Gas Report

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About the project

Funded by: Adam Smith International

Key Counterpart: RAFTAAR

Impact: Based on this research, there was a nationwide campaign on television and radio to make consumers aware about gas conservation. This research was also presented at various forums in Islamabad.

This report was prepared by Dr. Hanid Mukhtar (CDPR Fellow), Shahid Sattar (Former Member Planning Commission), and Dr. Rashid Aziz (CDPR Fellow) and overall guidance was provided by Dr. Ijaz Nabi (IGC and CDPR).

In brief

- Energy shortage is an important factor that helps explain Pakistan's lagging economic growth. Over the last 10 years gas supply has stagnated, and severe shortages of natural gas have emerged since 2007. The shortfall was initially confined to the winter with the spike in gas use for heating purposes. Now the shortfall extends all year round.
- More than half of the existing reserves have been exhausted, with no significant additions. Simultaneously, the number of gas consumers has continued to increase at a steady rate. The government's gas allocation and consumer gas pricing policy contribute to the inefficient use of gas. These policies are (largely) discretionary and provide significant power to the decision-makers.
- In the short run, reducing the cost of gas for consumers can only be achieved by reducing losses, which may include outsourcing collections and theft reduction programs. In the long run, the government and the remaining stakeholders need to accept that they cannot be provided a "free lunch", i.e. a substitute for petrol and diesel, at prices that are lower than the cost of the latter products, forever.

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Executive Summary

Today it is inconceivable to achieve high growth rates for a long period of time, without sufficient and uninterrupted energy supply. Pakistan is currently experiencing an acute energy crisis and this has vast implications for economic growth and the standard of living of the population. Natural gas has been a major source of commercial energy in Pakistan for the last two decades. Exploration activity has remained robust over the last 50 years and gas production has expanded substantially over this period. An extensive pipeline network and infrastructure transmits this gas to all urban and some peri-urban areas and serves roughly 7.4 million consumers. The share of natural gas in Pakistan's commercial energy mix has remained high. It was close to 50 per cent for much of the last decade. This significant use of gas has enabled the country to reduce its reliance on (imported and costly) liquid fuels.

Over the last 10 years gas supply has stagnated while demand continues to increase, and severe shortages of natural gas have emerged since 2007. The shortfall was initially confined to the winter when there is a spike in gas use for heating purposes. Now the shortfall extends all year round.

Energy shortage is an important factor in helping to explain Pakistan's lagging economic growth. According to the authors' estimates, a 10 per cent increase (decrease) in energy consumption leads to a 2.7 per cent higher (lower) economic growth. Had there been no energy shortages, Pakistan's energy consumption may have been 20 per cent higher.[1]

The current government has responded to the crisis by announcing a Power Policy in July 2013.

Key Findings

While more than half of the existing reserves have already been exhausted, no noteworthy addition has been made to gas reserves in the last 17 years. The country now has sufficient reserves to last just over 15 years if the consumption is capped at present-day levels.[2]

Despite the government decision to not connect new settlements to the gas distribution system, the number of gas consumers has continued to increase at a steady rate throughout the period between FY81 and FY14 (presumably in settlements already connected). This, along with stagnating production, has reduced supply for consumers already connected to the system.

Findings from household-level analysis based on expenditure data from four rounds of the Household Income and Expenditure Survey (HIES)[3] show that the share of natural gas in household energy spending is higher in urban areas but it is also increasing in rural areas. The increased share of electricity has been offset by reductions in kerosene and biomass. The share of natural gas in the household energy mix has also declined.

Natural gas allocation and its consumption between/across various sectors reflect the shortfall in supply facing the country. The power sector now receives only about 60 per cent of the quantum of gas that it received a decade ago. Industrial users, including fertiliser plants, have been the second largest consumer of gas. Their (combined) share of gas use has risen to more than 40 per cent now [4]. Household consumption of gas continues to expand.

The government's gas allocation and consumer gas pricing policy contribute to the inefficient use of gas. These policies are (largely) discretionary and provide significant power to the decision-makers. They also create avenues for vested interests and pressure groups to advocate and achieve their own goals.

The exit of many international firms from Pakistan in the past 5 to 10 years essentially confirms that, while the government has now recognized the need to adapt the producer pricing formula to current realities, the delay in making this change has cost the country. Without a strong effort to overcome this weakening of incentives, it is unlikely that exploration activity or gas production in Pakistan will recoup the trend observed up to 2005, i.e. 6 to 8 per cent increase in production per annum.

[1] A Road Map For Energy Efficiency & Conservation in Pakistan - A Position Paper prepared by OICCI Energy Subcommittee 2012 http://oicci.org/wp-content/uploads/2012/07/Road-Map-for-Energy-Efficiency-Conservation.pdf
[2] Estimates provided by Oil and Gas Company Limited (OGCL)
[3] The surveys covered 2001-02, 2007-08, 2010-11 and 2011-12. These years are referred to as FY02, FY08, FY11, and FY12 in this report.
[4] Hydrocarbon Development Institute of Pakistan - Energy Yearbook (various issues)

Tariffs for household consumers are well below those for industry, power plants, or commercial users.[5] Tariffs for the gas used by fertiliser plants to manufacture nitrogenous fertiliser are also lower than for all other users.

The rate of increase in gas consumer prices has been much lower since FY13, in part because oil prices have been falling or stagnant over this period.
As CNG prices remain well below those of petrol and diesel (in thermal equivalent terms), the pricing policy provides explicit subsidy to vehicle owners and users. The largest benefit of the policy therefore accrues to the rich.

Gas losses amounting to 10 to 12 per cent of gas purchases are well above the norm for technical and commercial losses/theft in a gas system. One feature of gas supply in Pakistan is high losses in SNGPL's and SSGC's systems, referred to as Unaccounted for Gas (UFG). It is the difference between the volume of gas that these companies purchase and what they sell to consumers. It is chiefly due to inadequate and low quality infrastructure, poor workmanship and installation procedures above ground.

Furthermore, natural gas is used very inefficiently in Pakistan. This is partly because large quantities of appliances are produced by small-scale manufacturers (essentially one-room workshops or factories) that do not meet international standards of safety.

Utilities that operate on commercial principles have to achieve acceptable standards of performance and management and/or their staff face actions when minimum performance standards are not met. The Oil and Gas Regulatory Authority (OGRA) periodically sets targets for gas losses for each company, but it is unlikely that the Suis ever achieved those targets during the last decade. However, there is no evidence that the companies have been penalized for such failures. Clearly, this situation needs to change.

Solutions

- In the short run, reducing the cost of gas for consumers can only be achieved by reducing losses. The government and the Suis need to follow internationally accepted approaches, which may include outsourcing collections and theft reduction programmes, or outright privatization of the Suis (although the latter cannot be accomplished in the short term) to bring losses down.

- Performance of the judicial system is also critical. If investigation and conviction for gas theft does not speed up, the criminal elements will not only know the adverse consequences of such theft but will also know that the likelihood of facing such consequences is remote.

- The industry worldwide is now accustomed to bidding on the price of energy at which they will invest. The government should develop approaches that bring in such competition, particularly for new E&P rounds. The medium- to long-term gas prices can be controlled and reduced by bringing in some competition in the sector.

- Natural gas has been a source of considerable revenues for the government. Pricing gas to consumers at (or close to) parity with the prices of substitute fuels will generate a large margin between the cost of gas (covering the producer price, transmission and distribution costs) and consumer prices, and this gap can be taxed.[6]

- The economic costs/benefits of substituting gas for kerosene versus gas for fuel oil clearly favour continued allocation of gas to households. This should be supplemented by a review of the forward linkages of the industrial and power sectors and determining the true economic benefit of allocating gas to those large-volume users.

- The government and the remaining stakeholders need to be cajoled into accepting that they cannot be provided a "free lunch", i.e. a substitute for petrol and diesel, at prices that are lower than the cost of the latter products, forever.

[5] The rationale for this pricing policy can be to deliberately encourage households to use more gas. This runs counter to the argument that the cost of supply is higher for small and dispersed consumers, so gas prices for industry, power and other large users should be lower than for households. However, it also has an economic rationale; the substitute fuel for most household uses of gas is kerosene, while for the large consumers it is fuel oil. The former is more expensive than the latter and both are imported. Promoting larger gas use in households may therefore yield larger economic benefits to the country. In addition, households cannot pass on the cost of gas to the next stage/consumer, while for industry/power etc. gas is an intermediate input in the production process. They can pass on changes in prices to consumers of the product that they manufacture or supply.

- Some reductions in gas supply cost, and in the fiscal burden on the government when it provides guarantees that gas will be purchased by the Suis, can be achieved by promoting more competition in gas production and sale.

- Efforts to monitor the performance of the Suis can be supplemented, e.g. by introducing financial incentives for achieving performance targets and penalties for failure to comply.

- Pakistan Standards and Quality Control Authority (PSQCA) has notified standards for the thermal efficiency of all appliances (stoves, water and space heaters, etc.). Enforcing the standards will remain a challenge until:

  – Domestic producers agree to manufacture only appliances that meet the standards. This may require incentives, e.g. energy efficiency ratings, enabling manufacturers to charge premium prices for appliances that meet the standards, etc.

  – Traders, importers and vendors are also convinced and only sell appliances that meet the standards.

  – Small-scale manufacturers, often working out of one-room workshops, etc., are equipped to produce items of the necessary quality. This may require technical training and certification programmes for local mechanics, etc. to be introduced.

[6] This is actually a direct application of economic and fiscal theory; tax any product where there is a gap between the cost of supply and consumer willingness to pay and, if the product is consumed mainly by the rich, the tax regime may also become progressive and equitable.

Overview of the Gas Sector in Pakistan

1.1 Gas Production, Demand and Shortfall

1.1.1 Trends in Gas Production

Natural gas is a major source of commercial energy supply in Pakistan and its consumption has a large share in commercial energy use. In Pakistan, natural gas was discovered approximately 60 years ago. These discoveries prompted the government and the gas utilities to install large gas transmission and distribution networks. Unlike other developing countries (especially those in the region), Pakistan opted for providing piped gas to all types of consumers right from the outset. The decision was deemed appropriate as ample gas was available and the logistics of cylinder-based distribution systems were considered too cumbersome.[7] The transmission networks now extend across the country; almost all urban areas have access to natural gas through these distribution networks. Since FY04 natural gas has accounted for roughly 50 per cent of commercial energy supply.

Supplying gas to households requires large investments in order to connect many consumers with low per capita consumption. On the other hand, gas consumption of one industry or power plant can be larger than thousands of households. The cost of supply to households is thus much higher than the cost of supply to industry or power.

In the 1960s there was an abundance of gas in Pakistan, relative to demand. The government and utilities therefore (almost) gave gas connections to anyone, irrespective of the fact that the resource was not infinite. However, it should be noted that gas is a substitute for kerosene in households and for fuel oil in power plants, industries and other bulk users. The price of kerosene (which was imported) is significantly higher than fuel oil. Hence there is a higher saving for the economy when gas is a substitute for kerosene than when it replaces fuel oil.[8]

Gas production in Pakistan expanded fairly rapidly in the early years, partly in response to continued adjustments in the producer price of gas that provided high incentives for Exploration and Production (E&P) companies to explore natural gas in Pakistan. By the mid-1980s gas production had reached roughly 1 Billion Cubic Feet per day (BCF/D) increasing to 4 BCF/D by 2005.[9]

This sustained growth in gas production, along with extension of the transmission and distribution infrastructure, enabled gas utilities to continue providing gas to an increasing number of consumers. In the mid-1980s gas production reached 1 Billion Cubic Feet per day (BCF/D); by end of the 1990s total gas production reached 2.5 BCF/D; this level increased further to about 4 BCF/D by 2005. Gas production has, however, stagnated at or just below that level since 2008 – total gas supply has ranged between 3.8 and 3.9 BCF/D in the last 5 years. In FY14 it was recorded at 4.09 BCF/day.[10]

After a rapid expansion of the gas production and distribution network in the 1960s and 1970s, the sector adopted a complacent approach towards exploration and development of new gas fields. Consequently, by FY00, natural gas was being produced from 98 fields, of which nine contributed towards 80 per cent of the total gas supply. In the last two decades, exploration and production activity has largely been concentrated in Sindh (contributing 71 per cent of the total production in FY00).[12]

Presently, the transmission, distribution and sale of natural gas in the country are largely handled by two companies: Sui Northern Gas Pipelines Ltd (SNGPL) in Punjab and KP and Sui Southern Gas Company[13] (SSGC) in Sindh and Balochistan. These companies own and operate 10,750 km of transmission pipelines and roughly 130,000 km of distribution and service pipelines,[14] serving mostly residential/household consumers.[15]

The continued growth in gas supply (complemented by expansions in the transmission and distribution networks) enabled these companies to supply 1,220 BCF of gas to consumers in FY14.[16] In terms of energy units, this amounted to 30.96 million Tons of Oil Equivalent (TOE), more than 46 per cent of the country's total supply of commercial energy[17].

Meanwhile, the gas policy framework was creating a huge increase in the demand for gas. As discussed below, this had to do with both gas pricing and also the policy to expand gas connections. Thus, despite constraints on gas availability, as exploration of new

[7] Following the discovery of the country's largest gas reservoir (Sui, Balochistan) and some gas discoveries in northern Punjab in the 1960s, the government (through various government-owned companies) began constructing extensive transmission and distribution networks across the country. With further discoveries of gas reservoirs in various provinces, these networks were extended to all major urban areas in the four provinces over time.

[8] The "Netback value" of a commodity is the value derived from the price of substitute products. It is a standard technique for determining the economic value of various sources of energy. See also Box 2 in Section 2.2.2.

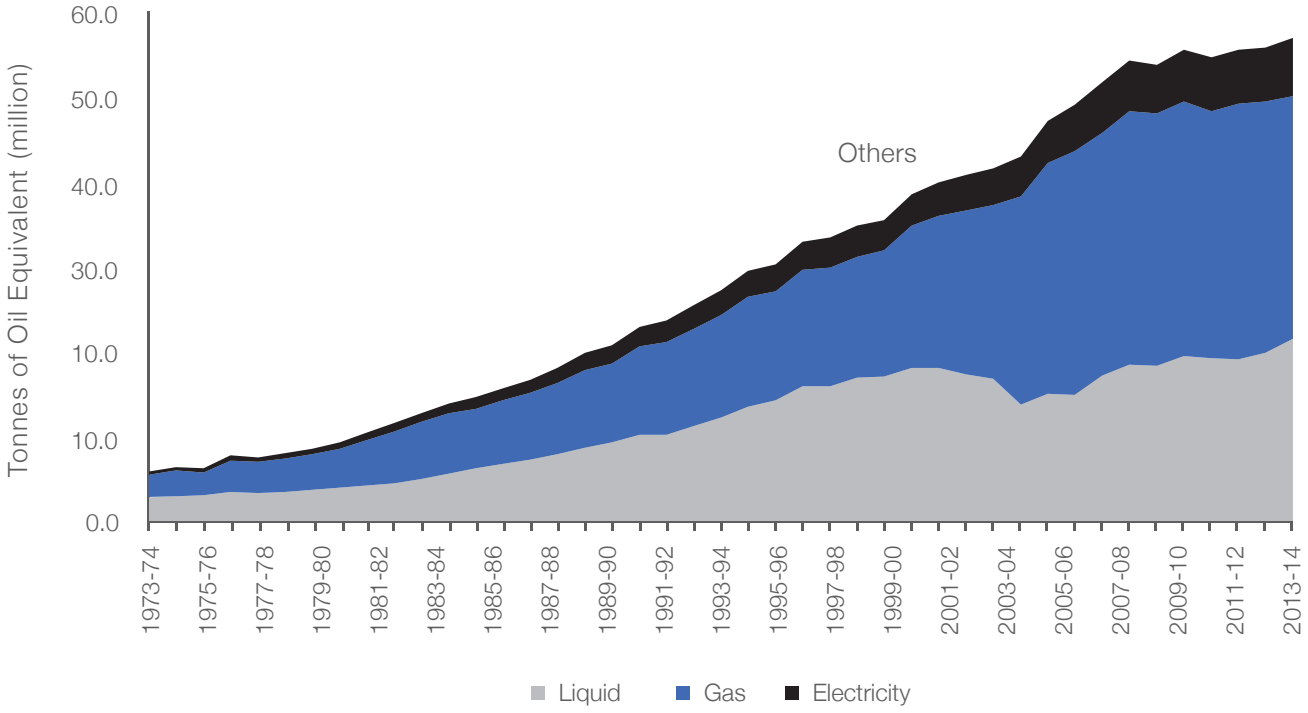
[9] Ministry of Finance, Economic Survey (various issues) Government of Pakistan

fields slowed down, SNGPL and SSGC continue to connect new consumers, with an annual increase of 5.6 per cent since FY09. This set the stage for gas shortages.

