of answering the questions correctly by the targeted respondents.	12			
3	The design and elegance of the questionnaire.	12			

The respondents rated each criterion on, "1" (strongly agree). This suggests that "Wording of statements has clarity", "Respondents are expected to answer correctly" and "Design and elegance of the questionnaire are good" have face validity.

Content Validity: Lawshe (1975) presented an empirical or quantifiable method to content validation. This method comprises approximating the statistical validity ratio (Lewis, 1995; Lawshe, 1975). It is unlikely to have several specialists on a specific research subject at one place and it was the same in this research as well. As an alternative, the researchers can take the liberty to send the content validity questionnaires to specialists located at different places under the quantifiable method. Therefore, different locations is not a problem confronted by the researcher. To complete the content validity for the transfer of training a quantitative approach was also considered along with a judgemental approach.

The content validity of the survey questionnaire was done by engaging a quantifiable method (Lawshe, 1975; Lewis et al., 1995) and the following steps were taken to authenticate the content of the constructs.

- Energy management experts were identified according to the relevant items from the studied literature about transfer of training. This led to the creation of questionnaire and the content validity of the same.

- Experts from IAEMP who were knowledgeable about energy conservation was selected to establish a content evaluation panel.
- Each expert in the panel was given the questionnaire. The experts were invited to reply each of the items independently about a specific construct on a three-point scale. These scales were: "1 = Not Necessary", "2 = Useful but Not Essential" and "3 = Essential".
- The replies received from all experts were then compiled. The responses indicating "essential" for each item were counted.
- The CVR value (Content Validity Ratio) was calculated for each of the items applying the formula as; CVR = [(n - (N / 2)) / (N / 2)] (Lawshe, 1975), where “N” denotes the total respondents number and “n” denotes the occurrence total of experts number for rating the items as "3 = Essential".
- Lastly, the CVR value was calculated for each of the items for its significance matching with the table of standard suggested by Lawshe (1975). If the calculated CVR value is equivalent to or more than the value in the standard table, then the item is accepted. If not, then it is rejected. The significance level of each of the items will depend upon the experts number for rating the item as 3.

The above mentioned steps were followed to assess the items under different sections included in the questionnaires. A sample of statements included under organization details, participant details, transfer of training, performance feedback, peer support, and energy conservation was identified from the reflections of the experts in energy conservation from IAEMP. Organization Details (OD) contains ten items measuring five constructs. Participant Details (PD) comprise twenty-four items calculating nine constructs. Transfer of Training (TOT) comprises fifty-five items calculating eleven constructs. Performance Feedback (PF) comprises forty-five items calculating nine constructs. Peer Support (PS) comprises forty-five items calculating nine constructs. Energy Conservation (EC) comprises forty-five items calculating nine constructs. In total there were: 5 OD constructs, 9 PD constructs, 11 TOT constructs, 9 PF constructs, 9 PS constructs, and 9 EC constructs. Content

validity questionnaires were then prepared on a scale of 1-3 where,"1= Not Necessary", "2 = Useful but Not Necessary", and "3 = Essential".

Twelve IAEMP experts were identified based on their expertise. The questionnaire was sent to these experts along with the stated purpose to undertake the study and the procedures for responding to each of the questionnaire items. The experts were requested to mark each of the items on the basis of different constructs on a three-point scale. These scales are; "1 = Not Necessary"; "2 = Useful but Not Essential"; "3 = Essential". Requested was also made to them for suggesting additional observations (if any) on an understanding of items, or any new items advisable to be included. Responses received from the experts were tabulated based on the number counts of ratings specified as "Essential" for each item.

CVR value was then calculated by using the earlier mentioned formulae and assessed for the statistical significance level of 0.05 for each of the items using Lawshe's (1975) method. This procedure was followed for each item included in the questionnaire. Entries with a significance level of < 0.05 were eliminated. Tables from 5.5 to 5.10 represent the estimated Content Validity Ratio value.

Table 5.5: Content Validity Ratio of Organization Details Constructs

Organisation Details construct	**N**	**3**	**2**	**1**	**n**	**Mean**	**CVR**
OD1	12	12	0	0	12	3	1
OD2	12	12	0	0	12	3	1
OD3	12	12	0	0	12	3	1
OD4	11	12	0	0	12	3	1
OD5	12	12	0	0	12	3	1

Legend: CVR = [(n - (N / 2)) / (N / 2)], where "N" denotes the total respondents number and "n" denotes the occurrence total of experts number for rating the items as "3 = Essential"

Table 5.6: Content Validity Ratio of Personal Details Constructs

Personal Details construct	N	3	2	1	n	Mean	CVR
PD1	12	12	0	0	12	3.00	1.00
PD2	12	12	0	0	12	3.00	1.00
PD3	12	11	1	0	11	2.92	0.83
PD4	11	11	1	0	11	2.92	0.83
PD5	12	12	0	0	12	3.00	1.00
PD6	12	12	0	0	12	3.00	1.00
PD7	12	12	0	0	12	3.00	1.00
PD8	12	12	0	0	12	3.00	1.00
PD9	12	12	0	0	12	3.00	1.00

Legend: CVR = [(n - (N / 2)) / (N / 2)], where “N” denotes the total respondents number and “n” denotes the occurrence total of experts number for rating the items as "3 = Essential"

Table 5.7: Content Validity Ratio for Transfer of Training Constructs

Code	N	3	2	1	n	Mean	CVR
T0T1	12	12	0	0	12	3.00	1.00
T0T2	12	12	0	0	12	3.00	1.00
T0T3	12	12	0	0	12	3.00	1.00
T0T4	12	11	1	0	11	2.92	0.83
T0T5	12	12	0	0	12	3.00	1.00
T0T6	12	11	1	0	11	2.92	0.83
T0T7	12	12	0	0	12	3.00	1.00
T0T8	12	12	0	0	12	3.00	1.00
T0T9	12	12	0	0	12	3.00	1.00
TOT10	12	12	0	0	12	3.00	1.00
TOT11	12	12	0	0	12	3.00	1.00

Legend: CVR = [(n - (N / 2)) / (N / 2)], where “N” denotes the total respondents number and “n” denotes the occurrence total of experts number for rating the items as "3 = Essential"

Table 5.8: Content Validity for Performance Feedback Construct

Code	N	3	2	1	n	Mean	CVR
PF1	12	12	0	0	12	3.00	1.00
PF2	12	12	0	0	12	3.00	1.00
PF3	12	12	0	0	12	3.00	1.00
PF4	12	10	2	0	10	2.83	0.67
PF5	12	12	0	0	12	3.00	1.00
PF6	12	11	1	0	11	2.92	0.83
PF7	12	12	0	0	12	3.00	1.00
PF8	12	12	0	0	12	3.00	1.00
PF9	12	12	0	0	12	3.00	1.00

Legend: CVR = [(n - (N / 2)) / (N / 2)], where “N” denotes the total respondents number and “n” denotes the occurrence total of experts number for rating the items as "3 = Essential"

Table 5.9: Content Validity for Peer Support Construct

Code	N	3	2	1	n	Mean	CVR
PS1	12	12	0	0	12	3.00	1.00
PS2	12	12	0	0	12	3.00	1.00
PS3	12	10	2	0	10	2.83	0.67
PS4	12	12	0	0	12	3.00	1.00
PS5	12	12	0	0	12	3.00	1.00
PS6	12	12	0	0	12	3.00	1.00
PS7	12	12	0	0	12	3.00	1.00
PS8	12	12	0	0	12	3.00	1.00
PS9	12	11	1	0	11	2.92	0.83

Legend: CVR = [(n - (N / 2)) / (N / 2)], where “N” denotes the total respondents number and “n” denotes the occurrence total of experts number for rating the items as "3 = Essential"

Table 5.10: Content Validity for Energy Conservation Construct

Code	N	3	2	1	n	Mean	CVR
EC1	12	12	0	0	12	3.00	1.00
EC2	12	10	2	0	10	2.83	0.67
EC3	12	12	0	0	12	3.00	1.00
EC4	12	12	0	0	12	3.00	1.00
EC5	12	12	0	0	12	3.00	1.00
EC6	12	12	0	0	12	3.00	1.00
EC7	12	11	1	0	11	2.92	0.83
EC8	12	12	0	0	12	3.00	1.00
EC9	12	12	0	0	12	3.00	1.00

Legend: CVR = [(n - (N / 2)) / (N / 2)], where “N” denotes the total respondents number and “n” denotes the occurrence total of experts number for rating the items as "3 = Essential"

Table 5.11 summarises the CVR derived from Tables 5.5 to 5.10. The findings presented in these tables confirmed that majority of experts considered all the organizational constructs (5), personal constructs (9), TOT constructs (11), PF constructs (9), PS constructs (9) and EC constructs (9) for determining transfer of training to be important and recommended to include all of them in the questionnaire (The CVR value is significant at 0.05 level).

Table 5.11: Content Validity Ratio Summary (OD, PD, TOT, PF, PS and EC)

CVR	Organisation construct	Personal Construct	Transfer of Training	Performance Feedback	Peer Support	Energy Conservation
0.90 – 0.99	5	7	9	7	7	7
0.80 – 0.89	0	2	2	1	1	1
0.70 – 0.79	0	0	0	0	0	0
0.60 – 0.69	0	0	0	1	1	1
0.50 – 0.59	0	0	0	0	0	0
0.40 – 0.49	0	0	0	0	0	0
0.30 – 0.39	0	0	0	0	0	0
0.20 – 0.29	0	0	0	0	0	0
0.10 – 0.19	0	0	0	0	0	0
0.00 – 0.09	0	0	0	0	0	0
Total	5	9	11	9	9	9
R.L.H.	0	0	0	0	0	0
Grand Total	5	9	11	9	9	9

Legend: R.L.H.= Number of Items that were rated Essential by less than half of the participants

Table 5.12 summarises the total number of items, respective average CVR values, and average mean value of each item to be included in the questionnaire.

Table 5.12: Summary of Content Validity of all Constructs (OD, PD, TOT, PF, PS and EC)

S. No.	Heads	Total items	Significant items	Average Content Validity Ratio	Average Mean
1	Organisation Details	5	5	1.00	3.00
2	Personal Details	9	9	0.96	2.98
3	Transfer of Training	11	11	0.97	2.44
4	Performance Feedback	9	9	0.94	2.97
5	Peer support	9	9	0.94	2.97
6	Energy Conservation	9	9	0.94	2.97

The calculated average CVR value of items ranged from 1 to 0.94 and the level of statistical significance is 0.05. CVR may vary between -1.0 and 1.0. The item is considered to be more essential if the CVR value is closer to 1.0 (Ndangurura, 2015). The results illustrates a high level of content validity for the data collection instrument. This indicates that each of the items were typical of a constructed universe and to be included in the questionnaire.

5.5.5 Data Collection Method

Survey: Feedback from the participants was obtained through a set of tested and verified questionnaires through a survey and checked for its correctness before analyzing the responses.

Meter Reading: in Air-Conditioning application at two different facilities in the food court and dining hall respectively as that was the only possible area the researcher was allowed by the facility owners to collect the data with a restriction of collecting the data only with the existing measuring mechanism. Data were measured for 90 working days. Data were recorded in three groups, each consisting of 30 working days. Actual energy consumption data were recorded before and after the LCECM training by facility engineers in consultation with the researcher. Data before the training is considered as the

baseline period energy. Data after the training was recorded with an increase in air-conditioning set temperature and reduced operating time without compromising with the occupant's comfort level and considered as reporting period energy. The deviation in time and temperature was done in such a way that there were no complaints from the facility users about any compromise with their comfort level. This was ascertained by placing a complaint box with sufficient visibility and announcement. And there were no complaints in both the facilities.

Introduction to IPMVP Protocol A: Internationally all ESCOs operate with the principle of performance contracting and the modus operandi is paid as you save. Because of this measurement and verification of the performance is an important element in energy conservation practice. IPMVP has four internationally accepted and practiced protocols such as A, B, C, and D (ateam.lbl.gov/mv). Protocol A applies to the existing facility and one application area of ECM. Protocol B is applicable for the existing facility and more than one application area of ECM but not the complete facility. Protocol C is applicable for all ECMs in the complete existing facility. Protocol D is for new facility and simulation in nature because of the absence of baseline data. Protocol A was opted for this study because the application is on air-conditioning only at both the sites.

Object of Study: Energy Conservation in air-conditioning applications in the food court and dining hall of two facilities.

LCECM condition: Air-Conditioning application to measure the impacts of LCECM training transfer in actual operations. At both locations, the impact of the training was measured by reducing the air-conditioning running hours and increasing the set temperature without compromising with the occupant's comfort level.

Longitudinal Study: Meter Readings in air-conditioning applications were monitored over a period of 90 working days divided into three groups of 30 days

each at two separate facilities to measure the actual effect of LCECM Training Transfer on Energy Conservation. These readings were taken before and after the LCECM training given to the participants during the same months but in subsequent years. Therefore, the temperature difference did not have any impact on the measured readings. The temperature variations were 3 degrees centigrade (30 to 33 Degree C) over these 90 working days for both the readings, that is before and after the LCECM Training. Measurements were recorded in an excel sheet. Each of these groups had 30 working days data. Data analysis was done as per "IPMVP Protocol A" and the formula used is;

"Savings = (Baseline Period Energy – Reporting Period Energy) ± Adjustments" to determine the quantum of savings.

The duration of meter reading taken before and after LCECM training is as follows:

Reading 1: 03 Sept. 2017 to 10 Jan. 2018.

Reading 2: 03 Sept. 2018 to 10 Jan. 2019.

Impact = difference between Reading 1 and Reading 2.

By doing so it was ensured that the effects of climatic condition on air-conditioning concerning ambient temperature had no adverse effect on the meter reading. The ambient temperature varied between 33 degrees C to 30 degrees C during both the periods from the month of September to January.

5.5.6 Coding and Tabulation

Organization Demography: Organization Demography data were collected with five questions. These data were entered into the spreadsheet as ON (Organization Name), HY (How Many Years In Operations), TO (Types of Operations), NPW (Number of Persons Working), and EP (Electrical Power or Other Power).

Participant Demography: Participant Demography data were collected with

nine questions. These data were entered into the spreadsheet as A (Age), G (Gender), Department, Designation, LS (Length of Service), LE (Level of Education), ECT (Energy Conservation Training in the past), NT (Number of Training) and PCM (Process to Convey Management for Training Need).

Transfer of Training: Feedback data for Transfer of Training were collected by using eleven questions and these data were entered into the spreadsheet under the variable names TOT1, TOT2, TOT3, TOT4, TOT5, TOT6, TOT7, TOT8, TOT9, TOT10, and TOT11.

Peer Support: Feedback data for Peer Support were collected by using nine questions and these data were entered into the spreadsheet under the variable names PS1, PS2, PS3, PS4, PS5, PS6, PS7, PS8, and PS9.

Performance Feedback: Feedback data for Performance Fedback were collected by using nine questions and entered into the spreadsheet under the variable names PF1, PF2, PF3, PF4, PF5, PF6, PF7, PF8, and PF9.

Energy Conservation: Feedback data for Energy Conservation were collected by using nine questions and entered into the spreadsheet under the variable names EC1, EC2, EC3, EC4, EC5, EC6, EC7, EC8, and EC9.

5.6 Pilot Testing

For pilot testing, one organization was selected and all the 13 employees were given LCECM training. Feedback was collected one-month after the training on "Likert 5 – point Scale (5 =Strongly Agree, 4 = Agree, 3 = Neutral, 2 = Disagree, and 1 = Strongly Disagree)" on the questionnaire having six sections. Also, air-conditioner meter reading was taken in the manager's room pre and post-training for analyzing actual energy saving as per "International Performance Measurement and Verification Protocol- A" (IPMVP-A) which was further analyzed by t-Test.

Pre-processing data: Pre-processing of the Organization and Participant Demography data was carried out using SPSS software for checking the consistency and correctness of the entered data. Upon checking the data the following corrections were made in the spreadsheet for further analysis.

a) HY (How Many Years) data was entered as a range of years. This was changed to actual years after verifying from the organization. This year indicates the years of operations of the organization at this particular location and not the actual age of the organization.
b) Response to A (Age) was in three ranges and the number of responses in the third range (More than 35 years) was negligible. Therefore, the second and third categories were merged and the final classification results with being greater than or less than 25 years.
c) Departments were entered into the spreadsheet both in upper and lower cases. The operations department was either Electrical or Engineering. Mistakes in upper and lower cases were corrected. The operations department was re-entered correctly either as Electrical or Engineering.
d) Designations were entered into the spreadsheet both in upper and lower cases. Mistakes in upper and lower cases were corrected. Similar designations were merged into standard designations and were re-entered correctly into the spreadsheet as Secretary, Technician, Supervisor, Accountant, and Manager.
e) Data for LS (Length of Service) were collected in three ranges. Representation for the third range (More than 7 years) was only 1 %. Therefore, second and third ranges data were merged. Data entered into the spreadsheet as '0' is up to two years and '1' is above two years.
f) NT (Number of Training) is entered into the spreadsheet as '0' meaning no training and '1' meaning one training. Since very few people got the training the same was dropped from the analysis.
g) Total data Disregarding Data dimension of the data after pre-processing is 348 x 52.

Disregarding Data: EP (Electrical Power) details were collected for evaluating the effect of the training if the organization was using non-electrical power from

alternative source of energy as the main power. Since all the organizations were using Electrical Power as the main source of energy the data was dropped from the analysis. Similarly, PCM (Process to Convey Management for Training Need) was also dropped from the analysis as there is no such process in any of these organizations. The number of Training (NT) was also dropped since a few of the participants received only one training.

Quality of Data: Three questions (Question TOT8, PS9, and PF6) were phrased in negative to check whether the given feedback is at random or with due diligence after reading the question correctly. It was answered correctly by all respondents. This justifies the quality of the collected feedback.

5.6.1 Results of Pilot Testing

For the purpose of pre-testing the questionnaire a pilot Test was done in one of the companies out of 27 participating companies willing to be part of the study. There were 13 employees in this company. The training was imparted and energy conservation in the manager's room air-conditioner was monitored before and after the training. Feedback was collected after one month of the training. Participants feedback was taken on the questionnaire and manager's feedback was taken about the ease of following the measures for energy saving in air-conditioner and again discussed the whole process with the twelve practicing energy conservational professionals from IAEMP to finalize the overall structure, statement of the items in the questionnaire and energy consumption measuring process. Further details are discussed in section 5.6.

5.7 Statistical Tool

ANOVA (Analysis of Variance) and Student-t-Test was done by using SPSS software version 23 for pre-processing the collected data for its relevance, correctness, and consistency. To find the Path Coefficient of the Models, PLS-SEM (Partial Least Squares Structural Equation Modeling) software R version 3.5.1 was used. The details are summarised in Table 5.13.

5.7.1 Statistical Tests and Software

The usage of statistical tests and software are summarised as below:

Table 5.13: Analysis of Factors over Demography

Analysis of Factors over Demographics			
Independent Variable	**Dependent Variable**	**Covariate**	**Statistic**
Peer Support	Transfer of Training, Energy Conservation	HY	ANOVA
Peer Support	Transfer of Training, Energy Conservation	TO	ANOVA
Peer Support	Transfer of Training, Energy Conservation	NPW	ANOVA
Peer Support	Transfer of Training, Energy Conservation	A	ANOVA
Peer Support	Transfer of Training, Energy Conservation	G	t- TEST
Peer Support	Transfer of Training, Energy Conservation	Department	ANOVA
Peer Support	Transfer of Training, Energy Conservation	Designation	ANOVA
Peer Support	Transfer of Training, Energy Conservation	LS	ANOVA
Peer Support	Transfer of Training, Energy Conservation	LE	ANOVA
Performance Feedback	Transfer of Training, Energy Conservation	HY	ANOVA
Performance Feedback	Transfer of Training, Energy Conservation	TO	ANOVA
Performance Feedback	Transfer of Training, Energy Conservation	NPW	ANOVA
Performance Feedback	Transfer of Training, Energy Conservation	A	ANOVA
Performance Feedback	Transfer of Training, Energy Conservation	G	t-TEST
Performance Feedback	Transfer of Training, Energy Conservation	Department	ANOVA
Performance Feedback	Transfer of Training, Energy Conservation	Designation	ANOVA
Performance Feedback	Transfer of Training, Energy Conservation	LS	ANOVA
Performance Feedback	Transfer of Training, Energy Conservation	LE	ANOVA

Testing of Hypothesis (Model 3 by PLS SEM)			
Hypothesis	**Independent Variable**	**Dependent Variable**	**Statistic**
H1	Peer Support	Transfer of Training, Energy Conservation	PLS SEM
H2	Performance Feedback	Transfer of Training, Energy Conservation	PLS SEM
H3	Transfer of Training	Energy Conservation	PLS SEM and t- Test

5.8 Multivariate Techniques

This study, to establish the defined objectives, uses multivariate statistical tools such as PLS with SEM structure. A multivariate tool such as a reliability estimation using Cronbach Alfa is used. A comparison of multiple means under factors of PS, PF, TOT, and EC was done using Analysis of Variance techniques.

