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Natural Gas Crisis: Mining for a Solution

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Executive Summary

Natural gas is Pakistan's premier source of energy. In the recent past, it has been observed that the demand and consumption of natural gas has increased rapidly in Pakistan. People have become dependent on this crucial resource. Therefore, sustained exploration and production of gas is imperative not only for the economy as a whole but also for businesses to realize their growth goals.

However, despite the increase in importance of natural gas for Pakistan, its exploration and production has declined in recent years, leading to a nationwide shortage. While the demand for natural gas is 8000 million cubic feet of gas per day (mmcfd), its supply is only 4000 mmcfd.

The popular explanation of this shortfall is associated with depletion of gas reserves. Through extensive literature review and data analysis, this report argues that while decrease in natural gas reserves may be a viable concern, the root of the problem lies in the flawed pricing of the gas industry. It is suggested that instead of controlling the pricing of natural gas, it should be indexed to that of oil – hence making it more competitive. This will encourage investors to undertake exploration and production of indigenous natural gas which costs only about $3 – $3.5 per mmbtu. Eventually, Pakistan's prospective reliance on expensive Liquefied Natural Gas (LNG) import of $8.63 per mmbtu will be reduced.

Introduction

Countries around the world utilize certain proportions of energy available to them to fulfil their energy needs. This combination of primary energy sources[1] is known as energy mix. It includes fossil fuels (coal, oil and gas), nuclear energy and also several types of renewable energy (biomass, wind, geothermal, water and solar). For most countries, fossil fuels account for 80% of the energy mix.[2]

While most economies of the world rely on oil or coal as the primary source of energy, Pakistan's energy mix is dominated by natural gas[3]. Natural gas, usually referred to as 'gas', is a fossil fuel used as a source of energy for heating, cooking and power generation. It is also used as fuel in vehicles and in the manufacturing of plastics and other commercially significant organic chemicals.

Although the demand for gas has seen a sharp increase of 60% from 2006 to 2015 in Pakistan, gas exploration has significantly fallen down[4]. Hence, there exists a shortage of natural gas in Pakistan.

This shortfall is largely associated with the depletion of natural gas resources in Pakistan. While this is a valid concern, this report argues that one of the major reasons for this problem is inefficient and discriminatory pricing structure for natural gas in the country which can be easily addressed through deregulation.

This report takes information from multiple public sources, academic and news articles and interviews with gas industry personnel and public officials. Section 1 covers the energy outlook of the world and of Pakistan; section 2 addresses the origins of the gas crisis in Pakistan; section 3 presents a brief description of the industrial structure for natural gas; section 4 discusses the pricing for natural gas; section 5 gives an overview of the natural gas sector of India and Bangladesh and finally section 6 suggests policies and recommendations for the problem.

1. Energy Outlook

To determine the energy outlook, it is customary to analyse the dynamics of demand and supply of energy. The data used for analysis in this section has primarily been taken from Pakistan Energy Outlook, 2015.

Given the global concern for preserving non-renewable energy, countries are now focusing on increasing energy efficiency, lower energy intensity and stricter climate change policies[5]. Coupled with slow paced GDP growth and prospective lower population increase, the growth in demand for primary energy can be expected to decrease in the future.

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[1] Energy sources that have not undergone any conversion process and remain in their natural state

[2] http://www.planete-energies.com/en/medias/explanations/about-energy-mix

[3] Pakistan Energy Year Book, 2014

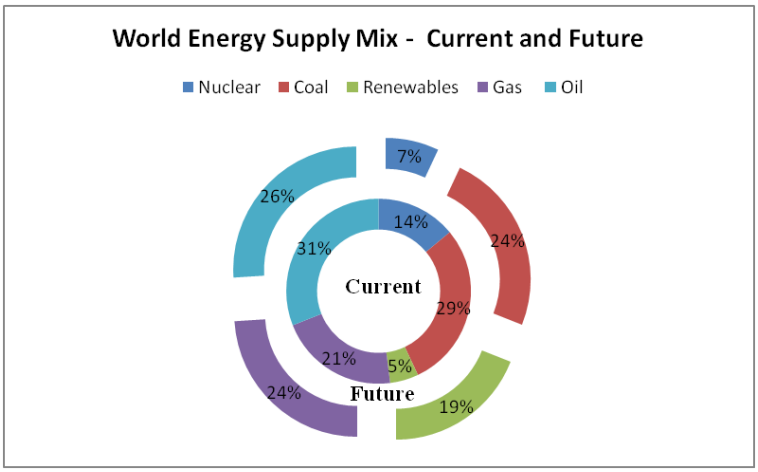
[4] Pakistan Energy Outlook, 2015

[5] To curb greenhouse effect and global warming, stricter climate change policies are being adopted around the world such as adoption of more efficient irrigation techniques to conserve water

Statistically, while the world demand for energy grew by 2.1 percent per annum during 1992-2012, it is expected to decline to 1.3 and 1.0 percent per annum during 2012-2025 and 2025-2040 respectively. However, in absolute terms, the demand for energy is expected to rise from 13, 361 mmtoe[6] in 2012 to 18, 283 mmtoe in 2040.

On the supply side, as a result of the climate change policies and a switch towards use of renewable energy sources, the share of energy produced by using fossil fuels will decline. The current and future outlook of the energy mix is shown in Figure 1.

