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Energy Security for Pakistan: An Analysis

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Abstract

Adequate, consistent, reliable and cost effective energy supplies are lifeline of modern economies and military. That is why energy reserves are also termed as strategic reserves. Therefore energy security lies at the center state of international politics. Pakistan as a growing economy, populated and strategically important country cannot ignore the significance of energy availability. Energy security is an important issue of concern for Pakistan to ensure its national defence, economic development and social cohesion. At the same time rational understanding of what energy security means for Pakistan is significant for resolution of the problem. Extensive reliance on imported fossil fuel is counterproductive for sovereignty of any country. Pakistan has been blessed by renewable and indigenous sources of energy and need to utilize them effectively. Energy drives economy and access to cheap energy potentially decides the shift in balance of power. In order to increase interdependencies & maximizing its power, Pakistan is a bridge between energy rich Central Asian States & Iran as well resource hungry China & India.

Key Words: Energy Security, Pakistan, Central Asia, dilemma, Capacity, renewable resources self sufficient, threats.

Energy has become pertinent for international economy and development since the industrial revolution. To acquire the energy security, states pursue their defense and foreign policy accordingly. What mystifies the concern of energy Security is the probability of mankind consuming all energy reserves as fossil fuel is not an unlimited commodity. This situation triggers the competition to access and possess as much as possible energy reserves leading to intense security dilemma among the states. Theorists argue that “energy insecurity combined with other global issues risks fueling conflict, repeating past mistakes in history” (Shah, 2011).

The population growth rate, industrial development and militarization make South Asia progressively eminent actor in the energy arcade. The International Energy Agency (IEA) carves that energy requirement especially in the South Asia will nurture at more than twice the velocity of entire world over the next decade. Approximately by 2030, India has the potential to be biosphere’s third largest consumer. Therefore, the greater exertions of energy security considerations will also complicate its impact on political-military

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restraints upon the region (McMillan, 2008). Energy security is not an isolated phenomenon but interlinked with several political, cultural and economic realities. Therefore, Pakistan being an important country of the region is pertinent for the regional economic development, domestic and regional peace and energy security. In this premise, this paper aims at understanding and enlarging the notion of Energy security, analysis of energy security for Pakistan and to contribute futuristic approach.

The Notion of Energy Security

Energy security has been a matter of agenda for policymakers across the globe for almost 150 years. Energy security from a political-military dimension is to fulfill the energy desires of martial forces but in the light of contemporary political-economic international system, energy security is much broader and larger than this perception (McMillan, 2008).Factually, professionals and politicians stated to "security of oil supplies" as "energy security," (Measuring Short Term Energy Security, 2011), because most of the industrial states are dependent upon foreign energy supplies.

Theoretically energy security is, "the uninterrupted physical availability of energy supplies at a price which is affordable, while respecting environmental concerns" (Bradshaw & Mike, 2014, p. 24). According to another definition "energy security is reliable, uninterrupted and adequate supply of energy at affordable prices" (Subhes C, 2011, p.463).

Here there is a need to understand the term "reasonable prices" is relevant as one need to decide what should be rational prices from the client's perspective rather opinion maker's assessment? The difference of perceptions and interests of consumer and producer state makes the concept of "Energy Security" more complicated and political. Nonetheless, "Cooperation, Self Reliance, and Efficiency of Energy Use" are the key concepts in determining the future energy security.

Inability of any state to ensure energy security leads to energy crisis. An energy calamity can be "a situation in which the nation suffers from disruption of energy supplies accompanied by rapidly increasing prices that threaten economic and national security" (Behuria, 2007, p. 171). However, two elements could be contained by the energy crisis: debility in GDP boom, generally a downturn, and a menace to national security. First element in this regard is vibrant and can be evaluated, it is problematic to examine or assess the later one (Williams & Alhajji, 2003),but they make energy security inevitable for the survival of any state.

There are two school of thoughts defining the concept of energy security, firstly, formulation of government policies are in response to the energy security which is an actual matter. Secondly, Energy security is “an empty concept used to achieve bad, self-serving public/foreign/defence policy” (Patrick, 1998).