5.8.1 Descriptive Statistics

To find the component ratings descriptive statistics such as means and standard deviations were used. This gives us an overall view of the variables and their behavior for different sub-categories.

5.8.2 Exploratory Factor Analysis

As many components are used to identify the factors PS, PF, TOT, and EC, their inter-relations were studied using Factor analysis with Vari Max- rotation. This helped us to identify unique components under each factor. The identified factors were used to construct the required questionnaires from which the observations were made. Also, the cumulative proportion of explained variance

is used to fix the number of components under each factor.

5.8.3 Analysis of Variance

The factor means were compared over deferent sub-groups that have more than two categories. The statistical testing part effectively makes use of the ANOVA technique, which compares the group means in terms of within and between-group variations. The normality of the variables was assumed here, that leads to Fisher's F- Test for testing its significance. Posthoc tests were carried out using Tukey's method.

5.8.4 Multiple Regression Analysis

“Multiple Regression Analysis” is carried out with dependent variables "the scores on the questionnaires" and the independent variables like the age of the organization and years of experience of the participants, etc.

5.8.5 Confirmatory Factor Analysis

In the “Confirmatory Factor Analysis”, we test whether the identified components influence their respective factors. Statistical tests were carried out and their efficiency was studied using the appropriate Fit index, such as Root Means Square Error (RMSE). The confirmed pattern is then used to structure the questionnaires.

5.8.6 Structural Equation Modelling

The structural model is represented using the following equation.

“Y = Y B + Z” (Armin et.al., 2012)

“Where Y represents the matrix for the latent variables for both exogenous and endogenous. The error terms Z are presumed to be centered, which is E [Z] = 0”. In the coefficient matrix for the elements that do not appear were replaced by zero. Structural Models (SM) are related to Latent Variables (LV) that are un-measurable. Measurement Model deals with Observable Variables (OV). The PLS-SEM (Partial Least Squares Structural Equation Model) combines

both Structural and Measurement Models and verifies its validity for a given dataset. Before formally introducing the PLS-SEM, some equations related to the basic model are presented below:

The LCECM Model 1, is described with the following sets of equations.

$$PS = PS + 0$$
$$PF = \mu_1 PS + Z_2$$
$$TOT = \mu_1 PS + \mu_2 PF + Z_3$$

The graphical representation of LCECM Model 1 is as follows:

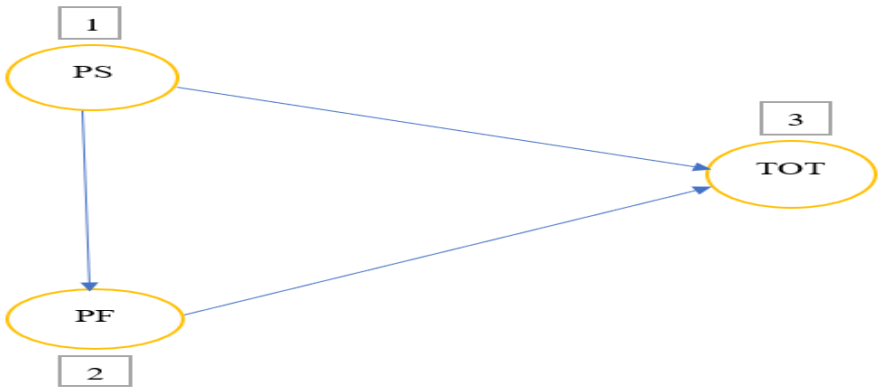

Figure 5.1: Structural LCECM Model 1

The LCECM Model 2, is described with the following sets of equations.

$$PS = \beta_0 + \beta_1 PF$$
$$PF = PF + Z_2$$
$$TOT = \beta_0 + \beta_1 PS + \beta_2 PF$$

The graphical representation of LCECM Model 2, is as follows:

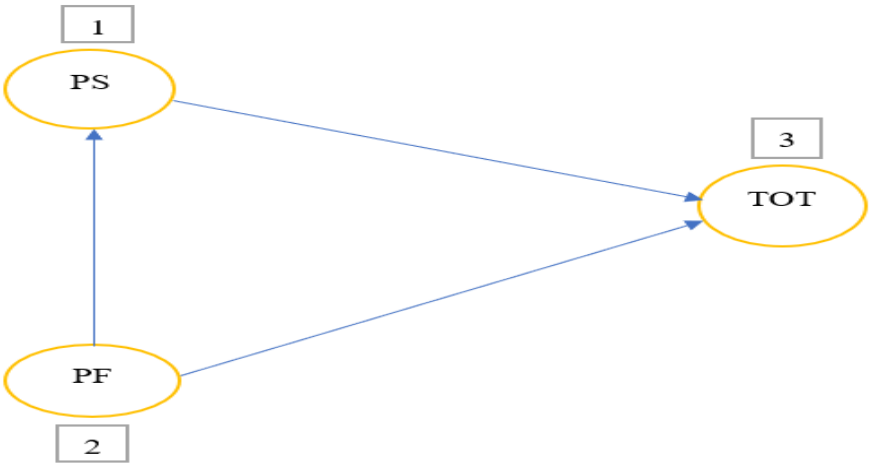

Figure 5.2: Structural LCECM Model 2

Table 5.14 - Adjacency Matrix for Model 1

	PS	PF	TOT
PS	1	1	1
PF	0	0	1
TOT	0	0	0

Table 5.14 shows the “Adjacency matrix “D” for the LCECM Model 1. If the entry dij = 1 the LV i is a antecedent of LVj. The matrix “D” can always be organized as a trilateral matrix”.

Table 5.15 - Adjacency Matrix for Model 2

	PS	PF	TOT
PS	0	0	1
PF	1	1	1
TOT	0	0	0

Table 5.14 shows the “Adjacency matrix “D” for the LCECM Model 1. If the entry dij = 1 the LV i is a antecedent of LVj. The matrix “D” can always be organized as a trilateral matrix”.

The Measurement model: "The measurement model which is outer model relays Measured Variables (MVs) to their Latent Variables (LVs)". Latent Variable (LV) is two types, i.e. Reflective and Formative. LV values are also called Factor Scores.

Oftenly "Measured Variables" are denoted as "Manifest Variables or Indicators", and "Latent Variables" are denoted as "Factors". Only one "Manifest Variable" can be related to one "LV", within the PLS framework. All "Manifest Variables" connected to one "LV" are termed as a "Block". The first block is PS consisting of 9 manifests (PS1, PS2, PS3, PS4, PS5, PS6, PS7, PS8, and PS9). The second block is PF consisting of 9 manifests (PF1, PF2, PF3, PF4, PF5, PF6, PF7, PF8, and PF9). The third block is TOT consisting of 11 manifests (TOT1, TOT2, TOT3, TOT4, TOT5, TOT6, TOT7, TOT8, TOT9, TOT10, and TOT11). The fourth block is EC consisting of 9 manifests (EC1, EC 2, EC 3, EC 4, EC 5, EC 6, EC 7, EC 8, and EC 9).

The following expectations can be made without lossing the generality:

- All the "Measurement Variables" confined in the data matrix "X" are measured to have "Zero Mean" and "Unit Variance".
- Every block of "Measurement Variables" "Xg" is by now changed to be definitely interrelated for all "Latent Variables", "Yg, g =1 ….. G".

Latent and Measurement Variables:

Table 5.16: Associtaion between Latent and Measurement variables

Table of Latent and Measurement Variables					
		Latent Variables			
		PS	PF	TOT	EC
Measurement Variables	PS 1	1	0	0	0
	PS2	1	0	0	0
	PS 3	1	0	0	0
	PS 4	1	0	0	0
	PS 5	1	0	0	0
	PS 6	1	0	0	0
	PS 7	1	0	0	0
	PS 8	1	0	0	0
	PS 9	1	0	0	0
	PF 1	0	1	0	0
	PF 2	0	1	0	0
	PF 3	0	1	0	0
	PF 4	0	1	0	0
	PF 5	0	1	0	0
	PF 6	0	1	0	0
	PF 7	0	1	0	0
	PF 8	0	1	0	0
	PF 9	0	1	0	0
PS = Peer Support, PF = Performance Feedback, TOT = Transfer of Training, EC= Energy Conservation					

Table of Latent and Measurement Variables					
		Latent Variables			
		PS	PF	TOT	EC
Measurement Variables	TOT 1	0	0	1	0
	TOT 2	0	0	1	0
	TOT 3	0	0	1	0
	TOT 4	0	0	1	0
	TOT 5	0	0	1	0
	TOT 6	0	0	1	0
	TOT 7	0	0	1	0
	TOT 8	0	0	1	0
	TOT 9	0	0	1	0
	TOT 10	0	0	1	0
	TOT 11	0	0	1	0
	EC 1	0	0	0	1
	EC 2	0	0	0	1
	EC 3	0	0	0	1
	EC 4	0	0	0	1
	EC 5	0	0	0	1
	EC 6	0	0	0	1
	EC 7	0	0	0	1
	EC 8	0	0	0	1
	EC 9	0	0	0	1
PS = Peer Support, PF = Performance Feedback, TOT = Transfer of Training, EC= Energy Conservation					

Table 5.16 displays the "Adjacency Matrix" "M" for the "Measurement Model". If the entry "mkg = 1" then the "MV k" is one of the indicators of the "LVg". The zeros are stippled out for better perceiving the "Block" construction.

The connection for one precise "LVyi" with its replacement is decided by their association, and the same for the antecedents, it is decided by a "Multiple Regression";

$$\text{“}\mathbf{y}_i = \mathbf{y}_i^{pred}\ \gamma\ + \mathbf{z}_i,\ \ E\,[\mathbf{z}_i] = 0,\ \ i = 1, \ldots, G\text{”}$$

with "y_i^{pred}" the antecedent set of the "LV y_i", meaning "y_i^{succ}" is the replacement set of the "LV y_i". The elements of the inner weight matrix "E" are;

$$e_{ij} \quad = \quad \begin{cases} \gamma_j & , \text{for } j \in \boldsymbol{y}_i^{pred}, \\ \mathrm{COR}(\boldsymbol{y}_i, \boldsymbol{y}_j) & , \text{for } j \in \boldsymbol{y}_i^{succ}, \\ 0 & , \text{else.} \end{cases}$$

SEMPLS ( ) is the functional model.

Using the above structure we arrive at the final PLS-SEM Model 3 that involves the Factors PS, PF, TOT, and EC. The graphical representation of the Structural Model and their estimated Path Coefficients are discussed in detail in chapter 4.

5.9 Research Process Flow Chart

The complete study parameters are summarized in Table 5.17 as given below.

Table 5.17: Research Question- Research Objective-Hypothesis and Statistical Tool

Research Question	**Research Objective**	**Hypotheses**	**Data Collection Tool**	**Statistical Test and Software**
RQ1 – "What is the impact of Peer Support on Transfer of Training (LCECM)"?	RO1- "To study the impact of Peer Support on Transfer of Training (LCESM)".	H_1- "Peer support positively influences the transfer of training".	Questionnaire and Field Energy Consumption measurement using measuring equipment.	"PLS-SEM using R Version 3.5-1". "ANOVA and t-Test using SPSS".
RQ2 – "What is the impact of Performance Feedback on Transfer of Training"?	RO2- "To study the impact of Performance Feedback on Transfer of Training".	H_2- "Performance Feedback positively influences the transfer of training".		"PLS-SEM using R Version 3.5-1". "ANOVA and t-Test using SPSS".
RQ 3 – "What is the impact of the Transfer of Training on Energy Conservation"?	RO3- "To study the impact of the Transfer of Training on Energy Conservation".	H_3- "Transfer of Training has a positive impact on energy conservation".		"PLS-SEM using R Version 3.5-1". "ANOVA and t-Test using SPSS". "IPMVP Protocol – A".

Source: Amalgamated by the researcher

Justification for using PLS-SEM: Statistical tests such as individual sample t-Test, ANOVA (Analysis of Variance), and F-Test for comparing variance, regression models, of which SEM is a particular case, all require random samples from a normal distribution. However, in reality, we find it very difficult to get the sampling frame of the entire industry and as a consequence to collect samples using a random sampling method. Also, our measurements need not have a normal distribution. All these shortcomings can be overcome by using the concept of the "Central Limit Theorem" (Ref: https://en.wikipedia.org/wiki/Central_limit_theorem) that generates a better approximation to these scenarios. That is possible if we take relatively a large sample size. In this study a pilot study was done initially, and based on that sufficient number of samples were collected, which address the issue of random sampling and the normality of measurement. Thus though our sampling procedure is not random, by large sample size it takes into account the features of random sampling, particularly the important one on "Representativeness". The researcher has used PLS-SEM, R Version 3.5-1 for analysis using convenience sampling without any ambiguity. Based on the above justifications one can use SEM with a convenience sample.

Justification for using IPMVP Protocol A: Protocol A is applicable if the ECM application is in one area. In this study for both the site's application area is air-conditioning. Both are existing facilities and one is a dining hall and another is a food court. Foot-fall during the study period was the same and the temperature variation of 3 degrees during the ninety days study period is reasonable. To negate the effect of 3 degrees whole ninety days duration was divided into three groups of thirty days each thereby making the temperature difference between two periods to be almost zero. This justifies the use of IPMVP Protocol A for the study. It was further reconfirmed by the researcher with the consultation of practicing energy conservation managers from IAEMP.

The research study is done in a planned and methodical manner with a step by step stages. The same is sketched out as a flow chart as shown below highlighting the complete research process.

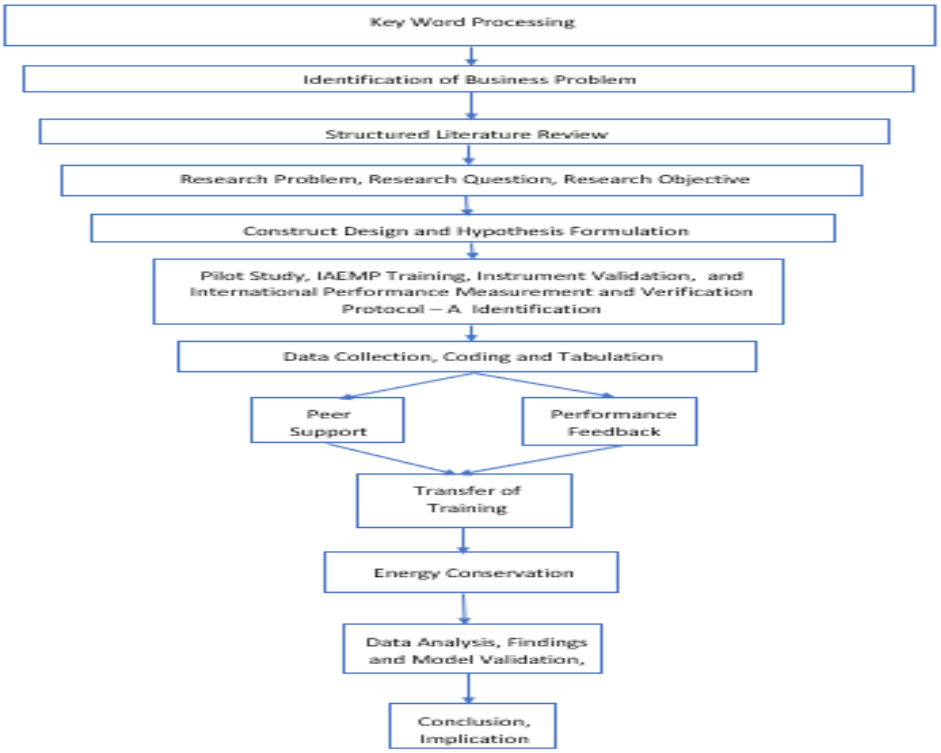

Fig. 5.3: Research Process Flow Chart

5.10 Summary

a) The research methodology assumed in this research study is mixed longitudinal as the meter reading is required before and after the LCECM training at two different time intervals.

b) The sample size is justified in three ways to ensure the adequacy of the samples.

c) Questionnaires are verified and tested for a pilot test to ensure accuracy.

d) Appropriate statistical tools and software are selected for appropriate analysis of collected data.

e) PLS – SEM (Partial Least Square Structural Equation Modeling) method is used for model testing and the necessary explanations are given for doing so.

f) Data collection will be in two ways. Firstly through the questionnaire from the participants and secondly actual energy consumption will be measured at two facilities by using test equipment.

g) The process flow chart for doing the research work concludes the chapter.

Chapter 6

Data Analysis and Findings

6.1 Introduction

Research methodology, data collection method, and research flow chart were deliberated in the previous chapter. Analysis of data and the subsequent findings will be discussed in this chapter. Analysis of data is done by two ways. Firstly, it is done by analyzing the feedback obtained from the participants through the questionnaires to prove all three hypothesizes. Secondly, it is done by analyzing the actual field energy consumption meter reading at two sites to prove hypothesis H_3 additionally. Feedback data is analyzed for path analyses using PLS-SEM and the field energy consumption data is analyzed first by IPMVP Protocol-A and then t-Test using SPSS. Feedback through a survey from the respondents is analyzed as socio-demography vs factors and organization demography vs factors. The meter readings are taken at two different periods for determining the impact.

6.2 Respondents Profile

Respondents are the employees for 26 companies operating at the Guindy Industrial area in Chennai. Further details are discussed in Section 6.2.2.

6.2.1 Demography Profile of Commercial Buildings Under Study

Building – 1: Multi-storied commercial building having 8000 Sq. Feet Food Court on the ground floor for public usage from morning 6.30 AM to evening 9.30 PM. High ceiling space with food outlets and cafeteria with centralized Air-Conditioner rated at 358 TR and 457 KW power input.

Building – 2: Two-storied commercial building having 600 Sq. Feet Dining Hall at the roof for public usage from 12.30 PM to 2.30 PM during the lunchtime. Dining Hall with centralized Air-Conditioner rated at 25 TR and 25 KW power input. The Dining Hall is also fitted with 10 numbers of ceiling fans but not in use.

6.2.2 Demography Profile of the Respondents

Employees in these companies are both male and female of different age groups and different educational levels. They are also from different departments with different responsibilities and varied years of working experience. One way ANOVA is done for all data except the gender where t-Test is done as it is only two sets of data, i.e. male and female. Analysis details of participant's Demography against the Factors are given below separately.

Gender of the Participants vs Factors: Gender of a total of 348 participants are analyzed against Factors such as TOT, PS, PF, and EC and summed-up in Table 6.1. Table 6.2 shows the t-Test result.

