

Energy Efficiency in Pakistan Industrial Sector: An analysis of Key Barriers

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Abstract— The prevalent energy crisis in Pakistan has affected people and systems in every aspect of the life for the past decade, impacting the economic growth the most of all. The main driver of this slump in economic growth has been the inefficient utilization of the energy resources, further exacerbated by the blunders in decision-making and policy formulation in the uppermost echelons of the country. Energy conservation and efficiency is extensively used to cope with energy crisis that the current world is facing as a powerful tool for addressing the global energy situation. There are different methods of energy efficiency management that can bring positive change i.e. reduce cost at different levels if executed correctly such as increasing energy security or by carrying out different measures to reduce carbon emissions to environment etc. Despite the fact that different energy efficiency management systems are gaining attention in the developed countries, their adoption in underdeveloped countries remains limited, particularly in Pakistan. Pakistan is now experiencing energy crisis, which entails a slew of complicated issues, all of which may be rectified by implementing an energy efficiency management system, if applied to the energy-intensive economy. This research was conducted to explore the different barriers to implementing Energy Management System in different industries across Pakistan. This research is relies on data collected through detailed questionnaire from the industries that participated in an incentive program funded by UNIDO for conducting free energy audits. 20 industries participated in the study. Regression and Pearson correlation analysis are used to study how different parameters create barriers to implementing Energy Management System in industries in Pakistan.

Keywords— EnMS, Industrial energy efficiency, International energy agency, NEECA, ENERCON, PEECB.

I. INTRODUCTION

The prevalent energy crisis in Pakistan has affected people and systems in every aspect of the life for the past decade, impacting the economic growth the most of all [1, 2]. The main driver of this slump in economic growth has been the inefficient utilization of the energy resources, further exacerbated by the

blunders in decision-making and policy formulation in the uppermost echelons of the country [3]. The industrial sector has faced the severest consequences of this downfall in energy utilization and the economic growth retardation, evident from the fact that a significant portion of the country's industry has either shutdown completely or shifted their operations to neighboring countries like Bangladesh [4]. This catastrophe could have been averted through programs enhancing the energy efficient systems and energy utilizations in the country, from the start, however there have been scarcely any such noticeable program. Pakistan's energy utilization trends have not been representative of healthy distribution of resources among domestic and commercial sectors with only less than 40 percent of energy consumed in the industrial sector, a further extenuating circumstance arises from the waste of energy in industries severely impacting the market competitiveness of the products produced indigenously. According to a survey, there exists a sizeable opportunity of energy efficiency improvement and energy conservation potential in the various sectors, such as 25% in industrial manufacturing, 20% in agriculture, 20% in transport sector, while 30% in domestic sector and buildings [5]. It is posited that the implementation of energy saving measures through an integrated energy management system can enhance the energy use in industrial sector by a significant margin [6-8]. However, as is the case in most developing countries, Pakistan, too, faces the shortage of such schemes to increase awareness of energy efficiency and the adoption of energy efficient practices is abysmal to say the least. Understanding and classification of the problems that deter the implementation of energy efficiency measures in Pakistan are very important. Although the government has said that it will support the adoption of energy efficiency initiatives, there have been several delays and inefficiencies in their implementation. There is a lot of advanced research done to identify various barriers to implementation; however, relatively little research has been done to identify difficulties posed by this energy-intensive economy. If these barriers are identified from an organization's perspective, key stakeholders in the sector will be better able to cope with the issues related to energy efficiency implementation, which will lead to greater benefits and outcomes.

There has been minimal change in the acquisition of energy efficiency in the energy consumption sectors both globally and in Pakistan especially. Furthermore, it is intensified by the lack of knowledge amongst the masses on how to efficiently save energy by reducing kilowatt-hours, expenditures, and Emissions of carbon dioxide. [8]. Capturing the Multiple Benefits of Energy Efficiency continues to highlight 2035 estimates, which suggests that “nearly 60 percent of potential to save energy will still remain untapped unless we bring a significant change of policies affecting the overall energy usage.” [9]. This is illustrated in Figure 1 below where the off-colored areas shows global unrealized energy efficiency potential in the most energy intensive sectors.

