Barriers, Drivers and Policy Options For Improving Industrial Energy Efficiency In Pakistan

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Abstract

Energy demand in Pakistan is far greater than its indigenous energy supply, leading to prevailing energy crises in the country. The industrial sector, as one of the largest consumers of energy in Pakistan has significant potential for widespread adoption of energy efficiency measures. However, past policies and plans on energy efficiency have not been widely adopted by the industrial sector of Pakistan. This paper identifies and addresses policy-related implementation and institutional gaps. A questionnaire used to collect data from the target group, selected from concerned government organizations, industry and academics in Pakistan. The results indicates the existence of economic, technical and organizational barriers to industrial energy efficiency and highlights stakeholders opinion about policy tools that can be adopted for promoting industrial energy efficiency in Pakistan. Based on results analysis, the paper explores key barriers and drivers to industrial energy efficiency in Pakistan. The paper also investigates that there is great scope for adoption of voluntary policy tools linked with incentive-based mechanism in energy intensive industries of Pakistan.

Keywords: Barriers, Drivers, Energy Policy, Industrial Energy Efficiency, Pakistan.

1. INTRODUCTION

Climate change and energy demand management are two defining global issues of the present age. Energy efficiency one of the key climate change abatement strategies has the potential to address both issues and offers tangible solutions [1]. Improvements in energy efficiency drive down energy consumption and, in turn, reduce greenhouse gas emissions [2]. The energy efficiency concept has vital applications in the industrial sector. It is one of the most significant and cost-effective options for mitigating greenhouse gas emissions from industry. Industry consumes almost 40% of the worldwide energy [3]. It contributes about 37% of the global GHG emissions [4]. The developing countries share of industrial CO_2 emissions from energy use rose from 18% in 1971 to 55% in 2005 [3].

Pakistan is a developing country located in South Asia. The energy sector in Pakistan has a vital role in the development and growth of the national economy. Energy supplies in Pakistan act as a major component for all sectors of the economy including the industrial sector. The supply side of Pakistan energy sector includes Water and Power Development Authority (WAPDA), Pakistan Atomic Energy Commission (PAEC), Karachi Electric Supply Company (KESC) and 28 Independent Power Producers [5]. Demand side of energy sector includes domestic, commercial, industrial, agricultural and transport sectors. Sector wise energy consumption in Pakistan is shown in figure 1. It shows industrial sector as one of the energy intensive sectors in Pakistan.

Energy demand in Pakistan is far greater than its indigenous energy supplies. Demand has risen significantly in the last few decades while energy supply has not increased at a pace to cope with rising energy demand [6]. As a result of this situation, the gap between demand and supply is increasing every year causing a state of energy crises in the country.

Electricity is the lifeline of all economic activities in the country. Pakistan has been facing an acute electricity shortage in the past decades and the situation has worsened in recent years. At the end of 2008, the electricity deficit in the country had reached 5000 MW and in a business as usual scenario the electricity deficit could touch 8000 MW in the years to come [7]. Electricity deficit of 8000 MW is a significant figure in view of the total installed electricity generation capacity of 22797 MW in Pakistan [5]. On the supply side, country has limited power generation capacity. Thermal power plants that generate more than 60% of power generation in the country rely mainly on imported fossil fuels. The rate of addition of new hydro power generation projects remained very low in the last two decades.

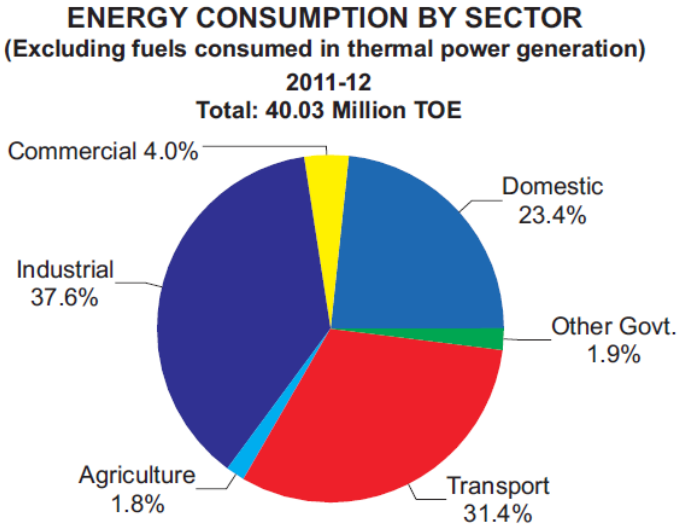

FIGURE 1: Energy consumption in Pakistan by sector for 2011-12 [5].

