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Energy Security Overview

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CPSD Monograph
December, 2018

Published by Centre for Peace Security and Developmental Studies
(CPSD),
D-127 Siddique lane, KDA Scheme #1, Tipu Sultan Road, Karachi

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Former Federal Minister

Sohail Wajahat Siddiqi is a well-known figure among the business circles of Pakistan. He had served as the Managing Director (MD) & Chief Executive Officer (CEO) of Siemens Pakistan (SP) for over 12 years. He was the first Pakistani to serve in this capacity in Siemens Pakistan. He was also a Board Member of Pakistan Steel, KPT, KASB Bank and PSO. In honor of his contributions, the government has awarded him Sitara-e-Imtiaz. The government of Pakistan, in recognition of his business acumen, also nominated him as Board member of EPZA, TDAP, STEVTA, EDB, and PEC.

Abstract

The monograph provides a comprehensive overview of the energy issues in Pakistan, providing key details of the problems in energy governance and management. The current policy structure is fragmented, with one policy contradicting the other, and can only be improved through establishment of a National Energy Authority, responsible for development of an integrated energy policy. The monograph provides the organizational structure and objectives of the authority as well as rationalizes the formulation of a single Ministry of Energy to implement the policy devised by National Energy Authority.

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Introduction

The broadness and density of the energy industry is hard to simplify. The purpose of this writing is to do the difficult job. To begin, a bird-eye view of the entire energy conversation chain is provided in the figure 1 below. It includes all key sources of power generation and have precise yet vital information about power transmission and distribution units in the chain. The cohesiveness of this picture needs to be adopted by our energy policy makers through implementation of a **National Energy Authority** covering all these sectors, so to come up with an integrated energy plan and to ensure transparency and avoid conflict of interest.

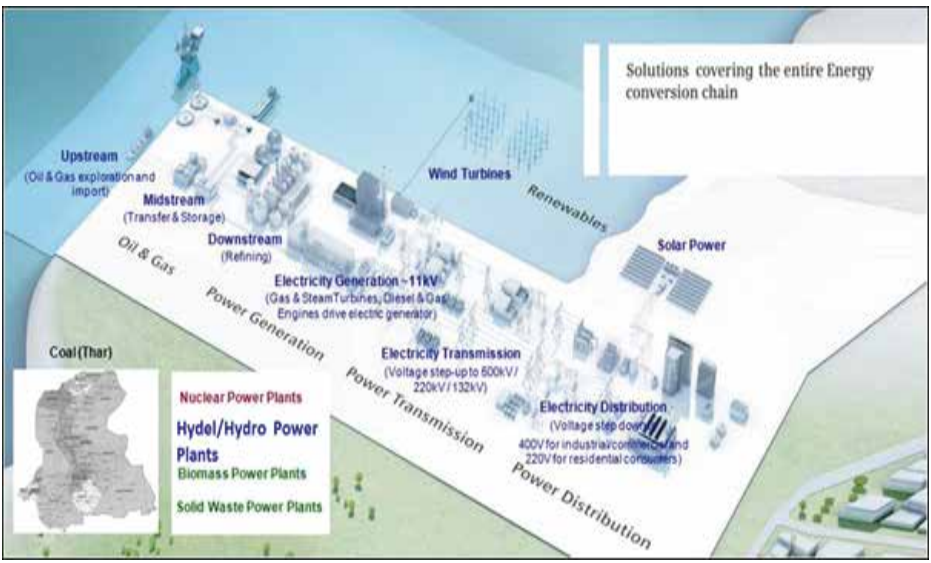

Figure 1: Solutions covering the entire energy conversion chain

In today's world if you want to destroy a country just destroy its Police and Energy. Pakistan is a prime example of how problems in the police and energy sector have influenced the security of the nation, exemplified through our negative sovereign rating in Moody's Investor Service score.[1] The solution to the problem of policing lies in better human resource management and introduction of lawful incentives to curb the issue of corruption, while improvement in the energy mix, and mitigation of circular debt and power losses are critical for energy sector. It is important here to highlight that there is need of very small investment to resurrect the energy sector.

