

## Energy Crisis in Pakistan

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**Abstract:** The study was conducted in the department of Electrical Engineering, University of Gujrat, Punjab, Pakistan to highlight the burning issue of energy crisis. Firstly, it overviewed the phenomenon on global level and estimated it as a global issue. Secondly, it studied the issue with reference to the present situation and position of Pakistan. It also high pointed the statistics of demand and supply and power production resources of the country. It discussed the causes of energy crisis in detail. It also put forth the consequences of the crisis with different dimensions. It also offered some solutions to improve the present situation. It also presented suggestions in order to resolve the issue. It was concluded that by owing to the recommended measures Pakistan can get rid of the dilemma of load shedding and short fall.

**Keywords – Energy Crisis, Pakistan, Non-renewable resources, Renewable resources, Short fall, WAPDA**

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### 1. INTRODUCTION

Globally, the “main cause of energy crisis” directly refers to the natural problem of scarce resources. As the whole world has scarce natural resources that are depleting with every tick of clock, the chance of converting natural assets into electrical energy is decreasing day by day [1]. Many countries are producing energy, solely, by burning coal. Some other countries are managing their electric needs mainly by nuclear production. Others do handle it by burning coal or natural gases. Some countries like India are utilizing water to produce energy [2]. The question is for how long these resources would be available to accomplish the escalating energy needs of human beings. So, simply we can say that our planet is relying on coal, natural gas, water, fossil fuels and petroleum to extract energy. We have depleted about 80% of our oil resources [3]. Moreover, we have used about more than 50% of our oil resources till now and if we continue to use the oil resources at same rate then we would probably run out of oil resources in about 32 years [4]. The whole world is trying to extract maximum oil and are enthusiastic to find more preservatives to fulfill the ever increasing demands but a study by M. King Hubbert [5] gave a concept of “peak oil”. According to him, a time would come when the whole world would reach at maximum rate of extraction called “the peak” after which it will start to decline with time.

This concept adds more despair to the present depressing situation. Fossil energy would also become rare, erratic and expensive in near future. Conversely, with the continuous appraisal in our living standards, electrical energy utilization is also increasing day by day. These statistics and discussion portraits that we are running short of our energy producing resources which simply imply that we are running out of electricity in near future.

The above stated problem becomes more serious if we dig it deep. The reliability on oil, gas and petroleum for energy generation is also not a secure step. Globally, major oil and gas suppliers are Qatar, Iran and Russia [6]. If they stop their supply around the world then many countries would face serious energy crisis and long hour's blackouts. Furthermore, they emit hazardous gases that cause environmental pollution and greenhouse effect. So, indirectly human being's survival is closely related to energy crisis. This highlights the importance of this central issue for the whole world.

To avoid this overwhelming situation, people around the globe are working hard to find alternate/renewable resources to prevent the world from blackout [7]. Some are starting "save energy" campaigns. Seminars and reports on the topic of "energy conservations" are also becoming common. The real solution of this problem can only be done by replacing all these above mentioned non-renewable resources with alternate renewable sources. Solar and wind are considered major example of this but they are not as reliable as coal or gas. So, what we should do to overcome this energy crisis. This is the major question of today.

The answer is to use all of our available resources in an intelligent way. A fraction of energy should be produced by no-renewable resources and the remaining amount should be fulfilled by that of renewable. Secondly, the ever increasing electric energy demands shall be discouraged and proper awareness should be provided to consumers about energy crisis; its impacts and challenges that world is facing, today, due to it. Thirdly, new resources should be explored. Fourthly, serious research shall be conducted to increase the efficacy or energy producing units and new technologies shall be introduced in this regard. Fifthly, a law should be made and implemented around the globe that no country can emit greater than specified amount of hazardous gases that cause pollution, greenhouse effect and environmental changes.

Point to ponder here is that is energy crisis only related to scarcity of non-renewable energy resources. Some intellects of United States of America directs energy crisis towards "affordability". According to them the expensive per unit cost of electricity is the main cause of this entire situation. America is more threatened because of this situation as it consumes around 25% of all energy produced around the globe and that cannot last forever [8]. So, we can say that not only Pakistan but also the whole world is affected by this termite. Pakistan gets its electrical energy supply from mixed resources; renewable and non-renewable. Renewable resource includes hydal, wind, tidal and solar, whereas Non-Renewable includes thermal and nuclear.