Table 6.1: Mean and Standard Deviation for Gender of the Participants vs Factors

	Gender	N	Mean	Std. Deviation	Std. Error Mean
TOT	Male	247	45.83810	2.11222	.13440
	Female	101	45.64360	2.02279	.20128
PS	Male	246	38.11790	1.72565	.11002
	Female	101	37.85150	1.69933	.16909
PF	Male	247	38.70450	3.56896	.22709
	Female	101	37.94060	1.59262	.15847
EC	Male	247	40.12960	1.00780	.06412
	Female	101	39.99010	1.16185	.11561

Table 6.2: t-Test outcome for Gender of the Participants vs Factors

		t-test for Equality of Means			
		Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference
					Lower
TOT	Equal variances	.431	.19449	.24646	-.29026
	Equal variances not assumed	.423	.19449	.24202	-.28285
PS	Equal variances	.190	.26640	.20304	-.13295
	Equal variances not assumed	.188	.26640	.20173	-.13154
PF	Equal variances	**.039**	.76386	.36953	.03704
	Equal variances not	**.006**	.76386	.27692	.21920
EC	Equal variances	.264	.13946	.12456	-.10554
	Equal variances not	.293	.13946	.13220	-.12157

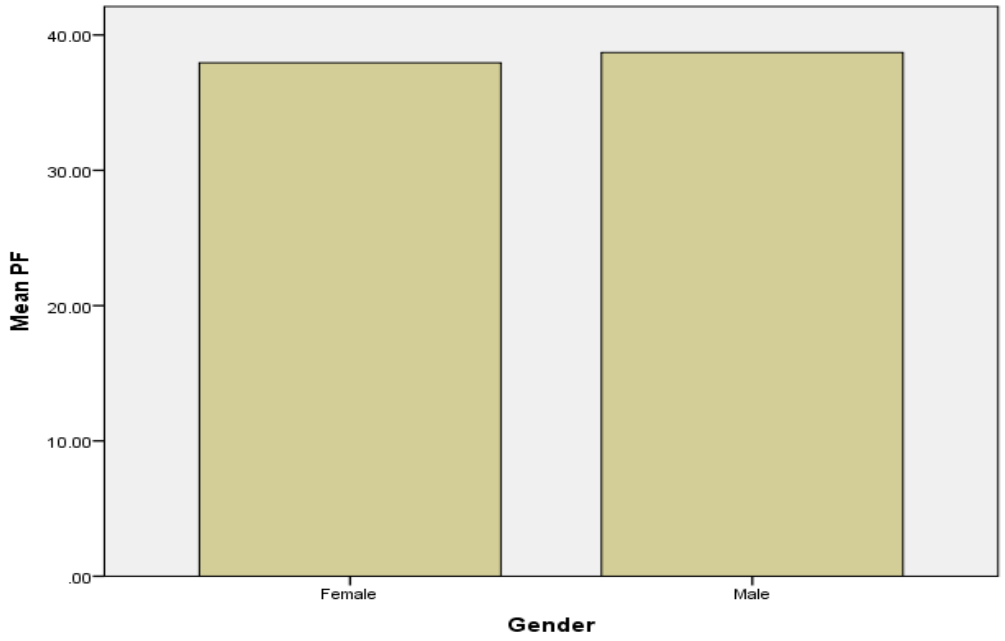

Figure 6.1: Comparison of PF over Gender of the participant

Observations:

- There is no significant difference between Male (M=45.8381, SD=2.11222), Female (M=45.6436, SD=2.02279) with respect to their Mean TOT (F = .19449, p = .431).
- Going by table 6.2 it is seen that the Gender of the participant (F=.26640, p=.190) is statistically not significant in influencing PS.
- Going by table 6.2 it is seen that the **Gender** of the participant (F=.76386, p=.039 is **statistically significant in influencing PF.** Male are more supportive compared to females. The same is reflected in graphical form in Figure 6.1.
- Going by table 6.2 it is seen that the Gender of the participant (F=.13946, p=.264) is statistically not significant in influencing EC.

Age of the Participants vs Factors: Age of total of 348 participants are analyzed against Factors such as TOT, PS, PF, and EC as summed-up in Table 6.3.

Table 6.3: ANOVA outcome for Age of the Participants vs Factors

		Sum of Squares	df	Mean Square	F	Sig.
TOT	Between Groups	6.668	2	3.334	.765	.466
	Within Groups	1502.734	345	4.356		
	Total	1509.402	347			
PS	Between Groups	19.423	2	9.712	3.327	.037
	Within Groups	1004.012	344	2.919		
	Total	1023.435	346			
PF	Between Groups	11.691	2	5.846	.590	.555
	Within Groups	3417.205	345	9.905		
	Total	3428.897	347			
EC	Between Groups	2.252	2	1.126	1.011	.365
	Within Groups	383.987	345	1.113		
	Total	386.239	347			

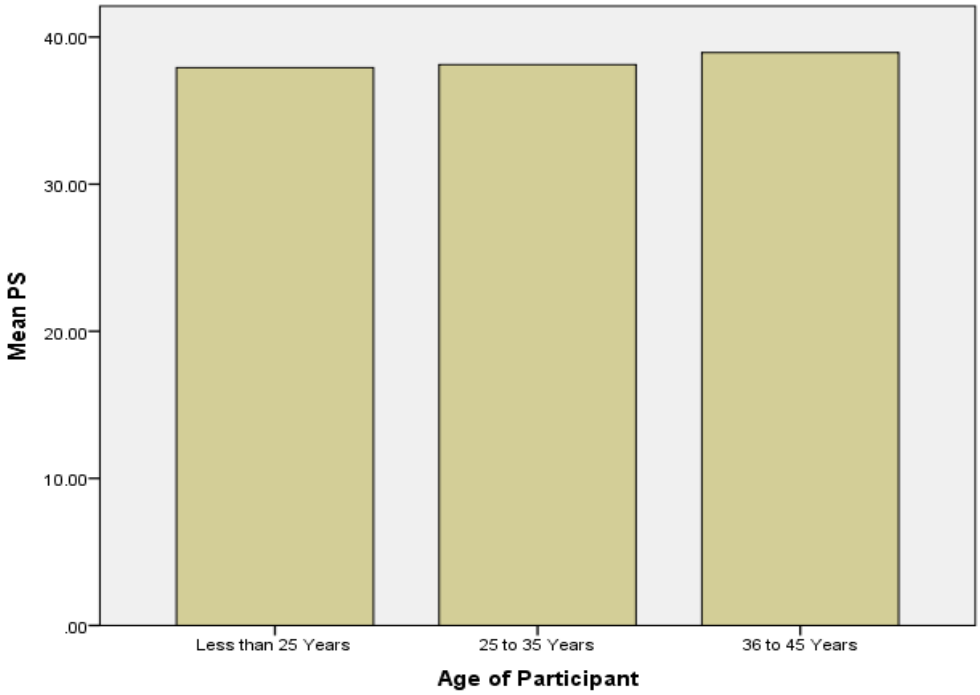

Figure 6.2: Comparison of PS over the Age of the participant

Observations:

- Going by table 6.3 it is seen that Age (F=0.765, p=0.466) is statistically not significant in influencing TOT.
- Going by table 6.3 it is seen that **Age** (F =3.327, p = 0.037) is **statistically significant in influencing PS**. A higher age group is in more agreement. The same is reflected in graphical form in Figure 6.2.
- Going by table 6.3 it is seen that Age (F=0.59, p=0.555) is statistically not significant in influencing PF.
- Going by table 6.3 it is seen that Age (F = 1.011, p =0 .365) is statistically not significant in influencing EC.

Level of Education of the Participants vs Factors: The Level of Education of a total of 348 participants are analyzed against Factors such as TOT, PS, PF, and EC as summarized in Table 6.4.

Table 6.4: ANOVA outcome from Level of Education of the participants vs Factors

		Sum of Squares	df	Mean Square	F	Sig.
TOT	Between Groups	.051	1	.051	.012	.914
	Within Groups	1509.352	346	4.362		
	Total	1509.402	347			
PS	Between Groups	1.921	1	1.921	.649	.421
	Within Groups	1021.514	345	2.961		
	Total	1023.435	346			
PF	Between Groups	5.501	1	5.501	.556	.456
	Within Groups	3423.396	346	9.894		
	Total	3428.897	347			
EC	Between Groups	1.242	1	1.242	1.116	.292
	Within Groups	384.997	346	1.113		
	Total	386.239	347			

Observations:

- Going by the above table it is seen that Level of Education (F = 0.012, p = 0. 914) is statistically not significant in influencing TOT.
- Going by the above table it is seen that Level of Education (F = 0. 649, p = 0. 421) is statistically not significant in influencing PS.
- Going by the above table it is seen that Level of Education (F = 0. 556, p = 0. 456) is statistically not significant in influencing PF.
- Going by the above table it is seen that Level of Education (F = 1.116, p = 0.292) is statistically not significant in influencing EC.

Length of Service of the Participant vs Factors: Length of Service of a total of 348 participants are analyzed against Factors such as TOT, PS, PF, and EC as summarized in Table 6.5.

6.5: ANOVA outcome on Length of Service of the Participant vs Factors

		Sum of Squares	df	Mean Square	F	Sig.
TOT	Between Groups	3.786	3	1.262	.288	.834
	Within Groups	1505.617	344	4.377		
	Total	1509.402	347			
PS	Between Groups	16.800	3	5.600	1.908	.128
	Within Groups	1006.636	343	2.935		
	Total	1023.435	346			
PF	Between Groups	15.055	3	5.018	.506	.679
	Within Groups	3413.841	344	9.924		
	Total	3428.897	347			
EC	Between Groups	2.972	3	.991	.889	.447
	Within Groups	383.267	344	1.114		
	Total	386.239	347			

Observations:

- Going by the above table it is seen that the Length of Service (F = .288, p = 0.834) is statistically not significant in influencing TOT
- Going by the above table it is seen that the Length of Service (F = 1.908, p = 0.128) is statistically not significant in influencing PS.
- Going by the above table it is seen that the Length of Service (F = 0.506, p = 0. 679) is statistically not significant in influencing PF.
- Going by the above table it is seen that the Length of Service (F= 0. 889, p = 0. 447) is statistically not significant in influencing EC.

Department of the Participant vs Factors: Department of a total of 348 participants are analyzed against Factors such as TOT, PS, PF, and EC as summed-up in Table 6.6.

Table 6.6: ANOVA outcome on Department of the participant vs Factors

		Sum of Squares	df	Mean Square	F	Sig.
TOT	Between Groups	1.955	3	.652	.154	.927
	Within Groups	1342.519	317	4.235		
	Total	1344.474	320			
PS	Between Groups	18.238	3	6.079	2.055	.106
	Within Groups	934.684	316	2.958		
	Total	952.922	319			
PF	Between Groups	41.476	3	13.825	1.315	.269
	Within Groups	3332.026	317	10.511		
	Total	3373.502	320			
EC	Between Groups	.962	3	.321	.292	.831
	Within Groups	347.791	317	1.097		
	Total	348.754	320			

Observations:

- Going by the above table it is seen that the department of the participant (F=0.154, p=0.927) is statistically not significant in influencing TOT.
- Going by the above table it is seen that the department of the participant (F = 2.055, p =0 .106) is statistically not significant in influencing PS.
- Going by the above table it is seen that the department of the participant (F = 1.315, p = 0.269) is statistically not significant in influencing PF.
- Going by the above table it is seen that the department of the participant (F = 0.292, p = 0.831) is statistically not significant in influencing EC.

Designation of the Participant vs Factors: Designation of a total of 348 participants are analyzed against Factors such as TOT, PS, PF, and EC as summed-up in Table 6.7.

Table 6.7: ANOVA outcome on the Designation of the participant vs Factors

		Sum of Squares	df	Mean Square	F	Sig.
TOT	Between Groups	28.251	1	28.251	6.600	.011
	Within Groups	1481.151	346	4.281		
	Total	1509.402	347			
PS	Between Groups	12.759	1	12.759	4.355	.038
	Within Groups	1010.676	345	2.929		
	Total	1023.435	346			
PF	Between Groups	29.161	1	29.161	2.968	.086
	Within Groups	3399.735	346	9.826		
	Total	3428.897	347			
EC	Between Groups	.558	1	.558	.501	.480
	Within Groups	385.680	346	1.115		
	Total	386.239	347			

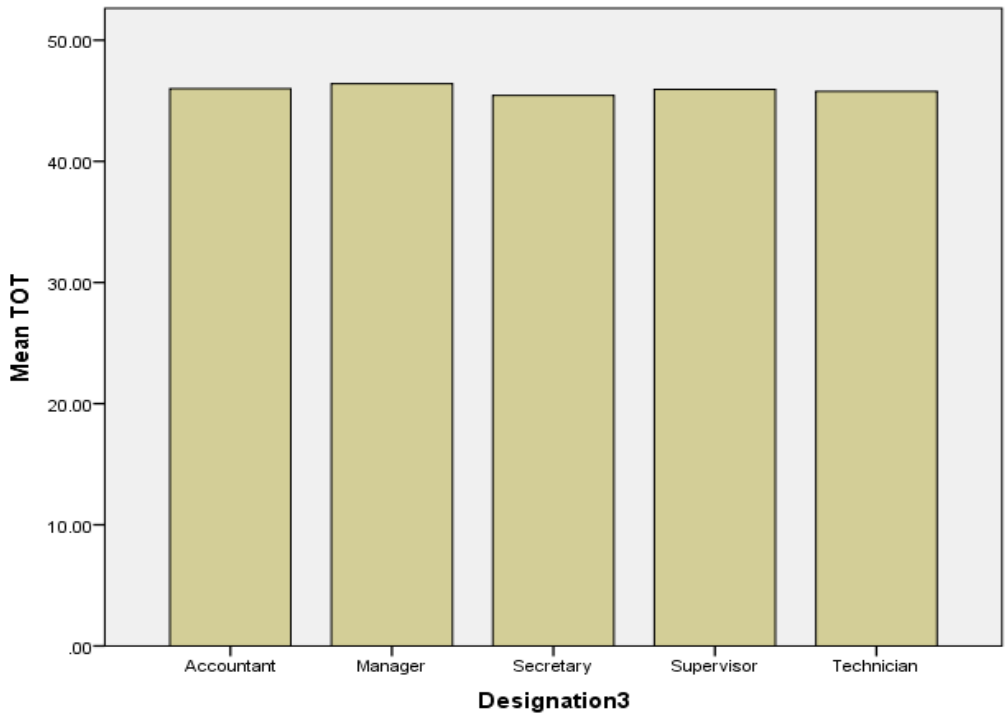

Figure 6.3: Comparison of TOT over Designation of the participant

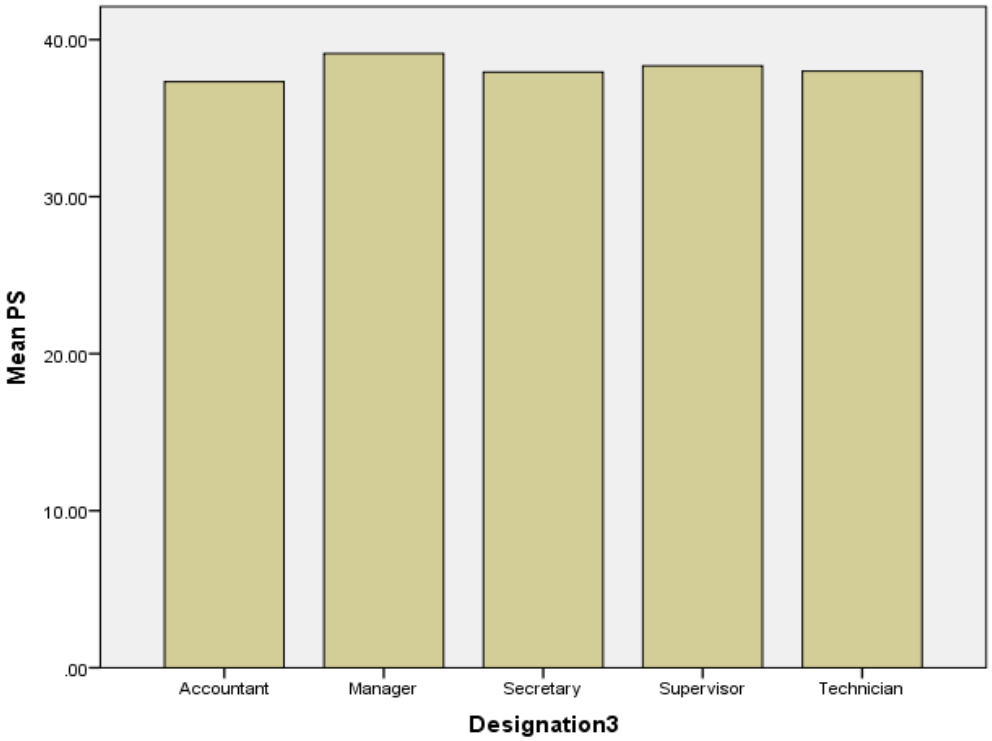

Figure 6.4: Comparison of PS over Designation of the participant

Observations:

- Going by the table 6.7 it is seen that the **designation** of the participant (F = 6.600, p =0 .011) is **statistically significant in influencing TOT**. Figure 6.3 reflects the same in graphical format.
- Going by the table 6.7 it is seen that the **designation** of the participant (F = 4.355, p = 0.038) is **statistically significant in influencing PS.** Figure 6.4 reflects the same in graphical format.
- Going by the table 6.7 it is seen that the designation of the participant (F = 2.968, p = 0. 086) is statistically not significant in influencing PF.
- Going by the table 6.7 it is seen that the designation of the participant (F = 0.501, p = 0. 480) is statistically not significant in influencing EC.

Function of the Organization vs Factors: Function of the Organization are analyzed against Factors such as TOT, PS, PF, and EC as summed-up in Table 6.8.

Table 6.8: ANOVA outcome on Functions of the Organization vs Factors

		Sum of Squares	df	Mean Square	F	Sig.
TOT	Between Groups	10.515	2	5.257	1.210	.299
	Within Groups	1498.888	345	4.345		
	Total	1509.402	347			
PS	Between Groups	2.121	2	1.061	.357	.700
	Within Groups	1021.314	344	2.969		
	Total	1023.435	346			
PF	Between Groups	3.731	2	1.865	.188	.829
	Within Groups	3425.166	345	9.928		
	Total	3428.897	347			
EC	Between Groups	1.430	2	.715	.641	.527
	Within Groups	384.809	345	1.115		
	Total	386.239	347			

Observations:

- Going by the above table it is seen that Type of Functioning of the Organization (F = 1.210, p = 0. 299) is statistically not significant in influencing TOT
- Going by the above table it is seen that Type of Functioning of the Organization (F=0.375, p=0.7) is statistically not significant in influencing PS.
- Going by the above table it is seen that Type of Functioning of the Organization (F=0.188, p=0.829) is statistically not significant in influencing PF.
- Going by the above table it is seen that Type of Functioning of the Organization (F = 0.641, p = 0. 527) is statistically not significant in influencing EC.

Years of Operation of the Organization vs Factors: Years of Operation of the Organization are analyzed against Factors such as TOT, PS, PF, and EC as summed-up in Table 6.9.

Table 6.9: ANOVA outcome on Years of Operation of the Organization vs Factors

		Sum of Squares	df	Mean Square	F	Sig.
TOT	Between Groups	28.154	4	7.038	1.630	.166
	Within Groups	1481.249	343	4.319		
	Total	1509.402	347			
PS	Between Groups	19.080	4	4.770	1.624	.168
	Within Groups	1004.355	342	2.937		
	Total	1023.435	346			
PF	Between Groups	76.529	4	19.132	1.958	.101
	Within Groups	3352.368	343	9.774		
	Total	3428.897	347			
EC	Between Groups	6.003	4	1.501	1.354	.250
	Within Groups	380.236	343	1.109		
	Total	386.239	347			

Observations:

- Going by the above table it is seen that the Age of the Organization (F=1.63, p=0.166) is statistically not significant in influencing TOT.
- Going by the above table it is seen that the Age of the Organization (F=1.624, p=0.168) is statistically not significant in influencing PS.
- Going by the above table it is seen that the Age of the Organization (F=1.958, p=0.101) is statistically not significant in influencing PF.
- Going by the above table it is seen that the Age of the Organization (F=1.354, p = 0.250) is statistically not significant in influencing EC.

The Number of Workforce in the Organization vs Factors: The Number of Workforce in the Organization are analyzed against Factors such as TOT, PS, PF, and EC as summed-up in Table 6.10.