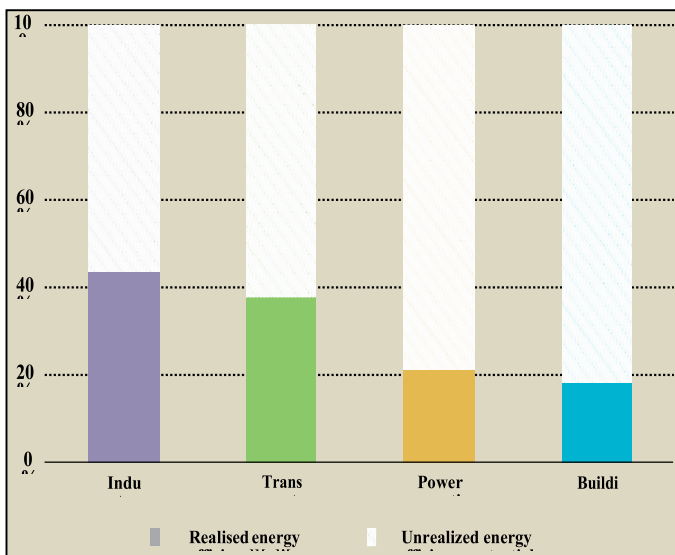


Figure 1. Global unrealized energy efficiency potential in the energy intensive sectors [9]

In addition, Pakistan has a small number of energy efficiency programs and very limited incentives are given to those who adapt these energy savings programs. This limitation emphasizes the need for continuity, improvement and expansion of effective schemes to promote energy efficiency. The current study focuses on companies that have participated in Sustainable energy initiative for industries in Pakistan (UNIDO) energy efficiency program, and know their utility bills, but have failed to use the different energy saving measures that were recommended to them by the energy auditing firm.

Given that effective energy usage may considerably reduce energy usage, a valid concern rises about savings and growth from economic perspective like what stops them from being adopted, for example, if the return on energy efficiency may surpass the return on investment in the business, generating robust cash flow via assured efficient technology and strong management commitment? Companies will gain tremendously from incentive programmes, particularly free energy auditing programmes, which will provide them with essential information and support in attaining energy efficiency.

II. LITERATURE REVIEW

All over the world a special emphasis has been creeping in on the adoption of energy efficient practices in manufacturing

and this sector is now considered as the most bountiful avenue of carbon mitigation around the world [10]. A number of studies have been conducted in countries from different spectrum of development indicating a vast potential for energy conservation such as in USA [11-12], UK [13], Bangladesh [14-16], India [17-19] and many others [20-29].

All these studies unanimously and unequivocally emphasise the importance of energy conservation and energy efficiency systems in achieving a diverse set of positive outcomes like decreasing utility bills, import bills in lieu of fossil fuels, improvement in the competitiveness of the products, improvements in environment, and extended lifetime of the residents [30]. Albeit the energy efficiency has been on a steep rise in the developing countries in the industrial and domestic sectors, the developing countries are still lagging behind in this arena [31]. This approach of energy management systems complements the overall development of the countries and the circular economy by reducing the costs of the most important commodity in the world [32].

Moreover with the advent of industry 4.0—the fourth industrial revolution, there has been special interest in the use of Internet of Things (IoT) for streamlining the industrial processes towards better efficiency in energy use [33].

The enhancement in energy efficiency in a country stems mostly from a concentric government effort in the policy sector for devising regulations and schemes for energy efficiency [6-8]. In Pakistan as well there have been considerable efforts on record for improving and moulding the energy policies towards energy management [34-44]. Researchers have found a general lack of use of modern energy modelling tools like LEAP/MARKAL as inputs to the policy formulation, and put greater emphasis on the use of these tools for sustainable and successful energy policies [35]. Research indicates that renewable resources have the potential to alleviate the energy pains of Pakistan in future scenarios when projected through the modern tools like MARKAL [36]. The renewable energy technologies, in addition to becoming more economically feasible, are also capable of addressing the looming climate change catastrophe facing the country [37, 38].