1.1.2 Trends in Demand/Consumption

Natural gas has been the fastest growing component of household energy consumption. Over the past 43 years, consumption of natural gas has increased at an average rate of 6 per cent per annum (somewhat below the growth in electricity consumption at 6.6 per cent per annum and not uniform for the entire period). By 2014, the share of gas in total energy consumption stood at 48 per cent, followed by oil at 36 per cent, electricity at 11 per cent and other sources at 5 per cent (See Figure 1 below).

Figure 1: Trends in Energy Consumption



Source: Government of Pakistan "Economic Survey 2014-15" and HIES (various issues)

Households represent the largest number of consumers (7.3 million) but their average gas use is only a fraction of that consumed by industrial users, power plants and fertiliser producers – household consumption stands at 25 per cent of total gas consumption in the country. There are approximately 77,000 commercial consumers and around 10,000 industrial and other consumers (e.g. power plants).[18]

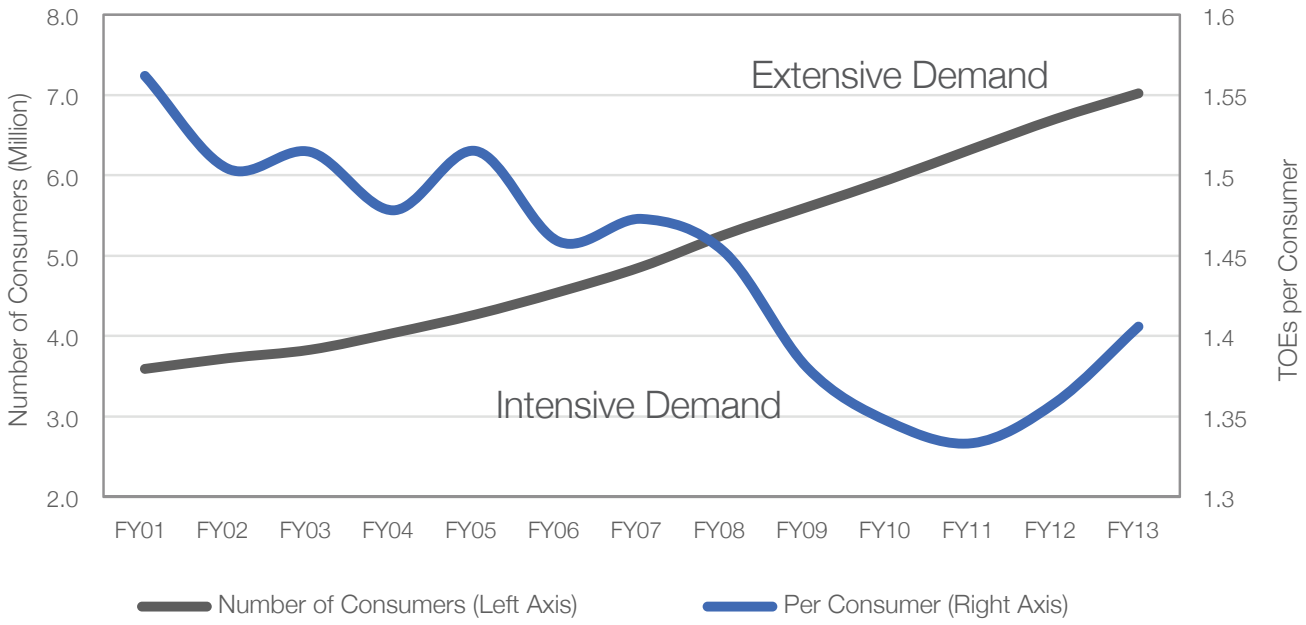
Nonetheless, over time the growth rate has decelerated.[19] Deceleration in consumption growth has been mainly due to increasing supply shortages rather than tapering of demand.[20] For insights into the slowdown in gas use, we divide consumption into "extensive" and "intensive" components.[21] The "extensive" component covers consumption growth that is due to increases in the number of consumers. This could be due to shortage of other energy sources:

[10] http://www.bp.com/en/global/corporate/energy-economics/statistical-review-of-world-energy.html
[11] http://www.sbi.gos.pk/pdf/sindh-profile.pdf
[12] Some dedicated networks connect gas fields to specific consumers: fertiliser plants and power stations.
[13] SSGC was established in the early 1990s by amalgamating the assets and functions of 3 companies that owned gas transmission systems across Sindh and in Karachi, and the distribution network in Karachi.
[14] Of these, 7,200 km of transmission lines and approximately 95,000 km of distribution lines are in Punjab and KP; the networks in Sindh and Balochistan account for the remainder.
[15] SNGPL and SSGC website
[16] Gas supply reached its peak in FY12, when the companies supplied 1,288 BCF of gas (4.26 Billion Cubic Feet per Day – BCFD) to consumers.
[17] Hydrocarbon Development Institute of Pakistan - Energy Yearbook (various issues)

– Increase in their prices relative to gas
– Changes in lifestyle or taste
– Extensions of the distribution network

The "intensive" component represents increases in consumption per consumer.

The trends in both components of gas consumption (intensive (more consumed by existing) and extensive (new consumers)) can be seen in Figure 2 below. It is apparent that, despite the government decision's to not connect new settlements to the gas distribution system, the number of gas consumers (i.e. "extensive consumption") has continued to increase at a steady rate throughout the period between FY81 and FY14 (presumably in settlements already connected). This, along with stagnating production, has reduced supply for consumers already connected to the system. As such, "intensive consumption" shows a declining trend.[22] The rate of decline is impacted by changes in the economy, especially economic growth. However, while the rate of growth of intensive consumption has declined, it has remained positive, i.e. consumption per consumer is rising, although at a slower rate than in the past, partly because income per capita has been rising.



Source: HDIP, Ministry for Petroleum & Natural Resources, "Energy Yearbook", various issues

This analysis, however, conceals regional variations in gas consumption. In FY06, the number of gas consumers (relative to the population) was the highest in Sindh. Due to their cooler climates, per-consumer consumption in KP and Balochistan was higher than the national average. However, consumption per consumer in KP was almost four times the level of Balochistan. This is attributable to higher household income, higher level of urbanization and a much more developed gas distribution network in KP. By FY13, gas consumption increased significantly in all four provinces but mainly due to a sharp increase in number of consumers.

[18] Hydrocarbon Development Institute of Pakistan, Year Book 2014
[19] What the country needs at this point is a focused multi-pronged approach that will improve the provision of primary and tertiary healthcare by building on existing infrastructure and expanding services into areas with limited outreach.
[20] It should also be noted that, on the energy ladder, gas is a high-end fuel source, superseded only by electricity. In addition, the price of gas remained relatively low throughout the period of analysis (Figure 8). As such, it is not likely that the decline in growth (with growth in per capita income accelerating) was due to wilful switching by consumers away from gas to other energy sources. The only possibility was electricity, but shortages in electricity supply were more acute than in gas.
[21] To define extensive and intensive demands, we focus on the following identity:
Consumption = per-consumer consumption X number of consumers.
The first part on the right-hand side of the identity defines intensive consumption, while the second part defines extensive consumption. It may also be noted that, by this identity, growth in consumption is the sum of growth in extensive and intensive consumption.

Table 1: Consumption of Gas across Provinces (2005-06 to 2012-13)

	2005-06			2012-13		
	Number (Million)	Per-Cons. TOE/Cons	Consump' (TOEs mil)	Number (Million)	Per-Cons. TOE/Cons	Consump' (TOEs mil)
Punjab	2.32	0.97	2.27	3.84	0.95	3.66
Sindh	1.68	0.20	0.34	2.32	0.27	0.63
Khyber Pakhtunkhwa	0.29	3.94	1.22	0.55	4.09	2.24
Balochistan	0.15	1.07	0.17	0.22	1.33	0.30

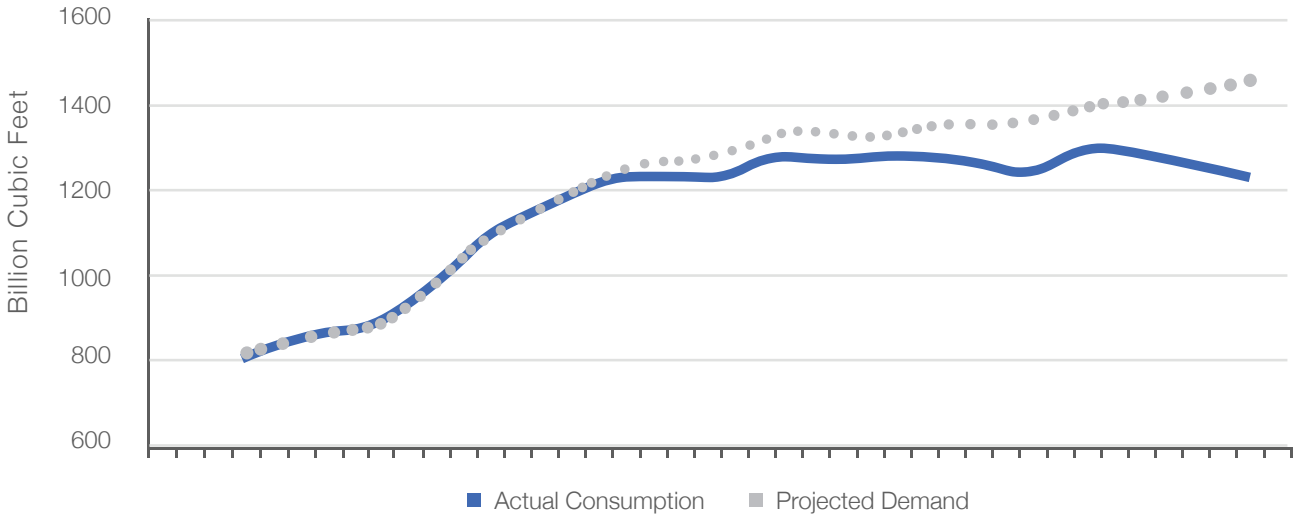
Source: Authors' compilation using data from Energy Yearbook 2013

Understanding the pattern of energy use by households is important for insights into how demand is evolving in rural and urban Pakistan and which income groups/households benefit from the expansion in the supply of energy and changes in energy prices. A deconstruction of energy into its main sources, i.e. electricity, gas, kerosene, and biomass then allows an understanding of the demand side of the gas sector. For a detailed analysis of household expenditure distribution on fuel please see Annex A.

1.1.3 Energy Shortfall and Implications for Gas Allocation

Gas shortages (demand began to outstrip supply) began to appear in FY06, worsening over time. Gas consumption stagnated in response to the low supply and fell increasingly short of the projected demand (see Figure 3). By FY14 consumption was 21 per cent below (projected) demand solely because of the shortfall in consumption in the household sector.[23]

Figure 3: Actual Consumption vs Projected Demand for Natural Gas



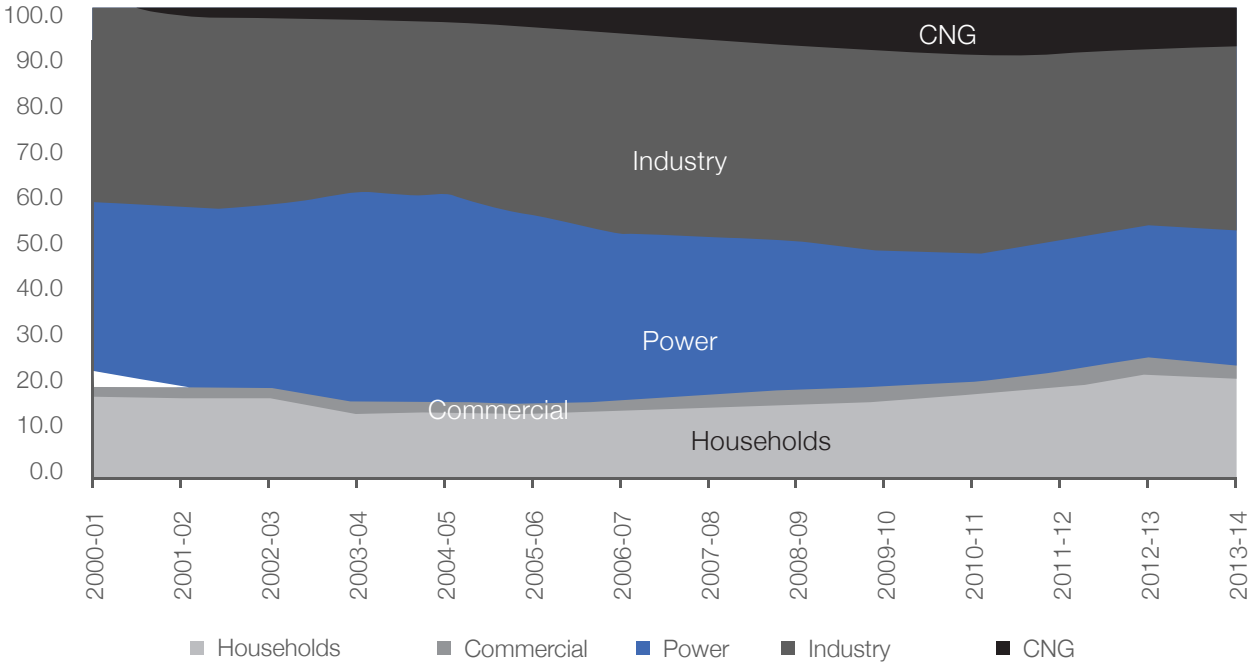
Source: Author's own projections based on Economic Survey 2014-15 data

[22] The upturn in the trend of "intensive consumption" is mainly due to increased supply to power plants.

This led to rationing of supply to users. Initially the supply of gas was restricted only for the larger consumers, but with time even households and small commercial establishments started facing curtailments in supply. The shortfall initially confined to periods of peak use (December to March) is now felt all year round. Even though gas consumption in winter from the Sui Northern Gas Pipe Line system is six times higher than in summer (and the spike is even more pronounced in the northern parts of the country: KP, western Balochistan, etc.), gas supply is not able to keep up with demand even during summer.

In response to the stagnating gas supply the government was forced to change gas allocation among various sectors (see Figure 4). Two changes were more pronounced. First, an increasing volume of gas was allocated for the CNG (transport) sector (see Section 3 and box below for a more detailed discussion). Second, since the mid-2000s, higher volumes (in proportionate terms) were made available to households, mainly at the expense of power generation. Although the netback value of gas use in households is high, the reduced supply of gas to power aggravated the power shortage and increased generation costs, having a significant adverse effect on the economy.

Figure 4: Changing Use of Natural Gas



Source: Government of Pakistan "Economic Survey 2014-15".

From the 1990s onward, the share of gas allocated to power plants remained above 30 per cent. By FY07, when supply shortages began emerging, the government started to curtail gas supply to power plants, industry and other large users. In FY09 the power sector's gas use fell to less than 30 per cent of the total gas produced. The trend in gas supply to industries, fertiliser plants, etc. is similar; in absolute terms it peaked in FY11 and has been stagnant or falling in subsequent years.