Table 6.10: ANOVA outcome on Number of Workforce in the Organization vs Factors

		Sum of Squares	df	Mean Square	F	Sig.
TOT	Between Groups	118.667	18	6.593	1.560	.069
	Within Groups	1390.735	329	4.227		
	Total	1509.402	347			
PS	Between Groups	73.577	18	4.088	1.412	.123
	Within Groups	949.858	328	2.896		
	Total	1023.435	346			
PF	Between Groups	170.371	18	9.465	.956	.511
	Within Groups	3258.526	329	9.904		
	Total	3428.897	347			
EC	Between Groups	28.640	18	1.591	1.464	.101
	Within Groups	357.598	329	1.087		
	Total	386.239	347			

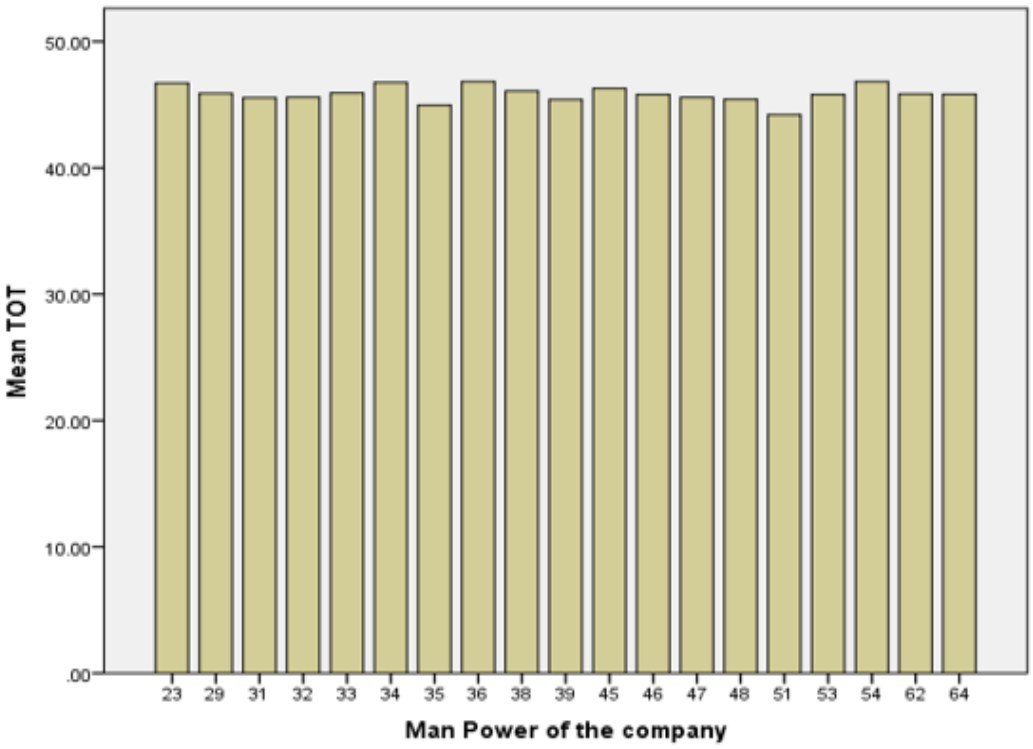

Figure 6.5: Comparison of TOT over Number of Workforce in the Organization

Observations:

- Going by table 6.10 it is seen that the **number of the workforce** of the Organization (F = 1.560, p = .069) is **statistically significant @ 10% in influencing TOT**. The same is graphically represented in Figure 6.5.
- Going by table 6.10 it is seen that the number of the workforce of the Organization (F = 1.412, p = 0. 123) is statistically not significant in influencing PS.
- Going by table 6.10 it is seen that the number of the workforce of the Organization (F =0 .956, p = 0. 511) is statistically not significant in influencing PF.
- Going by table 6.10 it is seen that the number of the workforce of the Organization (F = 1.464, p = 0.101) is statistically not significant in influencing EC.

Summary of Statistical Tests: All statistical tests are summarized and tabulated in Table 6.11 and 6.12:

Table 6.11: Summarization of One Way ANOVA and t-Test-Socio-Demography

Significance of Latent Variables over Socio - Demographic factors

Variable	Variate	Significant	Values
TOT	Gender of Participant	NO	T = .19449, p = .431
PS	Gender of Participant	NO	T =.26640, p=.190
PF	Gender of Participant	YES	T =.76386, p=.039
EC	Gender of Participant	NO	T =.13946, p=.264
TOT	Age of Participant	NO	F=0.765, p=0.466
PS	Age of Participant	YES	F =3.327, p = 0.037
PF	Age of Participant	NO	F=0.59, p=0.555
EC	Age of Participant	NO	F = 1.011, p =0 .365
TOT	Level of Education	N0	F = 0.012, p = 0. 914
PS	Level of Education	NO	F = 0. 649, p = 0. 421
PF	Level of Education	NO	F = 0. 556, p = 0. 456
EC	Level of Education	NO	F = 1.116, p = 0.292
TOT	Length of Service	NO	F = .288, p = 0.834
PS	Length of Service	NO	F = 1.908, p = 0.128
PF	Length of Service	NO	F = 0.506, p = 0. 679
EC	Length of Service	NO	F = 0. 889, p = 0. 447
TOT	Dept. of Participant	NO	F=0.154, p=0.927
PS	Dept of Participant	NO	F = 2.055, p =0 .106
PF	Dept. of Participant	NO	F = 1.315, p = 0.269
EC	Dept. of Participant	NO	F = 0.292, p = 0.831
TOT	Design. of Participant	YES	F = 6.600, p =0 .011
PS	Design, of Participant	YES	F = 4.355, p = 0.038
PF	Design. of Participant	N0	F = 2.968, p = 0. 086
EC	Design. of Participant	NO	F = 0.501, p = 0. 480

Significance of Latent Variables over Socio - Demographic factors

Level of significance = α = 0.05

Table 6.12: Summarization of ANOVA – Organizational Demography

Significance of Latent Variables over Organisational Demographic factors

Variable	Variate	Significant	Values
TOT	Function of Organisation	NO	F = 1.210, p = 0. 299
PS	Function of Organisation	NO	F=0.375, p=0.7
PF	Function of Organisation	NO	F=0.188, p=0.829
EC	Function of Organisation	NO	F = 0.641, p = 0. 527
TOT	Age of Organisation	NO	F=1.63, p=0.166
PS	Age of Organisation	NO	F=1.624, p=0.168
PF	Age of Organisation	NO	F=1.958, p=0.101
EC	Age of Organisation	NO	F = 1.354, p = 0.250
TOT	Strength of Workforce	YES	F = 1.560, p = .069
PS	Strength of Workforce	NO	F = 1.412, p = 0. 123
PF	Strength of Workforce	NO	F =0 .956, p = 0. 511
EC	Strength of Workforce	NO	F = 1.464, p = 0.101

Significance of Latent Variables over Organisational Demographic factors

Level of significance = α = 0.1

Findings: Findings of analysis based on Socio -Demography vs Factors and Organizational Demography vs Factors are summaries as below:

- Gender of the participant (F=.76386, p=.039 is statistically significant @ 5% in influencing PF. Male are more supportive compared to females.
- Age (F =3.327, p = 0.037) is statistically significant @ 5% in influencing PS. Higher age group is in more agreement.
- Designation of the participant (F = 6.600, p =0 .011) is statistically significant @ 5% in influencing TOT.
- Designation of the participant (F = 4.355, p = 0.038) is statistically significant @ 5% in influencing PS.
- Number of workforce of the Organization (F = 1.560, p = .069) is statistically significant @ 10% in influencing TOT.

6.3 Measurement Variables

The Measurement model: The measurement model which is outer model relays "Measurement Variables" (MVs) to their "Latent Variables" (LVs). "Latent Variable" (LV) is two types, i.e. Reflective and Formative. LV values are also called Factor Scores.

Oftenly “Measurement Variables” are denoted as “Manifest Variables or Indicators”, and “Latent Variables” are denoted as “Factors”. Only one “Manifest Variable” can be related to one LV, within the PLS framework. All “Manifest Variables” connected to one LV are termed as a “Block”. The first block is PS consisting of 9 manifests (PS1, PS2, PS3, PS4, PS5, PS6, PS7, PS8, and PS9). The second block is PF consisting of 9 manifests (PF1, PF2, PF3, PF4, PF5, PF6, PF7, PF8, and PF9). The third block is TOT consisting of 11 manifests (TOT1, TOT2, TOT3, TOT4, TOT5, TOT6, TOT7, TOT8, TOT9, TOT10, and TOT11). The fourth block is EC consisting of 9 manifests (EC1, EC 2, EC 3, EC 4, EC 5, EC 6, EC 7, EC 8, and EC 9).

The following expectations can be made without lossing the generality:

- All the “Measurement Variables” confined in the data matrix “X” are measured to have “Zero” Mean and “Unit” Variance.
- Every “Block” of “Measurement Variables” “Xg” is by now changed to be definitely interrelated for all “Latent Variables”, “Yg, g =1 ….. G”.

Latent and Measurement Variables: Association amongst the Latent and Measurement variables are summed-up in Table 6.13.

Table 6.13: Associtaion between Latent and Measurement variables

Table of Latent and Measurement Variables					
		Latent Variables			
		PS	PF	TOT	EC
Measurement Variables	PS 1	1	0	0	0
	PS2	1	0	0	0
	PS 3	1	0	0	0
	PS 4	1	0	0	0
	PS 5	1	0	0	0
	PS 6	1	0	0	0
	PS 7	1	0	0	0
	PS 8	1	0	0	0
	PS 9	1	0	0	0
	PF 1	0	1	0	0
	PF 2	0	1	0	0
	PF 3	0	1	0	0
	PF 4	0	1	0	0
	PF 5	0	1	0	0
	PF 6	0	1	0	0
	PF 7	0	1	0	0
	PF 8	0	1	0	0
	PF 9	0	1	0	0
PS = Peer Support, PF = Performance Feedback, TOT = Transfer of Training, EC= Energy Conservation					

Table of Latent and Measurement Variables					
		Latent Variables			
		PS	PF	TOT	EC
Measurement Variables	TOT 1	0	0	1	0
	TOT 2	0	0	1	0
	TOT 3	0	0	1	0
	TOT 4	0	0	1	0
	TOT 5	0	0	1	0
	TOT 6	0	0	1	0
	TOT 7	0	0	1	0
	TOT 8	0	0	1	0
	TOT 9	0	0	1	0
	TOT 10	0	0	1	0
	TOT 11	0	0	1	0
	EC 1	0	0	0	1
	EC 2	0	0	0	1
	EC 3	0	0	0	1
	EC 4	0	0	0	1
	EC 5	0	0	0	1
	EC 6	0	0	0	1
	EC 7	0	0	0	1
	EC 8	0	0	0	1
	EC 9	0	0	0	1
PS = Peer Support, PF = Performance Feedback, TOT = Transfer of Training, EC= Energy Conservation					

Table 6.13 displays the “Adjacency Matrix” “M” for the “Measurement Model”. If the entry “mkg = 1” then the “MV k” is one of the pointers of the “LVg”. The “Zeros” are stippled out for better perceiving the “Block” construction.

The connection for one precise “LVyi” with its replacement is decided by their association, and the same for the antecedents, it is decided by a “Multiple Regression”;

$$\text{“}\mathbf{y}_i = \mathbf{y}_i^{pred}\ \gamma\ + \mathbf{z}_i,\ \ E\,[\mathbf{z}_i] = 0,\ \ i = 1, \ldots, G\text{”}$$

with “y_i^{pred}” the antecedent set of the “LV y_i”, meaning “y_i^{succ}” is the replacement set of the “LV y_i”. The elements of the inner weight matrix “E” are;

$$e_{ij} \;=\; \begin{cases} \gamma_j & \text{, for } j \in \boldsymbol{y}_i^{pred}, \\ \mathsf{COR}(\boldsymbol{y}_i, \boldsymbol{y}_j) & \text{, for } j \in \boldsymbol{y}_i^{succ}, \\ 0 & \text{, else.} \end{cases}$$

SEM PLS ( ) is the functional model.

Using the above structure we arive at the final PLS-SEM Model 3 that involves the Factors PS, PF, TOT, and EC. The graphical representation of the Structural Model and their estimated Path Coefficients are discussed later in this chapter.

6.4 Peer Support: Mean, Standard Deviation, Correlations and Model Summary

The component scores were compared using statistics such as mean and standard deviation before they being tested under 5% of significance value (Table 6.1 and Table 6.2).

6.4 1 β Coefficients and Collinearity Statistics

As the model used to study the interdependencies of the variables, their respective β Coefficients were estimated and tested using Collinearity Statistics such as Variance Inflation Factor (VIF < 5).

6.5 Performance Feedback: Mean, Standard Deviation, Correlations and Model Summary

The component scores were compared using statistics such as mean and standard deviation before they being tested under 5% of significance value (Table 6.1 and Table 6.2).

6.5.1 β Coefficients and Collinearity Statistics

As the model used to study the interdependencies of the variables, their respective β Coefficients were estimated and tested using Collinearity Statistics such as Variance Inflation Factor (VIF < 5).

6.6 LCECMTT: Mean, Standard Deviation, Correlations and Model Summary

The component scores were compared using statistics such as mean and standard deviation before they being tested under 5% of significance value (Table 6.1 and Table 6.2).

6.6.1 β Coefficients and Collinearity Statistics

As the model used to study the interdependencies of the variables, their respective β Coefficients were estimated and tested using Collinearity Statistics such as Variance Inflation Factor (VIF < 5).

6.7 EC: Mean, Standard Deviation, Correlations, and Model Summary

The component scores were compared using statistics such as mean and standard deviation before they being tested under 5% of significance value (Table 6.1 and Table 6.2).

6.7.1 β Coefficients and Collinearity Statistics

As the model used to study the interdependencies of the variables, their respective β Coefficients were estimated and tested using Collinearity Statistics such as Variance Inflation Factor (VIF < 5).

6.8 Regression Equations of the Predicting Constructs

The required regression model is presented below:

$$\text{“}\mathbf{y}_i = \mathbf{y}_i^{pred}\ \gamma\ + \mathbf{z}_i,\ \ E\ [\mathbf{z}_i] = 0,\ \ i = 1, \ldots, G\text{”}$$

with “y_i^{pred}” the antecedent set of the “LV y_i”, meaning “y_i^{succ}” is the replacement set of the “LV y_i”. The elements of the inner weight matrix “E” are;

$$e_{ij} \quad = \quad \begin{cases} \gamma_j & , \text{for } j \in \boldsymbol{y}_i^{pred}, \\ \mathsf{COR}(\boldsymbol{y}_i, \boldsymbol{y}_j) & , \text{for } j \in \boldsymbol{y}_i^{succ}, \\ 0 & , \text{else.} \end{cases}$$

SEM PLS ( ) is the functional model.

6.9 KMO and Bartlett’s Test

The above tests were used for comparing sub-group information, to considered independent and dependent variables (Table 6.12).

6.10 Communalities

The influence of components over different factors were studied using commonalities (Table 6.12).

6.11 Factors Extracted through Principal Component Analysis

The Vari-Max rotation concept is used to identify the components and their respective factors.

6.12 Factor loadings after Vari-Max Rotation

The factor loadings were used to identify the factor-components associations.

6.13 Extracted Variables

The extracted components were variables that were used to group the components under different factors (Table 6.11).

6.14 Measurement Model Results

The model details and results are explained in section 6.18.

6.15 Measurement Model (MM) and Structural Model (SM) Fit Indices

The model details and results are explained in section 6.18.

6.16 Structural Model Fit Indices

The LCECM Model 1, is described with the following sets of equations.

$$PS = PS + 0$$
$$PF = \mu_1 PS + Z_2$$
$$TOT = \mu_1 PS + \mu_2 PF + Z_3$$

The LCECM Model 2, is described with the following sets of equations.

$$PS = \beta_0 + \beta_1 PF$$
$$PF = PF + Z_2$$
$$TOT = \beta_0 + \beta_1 PS + \beta_2 PF$$

6.17 Inferences on Validation of Hypotheses

The inference on validation of the hypothesis was carried out and tested using “p- values”. The model is considered to be statistically significant if the “p-value” is less than 0.05 and usually, it gets rejected.

Structure Equation Modelling: The study considers two models named "LCECM1" and "LCECM2". In both the models, the measurement part is the same with 9 sub-components from PS, 9 sub-components from PF, 11 sub-components from TOT, and 9 sub-components of EC. The two models differ in their structural part with PS and PF influencing TOT, TOT influencing EC in Model 1. Whereas, in Model 2 PS and PF influencing TOT, TOT influencing EC and also PS and PF influencing EC.

Model 1 is found to be significant and its estimated coefficient indicates the quantum of the relation between the Measurement and Latent Variables as well as amongst the Structural Variables. It is not the case in Model 2 as the influence of PS and PF on EC is negligible, which is 0.03 and 0.04 respectively. The estimated path coefficients are presented in Fig. 6.6 and Fig. 6.7 for both Model 1 and Model 2 respectively. Path estimates for both Model 1 and Model 2 are shown in Table 6.14 and 6.15 respectively. From the estimated coefficient we see that both the models do not have the same Structural coefficient. This indicates that in the absence of TOT there will not be any positive impact on EC by PS and PF. Therefore, Model 1 holds good with the construct and termed as Model 3 or Final Model.

Path Coefficiant LCECM Model 1: Estimated Path Coefficient LCECM Model 1

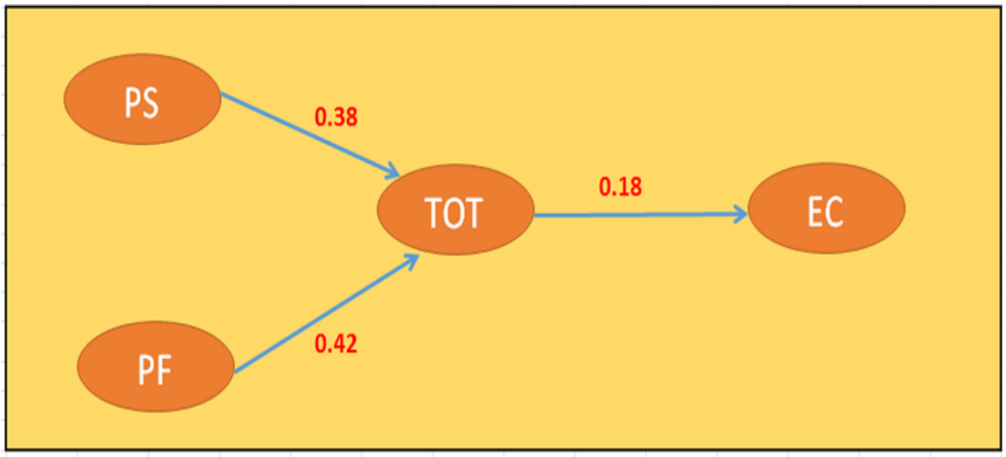

Figure 6.6: Path Coefficient LCECM Model 1

Peer Support (PS) has a direct effect on the Transfer of Training (TOT). Performance Feedback (PF) has a direct effect on the Transfer of Training. TOT has a direct effect on Energy Conservation (EC). Path coefficient estimate values are summarized as follows:

Table 6.14: Model 1- Path Estimate

lam_1_1	PF -> PF1	0.143
lam_1_2	PF -> PF2	0.551
lam_1_3	PF -> PF3	0.635
lam_1_4	PF -> PF4	-0.312
lam_1_5	PF -> PF5	0.026
lam_1_6	PF -> PF6	-0.143
lam_1_7	PF -> PF7	0.346
lam_1_8	PF -> PF8	0.178
lam_1_9	PF -> PF9	0.720
lam_2_1	PS -> PS1	0.584
lam_2_2	PS -> PS2	0.344
lam_2_3	PS -> PS3	0.044
lam_2_4	PS -> PS4	0.103
lam_2_5	PS -> PS5	0.328
lam_2_6	PS -> PS6	0.166
lam_2_7	PS -> PS7	0.719
lam_2_8	PS -> PS8	0.481
lam_2_9	PS -> PS9	-0.078
lam_3_1	TOT -> TOT1	0.224
lam_3_2	TOT -> TOT10	0.733
lam_3_3	TOT -> TOT11	0.581
lam_3_4	TOT -> TOT2	0.025
lam_3_4	TOT -> TOT2	0.025
lam_3_5	TOT -> TOT3	0.026
lam_3_6	TOT -> TOT4	0.304
lam_3_7	TOT -> TOT5	0.171
lam_3_8	TOT -> TOT6	0.497
lam_3_9	TOT -> TOT7	-0.304
lam_3_10	TOT -> TOT8	0.131
lam_3_11	TOT -> TOT9	0.581
lam_4_1	EC -> EC1	0.809
lam_4_2	EC -> EC2	-0.082
lam_4_3	EC -> EC3	0.500
lam_4_4	EC -> EC4	-0.351
lam_4_5	EC -> EC5	0.577
lam_4_6	EC -> EC6	-0.237
lam_4_7	EC -> EC7	0.639
lam_4_8	EC -> EC8	-0.448
lam_4_9	EC -> EC9	0.806
beta_1_3	PF -> TOT	0.438
beta_2_3	PS -> TOT	0.354
beta_1_4	PF -> EC	0.043
beta_2_4	PS -> EC	0.026
beta_3_4	TOT -> EC	0.131

Path Coefficiant LCECM Model 2: Estimated Path Coefficient LCECM Model 2

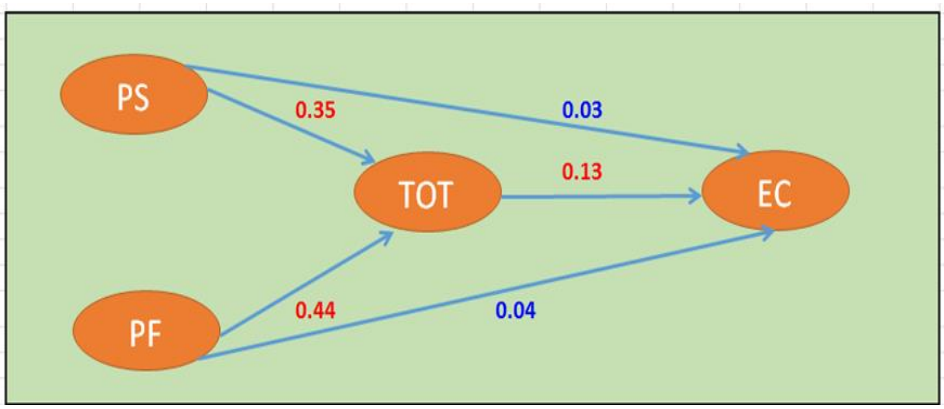

Figure 6.7: Path Coefficient LCECM Model 2

Peer Support (PS) has a direct effect on the Transfer of Training (TOT). Performance Feedback (PF) has a direct effect on the Transfer of Training. TOT has a direct effect on Energy Conservation (EC). EC is not directly influenced by both PS and PF. Path coefficient estimate values are summarized as follows:

Table 6.15: Model 2- Path Estimate

lam_1_1	PF -> PF1	0.143
lam_1_2	PF -> PF2	0.551
lam_1_3	PF -> PF3	0.635
lam_1_4	PF -> PF4	-0.312
lam_1_5	PF -> PF5	0.026
lam_1_6	PF -> PF6	-0.143
lam_1_7	PF -> PF7	0.346
lam_1_8	PF -> PF8	0.178
lam_1_9	PF -> PF9	0.720
lam_2_1	PS -> PS1	0.584
lam_2_2	PS -> PS2	0.344
lam_2_3	PS -> PS3	0.044
lam_2_4	PS -> PS4	0.103
lam_2_5	PS -> PS5	0.328
lam_2_6	PS -> PS6	0.166
lam_2_7	PS -> PS7	0.719
lam_2_8	PS -> PS8	0.481
lam_2_9	PS -> PS9	-0.078
lam_3_1	TOT -> TOT1	0.224
lam_3_2	TOT -> TOT10	0.733
lam_3_3	TOT -> TOT11	0.581
lam_3_4	TOT -> TOT2	0.025
lam_3_4	TOT -> TOT2	0.025
lam_3_5	TOT -> TOT3	0.026
lam_3_6	TOT -> TOT4	0.304
lam_3_7	TOT -> TOT5	0.171
lam_3_8	TOT -> TOT6	0.497
lam_3_9	TOT -> TOT7	-0.304
lam_3_10	TOT -> TOT8	0.131
lam_3_11	TOT -> TOT9	0.581
lam_4_1	EC -> EC1	0.809
lam_4_2	EC -> EC2	-0.082
lam_4_3	EC -> EC3	0.500
lam_4_4	EC -> EC4	-0.351
lam_4_5	EC -> EC5	0.577
lam_4_6	EC -> EC6	-0.237
lam_4_7	EC -> EC7	0.639
lam_4_8	EC -> EC8	-0.448
lam_4_9	EC -> EC9	0.806
beta_1_3	PF -> TOT	0.438
beta_2_3	PS -> TOT	0.354
beta_1_4	PF -> EC	0.043
beta_2_4	PS -> EC	0.026
beta_3_4	TOT -> EC	0.131

Path Coefficiant LCECM Model 3 (Final Model): Estimated Path Coefficient LCECM Model 3

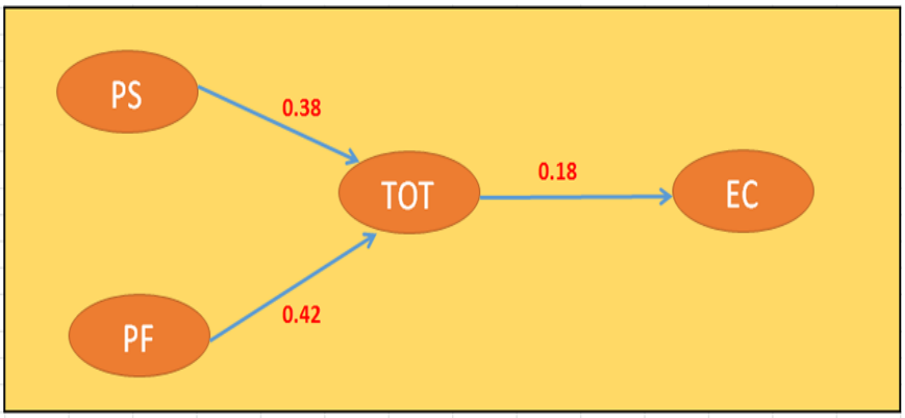

Figure 6.8: Model 3- Path Estimate

Peer Support (PS) (Al-Eisa et.al., 2009; Awoyini et.al., 2002) directly affect Transfer of Training (TOT). Performance Feedback (PF) (Bates et.al., 2000; Baldwin et.al., 1998) directly affect Transfer of Training. Transfer of Training (TOT) directly affect Energy Conservation (EC).

The Final Model as described in the above figure proves our considered Hypothesis that PS and PF individually influencing TOT, which in turn influencing EC. The Path Coefficient Estimates presented in the figure are Statistically Significant, Validating our final Model.

Table 6.16: Model 3-Path Estimate

lam_1_1	PF -> PF1	0.143
lam_1_2	PF -> PF2	0.551
lam_1_3	PF -> PF3	0.635
lam_1_4	PF -> PF4	-0.312
lam_1_5	PF -> PF5	0.026
lam_1_6	PF -> PF6	-0.143
lam_1_7	PF -> PF7	0.346
lam_1_8	PF -> PF8	0.178
lam_1_9	PF -> PF9	0.720
lam_2_1	PS -> PS1	0.584
lam_2_2	PS -> PS2	0.344
lam_2_3	PS -> PS3	0.044
lam_2_4	PS -> PS4	0.103
lam_2_5	PS -> PS5	0.328
lam_2_6	PS -> PS6	0.166
lam_2_7	PS -> PS7	0.719
lam_2_8	PS -> PS8	0.481
lam_2_9	PS -> PS9	-0.078
lam_3_1	TOT -> TOT1	0.224
lam_3_2	TOT -> TOT10	0.733
lam_3_3	TOT -> TOT11	0.581
lam_3_4	TOT -> TOT2	0.025
lam_3_5	TOT -> TOT3	0.026
lam_3_6	TOT -> TOT4	0.304
lam_3_7	TOT -> TOT5	0.171
lam_3_8	TOT -> TOT6	0.497
lam_3_9	TOT -> TOT7	-0.304
lam_3_10	TOT -> TOT8	0.131
lam_3_11	TOT -> TOT9	0.581
lam_4_1	EC -> EC1	0.809
lam_4_2	EC -> EC2	-0.082
lam_4_3	EC -> EC3	0.500
lam_4_4	EC -> EC4	-0.351
lam_4_5	EC -> EC5	0.577
lam_4_6	EC -> EC6	-0.237
lam_4_7	EC -> EC7	0.639
lam_4_8	EC -> EC8	-0.448
lam_4_9	EC -> EC9	0.806
beta_1_3	PF -> TOT	0.438
beta_2_3	PS -> TOT	0.354
beta_1_4	PF -> EC	0.043
beta_2_4	PS -> EC	0.026
beta_3_4	TOT -> EC	0.131

The study considers two models named "LCECM1" and "LCECM2". In both the models, the measurement part is the same with 9 sub-components from PS, 9 sub-components from PF, 11 sub-components from TOT, and 9 sub-components of EC. The two models differ in their structural part with PS and PF influencing TOT, TOT influencing EC in Model 1. Whereas, in Model 2 PS and PF influencing TOT, TOT influencing EC and also PS and PF influencing EC.

Model 1 is found to be significant and its estimated coefficient indicates the quantum of the relation between the Measurement and Latent Variables as well as amongst the Structural Variables. It is not the case in Model 2 as the influence of PS and PF on EC is negligible, which is 0.03 and 0.04 respectively. The estimated coefficients are presented in Table 6.14 and Table 6.15. From the estimated coefficient we see that both the models do not have the same Structural coefficient. This indicates that in the absence of TOT there will not

be any positive impact on EC by PS and PF. Therefore, Model 3 holds good with the construct and termed as the Final Model.

Findings:

i) **"Peer Support** positively influence **Transfer of Training" (H1 = 0.38)**. Studies in the past in non-energy conservation applications found that PS has a direct influence on TOT (Bates et al., 2007) and also, indirect influence on TOT (Nijman et al., 2006). Wai et al., (2006) used PS indirectly as antecedent in energy conservation study using A-B-C theory. In the present study, PS is used directly as an antecedent in the conceptual model using the A-B-C theory. Therefore, this study establishes the fact that PS influences directly on TOT in energy conservation applications like all other previous studies in non-energy conservation applications.

ii) "**Performance Feedback** positively influences **Transfer of Training**" **(H2 = 0.42).** Studies in the past in non-energy conservation applications established the fact that PF has a direct influence on TOT (Staddon et al., 2016). Wai et al., (2006) used PF indirectly as an antecedent in energy conservation study using A-B-C theory. In the present study, PF is used directly as an antecedent in the conceptual model using the A-B-C theory. Therefore, this study establishes the fact that PF influences directly on TOT in energy conservation applications like all other previous studies in non-energy conservation applications.

iii) "**Transfer of Training** has positive impact on **Energy Conservation**" **(H3=0.18).** Previous studies in energy conservation used a set of Dos and Don'ts for the participants to follow so that energy conservation can be realized and a parallel was drawn that if training on proper energy usage is imparted then the participants will practice the same in their own (Ishak et al., 2016). There is always a possibility of a slip between intention and action and that needs to be ascertained scientifically. That is why H_3 was further verified by actual meter readings at two different locations which are explained further in Section 6.18.

iv) **The impact of the Transfer of Training on Energy Conservation is highly significant.** This is first verified by analyzing feedback from the participants and then additionally verified by actual meter readings at two different locations which are explained further in Section 6.18.

v) **Peer Support** and **Performance Feedback** did not have any direct influence on **Energy Conservation** (0.03 and 0.04) without the **Transfer of Training**. Analysis of the conceptual model revealed that PS and PF did not influence each other. PS and PF also did not influence directly on EC. The influence was only through TOT.

6.18 Inferences on IPMVP Protocol-A

Item under Study: Air-Conditioning application at two different facilities. The first is a food court and the second is at the dining hall.

Recording Process: Data were recorded in three groups, each consisting of 30 working days
(3*30=90 days) by facility engineers in consultation with the researcher.

Base Line Data: Thirty days average data from the reading from 03 Sept. 2017 to 10 Jan. 2018 is considered as the baseline period energy.

Recording Duration:

i) The first reading is taken from 03 Sept. 2017 to 10 Jan. 2018.

ii) **Air Condition setting as per LCECM:** An increase in air-conditioning set temperature and reduced operating time without compromising with the occupant's comfort level and considered as reporting period energy.

Setting Specification:

a) Total Air-Condition running hours at the food court was reduced by 30 minutes and the set temperature was increased by one-degree centigrade during the second reading in comparison to the first reading.

b) Total Air-Condition running hours at the dining hall was reduced by 30 minutes and the set temperature was increased by two degrees centigrade while switching ON all the ten ceiling fans during the second reading in comparison to the first reading.

Setting Provision:

a) The deviation in time and temperature was done in such a way that there were no complaints from the facility users about any compromise with their comfort level. This was ascertained by placing a complaint box with sufficient visibility and announcement. The complaint box was empty for both the facilities.
b) By doing so it was ensured that the effects of climatic condition on air-conditioning concerning ambient temperature had no adverse effect on the meter reading. The ambient temperature varied between 33 degrees C to 30 degrees C during both the periods from the month of September to January.

iii) The second reading is taken from 03 Sept. 2018 to 10 Jan. 2019.

Analysis: The analysis is done using two methods. Firstly by using IMPVP Protocol-A and secondly with the help of statistical tool, t-Test by using SPSS software version 23.

1. **International Performance Measurement and Verification Protocol – A**: IPMV Protocol A is taken up. The formula used is –

"**Savings = (Baseline Period Energy – Reporting Period Energy) ± Adjustments"** to determine the quantum of savings.

Building 1: To study the impact of off-setting the air-conditioning set temperature and optimizing the air-conditioning running hours, without compromising the occupant's comfort level, on energy consumption. Power consumption readings are summarised as follows:

Table 6.17: Meter Reading of Building 1

Setting 1: Guindy Industrial Area, a first organization understudy						
Location	Food Court					
Area (Sq. Ft)	8000					
Capacity of AC (TR)	358					
Duration of readings	3 Sept 2017 - 10 Jan 2018 and 3 Sept 2018 - 10 Jan 2019					
Average Ambient Temperature	33 Degree C to 30 Degree C					
Running Hours	6.30 AM to 9 PM					
Condition for Meter Reading	Baseline Period Energy					
	Reporting Period Energy					
Calculation basis	Average of 30 Days					
Average daily power consumption before training (MWh)	First 30 days	**3.24**	Second 30 days	**3.21**	Third 30 days	**3.2**
Average daily power consumption after training (MWh)	First 30 days	**2.68**	Second 30 days	**2.57**	Third 30 days	**2.5**
Daily Average Savings (MWh)	First 30 days	0.55	Second 30 days	0.64	Third 30 days	0.7
Daily Average Savings %	First 30 days	**17.1**	Second 30 days	**19.9**	Third 30 days	**21.7**

Savings = (Baseline Period Energy – Reporting Period Energy) ± Adjustments,

Ref: IPMVP - A

Observation: Energy consumption data before and after LCECM training was compared for energy saving if any. The air-condition running hour was optimized and reduced by 30 minutes in 14.30 hours operation and the air-conditioning set temperature was optimized by increasing the set temperature by 1-degree centigrade. Daily savings for first, second, and third 30 days were 0.55 MWh, 0.64 MWh, and 0.7 MWh respectively. This corresponds to 17.1%, 19.9%, and 21.7% energy savings respectively.

Building 2: To study the impact of off-setting the air-conditioning set temperature and optimizing the air-conditioning running hours, without compromising the occupant's comfort level, on energy consumption. Power consumption readings are summarised as follows:

Table 6.18: Meter Reading of Building 2

Setting 2: Guindy Industrial Area, a second organization understudy						
Location	Dining Hall					
Area (Sq. Ft)	600					
Capacity of AC (TR)	25					
Duration of readings	3 Sept 2017 - 10 Jan 2018 and 3 Sept 2018 - 10 Jan 2019					
Average Ambient Temp.	33 Degree C to 30 Degree C					
Running Hours	12.30 PM to 2.30 PM					
Condition for Meter Reading	Baseline Period Energy					
	Reporting Period Energy					
Calculation basis	Average of 30 Days					
Average daily power consumption before training (KWh)	First 30 days	**14.72**	Second 30 days	**14.7**	Third 30 days	**14.68**
Average daily power consumption after training (KWh)	First 30 days	**11.72**	Second 30 days	**11.68**	Third 30 days	**11.55**
Daily Average Savings (KWh)	First 30 days	3	Second 30 days	3.02	Third 30 days	3.12
Daily Average Savings %	First 30 days	**20.4**	Second 30 days	**20.6**	Third 30 days	**21.3**

Savings = (Baseline Period Energy – Reporting Period Energy) ± Adjustments,

Ref: IPMVP – A

Observation: Energy consumption data before and after LCECM training was compared for energy saving if any. The air-condition running hour was optimized and reduced by 20 minutes in 2 hours operation and the air-conditioning set temperature was optimized by increasing the set temperature

by 2 degrees centigrade. Ten numbers of ceiling fans that were not used during the first reading as standard operating procedure were also kept ON during the post LCECM training meter reading. Daily savings for first, second, and third 30 days were 3 KWh, 3.02 KWh, and 3.12 KWh respectively. This corresponds to 20.4%, 20.6%, and 21.3% energy savings respectively.

The analysis result was further analyzed by t-Test using SPSS software version 23.

2. Result of t-Test on Meter reading output of building 1 and building 2: Result of the t-Test is summarized in table 6.19

Table 6.19: t- Test on IPMVP-A Outcome

Paired Sample Statistics					
		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Org. 1_Before	3.212	90	0.19223	0.02026
	Org. 1_After	2.5786	90	0.16936	0.01785
Pair 2	Org. 2_Before	14.7006	90	0.04656	0.00491
	Org. 2_After	11.6524	90	0.10449	0.01101

Paired Samples Test									
		Paired Differences							
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference		t	df	Sig. (2 tiled)
					Lower	Upper			
Pair 1	Org. 1_Before	0.6366	0.24468	0.02579	0.58542	0.68791	24.685	89	.000
	Org. 1_After	7							
Pair 2	Org. 2_Before	3.048	0.09893	0.01043	3.02746	3.0689	292.289	89	.000
	Org. 2_After	18							

It can be seen that the result is highly significant which in other words justifies the analysis report of IPMVP -A. Savings at both studies are highlighted in Figures 6.9 and 6.10.

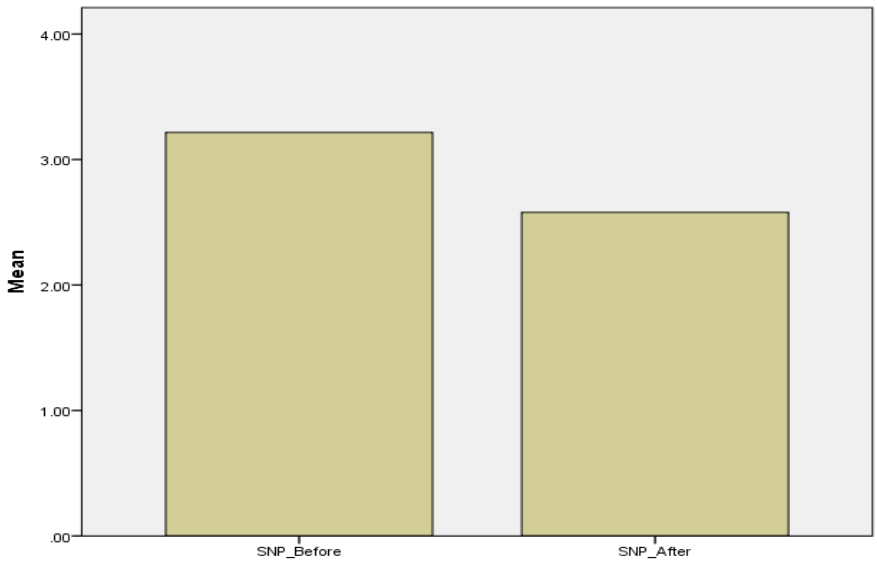

Figure 6.9: Building 1 Comparison of Meter Readings

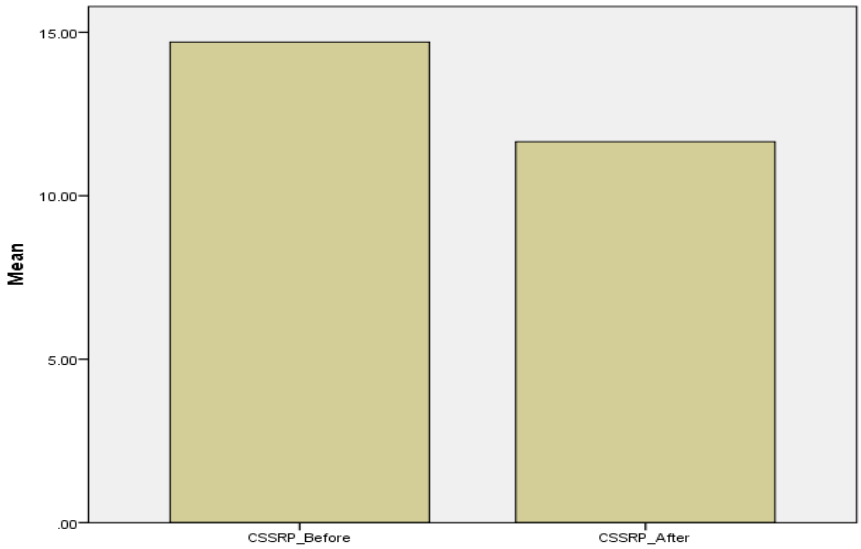

Figure 6.10: Building 2 Comparison of Meter Readings

Observation: Actual Energy consumption in air-conditioning was measured at two places using energy meter before and after the LCECM Training to the participants. The difference between both the readings was analyzed based on IMPVM Protocol A to determine the energy conservation. The differences in readings were further t-Tested to check the significance.

Findings: In building 1 energy consumption data before and after LCECM training was compared for energy saving, if any. The air-condition running hour was optimized and reduced by 30 minutes in 14.30 hours operation and the air-

conditioning set temperature was optimized by increasing the set temperature by 1-degree centigrade. Daily savings for first, second, and third 30 days were 0.55 MWh, 0.64 MWh, and 0.7 MWh respectively. This corresponds to 17.1%, 19.9%, and 21.7% energy savings respectively.