Perceptions of Energy Security

Every state, according to its environment, needs, policies and compulsions, defines energy security accordingly. For instance for some energy security is the matter of survival, (Andreas, 2013)rather a tool of enhancing hegemony(Stokes & Raphae, 2010). For others it can be an instrument to contain the influence of certain interest of the state (Shaffer, 2009, p. 88) and to ensure sustainable economic growth rate (Leal &Voudouris, 2013).Nevertheless, commonly known aspects of energy security are security of supplies, the environment and economy (Mitchell & Watson & Whiting, 2013, p. 13).

Therefore in order to explain and understand the concept, one has to focus on energy security vs energy insecurity, freedom vs incarceration, energy security vs reciprocal energy security, energy security vs national safty, energy security vs economic security, energy security vs environmental security, foreign investment vs formalization of dependence, protected areas vs unprotected areas for imports and investments, market prices vs administered prices, and high prices vs low prices (Sisodia & Behuria, 2007, p.171).

In nutshell, the polices to ensure energy security primarily focus on ensuring national security, economic growth and development, sustainable, safe and secure energy deliveries, availability at reasonable price and approach to low charge energy resources.

Strategies to ensure Energy Security

A methodical concept of energy security would take into account of the following aspects;

i. Resilience

Resilience is finest assumption of a “security margin” that allows a state to grips any slight tremors to energy supplies and “facilitate recovery after disruptions.” Said “buffer” have different procedures, including “spare production capacity, strategic reserves, backup supplies of equipment,

adequate storage capacity along the supply chain, and the stockpiling of critical parts for electric power production and distribution" (Globalization 101, 2013).

ii. Diversification of Supply

The US, for instance, has effectively succeeded to deter itself off complete reliance on the Organization of Petroleum Exporting Countries (OPEC) in last two decades, lessening their segment of energy imports from OPEC nations from seventy two percent in 1977 to fifty four percent in 2007. It is pertinent to mention that diversification of delivery does not secure an energy retailer from oscillations in the international marketplace (Globalization 101, 2013).

iii. Global Interdependence

'Energy interdependence' is an expression that has become a proverb since Richard Nixon used it after four weeks of the oil embargo of 1973(Yergin, 2006).All countries are seized into close and complicated global energy arcade and true safety lies in the "stability of this market." The thought of energy interdependence comprehends that manufacturers craving security of necessity of consumers require secure flow of energy. European Union gets thirty percent of its vitality from Russia, proves that Russia predominantly relies on the EU for twenty percent of its energy related incomes (Globalization 101, 2013).

Responsibility of Energy Security

A serious query arises who is responsible for energy security, consumer or producer!? The general perception prevails that "energy security" is responsibility of consumer state. But now theorists support the argument that energy security is the obligation of both consumer and producer (Janardhan & Fesmire, 2011)& (Calderon, 2003).

Apart from the debate over responsibility of energy security, there are certain threats to energy security as under:

- An un equal dispersal of energy materials led to substantial resistances (Fernan, 2010, p. 102).
- Political disparity of some energy producing countries, maneuvering of energy supply (iMinds, 2010).
- Assaults on energy sources and supply arrangements.
- Upsets and natural catastrophe.

- Limited supplies, un-even dispersal and increasing cost of energy.
- Incapacitation of energy assets and arrangements through radicalism or warring.
- Policy contradictions at national level.
- Government intervention.
- Cost regulation distorts the association between supply and demand that can lead to scarcities.
- Interaction between various energy security policies is also very important
- Use of oil as weapon.
- Energy security of one state is energy insecurity for the other state. “For Example if the trans-Afghan gas project is realized, Moscow experts say, the Russian economy will face two unpleasant consequences. Firstly, Russian energy sector will lose Turkmen gas that is now being delivered to Russia and, in the long-term perspective, also Uzbek gas. That could amount to 25 billion cubic meters annually. Secondly, if Central Asian gas exports are directed south, across Afghanistan to the Indian Ocean, Russia will lose transit revenue” (Khawaja, 2003, p. 48).