The 2005 Gas Demand Management Policy defined the priority order of gas consumer as (1) domestic consumers, (2) commercial consumers, (3) fertiliser production, (4) all others. However, in the wake of the electricity crisis, the 2012 Energy Policy changed this ordering to (1) domestic consumers, (2) commercial consumers, (3) power generation, (4) fertiliser, (5) cement production, (6) CNG.

[22] In order to project household demand for gas the following demand function was estimated using data from 1980-81 to 1999-00:

LOG(HGAS) = -28.7956 + 2.758845*LOG(GDPFCR/POPN) - 0.91431*LOG(PGAS) + 0.048531 TIME
(-4.49804) (4.126746) (-2.78483) (2.788253)

Adjusted R-Squared = 0.986485
Durbin-Watson Stat = 1.4856

Values for 2000-01 to 2013-14 were then projected using actual data on independent variables. Overall demand for gas was projected by adding the actual values of gas consumption in other sectors to the projected demand for gas in the household sector.

Box 1 - CNG Consumption

From the year 2000 (and because large increases in gas supply were forecast) the government began allowing natural gas to be used in transport vehicles (as compressed natural gas – CNG) as a substitute for petrol and diesel. Natural gas import constituted a large share in the country's imports and therefore a burden on the balance of payments. The decision represented an attempt by the government to utilize a product (natural gas) that was relatively abundant for a limited time and whose consumption could save foreign exchange.

Gas allocation to CNG stations expanded very rapidly during FY04 to FY10; its annual rate of growth exceeded 30 per cent per annum. By 2007, it rose to 12 to 13 per cent of total energy use in transport and about 5 per cent of overall gas supply. At its peak during FY09 to FY11, CNG accounted for nearly 10 per cent of total gas use. Since FY13 the government has instructed the Suis to cut off gas supply to CNG stations, especially during the winter.

1.1.4 Future Projections

On the surface, Pakistan's energy crisis appears somewhat unlikely. The country is endowed with ample energy resources, especially natural gas, hydroelectricity and coal.[24] However, consumption of gas and indigenously produced oil has been very high, causing rapid depletion of existing reserves. The Oil and Gas Development Company Limited (OGDCL) predicts indigenous oil reserves will be exhausted by 2025 and that Pakistan will run out of domestic sources of natural gas by 2030.

Gas prices for domestic consumers were kept low due to political reasons. The price of gas for power generation was linked to the price of imported fuel oil. However, the price was arbitrarily capped. As such, with a sharp increase in oil prices, it became even more important for the thermal power plants to use gas rather than fuel oil. The producer prices were also kept low. In addition, some of the agreements on gas pricing with the gas companies were not honoured. This deterred investors from making adequate investment in exploration and production, while, due to the government policy of keeping consumer price of gas artificially low, gas consumption increased considerably over the years.

While more than half the existing reserves have already been exhausted, no noteworthy addition has been made to gas reserves in the last 17 years. As a result, the country has sufficient reserves to last just over 15 years if the consumption is capped at present-day levels. These computations also include low BTU[25] gas, which accounts for one-third of the reserves. Natural gas is still cheaper than alternate fuels (kerosene, fuel oil) so one can expect its demand to continue rising. While this level of reserve may appear to be large, it is not considered adequate in sectors that require very large investments.[26] Finally, the gas shortage is very high in the winter but manageable in the summer. The winter shortage will grow to unmanageable levels in the next few years. Hence the country cannot be complacent over the need to replenish and expand its gas reserves.

It is important to note that, despite the stagnation in supply since FY09, gas use by households continued to grow by about 5 per cent per annum between FY09 and FY13. In FY14, however, gas use by households fell to roughly 10 per cent below the level in FY13. This trend (decline/stagnation in gas use by households) will most likely continue for the next few years as there are currently no projects that would substantially enhance gas supply in the short term.[27]

Experts also point out that enhancing domestic gas supplies has substantial prospects for saving foreign exchange. For example, academic work based on the Integrated Energy Model (PAK-IEM, which was financed by the ADB and installed by the Planning Commission) predicts savings of up to US$ 380 million per annum if domestic gas supplies are enhanced by 20 per cent. There is no doubt that such savings would grow if domestic gas production increases. The key question is whether the E&P effort required for increasing gas production by that percentage is feasible and who will finance such investments.

[24] In addition, indigenously produced oil meets 3-4 per cent of domestic oil consumption.
[25] BTU is short for British Thermal Unit: this is a standard measure of heating value of gas or other fuels.
[26] While the historical rate of growth in gas consumption can be curtailed through appropriate pricing policies, enforcing stringent appliance standards, etc., assuming that demand will not grow in future (and hence that reserves will last 15 years) is not at all realistic.
[27] Additional gas in the next 2-3 years will only come through LNG imports. Yet LNG will not constitute a major increase in supply, as the terminal that has been installed to process LNG has a capacity of only 600 MMCFD. The incremental supply through LNG will be less than 20 per cent of the country's current gas output/consumption.

1.1.5 Government Response

The current government responded to the crisis (severe shortage of power, shortfalls in gas supply relative to demand and high cost of power due to heavy reliance on fuel oil and other liquid fuels for power generation) by announcing a Power Policy in July 2013. The key aims of the Policy are to:

- Eliminate the power shortage by FY18 by investing heavily in power generation
- Lower power costs by limiting the new investments to low-cost fuels and sources (e.g. hydro and coal)
- Improve sector performance in part by inducting private management (through privatization) in key entities
- Introduce competition and a larger role for market forces in determining energy supply costs

Actions taken to implement the policy include:

- A large increase in hydropower generation (comprising about 10,000 megawatts of new capacity by 2020)
- Mobilizing the private sector and government resources to expand coal-based generation
- Investing in solar- and wind-based projects, which are partly funded by the federal and provincial governments
- Policy reforms to strengthen sector governance and improve efficiency

The investment programme has received strong endorsement and support from China, and some donors are assisting the government in implementing the policy reforms.[28] The success in mobilizing support for low-cost power generation projects and policy reforms is notable. However, it needs to be pointed out that hydropower and coal-based generation projects require substantial time (5 to 7 years, more in the case of hydropower) to be completed. Therefore, it is unlikely that even with the additional investments the power shortage will be eliminated by the target date. Furthermore, coal-based generation entails significant emissions and external funding for such projects is contingent upon limiting and reducing those environmental impacts. The government's efforts to mobilize funds for such projects will therefore require strict adherence to internationally accepted norms for emissions, etc. from those projects. These "mitigation costs" may enhance the cost of generation of those projects but this is a price that every country pays for investing in coal-based generation.[29]

The government recently started importing gas (as Liquefied Natural Gas – LNG), to supplement domestic supplies. It has been negotiating a bilateral agreement with Qatar for LNG supplies for roughly 10 years. The contract itself will be supplemented with LNG purchases from the international market at spot prices. Additionally, Pakistan State Oil (PSO) has been appointed as the agent to conduct competitive bidding and acquire LNG under short-term contracts. Furthermore, the government has expressed its interest in importing gas from Iran and Turkmenistan via pipelines. Those projects have been under discussion for more than two decades now but there is no real investment or progress on installing the pipelines in Pakistan. Therefore, those schemes should be considered as intents rather than actual projects or investments at this point in time.

The prospect for substantially increasing gas reserves by exploiting the country's shale and tight gas potential is frequently mentioned. While all opportunities for enhancing domestic gas reserves should be pursued, one needs to be cautious about predictions of the shale and tight gas potential, because: a) The reports, which refer to the large potential (50+ trillion cubic feet (TCF) of shale gas in the Lower Indus basin and 150 TCF in the whole Indus basin) are desk-level studies. These studies are based largely on satellite imagery or aerial mapping. The estimates still have to be confirmed through detailed investigations, seismic/other surveys and drilling. b) Pakistan's E&P industry has not been very enthusiastic about the government's shale and tight gas pricing policies, even though the price offered for tight and shale gas is higher than for "conventional gas reserves". There is no information to suggest that large exploration programmes have been launched by any of the companies.

[28] Asian Development Bank (ADB), Government of Japan (through Japan International Cooperation Agency – JICA) and World Bank (WB) are providing loans/credits to support the reforms. The loan/credit is disbursed in a single tranche, once the government undertakes the required reform steps/measures.

[29] Nevertheless, coal accounts for the largest share of power generation across the globe and most countries that are expanding generation capacity these days (e.g. China, India) continue to base much of their expansion programmes on coal despite the requirement for large investments in mitigation equipment and technologies. The same is true for Pakistan's planned investment programme; even after adopting the required mitigation measures, the proposed projects are likely to reduce (over the medium to long term) the cost of power generation in the country.

1.1.6 Key Findings

- Exploration activity has remained robust over the last 50 years and gas production has expanded substantially over this period.
- An extensive pipeline network and infrastructure transmits this gas to all urban and some peri-urban areas and serves roughly 7.4 million consumers.
- The share of natural gas in Pakistan's commercial energy mix has remained high. It was close to 50 per cent for much of the last decade. This significant use of gas has enabled the country to reduce its reliance on (imported and costly) liquid fuels.
- Development of the gas sector has, however, slowed down considerably. Total gas production has stagnated at around 3,900 Million Cubic Feet Per Day since 2008. As demand for gas has continued to grow, shortages of gas, particularly in winter, have started to constrain economic growth, productive activities, employment and exports.

1.2 SPECIAL NOTE: Energy as a Driver of Economic Growth

The importance of energy as a driver for economic growth is now well established. Economies having access to ample and inexpensive sources of energy have grown faster and for longer periods of time. Furthermore, with increased sophistication and modernization, production processes require larger volumes of energy. Today it is inconceivable to achieve high growth rates for long periods of time, without sufficient and uninterrupted energy supply. Currently, Pakistan is experiencing an acute energy crisis resulting in vast implications for economic growth and the standard of living for the population. Electricity supply already falls short of demand, the deficit exceeding 7,000 MW (roughly one-third of peak demand) during extreme periods.[30] Additionally, Pakistan faces a severe shortage of natural gas (which accounts for up to 45 per cent of commercial energy use)[31]. Shortages are most notable in the winter, when utilities can meet only one-half of the requirements. Growth in per capita energy consumption in Pakistan is also lower than other major South Asian countries. Similarly, this is a pattern that is also reflected in its economic growth rate. Per capita energy consumption in Pakistan, which in 1992 was the highest among South Asian countries, has stagnated (Table 2).

Table 2: Per Capita Energy Consumption in Selected Asian Countries

(KGOE)

	1992	2012	Growth p.a.
Bangladesh	119	214	3.0
China	753	2,143	5.4
India	378	624	2.5
Indonesia	574	861	2.0
Malaysia	1,567	2,799	2.9
Pakistan	412	483	0.8
Sri Lanka	330	554	2.6

Source: World Bank, "World Development Indicators 2015"

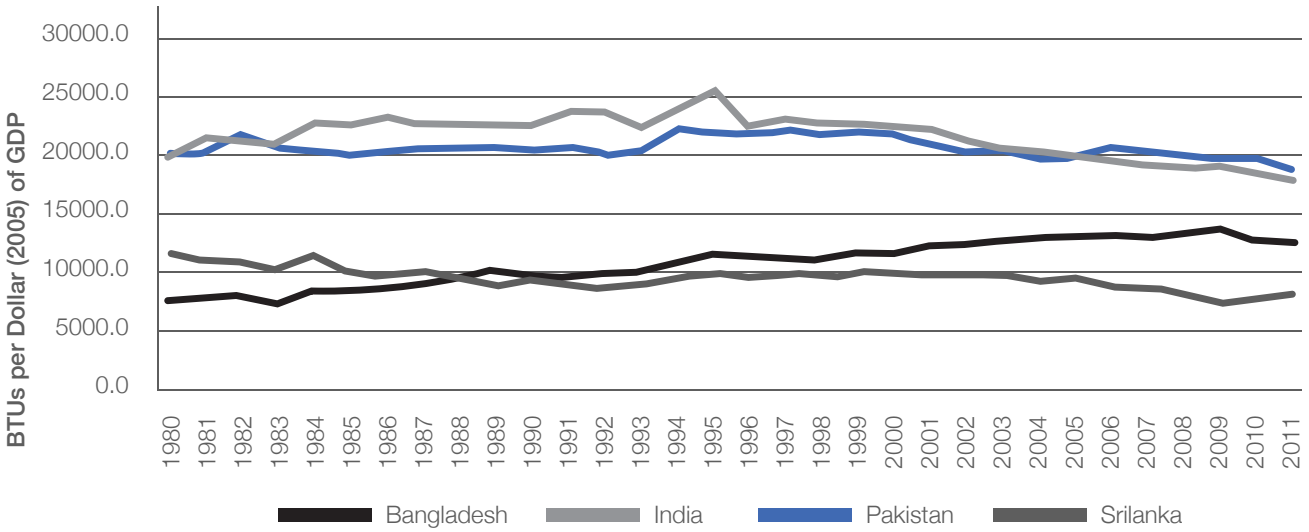
Despite the rapid increase in demand for commercial energy, due to the rapidly growing population, growth in per capita consumption of energy is rather sluggish. Barring Bangladesh, energy intensities[32] are declining in the major South Asian countries (Figure 5). Since 1997, use efficiency of energy in India has improved (1.9 per cent per annum) at a considerably faster rate than in Sri Lanka (1.5 per cent per annum) and Pakistan (1.3 per cent per annum).

[30] The shortfall was at its highest level in 2011, at 7,726 MW on October 1. See National Transmission and Despatch Company (NTDC), "Daily Operational Energy Data," Islamabad, available at www.ntdc.com.pk/doed.php (accessed April 15, 2015). These data are updated regularly; the government also provides it to the IMF and other donor missions. The shortfall represents the difference between a computed peak demand for power (based on various factors, such as weather conditions for the next day) and generating capacity available for meeting consumer demand. As the computation is specific to the following day, it should ideally not be used for projections or to compare with the estimated shortfall at other time periods.

[31] Ministry of Finance, Economic Survey 2014-15

[32] Energy intensity, calculated as the ratio of physical energy consumption to real GDP, is an index of the end-use efficiency of energy. It represents the rate at which energy is converted into economic activity (GDP).

Figure 5: Energy Intensity in Selected South Asian Countries

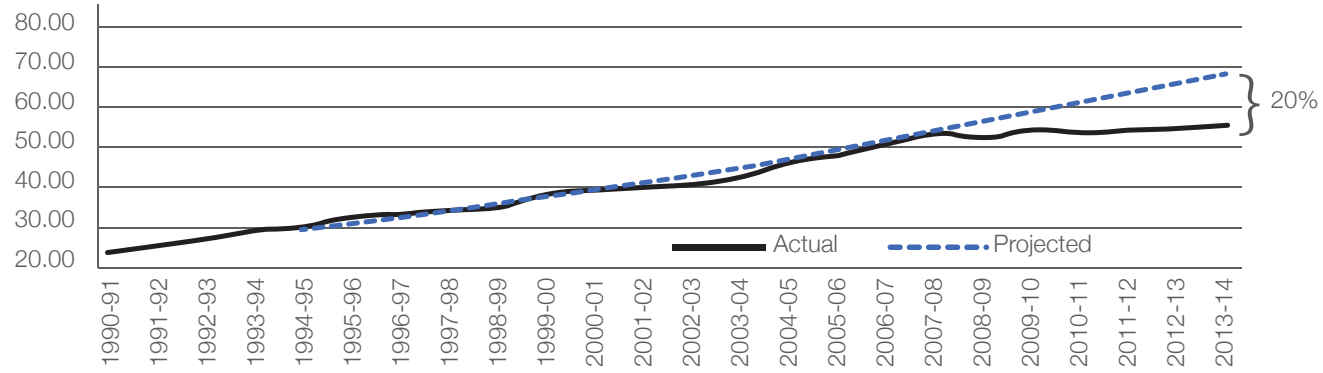


Source: US Energy Information Administration. www.eia.gov

Various studies have tried to determine the economic cost of energy shortages.[33] Although there are differences in the findings between studies, all studies are unanimous on the point that Pakistan's growth and productivity is severely constrained by the large and growing energy deficit. These deficits impose high costs on producers through losses in production, labour time and income. These costs are particularly high for the textile sector and small firms. According to some estimates, energy shortages have slashed two per cent from the potential GDP growth rate.[34] The crisis has also caused domestic businesses to postpone investment decisions and international investors to relocate their businesses. Additionally, energy shortages have forced a large number of businesses to close, exacerbating the already high levels of unemployment.