In addition some researchers presented a comparative analysis of various renewable energy technologies such as solar, wind, biomass, geothermal and others in the context of their techno-economic and socio-environmental impacts through various data analytics techniques and realized that the use of hydro power is the most feasible option considering the economic conditions of the country and the abundant availability of the resources [39]. Similarly another study analysed the CPEC energy projects in Pakistan and found that these projects have the potential to pump fresh life in to the economic and industrial lives of the country [40].

Considerable emphasis has also been placed by research works on the feasibility and importance of the energy management systems in industries for process improvement and economic competitiveness. The research work has addressed the energy use in diverse industrial sectors in Pakistan such as textile [41], Combined Cycle Power Plants [7], cement sector [8] and residential sector [42].

Nadeem et al. conducted studies highlighting the barriers to energy efficiency in the government sector in Pakistan, and the need for energy efficient infrastructure in various industrial processes [43]. Hassan et al. conducted another study in Pakistan that investigated the link connecting the size of firms, the capacity of the staff, in context of barriers to energy efficiency improvement [44].

A. Energy Management System Programs:

The 2018 state of industry report by NEPRA Pakistan states that close to 64% of the energy consumption in the country is produced by thermal energy sources, with the hydel contributing 26% and renewable 6% [45] as shown in the figure 2 a, while the proportion of energy used in different sectors of the country is shown in figure 2 b.

The end usage of energy in different fields is represented in the graph in figure 3 [46, 47]. There has been a consistent rise in the energy use profile of the country for the year 2013 until the year 2018 with the 5-year period accumulative increase amounting to 30%. In the same 5-year period the country added a capacity of 7000MW energy generation for addressing the shortfall. With the depletion of energy reserves, primarily natural gas, which accounts for 50% of the thermal power generation in the country, there needs to be an effort for increasing the resources of energy generation.

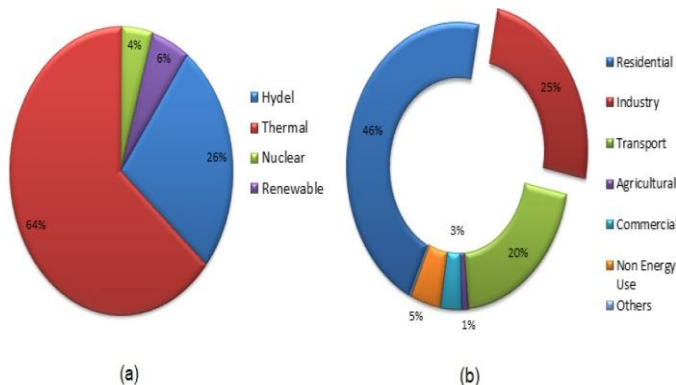


Figure 2. (a) Pakistan energy production in 2018 and (b) breakdown of energy consumption in different sectors.

All of the energy efficiency programs and initiatives in Pakistan are governed by a sub-autonomous government body known as Pakistan Energy Efficiency and Conservation Board (PEECB). Ever since the inception of the country in 1947, there has been a somewhat muted attempt at devising energy and power policies for enhancing the energy use. The first such attempt was made in the 1960s which was further extended through 5 year plans [34]. In 1986, the country’s first body dedicatedly addressing the need for energy efficiency in the country was established as National Energy Conservation Centre (ENERCON). ENERCON fulfilling its responsibility help made an energy conservation act which led to the creation of NEECA—National Energy Efficiency and Conservation Authority responsible for overseeing the implementation of energy efficiency programs in the country [35]. Accordingly, the

PEECB was modified to consist representatives of national and provincial governments, OGRA and NEPRA heads, one representative each from Chambers of Commerce and Agriculture, and five private citizens.