Human Resource Management – HAAMSEY and Pillars and Success

Human resource management is all about being first, different and courageous. All vital ingredients of an effective human resource management can be summarized in one word HAAMSEY, an acronym explained as follows:

H	Human Resource
A	Attitude
A	Approach
M	Market
S	Service
E	Execution
Y	Yield

Table 1: The Human Centric Approach - HAAMSEY

In addition, there are eight elements of prism of success: five Ps, two Cs and one G, that ensures the implementation of human-centric approach in policy making and implementation cycle.

Five Ps, Two Cs & One G	
Prism of Success	
People	To be Excellent, Responsible & Innovative. To convert the Human Capital into the most valuable asset of the Company.
Process	Optimization of processes and their execution with responsibility and efficiency.
Productivity	To enhance operational productivity by utilizing the same or reduced resources through Innovation and Excellence at individual and collective level.
Profit	To improvise profit by innovative and excellent strategies in order to maintain sustainable business.
Planet	To be conscious of natural resources and life forms on the earth.
Costs	Each penny counts. Employees to be entrusted with the responsibility of minimizing the unavoidable cost of doing and steering business. (Wastage)
Cash	Cash is King. To convert negative cash into healthy positive balance. (Cash Conversion Ratio = 1)
Growth	To improvise profit by innovative and excellent strategies in order to maintain sustainable business.

Table 2: Prism of Success

Pakistan Energy Issue – From Comfort to Growth Zone

Till 1970s Pakistan remained in the comfort zone with optimal supply of energy and limited electricity demand due to agricultural economy. With industrialization and increase in population, the country entered in the fear zone as the energy crisis started. Till now, Pakistan is in the fear zone, using ad-hoc measures and fire-fighting approach to deal with the problem. It now needs to enter in the learning zone, finding long-term solution to the problem of energy crisis. Once we have learned from our mistakes and have a consistent and cohesive energy security plan, we can expand it further through moving on to the growth zone.

Figure 2: The Comfort Zone

Circular Debt in Pakistan

No discussion of energy crisis in Pakistan is possible without reference to the issue of circular debt. The problem is deep-rooted, caused by multiple factors like old power plants, operation on low efficiency, steam power plants, less combined cycle power plants, bad governance, technical and administrative

losses, theft, Unaccounted for Gas (UFG) losses, and inefficiency in the power sector. The catchy term of circular debt can be explained to a lay-man through a simple diagram provided below. It is the gap between the electricity cost, the amount in bills and the received payments.

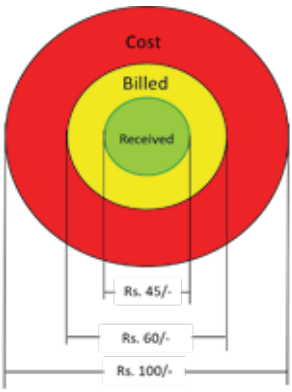

Figure 3: Circular Debt – A simplified example

As per estimates of a World Bank report, the circular debt crisis annually cost about 2.6% of GDP, with over 700,000 job losses and $5.8 billion damage to Pakistan's economy. Furthermore, to finance the subsidies, the government use borrowing from State Bank of Pakistan (SBP) and other commercial banks, leading to

- Higher inflation and lower credit availability to the private sector
- Lower production and investments lead to lower employment and an increase in crime and lawlessness
- Inefficient allocation of capital and diversion of management attention
- Greater vulnerability to changes in oil prices and devaluation
- Higher inflation and decentralization of energy supplies disproportionality impacts the poor

Several key factors contributes to this serious issue, of which the prime problem is artificial subsidized pricing in the oil and gas sector. In fact, the problem started in 2007 when government did not raise the domestic oil prices despite the exponential increase in the global market and tried the electricity prices to absorb. In addition, removal of back-to-back Letter of Credit (LCs) conditions caused the crisis to rise. The other factors include tariff history (higher tariff for power Pepco vs. Subsidized tariff for consumers); Inefficiencies of

government-owned generation & distribution companies; Overstaffing & free provision of electricity to WAPDA employees cost consumers 100 million rupees per day; Poor maintenance of power plants and use of obsolete technologies, resulting in technical losses; Controversial deals of Rental Power Plants; Non recovery of electricity bills; Latest Technology and Poor human resource and governance.