Our analysis indicates a definite and reasonably high (0.73) correlation between growth in energy consumption and economic growth. According to our estimates, a 10 per cent increase (decrease) in energy consumption leads to a 2.7 per cent higher (lower) economic growth (see Annex B - Technical Appendix). Had there been no energy shortages, Pakistan's energy consumption may have been 20 per cent higher (Figure 6). This implies that the actual economic growth today is less than half of what it could have been had there been no energy crisis.[35]

Figure 6: The Widening Gap between Actual and Projected Energy Consumption



Source: Author's projections using government data from Economic Survey, 2015

[33] Pasha et al. (2013), Siddiquie, R. (2004).
[34] The most comprehensive study on the impact of power shortages on economic activity has been undertaken by Pasha et al. (2013). The study estimated the cost of power outages at 7 per cent of GDP and determined that the electricity shortage has lowered economic growth in Pakistan by almost 2 per cent.
[35] This is about twice as high as the losses estimated by the government. This could be because of two reasons: first, the government estimates cover only the impact of power shortages (which is the most acute, but power accounts for only 17 per cent of commercial energy use), whereas our estimate takes into account all sources of energy. Second, our estimate takes into account not only the direct but also the indirect impacts of energy shortages.

Growth deceleration is only one of the negative impacts of energy shortages on the economy. Higher energy prices also stoke higher inflation. Despite energy subsidies, energy prices have increased by 7.6 per cent per annum between FY08 and FY14. The direct and indirect effect of increasing energy prices may have added 200 to 250 base points (bps) to overall inflation.[36]

The energy sector is also deeply connected to the overall fiscal position of the government. On one hand, high levels of electricity subsidy have been a major contributor to fiscal instability. On the other hand, the energy sector contributes heavily to the federal government's tax and non-tax revenue (Table 3). A well-functioning power sector can help lower government subsidies, while robust growth in the oil and gas sector can fortify government revenue.

Table 3: Federal Revenue Collected from Energy Sector (FY13) (Rs Billion)

	Oil	Gas	Total
Import Duties	20.4	0	20.4
Sales Tax	340.2	0	340.2
Federal Excises	0.2	11.5	11.7
Petroleum Levy	109.6	0	109.6
Tax Collection	470.4	11.5	481.9
% of Total Tax Revenue	23%	1%	24%
Non-Tax Revenue Collection	65.4	104.81	170.21
% of Total Non-Tax Revenue	9%	14%	23%
Total Revenue	535.8	116.31	652.11
% of Total Revenue	19%	4%	23%

Source: Authors' compilation from FBR data

[36] Energy items have a share of slightly more than 10 per cent in the basket of commodities used to calculate inflation. Hence, the direct impact of increase in energy price on CPI inflation is about 77 bps. However, energy items also constitute major inputs in some key industries, e.g. cement, fertiliser, etc. Increases in energy prices lead to higher production costs, which in turn impact consumer prices. This indirect impact is estimated to be significantly higher (160 to 225 bps). It should also be mentioned that energy inflation of 7.6 per cent incorporates the impact of (explicit and implicit) subsidies on energy items.

Gas Pricing

The policy and current process for setting gas prices covers two distinct stages:
1. Establishing gas prices for producers
2. Setting prices for the sale of gas to consumers

2.1 Producer Pricing

The government has announced a gas price for companies that are interested in exploring natural gas in the country, and developing the field(s) once they discover gas in their concession areas. The government's 2012 Petroleum Policy [37] provides the latest gas producer price. The process for allotting a concession area to any party involves the following steps:

1. Ministry of Petroleum and Natural Resources (MPNR), through the Directorate General Petroleum Concessions (DGPC), announces bidding rounds for various blocks of acreage. MPNR also holds promotion rounds to inform interested bidders about the location, physical and other characteristics of the area, qualification criteria for any interested party to be eligible to participate in the bidding, the incentives and concessions (if any) that the government will provide when it allots the block(s), and the financial, technical and other conditions of the bid.

2. Bidding is open to local and international firms that have experience in (oil and) gas Exploration and Production (E&P) and is conducted as per timetables, which are announced in advance.

3. Once bids have been submitted, the government (MPNR through DGPC) evaluates each bid, and determines the best bid for each concession. This decision involves a review of the technical, operational and financial aspects of each bid, including the resources, which the bidder commits to allocate for development of the local area. Since the producer gas price (in case there is a successful discovery) has already been announced in the Policy, the evaluation of bids does not follow the conventional "lowest price" criteria. Instead, the work plan submitted by the bidder is evaluated.

4. The successful bidder is first awarded a reconnaissance permit to conduct physical, seismic and other surveys in the area. After this, an exploration licence is awarded, which allows the bidder to initiate drilling in the area.

5. Once the drilling and well-testing activities confirm that natural gas can be produced from the field, the bidder is awarded a Development and Production Lease (DPL). The DPL requires the bidder to negotiate a gas sale agreement with one of the Sui companies, after the government has approved the allocation of gas from the field to SNGPL or SSGC.

6. Following the passage of the Eighteenth Amendment to the Constitution, the provinces now have a say in the process of awarding petroleum and gas concessions. The provincial input into the process is ensured by having the provinces nominate their representatives in the committee that DGPC appoints for the award of each concession.

7. The procedure for awarding concessions for oil and gas exploration also allows firms to apply for acreage, which has not been offered for bidding. When such proposals are received, DGPC advertises that acreage and requests competitive bids for it. Bids received in response to this advertisement are evaluated and the original applicant is allowed to match the "best bid". If that applicant updates its offer and matches the best bid, it is awarded the concession (following the principle of "right of first refusal"). If not, then the concession is awarded to the firm that offered the best bid.

Up until the mid-1980s the government used a "cost plus" approach for determining the gas producer price for each concession. Since then, the government's producer pricing policy links the gas producer price to an international benchmark price (see Appendix on evolution of pricing formula).

These evolutions of the producer pricing formula evinced strong interest from international and local companies and were followed by enhanced exploration efforts and discovery of new gas reserves. The phased increase in gas production discussed above (from 1.5 BCF/day to about 2 BCF/day in the mid-1990s and to around 4 BCF/day by the early 2000s) closely mirrors these amendments in the gas producer pricing formula.[38]

[37] The Petroleum Policy 2012 and earlier policies are available on the Ministry of Petroleum's website: http://www.mpnr.gov.pk

The recent decline in international oil prices[39] can (in theory) lead to substantial reductions in the producer price of gas in Pakistan in the near future. However, this conclusion ignores one key element of the producer pricing formula adopted in the late 1990s: the cap for oil prices agreed under that formula was US$ 35 per barrel (see Appendix A for more details). For gas supplies from all fields or concessions that were covered by the formula, the applicable/reference oil price remains US$ 35 per barrel. Therefore, unless international oil prices fall below US$ 35 per barrel and remain below that level for an extended period, the reference oil price for determining gas producer prices in Pakistan will not change.

This decline in oil prices will, however, dampen the interest of E&P companies in exploring for oil and gas in Pakistan, as is happening all over the world. The only qualifier is whether, despite the decline in world market prices, producer gas prices in Pakistan will still continue to rise because the reference price is above the previously agreed cap (US$ 35 per barrel).

2.1.1 Key Insights

A few conclusions can be drawn from the above analysis regarding gas producer prices:

a. The government has discarded negotiations (which enhance the discretionary powers of those in charge of the negotiations, and lack transparency) as the procedure for determining gas producer prices and has linked those to independent benchmarks.
b. These evolutions in the producer pricing formula evoked strong interest, promoted increased exploration activity and significantly enhanced domestic gas production.
c. However, since the formula did not adapt to current realities (the spike in international oil prices up to 2008), the attractiveness of Pakistan for international oil companies has been eroded. Without a strong effort to overcome this weakening of incentives, it is unlikely that exploration activity or gas production in Pakistan will recoup the trend observed up to 2005, i.e. 6 to 8 per cent increase in production per annum.
d. The strong correlation between producer price adjustments and gas production (with a lag of around 3 years) is not unique to Pakistan. Since E&P activity expands after any improvement in incentives, expansion in output invariably follows.
e. There were no adjustments in gas producer prices after the linkage to international crude oil prices in the late 1990s. As a result, the incentives for E&P in Pakistan did not improve, at a time when E&P firms were enjoying some of their most profitable years across the globe. Clearly, given the profit motive, the industry's decision to not invest substantially in Pakistan during the last 10 to 15 years cannot be faulted.
f. Adjustments in producer prices in Pakistan do not have any impact on government revenues. The principle used for determining consumer gas prices (Section 2.2.1) is to pass on all changes in the producer price of gas to the consumer price.

2.2 Consumer Pricing

2.2.1 Determining Consumer Tariffs

Consumer prices are normally set on a "cost plus" basis. The government (or, once it was set up, the Oil and Gas Regulatory Authority – OGRA) determines an average cost for the gas purchased by the Suis. The main cost items considered by OGRA are:

(a) The cost of gas purchased by the Suis from E&P companies
(b) The companies' expenditures for operation and maintenance of the networks, investments, debt servicing, etc. and a return to shareholders
(c) Government-imposed taxes, duties and charges. The sum of these costs becomes the companies' revenue requirement for the period of normally six months,[40] but it can vary. (As an illustration, consumer price of gas has been worked out in Table 4 using producer prices for 2012). The revenue requirement is covered through tariff revenues and the government or OGRA announces a tariff schedule (for various consumer categories and levels of consumption) that fulfils that requirement. OGRA's process for determining consumer tariffs is essentially the same as for power tariff (Box 2: Process for Determining Consumer Gas Tariffs)

[38] Hydrocarbon Development Institute of Pakistan - Energy Yearbook (various issues)
[39] Oil prices are currently hovering around US$ 40-50 per barrel, which is one-third of the peak (US$ 150 per barrel) in mid-2008. Even abstracting from that spike, oil prices were around or above US$ 100 per barrel during much of 2010-2013. However, one should also be cautious about predicting that the current price level will remain for an extended period of time.

Table 4: Gas Price Determination (2012)

	US$/MMBTU[41]
Producers' Price (Net of Royalties)	**3.85**
Royalties (@12.5% of producers' price)	0.48
Wellhead Price	**4.33**
Federal Excise Duty (@ 2% of wellhead)	0.09
Transmission & Distribution Costs (@8.5% of wellhead)	0.37
Return on Assets (@ 5% wellhead)	0.22
Other Incomes/Equalizations (@ -4% wellhead)	-0.17
Gas Development Surcharge (@ 1% of wellhead+)	0.05
Notified Consumer Price	**4.88**
General Sales Tax (16% of notified consumer price)	0.78
Consumer Price	**5.66**

Source: Authors' compilations based on OGRA, government, SNGPL and SSGC data for 2012

Box 2: Process for Determining Consumer Gas Tariffs

a. The Suis submit petitions to OGRA for adjusting their tariff rates whenever there is a sufficiently pronounced movement in one or more of the cost components.

b. OGRA admits the petition for a hearing once it confirms that it meets all requirements and includes whatever information and analysis is required to make a determination.

c. OGRA advertises the dates for the hearing, and asks interested parties to apply to become formal interveners in the hearing.

d. The hearing is open to the public and includes a presentation of the case for adjustment in tariffs (by the petitioner), the interveners' comments and inputs by the participants.

e. OGRA determines revised tariffs for the company, based on these inputs and its own analysis. There is one important difference in the process for gas tariff setting, relative to that for power tariffs. OGRA determines a tariff schedule and conveys it to the government for notification. If the government does not notify OGRA's determined rates within a fixed time period, the OGRA determined rates are automatically applied to/charged from consumers. The OGRA Act therefore gives less discretion to the government than is allowed under the NEPRA Act.

f. Transmission tariffs are determined through a "postage stamp" approach, i.e. the tariffs do not vary based on distance. This approach is used in many countries for determining transmission tariffs, so it is not unique to Pakistan. It also corresponds with the government's policy to maintain uniform consumer tariffs across the country.

[40] Producer gas prices are adjusted every six months (July and January) to incorporate changes in world market prices of oil into the producers' gas price. Therefore, the Suis normally submit petitions to OGRA every six months and request adjustments in tariffs to offset the changes in their gas purchase costs. However, the law also allows them to submit the petitions at shorter or longer intervals, based on whether there were any unexpected and pronounced changes in one or more of their main cost items.

[41] MMBTU or MBTU stands for one million British Thermal Units. It is a measure of energy content in fuel.

2.2.2 Economic Value of Gas

The process and historical evolution of policies described above for setting gas producer and consumer prices does not cover the methodologies used for determining the economic value of gas. These are summarized in Box 3: Methodologies for Determining Economic Value of Gas.

Box 3: Methodologies for Determining Economic Value of Gas

Globally, several methods are used to determine the economic value of gas – some of these are also used (by regulators, the governments, etc.) for determining gas tariffs. The adoption of a particular method depends on the prevailing market conditions and the weight assigned to the interest of the sellers vis-à-vis that of the buyers. Theoretically, an ideal method would be one that can encourage the most competition both in the producers' and buyers' markets. The most commonly used methods are listed below:

Cost-plus pricing (CPC): Cost-plus pricing is a cost-based method for setting the prices of goods and services. Under this approach, the entire cost of producing and delivering gas (i.e. the direct cost of capital, labour, the overhead costs, etc.) is computed; a "markup" (usually in percentage of cost, basically to create a profit margin) is added – to arrive at the price of the product. In other words, $P = (1 + \theta)C$ where P is the product price, C is the aggregate cost and θ is the percentage markup added to the cost. Different variants of CPC (i.e. justifiable returns on investment, returns on assets, etc.) have been used in the energy and other markets.

Long-run marginal cost pricing (LRMCP): Under this method, the price of the product (gas) is linked to an estimate of the long-run marginal cost, usually by using a mathematical model. By its very definition, this method gives no value to the fixed cost factors and looks only at the variable costs.

Opportunity cost pricing (OCP): This is a more generic version of LRMCP. The price of a product (natural gas, for instance) for a particular use (an energy source) under this method is determined from the value of the same product in the next best use (e.g. fertiliser production).

At times the OCP concept is turned around 180 degrees and the price of the product is established not on the basis of the alternative uses of the product but defined by the price of alternative (or competing) products in the same use. For example, the "Japanese Crude Cocktail" (JCC) method defines the price of imported Liquefied Natural Gas (LNG) by linking it to the weighted price of crude oil (which was considered as a competitive product to LNG) in its various uses. However, over the course of long-term changes in the energy market, the LNG price has also been modified to ensure competitiveness in the market by adjusting both the slope and the constant term coefficients of the formula. For example, among the technical means employed to maintain a proper relationship (not only from the point of view of price competitiveness) between LNG and other energy sources, has been the introduction of an S-curve concept. This acts as a "protector" for the sellers during periods when crude oil prices are severely depressed and for buyers when there are spikes or surges in prices.

Netback value pricing (NVP): "Netback" is the maximum value of any commodity (e.g. natural gas) in the production of any item (e.g. electricity). It is computed by taking the price of electricity and subtracting the contribution of all other inputs except fuel. The remainder is the Netback value of gas in electricity production.

