ENERGY CRISIS IN PAKISTAN: A THREAT TO NATIONAL SECURITY

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Introduction

Energy lies at the heart of economic security, as energy is the pre-requisite to generate any economic activity. In this way energy is a big determinant of development and growth of an economy especially in case of developing countries. In the modern global economy, the concept of “natural security” has emerged as a main component of security of nations. It means sufficient, reliable, affordable and sustainable supplies of natural resources for the modern global economy. The proponents of natural security refer to energy as the most important ingredient of natural security because of its finite supplies, especially in case of fossil fuels e.g. oil, gas and coal. Energy production of any country is the measure of its economy. Energy is essential to build a strong economic base in order to compete in today’s global economy. A study conducted by United States Agency for International Development (USAID), describes the strong relationship between the provision of energy services and global, economic, and political development.

An energy crisis is a great shortfall (or price rise) in the supply of energy resources to an economy. Global economy suffers from the fear of final energy crisis in the world, as world’s primary energy demand will continue to rise at about 1.7 percent annually, over the next twenty years, driven by economic growth. It is estimated that the developing countries of South Asia will account for the largest share of the growth in the world energy demand. In case of Pakistan, it is unfortunate to know that the concept of “energy security” has been ignored for decades till it took an atrocious shape and emerged in the form of acute shortages of electricity and power cuts (load shedding). The present energy crisis in the country has its roots in the structural inadequacies present in the policies of energy sector.

Due to lack of cohesion among various departments and ministries of the government managing energy sector, the energy
needs of the country have never been studied from one focal point so as to formulate an integrated energy policy with consultations from all energy sub-sectors. Each sub-sector has been pursuing its independent policies to meet the energy requirements which resulted in a disproportionate energy mix with huge imports and lack of energy diversity. Despite immense hydroelectric potential, the country relies on oil imports for power generation. In the same way, natural gas reserves are being rapidly consumed and depleted instead of increasing the consumption of coal in the energy mix. It shows lack of cohesion among Ministry of Petroleum and Natural Resources, Water and Power Development Authority (WAPDA) and National Coal Authority (NCA). There has been a delay and ignorance factor constantly involved, which has led to short-term solutions to control periodic energy deficiencies, rather than long-term and coherent initiatives to address the issue on pragmatic lines. There is a long history of lack of research capabilities and budget allocations to develop alternative energy resources to meet the growing energy demands. There are two main sources of energy; non-renewable or conventional sources (oil and natural gas, coal and coal products) and renewable or non-conventional sources of energy, (waste, geothermal, wind and tidal wave, photovoltaic, solar and geo-thermal energy). In Pakistan, there has been more focus on non-renewable sources of energy which has resulted in country’s increased reliance on foreign imports to satisfy the energy demands.

The essay is an exploratory study of the evolution of concept of energy security in Pakistan through tracing the evidences in the official data available. It explores links between energy security and national security implicitly through explaining the multi-dimensional nature of energy security and its connection to political stability. While analyzing the loopholes in the energy security policy of Pakistan, it traces the factors which have been operating for decades and have resulted in the present energy crisis in the country. Through a detailed study of the structural inadequacies and policy dilemma, it proceeds towards the options and choices available for averting energy crisis. The recommendations focus on exploitation of indigenous energy resources i.e. coal and hydro electricity, keeping in view the consequences of consumption of various resources.
It is not a scientific study of economic factors and statistical data has been analyzed in terms of its political and economic implications. In the essay, energy crisis is independent variable and economic development and national security are dependent variables. It draws a theoretical connection between energy and economic development and its impacts on national security. The pessimistic school of thought may seem to be dominant throughout the writing because there was a fear of ill-assessment of facts in the optimistic approach towards the issue.

Energy Security: Applying Energy Security Indicators to Pakistan

In the age of globalization and new economic order, the concept of Energy Security has four main dimensions. An analysis of the four dimensions indicates the energy security state of any country. These are:

- Energy Intensity
- Energy Diversity
- Energy Import Dependency
- Energy Transportation.

Energy Intensity

Energy intensity is a function of policy choices, made by policy makers of an economy. A country that uses energy more efficiently is going to have more energy reserves in the longer run. Energy intensity is measured in Tons of Oil Equivalent (TOE) per unit of Gross Domestic Productivity (GDP). Consequently there are wide disparities in the energy intensity of different economies.\(^5\)

In Pakistan, National Energy Conservation Center (ENERCON), an attached department of the Ministry of Environment is the focal national agency for coordinating a national program on energy management. But it seems to be ineffective in devising techniques to control the transmission and distribution losses and conservation of energy. The system-wide transmission and distribution losses are 24.8 percent (29 billion units / year) in
Pakistan. Pakistan is ranked among moderately energy efficient countries. It is also lacking on energy conservation techniques. The only way of reducing the 'energy gap' (supply and demand) is a nationally planned program of energy conservation.

**Energy Diversity**

Energy diversity indicator assesses the distribution of energy sources in the energy mix of a country or region. Energy diversity indicator declines when there is a growing dependence on one source, thus undermining energy security. Pakistan relies heavily on natural gas, constituting 47% of energy supply, with oil 31%, hydroelectricity 11%. On the other hand, the use of coal, Liquefied Petroleum Gas (LPG) and nuclear energy is 9%, 1% and 1% respectively as shown in Fig I. The increased reliance on natural gas and oil limits the energy supplies to only two main sources. It depicts the vulnerability of economy because any disruption in supply of oil and gas will directly affect the economic output. Unfortunately, renewable sources of energy have been ignored in the energy mix, despite their huge potentials.