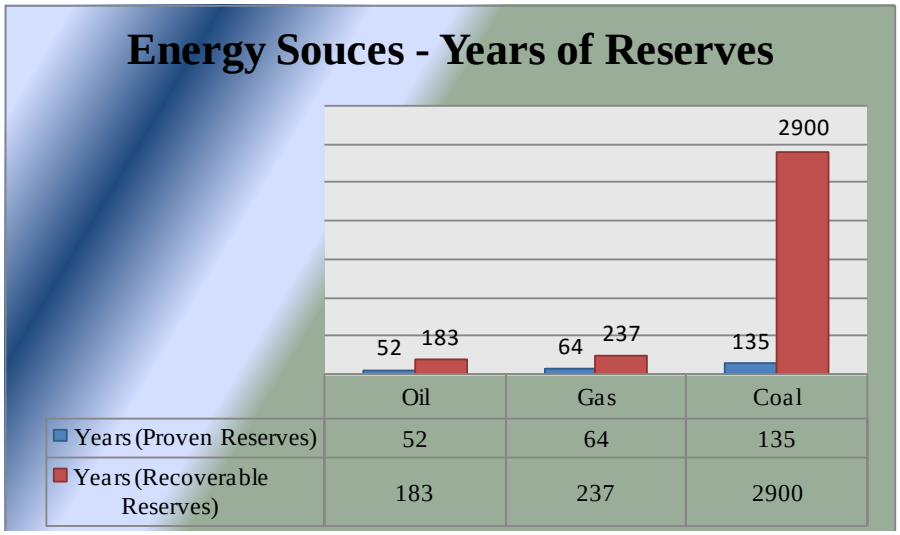
Figure 1: Energy Mix - Energy share as percentage



Source: Pakistan Energy Outlook 2015

Energy supply can also be studied by observing the number of years of reserves the world has (Figure 2). It is evident that coal has the highest potential of recoverable resources in terms of years of availability - more than ten times as compared to oil and gas. The recoverable and proven resources for gas are the lowest.

Figure 2: Future Prospects of Reserves

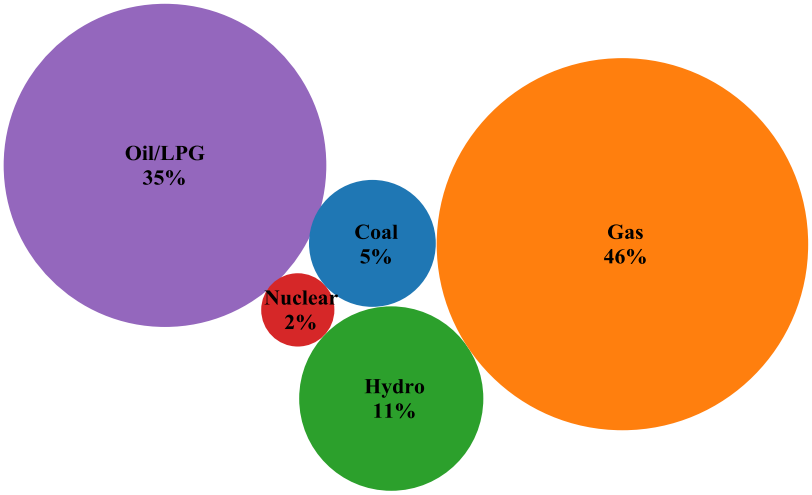


Source: Pakistan Energy Yearbook, 2014

[6] Million tonnes of oil equivalent

For Pakistan, the energy supply mix is dominated by natural gas with a 46.4% share (Figure 3). The second largest source of energy in Pakistan is oil. The other major sources in energy mix are can also be seen below.

Figure 3: Pakistan Energy Supply Mix



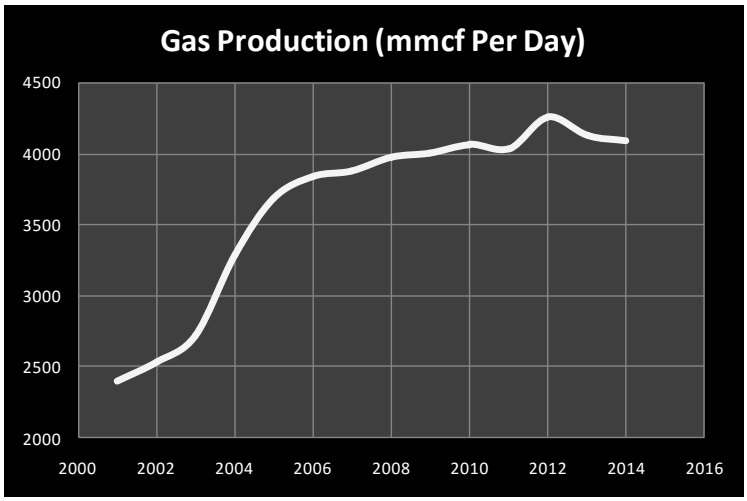
Source: Pakistan Energy Yearbook, 2014

On the consumption side, power and transport sector make up about two-thirds of primary energy consumption while the industrial sector consumes only 14.6% of primary energy. 10% of primary energy is consumed by the residential sector[7].