Many factors are causing energy crises situation in the country including inadequate energy supply capacity, inefficient utilization of energy resources and rapid increase in energy demand. Energy insecurity situation in Pakistan is creating short and long term effects. Immediate effects are appearing in the form of increased power and gas load shedding and high oil imports while associated short-to-long term effects can be seen in the form of slow economic growth and negative environmental impacts due to GHG emissions. Inefficient utilization of energy resources is one of the significant contributing factors to the prevailing energy crises in the country [8]. Pakistan is facing inefficiency problems both at supply and demand sides. On the supply side, thermal power plants that constitute almost 60% of power supply in the country are running at low efficiency. Moreover, power losses in distribution and transmission of electricity including unmetered use are very high averagely in the range of 25% [9]. On the demand side, inefficient use of energy resources is common due to many contributing factors including old and inefficient equipments and weak implementation of government policies on energy efficiency [10, 11].

Pakistan, a country that heavily depends on import of fossil fuels with limited energy supply capacity having high population load, can avail the opportunity of end use energy efficiency as an effective measure in combating rising energy crises. Pakistan industrial sector as one of the largest consumer of energy in Pakistan has significant potential for widespread adoption of energy efficiency measures and renewable energy technologies [12]. Highly inefficient energy usage in industrial activities is one of the major causes of deterioration of ambient air quality in Pakistan [13]. Pakistan has made so far little progress toward achieving energy efficiency [11]. In the past two decades, literature review indicates that energy efficiency subject remained a part of the Pakistan government policies and plans. [9,14,15,16,17]. However, past policies and plans on energy efficiency have not been widely adopted in the industrial sector of Pakistan. It indicates the existence of barriers and gap areas those restrict the implementation of policies in the industrial sector. Literature review on the above implementation aspects of Pakistan government

policies and plans on industrial energy efficiency highlights the policy related gaps including lack of Minimum Energy Performance Standards (MEPS) and relevant implementation mechanism for industry, barriers to energy efficiency in industry and weak connection between policy-making institutions and industry. Literature review was further extended for the purpose of identifying policy tools those are widely adopted globally for improving industrial energy efficiency. Table 1 indicates key policy tools those are widely in place globally and have the potential to improve industrial energy efficiency. However, the applicability of appropriate policy tools those can address the policy-related gap areas in the local context of Pakistan need to be explored.

TABLE I.

Policy Tools for Improving Industrial Energy Efficiency	
Energy Conservation Laws	Energy Performance Standards
Taxes	Subsidies
Voluntary Agreements	Binding Agreements
Benchmarking	Energy Audits
Awareness	Capacity Building
Energy Management Standards	Equipment Tune ups (e.g. Boilers, Furnaces)
Energy Conservation Award	Steam Surveys
Education Curriculum	Training Manuals/Workshops

Source: [18,19,20].

This research paper addresses gap areas by the adoption of appropriate policy tools for improving industrial energy efficiency in Pakistan. The paper also identifies barriers & drivers to energy efficiency in energy intensive industrial sector of Pakistan. Addressing those gaps can be a step towards more informed energy policies for meeting the challenge of energy insecurity in Pakistan.