Clearly, in Pakistan the netback value of gas can be high for domestic consumers: the competing fuel (kerosene oil or firewood) has a higher price than the fuels used (normally fuel oil) in other areas or sectors where gas can also be used (e.g. power, industries, large commercial units, etc.). For the transport sector, although the price of competing fuel (gasoline) is higher, the segment share (Natural Gas) is extremely low.

[42] Complete schedules of tariffs are posted on OGRA's website.

[43] The rationale for this pricing policy can be to deliberately encourage households to use more gas. This runs counter to the argument that the cost of supply is higher for small and dispersed consumers, so gas prices for industry, power and other large users should be lower than for households. However, it also has an economic rationale as the substitute fuel for most household uses of gas is kerosene, while for the large consumers it is fuel oil. The former is more expensive than the latter and both are imported. Promoting larger gas use in households may therefore yield larger economic benefits to the country. in addition, households cannot pass on the cost of gas to the next stage/consumer, while for industry/power etc. gas is an intermediate input in the production process. They can pass on changes in prices to consumers of the product that they manufacture or supply.

2.2.3 Gas Tariff Adjustments

For a brief period from the mid-1980s to the late 1990s, the government agreed with the World Bank to set gas prices for consumers based on international oil prices. For domestic consumers, the benchmark was the world market price of fuel oil; for all other consumers it was the landed cost (i.e. including duties, taxes and other charges on imports) of fuel oil. The balance between consumer prices linked to international oil prices and revenue requirements of the Suis accrued as fiscal revenues to the government. This policy had merits. It allowed the cost of gas supply to be fully recovered and provided signals to consumers about the true value of gas and thereby encouraged efficiency in gas use.

Gas prices have been adjusted regularly in recent years to accommodate changes in the Suis' revenue requirements. Those requirements have changed over time as the cost of gas purchased by the Suis has fluctuated in response to changes in producer prices, which moved in tandem with international oil prices. Changes since 2004 in consumer gas prices for the main categories are listed in Annex III.[42] Key features of the tariff levels and adjustments include:

a) Tariffs for household consumers are well below those for industry, power plants, or commercial users.[43] Tariffs for the gas used by fertiliser plants to manufacture nitrogenous fertiliser are also lower than for all other users. This policy reduces SNGPL's and SSGC's revenue, which then has to be made up through higher prices from other consumers. However, the policy does not appear to promote inefficient gas use in the plants as the quantum of gas allocated to each plant is fixed. Owners/managers cannot benefit from being lax on how they use the allocated amount(s) of gas.

b) Gas prices for most consumer categories have risen threefold since 2004. This trend is not too far off from overall inflation in the country. It also corresponds broadly with movements in producer prices.[44] The rate of increase in gas consumer prices has been much lower since FY13, in part because oil prices have been falling or stagnant over this period. However, there may not be substantial reductions in consumer gas prices in Pakistan even if international oil prices remain low.[45] Consumer prices for gas used in motor vehicles (as Compressed Natural Gas – CNG) have increased faster than for other users.[46] However, since CNG is a direct substitute for petrol and diesel, its absolute price level is not really relevant. As CNG prices remain well below those of petrol and diesel (in thermal equivalent terms), the pricing policy provides explicit subsidy to vehicle owners and users. The largest benefit of the policy therefore accrues to the rich. This regressive outcome further reinforces the point that a very low price for gas used as CNG in motor vehicles is not warranted.[47]

The fact that the government or OGRA continue to maintain the gas price for domestic consumers well below prices for industrial, commercial or power consumers raises a few concerns:

- The cost of supplying gas to large consumers (industries, power plants, etc.) is likely to be well below the cost of providing gas to households. This is because large investments have to be made, particularly in distribution networks, to connect the number of households whose consumption will be close to what is required by one power plant or industry. Therefore, adopting a "cost of supply" for pricing natural gas would mean gas prices for households should be much higher than those for large consumers.

- Alternatively, one can argue that gas is an intermediate cost, i.e. it is an input in the production process, for industrial, power or commercial users. The cost of inputs can be (and inevitably is) passed on to the next stage, in the price of the final product. For households, however, gas use represents "final consumption/expenditures" and households cannot pass on its cost to others.

- A most likely rationale for the government or OGRA is the need to protect (or support) the poor and providing gas at

[44] During this period, oil prices (the key reference point for gas producer prices in Pakistan) have also risen by about three times (from US$ 25 per barrel in 2004 to roughly US$ 150 per barrel in 2008, remaining above US$ 100 per barrel for the next 2-3 years) and falling to approximately US$ 50 per barrel in the last 2 years.
[45] Under the 2012 Petroleum Policy, the government has updated the ceiling to US$ 100 per barrel, from US$ 35 per barrel. Therefore, the actual price of oil (and not the ceiling price of US$ 35 per barrel) will become the reference for determining the gas producer price. Exceptions to this general trend include: (a) the first slab of domestic consumers and (b) fertiliser plants, particularly for gas used as feedstock.
[46] Since the government started allocating gas for CNG on a large scale (from 2005), the price of gas for CNG has generally been determined by the cost of supplying gas, not by the price of its substitutes.
[47] Yet investors in the CNG chain will claim that converting a minimum number of vehicles to CNG (thereby reducing greenhouse gas emissions from motor vehicles) was one of the MDGs that Pakistan adopted. This goal was the only MDG that Pakistan did achieve by the target date.

subsidized prices is one way to accomplish this goal. This argument assumes that the government or OGRA provide subsidies only to the bottom quintile, and prices for high-income groups are not maintained below the cost of supply, which is not always the case. In Pakistan, for example, the first consumption slab was up to 100 cubic metres per month. This is far higher than the monthly consumption of low-income households. Therefore, the rich also enjoy a large subsidy through the low tariff for the first consumption slab.

- The pricing structure for natural gas used as CNG in the transport sector was also misguided. Since gas is a direct substitute for petrol and diesel, there was no academic justification for maintaining CNG prices well below those of liquid products. The pricing policy promoted a very large increase in gas use in vehicles and diverted supplies from more productive uses, e.g. in industry, power plants, etc.

2.2.4 Efficiency in Gas Use

The level of consumer gas prices (for almost all sectors) appears to encourage wastage and inefficient use of gas. The National Energy Conservation Centre (ENERCON) estimates that conservation has the potential to save up to 20 per cent of all energy consumed in Pakistan. It can best be achieved by appropriate pricing, which forces consumers to make appropriate changes in equipment and lifestyles. This has happened in industry, which strives to stay energy efficient in order to remain competitive. However, the residential sector (which is the biggest consumer of electricity and a substantial user of gas) remains unmoved, because of the low gas tariffs. Government intervention through legislation, enforcing minimum standards, can have a serious impact on the inefficient use of gas.[48]

- Natural gas and petroleum products contribute significantly to government revenues, particularly during periods when oil prices are low. Similarly, when oil prices are high, these sectors become a drain on the budget as large amounts of subsidies are required, if prices are maintained below cost.

- Maintaining low gas prices for fertiliser plants has enhanced the profitability of fertiliser production. However, it is not clear whether (and as a result of this policy) domestic fertiliser prices have also been lower than those of imported fertiliser. Similarly, the economic impact of maintaining low gas prices for households depends on the assumptions used for determining “economic value”:

  - Using the Netback Value argument may yield larger benefits/savings by allocating gas to households.

  - Using multiplier effects, employment, exports, etc. as criteria to determine economic benefits would support larger allocations of gas to industry or power plants.

Pakistan’s energy (including gas) use patterns are inefficient and comprise a large economic cost. The country therefore consumes more energy than it actually requires. This inefficiency can ultimately be traced back to the government’s gas allocation policy. Since the government decides who receives gas and its decision can be influenced by vested interests and pressure groups, it is unlikely that considerations such as “efficiency” and “getting the best value for money” have any impact on the consumers’ decisions. However, the inefficient use of gas (and also electricity) stems in part from the low quality of appliances that are available and sold in Pakistan. Almost all gas appliances (space/water heaters, cooking appliances, burners, etc.) depict very low efficiency. Their “heat rates”[49] do not meet the standards established by Pakistan Standards and Quality Control Authority (PSQCA). This issue arises because:

- Gas appliances are manufactured and sold by many reputed firms, which recognize the need to maintain minimum efficiency standards for their appliances. However, since there is no oversight (or penalty for selling items that do not meet applicable performance standards), even such firms can be lax in enforcing their own equipment standards.

- There is a large market for gas appliances and other items (motors, pumps, etc.), which are produced in small workshops and factories in most cities. These workshops and producers may not have the skill to produce standardized appliances, knowledge about applicable performance standards, or access to high quality fixtures/components (nozzles, valves, etc.).

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[48] See also Section 2.2.3.

[49] This measures the quantum of energy required by an appliance to generate a required output; lumens in case of lighting, British Thermal Unit (BTU) or kilocalories in case of heating, etc.

[50] For its part, PSQCA appears to be content with only issuing the standards. It did not prepare guidelines or instructions on how to enforce those standards, e.g. for testing of equipment and appliances, penalties for manufacturing non-compliant items, penalties for sale of such items, etc.

Nevertheless, they do serve a large market. If the government intervenes to stop the manufacture and sale of such items, the inevitable result will be protests, hue and cry against police "high-handedness" and demonstrations to condemn the unemployment that the administration's actions has created, etc. Controlling the sale of such low-quality items is, therefore, not likely to be easy.

- The sale of sub-standard appliances has also not been stopped until now because the federal, provincial and local governments have not yet agreed on which branch of government is responsible for policing and enforcing the PSQCA prescribed standards.[50]

Table 5: Revenues from Petroleum and Gas Surcharges (Rs Million)

	FY07	FY08	FY09	FY10	FY11	FY12	FY13	FY14
Surcharges* of which:	64,546	35,178	126,026	114,650	113,103	83,329	141,837	142,064
Gas	34,888	20,708	14,015	25,908	30,358	22,960	32,171	38,530
Petroleum	29,658	14,470	112,011	88,742	82,745	60,369	109,666	103,534
Total Revenue	1,297,957	1,499,380	1,850,901	2,078,165	2,252,855	2,566,514	2,982,436	3,637,297
Surcharge on gas as % of Total Revenue	2.69	1.38	0.76	1.25	1.35	0.89	1.08	1.06

Source: Economic Survey 2014 – Statistical Supplement, Ministry of Finance, Government of Pakistan

2.2.5 Key Findings

a. Natural gas is used very inefficiently in Pakistan. This is partly because large quantities of appliances are produced by small-scale manufacturers (essentially one-room workshops or factories). The manufacture and sale of such appliances need to stop. However, doing so without creating public disturbances and protests (and inevitable appeals against the unemployment created by the government's high-handedness) remains a challenge.

b. The government's gas allocation policy and its policy/principles for consumer gas pricing also contribute to the inefficient use of gas. These policies are (largely) discretionary actions, provide significant power to the decision-makers and also create avenues for vested interests and pressure groups to advocate and achieve their own goals.

c. In the short run, reducing the cost of gas for consumers can only be achieved by reducing losses. The government and the Suis need to follow internationally accepted approaches. This may include outsourcing collections and theft reduction programmes, or outright privatization of the Suis (although the latter cannot be accomplished in the short term) in order to cut losses. OGRA also needs to improve its monitoring capacity.

d. The key is the performance of the judicial system. If investigation and conviction for gas theft does not speed up, the criminal elements will know the adverse consequences of such theft but will also know that the likelihood of facing such consequences is remote.

e. Globally, the industry is now accustomed to bidding on the price of energy at which it will invest and the government should develop approaches that bring in such competition – particularly for new E&P rounds. Over the medium to long term, gas prices can be controlled and reduced by introducing competition within the sector.

Gas Allocation and Consumption Patterns

3.1 Overview of Consumption Patterns

The main consumers of natural gas are power plants, industrial units, fertiliser producers,[51] and residential/domestic consumers.[52] From the year 2000 (and because large increases in gas supply were forecast) the government began allowing natural gas to be used in transport vehicles (as compressed natural gas – CNG) as a substitute for petrol and diesel. Natural gas import constituted a large share in the country's imports and therefore a burden on the balance of payments. The decision represented an attempt by the government to utilize a product (natural gas) that was relatively abundant for a limited time and whose consumption could save foreign exchange.

The price of gas used as CNG was regulated (and determined by OGRA). It was, however, not linked formally to the prices of substitute products. As a result (even after adding all taxes and duties and retailers' premiums/margins), CNG was available to consumers at prices that were well below those of petrol and diesel.

Consequently, there were large-scale conversions of the vehicle fleet to CNG and natural gas use as CNG started to become a significant share of total gas consumption. Gas allocation to CNG stations expanded very rapidly during FY04 to FY10; its annual rate of growth exceeded 30 per cent per annum. By 2007, it rose to 12 to 13 per cent of total energy use in transport and about 5 per cent of overall gas supply. At its peak during FY09 to FY11, CNG accounted for nearly 10 per cent of total gas use. Since FY13 the government has instructed the Suis to cut off gas supply to CNG stations, especially during the winter.[53]

The increasing use of CNG reflected the government's decision to allow gas use in the transport sector. As gas supply was sufficient to meet the demand for gas from other sectors and users, it was also based on fairly robust economic logic. The substitute products (particularly diesel) were in short supply and had to be imported. Petroleum product prices were at their peak; substitution of petrol by a local resource, which was not really in short supply, represented a sound economic decision.[54] The key point is the policy made sense as long as gas was not in short supply.

The initial impact of allocating gas for CNG was regressive as only private motor vehicles (which are owned by the rich) converted from petrol and diesel to CNG. Subsequently, however, large numbers of buses, taxis and other public transport vehicles also converted to CNG. The administration also announced two sets of fares for public transport: one based on CNG and another rate (which was inevitably higher) for public transport that used diesel or petrol. From press reports on this topic, one would assume the operators of passenger vehicles did not pass on the lower fares to commuters, even if they used CNG. However, if one asked the transporters, they inevitably claimed the public received all the benefits. The transporters could only charge the fares that were announced by the administration. Hence, determining whether the CNG pricing policy was progressive or regressive is (almost) a personal judgement or opinion.

However, the policy to allocate gas for CNG led to significant controversies. Firstly, the fact that this diversion of gas was only for a limited time (and only on an "as available" basis) was not explicitly conveyed to the public. As a result, after vehicle owners converted their vehicles to CNG they protested against the curtailment of gas for CNG; owners of CNG stations who had invested large sums of money to establish those outlets also adopted the same stance. As most CNG stations are located in cities and vehicle ownership is also much larger in urban areas, the protests and demonstrations had a disproportionately higher and visible impact.

The power sector was traditionally the largest user of gas. Its consumption exceeded 37 per cent of total gas production in FY06. From the 1990s onward, the share of gas allocated to power plants remained above 30 per cent. By FY07 however, supply shortages (initially in the winter months) started emerging. This prompted the government to curtail gas supply to power plants, industry and other large users. In FY09 the power sector's gas use fell to less than 30 per cent of the total gas produced.[55] The trend in gas supply to industries, fertiliser plants, etc. is similar; in absolute terms it peaked in FY11 and has been stagnant or falling in subsequent years (Table 6: Gas Statistics).

[51] Gas is used both as feedstock for making nitrogenous fertiliser and as energy in fertiliser plants. Therefore, its allocation and use in this industry is determined (and documented) separately from other industries.
[52] Gas is also used by commercial establishments (hotels, offices, etc.) but their consumption is only a fraction of the amounts used by the other sectors.
[53] Hydrocarbon Developement Institute of Pakistan
[54] See also the earlier discussion on gas pricing – particularly on using Netback Values versus forward linkages to determine the true economic value of gas.