## 1.1 Energy Demand and Supply Statistics

According to 2014 report total installed capacity of electrical energy production in Pakistan is 22,957.4 Mega Watts (MW). Total demand is 17000MW. Shortfall is about 4000-5000MW [9].

The Energy sector of Pakistan is categorized as under-developed, due to inadequate planning, supervision and management. The main problem is the gap between energy supply and demand so the major issue is energy generation that can never be balanced with ever increasing demand and constructive economic progress. Due to this, now we are at the edge of despair standing in condition where no short cut is available to sort out the problem. If we thoroughly ponder the situation from the other side, we would come to know that we have also done nothing practical to contain the ever increasing demand from the past two decades. To narrow down the gap between demand and supply, Pakistanis suffer from so called load management or more precisely "load-shedding". This crisis has omnipresent and extensive impacts and consequences on budget, economy, academics, society and overall operations of the country.

### 1.2 Power Production Sources

As described above, Pakistan has mix energy producing sources [10]. According to layman knowledge, the major contributing part of energy generation is hydal because every day we see discussion about new dams on media. However, the major contributing part is thermal. Unfortunately, Pakistan is also in that category of countries which has major reliance on non-renewable sources like coal, gas and petroleum [11].

The detail that how all these mix resources contribute a little to make the grand total installed production capacity of the whole country is tabulated below:

Resources	Total Production Capacity (MW)
<b>Thermal</b>	<b>14,365</b>
<b>Hydral</b>	<b>6,611</b>
<b>Nuclear</b>	<b>775</b>
<b>Wind</b>	<b>206.4</b>
<b>Solar</b>	<b>1,000</b>
<b>Total</b>	<b>22,957.4</b>

The above table clearly shows that maximum contribution emanates from thermal resources. Thermal power is a wide category comprising coal based, oil based, diesel/petroleum based and steam based

power plants. They produce cheapest energy. The per unit production cost of solar is many times less than hydal and nuclear [12]. The comprehensive discussion about all the above stated power sources and their brief comparison is presented below:

#### 1.2.1 Thermal Power Source

As described above, thermal power plants are contributing about more than 50% to illuminate Pakistan. The biggest power plant is situated in Kot Adhu having production capacity of about 1600MW [13]. Second biggest power plant is in Karachi called Bin Qasim Plant 1. Its production capacity is about 1260MW [14]. Its second branched plant called Bin Qasim Plant 2 has production capacity of 560MW approximately [14]. Another thermal plant is located near Karachi in Hub industrial area called Hubco Power Plant. There is another power plant at Jamshoro having production capacity of about 850MW [15]. A coal based power plant is located in Lakhra called Lakhra Coal Power Station having production capacity of 150MW [16]. .

#### 1.2.2 Hydral Power Source

Terbela dam has biggest power production capacity of 3475MW [17]. The second biggest dam is Ghazi Brotha having production capacity of 1450MW [18]. Mangla stands third in production capacity that is around 1120MW [18]. Neelam Jehlum power plant produces 960MW [19]. A power plant at Kakar produces 4500MW [19]. Warsac dam has production capacity of 243MW [20]. Some other dams' construction plans are under process for many years.

#### 1.2.3 Nuclear Power Source

There are two mainly considerable nuclear power plants installed in Pakistan. One is at Chashma having power production capacity of about 650MW [21]. The second one is built at Karachi, called Nuclear Power Complex Karachi, having power production capacity of 125MW [22]. The erection of new nuclear power plants always remains controversial not only in Pakistan but even around the globe due to long security permission taking procedures.

#### 1.2.4 Wind Power Source

We have two wind power stations in Pakistan. The dominating one is at Jhimper having power production capacity of 56.4MW [18]. The other one is located in Thatha having power production capacity of 150MW [23].

#### 1.2.5 Solar Power Source

There is only one solar power production unit situated in Pakistan that is named as Quid-e-Azam Solar Park with power production capacity of 1000MW [24]. The surprising thing is that only 100MW has been produced by it in operational season. So, we can say that very minute contribution is coming from solar power source. In other words, it is stated that we are not utilizing the solar power properly.