Few theorist termed Energy dependence as a flaw in national security and on the contrary some also termed this dependence or interdependence as “peace dividend” which incorporates the economic interests of regional states to forge ways for regional peace and mutual coexistence (Imran,, 2014). There are few facts about energy dependence, supporting each school of thought. It is noteworthy that Japan and Germany managed to sustain highest growth rates despite their 100% reliance on external oil (Alhajji, 2010, p. 16). Moreover India, China and Pakistan had a faster economic growth before recent recession despite oil price hike.

Energy Dependency

Russia withdrew gas distribution to Europe by 60 per cent. That caused energy scarcity resulting in strained bilateral relations. Bulgaria, Greece, Macedonia, Romania, Croatia and Turkey, all stated an end in gas import from Russia through Ukraine. The European Union in Brussels mentioned ’completely unacceptable’ (Lea, 2009), the state of abrupt end to some of its member countries. The withdrawal of oil supply by the Russia to Poland, Germany and Ukraine was due to its strained relations with its fellow citizen Belarus. According to the Russian state pipeline mechanist, Transnet, they stopped supplies on the Druzhba pipeline to protect Belarus unauthorized shipping of oil. Germany and Poland have sustainable energy reservoirs to maintain their economic growth (BBC News 2007). Russia ended gas supplies

to Belarus upon latter's inability to clear its debt. According to Gazprom, Belarus owes about $200m after failing to pay inflating prices (BBC News 2007).Europe bears energy disaster as Vladimir Putin ends gas availability. As the result Europe was indulged in energy insecurity after GASPROM seized 20% supplies to Europe in freezing temperature (The Telegraph, 2009).

Energy Security for Pakistan

Pakistan considers Energy Security as a mean to achieve economic development, to improve human security index and to ensure domestic and regional peace. Pakistan perceives energy security as a tool to address the issues of national security, leading the country towards socio – economic uplift and prosperity.

Oil production of Pakistan is 36 percent, whole 29% each from gas and hydel and 5% from nuclear to meet its needs. Unlike the worldwide exercise of making electricity through inexpensive energy sources, Pakistan is satisfying its energy requirements through oil and gas-based power lodges. The world is producing about 41% of electricity through coal, whereas Pakistan is producing just 1% electricity through coal. It produces 36% electricity through oil, 29 % of electricity is yielded through gas while 29 % is produced through hydel sources. In India and China, 68 % and 79 % of electricity is produced through coal respectively. Progression in population, augmented expansion and the excessive use of electronics have increased regional usage to 46% of total electricity utilization. Annual GDP development rate of 4.4% by the industry installed generation means increased over the years. Definite production in 2010/11 persisted 35% from furnace oil, 35% from hydel, 25% from gas, 3% from nuclear and 2% from other sources. The cost of electricity demand has developed an average gap of over 3,500MW in FY11 and reached to 5,000MW in FY12 – presently it is as high as 7,000MW relying on the weather and accessibility of hydel power (Mirza, 2014).

Current recorded 25% losses are due to poor infrastructure, professional negligence and inefficient transmission system and electricity theft. Taxpayers pay additional Rs 2.70 per unit despite the actual cost (averaging around Rs12). Yearly, power theft amounts to Rs140 billion (Mirza, 2014).

Before 2010 Pakistan used to import two third of its oil requirements (Hindustan Times, 2009). According to various estimations Pakistan annually requires some 437 barrels crude oil per day (Index Mundi, 2013). Furthermore Pakistan's oil need was probable to increase by 7 % during the fiscal year (2013-14). After closure of CNG station, non availability of the product and

circular debt issues, the energy requirements hiked to 21 million tons from 19.5 million tons (Azad, 2013).

Pakistan is manufacturing around 36 % from oil, 29 % each from gas and hydel and 5 % from nuclear to meet its requirements. Unlike the universal exercise of making electricity through inexpensive energy wells, Pakistan is satisfying its energy needs through costly oil and gas-based power plants. Globally, 41 % electricity is manufactured through coal, 21 % through gas, 16 % through hydro, 13 percent through nuclear, five percent through oil and three percent through other natural renewable means. Pakistan makes 36 % electricity through oil, 29 % of electricity is made through gas while 29 % is yielded through hydel sources (Mirza, 2014).