Technical and Administrative Losses

The main issue with our utilities are the energy losses which are on constant increase. Our installed capacity is close to 31,863 MW, which is much higher than the demand of 25,000 MW. Yet, the installed capacity cannot be translated into actual capacity due to technical and administrative losses of over 7000 MW leading to average power outage of 6 to 8 hours per day. A summary of the socio-economic cost of these power outages[4] is provided in table below.

Factors	Impact
Lack of reliable access to electricity cost the economy.	$5.8 Billion / year
Estimated income loss associated with daily outages.	1.6%/hour
Loss of employment in the economy	400,000+ jobs/year
Loss of exports.	$1.5 Bn+/year

Table 3: Socioeconomic Cost of Power Outages

In addition to these socio-economic impact, the energy shortfall is a major burden for our import bill. With nominal GDP growth projections of 2.5 – 4% the energy consumption by the year 2025 would be 142 MMTOE which translates to a Power Requirement of 38,000 MW. Oil Requirement will be 40.0 MMTOE Gas Requirement 67 MMTOE. The total energy import bill in 2025 at US$ 100/ bbl will be US $90 billion.

Here's a simple formula to calculate revenue losses caused by administrative and technical issues:

$$\textit{Total Revenue} = \textit{Average Tarriff} \times \textit{Total Units Consumed}$$

$$\textit{Revenue Losses} = 30\% \times \textit{Total Revenue}$$

Using estimates of FY 2017-18,[5]

$$\text{Total Revenue} = 0.18 \frac{\text{USD}}{\text{kWh}} \times 95.5 \times 10^9 \text{ kWh}$$

$$= \$17.19 \text{ billion}$$

$$\text{Revenue Loss} = \$5.16 \text{ billion}$$

Possible recovery of revenue loss (over 3 years) by simple methods of loss reduction is 15% which is equivalent to $ 3 Billion per annum. Hence, the economic burden of energy shortage can simply resolve through reduction of these losses.

National Energy Authority

The problem of energy crisis in Pakistan cannot be resolved without implementation of an Integrated Energy Plan, which can only be devised if there is a National Energy Authority. Also, instead of having three ministries of power, petroleum and water, a unified energy ministry should ensure the implementation of energy plan devised by the authority.

The organizational chart of the proposed National Energy Authority is provided in the figure 4 below. This Authority must comprise of the best of Pakistan's industry professionals from the state, private and public sectors. As shown, it will have the ability to coordinate the efforts of all the sectors, relating to implementation of the integrated energy policy and provide an oversight of regulatory issues and to work with the relevant ministries and the planning commission.

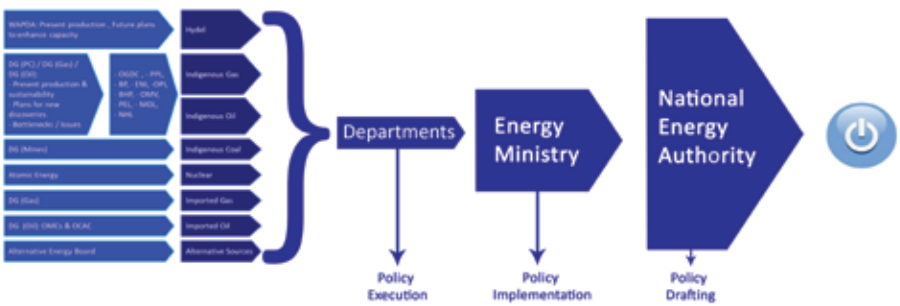

Figure 4: Organogram of National Energy Authority

For the optimal functioning of the proposed National Energy Authority, it should have backing of experts working in think-tanks from E&P Sector; Refining industry; Oil Marketing / Distribution (PSO, Shell, Caltex, Total, BYCO, APL,