## 2 DISCUSSION

The above described power production capacities of plants create a very pleasant scenario because the total power production capacity of all plants is 22,957.4MW and the demand is only 17000MW. Now, the question arises that if these figures are correct then why Pakistan is facing load shedding, power cuts and blackouts every day. Why we have shortfall in production if we are capable of cumulatively producing 22957.4 MW. Actually, the word “production capacity” is deceiving the whole country. If plants have capacity to produce the above specified megawatts of energy, then why they are not able ,or more precisely, capable of producing that specified amount and if they are not capable to produce that specific quantity, then why that specified capacities are mentioned by our country’s officials. If the first implication (that they are truly capable) is true, then the concept of scarcity does not apply to Pakistan. Because we have resources and we have installed power plants but still we have power crisis issues. So, what are the causes of electricity deficiency in Pakistan? The detailed analysis of main causes of energy crisis is discussed below under the heading of causes of electrical energy crisis and depreciations.

If second implication is true, then all the above mentioned facts and figures are wrong. All the stats provided by officials would probably be bogus. Or, we can say that there are “ghost power plants” in Pakistan. This seems a really depressing and annoying situation for the natives. So, let’s evaluate basic causes and problems that Pakistan is constantly suffering from many years. What are those issues that couldn’t get resolved? Many scholars at a seminar at the Woodrow Wilson International Centre for Scholars, Washington read many essays from the book “Pakistan’s Interminable Energy Crisis: Is there a way out?” and implied that this issue is too complex to be sorted out overnight.

The present review highlights the main causes of this giant issue, its consequences on our country’s economy and suggestions in this regard to sort out this problem, if not even in midnight then as early as possible.

## 3 Causes of Energy Crisis

There are many factors that collectively result in energy crisis. Some of them are local but many of them overlap with the problems faced globally. The main causes are as follows:

### 3.1 Poor Distribution Infrastructure

The distribution system’s infrastructure of our country is very long-standing, aging, non-reliable and is in very miserable condition. The condition of this old transmission network is too poor that intense weather conditions affect them. This increase the line losses day by day as transmission lines gets older and older resulting in increase in tolerance of line.

### 3.2 Power Theft and Under Recovery Bills

The rate of theft is increasing as per unit rates are increasing. This also adds to transmission losses leaving bad impacts on economy. This is the major factor for me because it directly impacts our economy. Consider, we have produced 100 units. 22 of them are the calculated transmission and distribution losses. If another 18 units are loosed due to theft, then government would only get bill of 70 units. If total subsidy per unit is 6 Pakistani Rupees, then we can simply figure it out that how much revenue is being generated on 100 units collectively after all losses. It is approximately 60%. This means that we have clear deficits of 40%. These calculations do not include power factors yet. After their inclusion, the deficit will increase much more. That's what Water and Power Development Authority (WAPDA) talks all about. Pakistan is not only facing domestic level theft but also facing commercial and industrial level theft.

Power theft and under recovery of bills by DISCOs (Distribution Companies) collectively resulted into the big loss of Rs.260 billion to the power sector and this badly affected the investment in the power sector. The National Transmission and Despatch Company (NTDC) purchased 98342 GWh (Gega Watt-hour) in 2013 for transmission to DISCOs while the units billed by DISCOs were only 75926 GWh, the difference between these two statistics clearly indicates the power theft at great level across the country. The consumers' annual arrears have increased greatly from 10 billion in the year 2008 to 63 billion in 2013.

### 3.3 Poor Real Production Factor

Pakistan has already installed capacity that is more than demanded one but still it is facing worse energy crisis. The installed units are not working enough. There are many dam turbines that are static for the years. Many fuel generators that are not working for many years. Many plants are shut down. The only reason told to Pakistanis is that we have lack of fuel, water and other resources. Is this the real truth? Geologically, Pakistan has been gifted with many resources from Almighty *ALLAH*.

### 3.4 Reliance On Non-Renewable Energy Sources

Above mentioned calculations clearly show that we rely mainly on thermal power source. According to WAPDA (Water and Power Development Authority) official statements; there are three main big sources of electrical energy production in Pakistan that include thermal (gas//petroleum/furnace oil) producing 13,637 MW that is 65% of total production [25]. The disadvantages and clear threats of reliance mainly on non-renewable resources are discussed in the above section 1.