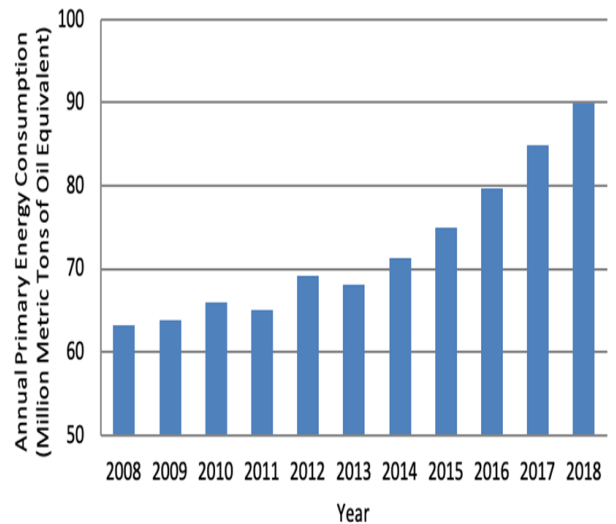


Figure 3. Energy use in Pakistan from 2008 to 2018.

Barring the establishment of the authority, there have not been any concrete government sector efforts in the improvement of energy conservation and energy efficiency profiles of the country with the most prominent programs in the sector spearheaded by international funding agencies and UN. Even that the ENERCON itself was established with funding from USAID [48]. An initiative by Royal Netherlands Embassy supported an initiative for reduction of waste energy in the industrial sector through Energy efficiency measures [49]. In addition GIZ and Switch Asia Programs were launched with funding from European Union to improve the effect of the energy management programs on industrial efficiency. The program worked in the textile, steel rolling, foundry, edible oil, hospitals, sugar, and tannery sectors and achieved significant improvements in the targeted industries [50]. A similar program was launched by USAID in 2009 for delivering the trainings to industrial sector personnel and also looked in to development of energy efficiency plans for industrial sectors.

More recently UNIDO’s Sustainable energy initiative for industries in Pakistan was launched under the umbrella of REE and GEF. The project, started in 2019 undertook the implementation of ISO 50001 Energy Management System in 50 industries in Pakistan as pilot project. The project also delivered trainings to the personnel in the industries to carry the program forward in future.

Adding to the apparent savings in energy consumption, the European Environment Agency (EEA) points to plenty of other benefits of energy efficiency adaptation, leading to not only enhanced social life and better economic situation but environmental conservation as well [51].

B. Energy Efficiency as a mechanism to mitigate climate change:

Baumert in his research asserted that the problem of climate change is mostly because of the inefficient use of energy resources [52]. Even though the basic purpose of this research is not addressing the issue of climate change, still it is imperative to highlight the connection between climate change and energy efficiency. Kalichi in his research established that since the industrial revolution there has been a large upsurge in the emission of pollutants and greenhouses gases into the atmosphere causing the overall increase earth temperature [53]. IPCC quantified in their report that about 78 % of total increase in green house gas emissions between 1970 and 2010 were caused by the using of fossil fuels. Furthermore the report asserts that of that increase in green house gas emissions, around 47% came directly from the use of energy, industries contributed about 30 % and transport had a share of 11% which justifies Baumert assertion of climate change being an energy problem [54].

Many countries "strategically integrate energy efficiency programmes with GHG reduction targets" along with their demanding commitments to decrease the emissions of GHG in order to extenuate the climate change [55]. The International Energy Agency (IEA) produced twenty-five suggestions to bring improvement in energy efficiency related policies and practices for member nations in 2008. The major sectors that were covered in the suggestions consisted of policy suggestions for energy efficiency in buildings, energy efficiency in appliances, lighting, energy efficient means of transportation and bringing energy efficiency in industries. [56] The IPCC also identified all of these categories as substantial sources to CO₂ emissions [53].

Conferring to the International Energy Agency (IEA) policy suggestions to its member states for energy efficient policies, if these twenty-five policies were adopted internationally, CO₂ emissions would be reduced by 7.6 gigatonnes (Gt) each year by 2030.