2. Natural Gas: Genesis of the Crisis

The supply of natural gas grew by 9.5 percent annually between 2000 and 2006 due to commercialization of discoveries made in the 1990s. However, in the subsequent years, the increase in gas supply slowed down and declined after peaking in 2012 (Figure 4).

Figure 4: Gas Production Overtime

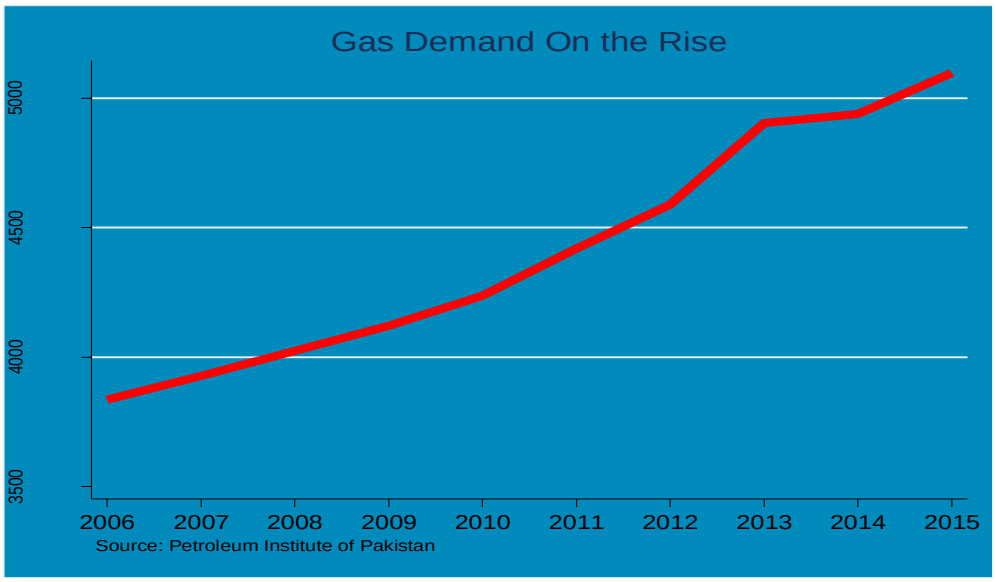


Source: Pakistan Energy Outlook, 2015

[7] Pakistan Energy Outlook, 2015

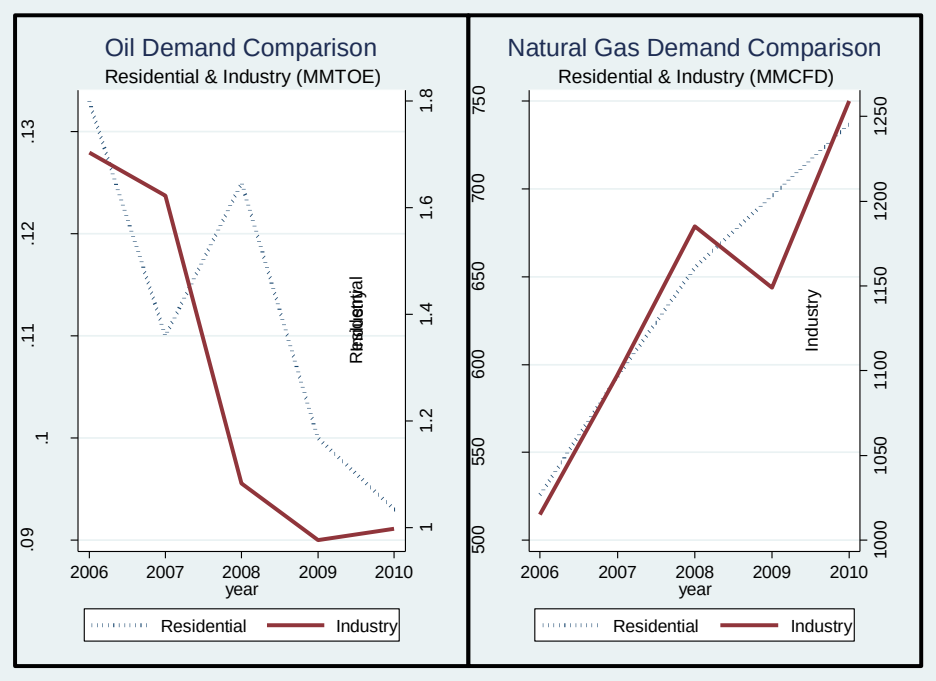
Owing to rising population, the demand for natural gas, on the other hand, has witnessed a positive, sustained and steady trajectory (Figure 5).

Figure 5: Gas Demand



The rise in demand has also been stimulated by lower end-user tariffs in general and a rising oil price in mid-2000s. These factors brought forth a structural change in the composition of energy demand favouring natural gas in place of oil for both the residential and industrial consumers. This structural change is presented in Figure 6.