### 3.5 Ever Increasing Energy Demands

With the increase in standard of living, energy demands are increasing day by day making the crisis more worse and the condition more miserable. New projects of electrification of rural areas are being made. This adds more burden to the existing system.

### 3.6 Low Rate of Hydro-Power Production

We have few dams that are working 24/7 to produce electricity; however, we have many sites available for building dams. We are not fully utilizing our available resources. On the other hand, India has made a number of dams on the same rivers we have. This has made our situation more drastic.

### 3.7 Fuel Shortage

Fuel to run generators are mostly shorted. Fuel supply to power production areas is cut out resulting in lack of generation. Gas cut downs are also common in Pakistan. Due to these shortages and cut downs the operational equipment is not working for its total operational hours, thus, is not generating the rated amount of electricity.

### 3.8 Return On Investment; the Circular Debt

The periodic problem of circular debt produces cash flow problems for our country at each and every stage of the supply chain and that resulted directly into deficit in power generation. Maximum reliance on gas and oil not only increases circular debt but also enhances the cost of electricity per unit resulting in pressure on government that it has to invest more and more on subsidy. The 2014-15 budgets have marked the amount of Rs.350 billion for power subsidy [26]; however, the actual subsidy is expected to be Rs.600 billion and this condition directly impacts and complicates the energy crisis in Pakistan.

### 3.9 Poor Policy Making

The real policies to eradicate this major problem from the country are never witnessed by Pakistanis. Every government makes a number of commitments, makes different committees, and creates new policies but all in vain. No policy was ever up to the mark. Every government is focused to install new plants. More money is invested on their capital cost and fewer revenues are being generated by them. Even some of the new plans never reach to their operational conditions even for years.

### 3.10 Lack of Technical Staff in Decision Making

The decision making authorities are not aware of electrical analysis techniques, neither have they known the technicalities nor they are well educated to understand it. This creates an acute problem in this regard. Due to this condition, instead of solving problem; situation heads towards creating problems.

### 3.11 Development of New Housing Schemes

New housing schemes are being constructed now a day like Bahria town, Defense Housing Scheme, Sukh Chain housing scheme etc. These schemes not only require new electricity connections but also require uninterrupted supply. The load shedding rate is very minor in these areas. So, directly they also add encumbrance to the prevailing system.

### 3.12 Lack of Ergonomists In Pakistan

For finding effective solution of this problem we need those scholars that are being qualified specifically in energy economics and are called ergonomists. Pakistan is not focusing to give education in this area.

### 3.13 Unmapped Renewable Energy Selections

As Pakistan has God gifted many resources, we should explore those new resources and make clever selection among the available resources. Pakistan should take maximum benefits from available resources.

### 3.14 Postponement In Commissioning of Power Plants

The installment procedure of new power plants goes through a number of delaying stages. After forecasting and commitment of units the making of prototype takes time. Convincing higher authorities, to start a new plan, take time. Passing of the new plan from higher authorities to parliaments take time. Parliaments take time to decide and approve it. It takes more time in development of construction procedure. Taking approvals for cost of capital is also a cumbersome procedure. Starting implementation even takes time because presence of officials in inauguration ceremonies is a political ritual. Construction and installation process also takes time. So, basically delay of days gathers up to make week and even weeks gather up to make years in some situations.

### 3.15 Seasonal Oscillations

Hydral power plants are more affected by season. Water level depends on climatic changes. According to WAPDA official statements (2015); There are three main big sources of electrical energy production in Pakistan that include hydral power source on second rank producing 6,654 MW that is 31% of total power production in Pakistan. WAPDA also added that this production varies between two extremities that are minimum of 2,414 MW and maximum of 6,761 MW, depending upon the river flow. This complicates the situation because as we know; Pakistan always suffers from water crisis due to Indian dams on our rivers.

### 3.16 Overpopulation

Population is increasing with the tick of clock. New connections are being made. That adds more sharpness to increasing demand rate gradient. This situation needs that production should proportionally increase with demand but, this is not happening making the situation more critical.