**Fig I: Pakistan’s total Primary Energy supply, 2007-08.**

Source: Asian Development Bank: Clean Energy Development in Pakistan.
Energy Import Dependency

It means reliance on foreign sources of energy to fulfill the energy requirement of the country. Energy import dependency increases when “annual primary energy production” is growing at a lower rate than the rate of growth in the “primary energy demand”. The reliance on foreign energy resources for economic development and prosperity increase the dependence: a state of being determined or significantly affected by external forces (international market rates). In case of Pakistan, the fluctuating rate of oil in the international market and domestic market and the difficulties faced by government in determining the suitable consumer prices have affected the economic growth of the country and the industrial output directly and the national security indirectly. It arouses public anger also.

Pakistan relies heavily on imported energy. Only 18% of the oil demand is met through indigenous oil. It shows country’s economic vulnerability in case of any supply disruptions because oil constitutes 31% of the energy mix of Pakistan. During 2007-08, Pakistan’s energy imports were 34%, with 66% indigenous production, as shown in the Figure II. A country’s over reliance on energy imports can be justified on basis of scarcity of indigenous resources. But in case of Pakistan with huge potentials of coal and renewable energy, 34% of energy imports are not a feasible choice. This excessive reliance on energy imports to fulfill the energy requirements undermines the energy security of the country.

Figure II: Total Energy Availability: Indigenous Production and Imports, 2007-08.

Source: Asian Development Bank: Clean Energy Development in Pakistan.
Energy Transportation

It means appropriate and timely delivery of energy from different sources. It is an important component of energy security because supply disruption adversely affects energy security of a country. The natural gas and oil resources of Pakistan are concentrated in Balochistan and Sindh. But the unequal distribution of revenue generated from resources in Balochistan has added to the grievances of Baloch people and justified their resort to force and destruction of gas pipelines. The targeting of supply pipelines in Balochistan resulted in periodic disruptions in transportation of gas in the country. Attacks by terrorists or militia on important infrastructure are a possible problem in future as well for domestic energy consumers.

Moreover, it has also affected the international gas pipeline project: Iran-Pakistan-India (IPI) gas pipeline. According to the original design, the Iran–Pakistan–India (IPI) gas pipeline was to be 2,775 kilometers (1,724 miles) starting from Iran's South Pars gas field in the Persian Gulf through the Pakistani city of Khuzdar in Balochistan, with one branch going on to Karachi and a second branch extending to Multan (898 kilometers) and then on to India (740 kilometers). Recently, the project has been finalized between Iran and Pakistan only, because security assurance of the transporting pipeline in the Pakistani territory (Balochistan) has been an irritant for government of India thus hindering finalization of the IPI gas pipeline deal. Some of the energy security thinkers believe that the security of transporting pipeline in Balochistan territory is one of the reasons for India’s not signing the pipeline project with Iran and Pakistan. However, the pipeline project has been signed between Iran and Pakistan, keeping in view the energy demands of the country.

According to the official report prepared by the Petroleum Ministry and Inter State Gas Systems (ISGS), the gas purchased will be used for power generation and it would enable Pakistan to generate 5,000 MW power. The report says that power generation and usage of imported gas by the industrial sector will contribute $1 billion to the annual savings. This will help to replace the costly
fuel used in thermal powerhouses and save over 1 billion dollar for national kitty if the crude oil price stands even at just $70 per barrel.\textsuperscript{12}

Pakistan is fortunate in regard to its geo-political location as it can pursue projects of import of gas and oil independently, as compared to India. But unfortunately, there is a lack of concern towards the issue, and most of such projects face long delays thus dragging the country to an energy crisis. In case of Iran-Pakistan pipeline project also, the work on the project will start by mid 2010 and the estimated time period is five years.

**Nature of Energy Crisis in Pakistan**

The main objectives of Pakistan’s energy sector as stated by Mukhtar Ahmed (Former Advisor to the Prime Minister of Pakistan on Energy) are: to ensure adequate and affordable energy supply to meet the needs of an expanding economy, maintain a balanced energy mix through maximum indigenous resource utilization with a focus on renewable sources of energy, exploiting the potential for cross border energy transactions and to create a conducive environment to mobilize private sector investment.\textsuperscript{13} In its organizational mechanism, it is to strive for appropriate distribution of responsibilities (policy formulation, regulation, administration), a rational industry structure (Government’s ‘strategic’ presence, public-private partnership, exclusive private ownership), and sustainable pricing regime (cost-of-service, transparent and targeted subsidies).\textsuperscript{14} But a study of various energy sub-sectors (discussed below) reveals that the facts are contradictory to these objectives. The shortcomings in the policy planning and implementation mechanisms in the energy sector have resulted in negative effects on the economic growth of the country.

An overview of energy sector (institutions and resources) is necessary to understand the nature of energy crisis in Pakistan. Potential of various resources, their exploration and contribution in the energy mix of the country is discussed in detail. The limitations of related institutions and organizations have been highlighted to understand the factors behind present energy deficit of the country.
Electric Power Sector

Electricity is the major mode of Power expression as different sources of energy are harnessed in the form of electricity. Pakistan has two integrated public sector power utilities, the Water and Power Development Authority (WAPDA) and the Karachi Electric Supply Corporation (KESC). WAPDA supplies power to the whole of Pakistan except the metropolitan city of Karachi, which is supplied by KESC. With the development of nuclear energy, Pakistan Atomic Energy Commission was established in order to use nuclear energy for power generation however the Independent Power Producers (IPPs) represent the private power sector in Pakistan. National Electric Power Regulatory Authority (NEPRA) regulates the distribution companies. The installed capacities owned by various agencies operating in the country are:

- Water & Power Development Authority (WAPDA): Total installed capacity of WAPDA stood at 11,454 Mega Watt (MW) during July-March 2008-09 of which, hydel accounts for 57.2 percent or 6,555 MW, thermal accounts for 42.8 percent or 4,899 MW
- Karachi Electric Supply Corporation (KESC): 1,884 MW
- Pakistan Atomic Energy Commission (PAEC): 462 MW
- Independent Power Producers (IPPs): 5,954 MW