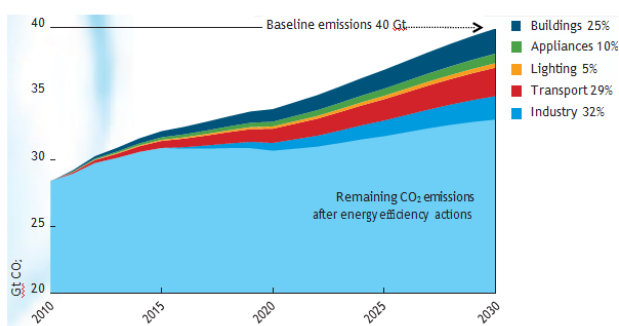


Figure 4. Potential CO₂ savings from adaptation of IEA's recommendations for energy efficiency measures and policies [53]

Figure 4 shows the CO₂ savings potential of the above-mentioned EE policy proposals, which is small in contrast to the remaining CO₂ emissions. The fact that industry contributes for 32% of potential savings is particularly important to our study. In 2010, the industrial sector accounted for 13 Gt of GHG emissions, which are expected to increase by 150 percent by

2050 "unless energy efficiency improvements are implemented at an emergency basis" [53], emphasizing the significance of rigorous technological, governmental, and social energy-efficiency measures. According to one study, "Adaptation of energy efficiency measures and practices in the manufacturing sector is the most essential and economical way of reducing greenhouse gas emissions" [54]. Recent data around climate change has moved the climate change policy discussion from an "if" to a more forward-thinking and immediate "when" and "how" attitude with relation to greenhouse gas emissions reduction [55]. While energy efficiency is not the sole factor in lowering GHG emissions, it is unquestionably an important instrument in attaining these global objectives.

C. 2.3 Energy Efficiency as a mechanism to mitigate energy insecurity

Amongst the benefits of adapting different measures for the uptake of energy efficiency is that "supply security improves and different resources that are finite are conserved," making energy efficiency a viable solution to energy insecurity [56]. Energy security is defined as the "uninterrupted supply of critical energy services" by the International Institute for Applied Systems Analysis (IIASA), which further distinguishes energy vulnerabilities between industrial or industrialized countries and emerging economies [57]. Winzer in his research outlines some political vulnerabilities, emphasizing the significance of efficient energy use to promote energy security:

- United States: a reduction in political extortion vulnerability (by actively promoting energy self-sufficiency and increasing renewable energy shares)
- Brazil: a reduction in political extortion vulnerability (by decreasing the import of fossil-fuel and increasing the share of renewable energy in energy mix)
- Protection of the poor citizens against the fluctuations in costs. [58]

Cherp et al in their research identified three distinct strategies to energy security that have been academically discussed and preferentially developed based on the policy objectives described previously. The following are the three methods or perspectives: natural science and engineering; political science; and economics, as well as the study of complex systems [59].

Cherp et al in their research also identified different historical causes or vulnerabilities that were the basis for shifting attention towards energy security, some of them are as follows.

During World War 2 the demand for fossil fuel was very high at the time, nonetheless many institutions like British war forces etc, were unable to avoid relying on imported oil. Battles over oilfields erupted in places like the Middle East and Romania during this time, leaving many nations and militaries vulnerable owing to a shortage of energy resources. Moreover, developed economies were significantly reliant on more oil than they could generate on their own at the time. Acquiring oil was critical for a variety of tasks, including transportation, agriculture, industries, and power generation. Concerns regarding energy security have grown as a result of emerging, conflict-ridden oil nations' reliance. In turn, the same emerging

oil countries grew economically and politically reliant on oil exports, resulting in the creation of a "oil weapon" system. [59]

Natural resource dependency arose in the twentieth century as a result of this. For example, the EU's power generation is highly reliant on imported natural gas. During the 2009 Russian-Ukraine gas crisis, the EU's energy security was jeopardised due to supply interruptions. [59]

Cherp et al carry on discussing the idea of limited resources which contributes further to the already existing energy concerns. The expansion of different economies as well as population across the globe cannot be sustained owing to the limit quantity of resources, as scientific evidence shows. The impact climate change owing to the consumption of these resources has lately heightened public consciousness of the issue of energy security. The substantial reliance on diminishing resources like coal or oil for energy systems, raises concerns about "mainstream energy security" [59]. Since the repercussions of disasters like Chernobyl have been so lifelong, a continuous discussion over nuclear power plant safety also adds to the definition of energy security globally.