### 3.17 Failures, Interruptions and Accidents

Major mishaps and accidents like pipeline burst and natural calamities like floods, earthquakes can also affect the power supply and cause interruptions. This contributes more to create an imbalance between demand and supply of energy that results in rise in prices of essential items that gives rise to inflation.



### 3.18 Impact of Instabilities in legislation

As the government changes, it seizes all the projects that were run by the previous government. This instability creates a great problem in development and solving problem.

### 3.19 Generating Less than Capacity

According to statistics given by WAPDA, thermal power production is 13637MW (now). However, the capacity of thermal as mentioned in the above table is 14365MW (even in 2014).

### 3.20 Lack of Funds

The bitter reality is that, we always take funds from outside to start new projects. Many new projects are pending due to the lack of funds. A lot of maintenance work is pending due to lack of funds. The reliance of funds has shattered our system. We are on knees to externals for the extraction of funds.

### 3.21 Miscellaneous Factors

Increasing Taxes, strikes, disturbances in law and order, military takeover, political trials, intense hot summers and freezing cold winters cause sudden increase in demand of energy and congests the supplying system. For example: a strike conducted by union of oil producing firms can absolutely cause the energy crisis.

### 3.22 Lack of Proactive and Integrated Planning for Production of Energy

Pakistan has inclusive capacities to tap energy but due to dearth of any proactive and integrated planning for production of energy, we are producing very fewer amount of energy as compared to demand. Consequently, from many years, the gap between energy supply and demand is radically increasing.

### 3.23 Inadequate Utilization of Nuclear Energy

Pakistan is sixth atomic power in the world. Yet we have a sole nuclear power production plant. There are many countries in the world like, Belgium that are relying on nuclear power plants. Nuclear power covers their more than 50% of the needs. Pakistan can also do this but is not taking the maximum benefit even from nuclear power source.

## **4 Consequences of Energy Crisis in Pakistan**

Energy crisis has badly affected the economical, agricultural and industrial sectors of our country. It has resulted in high rates of inflation, social evils, crimes, frustration in masses, unemployment and poverty. The detailed discussion about these issues is given below.

#### 4.1 Humanitarian Crisis

Energy crisis is actually the humanitarian crisis. Electricity has become the basic commodity today. Load shedding and blackouts create frustration in society, lack of tolerance, increasing rate of crime, rate of disputes, murders and such other social evils. Workers on daily wages are suffering a lot due to this crisis.

#### 4.2 Economic Effects

Energy crisis is penetrating in all key sectors of economy; shaking the quality and distressing the standard of life of natives' at large scales.

Economic sector is being adversely affected because energy is essential for the smooth running of its various sectors. Economic losses are suffered due to less productivity and unusual termination of operations due to load shedding. Inferior gross domestic profit (GDP) and extraordinary inflation rate can be attributed directly to energy crisis. Textile sectors have turned to local markets. Many branded textile producing industries like Gul Ahmed and Nishat have shifted their set ups to Bangladesh and India due to power crisis. This phenomenon greatly affected our economy.

#### 4.3 Agriculture Sector

Agriculture sectors are also affected badly due to power crisis because productivity profoundly depends on the electronic machineries like tube wells etc. Moreover, production of insecticides, pesticides and fertilizers is also hindered. Thus, decline in electrical production cause decline in agricultural output that is the backbone of Pakistan's economy.

#### 4.4 Industrial Sector

Industrial sector has shoddier and worse effects of energy crisis. Industrial units get un scheduled shutdown and termination that affects productivity badly. Moreover, local and foreign investors are shifting their capitals from Pakistan to India and Bangladesh. This is not only threatening for economy but also for industrial growth rate. If the present situation would prolong, then industrial growth would see reversals. No foreigner will ever invest not only in industrial production but also in innovative ideas.

Protracted and unscheduled load shedding in Karachi's five major industrial sectors has resulted loss of billions of rupees as the production activity was terminated and graph of production had fall about 50 per cent. KESC, Karachi Electric Supply Company, is facing severe shortfall of around 700MW against the total demand of 2200MW. Almost all forms of power generation are influenced by these crisis .i.e. nuclear, fossil fuel-fired, thermal operated or hydroelectric power plants.