The country has a total installed generating capacity of about 19522 MW. The current production is 11,000 MW, while current demand is 15,000 MW. It means that only 55% of the total installed capacity of power generation is being utilized. According to the Water and Power Minister, the present government has inherited a 3,500 megawatts shortfall, but it succeeded in generating 1,500MW by upgrading the system but despite government’s initiatives, the demand for electricity is rising rapidly and it has shot up to 16,000 MW per day. There are allegations of concealing the exact figures of energy shortfall from public which fosters public anger. Figure III, shows electricity demand projection and energy supplies in future. It shows that the demand is gradually rising.
Developments in power production sector remained stagnant and it is seen that electricity consumption by different sectors has merely increased by 0.7 percent during July-March 2008-09, due to shortages in electricity supply despite increase in demand.20 (See Table I) This trend of moving towards negative growth and the reduction in the consumption of electricity is coupled with higher cost due to gradual phasing out of a subsidy on electricity which has fostered public anger and protests in major cities.

Table I: Sector-wise Electricity consumption.

Source: Private Power Infrastructure Board

Source: Pakistan Economic Survey 2008-09.
Since beginning (1947-1955), Pakistan’s power sector focused on construction of small thermal plants and small canal fall hydel stations to achieve quick results. It started with two small hydroelectric power stations with a total installed capacity of 10.7 MW.\textsuperscript{21} In 1955, Pakistan’s installed generating capacity of 342.4 MW comprised of four hydroelectric power plants and about 90 thermal stations.\textsuperscript{22} This shows the shortsightedness of the policy planners as these small thermal plants with quick results were of little benefit in the longer run. Moreover, the focus on thermal plants left the hydroelectric potential of the country unexploited.

Conventional thermal plants using oil (28.7%) natural gas (35.7%), and coal (0.3%) account for about 66 percent of Pakistan’s capacity, with hydroelectricity making up 33\% percent and nuclear (2.3\%) percent.\textsuperscript{23} Despite huge hydropower potentials, country relies on imported oil for electricity generation.

WAPDA operates the majority of thermal power plants in Pakistan, with over 5,000 MW of installed capacity in its control. These thermal plants are run by imported oil, thus the cost of electricity generated by them is higher than hydroelectric power plants.

“The production cost of furnace oil electricity is Rs 16 per unit, add to it the transmission, distribution cost (including loses), the total cost of such electricity works out to approximately Rs 22 per KWh. It is estimated that the country consumes at least 25 billion units of electricity produced annually through furnace oil, which amounts to the total deficit of Rs 425 Billion. Government does not have enough resources to pay such a huge subsidy to WAPDA and increase in tariff can not solve the problem alone.”\textsuperscript{24}

As a result most of the thermal power plants of WAPDA are working at 50-60 percent of their dependable capacities.\textsuperscript{25} (See Table II). This has led to the current power outages in the country, thus affecting industrial output and discomfort for the domestic consumers. WAPDA is also delays payments to the oil companies and IPPs. So the IPPs are not producing electricity to their full
capacities. Under these circumstances, country’s total installed capacity is not being fully utilized.

Table II: Installed Generation Capacities, Dependable Capacities and Power Generation.

<table>
<thead>
<tr>
<th>Thermal Power Station</th>
<th>Installed Capacity (MW)</th>
<th>Dependable Capacity (MW)</th>
<th>Power Generator (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jamshoro TPS</td>
<td>850</td>
<td>700</td>
<td>415</td>
</tr>
<tr>
<td>Kotri TPS</td>
<td>174</td>
<td>140</td>
<td>118</td>
</tr>
<tr>
<td>Lakhara TPS</td>
<td>150</td>
<td>-</td>
<td>Non- Functional</td>
</tr>
<tr>
<td>Guddu TPS</td>
<td>1655</td>
<td>1155</td>
<td>873</td>
</tr>
<tr>
<td>Muzaffargarh TPS</td>
<td>195</td>
<td>60</td>
<td>38</td>
</tr>
<tr>
<td>GTPS F/ABAD</td>
<td>244</td>
<td>210</td>
<td>58</td>
</tr>
<tr>
<td>KAPCO (IPP)</td>
<td>1638</td>
<td>1386</td>
<td>1272</td>
</tr>
<tr>
<td>F/ABAD TPS</td>
<td>132</td>
<td>100</td>
<td>70</td>
</tr>
<tr>
<td>Malakand-III TPS</td>
<td>81</td>
<td>81</td>
<td>44</td>
</tr>
</tbody>
</table>


Moreover, due to reliance on imported oil to meet the energy demands, country’s own hydroelectric potential remained unexplored. WAPDA controls the country’s major hydroelectric plants; with the largest being the Tabela plant at 3,046 megawatts (MW) installed capacity. Additional hydroelectric plants in operation include Mangla (1,000 MW), Warsak (240 MW), and Chashma (184 MW). Apart from large dam projects, the canal network has immense potential. The hydropower potential of canal system in Pakistan ranges from 1 MW to more than 10 MW. However, the total hydro potential of the country is estimated at about 50,000 MW. The proposed sites for hydropower generation from canal network are given in Table III.
Table III: Proposed Sites and their Discharge, Fall and Power Potential

<table>
<thead>
<tr>
<th>Name of Channel</th>
<th>Location</th>
<th>Discharge in Feet/second</th>
<th>Fall in Feet</th>
<th>Power Potential (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baloki-Sulamanki Link-1</td>
<td>RD106250</td>
<td>12500</td>
<td>10.64</td>
<td>10.00</td>
</tr>
<tr>
<td>Baloki-Sulamanki Link-2</td>
<td>RD33430</td>
<td>9000</td>
<td>17.86</td>
<td>10.72</td>
</tr>
<tr>
<td>Chanab-Jhehlum Link (Tail)</td>
<td>RD316622</td>
<td>13527</td>
<td>41.70</td>
<td>40.00</td>
</tr>
<tr>
<td>Upper Chanab</td>
<td>RD0</td>
<td>16500</td>
<td>8.83</td>
<td>9.70</td>
</tr>
<tr>
<td>TP Link Canal (DG Khan)</td>
<td>RD183000</td>
<td>12000</td>
<td>3.00</td>
<td>12.28</td>
</tr>
</tbody>
</table>