Hascol, Admore, OOCTL, Bakri, Zoom); Transportation/ Logistics (Ships, Pipeline, Railway and Tankers); Gas Transmission & Distribution (SNGPL & SSGC); LNG; LPG; CNG (Creating low pressure); Shale Gas; Coal; Alternate Fuels; Renewable (Wind / Solar); Power Generation sector including Thermal, Hydel, IPPS and Nuclear industries; and Power Transmission & Distribution sector. Using HAAMSEY approach and Pillars of Success (Five Ps, Two Cs & One G) mentioned above, this National Energy Authority can lead to decline in imports, cost reduction, competitive consumer pricing, increased efficiency, and import substitution.

The Proposed National Energy Authority is aimed to

- Ensure availability of sufficient energy on sustainable basis and at affordable prices to achieve.
- Maximum utilization of indigenous resources (coal, gas, hydel, nuclear, oil, and renewables) to meet the growing demand on a sustained and affordable basis thereby providing energy security, sovereignty and sustainability.
- Promotion of R&D for improvement in energy efficiency and conservation and development of energy efficient appliances.
- Improve quality of consumer services and creating competitive environment to solicit maximum private sector participation.
- Increase share of indigenous coal in the energy supply mix.
- Reduce dependence on imported oil through accelerated exploitation of indigenous resources.
- Resort to import of natural gas and LNG through multiple sources on best possible terms if indigenous resources fall short.
- Improvement of value addition to energy consumption ratio through better efficiency – at least 10% improvements.
- Maximize indigenization of design and manufacturing of PME to minimize capital cost and O&M expenses.
- Facilitate refurbish establishment of refineries on world standards (efficient refineries).
- Promotion of renewable/alternate energy sources (wind, solar, hydel).

Pakistan Energy Sector at Present

At present, the average energy-mix cost in Pakistan is one the highest in the region, as provided in the table below. In addition, there is serious demand-supply gap, reaching over 7000 MW. The immediate low-cost solution to this growing short fall lies in operating existing plants at optimum capacity to increase output, enhancing transmission & distribution efficiency, and enhancing efficiency at consumer level.

	Avg Cost of Generation (Rs/kwh)		Total Generation (in 000 Gwh)		% share in Generation	
	FY 14	FY 15	FY 14	FY 15	FY 14	FY 15
Hydel			32.2	32.6	32.9	32.5
Gas	4.8	4.7	19	22.5	20.1	23.5
Coal	4.01	4.5	0.1	0.1	0.1	0.1
Nuclear	1.3	1.2	4.4	5	4.8	5.4
RFO	16	12.4	36	31.7	38.5	33.2
HSD	22.2	17.4	1.6	2.9	1.7	3.1
Wind			0.3	0.5	0.3	0.5

Table 4: Cost of Power Generation in Pakistan[6]

In the **Natural Gas** sector there is no dearth of pipeline infrastructure with 4030 transmission networks under SSGC and 8103 transmission networks under SNGPL. Instead of building more pipeline, the investment should be made in building more island solutions. The major issues in the natural gas sector are highlighted in the figure 5. One key issue is that of consumption with close to 860 MMCFD utilized in the most inefficient domestic sector and much lower share of in dustry (570 MMCFD) and Fertilizer (613 MMCFD). In addition, the tariff designed for gas pricing is a complicated one, having separate tariff for different sectors.