Nation's primary energy need is met by 43.5 % of oil, natural gas 47.5% and coal 5.1 %, while the residue is met by hydro-electricity and very less from nuclear power. According to data offered, the country had petrol assets for 20 days and furnace oil for 21 days.

The declining natural gas reserves of Pakistan and a low gas price has become a considerable discouragement in fascinating new gas supplies, either through risen regional examination activities or via imports of liquefied natural gas (LNG) or regional gas pipeline imports. If current gas strategies continue, then Pakistan's natural gas delivery is probable to decrease from 4 billion cubic feet per day (bcfd) in 2010/11 to less than 1 bcfd by 2025/26. This will lead to a growing gas/energy deficit approaching 8 bcfd (over 50 million TOEs) by 2025/26 and will reduce Pakistan's average GDP growth rate over the next 15 years. Pakistan's average gas necessity is 6.5 billion feet. In 2012 the shortfall was 700mmcfd (Dawn, (n.d.)).

Over the world, administrations are appreciating the utilization of renewable energy possibilities in energy mix, in order to address the issues of climate change and to cope with higher cost of fossil fuel. Pakistan carries 32 per cent of energy production through hydel power. Almost 400 to 500 MW of power has been generated through wind fields. Moreover different solar projects are under construction, government has offered subsidies and other initiatives for its use on the micro-level. Pakistan's has huge potential of renewable resources, eg. solar and wind an produce nearly 300,000 megawatts (Dawn, (n.d.)).

The single most important natural resource is provided by the Hydel power. It contains numerous advantages. The cheapest form of electricity we get is from the Hydropower, if once its initial recovery is observed. For the purpose of irrigation and drinking, the water storage is helpful. Then the flood

regulation is frequent. It's very much difficult for a single dam to carry multiple functions at a time, but its possibility is noticeable. Hydro power can generate at least 60,000MW, maximum of this from KPK and GB. The entirely mounted aptitude of hydropower is 6,800MW. Projects with entire production capability of over 50,000MW are 'in progress', According to WAPDA and the PPIB. The lack of political will and consensus causes a measureable hindrance. Secondly the financial hurdle, seeing Pakistan's declining ability to fascinate foreign stakeholders due to the security situation. The continuous water dispute with India stays a third major hurdle.

In KPK only 19 out of 142 projects are installed and further 27 are under consideration. Similarly only 8 out of 296 projects are functional and 38 under execution by the compiled data from the report of Engro on energy (Baig, 2013).

The estimation of the natural coal resources of Pakistan resulted in a vast asset, but for its usage, very least progression was seen. Whereas the total natural reserves remained 185 billion tones, with its proclaimed location in Sindh. Coal usage in Pakistan's energy mixture rests lower than 0.1 %, less than the global average of forty percent. According to a report, Thar dessert contains the globe's 7th largest oil reserves, estimated at 175 billion tones. In this regard the government tends to develop the utmost infrastructure in order to generate the possibility of economic growth, with improved infrastructure. There features the importance of tapping Pakistan's coal reserves to effectively diminished energy crisis so that to avoid exhaustion of other short resources (Dawn, (n.d.)).

Coal of Thar, where the country possesses the 7th largest lignite reserves globally, is estimated as the Pakistan's entire short or medium term solution of addressing her energy calamity efficiently. Coal-based power production is economically a feasible choice. The utmost issue with the development of coal industry in Thar is excessive sulphur deposition. Geographical footprint rests another issue with the coal. Most people and the environmental activists make generally this kind of argument with footmark of huge dams for producing hydropower requires relocation of concerned population. Similar sort of issue also lies with the Thar (Baig, 2013).

Pakistan broadly recognized as an oil-rich state while untouched, along with the firm calculation of substantial or unsubstantial reserves. OGDCL, along with other private companies mapped the oil exploration up till the 80s, but mostly energy generation remained uniform, at roughly sixty thousand barrels daily. Authorities have now aimed at lifting it to hundred thousand barrels a

day. Pakistan's oil ingestion is 410,000 bbl/day, consequently the mass necessity will still be satisfied through foreign fuel (Dawn, (n.d.).