Despite a small number of water reservoirs, the construction of new dams as well as small canal power projects has been ignored by successive regimes. It is very unfortunate to know that Pakistan has developed only about 4,800 MW of its total power potential in sixty years. The construction of Kalabagh dam has been delayed for decades. Kalabagh dam project will have an installed capacity of 3600 MW, which will be 20% of the peak demand. It will generate on average 11,400 million KWH annually. Moreover, the conjunctive operation of Kalabagh and Tarbela will enable to generate 336 million KWH of electricity in addition to its existing power production, with an average power benefits estimated as Rs. 35.94 billion per annum.\textsuperscript{28} But the project has long been delayed due to provincial divergences. Consequently, the country is facing acute energy crisis.

“If Kalabagh was in position today, there would have been no load-shedding in Pakistan.”\textsuperscript{29}
In recent years, growth in Pakistan’s thermal power generation has come primarily from new Independent Power Producers (IPPs), some of which have been funded by foreign investors. At present there are 16 private power projects with a capacity of above 5500 MW which are in operation. This is roughly one-third of the total power generation capacity of Pakistan. It shows that WAPDA has not been successful in pursuit of its core objectives. It is also responsible for non-functioning of IPPs. It is now opting for rental power plants to meet the energy requirements. Instead of rental power plants, there is a need to make IPPs functioning through payments by WAPDA, as country has invested in IPPs already and they have the capacity to generate electricity to suffice the demands. It is only because of the delays of payments by WAPDA, that these power stations are closed.

**Oil and Gas Sector**

Pakistan’s Ministry of Oil and Natural Resources regulates the country’s oil sector and decides taxation mechanism and royalty payments to the oil companies. Pakistan’s largest national oil companies include: Oil and Gas Development Company Limited (OGDCL), Pakistan Petroleum Limited (PPL), and Pakistan State Oil (PSO). However, major international oil companies in Pakistan include: British Petroleum (BP), Österreichische Minenölverwaltung: Austrian mineral oil authority (OMV), Orient Petroleum International (OPI), Petronas and Tullow. Pakistan has five refineries, with total 270,000bbl/d capacity. These include: National Refinery Limited (NRL), Pakistan Refinery Limited (PRL), Pak-Arab Refinery (PARCO) and Attock Group of Oil Refineries. Government policy in the oil sector always aimed at increasing the production of oil, but due to lack of capital and resources, the sector remained mainly at the mercy of international oil companies. It was in 1961, that OGDC was established, before that government was in joint ventures with the private companies, providing them negotiated risk capital in rupees.

Pakistan has proven crude oil reserves of 313 million barrels as of 1st January 2009. But since the late 1980s, Pakistan has not experienced many new oil fields coming online. As a result, oil
production has remained fairly flat, at around 60,000 barrels per day, while consumption increased to 350,000 barrels per day. This has resulted in increase in the net imports of the country. (see Figure IV) Pakistan’s strategic oil reserves are at precarious level with only 29 days stockpiling. It does not meet IEA standards of stockpiling which is a minimum of 90 days.® According to a study on Pakistan’s oil production and demand, there is a forecast of decrease in Pakistan oil production of 19.1%, with crude volumes falling steadily to 55,000b/d in 2018.35

Figure IV: Pakistan’s Oil Production and Consumption.

On the other hand, oil consumption between 2008 and 2018 is set to increase by 23.7%, with growth slowing to an assumed 3.0% per annum towards the end of the period and the country using 481,000b/d by 2018.36 These figures indicate that in future, country’s import dependency will increase thus making the economy more vulnerable to oil price fluctuations in the international market. This will further undermine the energy security state of the country in near future.

In natural gas sector, Pakistan’s state owned PPL and OGDCL are the main actors, which produce 30% and 25% natural gas respectively. The foreign natural gas producers include: OMV and BP.37 In the recent years, due to increased use of gas, the household and industrial sector is facing shortage of gas supply especially in the cold winters. It is assumed that in the near future,
Pakistan will face a shortfall of natural gas, despite recent gas discoveries, which will be insufficient to meet the rising demand. Gas demand is set to rise from an estimated 31.2bcm in 2008 to 39.2bcm by 2013, requiring imports of at least 1.2bcm. Gas production is expected to further rise to a possible 45.0bcm by 2017/2018. With demand growth of 60.5%, this requires imports rising to 5.1bcm by the end of the forecast period. This is the result of lack of diversity in the energy mix and increased use of gas. This over consumption of natural gas has resulted in unmanageable gas shortages in winter adding to the woes of consumers. It does not seem to be a feasible choice to move to an integrated energy policy (with maximum exploitation of coal and wind energy) after complete depletion of gas reserves of the country.

The overall share of imported energy in Pakistan has risen to 34-35 percent in the FY08 against 30 percent in FY04. This is mainly due to higher imports of crude oil and liquefied petroleum gas (LPG) for meeting the local demands of various sectors. The recent oil price hike in the international oil market caused an increase in the prices of energy in the domestic markets relative to other goods and services and adversely affected economy of the country.

On the other hand, in oil refining industry, the installed refining capacity in Pakistan remained stagnant due to acute shortage of capital required to build modern refining complex. As a result, the scale of operation of refineries in Pakistan is small and the normal refinery capacity utilization is 80%. Foreign investors in oil refining industry are reluctant due to high rate of return on investment. There is an increase in demand of natural gas and furnace oil particularly for electricity generation but Pakistan produces only 18% of the oil it consumes, rest of the requirement is fulfilled through imports resulting in financial strains.