In building 2 energy consumption data before and after LCECM training was compared for energy saving, if any. The air-condition running hour was optimized and reduced by 20 minutes in 2 hours operation and the air-conditioning set temperature was optimized by increasing the set temperature by 2 degrees centigrade. Ten numbers of ceiling fans which were not used earlier as standard operating procedure were also kept ON during the post LCECM training meter reading. Daily savings for first, second, and third 30 days were 3 KWh, 3.02 KWh, and 3.12 KWh respectively. This corresponds to 20.4%, 20.6%, and 21.3% energy savings respectively.

In building 1 saving was between **17.1% to 21.7%** by reducing the Air-Conditioning running time by 30 minutes and increasing the Air-Conditioner set temperature by 1-degree centigrade.

In building 2 saving was between **20.4% to 21.3%** by reducing the Air-Conditioning running time by 20 minutes and increasing the Air-Conditioner set temperature by 2 degrees centigrade. Before the training readings, 10 ceiling fans were not in use as per the facility's standard operating practice, but after the training 10 ceiling fans were 'Switched-On' that helped to increase the set temperature by 2 degrees centigrade.

A t-Test on the IPMVP-A analysis result is highly significant. **Transfer of Training has positive impact on Energy Conservation (H3=0.00)** in both cases.

6.19 Summary

- This study establishes the fact that **Peer Support** influences directly on **Transfer of Training** in energy conservation applications like all other previous studies in non-energy conservation applications **(H1 = 0.38).**

- This study establishes the fact that **Performance Feedback** influences directly on **Transfer of Training** in energy conservation applications like all other previous studies in non-energy conservation applications **(H2 = 0.42).**
- There is always a possibility of a slip between intention and action and that needs to be ascertained scientifically. **Transfer of Training** has positive impact on **Energy Conservation (H3=0.18)** is established convincingly in this study**.**
- The impact of the **Transfer of Training** on **Energy Conservation** is **highly significant**. This is first verified by analyzing feedback from the participants and then additionally verified by actual meter readings at two different locations which are explained earlier in Section 6.18.
- Analysis of the conceptual model revealed that **Peer Support** and **Performance Feedback** did not influence each other. **Peer Support** and **Performance Feedback** also did not influence directly on **Energy Conservation** (0.03 and 0.04). The influence was only through the **Transfer of Training**.
- In building 1 saving was between **17.1% to 21.7%** by reducing the Air-Conditioning running time by 30 minutes and increasing the Air-Conditioner set temperature by 1-degree centigrade without any adverse impact on the comfort level.
- In building 2 saving was between **20.4% to 21.3%** by reducing the Air-Conditioning running time by 20 minutes and increasing the Air-Conditioner set temperature by 2 degrees centigrade without any adverse impact on the comfort level.
- **LCECM** training has huge potential to save energy daily which costs a very negligible amount of money if engaged external expert and nil if done by in-house training.
- It is advisable to implement **LCECM** training by every organization. It is not only cheap and simple but also environmentally friendly.

Chapter 7

Discussion, Contributions, and Conclusion

In this chapter discussion is on conclusion of the research concerning the status, procedures, policy, and practice considerations relating to energy conservation through LCECMs. The aim is to present the final conclusions derived from the analysis of the primary data collected through feedback and meter readings. The chapter reviews the discussion on the main findings arrived at throughout this study as per the research problem. Also, this chapter covers a demonstration of the major contributions of the present study, along with their implications on business problems spelled out in chapter one. Some suggestions for a future research road map on this topic is further discussed.

7.1 Discussion on Research Objective 1

To study the impact of Peer Support on Transfer of Training (LCECM).

7.1.1 General Discussion on Research Objective 1

Energy conservation became a matter of concern in the world ever since the first energy crises were felt in the mid-nineteen seventies. Most of the countries came out with energy policies concerning power generation, transmission, and distribution for better energy management. Energy conservation in India was taken on priority during 2000. Subsequently, the Energy Conservation Act 2001 was also revised several times to bring better clarity and broaden the horizon of the Act. ECBC (Energy Conservation Building Code) is one such initiative that was implemented in 2018. The literature review illustrates that LCECM training can perform a significant part in energy conservation initiatives in India under the ambit of Energy Conservation Act, 2001. ECBC implementation was for practicing energy conservation in the Indian building sectors. One of the purposes is to create awareness about energy conservation through training to the consumers about the proper utilization of energy. As stated in Chapter 4 that

“Transfer of Training” as a dependent variable is influenced by “Peer Support” as an independent variable and it is a proven fact in applications other than LCECM transfer of training. Studies in the multi-storied residential building in the non-Indian application found more energy-saving where the residents shared information and experience with fellow residents compared to buildings where it was not shared. Based on the researcher's personal experience in energy conservation for more than 15 years and the experiences shared in the literature from similar studies in the building sectors it is assumed that “Peer Support” will have a direct influence on the “Transfer of Training” for LCECM training.

“Peer Support” can have a lasting effect on any individual as a predictor of “Transfer of Training” in “Energy Conservation” application and should be used as an antecedent in the training process (Carrico et al., 2011). Usually, there is some kind of monetary incentives to encourage the participants for putting in practice the learnings from any training into the work process (Wilson and Dowlatabadi, 2007). Human thinking and behavior are complex and unique in nature. That is why Bhatti et al. (2013) suggested the need for more studies on peer support to understand the impact of training on actual applications. Studies in non-energy conservation applications found “Peer Support” to have a direct influence on “Transfer of Training” (Bates et al., 2000; Cromwell and Kolb, 2000; Holton et al.,1997). Similar studies also found “Peer Support” can have an indirect influence on “Transfer of Training” (Kirwan and Birchall, 2006; Nijman et al., 2006; Chiaburu and Tekleab, 2005; Ruona et al., 2002).

There is a scarcity of literature to suggest that “Peer Support” impacts the “Transfer of Training” on “Energy Conservation” applications through training similar to LCECM training. Customized energy conservation training was recommended in 2016 by Ales et al., for energy conservation in building sectors. Aditya et al., in their 2016 report to the Government of India on energy consumption in residential building sectors, has suggested energy conservation training to encourage energy conservation practices. Wai et al., (2006) created a model on the principle of A-B-C theory to use PS indirectly for creating an awareness program in energy conservation application in an educational

institute. Studies suggest that policies need to address Energy Conservation by all means to preserve Fossil Fuel (Ghosh et al., 2013). A conceptual model is created in this study on the principle of A-B-C theory for energy conservation applications suitable for commercial buildings. In this model Peer support is an antecedent similar to the A-B-C theory for Transfer of Training which is like behavior in A-B-C theory. This study proves that the "Transfer of Training" is influenced directly by "Peer Support" through LCECM training which leads to "Energy Conservation". The findings of this study fill a gap in energy conservation practices to suggest that teamwork through Peer Support can give encouraging outcomes.

7.1.2 Theoretical Contribution of Research Objective 1

In this study, LCECM training is given by the energy conservation practicing professionals who are highly qualified and experienced. The training was tailored made as per the actual requirements of the facilities and the topics for the training were chosen in consultation with the building occupants. The outcome of the training was measured and analyzed by way of collecting feedback from the participants through a set of questionnaires and also by actual measurement of energy consumption at two facilities on two different occasions, i.e. before and after the training. The objective is achieved by feedback from the participants. Thereby, it is obvious that "Peer Support" has an influence on the "Transfer of Training" for "Energy Conservation".

The underpinning theory of the present study is Antecedent-Behavior-Consequence (A-B-C) theory. As per this theory a stimulant act as Antecedent to have an impact on the Behavior by way of training leading to a Consequence that translates into a measurable outcome. "Peer Support" (PS) is the first antecedent in this study, which is an independent variable and having a direct impact on "Transfer of Training" (TOT). TOT is the dependent variable and individual behavior gets changed towards energy conservation because of the influence from PS. Change in energy usage behavior leads to "Energy Conservation" (EC) which is the Consequence of the theory.

Past studies on energy conservation application recommended the need to ascertain the impact of antecedents on the transfer of training in future studies on similar applications (Staddon et al., 2016; Ishak et al., 2016). Wai et al., (2006) developed a model with three main stages based on A-B-C theory and used PS indirectly. Future studies on "Energy Conservation" with LCECM training should take the training design separately. It should also consider "Peer Support" for having more impact on "Transfer of Training" that will lead to the implementation of LCECM training in a more effective manner. This study establishes the fact that PS has a direct impact on TOT for EC that can be proved both by feedback and actual meter reading in real-life applications.

7.1.3 Practical Contribution of Research Objective 1

LCECM training, if designed and executed in-house by the organization then it does not cost any money to the organization but if the same is done by engaging an expert from the industry then it cost negligible amount of money which can be recovered from the savings in monthly energy bill in few months. The monetary burden to implement such energy conservation measures is minimal and affordable by any organization. The bigger impact is building a work culture that will have an impact beyond the organization as it will be carried, practiced, and propagated by employees wherever they go after the working hours like public places and their residents. Cumulative impact will be a change in energy usage behavior in the country at large in few years leading to not only energy conservation but also a constructive effect on the environment and government exchequer for the reduction in energy import bill. On April 5, 2020, when the lights at home across India were Switched Off for nine minutes on the request of the Prime Minister the load managers recorded 32,000 MW reduction in demand (POSOCO Report). Switching Off unwanted loads in our homes and offices can save a huge amount of energy when it is practiced by all across the country and it does not cost any money to do so. Peers are very influencing agents in our lives be it at homes or workplaces when we talk about sharing the knowhows in energy conservation practices. It helps us push the individual limits while course-correcting the actions required to increase the efficiency in energy usage at homes and workplaces.

7.2 Discussion on Research Objective 2

To study the impact of Performance Feedback on Transfer of Training (LCECM).

7.2.1 General Discussion on Research Objective 2

Energy conservation became a matter of concern in the world ever since the first energy crises were felt in the mid-nineteen seventies. Most of the countries came out with energy policies concerning power generation, transmission, and distribution for better energy management. Energy conservation in India was taken on priority during 2000. Subsequently, the Energy Conservation Act 2001 was also revised several times to bring better clarity and broaden the horizon of the Act. ECBC (Energy Conservation Building Code) is one such initiative that was implemented in 2018. The literature review illustrates that LCECM training can perform a significant part in energy conservation initiatives in India under the ambit of Energy Conservation Act, 2001. ECBC implementation was for practicing energy conservation in the Indian building sectors. One of the purposes is to create awareness about energy conservation through training to the consumers about the proper utilization of energy. As stated in Chapter 4 that "Transfer of Training" as a dependent variable is influenced by "Performance Feedback" as an independent variable and it is a proven fact in applications other than LCECM training transfer. Staddon et al. (2016) and Oliveira et al. (2010) found "Performance Feedback" has a direct impact on the "Transfer of Training". Studies in the multi-storied residential building in the non-Indian application found more energy-saving where the residents were given feedback on a daily and weekly basis through various means compared to buildings where the feedback was not given. Based on the researcher's personal experience in energy conservation for more than 15 years and the experiences shared in the literature from similar studies in the building sectors it is assumed that "Performance Feedback" will have a direct influence on the "Transfer of Training" for LCECM training.

“Performance Feedback” can have a lasting effect on any individual as a predictor of “Transfer of Training” in any energy conservation application and should be used as an antecedent in the training process (Carrico et al., 2011). Ishak et al., (2016) defines that "Consumer energy behavior can be understood at its fundamental level by examining the interactions between cognitive norms, material culture, and energy practice". Oliveira et al,. (2011) defines the feedback as "Transforms the behavior of users of public buildings regarding Energy Efficiency". Ross et al., (2016) defines the same as "Energy-efficient behaviors are shaped by factors such as price, awareness, trust, and a sense of moral obligation to the community". While, Carrico et al., (2011) suggests "Information disseminated through block leaders is more effective than traditional routes of public education because of feedback". Performance feedback is meaningfully connected to transfer of training in many applications but energy conservation (Velada et al., 2007; Oliveira et al., 2010; Staddon et al., 2016; and Amanda et al., 2010). Carrico et al., in 2011 have advocated Performance Feedback as antecedents of Transfer of Training. There is necessity for more studies on performance feedback to justify the effect of training on energy conservation (World Bank Report, 2008).

There is a dearth of literature to support that Performance Feedback influences Transfer of Training on Energy conservation applications through training similar to LCECM training. Customized energy conservation training was recommended in 2016 by Ales et al., for energy conservation in building sectors. Aditya et al., in their 2016 report to the Government of India on energy consumption in residential building sectors, has suggested energy conservation training to encourage energy conservation practices. Wai et al., (2006) created a model on the principle of A-B-C theory to use Performance Feedback indirectly for creating an awareness program in energy conservation application in an educational institute. Studies suggest that policies need to address Energy Conservation by all means to preserve Fossil Fuel (Ghosh et al., 2013). A conceptual model is created in this study on the principle of A-B-C theory for energy conservation applications suitable for commercial buildings. In this model Performance Feedback is an antecedent similar to the A-B-C theory for

Transfer of Training which is like behavior in A-B-C theory. This study proves that the "Transfer of Training" is influenced directly by "Performance Feedback" through LCECM training which leads to "Energy Conservation". The findings of this study fill a gap in energy conservation practices to suggest that feedback on the initiatives taken by the individuals can give encouraging outcomes.

7.2.2 Theoretical Contribution of Research Objective 2

In this study, LCECM training is given by the energy conservation practicing professionals who are highly qualified and experienced. The training was tailored made as per the actual requirements of the facilities and the topics for the training were chosen in consultation with the building occupants. The outcome of the training was measured and analyzed by way of collecting feedback from the participants through a set of questionnaires and also by actual measurement of energy consumption at two facilities on two different occasions, i.e. before and after the training. The objective is achieved by analyzing the feedback from the participants.

The underpinning theory of the present study is Antecedent-Behavior-Consequence (A-B-C) theory. As per this theory a stimulant act as Antecedent to have an impact on the Behavior by way of training leading to a Consequence that translates into a measurable outcome. "Performance Feedback" (PF) is the second antecedent in this study, which is an independent variable and having a direct impact on "Transfer of Training" (TOT). TOT is the dependent variable and individual behavior gets changed towards energy conservation because of the influence from PF. Change in energy usage behavior leads to "Energy Conservation" (EC) which is the Consequence of the theory.

Past studies on energy conservation recommended the need to ascertain the impact of antecedents on the transfer of training in future studies on similar applications (D'Oca, 2016; Sutherland, 2016). Wai et al., (2006) developed a model with three main stages based on A-B-C theory and used PF indirectly. Future studies on energy conservation with LCECM training should take the

training design separately. It should also consider “Performance Feedback” for having more impact on “Transfer of Training” that will lead to the implementation of LCECM training in a more effective manner. This study establishes the fact that PF has a direct impact on TOT for EC that can be proved both by feedback and actual meter reading in real-life applications.

7.2.3 Practical Contribution of Research Objective 2

LCECM training, if designed and executed in-house by the organization then it does not cost any money to the organization but if the same is done by engaging an expert from the industry then it cost negligible amount of money that can be recovered from the savings in organization's monthly energy bill in few months. Monetary burden to implement such energy conservation measures are minimal and affordable by any organization. The bigger impact is building a work culture that will have an impact beyond the organization as it will be carried, practiced, and propagated by employees wherever they go after the working hours like public places and their residents. Cumulative impact will be a change in energy usage behavior in the country at large in few years leading to not only energy conservation but also a constructive effect on the environment and government exchequer for the reduction in energy import bill. On April 5, 2020, when the lights at home across India were Switched Off for nine minutes on the request of the Prime Minister the load managers recorded 32,000 MW reduction in demand (POSOCO Report). Switching Off unwanted loads in our homes and offices can save a huge amount of energy when it is practiced by all across the country and it does not cost any money to do so. Feedback from peers at home or at the workplace on individual efforts to conserve energy through proactive approaches is not only encouraging but also helps trying energy conservation by innovative methods as one pill for all approach does not hold good when we talk about energy conservation. Regular feedback about the efforts put up by individuals for energy conservation also motivates others to do so.

7.3 Discussion on Research Objective 3

To study the impact of Transfer of Training on Energy Conservation.

7.3.1 General Discussion on Research Objective 3

The Energy Conservation initiatives opened a new chapter in India with the implementation of the Energy Conservation Act, 2001. ECBC is a by-product of that Act. Energy Conservation Training is part of ECBC and subsequently, BEE (Bureau of Energy Efficiency), the nodal agency of the Indian Government responsible for implementing the Energy Conservation Act 2001, examined and qualified over fifteen thousand Energy Managers and Energy Auditors. Studies had been done in developed countries mostly in an educational institute and various residential buildings with certain Dos and Don'ts as a set of instructions to evaluate the impact on energy conservation initiatives. There are several studies to demonstrate the effect of the transfer of training but not on energy conservation applications. Technological excellence alone cannot achieve optimal energy utilization and unlikely to be sustainable in the longer run. Energy management will have the major effect when behavioural training is addressed i.e. individual's energy usage behavior in any organization will have direct effect on energy consumption. As stated in Chapter 4 "Energy Conservation" is the dependent variable and effected by the "Transfer of Training". Energy Conservation is the final goal in this study that needs to be proven beyond any reasonable doubt so that a conclusion can be drawn. That is the reason it is important to prove $Hypothesis_3$ not only based on feedback from the participants but also by actual measurement of the consumed energy in actual applications. This will prove the fact that the intent to act after the LCECM training is embedded into the personality to act at a later time when it was needed.

The impact of "Transfer of Training" on Energy Conservation was done by way of some Dos and Don'ts instructions (Abdulrahman et al., 2016; Sam C et al., 2016; Ronald J. Sutherland, 2016). The study analysis was done after collecting the feedback from the participants through a set of questionnaires about their intentions of applying the instructions for energy conservation. There is always a gap between the intention to do an action and doing the action. Therefore, the studies were done mainly in an indirect manner but there is a need for direct measurement in actual application to see the actual impact (Ghosh et al., 2013).

This study proves that if Transfer of Training through LCECM training takes place as intended then the antecedents will act as triggers to encourage individuals for Energy Conservation. Previous studies in energy conservation used a set of Dos and Don'ts for the participants to follow so that energy conservation can be realized and a parallel was drawn that if training on proper energy usage is imparted then the participants will practice the same in their own (Ishak et al., 2016).

The effect of the Transfer of Training is tested in two ways. First, it is tested based on the analysis done on the feedback obtained from the participants and found to hold good. To rule out the possibilities of a slip between intention and action the study is taken to the next level. Actual energy consumption was measured at two different buildings in the air-conditioning application. The readings are first analyzed through an internationally accepted protocol to establish the actual energy conservation. This analysis report is further analyzed by t-Test to check the significance of the finding. The conceptual model of this study is on the principle of A-B-C theory for "Energy Conservation" applications in commercial buildings. In this model "Transfer of Training" is similar to the "Behaviour" of the A-B-C theory and "Energy Conservation" is similar to the "Consequences" of the A-B-C theory. The present study proves that the "Transfer of Training" directly impacts "Energy Conservation". The findings of this study fill a gap in Energy Conservation practices to suggest that the Transfer of Training for Energy Conservation can also be measured in actual applications.

7.3.2 Theoretical Contribution of Research Objective 3

In this study, LCECM training is given by the energy conservation practicing professionals who are highly qualified and experienced. The training was tailored made as per the actual requirements of the facilities and the topics for the training were chosen in consultation with the building occupants. The outcome of the training was measured and analyzed by way of collecting feedback from the participants through a set of questionnaires and also by actual measurement of energy consumption at two facilities on two different

occasions, i.e. before and after the training. The objective is achieved by analyzing the feedback from the participants.

The underpinning theory of the present study is Antecedent-Behaviour-Consequence (A-B-C) theory. As per this theory a stimulant act as Antecedent to have an impact on the Behaviour by way of training leading to a Consequence that translates into a measurable outcome. In this study it is seen that Energy Conservation (EC) as a dependent variable is directly affected by Transfer of Training (TOT). It is similar to Behaviour – Consequence stages of A-B-C theory. Change in energy usage behavior because of transfer of training leads to Energy Conservation (EC) which is the Consequence of the theory.

Need to ascertain the effect of the "Transfer of Training" for energy conservation in future studies were recommended in the past (Trombley et al., 2017; Tsuda et al., 2016). Wai et al., (2006) developed a model with three main stages based on A-B-C theory and used TOT through an energy awareness process for energy conservation. Future studies on energy conservation with LCECM training should take the training design separately. It should also consider Transfer of Training for having more impact on Energy Conservation that will lead to the implementation of LCECM training in a more effective manner. This study establishes the fact that TOT has a direct impact on EC that can be proved both by feedback and actual meter reading in real-life applications.