Gas supply to domestic consumers was not cut by the government or the companies until very recently. The primary reason for this was safety. Most gas appliances sold in Pakistan do not have automatic cut-off valves or controls when gas supply is shut off. Consequently, when gas supply resumes, the burners do not ignite and the gas flows freely into the premises. The gas is poisonous and dangerous as it fills up the premises and ignites when there is a spark or a flame. This could lead to explosion or fire in consumer premises. In practical terms, it is far easier to shut off one large user such as an industry or power plant (and save the gas required by hundreds, if not thousands, of small consumers) than it is to manually shut off gas supply to countless households. Therefore, despite the stagnation in supply since FY09, gas use by households continued to grow by about 5 per cent per annum between FY09 and FY13.[56]

In FY14, however, gas use by households fell to roughly 10 per cent below the level in FY13. This trend (decline/stagnation in gas use by households) will most likely continue for the next few years as there are currently no projects that would substantially enhance gas supply in the short term.[57]

The pattern of gas consumption discussed (levels, shares, changes over time) reflects the government's policy decisions on gas allocation. As stated earlier, the determination of which sectors or consumers should receive gas is primarily a political decision, taken by the ECC or the Cabinet.[58] Economic impacts, e.g. the balance of payments impact of allocating gas to any sector are cited as key factors in determining the quantum or share of gas to be provided to each sector.[59] However, one cannot discount the fact that "influential" sectors or consumers can play a major role in the final decision. Since it is a government decision (i.e. a discretionary action), preparation and approval of gas allocation or pricing policy grants substantial power to the decision-makers. It also opens up opportunities for legitimate or vested interest groups to stake their claims.

The debate on allocating gas to households versus productive sectors has been going on almost since gas was discovered in Pakistan. The merits of installing expensive distribution networks to provide piped gas to millions of households or serving them through bottled gas/cylinders[60] and reserving the networks for large consumers only[60] are also debated. This debate has intensified recently, as the cost of power generated from gas is well below that of fuel-oil and diesel-based generation. These are valid issues and some economic implications (e.g. using Netback Value versus inter-industry linkages, multiplier effects, etc. to compute economic benefits) have been discussed earlier. The answer to the question "which sector or consumer unit/group constitutes the optimal use of gas?" appears to be subjective, as it depends on the assumptions one uses.

3.2 Key Insights

Some key insights from the above analysis include the following:

a. Natural gas allocation between/across various sectors and its consumption has started reflecting the shortfall in supply facing the country. Supply of gas to large consumers is now being cut off, mainly during the winter, in response to these shortages.

b. The first sector to face gas supply cuts was power. Its allocation started to be curtailed from 2004-05. For other sectors, consumption started to decline (mainly due to cuts in supply) only after 2010.

c. In the first half of the last decade, the power sector was allocated the largest share of gas. Gas accounted for almost 45 per cent of total gas consumption in FY04 and FY05. It now receives only about 60 per cent of the quantum of gas that it received in that period.

d. Industrial users, including fertiliser plants, have been the second largest consumer of gas. Their (combined) share of gas use has now risen to more than 40 per cent.

e. Household consumption of gas has continued to expand. Even in FY13, gas use by households increased by 0.7 million tons of oil equivalent (this represents growth of more than 10 per cent in the sector's gas use in that year). As gas supply to households is also now being curtailed (at least in the winter), the sector's gas use fell by a similar magnitude during

[55] Hydrocarbon Development Institute of Pakistan, Yearbook (various issues)
[56] Hydrocarbon Development Institute of Pakistan, Yearbook (various issues)
[57] Additional gas in the next 2-3 years will only come through LNG imports. Yet LNG will not constitute a major increase in supply, as the terminal that has been installed to process LNG has a capacity of only 600 MMCFD. The incremental supply through LNG will be less than 20 per cent of the country's current gas output/consumption. Hydrocarbon Development Institute of Pakistan, Yearbook (various issues)
[58] In taking the decision, the ECC or Cabinet also considers factors such as the investment programmes of SNGPL and SSGC, the projected demand for gas in each company's service area, etc.
[59] In the press conference following the Cabinet or ECC meeting, the spokesperson (normally the Minister for Information and Broadcasting but it can also be the Minister for Petroleum) normally refers to the foreign exchange that will be saved due to the decisions taken at the meeting.

FY14. Due to this continued growth in consumption, the sector now accounts for 25 per cent of total gas use. It was 16 to 17 per cent in the first half of the last decade. The volume of gas supply to households is now close to that of industry (about 270 BCF per anum).

f. Clearly the government did not make its decision "...to allocate gas to CNG, only as long as their gas supply was plentiful..." explicit to consumers and investors. Consequently, the reversal of the policy decision (once supply shortages emerged and gas supply to CNG stations started to be curtailed) has evoked strong protests.

3.3 Key Findings

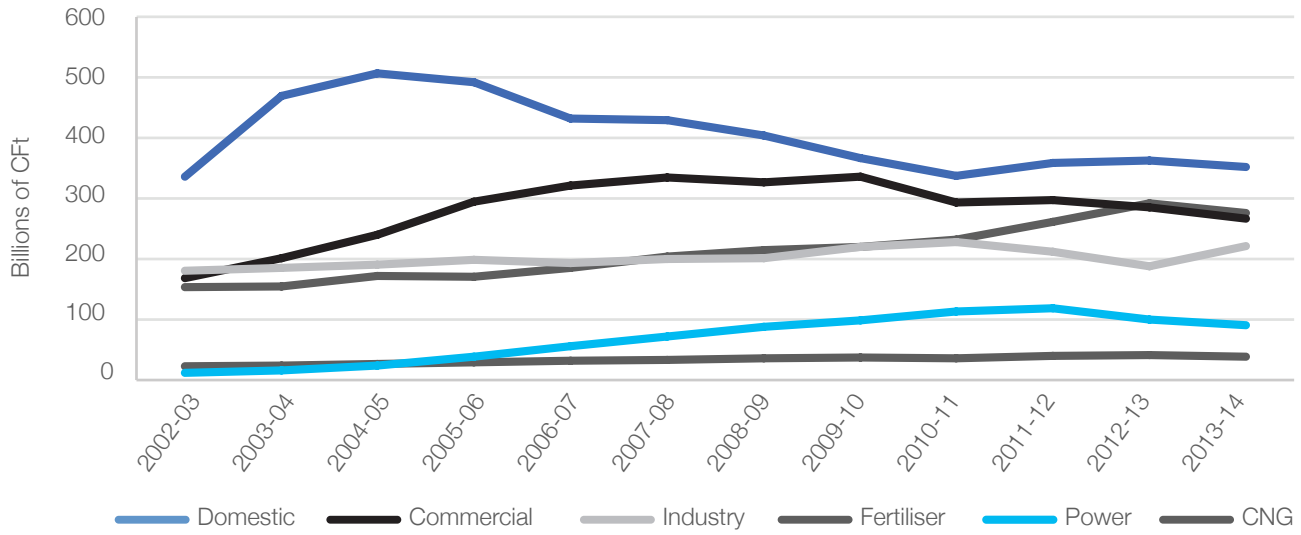
Natural gas is a source of considerable revenue for the government. Pricing gas to consumers at (or close to) parity with the prices of substitute fuels will generate a large margin between the cost of gas (covering the producer price, transmission and distribution costs) and consumer prices, and this gap can be taxed.[62] This approach to consumer pricing also leaves substantial room to further increase producer prices, although large adjustments in those prices will leave a smaller margin to mop up as fiscal revenue.

One of the key challenges to consider and address is whether continued increases in gas supply to households represent good economic decisions or not.[63] The economic costs/benefits of substituting gas for kerosene versus gas for fuel oil clearly favour continued allocation of gas to households. This should be supplemented by a review of the forward linkages of the industrial and power sectors and determining the true economic benefit of allocating gas to those large-volume users.

The government and the remaining stakeholders need to be cajoled into accepting that they cannot be provided a free lunch, i.e. a substitute for petrol and diesel, at prices that are lower than the cost of the latter products, forever.

An important message for government is that "allocations and discretionary decision-making" as a means to promote gas use in various sectors has severe limitations. Adopting this approach for allocating gas across sectors will meet pressures from vested interest groups and it will be difficult to stick to even sound economic judgements and decisions. A much better course of action would be to let market forces determine gas allocation, by allowing the Suis to sell gas to consumers or sectors that can (or are willing to) pay the highest price of gas. Clearly, this approach will not be favoured by those who benefit from discretionary power, both as decision-makers and as recipients of cheap resources. However, such vested interest groups have to be confronted at some point in time.

Figure 7: Gas Consumption by Sector (MMCFD)



Source: HDIP, "Pakistan Energy Yearbook (various issues).

[60] Limited or no distribution networks for household consumers is also expected to save gas, as gas losses are much larger in the distribution system than in high-volume and dedicated pipeline systems.
[61] In India, for example, there is no gas distribution network even in cities where gas is available; retail consumers receive gas in cylinders, and dedicated pipelines serve industrial units of power plants only.
[62] This is actually a direct application of economic and fiscal theory. Tax any product where there is a gap between the cost of supply and consumer willingness to pay. If the product is consumed mainly by the rich, the tax regime may also become more progressive and equitable.
[63] The safety angle, i.e. the risks of fires and explosions when gas supply to households is interrupted, also needs to be considered.

Table 6: Gas Statistics

Gas Statistics												
Natural Gas Consumption (by sector)										Units: Million Cubic Feet and Tons of Oil Equivalent (TOE)		
	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14
Domestic	153,508	155,174	172,103	171,109	185,533	204,035	214,113	219,382	232,244	261,915	291,917	269,135
TOE	3,592,094	3,631,072	4,027,210	4,003,955	4,341,475	4,774,412	5,010,247	5,133,540	5,434,507	6,128,822	6,830,868	6,297,770
Commercial	22,776	24,192	27,191	29,269	31,375	33,905	35,536	36,955	36,466	39,627	40,689	38,117
TOE	532,964	566,093	636,268	684,886	734,180	793,367	831,547	864,747	853,313	927,272	952,115	891,927
Industry	152,068	178,942	211,766	263,348	290,214	305,662	305,042	320,476	279,717	286,055	274,450	250,490
TOE	3,558,395	4,187,245	4,955,321	6,162,353	6,791,013	7,152,491	7,137,980	7,499,138	6,545,378	6,693,679	6,422,139	5,861,460
Steel Mill	12,900	14,453	14,350	15,498	16,386	16,901	13,961	13,032	11,951	10,125	9,827	8,542
TOE	301,860	338,200	335,790	362,653	383,432	395,483	326,687	304,949	279,653	236,925	229,952	199,883
Cement	3,445	7,711	13,383	15,335	14,686	12,736	7,305	1,944	1,378	1,266	586	522
TOE	80,619	180,437	313,164	358,834	343,646	298,025	170,927	45,490	32,240	29,629	13,720	12,215
Fertiliser - Feedstock	140,975	145,128	149,869	155,258	153,458	160,062	162,028	175,631	175,912	168,694	148,782	164,378
TOE	2,745,637	2,842,095	2,938,731	3,033,832	2,989,825	3,145,626	3,186,253	3,421,523	3,350,683	3,157,367	2,754,794	3,024,845
Fertiliser - Fuel	39,636	40,222	40,540	42,917	40,224	40,001	39,072	44,493	52,548	43,134	39,237	52,139
TOE	779,054	793,123	797,852	842,662	786,437	782,979	765,787	860,424	990,662	817,280	727,491	963,123
Power	335,636	469,738	503,983	490,142	432,607	429,892	404,140	366,906	337,401	358,381	362,262	349,535
TOE	6,439,339	9,462,986	10,305,897	9,978,369	8,640,208	8,491,536	7,830,065	7,106,962	6,493,766	6,732,876	7,084,177	6,602,422
CNG	11,320	15,858	24,443	38,885	56,446	72,018	88,236	99,002	113,055	119,000	100,228	87,634
TOE	264,885	371,075	571,961	909,908	1,320,841	1,685,232	2,064,722	2,316,646	2,645,493	2,784,591	2,345,331	2,050,646
Total:	**872,265**	**1,051,418**	**1,157,628**	**1,221,762**	**1,220,929**	**1,275,212**	**1,269,433**	**1,277,821**	**1,240,671**	**1,288,198**	**1,267,980**	**1,220,493**
TOE	**18,294,846**	**22,372,325**	**24,882,193**	**26,337,452**	**26,331,057**	**27,519,152**	**27,324,216**	**27,553,419**	**26,625,696**	**27,508,442**	**27,360,587**	**25,904,290**

Source: Energy Yearbook 2014

Governance Aspects

4.1 Regulatory Structure

The petroleum and gas sub-sector presents a fairly diverse picture in terms of its ownership and management. A number of foreign and domestic privately owned companies operate in Pakistan, although the number of international companies (particularly the ones that operate a concession area and do not merely own shares in one or more fields) has dwindled over the last 15 to 20 years.[64] In the downstream sector (comprising the two Suis) the government is the largest shareholder either directly or through government-owned investment companies. However, the private sector also owns substantial shares in these companies. Therefore, the private sector also nominates its representatives to the Boards of Directors and shares responsibility for overseeing the performance of the companies with the government.

The Oil and Gas Regulatory Authority (OGRA) was established through an Act of Parliament in 2002 and acts as an autonomous regulator for the downstream sector. OGRA's functions (in the gas sector) include:

(a) Awarding licences to, and establishing performance standards for, entities that wish to transmit, distribute or sell natural gas to consumers
(b) Determining tariffs for the sale of gas to consumers
(c) Monitoring the performance of transmission and distribution companies in accordance with the established standards.

The government retains the authority to license, award, establish performance standards for and monitor the performance of the E&P companies. This function is performed by DGPC, with oversight by key government entities, e.g. Economic Coordination Committee of the Cabinet (ECC).

The government discharges its ownership role largely through the Boards of Directors of the Suis. However, MPNR retains (ostensibly for policy reasons) a major say in operational aspects of the companies' performance. Therefore, MPNR provides directives (e.g. based on decisions taken by ECC) to the Suis to allocate gas to specific sectors and consumers. On the face of it, this decision should be made by the companies' management and they should follow a profit-maximising approach for their gas sales.

4.2 Gas Losses

4.2.1 Reasons for and Impact of Gas Losses

One aspect of the gas sector in Pakistan that deserves special mention is the significant losses of gas in the companies' systems. This is referred to as Unaccounted for Gas (UFG) in Pakistan. UFG represents the difference between the volume of gas that the Suis purchase from the E&P companies and the volume they sell to all consumers. The volume of UFG has increased sharply over the last 10 years. It was just above 7 per cent in the SSGC system and 6.75 per cent in the SNGPL system during FY04. By FY15, it had risen to above 15 per cent in SSGC and 9.96 per cent in the SNGPL system.[65]

Some other factors that may account for the growing losses include:

- The Suis' infrastructure, particularly the distribution networks, have not been properly maintained or upgraded. Much of the network, particularly distribution pipelines, is more than 30 years old, the lines have corroded, and the gas leaks under the ground and is often untraceable.[66]

- Due to poor workmanship and installation procedures, above-ground fixtures (meters, house connections, regulators, etc.) are not installed properly, nor maintained well over time. After a while these start leaking gas into the atmosphere.

- While there is no formal survey or estimate for it, part of the losses represents theft of gas from unprotected installations (such as meters) or tapping directly into pipelines or distribution mains. Such theft can involve collusion by staff, or consumers may be indulging in this practice on their own. The volume of such losses has not been documented and it may be impossible to separate these losses from the types of losses listed above.

[64] More than 20 foreign oil and gas companies operated in Pakistan 2-3 decades back (21, to be exact, in 1980), now the number is 7. Apart from the number, the stature of the firms and nature of their involvement has also gone down. In the 80s-90s firms like Shell, Burmah Group, BP, Premier, Occidental, Union Texas worked in Pakistan, now the firms are mainly from Eastern Europe (Poland, Hungary, Austria, etc.) or the Far East. Also, earlier most international firms operated/managed the fields, now they often are only shareholders in projects where local firms (OGDCL, PPL, etc) are the operator.