**Coal**

According to 2007-08 figures, coal consumption in Pakistan has increased from 6 percent 1996-97 to 13.7 percent in 2008-09. Figure V, shows a positive trend in terms of decreased oil
consumption and increasing coal consumption, but in a period of ten years, it is a relatively slow transition and needs to be accelerated.

Figure V: Coal Consumption: 1996-97 and 2007-08.

Pakistan has immense coal reserves and Tharcoal mines are one of the biggest coal mines. Pakistan has an estimated at 185 billion tons of coal reserves, which, according to Dr. Akram Sheikh (ex-Deputy Chairman, Planning Commission) are equivalent to at least 400 billion barrels of oil, in other words equivalent to the oil reserves of Saudi Arabia and Iran combined. According to the vice chancellor of Punjab University, Professor Dr. Mujahid Kamran, these coal reserves equal to 618 billion barrels of crude oil. At $50 per barrel this asset is worth up to $30.0 trillion and equivalent to more than 187 times of Pakistan’s current GDP. These are astonishing figures, and it seems unbelievable that a country with immense potential of energy resources is suffering from an energy crisis.

In 1972, after the discovery of gas, the share of coal in the total energy consumption declined from 8.3% to 5.5% in 1977-78, as coal was gradually replaced by gas and petroleum products in the absence of any comprehensive coal development plan, dealing with its production, transportation and utilization. After creation of National Coal Authority (NCA), which aimed to promote the use of indigenous coal, there was a realization that the coal imports were made at a high cost in foreign exchange, which could be fulfilled more economically by indigenous coal. But the projects could not
be implemented successfully due to a lack of political will. Even recently we see that a Chinese firm that had agreed to set up a 600 MW project at the Tharcoal mines for 5.79 cent per unit quit from its project recently, when the authorities refused to offer a tariff more than 5.39 cents per unit. There is a need to focus on coal-based power generation as seen in case of other countries of South Asia. Coal is the most preferred source of energy in China and India, constituting 81 percent for China and 51 percent for India despite environmental concerns.\textsuperscript{45}

**Nuclear Power**

Presently, Pakistan has one nuclear power plant, Chashma-1 and nuclear energy constitutes 0.735 percent in the primary energy mix. The Pakistan Atomic Energy Commission (PAEC) operates the nuclear plant. Pakistan is currently working on second nuclear power plant (Chashma-2), with the help of China National Nuclear Corporation. The plant will have 325 MW of installed capacity and could be completed by end of 2009.\textsuperscript{46} But keeping in view, the country’s vast coal reserves, any investment to develop nuclear energy on immediate basis does not seem a viable option. Nuclear plants are capital intensive and have long gestation periods which make them less cost-effective as compared to coal fired plants.

**Renewable Energy**

Alternative Energy Development Board (AEDB) was created in 2003, keeping in view the potential of renewable energy sources.\textsuperscript{47} It acts as a central national body on the subject of renewable energy with the main objective to facilitate, promote and encourage development of renewable energy in Pakistan. Pakistan is blessed with huge potentials of hydro-power and wind energy. But presently, alternative fuels only constitute less than one percent (it was zero percent before 2009) of energy mix of Pakistan. Wind energy is an important form of renewable energy. It has been estimated that the potential of wind energy in Pakistan is 350,000 MW.\textsuperscript{48} Coastal areas of Sindh and Balochistan (Karachi, Thatta, Hyderabad, Jiwani and Pasni coastal areas) present an ideal location for the wind mills. In case of solar energy, Pakistan is located in the
sunny belt but currently, the use of solar energy is very limited due to the higher cost of solar plant infrastructure and lack of silicon semiconductor industry in Pakistan.

There is absence of commercialization of clean energy and market facilitation efforts. Government has long been hesitant towards development of renewable sources of energy due to the high cost of infrastructure required. There is a need to realize that cost of development of renewable sources of energy is far less than the amount paid for oil imports every year. Replacing oil imports with renewable sources of energy and indigenous crude oil will be beneficial in the longer run, keeping in mind the fluctuation in oil prices in the international oil market and the predictions about final energy crisis in the world. It is commendable to know that current energy crisis in Pakistan has raised governmental concerns for development of wind energy projects to avert the energy crisis. But there is a need to have consistency in development of renewable energy.

**Analysis of Root Causes of Energy Crisis in Pakistan**

- In addition to the factors discussed above, there have been structural inadequacies in the policy planning and lack of adequate economic reforms in transition phase from an agriculture based economy to an industrial based economy.
- Reluctance towards technical change which affects the energy intensiveness of consumption (see page 3, Energy Intensity). This has resulted in huge transmission and distribution losses. According to economic survey report 2008-09, the transmission and distribution losses of WAPDA alone are 19.41 percent after the up gradation of the system in the present regime. In the past, these figures were above 20 percent since 1998 when it was 25.8 percent. (See Table IV).
There is an increase in the energy demands of the country but means of energy production have not been developed consistently. With increase in population and rapid industrialization, there is an increase in the stock of energy-consuming goods, and utilization rate which require increase in energy production. Table V, shows the projected indigenous energy supply and deficit of Pakistan. It shows that energy deficit will increase to 46 percent in the fiscal year 2015 and further to 64 percent in the fiscal year 2025, which is very alarming.49

Table IV: WAPDA Transmission and Distribution Losses (%)

<table>
<thead>
<tr>
<th>Year</th>
<th>Transmission and distribution losses (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1998-99</td>
<td>25.8</td>
</tr>
<tr>
<td>1999-00</td>
<td>24.6</td>
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<tr>
<td>2000-01</td>
<td>23.8</td>
</tr>
<tr>
<td>2001-02</td>
<td>23.6</td>
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<tr>
<td>2002-03</td>
<td>23.9</td>
</tr>
<tr>
<td>2003-04</td>
<td>23.5</td>
</tr>
<tr>
<td>2004-05</td>
<td>22.3</td>
</tr>
<tr>
<td>2005-06</td>
<td>21.9</td>
</tr>
<tr>
<td>2006-07</td>
<td>21.2</td>
</tr>
<tr>
<td>2007-08</td>
<td>20.92</td>
</tr>
<tr>
<td>2008-09</td>
<td>19.41</td>
</tr>
</tbody>
</table>

Source: Pakistan Economic Survey 2008-09

Table V: Projected Energy Supply and Deficit of Pakistan.