The preferred choice of power generation in many of the countries in the world including Japan (18% of total power generation), France (74%), Belgium (51%), and the US (19%) remained through the Nuclear Power. It can be unfeasible, or tactfully and economically dreadful for Pakistan to produce an important portion of its electricity using nuclear, the present situation with installed capacity of total 755MW, nuclear power pays a bleak 1% to the overall energy supply of Pakistan, which is in fact intolerable. But certainly this situation where Pakistan needs to pay heavy attention, especially in Punjab regions which are not on a liability line (Baig, 2013).

Metrological Department of Pakistan claims that, the Gharo-Keti Bandar wind strip is sixty km broad and about 180 km stretched. It may produce about 50,000 megawatts. Wind energy can be used to electrify isolated areas and population to incorporate them in national network and to create a saving at optimum level especially on laying wires and providing the electricity on high distances. The approved tariff that has been accepted is 13 % per kilowatt hour, which is quite costly in comparison with the rest. This may not be sufficient to cheer financers/ donors therefore it should be increased to sixteen %. From this it is explicit, that environment friendly will be costly and will preferably charge about sixteen cents per kw hour along with ecological footmarks. Hundred thousand of land requirements needed to obtain the extreme pressure of such an energy source. Sterling suggestion of installing wind mills at coastal line will be expensive. (Baig, 2013).

The renewable shale gas reserves are 105 TCF and more than nine billion barrels of oil is situated in Pakistan. The estimated reserves are so vast that yet has not been proven of 24 TCF for gas and about 300 million barrels for oil. Pakistan's present production is about 4.2 billion cubic feet of gas and about 70,000 barrels of oil per day (Kiani, 2013)

So far Pakistan's energy capacity and consumption is concerned, in 2010, the estimated per capita energy intake in Pakistan at 14.2 million BTU (British Thermal Unit), which is much more than Bangladesh's 5 million BTUs per capita but less than India's 15.9 million BTU per capita energy consumption. Country's entire energy consumption ranked at 39.4 million tones with the shares of gas and oil's in energy intake at 40.3 % and 29.3 %, whereas the, electricity, coal and LPG at 15.2 %, 13.7 % and 1.5 %singly (RiazHaq, 2009).

About 19500 MW capacities are installed in Pakistan. Hydro power generation is around 8000MW; while the generation capacity remained of 11500 MW is

reliant on thermal power. They utilize natural gas/furnace oil, furnace oil only or coal (Hassan, 2013), (Lakhra Power Plant). Natural gas cannot be provided for power production and Lakhra is producing twenty five percent of its capacity, sixty percent power stations are now running on furnace oil. All these plants run on the imported fuel which is more in sulphur and that's why their life has diminished and they are working at thirty to fifty percent of their capability. Their generation capacity ranges between twenty eight–thirty three percent at extensive cost. The association of serious problems in burning the furnace oil and the International etiquettes are getting harsh in the implementation of regulations against dispersing pollution.

Towards the end of the Musharraf's regime, power failures got motion when load-shedding increased over 2,000 megawatts (MW). For the first time in history this had happened, after an unusual time that witnessed Pakistan with extra electricity from the late 1990s to 2004-05. Soon the power shortage crossed the stage of 6,000MW during 2011-12, and has only degraded since. In May, 2013, this exceeded shortage 7,000MW. A drop of almost 33% over six years has been seen due to the first division of natural gas to other areas. Produced electricity from natural gas, which ranked at a peak of 43,472 gigawatt hours (GWh) in 2005, diminished harshly to 25,879 GWh in 2011. One percent of GDP growth in Pakistan demands 1.25% escalation in energy production (Hassan, 2013).

Highlights of Energy Situation

Pakistan lacked to incorporate its energy security strategy until 2005.Although after that Pakistan started to formulae national energy plan but none was implemented in true letter and spirit yet. Generally, one capita energy ingestion is a key progress gauge of "quality of life" of the nation. Pakistan has14 MMBTUs per capita energy intake related to 92 MMBTU of Malaysia and 514 MMBTU of Japan (Malik &Shiekh 2010). Pakistan's reliance on foreign energy products has mounted by 5% (Yasir,2009).Therefore in recent past inaccessibility of continual and reasonable energy to market has repressed economic progress and created falling drive for economic investment (Malik &Shiekh 2010).