Gas losses amounting to 10 to 12 per cent of gas purchases by the Suis are well above the norm for technical and commercial losses (i.e. theft) in a gas system. The maximum amount considered acceptable is 1.5 to 2 per cent.[67] Therefore, the Suis are losing large amounts of a scarce resource and the consumer ends up paying for these inefficiencies.

One aspect of performance monitoring that needs to be probed further is the impact (or lack of it) of gas losses, particularly for the Suis' staff and management. There is no evidence to conclude that the latter have faced any consequences due to the high level of, or continued increase in, gas losses. For utilities that operate on commercial principles, the companies are held accountable for their performance and management and/or staff face actions when agreed or approved performance standards are not met. OGRA periodically sets targets for gas losses for each company but it is unlikely that the Suis have ever achieved those targets, particularly during the last decade. However, there is no evidence that the companies have been penalised for such failures. Clearly, this situation needs to change.

4.2.2 Dealing with Gas Losses

Dealing with the gas losses has to be accorded high priority. On the one hand, the companies have to be provided resources to invest in upgrading their networks. This is not as easy as it seems. All stakeholders seem to be against allowing resources to the utilities solely to invest in replacement and upgrading of their infrastructure:

- The Government and OGRA argue that the Suis should first improve their performance and ask for funds only after they comply with OGRA standards for gas losses. Approval of the utilities' projects to upgrade their networks is therefore very challenging.

- The media, politicians and other interest groups contend that investments (and contract awards) only enhance corruption and misuse of public resources. Therefore they also do not favour increased allocations for investment.

- Consumers also are not in favour of providing more resources for investment, because it enhances the Suis' revenue requirement and therefore means higher consumer tariffs.

Nevertheless, it is myopic to expect that losses can be reduced without more investment.

Dealing with losses also requires that the Suis as well as OGRA develop better procedures to detect and address gas losses and to penalize the companies for failures to achieve agreed performance targets. This can include financial incentives (reward and penalty schemes) for the companies' management and staff. It also requires the companies to install up-to-date information and management systems, e.g. smart metering systems, monitoring systems, response procedures, etc.

Finally, there is little likelihood that gas losses can decline without substantial improvements in the judicial system's performance. It is likely that only a fraction of complaints that the companies launch with the police are investigated. Cases registered by the courts are again likely to be a small percentage of all investigations and decisions by the courts on such cases can take years. Hence, consumers who steal gas are rarely penalised, or can benefit from many years of free gas before they face any penal actions.

4.3 Market Forces and Competition

A final aspect of gas sector governance involves the role of market forces and commercial management, to reduce discretion and improve performance. As discussed above, the gas sector is run largely on a cost plus basis. Prices are determined upfront and there is no competition (between E&P firms, for example) on the price of gas. Similarly, E&P companies do not face any market risks, e.g. to develop their own customer base and not rely solely on the government for the purchase of all their gas by one of the Suis. Both these aspects could be reconsidered. The E&P industry is now accustomed to bidding on the price for the sale of their gas.

At one extreme, this can include privatisation of the gas companies. This has been a key objective of all governments for more than 20 years, but there has been very limited progress towards this goal. Privatization has significantly improved the performance of companies across the globe and there is no reason to argue that similar improvements cannot be achieved in Pakistan.

[65] OGRA reports (various issues)
[66] Limits set by NEPRA

Much of the gas sector is licensed and operates with government guarantees. Examples include the guaranteed gas for producer price, which guarantees that all of the E&P companies' output will be purchased by the Suis etc. Each of these practices should be reconsidered, and actions to bring about the required (and agreed) changes should be started.

4.4 Politicisation of the sector

The report has amply demonstrated that the entire gas sector is highly politicised: market clearing price of gas is not allowed, incentives for oil exploration are eroded and gas utilities are not disciplined for systems losses. These combine to result in excess demand. Solutions to these problems have been offered throughout the report. Denying connections to new consumers is a form of solution but one that is very difficult to sustain in democracies. Such rationing would also be seen as "politicisation", i.e. denying gas connections to some citizens while others enjoy subsidized home-piped gas. A more rationally organised gas sector that addresses the endemic politicisation of various stages of gas production and supply would easily accommodate more connections – and that is where reform should focus.

Conclusions and Recommendations

The gas sector in Pakistan is fairly well developed:

- Exploration activity has remained robust over the last 50 years and gas production has expanded substantially over this period.
- An extensive pipeline network and infrastructure transmits this gas to all urban and some peri-urban areas and serves roughly 7.4 million consumers.
- The share of natural gas in Pakistan's commercial energy mix has remained high. It was close to 50 per cent for much of the last decade. This significant use of gas has enabled the country to reduce its reliance on (imported and costly) liquid fuels.
- Development of the gas sector has, however, slowed down considerably. Total gas production has stagnated at around 3,900 Million Cubic Feet Per day since 2008.[68] As demand for gas has continued to grow, shortages of gas, particularly in winter, have started to constrain economic growth, productive activities, employment and exports.

One of the main reasons for the slowdown has been the government's reluctance to address anomalies in the gas "producer pricing" framework. The formula was successful in generating interest in gas exploration and production over periods when international oil prices were low. However, in recent years, the formula lost relevance as the price of the substitute product (oil) ranged between US$ 100 and US$ 150 per barrel, while producer gas prices in Pakistan were confined to a ceiling price of US$ 35 per barrel. While the government has recognized the anomaly and attempted to address this under the 2012 Petroleum Policy, it remains to be seen whether the revised formula can successfully evoke interest among international E&P companies.

Meanwhile, the government has begun importing natural gas, initially as liquefied natural gas (LNG) and for the long term through pipelines from neighbouring countries. The cost of LNG or imported gas will be substantially higher than domestically produced gas. Clearly, by delaying amendments to the producer pricing formula, to enable producers to acquire some windfall gains from the spike in international oil prices, the government is imposing substantial costs on the economy, in the form of higher prices for LNG and imported gas. The higher cost of LNG has to be passed on to consumers, partly because it is a requirement of the OGRA Act. However, requiring consumers to pay the full cost of LNG (and a higher price for all gas, since LNG costs feed into the "weighted average" cost of gas) does not imply a cost-plus pricing formula.[69] As stated in this report, competitive bidding for supplies to the Sui companies can yield savings in overall gas costs. Firms may be willing to offer discounts to the government, in order to acquire the most promising acreage. The same principle is also true for LNG; the government, SNGPL/SSGC (or any entity acting as the government's agent) can conduct competitive bidding for LNG deliveries to Pakistan.[70]

The challenge in improving performance of the sector lies in implementing a sound reform programme. Implementation is greatly facilitated if the policy framework for the gas sector is designed around the sound principles of fairness and transparency. The report has discussed in detail what those design elements are and what it takes to put them into practice. Furthermore, the proposal (to move to competitive and market-based principles) will avoid discretionary power and decision-making and is not amenable to capture by pressure groups/lobbies. It will enjoy the support of all interested parties. Institutions that design and help to put in place a policy framework incorporating the three principles of fairness, transparency and competition are an integral part of implementation.

One overarching message for government officials about the pricing of close substitutes is to inform them that approving higher prices for imported products (e.g. LNG) but not allowing equivalent prices for domestic supplies is not only unfair, it also (only) hurts local firms and reduces investment and employment.

The downstream (transmission, distribution and sale) sub-sector is constrained in meeting the growing demand for gas, by the lack of gas. Inefficiencies in their operations, including very high levels of losses, further constrain the companies' ability to meet consumer needs. As a result, there is considerable dissatisfaction (in almost all segments of society) about the working of the gas companies'.

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[68] In fact, gas production has declined from 4.3 BCF per day in 2011-12 to about 3.8 BCF per day now.

[69] The recommendations of this report imply hybrid formulae for both producer and consumer stages:
- Producer pricing based on cost plus/existing contract terms and full pass through for all existing fields, bid-based prices (and full pass through) for new exploration and LNG.
- Parity (or close to parity) with the prices of substitute products and subsidized prices based on expenditure and income levels for only the lowest quintile, for consumer prices.

[70] Appointing/authorizing PSO to import LNG on short-term contracts represents precisely this approach.

Some of this frustration represents a myopic reaction. Almost no segment of society accepts the fact that keeping the price of any product well below the price of substitute products leads to inefficiencies in the use of that product, generates excess demand and also precludes large increments in supply. This is due to the fact that prices are not sufficient to attract serious investors. Despite this reality, all consumer classes insist that they should be accorded priority in the allocation of gas. They also insist that the gas price should not be linked to the price of petrol (for use in the transport sector), kerosene or LPG (for cooking, space and water heating by households), or of fuel oil (for power plants and other large industrial and commercial users). As a result, consumers continue to use more expensive sources of energy and do not recognize the need or benefits of using natural gas efficiently.

Consumers must understand the real impact of shortages, for example, by being convinced of the additional cost that they pay for kerosene, fuel wood and other fuels for cooking, heating, etc. when gas supplies are constrained. Keeping gas prices low for extended periods will require subsidies, which the fiscal situation does not allow; it promotes inefficiency in gas use and it generates excess demand for gas.

One measure that could (over time) promote greater efficiency in gas use is to shift to more efficient appliances. Pakistan Standards and Quality Control Authority (PSQCA) has notified standards for the thermal efficiency of all appliances (stoves, water and space heaters, etc.). However, further actions are bogged down in discussions over who is responsible for enforcing these standards (PSQCA, the provinces, local governments, etc.). In parallel it needs to be recognised that enforcing the standards will remain a challenge until:

- Domestic producers agree to manufacture only appliances that meet the standards. This may require incentives, e.g. energy efficiency ratings, enabling manufacturers to charge premium prices for appliances that meet the standards, etc.

- Traders, importers and vendors are also convinced and only sell appliances that meet the standards.

- Small-scale manufacturers, often working out of one-room workshops, etc., are also equipped to produce items of the required quality. While there is no estimate of the share of the market for consumer appliances that such manufacturers serve, it is surely not trivial. Making sure that they only produce goods of the required quality is therefore essential. This may require technical training and certification programmes for local mechanics, etc. to be introduced.

Efforts to monitor the performance of the Suis can be supplemented, e.g. by introducing financial incentives for achieving performance targets and penalties for failure to comply.

The government has conveyed its intention to privatise the gas utilities for more than 20 years (the first plan to privatize SSGC was in fact prepared during the PPP government's first tenure from 1987 to 1991). Yet there has been no progress on that plan. Since privatisation may represent the best short-term solution for improving the utilities' performance, it needs to be vigorously propagated. The campaign also needs to develop messages to counter the criticisms that will inevitably be generated by vested interests, by highlighting case studies of performance improvements following privatization from across the globe.

Some reductions in gas supply cost and in the fiscal burden on the government when it provides guarantees that gas will be purchased by the Suis can be achieved by promoting more competition in gas production and sale.

The government must realise the benefits of transparency and the risks of allowing too much discretionary power to any individual or office. Therefore, they should consider allowing market forces (and not administrative decisions) to determine the best/optimal allocation of gas. Similarly, the industry must be educated that the government cannot be asked to provide guarantees for all investment decisions. They need to help to reduce the government's contingent liabilities and towards this end they need to start taking more of the commercial risks on themselves, rather than insist that the government covers all their risks.

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Annex

A. Household Energy Distribution Analysis

Household Integrated Economic Surveys (HIESs) provide the breakdown of household expenditure on energy and non-energy items. In order to show changes in the composition of household consumption expenditure, comparison is made using data from HIES 2001-02, 2007-08 and 2013-14. To facilitate inter-temporal comparisons, income and expenditures are converted into real income and spending by deflating them by appropriate consumer price indices.[71]

Household Spending on Energy

A look at the real expenditures in Table 7: Average Monthly Household Real Expenditures also indicates significant disparities between urban and rural areas. Average real income of urban households remains higher than rural households. Recent figures confirm that the share of energy spending in total expenditure of urban households is also significantly lower than that of rural households, implying higher energy poverty among rural households. The urban-rural disparity is even more pronounced in the composition of household energy use. In rural areas, bio fuels, such as firewood, charcoal and agricultural waste, constitute a major portion of total household energy consumption, while in urban areas, kerosene, electricity and gas (piped and LPG) are the major sources of energy. The dependence of rural households on biomass energy is very large. Spending on biomass fuels by urban households is lower than that by rural households. Similar disparity is also evident for kerosene oil, although on a much smaller scale. On the other hand, spending on electricity and gas among urban households is also higher than in rural households, reflecting much higher availability of (and demand for) cleaner fuels to (by) urban households.

Over time, income and total expenditure disparity has narrowed down; however, the disparity in fuel spending has widened sharply, greatly lowering the urban-rural gap in the share of fuel in the household budget. Lowering income disparity indicates a faster growth in rural incomes compared to those of urban households. Household income, especially its growth, influences energy consumption in many ways:

- Firstly, with the rise in income levels, food consumption increases, due to an increase in the quantity and quality of food. Preparation of greater quantity of food requires a larger amount of energy. Similarly, switching to better quality food (grains to vegetables, vegetables to meats) may also require additional energy.
- Secondly, with increasing incomes, the price of the fuel is less of a constraint. Households prefer to use cleaner and more convenient forms of energy, such as electricity and gas (including LPG).

The shares of spending on biomass energy and kerosene oil in overall fuel expenditure has declined sharply among both urban and rural households. The decline among rural households has been faster, however. On the other hand, there has been a rapid increase in shares of expenditure on electricity and gas, with the increase in spending of rural households exceeding that of urban households.