To conclude, according to the IPCC adapting energy efficiency measures would make systems more robust to different types of disruptions and pressures, as well as help protect economies from price swings and unforeseeable disruptions in supply" [52]. Energy efficiency is unquestionably a good option since it may help relieve the challenges to energy security in a variety of ways.

III. METHODOLOGY

To conduct this research a questionnaire was developed based on literature review consisting of 17 different questions representing the 3 main variables i.e. Technical Issue, Management issue, Financial Issue. Quantitative research method was used for this research based on questionnaire survey. The following figure 5 shows the flowchart that was followed to conduct this research study

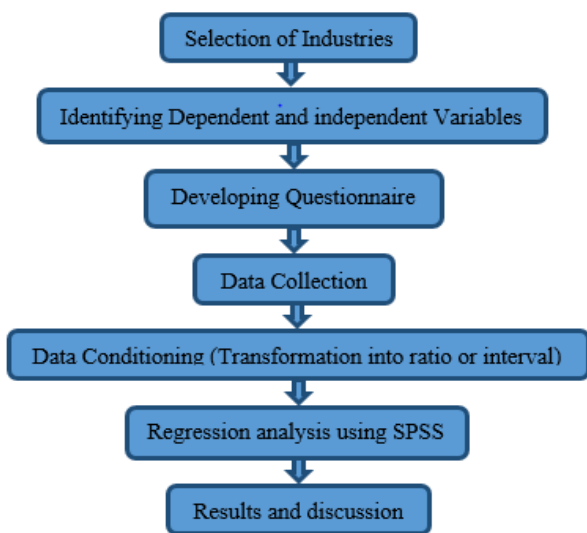


Figure 5. Methodology Flowchart

There are two types of variables used in this study. First one is dependent variable and second one is independent variables. The dependent variables in this study is barriers to energy management system implementation. There are 3 independent variables used in this study to see their effect on the barriers to EnMS implementation. The independent variables used in this research study are financial issues, Technical issues and Management issues.

A. Research Sample

The target industries for this research study were 20 industries that participated in UNIDO funded energy audit initiative. These 20 industries already had the energy audit report that identified the energy savings measures need to be taken in order to be energy efficient. The industries had problems implementing the energy saving measures identified in the energy audit report. The mid and upper level management employees were selected from each company to fill out the survey. The survey consisted of 19 different questions and it was shared online with all the industries that were part of the research sample.

B. Data collection procedure

Questionnaire was developed from literature review. The questionnaire consisted of 19 different questions representing three independent variables. The industries were asked to fill the survey using Likert scale ranging from 1 to 5, 5 being the most important. The responses collected from the survey was then grouped accordingly to represent the 3 independent variables.

C. Normality Tests

Normality tests are performed to check whether the data we have is normally distributed or not. If the results of normality tests shows that the data is normally distributed then we will use ANOVA and Pearson correlation tests. However, if the results of the normality tests indicates that the data distribution is not normal then we will use non-parametric tests like Kruskal-Wallis H test and Spearman correlation.

After the data collection from survey Normality tests were performed to check the distribution of the data. The following table 1 shows the result of the test:

TABLE I. RESULTS OF NORMALITY TESTS

	Tests of Normality					
	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	Df	Sig.
FinRes	.133	20	.200 [*]	.963	20	.612
TechRes	.173	20	.118	.915	20	.081
Manalssue	.166	20	.150	.930	20	.154

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

The Shapiro-Wilk test shows that the p-value of all the variables is greater than 0.05, indicating that the data normally distributed. Therefore parametric tests i.e. linear regression will be used in this study.

D. Skewness and Kurtosis of Likert scale

Skewness test and kurtosis test are used to check the assumptions of conducting parametric tests, like Pearson correlation. "Skewness test evaluates the range to which a variable's distribution is symmetrical. If the distribution of responses for a variable stretches toward the right or left tail of the distribution, then the distribution is stated to be skewed. Kurtosis test is a measure of whether the distribution is too peaked (a very narrow distribution with most of the responses in the centre) [64].