Almost, 5800 MW natural gas is delivered to thermal plants, but it does not fulfill their requirements resulting in increased dependency on furnace oil for production of at least 9000 MW (Agha, 2008) This costs Rs 16 per unit in 2013 (Khan, 2013). After including the diffusion, dissemination price (including loses), "the total cost of such electricity works out to approximately Rs 22 per kWh. The difference between WAPDA tariff and the furnace oil electricity cost is Rs17 per kWh." In 2008 at least 25BU

was generated through furnace oil (Agha, 2008).The energy source intake broadly beats the supply. On another way, hydro and coal are maybe under usage, as Pakistan has excessive supply of both. Currently the country mislays 29BU because of great thrashing in the structure. If reduction in the losses become 5 %, then there deeming will be uptil 7 Billion rupees per year(Agha, 2008),as the cost of electricity unit is rupees 6.73 (Malik, 2012). Depending upon the price of crude oil and bilateral agreements with IMF, one may expect changes in per unit cost. Electricity subsidies were very high at 44% of total subsidies in Fiscal Year (FY) 2009 and remained a notable budget drain. The power tariff phasing of the government increases to lean these grants.

In the alone power sector, the required investments are calculated at US$ 150 billion for the extra 143,310 MW of fixed capacity. Total oil and gas compared investments up till 2015 were calculated at US$ 16 billion. Moreover the economic requirements for encountering its recoverable energy growth targets up to 2015 are calculated to be US$ 2.2 billion. All of these were massive potentials (Rehman, 2008)

While keeping in view the afore mentioned situation, it would be interesting to articulate the objectives of Pakistan's energy security plans.

Pakistan's Energy Security Plan. Objectives of national energy security plan are proffered as following: (World Bank Report, 2005**)** & (Boureston, 2008).

- Ensure Sufficient energy at sustainable bases and affordable prices
- Maximum utilization of Indigenous resources
- For effective improvement in R&D promotion efficiency and maintenance and growth of energy efficient usage.
- Improvement of quality based consumer skills and making cut throat environment to implore optimum private are a contribution.
- Improvement of strategic oil reservation of 45 days
- Reduce dependence on imported oil
- Diversified Energy Supplies through Gas pipelines and LNG Imports
- Sufficient facilitation to the instituting refineries and petrochemical industry
- Promotion of Non-traditional means of Nuclear/renewable/alternate energy
- Promotion of human resource growth to guarantee accessibility of needed manpower to attain Plan goals.

Options for Energy Security

Pakistan has to diversify its energy supplies to ensure energy security. Following options are available;

i. Coal Power Potential:

World's fastest promoting source of energy is the coal similarly in the underdeveloped states. The importance of the coal is highlighted in the fact it offers 26 % of basic energy and forty percent of global consumption. Moreover coal intake of the world is probable to increase by 74 % from 2004 to 2030. Expected world trade of coals to increase about 40 %, from 800 million tons in 2007 to 1122 million Tons in 2030. Sharing of coal in world's energy consumption is expected to increase to 28 % by 2030 but its distribution in electricity generation is probable to remain 41 %generally at the present stage. Coal as an indigenously accessible mean has a strategic position and is world's widest developing fuel. China today has a credit of being the world's largest consumer as well as producer of the coal which justifies for 78% of its total energy needs (Sultan, 2008).

The extending field coal of Thar around 9500 square km and has 175 BT of coal. Coal deposition seams at the deep depth of 160 to 175 meters. It can produce 50,000 MW of electricity and 100 MB of oil annually for coming five centuries. These reservations are one hundred times the reserves in the Middle East, Iran and Iraq Collectively. The production of electricity from the coal based installations cost around Rs 3.5 to 4.5 per unit. Hence minimum health and environmental risks are chanced (Mubarak, 2010).

ii. Nuclear energy Potential:

Nuclear energy has been termed as "Safe, reliable, economical." The environmental advantages that the Nuclear energy possesses compared to conventional thermal power plant because of the absent emission of toxic carbon dioxide and sulfur oxides. Pakistan should consider Nuclear power plants because of less price of the generated electricity and the deficiency of harmful discharge compared to conventional energies.