2. METHODOLOGY

The methodology followed for this research study had the following main steps. The starting point was to review the Pakistan energy sector, prevailing energy crises, causes and effects of the energy insecurity situation and defining the need for industrial energy efficiency in Pakistan. Secondly, legislative, economic and voluntary policy tools related to industrial energy efficiency were studied and policies on industrial energy efficiency in Pakistan were reviewed and policy-related gap areas were identified. The above literature review provided basic understanding for the development of Questionnaire. Thirdly, a questionnaire survey was developed and conducted in Pakistan for identifying key barriers and drivers. The questionnaire was also aimed for better understanding of policy- related gaps and to find out stakeholders opinion for adoption of appropriate policy tools in the local context of Pakistan industrial sector. The questionnaire was sent to the target group in Pakistan via electronic mail. The target group selected from concerned government organizations, energy intensive industries and relevant academic institutions in Pakistan. The anonymity and confidentiality of the responses was ensured. In the final step, the data collected through the questionnaire survey was analyzed and research findings were discussed.

Regarding industry, energy intensive industries were targeted by exploring country level data on energy consumption of all industrial subsectors in Pakistan [11]. The energy intensive sectors were ranked based on their energy consumption and selected the energy intensive industrial subsectors including fertilizer, paper, cement and oil refining industry. In regards to government sector, concerned government departments including National Energy Conservation Center (ENERCON) and Planning Commission of Pakistan, who have been directly involved in policy formulation on industrial energy efficiency were focused. Six major engineering universities were targeted. By focusing target group, the questionnaire was electronically sent to 89 organizations and was intended to be answered by energy managers and the executives concerned with the energy issues. The response rate was 48 % which can be considered moderate as compared to closely related studies; e.g. [21].

3. RESULTS AND DISCUSSION

Responses related to awareness indicate that the majority of respondents were 'somewhat' familiar with the policies and plans on industrial energy efficiency. Figure 2 indicates that level of awareness about policies on industrial energy efficiency is low in industry, government organizations and academics.

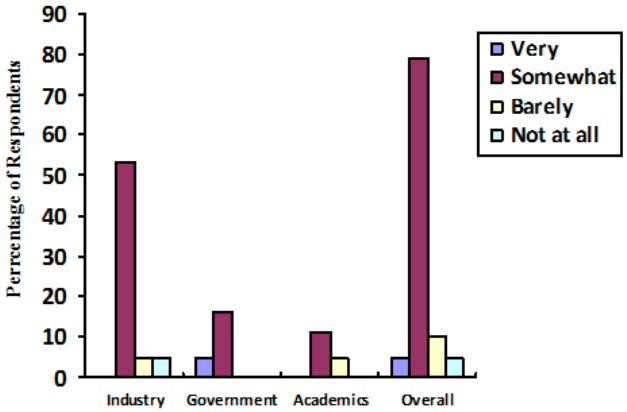

FIGURE 2: Awareness level of stakeholders about polices on industrial energy efficiency.

Literature review on the implementation aspects of Pakistan Government policies and plans on industrial energy efficiency highlights the existence of various impediments. In many past plans and policies, industries were proposed to identify and implement low cost fast payback energy efficiency measures. However, there appears to be a widespread reluctance on part of industry for adopting policy initiatives. Industrial low response to existing policy initiatives can be due to the existence of various economic, technical and organizational barriers within industry those were identified and prioritized by questionnaire through energy intensive industries target group. In regards to economic barriers to industrial energy efficiency, the top priority was given by the respondents to 'lack of access to capital for investing energy efficient technologies' followed by 'other priorities for capital investment' and 'cost of production disruption'. The highest priority issue of 'lack of access to capital for investing energy efficient technologies' raised by the respondents (Figure 3) could be focused through other financing options by involving various international agencies such as ADB already working and assisting in similar projects in Pakistan.

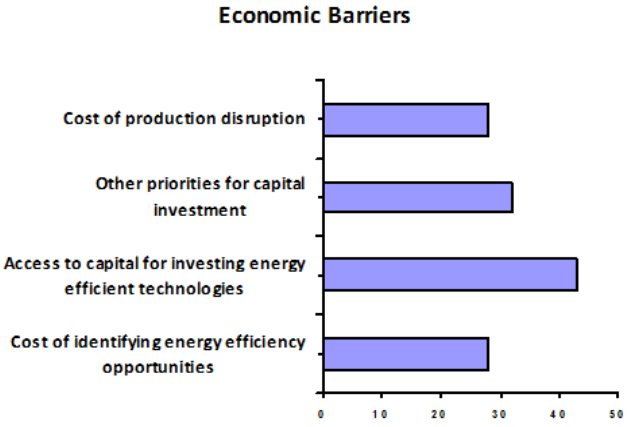

FIGURE 3: Economic barriers are ranked from the questionnaire.