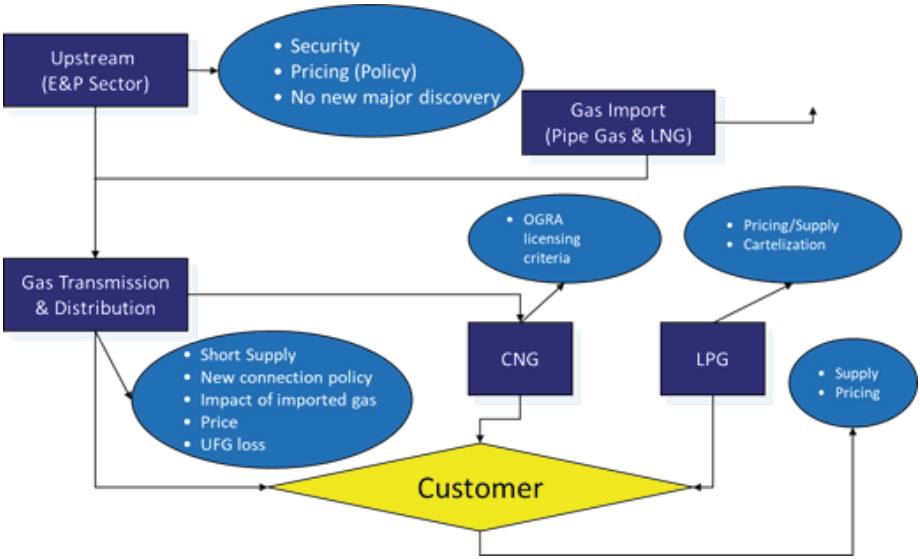

Figure 5: Major Issues in Gas Sector

In the **oil sector**, the main issues are lack of policy consistency and poor governance. Despite having a vast potential of hydrocarbon exploration (shown in figure 6) we are relying on importing petroleum products. This is because an exploration project can take up to 3 years while the government use firefighting approach to seek immediate solutions.

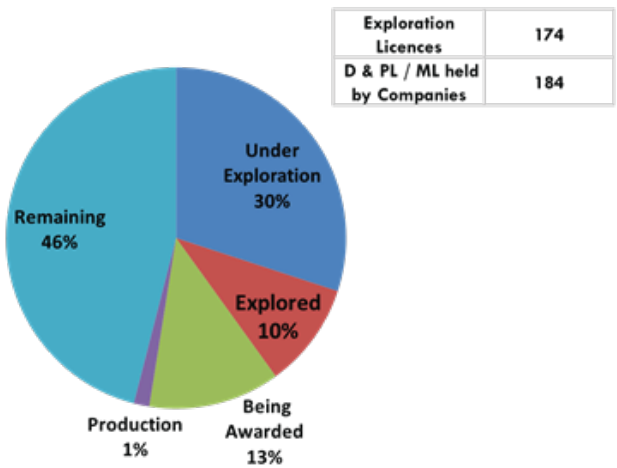

Figure 6: Exploration Potential in Pakistan

Pakistan also have a vast potential of **Shale Oil and Gas**, with total shale gas reserves around 586 TCF (technically recoverable are close to 100-105 TCF) and total shale oil reserves of approximately 227 billion (technically recoverable are around 9.1 billion barrels). This unconventional gas potential can immediately affect the demand supply gap, as the decline in predicted conventional natural gas potential is reversed somewhat through commencement of Tight Gas production in 2015-16. Shale Gas production is expected to commence production from 2018-19. However, deficit in supply of natural gas will still need to be met through transnational pipelines, LNG imports and through fuel substitution, as shown in figure 7 below:

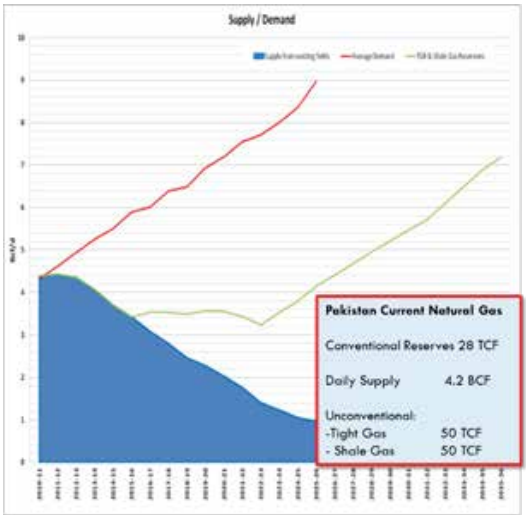

Figure 7: Current Demand Supply Gap in Pakistan Natural Gas Sector[7]