Nuclear energy represents only 0.9 - 2.6 percent of the electricity produced in Pakistan Construction of Chashma II is under discussion, as six nuclear power plants projects are under consideration. As per some researches "Economics of nuclear energy in Pakistan showed that nuclear energy is little more expensive than conventional thermal energy, cost of nuclear energy is 10.5 cents per unit compared to 8.2 cents per unit for thermal energy. Nuclear

energy is hence not an affordable response to energy deficit (SPDI Research and News Bulletin, 2004).
Currently Pakistan has two functional nuclear power plants;

Kanupp 1, which is totally gross capacity of 137 Mega Watts, working for more than 40 years and produces around 80 MW. Its been in a profitable process since 1972. KANUPP is part of Karachi Nuclear Power Complex (KNPC) and is kept and processed by Pakistan Atomic Energy Commission (PAEC). (80 MW producing as its life is over 40 years late)(Gillani, 2010).

KANUPP-2 and KANUPP-3 are under rehabilitation and are brought by PAEC. The KANUPP-2 (1000 MWe) and KANUPP-3 (1000 Mwe) part of civilian program. The three units of nuclear power plant are under IAEA protections (Mann, 2009).

Chasnupp 1, "construction started in 1992 with the help of China, was operational in 2000 and produces 340 MW" (Mustafa, 2011).

"The construction of **CHASNUPP-2** started on April 8, 2005 and now it is near completion. It is also under IAEA safeguards and expected to be functional by 2011" (International Business Publications, 2013).

iv. Pakistan Nuclear Power Reactors((n.d.) Nuclear Power …..)

Reactor	Type	MWe net	Location	Status
CHASNUPP-1	PWR	300	Chashma	Operational since June, 2000.
CHASNUPP-2	PWR	300	Chashma	Operational since May,2011.
CHASNUPP-3	PWR	300	Chashma	Approved. To be constructed by China.
CHASNUPP-4	PWR	300	Chashma	Approved. To be constructed by China.
KANUPP-1	PHWR	125	Karachi	Operational since 1966.
KANUPP-2	PWR	1000	Karachi	Under-construction.
KANUPP-3	PWR	1000	Karachi	Proposed.

v. **Electricity Trade potential from Central Asia:** Pakistan, Afghanistan,Tajikistan and Kyrgyzstan have signed various inter-governmental MoUs and agreements for the export of 1300 MW from these states to Pakistan (1000MW) and Afghanistan (300MW), this could be lifted to 4,000MW (Kiani, 2008).

vi. **Hydropower Potential:** Except the big contentious "dams, Pakistan has over 25,000MW of hydropower capability based on run-of-the-river model" (Kiani, 2008).

vii. **Wind Energy Potential:** Sindh province of Pakistan can generate almost 11,0000-35,0000 MW from this environment friendly source. Pakistan contains certain windswept energy streams which could probably help in producing the wind energy.

Pakistani Government has given a pavement to "Alternative Energy Development" board (ADEB) a target of making 700MW of electricity through wind energy by the end of 2010 and around 9700MW by the end of 2030 (Iftikhar, 2011).

Different individual electricity generators has built a small wind farms on a small level, Perhaps to measure the capability of wind energy in Pakistan, which is supposed to be larger.

"Wind power plant deal has been signed by the Hyderabad electric supply company (HESCE) and a Turkish firm. This wind-farm will provide HESCO with 6MW electricity, powering almost 6900 homes by installing 50mw battery" (Haq, 2011), "If the AEDB is able to achieve its target by producing 700MW of electricity through wind energy; it will be a trend setting breakthrough for Pakistan's energy" (Faheem, & Mir, 2009).

viii. **Waste Energy Plants Potential:** Pakistan has the potential to produce 20,000MW from waste energy plants in urban areas.

The substantial viability of biogas in the physical and socio-economic conditions is proven. Pakistan has excessive source of biogas, providence of the energy from the technology is more than three times than that dung directly burnt, and also produces nutrient-rich manure. Further making of Biogas, the Biogas Plants can finish in refining economic and financial situations at micro as well as macro stages and narrowing discharge of greenhouse gases that has been polluting the environment due to its direct exposure (Ahsan, 2014).

ix. **Solar Energy Potential:** Pakistan is blessed with high levels of nineteen "mega joules per square meter of solar radiation throughout the year", making its potential to produce solar energy quite substantial ((n.d.) Mr. Saqib's Findings…..).