Regarding technical barriers, 'technical risks of production disruptions' were considered highest priority technical barriers by respondents among others (Figure 4). This was probably because

the management focus was on production as the core activity not energy efficiency and they consider production losses and changes in processes as one of the significant hurdles for undergoing energy efficiency investments.

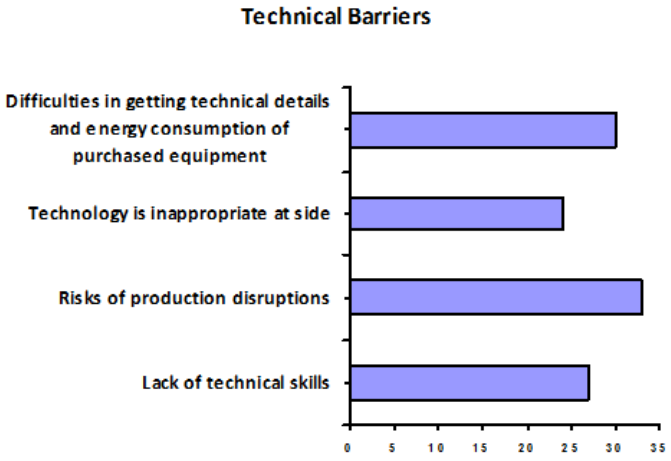

FIGURE 4: Technical barriers are ranked from the questionnaire on a scale of 1 to 4.

Regarding organizational barriers, the top priority was given by the respondents (Figure 5) to 'energy objectives not integrated into operating, maintenance and purchasing procedures' followed by a 'lack of staff awareness on energy efficiency'. The reason being here likely to be the absence of effective energy management system in industries of Pakistan.

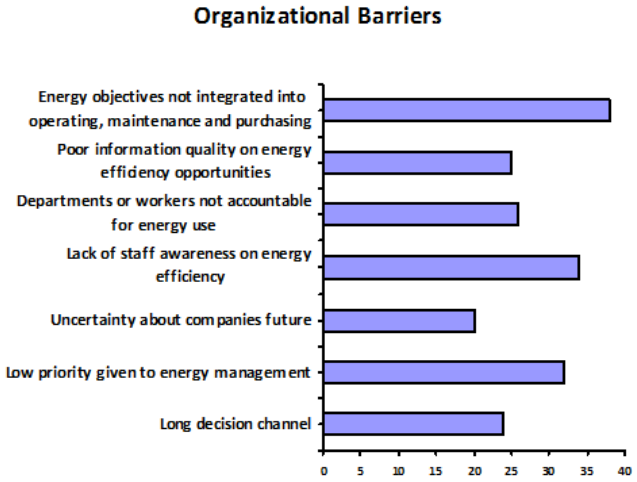

FIGURE 5: Organizational barriers are ranked from the questionnaire on a scale of 1 to 4.

Regarding drivers to industrial energy efficiency, 'third party financing' was considered as high priority options (**Figure 6**) while Clean Development Mechanism (CDM) was given the least priority driver. It was probably due to low awareness about CDM concept in industries of Pakistan.

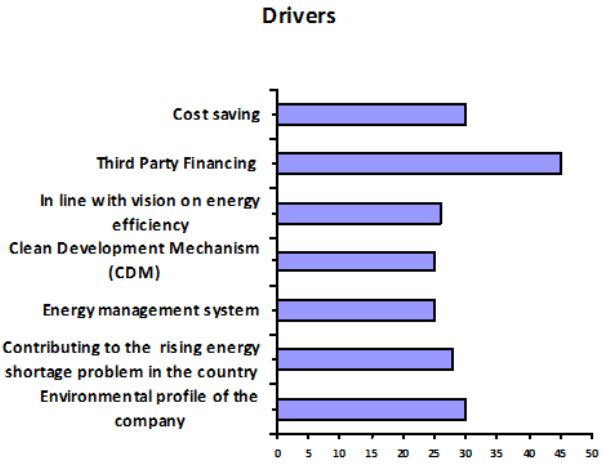

FIGURE 6: Drivers are ranked from the questionnaire on a scale of 1 to 4.