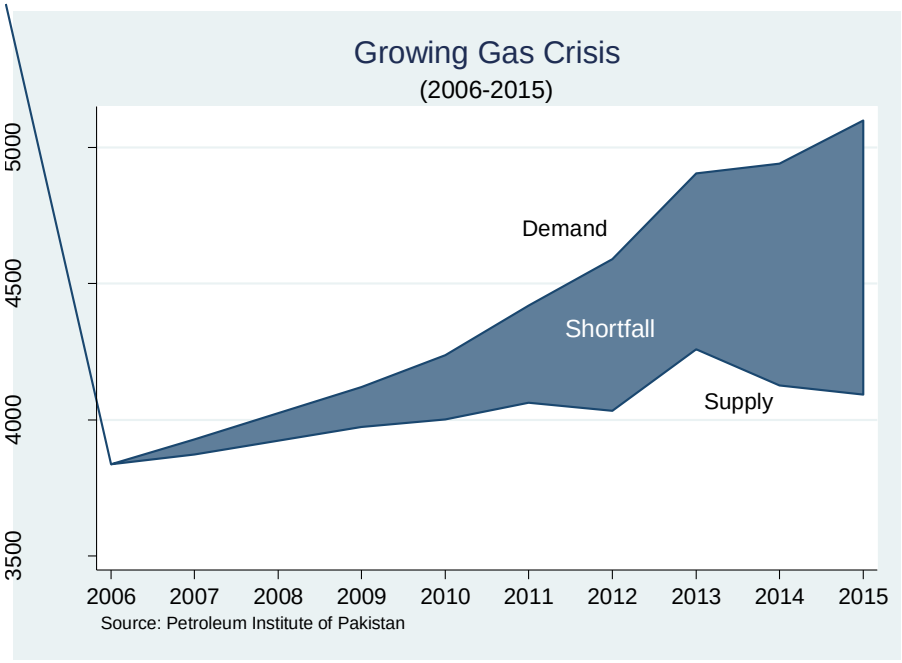
Figure 6: Changing Demand Patterns for Energy in Pakistan



Source: Pakistan Energy Outlook, 2015

Since supply of gas has not seen a corresponding increase, there exists a shortage of natural gas in Pakistan depicted in Figure 7.

Figure 7: Natural Gas Demand, Supply, and Deficit (MMCFD)

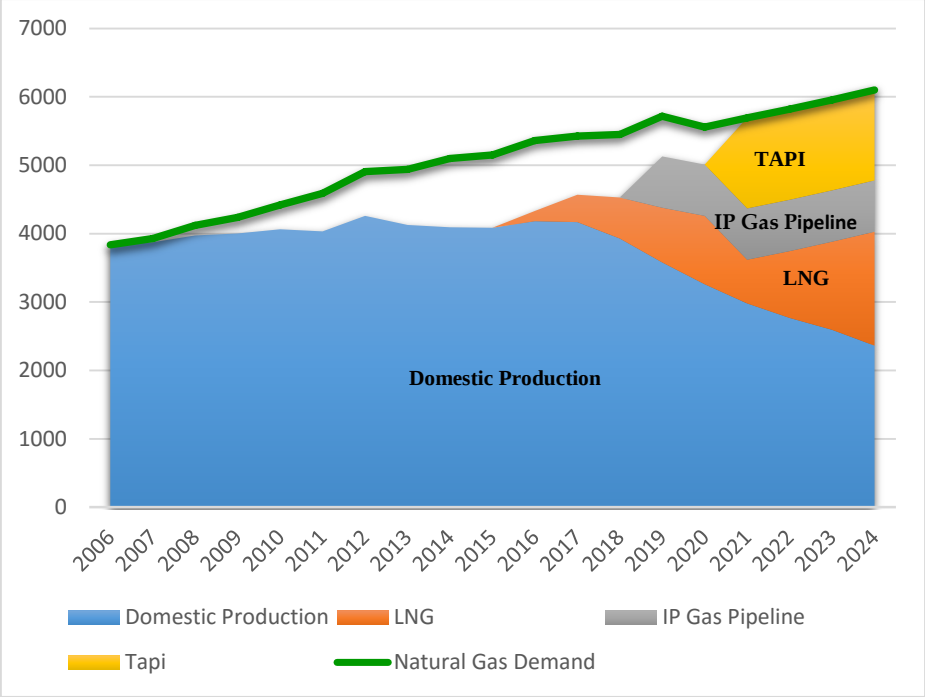


The figure shows that the supply of natural gas was 4085 mmcfd for 2015, while the demand was 5150 mmcfd. However, considering that the consumption of gas is highly regulated for all the sectors, the actual demand stood at around 8000 mmcfd.[8] Economic Survey of Pakistan (2014-15), also reports that the demand for natural gas is 8000 mmcfd, whereas its supply is only 4000 mmcfd.

This shortfall in natural gas is expected to decrease from 2016 onwards due to import of Liquefied Natural Gas (LNG) in the future as shown in Figure 8. It is also expected that from 2021, the supply of natural gas in Pakistan will match with the demand of natural gas since supply will be reinforced by Iran-Pakistan (IP) and Turkmenistan-Afghanistan-Pakistan-India (TAPI) gas pipelines.

[8] Joint Secretary, Ministry of Petroleum and Natural Resources (Interview on January 6, 2016)

Figure 8: Natural Gas Demand and Supply Projections (MMCFD)



Source: Pakistan Energy Outlook, 2015

Apart from heavy reliance on gas domestically (for heating cooking etc.), many businesses and industries largely depend on it. In fact, half of the total demand for natural gas comes from the industrial sector. According to a report by State Bank, due to the shortage of gas in 2014, paper mills had to shift to more expensive oil, which negatively impacted their production. The gas sector witnessed a similar fate[9]. Therefore, the increase in supply of natural gas to industrial units will enhance their productivity. The efficiency of this production is yet to be analysed since cheaper natural gas may be indigenously available if the pricing of gas is deregulated. The later sections discuss this in detail.