#### 4.5 Unemployment

As a consequence of the above mentioned consequences occurred due to energy crisis like closing of units, breakage in operations, and shifting industries to abroad great dismissals of workers lead to increasing unemployment. Moreover, increasing inflation rate also worsened the condition. New employment opportunities are also not there because businessmen, financiers and investors have stopped investing in Pakistan.

#### 4.6 Social and Psychological Problems

Due to the above mentioned problems, people got frustrated and they come to road, unbridling their frustration on public and private property, raise slogans, making some of the most terrible scenes of coarseness. This not only creates mental distractions to the natives but also leaves a very bad impact on foreigners when they watch all this on media.

#### 4.7 Affecting Tourism

As described earlier, energy crisis has affected our country's reputation to foreigners. Media is showing all these negativities, curbs, social evils and frustrations 24/7 that is affecting our image globally. People do not want to visit that country whose natives are frustrated and unsatisfied. This has declined the tourism in Pakistan.

#### 4.8 Poverty

Decline in industrial growth, low agricultural production, deteriorating economy, unemployment and wicked social conditions: all result in aggregating poverty. Presently, about 40% of Pakistan's population is living below the poverty line and this numerical figure is increasing day by day. Sufficient control on energy crisis is required instantly to eradicate this poverty.

### **5 Suggestion/ Recommendations and Solutions**

- i. Maximum outputs should be taken from installed units. Efficiency of these units should be increased. Proper fuel supply to these plants should be insured.
- ii. Power theft should be controlled. Implementation of law in this regard should be made. Thieves should be punished severely so that it will become the benchmark for others.
- iii. A research center should be made by the government to explore new energy producing resources available in Pakistan and to find out the ways through which maximum output can be taken from installed power plants.
- iv. Production from non-renewable power resources like solar, tidal and biomass should be promoted at public level as well as individual level. Government should provide finance, research and technical facilities as well as expertise to common man through workshops and funds.

- v. Transmission and distribution system should be renovated and their great maintenance should be carried out.
- vi. A critical improvement in billing procedures and retrievals from DISCOs to progress the cash flows is required. This will directly help in increasing power production and reducing load shedding. This step can only be taken by the administration. Moreover, improved management's performance and better accountability procedure should be adopted.
- vii. To ensure consistent gas supply to gas power stations is required, for greater generation at low cost.
- viii. Applications of Independent Power Plants (IPP's) should be approved without delay.
- ix. The quality of services provided by WAPDA and other power companies should be enhanced.
- x. Making policies that convince public to investment in power sectors. This will make GENCOs and DISCOs efficient organizations.
- xi. Finding alternative sources of energy to fulfill the gap between demand and supply. To eradicate reliance on thermal power alternate power/fuels should be searched and utilized like fuel cells, hydrogen fuel, bio methanol, and biodiesel and Karrick process. Moreover, more green energy power plants like solar, tidal and wind energy should be deployed. In Pakistan, only hydroelectricity, solar power plants and nuclear power plants have been considered the effective alternatives to thermal energy but they have great ecological problems.
- xii. Start buying energy efficient products .i.e. replacing old bulbs with energy savers and LED's. These devices consume less wattage of electricity and lasts for longer times. Similarly, old energy consuming big Cathode ray oscilloscope Televisions should be replaced by smart energy saving devices.
- xiii. We should move our maximum load on renewable resources. To improve overall conservation efforts the best step is to switch to renewable resources. Most of the industrial age was formulated using fossil fuels, but these new emerging technologies that utilize renewable energies like solar, wind, and steam etc. can take their place easily. The major concern is not only the problem of scarcity but also the pollution. As the use of coal is continually polluting the environment and is destroying other natural resources that deteriorate in the process of mining of coal. This would need a great reform because our entire industrial and commercial load is powered by coal, gas and steam power plants.
- xiv. The easier grid access should be made. A common person, that can generate power from several different options, should be given special approval to plug into the grid and generating revenue/credit for power that they feed into the system. The annoyances of getting credit of supplying spare power back into the grid should be removed.
- xv. Energy simulation software should be used by big companies and firms to reform building unit and should lessen running business energy costs. Engineers, designers and architects could use this design to come with most energy efficient building and reduce carbon footprint.