<table>
<thead>
<tr>
<th>Energy Resources</th>
<th>FY 06 (MTOE)</th>
<th>FY 15 (MTOE)</th>
<th>FY 25 (MTOE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil</td>
<td>3</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Gas</td>
<td>29</td>
<td>34</td>
<td>19</td>
</tr>
<tr>
<td>Coal</td>
<td>2</td>
<td>5</td>
<td>13</td>
</tr>
<tr>
<td>Hydel</td>
<td>7</td>
<td>13</td>
<td>29</td>
</tr>
<tr>
<td>Renewable and Nuclear</td>
<td>1</td>
<td>3</td>
<td>12</td>
</tr>
<tr>
<td>Total Indigenous Supply</td>
<td>41</td>
<td>61</td>
<td>75</td>
</tr>
</tbody>
</table>
Energy consumption and productive activity: A lesser amount of energy is used for productive activities contributing to GDP growth of the country.

Policy Dilemma: Pakistan’s Energy Security Policy has been a victim of changing regimes and their agendas. An analysis of the five-year plans shows that although there have been programmatic interventions made on pragmatic lines, but those policies suffered a lack of sustainability due to changing regimes and an insufficient follow-up support provision. Some of the plans suffered a set-back due to dependency on external technical assistance, and the budgetary constraints. Most of our leaders believe that some minor alterations in the economic policy will be sufficient to prevent these problems from adversely affecting the economy. But they fail to see the long-term threats and consequently fail to do much about them, their initiatives does not go beyond their tenure in the government service. It is the duty of democratic decision-makers and parliamentary representatives, to work with conviction to take reasonable decisions with long term viability.

**Impact of Energy Crisis on National Security**

No country can achieve high economic growth without producing sufficient energy. In this way, production of energy reflects industrial and agricultural output of a country. Energy security fosters economic security of a country, which has emerged as a vital ingredient of national security. It has become a gadget in measuring the national security of a country. China is emerging as a global power due to its strong economy. It is the economic power of a country, which serves as a first line of defence as well as a threat.
to the enemies. On the other hand, an economic recession can undermine the power and national security of a country. National security refers to the survival of a nation-state through the use of economic, military and political power and the exercise of diplomacy. In this regard, adequate and cost effective supply of energy is the pre-requisite for socio-economic development and economic prosperity, which ultimately contributes to national security of a country.

When energy supply of an industry is restricted, its output decreases and cost of production increases. Periodic load shedding/power cutoffs lead to a reduction in the gross domestic production and exports of the country. In this way, energy crisis adversely affects the national economy by way of industrial output, agriculture growth, business and quality of life. Consequently, the macroeconomic implications of a supply-induced energy crisis are large as energy is the resource used to exploit all other resources. Table VI, shows the relationship between economic growth and energy in case of Pakistan. An overview of the figures from 1990-2007 reveals that the gross domestic production (GDP) of Pakistan has been significantly affected by energy productions. But despite this close linkage between energy and GDP growth, the energy sector has suffered from lack of attention by the successive regimes. Pakistan’s GDP growth for FY 2009-10 is forecast by Business Monitor International (BMI) at 2.5% down from 5.8% in 2008. In 2010, growth is put at 3.5%, followed by 4.3% in 2011, and 4.8% in 2012-2013 mainly due to energy shortages. In the 58 years history of the country, there have been only a few golden years where the economy grew above 7 percent. This unstable economy will have adverse effects on national security. Energy crisis in Pakistan has emerged as a threat to national security because of its intensity and multidimensional nature. Industrial output is reduced and exports are declining due to long hours of power cutoff.
Table IV: Pakistan’s Economic and Energy Growth (1990-2007)


As a result, country’s trade deficit is increasing rapidly. Like industry, agriculture is heavily dependent upon electricity and oil. Our crop production has failed to achieve its target and this failure is leading to the creation of another crisis, which is ‘Flour Crisis’. The lack of diversity of sources in the energy mix caused increase in the prices and availability of oil and natural gas which has directly affected transport. Expensive commercial transport further increases cost of a product, and decreases the ‘purchasing capacity’ of people, which means depreciation of national currency. Moreover, this has resulted in increase in the cost of living and it has made life difficult for the public. The power outages and long hours of load shedding apart from their economic costs also foster political instability by provoking public anger. The situation is further aggravated by the rising electricity prices.

**Recommendations: Averting the Energy Crisis**

The solutions can not follow any set prescription. Diversity of resource endowment, environmental, demographic, cultural, economic and political conditions force each nation to pursue a specific path. In case of Pakistan, the existing energy resources should be exploited to build a strong exploration and production base. The efforts should be directed at achieving cost effectiveness, reduction in import dependence, promotion of self reliance through accelerated exploitation of energy resources and minimum
environmental degradation. In addition, a number of far reaching measures need to be taken which include: attracting private foreign investment, creating a qualitatively improved infrastructure in oil and gas industry. The energy security policy should be grounded in national security with a strategic decision; to ensure a sustainable supply of energy resources for economic growth.

- The most important and initial step in averting energy crisis is energy conservation. An effective and full use of energy generated is more essential and effective to minimize energy shortages than materializing new projects in the field. Energy efficiency and conservation techniques should be adopted to minimize transmission costs and avoid transmission losses. There is a need to rehabilitate the transmission and distribution networks to reduce these technical and non-technical losses (i.e. electricity theft) through improving the efficiency of operations. There are trends of wasting energy instead of energy conservation among the masses. These trends need to be discouraged through energy conservation campaigns by Government.