Respondents were asked to give their opinion on adoption of appropriate policy tools for the implementation of policies and plans on energy efficiency in Pakistan. Applicability of policy tools such as Energy Management Standard (EMS) and Voluntary Agreements in the local context of Pakistan was assessed through Questionnaire.

The collected response (Figure 7) in this section shows that the respondents largely considered adoption of energy management standard in industry as one of the effective mechanisms for implementing policies on energy efficiency in Pakistan.

In regards to the reasons for the lack of Minimum Energy Performance Standards (MEPS) in Pakistan, 'low awareness of industries on MEPS' and 'absence of laws and regulations' were considered as the highest priority options by the respondents. Further, 'boilers' and 'furnaces' were considered by respondents as the preferred targeted industrial equipment for the start of MEPS in Pakistan and 'energy use threshold per item' was considered as the preferred medium for the prioritization of targeted industrial equipments while least priority was given to 'equipment manufactured in Pakistan' Possible reason for this response could be that the number of industrial equipment manufactured in Pakistan is low compared to imported equipments.

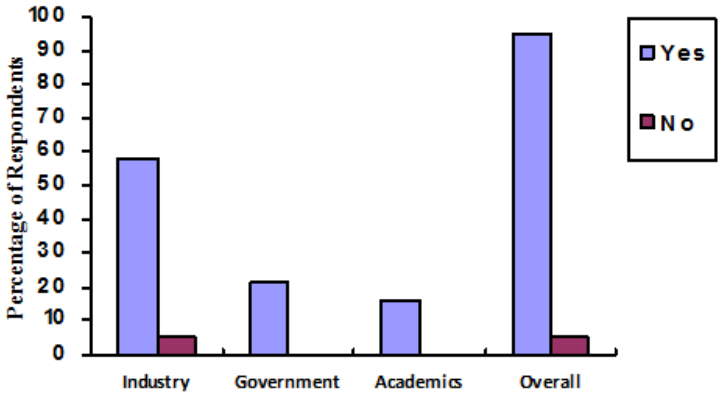

FIGURE 7: Adoption of energy management standard in local context.

Respondents were also asked about what should be the appropriate way of implementing an energy management standard in industries of Pakistan. Respondents were given options in this regard including separate energy management standard option or merging it into existing standards. The overall results show (Figure 8) that separate energy management system is viewed at the most appropriate way of implementing energy management standard in Pakistan

instead of merging it into existing systems. A possible reason might be that implementing separate energy management standard may give specific importance and attention to energy management in industrial setups and may not be get influenced by other priorities of the industrial management.

Respondents were asked to give an opinion about Voluntary Agreements as a mean for improving the connection between concerned governmental institutions and industry.

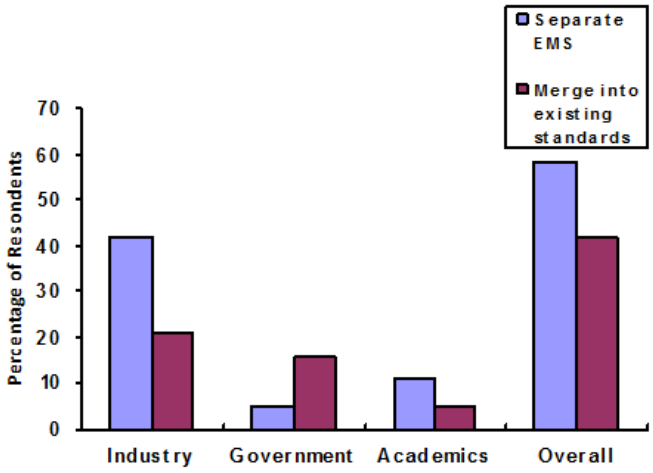

FIGURE 8: Preferred way of implementing energy management standard.