As per 2017 estimates, Pakistan has 20.8 TCF reserves of natural gas leading to production of 4,032 million CFt/Day. Similarly, there are 332 million barrels crude oil reserves that can result in indigenous production of 88,409 BPD. The reserve replacement ratio calculated using these estimates is close to 24%. The two major hurdles in exploration and production through these local reserves of hydrocarbons are of pricing of local gas and oil and of security and legislative issues. Also, Pakistan's **refineries** production FY 2015-16 was 11.7 MTons as opposed to the designed capacity of 18.76 MTons.[10] All refineries need to be upgraded as per new world standards and specifications, these costs were charged by the refineries but not used for the said purpose.

Due to the aforementioned problem, Pakistan cannot make use of its indigenous resources at full and has to rely heavily on **imports of crude oil, petroleum products and coal**. In FY 2017-2018, Pakistan energy import bill

reached at around $11 billion, which further rose by 30.08% amounting to $2.64 billion in just the first two months of FY 2018-19.[11] Use of indigenous resources can reduce this bill to half.

Similarly, Pakistan has around 63000 MW **hydropower** generation capacity of which only 7434 MW is provided through operational hydel plants.[12] There are multiple hydropower projects whose feasibility studies and spade work has been completed. Six hydropower projects namely Tarbela Ext, Kala Bagh, Bhasha, Bunji, Akhori and Dasu have been approved, and event tendred, yet no work has been taken place as yet.

Pakistan is equally rich in terms of **alternative and renewable energy** resources, yet a lot needs to be done to harness the potential of wind, hydel, solar and biomass energy sources. At present, the total installed capacity of hydropower is close to 7000 MW, though the potential is over 60,000 MW.[13] In particular, there is significant potential for developing small-scale (1-50 MW) run-of-river hydropower projects. Due to high solar irradiation, Pakistan has high potential for solar power generation as well, yet the installed capacity is below 500 MW. Similarly, while the potential of wind energy is over 50,000 MW, the installed capacity is close to 600 MW only.[14]

According to the World Bank, over 25 million tons of biomass feedstock is produced annually that can be utilized for electricity generation, instead of being used by local farmers as a fuel source. At present we have been able to add only 200 MW of power in the national grid through biomass resources, though the under-construction projects were estimated to add up to 700 MW by the end of 2018.[15]

As per AEDB estimates, upfront tariffs of Wind power plants in 2015-16 was close 12 cents/KWh. However, recent global estimates are below 6 Cents/KWh. In solar sector, upfront tariff awarded by NEPRA to IPP is between 12-16 cents/KWh but the global cost is much lower, i.e. 2.5 cents.

With RekoDiq and Saindak discoveries, Pakistan has large reserves of natural resources at present. RekoDiq has over 5 billion tons of mineral reserves of which 0.64% are of copper and 0.44 g/t of gold. The Saindak project is estimated to have ore reserves of 412 million tonnes containing on average 0.5 gram of gold per ton and 1.5 grams of silver per ton. According to official estimates, the project has the capacity to produce 15,800 ton of blister copper annually, containing 1.5 ton of gold and 2.8 ton of silver. However, to improve the project feasibility, local smelters are required.

At Thar we have the world's 7th largest **coal** reserves of 175 billion tons which is equal to 50 billion TOE (more than Saudi and Iranian oil reserves) and 2000 TCF (68 times higher than Pakistan total gas reserves). Entire Thar Coal Reserves can be used to generate 100,000 MW of electricity for over 200 years.