3. Industry Structure[10]

The production and exploration of natural gas in Pakistan is undertaken by a total of sixteen companies. The two public sector gas production and exploration companies i.e. Oil and Gas Development Company Limited (OGDCL), and Pakistan Petroleum Limited (PPL) have a dominant share of about 44% of the total gas produced, while 56% of the share is distributed between the remaining 14 private companies. Amongst these private firms, six firms make up for almost 95 percent of total private sector production which implies that production is limited to only to a few firms in the sector.

[9] State Bank of Pakistan Annual Report 2013 – 14, http://www.sbp.org.pk/reports/annual/arFY14/Real.pdf

[10] The data presented in this section draws from Pakistan Energy Yearbook 2014.

Hence, in terms of industrial organization, natural gas industry can be categorized as an oligopoly. The concentration ratio i.e. the market share of the largest firms in the industry is 68 percent[11] for the four larger companies.

On the other hand, the gas distribution and transmission is completely in the hands of the government. The two companies responsible solely for the distribution of natural gas in the country are Sui Southern Gas Company Limited (SSGCL) and Sui Northern Gas Pipeline Limited (SNGPL). Resultantly, in case of gas distribution industry, the concentration ratio ranges between 80 to 100 percent implying that the industrial structure is that of a duopoly. The industrial structure is expected to appear as a natural monopoly in the future since the two gas distribution companies are expected to be merged as one. Therefore, both the gas exploration/production industry and gas distribution/transmission industry lack competition in Pakistan

Since public sector is playing a significant role in both gas production and distribution, it is natural that the gas industry in Pakistan is heavily regulated. Activities ranging from exploration from the well to the final allocation of gas are all regulated. The extent of regulation, though evolving, has consistently increased overtime. The Ministry of Petroleum and Natural Resources has recently proposed to the Council of Common Interests for regulating prices even for LPG[12].

The main body responsible for regulation of oil and gas in Pakistan is Oil and Gas Regulatory Authority (OGRA); established in 2002 to regulate mild and downstream petroleum sector. The objectives of OGRA were to foster competition and increase the private sector investment and ownership while protecting public interests. This regulatory body is autonomous, however, Government of Pakistan can issue guidelines to OGRA provided that they are not inconsistent with the ordinance dictating OGRA. Some of the other main functions of OGRA are listed in the Annexure 1.

4. Pricing of Natural Gas

The Law of One Price in Economics states that with the passage of time, the price of a commodity in a competitive market converges to a single price, all other variables remaining constant. A good example demonstrating this law is the oil market, where convergence of price is observed globally. Irrespective of the geographic location, the prices tend to move together with slight differences owing to difference in transportation costs.

However, price of natural gas varies across countries, meaning that price movement in one area is not followed by others. The main reasons for this divergence in the global natural gas prices are as follows:

1. Different pricing structure in different regional markets;

[11] The industry structure is oligopoly when the concentration ratio ranges between 50 to 80 percent.

[12] "Only Solution to energy crisis is gas import". Abbasi. http://tribune.com.pk/story/1022566/only-solution-to-energy-crisis-is-gas-import-abbasi/. Retrieved on 15th Jan, 2016

2. High government regulations on the entry and exit of the gas exploration and production market which reduces competition;
3. To hedge against risk associated with natural gas sector, the suppliers try to lock-in into long term contracts that bind prices and quantities which ultimately limits price convergence.

Natural Gas Pricing Structure in Pakistan

There are two types of prices involved in natural gas production and distribution; wellhead price and prescribed price. The wellhead price is the price of gas at the mouth of well and represents the cost excluding other expenses required to transport and deliver natural gas. This price is set for companies involved in gas exploration and production. The prescribed price, on the other hand, is for gas distribution companies and refers to the price at which gas is sold.

In case of Pakistan, the pricing structure that governs these two prices is set by OGRA in accordance with the revenue requirements of gas exploration or production and distribution companies. As for wellhead price, it currently ranges from $0.8 to $7.6 per mmbtu[13] with an average price of $3.03 per mmbtu. The apparent difference is due to the zonal distribution of producing fields by OGRA[14]. The prescribed price takes into account cost of gas, operating costs of gas distribution companies and the fixed return of assets. This fixed return on assets is 17.0 percent and 17.5 percent for SSGCL and SNGPL respectively.

The consumer prices are also highly regulated, the regulator has the autonomy over setting prices for different sectors and the prices vary according to the direct and indirect taxes levied on the specified sector. Table 1 shows the price of natural gas for each sector of the economy.