E. Regression Analysis

Regression analysis is used to find a relationship between two or more variables. These variables consists of dependent and independent variables. Simple linear regression contains only one explanatory variable whereas multiple linear regression consists of more than one variable. The aim of regression analysis is to predict dependent variable using independent variables.

The equation for simple linear regression is as follows

$$Y_i = \alpha + Bx_i + \sigma_{res}$$

Whereas for multiple linear regression the following equation is used

$$Y_i = \beta_0 + \beta_1X_1 + \dots + \beta_nX_n + \sigma_{res}$$

Y= Dependent Variable

X= Independent Variable

Is the Intercept

B= slope line

β_0 = is the intercept

β_1X_1 = regression coefficient

σ_{res} = Residual standard deviation

IV. RESULTS

After data collection linear regression analysis was carries out and results were collected to demonstrate the relation between different variables and their overall impact on barriers to implementation of energy management system. The following table 2 shows the results of normality test run on the different variables while table 3 shows the means, standard deviation and skewness and kurtosis results of all the variables present in the current study. Financial resources has a mean value of 3.82 with standard deviation value of only 0.45. The technical issues has a mean value of 3.13 with standard deviation value of 0.57. The management issues has a mean value of 2.58 with standard deviation value of 0.42.

TABLE II. RESULTS OF NORMALITY TEST RUN ON THE DIFFERENT VARIABLES

	Tests of Normality					
	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
FinRes	.133	20	.200 [*]	.963	20	.612
TechRes	.173	20	.118	.915	20	.081
Manalssue	.166	20	.150	.930	20	.154
EnMSB	.246	20	.003	.916	20	.082

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

TABLE III. DESCRIPTION OF MEAN, STANDARD DEVIATION AND SKEWNESS AND KURTOSIS VALUES

		Statistic	Std. Error	
FinRes	Mean	3.8200	.10250	
	95% Confidence Interval for Mean	Lower Bound	3.6055	
		Upper Bound	4.0345	
	5% Trimmed Mean	3.8333		
	Median	3.8000		
	Variance	.210		
	Std. Deviation	.45837		
	Minimum	2.80		
	Maximum	4.60		
	Range	1.80		
	Interquartile Range	.60		
	Skewness	-.456	.512	
Kurtosis	.167	.992		
TechRes	Mean	3.1333	.12773	
	95% Confidence Interval for Mean	Lower Bound	2.8660	
		Upper Bound	3.4007	
	5% Trimmed Mean	3.1667		
	Median	3.1667		
	Variance	.326		
	Std. Deviation	.57124		
	Minimum	1.83		
	Maximum	3.83		
	Range	2.00		
	Interquartile Range	.92		
	Skewness	-.892	.512	
Kurtosis	.225	.992		
Manalssue	Mean	2.5875	.09601	
	95% Confidence Interval for Mean	Lower Bound	2.3865	
		Upper Bound	2.7885	
	5% Trimmed Mean	2.5764		
	Median	2.5000		
	Variance	.184		
	Std. Deviation	.42939		
	Minimum	1.63		
	Maximum	3.75		
	Range	2.13		
	Interquartile Range	.47		
	Skewness	.569	.512	
Kurtosis	2.544	.992		

A. Regression Analysis

Regression analysis gives the following results.

TABLE IV. DESCRIPTION OF MEAN AND STANDARD DEVIATION OF VARIABLES

	Descriptive Statistics		
	Mean	Std. Deviation	N
EnMSB	3.2833	.43629	20
FinRes	3.8200	.45837	20
TechRes	3.1333	.57124	20
Manalssue	2.5875	.42939	20

TABLE V. PEARSON CORRELATION VALUES AND SIGNIFICANCE BETWEEN VARIABLES

		Correlations			
		EnMSB	FinRes	TechRes	Manalssue
Pearson Correlation	EnMSB	1.000	.672	.697	.657
	FinRes	.672	1.000	.251	.412
	TechRes	.697	.251	1.000	.236
	Manalssue	.657	.412	.236	1.000
Sig. (1-tailed)	EnMSB	.	.001	.000	.001
	FinRes	.001	.	.143	.036
	TechRes	.000	.143	.	.158
	Manalssue	.001	.036	.158	.
N	EnMSB	20	20	20	20
	FinRes	20	20	20	20
	TechRes	20	20	20	20
	Manalssue	20	20	20	20

Since the data we have is normally distributed and no outliers are detected for the last scale, the parametric Pearson Correlation is used. The Pearson correlation, is used to calculate the linear association between two variables. The coefficients of Pearson correlation range from -1 to 1 where -1 specifies a perfectly negative linear correlation between two variables; 0 indicates that there is no linear correlation between the variables, and 1 indicates a perfectly positive linear correlation.