Finally, the present **energy mix** for power supply and generation is not in Pakistan's interest, having much lesser share of hydroelectric and alternative energy resources.[16]

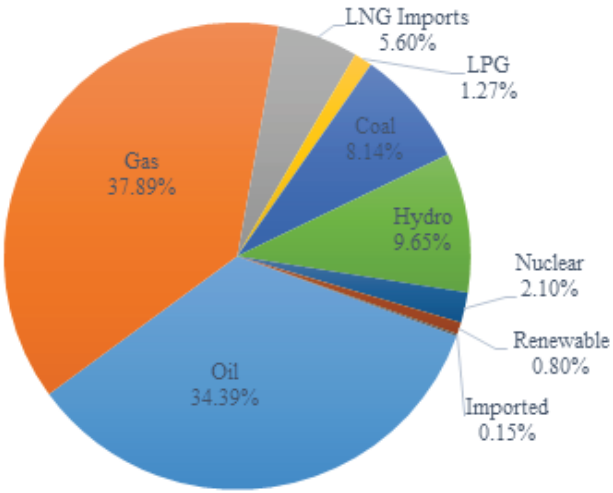

Figure 8: Current energy mix of Pakistan

Intra-Regional Trade Linkages

It is important to briefly outline the geopolitical position of Pakistan for energy trade. Pakistan is located at a strategic location between energy importing and exporting countries and can be the main energy trade link for India. For that, it is highly recommended for Pakistan to,

- Revisit Afghan transit treaty to take care of Pakistani business concerns and address trade opportunities with Afghanistan and Central Asia.
- Increase trade linkages with Iran with specific emphasis on energy.
- Work for creation of a fully integrated South / Central / West Asia energy grid.
- Enter into Agreement with LNG exporting countries.

A summarized overview of the energy trade potential in Pakistan is provided in figure 9 below:

Figure 9: Intra-regional energy trade links

Way Forward

Based on above discussion, following are the immediate actions to be taken by the government of Pakistan,

- Control and Reduction in UFG of two gas distribution Companies.
- Issue Third Party Access Policy.
- Issue Gas pricing policy.
- Engineering and Implementation of Gas Sector.
- Segmentation plan for Synthetic Natural Gas (SNG) usage.

- Implement Tight Gas recovery plan.
- Efficiency improvement study of power plants.
- Prepare plans for Fast Tracking E&P activities.
- Develop long term Integrated Energy Plan.
- Refining Sector: Investment, deep conversion, self sufficient capacity
- Fast track LNG imports on competitive pricing

In addition to these, below are few other important recommendations to deal with energy shortage:

1. Fuel Supply
   Gas to be priced closer to relevant alternative fuel prices
   Reallocation of gas & RFO from inefficient power plant.

2. Fuel to be diverted from power plants having less than 50% efficiency. Moving to efficient power plants increases generation by 1.5 times.

3. Rehabilitation of public sector power plants.
   Improvement in efficiency will increase production
   Increase of 10% efficiency increases power generation by 20%.

4. Conversion of public and private sector power plants into indigenous coal or other cheaper fuel options. Cheaper generation of power can save almost $ 2 bn annually in the import bill.

5. Increase efficiency of public and private sector plants – Cheaper generation of power .

6. Renegotiate IPPs present agreements.

In this regards the ministry has already taken following policy initiatives:

- LNG & LPG Policy 2011
- Tight Gas Policy 2011

- Criminal Law (Amendment) Act, 2011 to deal with Petroleum theft
- Gas Infrastructure Development Cess Act, 2011
- Low BTU Gas Policy 2012
- Petroleum Policy 2012
- LPG Policy Guidelines 2013
- National Mineral Policy 2013
- Marginal and Stranded Gas Pricing Guidelines 2013
- Deregulation of prices of Petroleum products
- Purchase of Progas Terminal (Rs 2.25 billion)
- Gas Conservation, Efficiency and Reduction in UFG (Projects under execution)

The current policy structure is fragmented, with one policy contradicting the other, and can only be improved through revision of these policies. National Energy Authority must improve these policies to the international standard and should devise an integrated policy framework, to be implemented through an energy ministry.

Notes

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