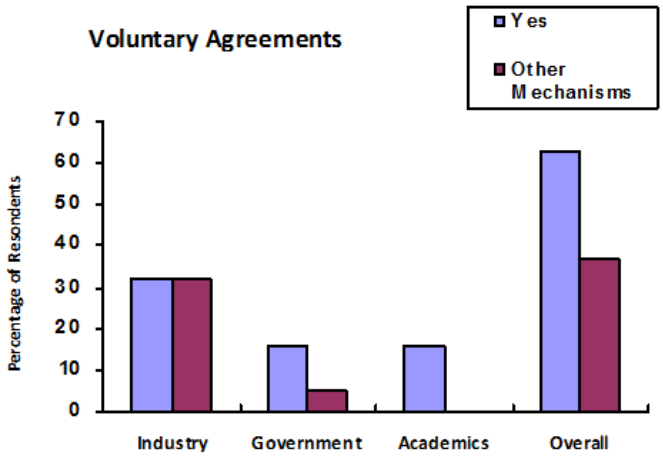

FIGURE 9: Adoption of voluntary agreements in local context.

Results indicate (**Figure 9**) that 63% of total respondents agreed that voluntary agreements between government and industry can play a good role in improving industrial energy efficiency by setting mutually agreed targets in Pakistan, while 37% suggested other mechanisms. Alternative mechanisms suggested by respondents (Figure 9) include binding agreements based on legislation in combination with incentive program, committee comprising industry and government officials, development of laws and regulations and government-funded subsidies.

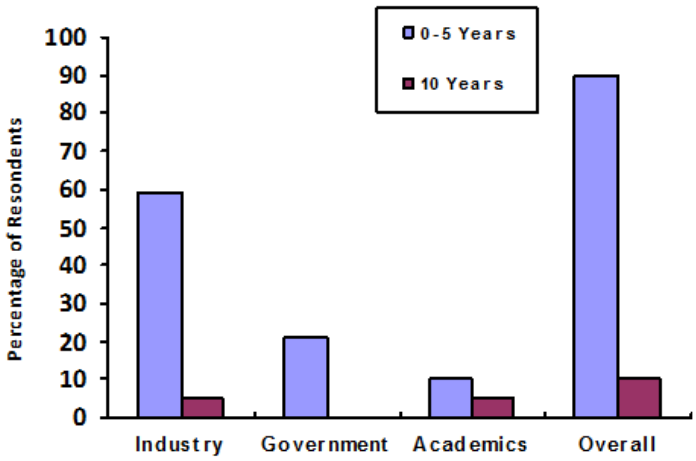

FIGURE 10: Appropriate duration of voluntary agreements.

Regarding duration of voluntary agreements (Figure 10), respondents were asked about the appropriate duration of voluntary agreements in Pakistan. Results indicate that (0-5) years were largely considered by respondents as the appropriate duration of voluntary agreements in Pakistan. In this regard, it might be felt by the respondents that a very long duration of the voluntary agreements (> 10 years) may jeopardize their consistency due to changing government priorities and political instability in the country.

Although the findings of this research study related to policy-related implementation gaps, institutional gaps and awareness/education specific to the context of Pakistan with main focus on energy intensive subsectors of Pakistan and such studies are much more limited to the developing countries, including Pakistan. However, few of results can be viewed similar with somehow analogous studies such as a study on demand side management (DSM) in India targeting high tension industries of Maharashtra with demand greater than 150 KVA [22]. In study of Indian context, a field survey was conducted in India with the following objectives: (i) to determine the extent of awareness about DSM options in industry; (ii) to learn industry perceptions on barriers to acceptance of these options; and (iii) to ascertain the role of policies and to identify adequate levels of acceptable mechanisms for policy intervention to accelerate the diffusion of DSM programs. The analysis of the field data of industries in India highlights financial, technological and institutional aspects. The survey suggests initial funding as the single strongest financial barrier needed for widespread use of DSM options. In regards to technological aspects barriers include: (i) limited awareness among potential users of DSM options; (ii) limited ability of users in selecting and assessing suitability of available options; (iii) the need to keep abreast of developments in this area outside India; and (iv) the need to standardize the energy efficient equipment. In regards to institutional aspects for DSM-plan implementation, study suggests institutional mechanisms are as important as technology and funding aspects. The study suggests policy measures for efficient implementation of DSM plans in India. In another study [20] discusses about the energy efficiency status in India in the context of policy measures taken. In India, many policy initiatives were taken in the past two decades of 1990-2010 to overcome barriers to energy efficiency including many voluntary policy initiatives. Malaysian Industrial Energy Efficiency Improvement project (MIEEIP) is another major voluntary program example in Asia. MIEEIP is targeting more than 700 industrial units in Malaysia comprising of eight energy intensive sectors and focusing many policy initiatives including industrial benchmarking [23].