7.3.3 Practical Contribution of Research Objective 3

LCECM training, if designed and executed in-house by the organization then it does not cost any money to the organization but if the same is done by engaging an expert from the industry then it cost negligible amount of money which can be recovered from the savings in organization's monthly energy bill in few months. Monetary burden to implement such energy conservation measures are minimal and affordable by any organization. The bigger impact is building a work culture that will have an impact beyond the organization as it will be carried, practiced, and propagated by employees wherever they go after the working hours like public places and their residents. Cumulative impact will be

a change in energy usage behavior in the country at large in few years leading to not only energy conservation but also a constructive effect on the environment and government exchequer for the reduction in energy import bill. On April 5, 2020, when the lights at home across India were Switched Off for nine minutes on the request of the Prime Minister the load managers recorded 32,000 MW reduction in demand (POSOCO Report). Switching Off unwanted loads in our homes and offices can save a huge amount of energy when it is practiced by all across the country and it does not cost any money to do so. If Transfer of Training takes place as intended then regular practice in the real-life application becomes a habit over a while and that becomes a new norm of energy usage which will have cascading effects on people around us at every walks of life.

Policy Implication: If well-structured tailor-made **LCECM** training is given to the building occupants and if the management provides a conducive working atmosphere then the building occupants can improve their energy usage behavior by practicing the learned tips and guidelines leading to efficient utilization of energy as a whole for the building. **LCECM** is something that most of us know but gets either overlooked or ignored due to our preconceived mindset of thinking it to be insignificant. It is something that can easily be practiced daily if it becomes a habit. The Indian government has implemented the **ECBC (Energy Conservation Building Code, 2017)** for improving the energy index of any building through such **LCECMs** but it is left as optional and not obligatory. If its implementation is mandated under **ECBC** then it can help in reducing energy usage daily in the Indian Commercial Building Sector leading to saving cost and energy as well as the environment through operational excellence. For that matter such practices can be made mandatory across all sectors in India.

Energy conservation initiatives started in India after the Energy Conservation Act 2001 passed by the Government and it was mainly for identified 7 designated consumers. These designated consumers were mainly big industries like sugar, cement, fertilizers, etc. Subsequently, revisions were made in the act

to accommodate more industries into the list of designated consumers but these remained confined to manufacturing and production activities. Prayas Energy Group presented a detailed report in 2016 to the Government of India after surveying 21 states in India about the domestic energy consumption pattern. This study was mainly to discovery the energy conservation opportunities in the Indian building sector. Two main highlights of this report were (1) sustainability of energy conservation by training and its assessment and (2) Behavioral training on low-cost energy conservation measures to the occupants of a commercial building can perform a part in reducing the difference between supply and demand. Accordingly, ECBC was amended and the Government of India implemented ECBC 2017 during 2018. However, LCECM training remained an optional item and left to the end user's choice. As discussed in Chapter 4 that energy conservation is bi-directional. One is technological excellence and the second one is the energy user's behavior. Behavior can be influenced by proper training. Therefore, if the energy conservation training to enlighten the end-users is mandated under the Energy Conservation Act then that will help in bringing sustainability in the energy conservation movement in India.

Strategic Implication: Indians witnessed a unique experience on April 5, 2020, when only lights in Indian homes were switched OFF for nine minutes in response to the call given by the Indian Prime Minister. The total reduction in all India demand recorded during the event was 31089 MW (POSOCO Report). It opens a window of opportunity for Demand Side Management (DSM) by controlling morning and evening peaks through lighting load alone. Because Switching Off lights do not cost any money and yet can help in reducing electricity demand significantly. It has also the potentials to help the nation in saving fuel bills for power plants along with the reduction in CO_2 emission. And all of these can be done free of cost regularly which in other words called low hanging fruits in business terminology. Strategic implications of the learnings from this study can be multi-dimensional for policymakers both in government and private sectors.

7.4 Conclusions

Chapter discussion is summarized under three headings such as (1) Peer Support and LCECM Training Transfer, (2) Performance Feedback and LCECM Training Transfer, and (3) LCECM Training Transfer and Energy Conservation.

Peer Support and LCECM Training Transfer: Peer Support (PS) is an independent variable and an antecedent to Transfer of Training (TOT) for Energy Conservation (EC). The requirement for the training was need-based and suitable for the companies under study. Peers are the co-workers, supervisors, and managers in the company. The training was adopted from the Indian Association of Energy Management Professionals (IAEMP). IAEMP is an Indian NGO consisting of more than 5000 practicing energy conservation professionals who are certified Energy Managers and/or Energy Auditors. The members of this association are from every sector of the industries and across India. LCECM training to the participants was imparted by the experienced trainers from IAEMP. Feedback on training was collected through a survey by a set of questionnaires addressing Peer Support, Transfer of Training, and Energy Conservation, and the same was analyzed as discussed in chapter 6. Conceptual Model was tested to find the impacts of Peer Support. Feedback analysis shows PS has a direct impact on TOT. Peer Support does not have any direct impact on PF or EC. Therefore, it can be said that PS influences behavior change through TOT which leads to Energy Conservation.

Working Definition of Peer Support: It is the help, encouragement, and support of the co-workers, supervisors, and managers to implement the learned skills of energy conservation into work. Bates et. al., (2007) define peer support as "The extent to which a trainee's peers reinforce and support the use of learning on-the-job." Kirwan and Birchall (2006) describe this form of support as the "Amount of help in applying new learning from peers."

Performance Feedback and LCECM Training Transfer: Performance Feedback (PF) is an independent variable and an antecedent to Transfer of Training (TOT) for Energy Conservation (EC). The requirement for the training

was need-based and suitable for the companies under study. Performance Feedback was on the efforts put up by the participants based on the training. The training was adopted from the Indian Association of Energy Management Professionals (IAEMP). IAEMP is an Indian NGO consisting of more than 5000 practicing energy conservation professionals who are certified Energy Managers and/or Energy Auditors. The members of this association are from every sector of the industries and across India. LCECM training to the participants was imparted by the experienced trainers from IAEMP. Feedback on training was collected through a survey by a set of questionnaires addressing Performance Feedback, Transfer of Training, and Energy Conservation, and the same was analyzed as discussed in chapter 6. Conceptual Model was tested to find the impacts of Performance Feedback. Feedback analysis shows PF has a direct impact on TOT. Performance Feedback does not have any direct impact on PS or EC. Therefore, it can be said that PF influences behavior change through TOT which leads to Energy Conservation.

Working Definition of Performance Feedback: Feedback of performance after obtaining the training to assess the effectiveness of the applications of new skills/knowledge on work. Velada et., al. (2007) defined performance feedback as: "Feedback on the transfer of training that translates into actual measurable output."

LCECM Training Transfer and Energy Conservation: Transfer of Training (TOT) is an independent variable and an antecedent to Energy Conservation (EC) for Energy Conservation (EC). The requirement for the training was need-based and suitable for the companies under study. Energy Conservation is the result that was expected to be established beyond any reasonable doubt through this study. The training was adopted from the Indian Association of Energy Management Professionals (IAEMP). IAEMP is an Indian NGO consisting of more than 5000 practicing energy conservation professionals who are certified Energy Managers and/or Energy Auditors. The members of this association are from every sector of the industries and across India. LCECM training to the participants was imparted by the experienced trainers from IAEMP. Feedback

on training was collected through a survey by a set of questionnaires addressing Transfer of Training and Energy Conservation and the same was analyzed as discussed in chapter 6. Conceptual Model was tested to establish the effect of Transfer of Training. Feedback analysis shows TOT has a direct impact on EC. Earlier researchers hinted that the transfer of training should be tested in actual applications since there is a difference between the intention to do an act and doing the act in reality. Keeping that in mind implementation of TOT for EC was measured by the meter at two sites on air-conditioning application to ascertain whether the intention was practiced or not. The meter readings were analyzed by two methods to establish the impact of TOT on EC and found to be true. Therefore, it can be said that PS and PF influence behavior change through TOT which leads to Energy Conservation.

Working Definition of LCECM: It is self-disciplining to optimize the usage of energy without compromising with the comfort level or output. This can be done by training to enhance the knowledge, upgrade the skills, and change the attitude towards energy usage such that it leads to the reduction of energy consumption. The same is defined by others as follows:
"Train consumers on optimal utilization of energy using Low-Cost Energy Efficiency Measures" (PCRA Reference Manual, 2008). "Energy Efficiency Assessment refers to measuring and analyzing energy use and energy losses in a process, facility or activity area to identify, investigate, evaluate, make the business case for and report on energy use and energy efficiency opportunities in energy using entity over time" (DERT, 2010).

7.5 Research Limitations

i) The study is focused on Low-Cost Energy Conservation Measures Training Transfer on which past studies are mainly focused on only one or two predictors.
ii) The present study follows the training provided by IAEMP.
iii) The present study follows the Low-Cost Energy Conservation Measure manual of IAEMP.

iv) The energy conservation measurement is made with limited facilities and restrictions imposed by the respondents.
v) The dearth of study on Indian commercial buildings for energy conservation is limited as well as future scope in context to the present study.

7.6 Future Research Directions

The study is done in commercial buildings in one MSME cluster in Chennai engaged in various business operations like manufacturing, back-office operations, trading, etc. The training given was adopted from IAEMP being a professional practicing energy conservation organization. Due to resource crunch and restriction imposed by the organization only two predictors namely Peer Support and Performance Feedback are considered for the study and could manage to collect actual energy consumption meter reading at two facilities in the air-conditioning application alone. Therefore, more predictors, more actual meter readings, more applications, and of course other industry sectors can be considered for future studies. Few are suggested as follows:

i) Future researchers can also research on Low-Cost Energy Conservation Measurement Training Design.
ii) Future Researchers can take up more predictors accordingly depending upon the conclusions of the present study.
iii) Future researchers can also take up designing the measurement technique and check the impacts on LCECM Training Transfer.
iv) Future researchers can replicate the present study for the manufacturing and transportation sectors as well.

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APPENDIX - 1

Questionnaire for Feedback

This questionnaire is a component of an ongoing PhD thesis on energy conservation through transfer of training. Your response is voluntary and without any prejudice. Your responses will **only** be used for the purpose of academic studies. Sincere appreciations in advance for your cherished contribution.

Section 1 – Organisation Details (OD)

Organisation Details (OD)		
1	Organisation Name **(ON)** :	
2	How many years in operation **(HY)**:	
3	Types of operations **(TO)** : [1] Back office, [2] ware house, [3] Manufacturing, [4] Soft Ware, [5] Other (Specify) …..	
4	Number of person working **(NPW)**:	
5	Electrical Power used **(EP)** : [1] Yes. [2] No	

Section 2 – Participant Details (PD)

Participant Details (PD)		
1	Age in Years **(A)** :[1] Less than 25, [2] 25-35, [3] More than 35	
2	Gender **(G)** : [0] Female, [1] Male	
3	Department :	
4	Designation :	
5	Length of service in this organization in years **(LS)**: [1] Up to 2, [2] 2-7, [3] More than 7	
6	Level of Education **(LE)** : [1] Intermediate, [2] Diploma, [3] Graduation, [4] Post Graduation, [5] Any other (specify) ……..	
7	Got Energy Conservation Training in the past **(ECT)** : [0] No, [1] Yes	
8	If Yes, number of training given to each employee **(NT)**: [1] 0, [2] 1, [3] 2, [4] More than 2	

Section 3 - Transfer of Training (TOT)

Every statement narrated in this section explains a feature of "**Transfer of Training**" applicable at your work environment that might decide how efficiently you are able to practice the skills learned through a formal training on LCECM for "Energy Conservation". You are requested to indicate whether you "Agree" or 'Disagree" with each of the statements given below by using the scale as mentioned below for your guidance.

Please complete the box with a number from the scale below, that describes your response the best.

"1 = Strongly Disagree", "2 = Disagree", "3 = Neither Agree nor Disagree", "4 = Agree", and "5 = Strongly Agree".

Transfer of Training (TOT)		
1	Using the new knowledge and skills has helped me improve my energy saving actions **(TOT1)**	
2	I can accomplish energy saving tasks faster than before LCECM training **(TOT2)**	
3	I can accomplish energy saving tasks better by using new knowledge and skills **(TOT3)**	
4	The quality of my work has improved after using new knowledge and skills **(TOT4)**	
5	I can make quick decisions to save energy than before LCECM training **(TOT5)**	
6	I have applied what was taught into my work **(TOT6)**	
7	I use almost everything that was taught in LCECM training into my work on daily basis **(TOT7)**	
8	I use very little of what was taught during the LCECM training **(TOT8)**	
9	I aim to master in energy saving skills with regular practice **(TOT9)**	
10	I remember the main topics learned in the LCECM training **(TOT10)**	
11	I can easily say several things learned in the LCECM training **(TOT11)**	

Section 4 – Peer Support (PS)

Every statement narrated in this section explains a feature of "**Peer Support**" applicable at your work environment that might decide how efficiently you are able to practice the skills learned through a formal training on LCECM for "Energy Conservation". You are requested to indicate whether you "Agree" or 'Disagree" with each of the statements given below by using the scale as mentioned below for your guidance.

Please complete the box with a number from the scale below, that describes your response the best.

"1 = Strongly Disagree", "2 = Disagree", "3 = Neither Agree nor Disagree", "4 = Agree", and "5 = Strongly Agree".

	Peer Support (PS)	
1	Peers appreciate colleagues using new skills that they have learnt in LCECM training **(PS1)**	
2	Peers encourage their colleagues to use new skills that they have learnt in LCECM training **(PS2)**	
3	Peers expects colleagues to use what they have learnt in LCECM training at work **(PS3)**	
4	Peers appreciate getting energy saving training **(PS4)**	
5	Peers are patient with their colleagues when they apply newly learnt skills and technique at work **(PS5)**	
6	Peers encourage their colleagues to attend seminars, symposia etc. on energy saving **(PS6)**	
7	Peers give colleagues opportunity to try out their newly learnt skills and technique on the job immediately after LCECM training **(PS7)**	
8	Peers help colleagues in setting realistic goals for performing their work as a result of the LCECM training **(PS8)**	
9	I do not expect Peers showing interest in what is taught in LCECM training **(PS9)**	

Section 5 – Performance Feedback (PF)

Every statement narrated in this section explains a feature of "**Performance Feedback**" applicable at your work environment that might decide how efficiently you are able to practice the skills learned through a formal training on LCECM for "Energy Conservation". You are requested to indicate whether you "Agree" or 'Disagree" with each of the statements given below by using the scale as mentioned below for your guidance.

Please complete the box with a number from the scale below, that describes your response the best.

"1 = Strongly Disagree", "2 = Disagree", "3 = Neither Agree nor Disagree", "4 = Agree", and "5 = Strongly Agree".

	Performance Feedback (PF)	
1	Post LCECM Training conversation with the trainer about how to improve my job performance was encouraging **(PF1)**	
2	After LCECM training I received feedback from trainer on how well I am applying that I learned **(PF2)**	
3	Feedback from the supervisor regarding my application of LCECM training was encouraging to me **(PF3)**	
4	People often make suggestions about how I can improve my job performance **(PF4)**	
5	I get regular advice from colleagues about how to do my job better **(PF5)**	
6	It will not help me getting higher performance ratings if I use what I learned in LCECM training **(PF6)**	
7	I am more likely to be recognized for my energy saving work if I use the learning from LCECM training **(PF7)**	
8	Employees in my organization receive various perks when they utilize newly learnt skills on the job **(PF8)**	
9	My job performance will improve when I use new things that I have learnt from LCECM training **(PF9)**	

Section 6 – Energy Conservation (EC)

Every statement narrated in this section explains a feature of "**Energy Conservation**" applicable at your work environment that might decide how efficiently you are able to practice the skills learned through a formal training on LCECM for "Energy Conservation". You are requested to indicate whether you "Agree" or 'Disagree" with each of the statements given below by using the scale as mentioned below for your guidance.

Please complete the box with a number from the scale below, that describes your response the best.

"1 = Strongly Disagree", "2 = Disagree", "3 = Neither Agree nor Disagree", "4 = Agree", and "5 = Strongly Agree".

Energy Conservation (EC)		
1	I switch ON air-conditioner and fan at the same time for energy conservation without compromising with the comfort level **(EC1)**	
2	I ensure the doors and windows are closed properly before switching ON the air-conditioner **(EC2)**	
3	I increase the air-conditioner set temperature by 2 degree C when the Fan is switched ON **(EC3)**	
4	I replaced all incandescent bulbs inside the air-conditioned room **(EC4)**	
5	I report faulty door closures immediately for servicing **(EC5)**	
6	I ensure only the required lights are switched ON when the air-conditioner is ON **(EC6)**	
7	I use natural light as much as I can when the air-conditioner is ON **(EC7)**	
8	I ensure the air filter of air-conditioner is cleaned regularly **(EC8)**	
9	I switch OFF the air-conditioner 10 minutes before leaving the office if I am the last person to leave **(EC9)**	

APPENDIX – 2

Site Measurement Sheet– 1

Measurement Site 1														
Site Details														
Location	Food Court AHU													
Area (Sq. Ft)	8000													
Occupant (No of persons - Aprox)	2000													
AC ON Time in 2017	**6.30 AM**													
AC OFF Time in 2017	**9:00 PM**													
Set Temp in Degree C in 2017	**21**													
Average daytime ambient Temp. in Degree C	**Sept**	**33**	**Oct**	**32**	**Nov**	**31**	**Dec**	**30**						
Duration of reading	**Sept. to Dec. 2017 and Sept. to Dec. 2018**													
Average Voltage	**412V**	**Average Power Factor**	**0.82**											
AC Name plate details	Make -McQUIN	Screw Compressor	Model: ALS3583SEST3	Nominal Capacity	457 KW	**Total TR**	**358**							
Ultrasonic Heat Meter descriptions	Make	SHENTECH	Model	280T-DN80										
Formula used to convert BTU into KWhr*	BTU= GPM*DeltaT*500	Kwhr = BTU*0.0002931												

Site Measurement Sheet – 1 (Contd.)