- xvi. Energy audit should be done. It is a process that helps us to identify the specific area or sector where our system i.e. home or office is losing energy. It helps us to improve our energy efficacy. If it would be done by professionals, then it can not only help us in saving energy and reducing billing amounts but also can lessen our carbon footprint; thus, eradicating the energy crisis.
- xvii. A serious stand on climatic changes should be taken. Though, we are under developing country but we should take stand against climatic changes as equal as developing countries are taking. We should focus to decrease greenhouse gas emissions.
- xviii. Enhancing civilian nuclear capacity
- xix. More Dams should be set up.
- xx. Awareness should be given on usage of electricity saving devices.
- xxi. Awareness campaign for energy saving should get started.
- xxii. We should tap home-grown resources like Thar coal.
- xxiii. The industrial power usage should be controlled and decreased with the installation of effective equipment, energy saving and energy efficient machinery.
- xxiv. We should decrease our reliance on rental power plants, because they are producing less energy at greater cost.
- xxv. We should decrease line losses by using efficient and highly conductive power transmission cables.
- xxvi. New energy resources should be developed.
- xxvii. Natural gas should be import of by IPI (Iran Pakistan India) and TAPI (Turkmenistan, Afghanistan, Pakistan and India) gas pipelines. Electricity should be imported from China, Tajikistan or any other country
- xxviii. Alternative energy resources like wind, biomass, tidal and solar should be incorporated.
- xxix. Offices, academic institutions, markets, marriage halls should be closed till 8 pm to keep balance in peak hours.
- xxx. Before installation of new systems forecasting should be done.
- xxxi. Restrictions on energy demands should be applied. Actions should be made to consume reduced amount of Energy. Evidently, reduction of energy consumption not only decreases the energy crisis, but also restricts environmental hazards. Thus, there is covenant between environmental and energy interests on the need for conservation. Actions required in this aspect include:
- Progress of an energy conservation program
  - Mass transportation
  - Resource regaining programs
  - Fuel economy labeling programs
  - Land usage program
  - Creation and adaptation of more competent auto propulsion units.
- xxxii. "Save energy" campaigns should be started for awareness of the masses.

- xxxiii. Natural Gas prices should be deregulated. Presently, the shortage of natural gas is due to the fact that it is underpriced as compared to other energy sources. Underpricing produces motivations for extreme consumption. The resulting natural gas shortages direct the users towards coal, petroleum and oil that considerably cause more damage to the environment
- xxxiv. Regulation of Coal Mining should be done.
- xxxv. A systematic process should be followed for locating power plants sites. A review of total capital costs, production capacity and revenues should be done prior to the construction.
- xxxvi. Pakistan should adopt more robust maintenance regimes to ensure that power plants, transmission lines, and other key infrastructure do not fall into serious disrepair.
- xxxvii. Pakistan should enhance collection rates by having budget adjusters that will help to recover arrears throughout the provinces. Improved bill collections can be made by issuing serious threats to disconnecting supplies to those customers who refuse to pay.
- xxxviii. In power sectors financial planning should be done on monthly basis.
- xxxix. To fill the gap between supply and demand, government should make and implement energy conservation law. To eradicate load shedding and to decrease shortfall institute stricter building codes should be made.
- xl. Unexploited resources with tremendous capacity of producing energy should be tapped. In Thar, 175 billion of coal reservoirs are available. We should extract it to get maximum benefits.

## 6 CONCLUSION

Keeping in view the above mentioned ground realities, it is concluded that burning issue of energy crisis is not new to Pakistan rather this is the global issue. Not only under developed countries like Pakistan but also many developed countries are threatened by energy crisis.

As tabulated above, Pakistan has already enough installed capacity that can cope with the present demand if all the installed units would operate and give their maximum possible outputs. Moreover, according to the given records, Pakistan has many untapped fuel reservoirs which may meet the increasing demands of the country. Influential planning on the part of government is required. In that case, this issue can be easily resolved. Furthermore, efforts are required on individual basis by wise consumption of energy as well as timely bill payment system to improve the efficiency of the concerned department.

In the same line, media needs to play its positive role to improve our social behavior rather than creating any frustration among the masses.

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