Two successful examples of voluntary agreements outside Asia can be seen in Denmark and Netherland. In Denmark, voluntary industrial energy efficiency agreements were introduced in 1996 for a period of five years. Between 1996-2001, 330 Danish industries representing more than 50% of total industrial energy consumption entered into an agreement with Danish Energy Authority (DEA) for reducing energy consumption. Danish voluntary energy efficiency program

has resulted considerable reduction of energy consumption during program period and has led industries to take energy management more seriously [24]. In Netherland, voluntary industrial energy efficiency agreements were introduced in 1989 for a period of 10 years. Between 1989-2000, about 1000 industries representing 90% of industrial energy consumption in Netherlands made agreements with Dutch ministries and target was set an improvement of energy efficiency of 20% during the program period. At the end of the program, average improvement of energy efficiency was recorded as 22.3% between 1989-2000 [18]. Effective energy saving policies including adoption of energy saving technologies and energy management practices can play significant role in reducing energy consumption in industrial sector [25.]

The major findings of this research study related with Pakistan energy intensive sectors at demand side highlights economic, technical and organizational barriers and drivers in the local context. The study finds significant scope for the adoption of Minimum Energy Performance Standards (MEPS) and Voluntary Agreements at the implementation side. The majority of respondents indicated that voluntary agreements with incentive-based mechanism can be implemented in Pakistan and can establish better connection between government and industry on energy efficiency. Voluntary agreements may establish ground for moving towards more advanced stage of binding agreements with legislative cover in Pakistan. The scope of this study limited with demand side energy management with review of policies on industrial energy efficiency in Pakistan. However, there is wide scope for further research at supply side energy efficiency aspects in Pakistan.

4. CONCLUSION

The gap between energy demand and supply in Pakistan is increasing every year causing a state of energy crises in the country. Many factors are causing this situation in the country including inadequate energy supply capacity, inefficient utilization of energy resources and a rapid increase in energy demand. Energy insecurity situation in Pakistan is creating short and long term effects. Immediate effects are appearing in the form of increased power and gas load shedding and high oil imports while associated short-to-long term effects can be seen in the form of slow economic growth and negative environmental impacts due to GHG emissions. Pakistan is facing an energy inefficiency problem both at supply and demand side. On the supply side, issues include low efficiency of power generation plants and high transmission and distribution losses. On the demand side, inefficient use of energy resources is common. The industrial sector, as one of the largest consumers of energy in Pakistan has significant potential for widespread adoption of energy efficiency measures. However, policies and plans on energy efficiency have not been widely adopted by the industrial sector of Pakistan due to the existence of various impediments. A questionnaire was used to collect data from the target group, selected from concerned government organizations, industry and academics in Pakistan. The findings identified that awareness about MEPS is low in industry and ‘energy use threshold per item’ was considered as the preferred medium for the prioritization of targeted industrial equipments. The respondents considered adoption of a separate EMS for industry as one of the effective mechanisms for implementing government policies on energy efficiency in Pakistan. The major research findings indicate ‘lack of access to capital for energy efficiency investments’ as a key economic barrier while ‘technical risks of production disruptions’ as high priority technical barrier in energy intensive industries in Pakistan. The study found ‘non-integration of energy objectives in operational procedures’ as a key organizational barrier. ‘Third party financing’ was considered by respondents as key driver to industrial energy efficiency investments. The findings suggest that adoption of short duration voluntary agreements can be more appropriate choice over binding agreements with legislative cover for improving industrial energy efficiency in Pakistan.

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