D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	D17	D18	D19	D20	D21	D22	D23	D24	D25	D26	D27	D28	D29	D30	Daily Average
30-11-2017	03-12-2017	04-12-2017	05-12-2017	06-12-2017	07-12-2017	10-12-2017	11-12-2017	12-12-2017	13-12-2017	14-12-2017	17-12-2017	18-12-2017	18-12-2017	19-12-2017	2012-2017	21-12-2017	24-12-2017	26-12-2017	27-12-2017	28-12-2017	31-12-2017	01-01-2018	02-01-2018	03-01-2018	04-01-2018	07-01-2018	08-01-2018	09-01-2018	10-01-2018	

D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	D17	D18	D19	D20	D21	D22	D23	D24	D25	D26	D27	D28	D29	D30	Daily Average
30-11-2018	03-12-2018	04-12-2018	05-12-2018	06-12-2018	07-12-2018	10-12-2018	11-12-2018	12-12-2018	13-12-2018	14-12-2018	17-12-2018	18-12-2018	18-12-2018	19-12-2018	2012-2018	21-12-2018	24-12-2018	26-12-2018	27-12-2018	28-12-2018	31-12-2018	01-01-2019	02-01-2019	03-01-2019	04-01-2019	07-01-2019	08-01-2019	09-01-2019	10-01-2019	
																												Daily Average Savings		
																												% Savings		

D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	D17	D18	D19	D20	D21	D22	D23	D24	D25	D26	D27	D28	D29	D30	Daily Average
17-10-2017	19-10-2017	22-10-2017	23-10-2017	24-10-2017	25-10-2017	26-10-2017	29-10-2017	30-10-2017	31-10-2017	01-11-2017	02-11-2017	05-11-2017	07-11-2017	08-11-2017	09-11-2017	12-11-2017	13-11-2017	14-11-2017	15-11-2017	16-11-2017	19-11-2017	20-11-2017	21-11-2017	22-11-2017	23-11-2017	26-11-2017	27-11-2017	28-11-2017	29-11-2017	

D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	D17	D18	D19	D20	D21	D22	D23	D24	D25	D26	D27	D28	D29	D30	Daily Average
17-10-2018	19-10-2018	22-10-2018	23-10-2018	24-10-2018	25-10-2018	26-10-2018	29-10-2018	30-10-2018	31-10-2018	01-11-2018	02-11-2018	05-11-2018	07-11-2018	08-11-2018	09-11-2018	12-11-2018	13-11-2018	14-11-2018	15-11-2018	16-11-2018	19-11-2018	20-11-2018	21-11-2018	22-11-2018	23-11-2018	26-11-2018	27-11-2018	28-11-2018	29-11-2018	
																												Daily Average Savings		
																												% Savings		

DATA COLLECTION	From Sept 3, 2017 to Jan 10, 2018																													
Data collection day	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	D17	D18	D19	D20	D21	D22	D23	D24	D25	D26	D27	D28	D29	D30	Daily Average
Data collection date	03-09-2017	04-09-2017	05-09-2017	06-09-2017	07-09-2017	10-09-2017	11-09-2017	12-09-2017	14-09-2017	17-09-2017	18-09-2017	19-09-2017	20-09-2017	21-09-2017	24-09-2017	25-09-2017	26-09-2017	27-09-2017	28-09-2017	01-10-2017	03-10-2017	04-10-2017	05-10-2017	08-10-2017	09-10-2017	10-10-2017	11-10-2017	12-10-2017	15-10-2017	16-10-2017	
Current (A)	377.2																														
Power Consumption (MW)	3.2																														

DATA COLLECTION	From Sept 3, 2018 to Jan 10, 2019																													
Data collection day	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	D17	D18	D19	D20	D21	D22	D23	D24	D25	D26	D27	D28	D29	D30	Daily Average
Data collection date	03-09-2018	04-09-2018	05-09-2018	06-09-2018	07-09-2018	10-09-2018	11-09-2018	12-09-2018	14-09-2018	17-09-2018	18-09-2018	19-09-2018	20-09-2018	21-09-2018	24-09-2018	25-09-2018	26-09-2018	27-09-2018	28-09-2018	01-10-2018	03-10-2018	04-10-2018	05-10-2018	08-10-2018	09-10-2018	10-10-2018	11-10-2018	12-10-2018	15-10-2018	16-10-2018	
Current (A)	325.3																														
Power Consumption (MW)	2.76																														
																														Daily Average Savings	
Note: Highlighted in Blue is to be compared against highlighted in Green																														% Savings	

APPENDIX - 3

Site Measurement Sheet – 2

Measurement Site 2													
Site Details													
Location	Dimming Hall												
Area (Sq. Ft)	600												
Occupant (No of persons - Aprox)	50												
AC ON Time in 2017	**12.30 PM**												
AC OFF Time in 2017	**2.30 PM**												
Set Temp in Degree C in 2017	**21**												
Average daytime ambient Temp. in Degree C	**Sept**	**33**	**Oct**	**32**	**Nov**	**31**	**Dec**						
Duration of reading	**Sept. to Dec. 2017 and Sept. to Dec. 2018**												
Average Voltage	**372 V**	**Average Power Factor**	**0.82**										
AC Name plate details	Make - Voltas	Rotary Compressor	Model: MDV252W	Nominal Capacity - 25.2	Rated Current - 20.8 A	Total TR- 25							
Ultrasonic Heat Meter descriptions	Make	SHENITECH	Model	280T-DN80									
Fan Details - 10 Nos.	Make	Orient	Model : IS 80	Rated	80	Fan Current	4.5	Total Power	790				

Site Measurement Sheet – 2 (Contd.)

D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	D17	D18	D19	D20	D21	D22	D23	D24	D25	D26	D27	D28	D29	D30	Daily Average
30-11-2017	03-12-2017	04-12-2017	05-12-2017	06-12-2017	07-12-2017	10-12-2017	11-12-2017	12-12-2017	13-12-2017	14-12-2017	17-12-2017	18-12-2017	18-12-2017	19-12-2017	2012-2017	21-12-2017	24-12-2017	26-12-2017	27-12-2017	28-12-2017	31-12-2017	01-01-2018	02-01-2018	03-01-2018	04-01-2018	07-01-2018	08-01-2018	09-01-2018	10-01-2018	

D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	D17	D18	D19	D20	D21	D22	D23	D24	D25	D26	D27	D28	D29	D30	Daily Average
30-11-2018	03-12-2018	04-12-2018	05-12-2018	06-12-2018	07-12-2018	10-12-2018	11-12-2018	12-12-2018	13-12-2018	14-12-2018	17-12-2018	18-12-2018	18-12-2018	19-12-2018	2012-2018	21-12-2018	24-12-2018	26-12-2018	27-12-2018	28-12-2018	31-12-2018	01-01-2019	02-01-2019	03-01-2019	04-01-2019	07-01-2019	08-01-2019	09-01-2019	10-01-2019	
																												Daily Average Savings		
																												% Savings		

D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	D17	D18	D19	D20	D21	D22	D23	D24	D25	D26	D27	D28	D29	D30	Daily Average
17-10-2017	19-10-2017	22-10-2017	23-10-2017	24-10-2017	25-10-2017	26-10-2017	29-10-2017	30-10-2017	31-10-2017	01-11-2017	02-11-2017	05-11-2017	07-11-2017	08-11-2017	09-11-2017	12-11-2017	13-11-2017	14-11-2017	15-11-2017	16-11-2017	19-11-2017	20-11-2017	21-11-2017	22-11-2017	23-11-2017	26-11-2017	27-11-2017	28-11-2017	29-11-2017	

D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	D17	D18	D19	D20	D21	D22	D23	D24	D25	D26	D27	D28	D29	D30	Daily Average
17-10-2018	19-10-2018	22-10-2018	23-10-2018	24-10-2018	25-10-2018	26-10-2018	29-10-2018	30-10-2018	31-10-2018	01-11-2018	02-11-2018	05-11-2018	07-11-2018	08-11-2018	09-11-2018	12-11-2018	13-11-2018	14-11-2018	15-11-2018	16-11-2018	19-11-2018	20-11-2018	21-11-2018	22-11-2018	23-11-2018	26-11-2018	27-11-2018	28-11-2018	29-11-2018	
																												Daily Average Savings		
																												% Savings		

DATA COLLECTION	From Sept 3, 2017 to Jan 10, 2018																														
Data collection day	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	D17	D18	D19	D20	D21	D22	D23	D24	D25	D26	D27	D28	D29	D30	Daily Average
Data collection date	03-09-2017	04-09-2017	05-09-2017	06-09-2017	07-09-2017	10-09-2017	11-09-2017	12-09-2017	14-09-2017	17-09-2017	18-09-2017	19-09-2017	20-09-2017	21-09-2017	24-09-2017	25-09-2017	26-09-2017	27-09-2017	28-09-2017	01-10-2017	03-10-2017	04-10-2017	05-10-2017	08-10-2017	09-10-2017	10-10-2017	11-10-2017	12-10-2017	15-10-2017	16-10-2017	
Current (A)	13.86																														
Power Consumption (MW)	14.65																														

DATA COLLECTION	From Sept 3, 2018 to Jan 10, 2019																														
Data collection day	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	D17	D18	D19	D20	D21	D22	D23	D24	D25	D26	D27	D28	D29	D30	Daily Average
Data collection date	03-09-2018	04-09-2018	05-09-2018	06-09-2018	07-09-2018	10-09-2018	11-09-2018	12-09-2018	14-09-2018	17-09-2018	18-09-2018	19-09-2018	20-09-2018	21-09-2018	24-09-2018	25-09-2018	26-09-2018	27-09-2018	28-09-2018	01-10-2018	03-10-2018	04-10-2018	05-10-2018	08-10-2018	09-10-2018	10-10-2018	11-10-2018	12-10-2018	15-10-2018	16-10-2018	
Current (A)	11.2																														
Power Consumption (MW)	11.66																														
																													Daily Average Savings		
Note: Highlighted in Blue is to be compared against highlighted in Green																													% Savings		

APPENDIX - 4

Participant's Feedback Record Sample

	Section 1: Organisation Details				Section 2: Participant Details							Section 3: Transfer of Training										Section 4: Peer Support									Section 5: Performance Feedback									Section 6: Energy Conservation								
Sl No	ON	HY	TO	NPW	A	G	Department	Designation	LS	LE	ECT	INT	TOT 1	TOT 2	TOT 3	TOT 4	TOT 5	TOT 6	TOT 7	TOT 8	TOT 9	TOT 10	TOT 11	PS 1	PS 2	PS 3	PS 4	PS 5	PS 6	PS 7	PS 8	PS 9	PF 1	PF 2	PF 3	PF 4	PF 5	PF 6	PF 7	PF 8	PF 9	EC1	EC2	EC3	EC4	EC5	EC6	EC7	EC8	EC9
1		9	1	32	1	0	Admin	Secretary	0	3	0	1	4	4	4	4	4	4	5	3	4	4	4	4	4	4	4	5	4	4	4	3	5	4	4	4	4	2	5	4	4	5	5	5	4	4	4	5	4
2		9	1	32	1	1	Electrical	Supervisor	0	3	1	2	4	4	4	4	4	4	5	2	5	4	4	4	4	5	4	4	5	4	5	5	3	4	5	5	5	3	4	5	4	5	4	4	5	4	4	5	4
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BRIEF PROFILE OF THE AUTHOR

Senior techno-commercial professional with over **37 years** of experience with international exposure in business leadership, project management, client interaction, operations and maintenance, manufacturing, energy conservation, concept selling, marketing, training, and team building. **PMI certified Project Manager** has more than 50 project execution experience. **Certified Professional Engineer, BEE Certified Energy Manager, and Energy Auditor,** IIT Delhi, and NPC Chennai trained Energy Auditor with **20 years of hands-on ESCO experience** in performance contracting business. Recognized for visionary leadership and the ability to deliver tightly time jacketed assignments. Experience includes service onboard Indian Naval ships and dockyards in India and UK.

Key Skills:

1) Operations leadership, P, and L management.
2) Business development, marketing, finance management, and revenue flow.
3) Greenfield and brownfield projects management for new and running manufacturing facilities, Electrical Sub-Stations, Commercial buildings, and multistoried residential buildings.
4) Energy conservation, diagnostic engineering, operations and management (Marine and Non-Marine), manufacturing, project management, concept selling, marketing, and business development in marine, oil and gas, utilities, and manufacturing.
5) Conducting energy audits (In 3 ESCOs) and detailed value engineering to save much more with much less investment.
6) Tendering processes and driving institutional business.
7) ESCO Business (Performance Contracting) and materials management.

8) Project management, scoping, and coordination business requirement agreements and documentation.
9) Client interaction, onsite operational, and technical support.
10) Supply chain management, strategic sourcing, and procurement,
11) Cost mitigation and inventory management.
12) Team management, professional development, and training.
13) Relationship management and collaboration.
14) Set up and roll out and production management.

Significant Professional Achievements:

1) Design, manufacturing, installation, and commissioning of SCADA systems for 27 sub-stations in 5 zones in Saudi Arabia as GE VAR for JAL International within budget and schedule to replace/upgrade the existing systems.
2) Securing single order for a single GE product worth USD 7.6 M for JAL International as GE VAR in Saudi Arabia.
3) Conducted audits and submitted more than 50 energy conservation proposals worth a business potential of US $ 100 M for ESCO, Muscat.
4) Introduced 3 new business lines i.e. Capacitor Bank, Control & Relay Protection Panels, and Analyzer Shelter for JAL International in Saudi Arabia.
5) BEE (Govt. of India) accreditation as an ESCO for Baron Power Ltd. and the ONLY one in its field of Business for power quality solutions provider.
6) Instrumental in securing 16 municipality corporation street lights energy conservation projects in T N by Asian Electronics Ltd.
7) SEC, Aramco, and CSA (Canadian) accreditation of JAL International manufacturing facilities for Scada systems, gas detectors, and analyzer shelters within 6 months as GE & Detcon VAR.
8) Placed Baron Power Ltd. company all over Indian markets by presenting technical papers in CII, FICCI, and all India Cement manufacturers fora.
9) One amongst very few engineers who could maintain Russian weapon control systems and the same made on western technologies that are

used by the Indian Navy.

10) Increased the monthly order booking from Rs. 50 L to Rs. 2.5 Crores from Jan. 2007 to March 2008 for Baron Power Ltd.
11) Managed a temporary ship repairing facility at Chennai with limited resources for 4 years with visiting engineers and technicians (Service personnel and dockyard civilian employees) from Visakhapatnam Dockyard for giving repair/maintenance support to visiting Indian Naval ships. Worked in Vizag dockyard and Devonport dockyard in the UK with Royal Navy for refit and recommissioning of INS Viraat (Aircraft Career Ship) in the Indian Navy.
12) Completed the major modification/modernization of a running factory of Al-Kuhaimi Metal Industries in Saudi Arabia without stopping the production even for a day and within the given time and budget.
13) Set up a new manufacturing facility for Al-Kuhaimi Metal Industries from the design stage to commissioning as the project manager and doing the complete electrical job in-house without any external support.
14) Instrumental in developing evaporative condenser for ESCO Muscat in collaboration with IIT Delhi in HVAC applications for energy conservation.
15) Introduced Maintenance Management system in three plants of Al-Kuhaimi Metal Industry in Saudi Arabia.

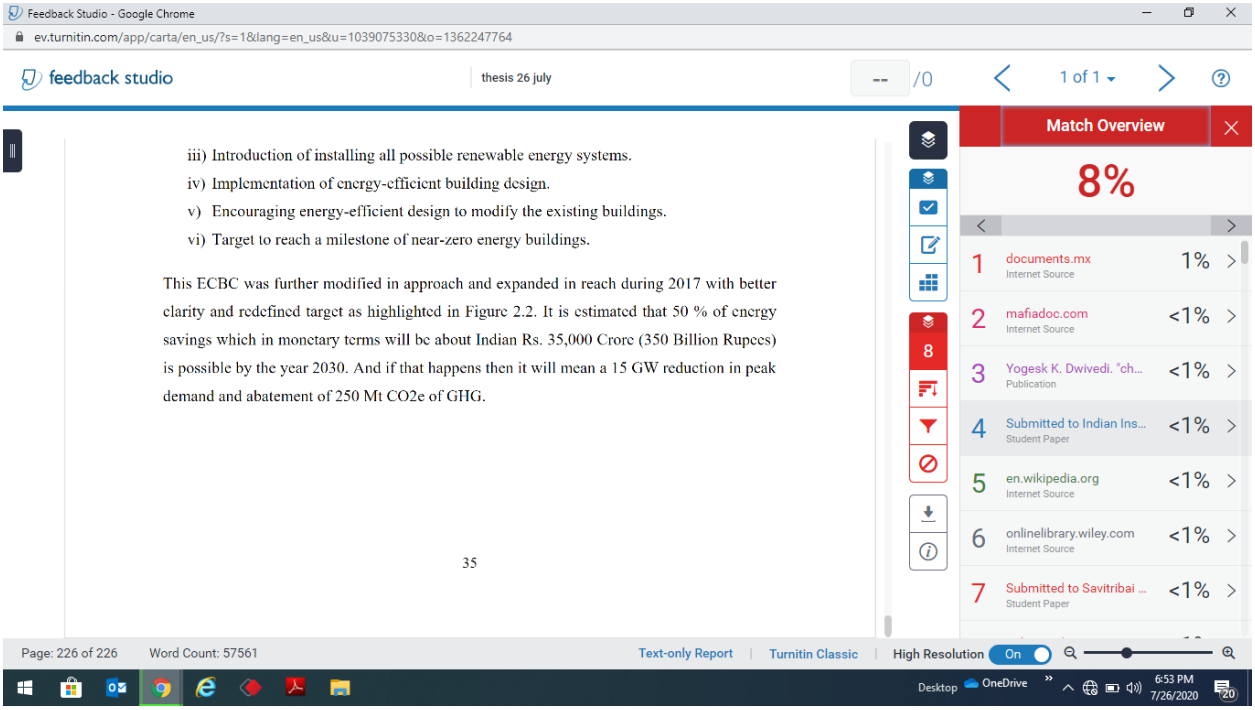
Publications:

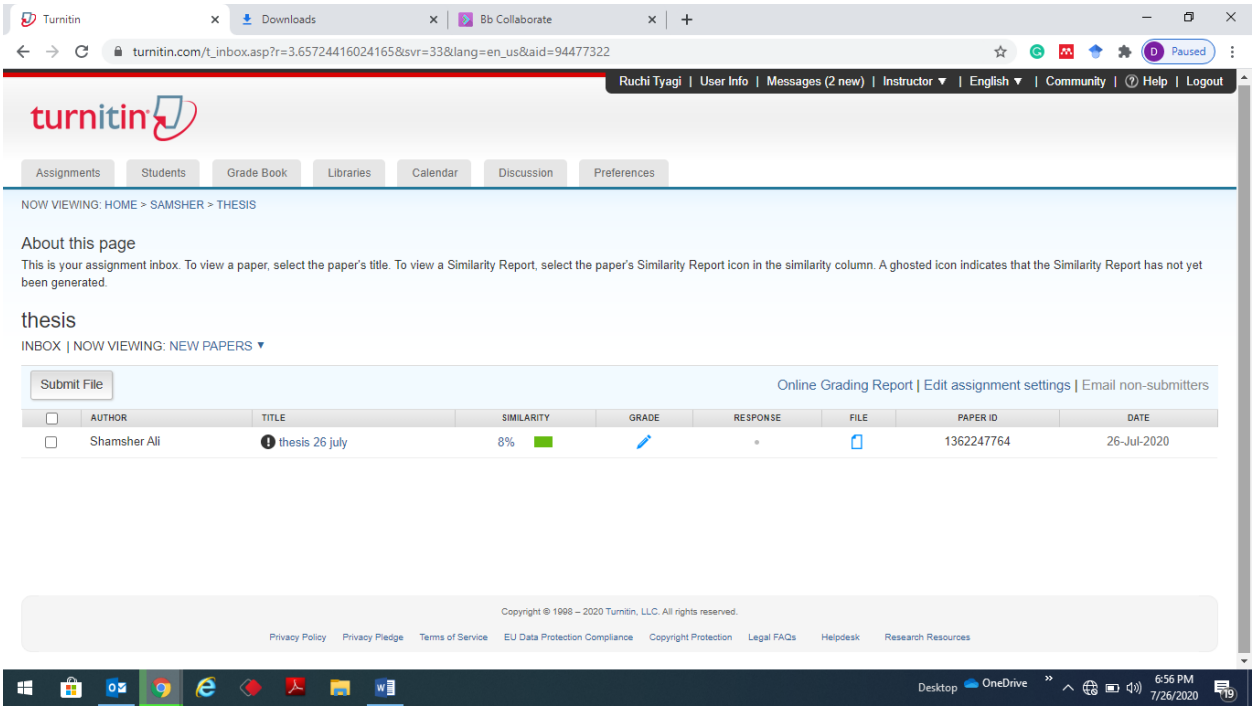
1. **S S Ali** and Ruchi Tyagi (2020); "The role of Energy Conservation Building Code 2017 in Indian Energy Policy"; International Journal of Recent Technology and Engineering (IJRTE) ISSN: 2277-3878, Volume-9 Issue-1, May 2020, https://www.ijrte.org/wp-content/uploads/papers/v9i1/A2212059120.pdf
2. **S S Ali**, Ruchi Tyagi and Ragini Chauhan (2019); "Energy conservation project funding in commercial building: an expenditure or investment?"; International Journal of Power Electronics and Drive System (IJPEDS),

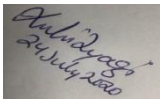
Vol. 10, No. 1, March 2019, pp. 504~513 ISSN: 2088-8694, DOI: 10.11591/ijpeds.v10.i1.pp504-513.

3. Ruchi Tyagi, Atul Agrawal and **S S Ali** (2018); "Indian Renewal Energy Act 2015: a step towards reducing carbon footprint"; Indian journal of power and river valley development, Vol. 68, Nos. 9 & 10, (2018) pp 145 -151.
4. **S S Ali** and Ruchi Tyagi (2018); "Economic way to mitigate harmonics in industry: a case study"; Indian journal of power and river valley development, Vol. 68, Nos. 3 &4, (2018) pp 37 -42.
5. **S S Ali** (2018); "No cost energy conservation measures (NCECM) leads to energy saving: A Fad or Truth"; Journal of Power electronics and power systems, Vol. 8, No. 1 (2018) pp 53-59.
6. **S S Ali** (2016); "Wind Turbine and Harmonics"; Windpro, Vol.4, Issue 5, (2016) pp 17-19.
7. **S S Ali** and Nidhi M J (2016); "Carbon Credit for financing renewable projects": Electrical India, Vol. 56, No. 12, (2016) pp 72-74.
8. **S S Ali** (2014); "How concerned are we about energy which is going to be exhausted one day?"; Electrical India, Vol. 54, No.1, (2014) pp 118-122.
9. **S S Ali** (2009); "Should we be concerned about power harmonics?"; Energetica India, #002, (2009) pp 52-54.
10. **S S Ali** (2008); "Harmonic mitigation for technological excellence"; Madurai Productivity Council, 28Th All India Cement Seminar, Nov. 2008, pp 39-88.

Plagiarism Check Report







Dr. Ruchi Tyagi

Dr. Ragini

Dr. Vijaykumar Kunche