- There is a need to pursue a policy of diversification of energy resources. Hydroelectric power generation, nuclear power generation and renewable energy share in the energy mix needs to be increased. “Invert the Prism Model” is suggested to diversify the sources of energy with a maximum utilization of indigenous resources (See Figure VI). According to this model, indigenous coal should form the base of energy mix and reliance on gas should be minimized keeping in view fast depletion of natural gas resources of the country. The model suggests an increased share of renewable sources and nuclear energy, thus minimizing the imported oil consumption, though it can not be eradicated completely due to demands of industrial sector.
Explanation: Invert the Prism Model has been designed, keeping in view the potential of various energy resources in Pakistan and the relative costs of harnessing energy through their exploitation, i.e. coal reserves: 185 billion tons, hydro potential: 50,000 MW, Wind energy potential: 350,000 MW in coastal areas of Sindh alone. It suggests a decrease in the use of natural gas and focuses on diversification to avoid rapid depletion of gas reserves. The percentage of nuclear energy is kept below 5% due to the high costs for its development. The percentage of oil is suggested to 1-2%, to cut short enormous oil imports. It is suggested that oil requirements should be fulfilled through indigenous oil production to avoid the negative impacts of oil price hike and of global energy crisis (as predicted) on country’s economic growth and development.

Source: Author.

- In case of high cost of electricity generated by thermal plants, Inver the Prism Model will help in low cost production of electricity through construction of additional hydroelectric, nuclear and coal-fired electricity generation facilities. Moreover,
importing electricity from Iran and Tajikistan is a feasible option but it should be limited for a short time-span. Meanwhile, the indigenous electricity generation capacity of WAPDA, KESC and IPP should be enhanced.

- There is a need to revise the petroleum policy aiming at increasing the indigenous oil and gas production as well as to attract foreign investment in oil refining industry. Pakistan relies on 34 percent energy imports. There is a need to foster the process of oil exploration. According to economic survey report 2008-09, the total recoverable reserves of crude oil in Pakistan as of 1st January 2009 have been estimated at 313 million barrels. But unfortunately, there is lack of infrastructure and refining companies. So there is a need to decrease dependence on imported oil, through encouraging indigenous oil production.

- The infrastructure of oil exploration companies and refineries needs to be improved. The installation of infrastructure and machinery will reduce dependence on foreign sources. The demands of foreign investors for minimum rate of return should be considered and negotiated Rate of Return (RoR) be offered, keeping in view country’s over reliance on oil imports.

- Renewable sources of energy- Clean energy: In order to reduce country’s reliance on imported energy, especially oil, it is required to increase spending on alternative fuels, particularly wind and hydroelectric power, keeping in view the assessment of their potential in Pakistan. Currently, although the cost of energy generated from renewable resources is generally higher than that produced by “conventional” energy sources. However, as renewable resources become more established and the benefits of mass production take effect, the gap will reduce. Moreover, there will be positive local environmental impacts of renewable energy schemes, thus contributing towards clean environment. There is a need for political will and foreign investment
friendly policies to move these projects from laboratory or pilot project stage to full scale developmental, energy generation plants.

- Promoting coal production: Being a member of Kyoto protocol, there is a rising concern over environmental aspect of coal-use. In addition to it, Sindh Coal Authority (SCA)’s concerns over tariff have hindered the coal exploration and consumption in Pakistan. After the massive shift to natural gas in the transport sector and policy of de-dieselization, the total amount of pollutants emitted per day will remain almost the same. In addition, the LPG supplies have been increasing at an annual cumulative growth rate of 18.2 percent during last few years, which has resulted in decreasing the rate of deforestation. In order to minimize negative environmental impacts of coal-use, Coal gasification techniques can be applied. (See Figure VII) Moreover, the use of coal can be planned for a limited time and meanwhile renewable resources of energy (e.g. hydroelectric, wind and solar energy) can be developed.

Figure VII: Synthetic Fuel Production.

Keeping in view Pakistan’s fast depleting natural gas reserves; there is a need to encourage the building of transnational pipeline grids. The IPI gas pipeline project has been finalized between government of Pakistan and Iran. The project will be completed in 5-years, and it will help to avert the electricity crisis in the country. There is a need to pursue more projects on same lines in order to diversify imported gas supplies, but the security issues in Balochistan needs to be resolved first.

In Pakistan, there is a culture of politicization of issues of national interest. In the last three decades, the energy generating projects have remained stagnant as seen in case of Kalabagh dam. There is a need to separate development projects from the political ambitions of the leaders.

Petroleum consumption: Although share of imported energy is increasing in the energy mix but in case of POL products, the consumption has decreased in the last decade dramatically from 17,768 tones in 1990 to 12,892 tones in 2008 due to the higher consumer prices. There is a need to promote indigenous oil production, through exploration of oil fields of Sindh and Balochistan which will be cheaper.

It is required to develop nuclear origin electricity generation units. But keeping in view the economic recession in the country and huge costs of developing nuclear energy, the pace of development should not be very fast.

The role of private enterprise in the energy sector is hindered by the unstable political situation and security conditions in the country. There is a slow rate of deregulation and privatization, the political controversies and provincial disagreements over the storage-based hydroelectric power generation projects, and lack of investment friendly policies. John Hammond of the U.S. Energy Association detailed some of the barriers to U.S. investment in Pakistan’s energy sector, he said:
“Pakistan must demonstrate to the investing world that successful, unaltered private-power projects can operate without government interference.”