Table 1: Natural Gas Sector-wise Prices

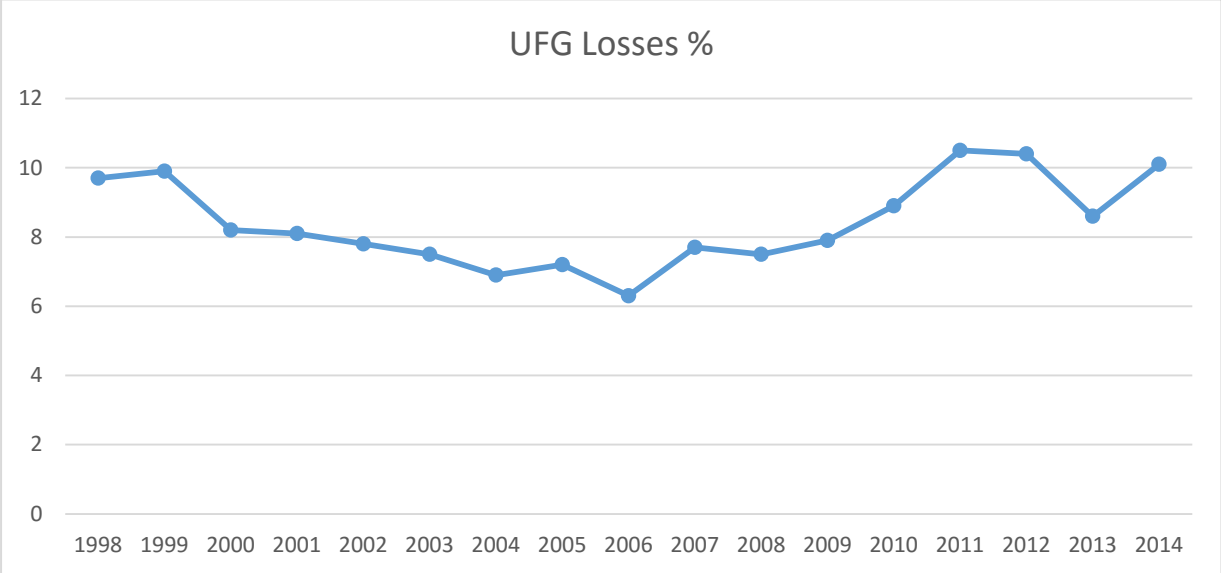
Sale price:	Rs./MMBTU
Domestic Use: From 0 to over 300 M³ per month	**Rs 110-600**
Commercial Use: All off-takes at flat rate of	Rs. 700.00
Ice Factory: All off-takes at flat rate of	Rs. 700.00
Industrial Consumer	Rs. 488
Power	Rs 573
CNG Station	Rs 656
Cement	Rs 742
Pakistan Steel	Rs 488
Fertilizer companies (Feed stock to fuel)	Rs 123-488

Source: OGRA Annual Report 2013-14

[13] Million British Thermal Units
[14] See Annexure 3 for details

The final consumer price also contains the unaccounted for gas (UFG) losses made by the distribution companies. UFG means the difference between the total volume of gas obtained and supplied to the end consumer. Although OGRA has started to charge SNGPL and SSGCL for the wastage of gas but that is not sufficient to cover the revenue loss occurred by them for the reason that one percent UFG by the two utility companies account for Rs. 6 billion as per the natural gas rate in FY 2013-14.[15] Figure 9 shows that the UFG losses by both the distribution companies are increasing every year.

Figure 9: Losses by SSGCL & SNGPL



Source: Pakistan Energy Outlook 2015

5. International Models

Bangladesh

Gas sector in Bangladesh is similar to that of Pakistan. The public sector produces about 48 percent of total gas produced in the country[16]. The distribution is solely in the hands of PetroBangla, a government owned national oil company. On top of that, the consumer prices are also heavily subsidized. This regulated structure of gas industry in Bangladesh has resulted in shortfall of gas of 340 mmcfd[17]. Bangladesh, like Pakistan, is also relying on imports of LNG to address this apparent gas shortfall.

[15] OGRA Annual Report 2013-14

[16] http://idlc.com/sector_coverage/1332567043Research%20Report%20on%20Energy%20Sector%20of%20Bangladesh-Initiation,%20Mar%2015,%2011.pdf

[17] http://www.naturalgasasia.com/bangladesh-has-1659-tcf-of-gas-reserves

India

India has recently overhauled its structure of gas industry through initiating market based reforms. These reforms were a response to a concern among investors that the tariff structure was too low to undertake exploration and production activities. Hence, in order to attract investment in the field, India has liberalised prices of locally extracted natural gas and provided autonomy to producers in their new rules for auctioning exploration blocks.[18] Along with this, the government is providing a consistent and predictable uniform licensing policy for the operators of all kinds of oil and gas exploration (methane bed, shale, natural gas, tight gas etc.).

6. Policies and Recommendations

The following section discusses the relevant government policies affecting the natural gas sector and recommends more viable solutions:

Domestic Consumption and Prices

Natural gas is heavily subsidised in Pakistan for the domestic consumers. It is supplied to the domestic consumer at the average rate of $2/MMBTU while the production cost ranges from $0.8-$7.5/MMBTU.

These subsidised low prices of gas result in enormous wastage of the resource in inefficient home energy appliances. It discourages consumers to opt for efficient appliances since cost of that particular appliance is the only consideration. According to an estimate, most commonly used home appliances run by natural gas such as heater, geysers and cooking range are only 30% efficient[19]. Moreover, the opportunity cost for wasting gas is pretty low. Therefore, over-utilization and inefficient usage of gas has resulted in its depletion.

Had the prices not been subsidised and based on market dynamics (which would increase the price), consumers would have started using more energy efficient appliances or switch to other alternatives. Use of air conditioners is an example of this phenomenon where consumers responded to high electricity tariff by replacing energy inefficient one-unit window air conditioners with energy efficient split unit air conditioners. Hence, it is recommended that subsidies should be removed for consumers in Pakistan.