The best use of solar energy, for now, is in domestic applications such as water heating and for UPS (Uninterrupted Power Supply) systems. It is also beneficial for providing electricity to rural areas and far off villages where it is not feasible to connect them directly to the national grid (Syed & Mir, (2009).

The USA is encouraging solar energy consumption in FATA and more than 300 villages are expected to benefit from the solar energy (Kiani, 2008)

x. Ocean Wave Energy/Tidal Power: Wave energy is at earlier stage of development, It offers more predictable outputs than wind. Wave energy generation devices can be categorized as fixed and floating(Water Encyclopedia., (n.d.). In November 2000, the world's first commercial wave power station became operational in UK. It is rated at 500kW, and can provide electricity to 400 households(Zaigham & Nayyar, 2005).

Pakistan has about 1000 km long coastline of with complex network of creeks in the Indus deltaic area. The erosional features along the Makran coastal areas show the relevance of strong wave energy, which could be harness for the generation of electric power for rapidly developing coastal cities, Gawader, Pasni, Ormara, Gadanietc (Zaigham&Nayyar, 2005). From available data, the known natural advantages that Pakistan has for tidal energy development include a 170km creek system of the Indus delta, 2-5 meter high tides at Korangi creek and over 5 meters at Sir Creek The infrastructure setup for tidal power plants is expensive and improvements are still needed in the system for a cost effective solution to cater to Pakistan's requirements (Syed & Mir, (2009).

xi. Furnace oil Power Plants: More than **30,000 tonnes furnace oil being used daily for thermal power generation.** Furnas oil based power plants cost approximately 1.5 to 1.6 dollar per KWH. Despite low investment cost, it harms environment more than acceptable level. High content of sulphur in Furnas oil causes boilers corrode reducing the generation capacity to 50% within 4-5 years. The cost of electricity is about 9-10 RS per KWH (Mubarik, 2010).

xii. **TAP:** In 1995 Turkmenistan, Afghanistan and Pakistan signed a MoU to pave the way for the construction of Trans Afghan Pipeline. This $7.6

billion, 56-inch diameter gas pipeline would supply 3.2bcf (billion cubic feet) of natural gas per day (Naveed, 2010).

xiii. **IPI:** Almost 1500 km ipi pipeline will pass through Baluchistan. IPI is 2775 km of 56 inches pipeline was to be laid down to supply 750 MMSCFD gas to Pakistan for 25 years (Mehboob, 2010).

Conclusion

Energy interdependence can affect national security in either ways. Pakistan's energy security policies will result in conflict resolution of regional conflicts and ac as peace dividend for regional peace. For example TAP may bring stability in troubled areas of Afghanistan. Dependence on foreign fuel supplies is against the national security paradigm. Energy security and national security are interlinked and that makes it more significant. The construction of a natural gas pipeline system between the Soviet Union and Western Europe in the 1980s raised fears that were expressed in a 1982 U.S. National Intelligence Estimate:

"[The USSR] calculates that the increased future dependence of the West Europeans on Soviet gas deliveries will make them more vulnerable to Soviet coercion and will become a permanent factor in their decision making on East-West issues" (McMillan, 2008).

Given the strategic location and geopolinomic significance of Pakistan, following is recommended to ensue energy security;

a. Relaying on indigenous resources is the best strategy to ensure energy security.
b. Friends of Pakistan should help Pakistan to utilize its vast coal deposits' to produce electricity.
c. Sufficient, affordable and constant energy supplies are vital for economic progress and peace.
d. Pakistan needs to evaluate pros and cons of its policy to offer itself as a transit state to supply Gas to neighboring countries more carefully.
e. Energy Independence by achieving self sufficiency and energy corridor for the neighbouring is the most pertinent answer to the question of energy security.
f. Pakistan's role as producer and consumer states would be the optimum solution to energy security issues.

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