The Pearson correlation in table 5 shows a significantly positive correlation between the Management issue and EnMS barriers ($r = .657$), $p = .001$. The correlation between Financial issue and EnMS barriers was also positive and significant ($r = .672$), $p = .001$. A similar statistically significant positive correlation was found between Technical issue and EnMS barriers ($r = .697$), $p = .000$.

TABLE VI. MODEL SUMMARY

Model Summary ^b					
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.930 ^a	.864	.839	.17517	2.765

a. Predictors: (Constant), Manalssue, TechRes, FinRes
 b. Dependent Variable: EnMSB

The model summary in table 6 depicts a 93% relationship between all the variables. The variation caused by the independent variable in the dependent variable is 86% as per the model summary. This means that these 3 independent variables can account for more than 86% variance in the EnMS implementation.

As shown in the Anova Table 7, regression analysis is used to check the prediction of barriers to EnMS implementation and Management Issue, Technical issue and Financial Issue. The F-statistics value ($f = 33.957$) is significant at 1 percent level ($sig. f < 0.0$) having a freedom between 3 and 19 degrees. This result approves the fitness of model.

TABLE VII. ANOVA ANALYSIS

ANOVA ^a						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	3.126	3	1.042	33.957	.000 ^b
	Residual	.491	16	.031		
	Total	3.617	19			

a. Dependent Variable: EnMSB
 b. Predictors: (Constant), Manalssue, TechRes, FinRes

TABLE VIII. COEFFICIENTS TABLE

		Coefficients ^a						
		Unstandardized Coefficients		Standardized Coefficients		95.0% Confidence Interval for B		
Model		B	Std. Error	Beta	t	Sig.	Lower Bound	Upper Bound
1	(Constant)	-.342	.377		-.907	.378	-1.142	.458
	FinRes	.370	.098	.389	3.793	.002	.163	.578
	TechRes	.390	.074	.511	5.306	.000	.234	.546
	Manalssu	.382	.104	.376	3.676	.002	.162	.602
	e							

a. Dependent Variable: EnMSB

The co-efficient table 8 shows that there is a statistically significant positive impact of management issue, technical issues and financial issues on barriers to EnMS implementation in all the participating industries. Therefore, we reject the null hypotheses that state that there is no impact of management issue, technical issues and financial issues. We accept the alternative hypothesis that states that there is a positive impact of management issue, technical issues and financial issues.

V. CONCLUSION AND RECOMMENDATIONS

Knowing that effective energy usage may considerably decrease energy usage, the argument from an economic standpoint raises valid concerns about savings and growth. What stops them from being adopted, for example, if the return on energy efficiency may surpass the return on investment in the business, generating strong cash flow via assured technology and management? Companies will gain tremendously from implementing EnMS, which will provide them with essential information and support in attaining energy efficiency.

Regression analysis of the data collected through questionnaire showed that availability of technical personnel for conducting and daily supervising industry activities was the main barrier in implementing EnMS in the industry. The second major component was financial issues i.e. lack of availability of funds for conducting energy audits and acquiring energy efficient machines and equipment. Lastly Management issue also rises in implementing EnMS in industries as there are long decision chains and energy objectives not integrated into operating, maintenance and procuring procedures. The response of participating industries suggests that dedicated technical personnel for conducting and implementing energy efficiency measures should be hired immediately.

The results of this study is compatible with the results from developed countries regarding barriers to implementing EnMS in industries. This study only used responses from 20

industries. In the future if more industries participate in the study the data will be more reliable.

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