Unaccounted for Gas (UFG)

UFG losses by both the distribution companies are directly added to the consumer prices, which increase the consumer burden. The losses can be reduced by strictly monitoring the supply chain and putting the cost of the losses on the distribution companies which will ultimately ensure their efficiency. At present OGRA is charging a very nominal UFG

[18] http://www.bloomberg.com/news/articles/2015-11-16/india-plans-to-free-natural-gas-prices-under-new-auction-rules

[19]http://www.dailytimes.com.pk/islamabad/06-Jan-2014/substandard-heaters-geysers-main-cause-of-gas-wastage

disallowance to SNGCL and SSGCL which is not sufficient to motivate and ensure efficiency.

Petroleum Policy

One of the major objectives of petroleum policy in Pakistan is to ensure sustained supply of energy by enhancing domestic exploration in the country[20]. However, for natural gas, it seems that the policies in place have been rather unable to achieve this objective (Figure 10). The quantity of recoverable gas started increasing after 1997 (when the producer prices were first indexed to the C&F[21] price basket through the Petroleum Policy 1994). The recoverable reserves increased to 32.8 TCF[22] in 2005 after which it started declining due to the impact of the Petroleum Policy of 2001 which introduced the floor and ceiling prices[23].

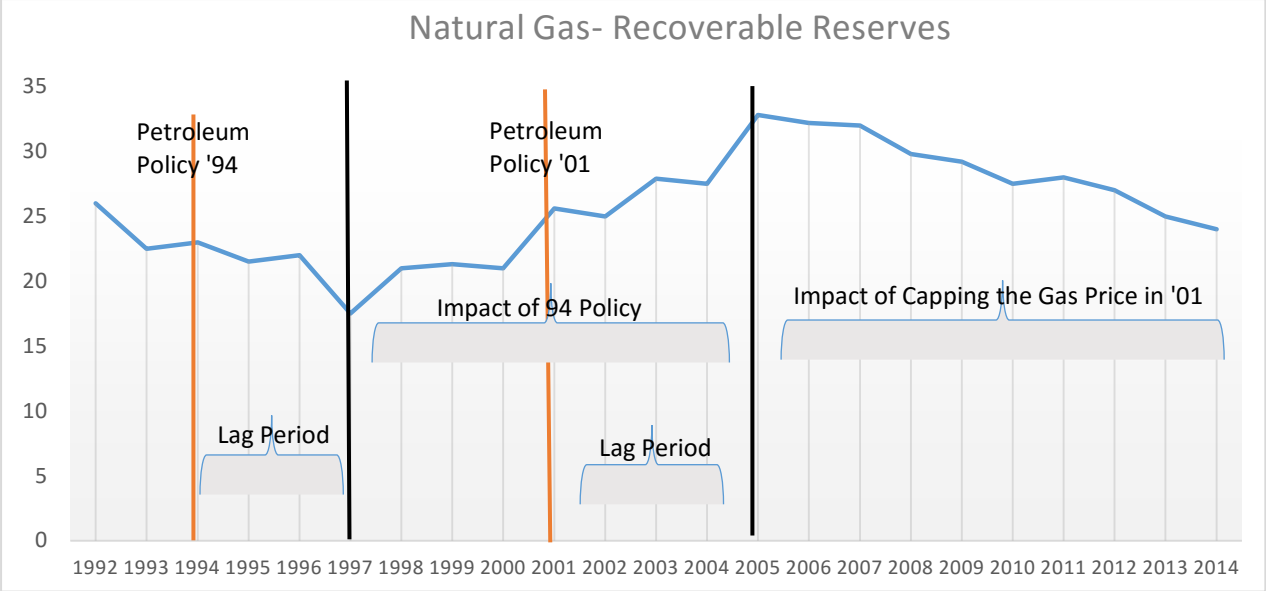
These price ceilings for gas were introduced to enhance consumer welfare directly; however, its indirect negative impact on the economy, such as import of expensive LNG (Table 2), may overcome its positive effect. The impact can actually turn out to be negative when the indigenous gas becomes expensive in the future as the natural gas resource depletes. This shall result in further strain on Pakistan's already burdened foreign exchange reserves.

Table 2: Prices of Alternative Sources

Source	$per MMBTU
Crude Oil	$5.5-6.5
LNG Import	$8.63[24]
Pipeline Import (TAPI, Iran)	$6.5[25]
Tight Gas	$5.75
Current Producer Gas Price	$3-3.5[26]

[20] Objective 7: To ensure the energy secure of the country by enhancing domestic exploration. Petroleum Policy, 2012.
[21] Cost and Freight
[22] Trillion Cubic Feet
[23] See Annexure 2 for detail.
[24] http://tribune.com.pk/story/969242/long-awaited-decision-ogra-sets-lng-price-ahead-of-qatar-deal/
[25] http://paktribune.com/news/Turkmenistan-to-invest-25-billion-to-deliver-around-32-BCFD-of-gas-Shahid-Khaqan-Abbasi-275277.html
[26] Calculated from the wellhead prices notified by OGRA

Figure 10: Impact of Petroleum Policies



Source: Pakistan Energy Outlook 2015

Conclusion

Based on the above analysis, it is recommended that Pakistan should de-regulate natural gas sector and liberalize the pricing structure. This is also being experimented by India as it has recently de-regulated its natural gas sector. Pakistan, too, can reap benefits of a liberalized policy regime.