There is a need to establish strategic oil reserves and engage in bilateral and multilateral energy cooperation. Asian countries should devise a common energy policy with the objective of creating energy security measures and addressing environmental issues. In order to enhance South Asia’s energy security, efforts must be made to create political stability in Afghanistan, as South Asia future energy routes emanate from Central Asia. Pakistan must promote its indigenous energy related organizations at national and regional levels in Asia in order to foster cooperation in the energy sector. In this regard, SAARC- Energy Centre can play a significant role.

The recommendations need to follow a systematic path for their effective implementation to avert the energy crisis in the country. Strategic steps need to be taken to acquire energy resources in future. After an analysis of the factors leading to energy crisis and Energy Security Strategy is suggested in light of recommendations made, to avert energy crisis in the country. (see Figure XII)

**Figure XII: Energy Security Strategy for Pakistan**

- Structural inadequacies and loopholes in eco-dev planning
- Lack of eco-reforms while transition from Agricultural to industrial base
- Resulted in increased energy demand
- Increase in energy consumption by industry + Energy consuming goods
- Reluctance towards technical change
- Policy Dilemm; lack of continuity of policies
- Politicalization of issues of National interest
- Stagnated Energy Mix
- Lack of indigenous resource development
- Over-Reliance on Imports: Fluctuating oil prices in Intl market
- Lack of Research and Development Culture
- Formulation of a comprehensive development plan
- Policy of Diversification of Energy Resources
- Promoting Indigenous Resources
  - Invert the prism Model.
  - Increasing coal percentage in energy mix
  - Promoting renewable energy
  - Improving oil exploration and refining infrastructure
- Energy efficiency and conservation
- Energy reserves
- Dam construction and Electricity Generation
- Regional Co-operation for energy security
- Building Translational gas pipelines
There are some positive initiatives taken by the present government. There is an increasing focus on development of wind energy projects to avert the energy crisis and some projects are in the initial phases. In case of solar energy also, Government has finalized some projects, e.g. Punjab Government has selected the Islamia University Bahawalpur for installation of a solar power plant worth $10 million, having a generation capacity of 2.5 megawatts. According to government, 17 power projects will be completed in 2010. But Government needs to communicate to public about the future power projects in order to create awareness among them. It will also help government to regain trust of public, and will pacify public anger.

**Conclusion**

The study shows that the energy crisis in Pakistan has not emerged over night. It is a result of long-term ignorance towards development in the energy sector. It seems to be a supply-induced crisis as there have been a short history of reforms in the energy sector and a lack of focus on diversification of energy resources and over reliance on imports. Energy plays a pivotal role in the economic growth of a country which leads to social development and political stability. For development of Pakistan’s economy, it is necessary to take advantage of any source which can be harnessed, converted, transported, and used in practical and reasonably efficient ways. Those countries which discover significant deposits of oil and gas will have the least number of problems in their development.

Pakistan’s energy sector has a history of short-term, temporary and urgent initiatives. Although these initiatives suppressed the issue for a short time but resulted in greater fallouts in the longer run due to lack of vision. There is a need of continuity of reforms in the energy sector instead of short term solutions to periodic energy fallouts. The demand for electricity is growing by about 9 per cent per annum but there is no positive development on Kalabagh dam or small canal power projects as yet. Moreover water distribution issues with India are not resolved which has resulted in further shortages of water supplies.
There is a need to formulate a comprehensive and well integrated energy security strategy with a focus on developing indigenous energy resources, a strong oil and gas exploration and production base to minimize dependency on imports through increasing self-reliance, energy conservation through improved infrastructure, promoting private foreign investment. Recently, Prime Minister Syed Yusuf Raza Gilani has welcomed President Obama’s initiative to form a joint task force for assisting Pakistan in overcoming the present energy crisis. This joint task force may help in improving the coordination among various energy sub-sectors to formulate a comprehensive energy policy. The development of renewable resources and nuclear energy will take time and it requires a continuity of policies, but once developed, it will save the country from huge national bills of oil imports. The vital relationship between energy availability and economic growth can not be denied so in order to keep pace with the developing nations of the world, it is necessary to establish a strong energy base through exploitation of indigenous resources, and coal is the most feasible choice in terms of its availability and cost effectiveness. This is the only way to transform a country with energy crisis into one with a strong energy base and to avert the ill-effects of energy crisis on national security. Being a mature nation, there is a need to strive for a coherent and comprehensive energy policy this time to tackle the issue on pragmatic lines instead of short-term solutions again.

“Fears of scarcity will also prove to be a poor guide for energy choices. Rather energy choices should be made in a comprehensive and integrated manner weighing environmental concerns, technological trends, and security considerations.”

Notes

3 Energy and Poverty, International Atomic Energy Agency, Available at,
3 The oil-fired thermal power plants cost Rs.15-22 per unit of electricity as compared to hydro-electricity which costs Rs. 0.20-0.45 per unit of electricity. The Nation, “Pakistan Electricity Crisis- A Real Perspective”, By: Amjad Agha, 10th June, 2008. Available at, www.opfblog.com, Retrieved on, July 4th, 2009.
4 Energy efficiency of appliances and buildings, fuel economy of vehicles, better methods and patterns of transportation, capacities and utility of mass transit, energy rationing or conservation efforts, energy prices, ‘off-grid’ energy sources, and stochastic economic shocks such as disruptions of energy due to natural disasters, wars, massive power outages, new sources of energy, efficient uses of energy or energy subsidies may all impact overall energy intensity of a nation.
6 Ibid.
7 Ibid.
8 Ibid.
9 The total revenue generated from Baloch resources is Rs. 1.4 billion; however Baluchistan’s royalty from federation stands at Rs. 2550 million only. Available at, www.nation.com.pk, Retrieved on, July 25th, 2009.
14 Ibid.
15 Distribution companies are: LESCO, GEPCO, FESCO, IESCO, MEPCO, PESCO, HESCO, and QESCO.
21 Dr. Abdul Latif, “The Implementation of Energy Policy in Pakistan”, Royal


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