Moreover, since investors' interest lies in minimizing costs and maximizing profits, an arrangement in which price caps are not installed can be attractive for investors. In this way, it can also achieve some of its other objectives specified in petroleum policy of 2012. These objectives include:

1) Accelerate Exploration and Production activities in Pakistan.
2) Promote direct foreign investment in Pakistan and also promote involvement of Pakistani oil companies.

In a nut-shell, the analysis presented proposes the following:

- ***Deregulating gas pricing is the most robust instrument in increasing and attracting exploration activities.***
- ***Increase in indigenous gas reserves is economically the most viable option.***

Annexure 1

Functions of OGRA

1. Granting of licenses in the field of Gas, Oil, CNG, LPG and LNG;
2. Setting of gas prices for producers (well-head price) annually;
3. Notifying of prescribed prices and consumer prices of natural gas;
4. Fixation of revenue requirements for natural gas utilities;
5. Enforcement of technical standards and ensuring compliance to specified procedures;
6. Formulation of rules and regulations.

Annexure 2

Petroleum Policy	Natural Gas Pricing Structure
1994	The price for Gas will be indexed to the C&F price of a basket of imported Arabian/Persian Gulf Crude Oils as follows: Zone-1…….. 77-1/2% Zone-2…….. 72-1/2% Zone-3……. 67-1/2%
1997	Same along with the introduction of production sharing arrangement.
2001	**Introduction of floor and ceiling of US$10 and US$ 36/barrel of C&F**
2007	Reference Crude Price (RCP) equal to the C&F price of a basket of Arabian/Persian Gulf Crude Oils imported in Pakistan along with specified floor and ceiling prices
2009	The gas pricing shall be calculated according to the following formula: Pg = Pm * Dz / Cf Where Pg is the Gas Price in USD per MMBTU Pm is the Applicable Marker Price in USD per barrel along with floor and ceiling caps.
2012	The price for Associated or Non Associated Gas will be indexed to the C&F price of a basket of Arabian/Persian crude oil import in Pakistan during the first six months period of the seven months period immediately preceding the relevant price notification period (import Basket). The RCP ceiling of USD 110/barrel would be reviewed after every five years or as and when the pricing dynamics significantly change in the international market, as provided in the applicable rules.

Source: Compiled from Different Petroleum Policies

Annexure 3

Field Wise Well Head Gas Prices			
Sr. No	**Field Name**	**Units**	**Price Effective 07-2015**
1	Adhi	Rs. per MMBTU	149.60
2	Ayesha Field	$ per MMBTU	5.0726
3	Bhit	$ per MMBTU	3.4370
4	Bhadra	$ per MMBTU	3.4370
5	BOBI	Rs .per MMBTU	324.10
6	Chachar	$ per MMBTU	1.5513
7	Chanda	$ per MMBTU	2.7672
8	Dakhani	Rs .per MMBTU	150.01
9	Dhodak	Rs. per MMBTU	299.73
10	Kandkot	Rs. per MMBTU	158.13
11	Kadanwari	$ per MMBTU	7.6425
12	Koonj - 1	$ per MMBTU	2.5930
13	Latif Field	$ per MMBTU	2.6736 production of natural gas below 53.68 4.8226 production of minimum natural gas 53.68 and over and above 48.8
14	Loti	Rs. per MMBTU	140.94
15	Mela	$ per MMBTU	2.7672
16	Meyal / Dhulian	Rs. per MMBTU	131.88
17	Miano	$ per MMBTU	3.1999
18	Mari	$ per MMBTU	0.8238
19	Nashpa	$ per MMBTU	2.7672
20	Pirkoh	Rs. per MMBTU	140.94
21	Qadir Pur	Rs. per MMBTU	297.55
22	Rehman Field	$ per MMBTU	5.1731 production of natural gas up to 8.751 4.8282 production of natural gas over 8.751
23	Sadkal	Rs. per MMBTU	473.11
24	Sari Hundi	Rs. per MMBTU	459.83
25	Sawan	$ per MMBTU	3.1999
26	Sui	Rs. per MMBTU	158.13
27	Sujjal	$ per MMBTU	4.5814 for specification gas 4.3403 for off-specification gas
28	Sujawl X-1	$ per MMBTU	3.0900
29	Zamzama SSGCL	$ per MMBTU	3.1099
30	Zamzama SNGPL	$ per MMBTU	3.1124
31	Zamzama Wapda/Guddu	$ per MMBTU	3.1529
32	Zamzama - Phase - II	$ per MMBTU	3.1999
33	Zarghun South	$ per MMBTU	2.8661 for conventional gas 5.7565 for Tight Gas

PRIME Analytical Services

Introduction

PRIME Institute is an independent think tank based in Islamabad working for an open, free and prosperous Pakistan. Set up in January 2013, PRIME has published 26 reports and has organized around 50 events. It has published reports and papers on important policy and economic issues such as State Owned Enterprises, Housing Market, Trade Liberalization, Informal Economy, Public Debt, and Energy. The reports are available at: www.primeinstitute.org/publications.html. PRIME Institute also conducts capacity building workshops for youth leaders and business community leaders.

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