Table 7: Average Monthly Household Real Expenditures (at 2007-08 Prices)

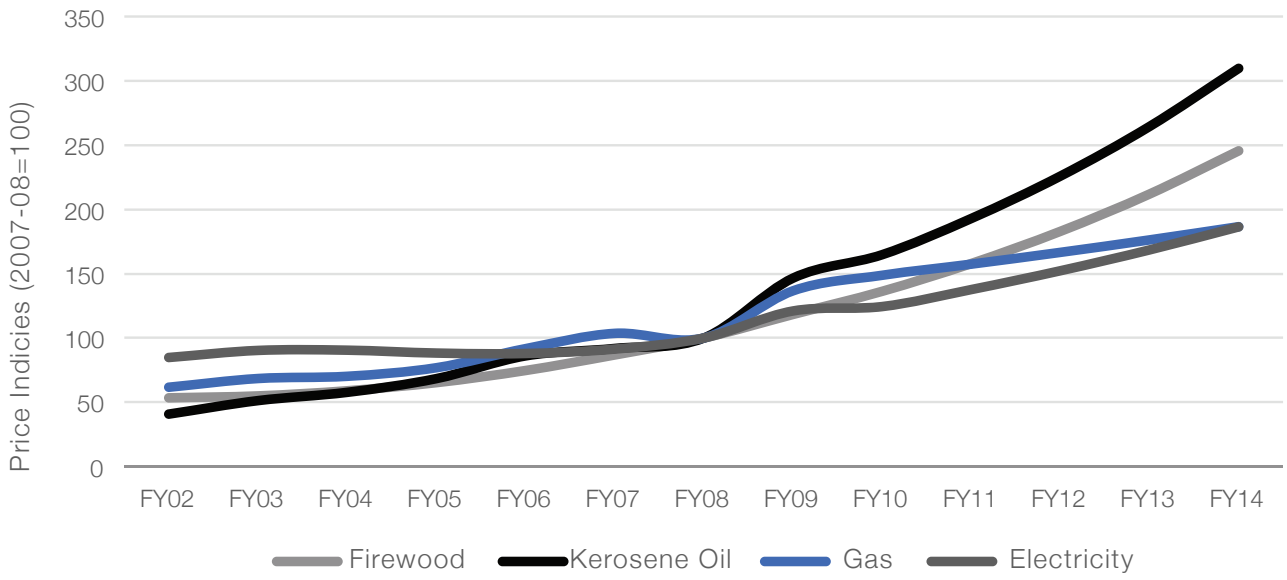
	2001-02				2007-08				2013-14			
	Pak.	Urban	Rural	Urban/ Rural Ratio	Pak.	Urban	Rural	Urban/ Rural Ratio	Pak.	Urban	Rural	Urban/ Rural Ratio
Household Income	11,948	16,510	10,054	1.64	14,456	17,970	12,626	1.42	15,643	19,642	13,349	1.47
Total Expenditure	11,192	14,997	9,612	1.56	12,660	15,601	11,128	1.40	13,904	16,946	12,159	1.39
Fuels	791	876	756	1.16	922	1,026	867	1.18	907	1,086	804	1.35
Biomass	360	123	459	0.27	292	86	399	0.22	237	56	341	0.16
Kerosene oil	56	36	64	0.56	11	3	16	0.17	3	0	5	0.10
Gas	97	250	34	7.44	144	255	86	2.98	194	330	116	2.84
Electricity	278	468	199	2.35	475	682	368	1.85	472	699	342	2.05
Fuels (% of Total Expend.)	7.1	5.8	7.9	0.74	7.3	6.6	7.8	0.84	6.5	6.4	6.6	0.97
Per cent of Energy Expend:												
Biomass	45.5	14.0	60.7	0.23	31.6	8.4	45.9	0.18	26.1	5.1	42.4	0.12
Kerosene oil	7.1	4.1	8.5	0.48	1.2	0.3	1.8	0.14	0.4	0.0	0.6	0.07
Gas	12.3	28.5	4.4	6.42	15.6	24.9	9.9	2.52	21.4	30.4	14.5	2.10
Electricity	35.1	53.4	26.3	2.03	51.6	66.5	42.4	1.57	52.1	64.4	42.5	1.51

Source: Author's compilation using HIES (2001-02, 2007-08 and 2013-14) data

[71] The General Consumer Price Index (CPI) was used to obtain real income and total expenditure, whereas consumer price indices for electricity, gas and kerosene oil were used to deflate nominal expenditures on each of these items. As firewood comprises more than one-third of expenditure on all biomass energy items, the consumer price index of firewood is the only biomass item of energy for which CPI is available.

It is important to keep in view that we are referring to real expenditures; hence the impact of a very sharp increase in price is largely negated. Nonetheless, the impact on demand of relative prices of energy items cannot be discarded. Relative prices played a significant role in the switch from traditional to commercial sources of energy. Between FY02 and FY14, the consumer price of gas increased at an average rate of 6 per cent per annum, electricity by 8 per cent per annum, biomass fuel (firewood) by 15 per cent per annum and kerosene oil by 18 per cent per annum. These large discrepancies in price increases of traditional and cleaner fuels also supported the switch from former to latter (see Figure 8 below).

Figure 8: Consumer Price Indices of Components of Household Energy Demand



Source: Authors compilation using Pakistan Bureau of Statistics data on consumer price indices

To determine the effect of changes in household real income, household size, energy prices and urbanization, a system of estimated household demand equations was formulated (see Table 8 below).[72]

Table 8: Estimated Energy "Demand" Functions

Fuel	Constant	Income	Price of				Household Size	Urban
			Biomass	Electricity	Gas	Oil		
Biomass	-2.3794*	0.2485*	-1.2600*	0.4086	0.0222	0.5740	2.0065***	-1.689***
(t-Statistics)	(-1.6872)	(1.7076)	(-1.6577)	(0.8842)	(0.1181)	(1.1429)	(7.9711)	(-19.19136)
Electricity	1.2186*	0.4935***	0.5115	-1.125***	0.1985**	0.1778	-0.7657***	0.6208***
(t-Statistics)	(1.7225)	(6.7587)	(1.3415)	(-4.8525)	(2.0965)	(0.7055)	(-6.0637)	(14.0602)
Gas	-9.6142	1.6418***	1.8359**	-0.1993	-0.7581***	-0.8115*	0.3512	1.2954***
(t-Statistics)	(1.4212)	(11.3774)	(2.5172)	(-0.6556)	(-3.71814)	(1.7027)	(1.0827)	(16.2701)
Kerosene Oil	-2.3104	0.7881*	-5.3004**	1.2869	1.1537*	0.9700	2.959***	-2.9334***
(t-Statistics)	(-0.5010)	(1.6560)	(-2.1327)	(0.8516)	(1.8700)	(0.5905)	(3.5950)	(-10.1935)

Source: Authors' computations
Terms in parentheses are the t-statistics.
* implies statistically significant at 90% level of confidence.
** implies statistically significant at 95% level of confidence.
*** implies statistically significant at 99% level of confidence.

The results indicate that real income has a positive effect on demand for each source of energy, with demand for gas expected to increase at a 50 per cent higher rate than increase in household income. The demand for other fuels is also expected to increase with income, but at a slower pace than increase in income. Own-price elasticities are negative and significant for biomass, electricity and gas. For kerosene oil, the own-price elasticity is positive but statistically insignificant. The elasticity of household size variable is negative (and significant) for electricity, showing economies of scale. For other fuels it is positive (insignificant for gas), implying no economies of scale in consumption of biomass, gas or kerosene oil. The coefficient of the urban (dummy) variable is negative for biomass and kerosene oil and positive for electricity and gas. The estimated coefficient clearly highlights that, with urbanization, demand for electricity and gas is expected to increase, while that of biomass energy and kerosene oil is expected to decline.

Overview of Household Expenditure patterns

This section reviews household expenditure on energy patterns based on Household Income and Expenditure Survey (HIES) data. The data in four surveys[73] was analysed – with a focus on (a) country-wide expenditure patterns and trends, (b) patterns and trends within various provinces and across provinces, and (c) patterns and trends in urban and rural areas – both nationally and in each province. To facilitate inter-temporal comparisons, income and expenditures are converted into real income and spending by deflating them by appropriate consumer price indices.

Composition of Overall Expenditures on Energy

There were visible changes in expenditure on energy patterns across these surveys.

The most obvious ones are discussed below:

1. Across the country, the level and share of energy in household expenditure escalated sharply between FY02 and FY08. In FY02, energy accounted for 3.1 to 6.2% of household expenditure; by FY08 the shares rose to between 8.1 and 11.9% of outlays. The breakdown of FY02 expenditures shows that energy accounted for 4.4%, 3.1%, 3.8%, 4.4% and 6.2% respectively of household expenditure in 5 quintiles (ranked in terms of the lowest expenditure to the highest expenditure). By FY08, these shares had risen to 9.1%, 8.1%, 8.8%, 9.9% and 11.9% respectively.

2. There were only minimal changes in the share of energy in household outlays in the next two surveys. By FY12 energy accounted for 8.3 to 12.4% of household spending.

Energy accounted for a larger share of household spending in urban areas than in rural areas. In FY02 the share of energy in total spending (for the 5 quintiles) was 6.3%, 4.7%, 4.9%, 5.2% and 6.4% in urban areas, and 3.3%, 2.5%, 3.4%, 3.6% and 5.9% in rural areas. In later years, the difference was smaller, but still noticeable. For example, in FY12 the shares were 11.6%, 10.1%, 9.8%, 10.8% and 12.6% in urban areas, and 9.9%, 8.3%, 9.1%, 10.3% and 12.4% in rural areas. The larger share of energy expenditures in urban households' budgets reflects two specifics:

1. Urban households have far greater access to electricity and gas (particularly the latter) than rural households. Using electricity and gas invariably involves cash expenditure, which is captured in the HIES surveys. By comparison, energy expenditures of rural households include a larger share of biomass and fuel wood. The latter is often collected, not purchased – and therefore may not be captured by the HIES surveys.

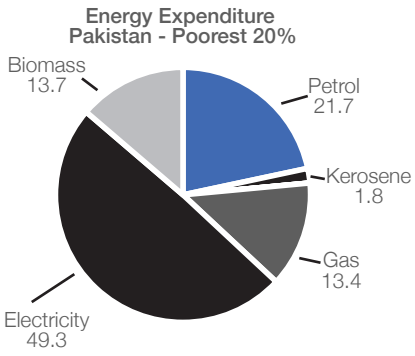
2. The lower levels of energy expenditure in rural areas may depict lower energy use than in urban areas. While this can be due to disproportionately lower access to modern fuels in rural areas, it should be recognized that part of rural households' energy needs are met through collected, not purchased, fuels.

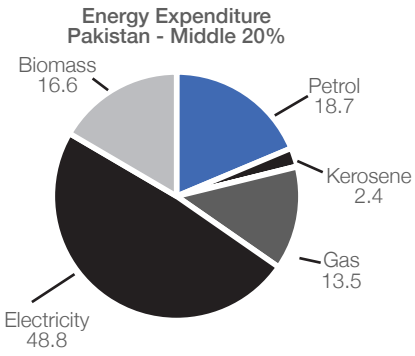
[72] Care is needed in interpreting the results of estimated "demand" functions. For much of the sample period, consumption data represented energy demand. However, during the last few years, supply constraints have become increasingly binding. The government policy favoured household consumption, yet loadshedding indicates that there was significant unmet demand for electricity and gas. This implies that consumption data may not be reflecting actual demand, which could distort estimation results. In addition, the negative (and almost statistically significant) coefficient of oil price in gas demand is a counter-intuitive result of the estimation process as gas and kerosene oil are not "complimentary goods" in any sense. Part of the reason could be the data problem highlighted earlier. That is, the estimated demand functions (especially for gas and electricity) may not reflect the actual demand. The negative coefficient of kerosene price may be reflecting the end-sample situation where consumption of gas stagnated while price of kerosene oil continued to increase at a significant rate.

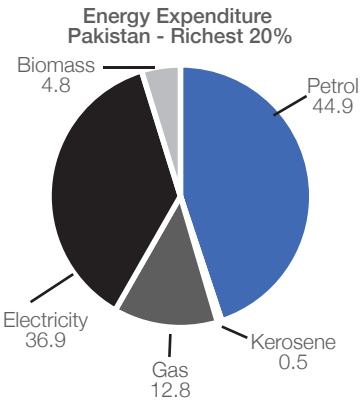
[73] The surveys covered 2001-02, 2007-08, 2010-11 and 2011-12. These years are referred to as FY02, FY08, FY11, and FY12 in this report.

Expenditures on Energy – National

Shares of energy expenditures for the top, middle and bottom quintiles are shown below:







A review of variations in expenditures for energy reveals a few key insights:

The increase in energy spending was largely for electricity. In FY02 average household expenditure on electricity ranged from less than Rs 100 to Rs 424 (i.e. between 5.8 and 10.9% of total spending on energy) for the 5 quintiles. By FY08 this had risen to between Rs 3,175 and Rs 11,176 (37 to 52% of the total outlay on energy). Changes in the share of electricity expenditures in the subsequent surveys were not significant – e.g. in FY12 electricity accounted for between 38 and 56% of expenditure on energy. Urban and rural areas depicted the same pattern. Electricity spending rose very sharply between FY02 and FY08. In FY02 electricity spending ranged from 5 to 9% of energy expenditures in urban areas, and 7.6 to 14.2% in rural areas. By FY08 the share of electricity had risen to between 35 and 55%, across both urban and rural areas. In addition, subsequent surveys did not depict a major change in the share of electricity in total energy spending.

Rapid growth in expenditures on electricity was accompanied by slower growth in expenditures on (and as a result, a decline in the shares of) kerosene and biomass. The share of kerosene in energy expenditures was between 3 and 20% of household spending in FY02; by 2012 this had fallen to between 0.2 and 1.4% of total energy spending. Similarly, biomass accounted for 11 to 41% of total outlays on energy in FY02; by FY12, its share had fallen to between 4 and 14% of energy expenditures.

The continued decline in the use of biomass and kerosene – and their replacement by electricity and gas – demonstrates a (natural) transition up the energy ladder, involving substitution of "dirty fuels" by cleaner alternatives. This decline may also be due to the high pace of rural electrification in the last two decades. Until the late 1990s, the Japanese Government and World Bank financed rural electrification programsme, to connect 2,500 to 3,000 villages and settlements to the grid each year. After those projects closed, the government continued these efforts through its own resources (under the Public Sector Development Programme – PSDP); the programmes was also accelerated, and connected around 7,500 villages in a few years. More recently, as most villages and settlements that can be served by the utilities have already been connected, the focus of the PSDP is on providing electricity to remote villages and settlements through renewable sources and through the Alternate Energy Development Board – AEDB.

There were (and continue to be) differences in the shares of these fuels in total energy use, particularly biomass, between urban and rural areas. As expected, the share of biomass in total spending remains higher in rural areas (19 to 48% of household energy spending in FY02, and 10 to 18% in FY12) than in urban areas. By contrast, in FY02 the share of kerosene was significantly higher for rural consumers (it accounted for 6.6 to 29% of their expenditures) than for urban consumers (it ranged from 1.7 to 7.2% of their spending on energy); by FY12, this gap had narrowed (it ranged from 0.6 to 2% of household energy spending in rural areas, and 0.1 to 0.2% in urban areas).

One can conclude that kerosene and biomass are gradually being eliminated as energy sources by households across the country.

Natural gas remains a major source of energy for households. Its share in household energy spending is higher in urban areas, but it is increasingly used in rural areas. As per the surveys, in FY02 for the country as a whole natural gas accounted for 18.6 to 29.4% of household energy spending; by FY12 the share fell to between 12.2 and 14.2%. The decline was (more or less) gradual across the four surveys, although the sharpest drop was between FY02 and FY08.

In urban areas gas accounted for 30 to 46% of energy use in FY02; the corresponding range in rural areas was 4.3 to 8.1%. By FY12, urban households were allocating 12 to 18.7% of their energy expenditure to natural gas, while for rural households the share ranged from 8.2 to 12%.

The trend – increasing use of gas in rural households, with its share falling steadily in urban areas – requires some analysis. The continued increase in gas use in rural areas is due to the energy transition mentioned above: access to the utilities' networks will inevitably lead to higher gas consumption at the expense of biomass and kerosene; and since all major urban areas have already been connected, most of the recent expansions of the networks have been for villages and settlements that are close to large urban areas.

Provinces – Deconstructing Energy Spending

The share of electricity in households' total spending on energy rose sharply between FY02 and FY08 across all provinces. In Punjab, electricity expenditures were 6 to 11% of household spending on energy during FY02; by FY08, this share had risen to 50 to 60% for Q1 to Q4, and for Q5 electricity accounted for nearly 40% of total energy spending. In the case of Sindh, the share of electricity showed a similar jump – by FY08 electricity accounted for between 37 and 59% of energy spending by various quintiles, and this share remained largely unchanged during FY11 and FY12. In KP also, the share of expenditure on electricity in total energy spending rose from 17 to 22% for various quintiles during FY02, to between 39 and 53% in FY08; during FY11 and FY12, the share of electricity remained high (between 38 and 56% of total energy expenditures). For Balochistan, the share of electricity in energy spending remained lower than in other provinces for all survey years. It was 3 to 6% for various quintiles in FY02, between 22 and 26% in FY08, and 20 to 35% in FY11 and FY12. These shares are well below the national (or other provinces') averages. In Balochistan, the percentage of population with access to electricity is lower than in other provinces or across the country. The survey data (which only yield average expenditures – in this case on electricity) therefore show a distorted picture. The proportion of population without access to electricity – and therefore showing zero expenditure for electricity – pulls down the provincial average in Balochistan.

The increased share of electricity is offset by reductions in kerosene and biomass. However, the share of natural gas in the household energy mix also declined.

1. In Punjab, during FY02 expenditure on kerosene amounted to more than 10% of total energy spending, especially for the bottom quintiles, and for biomass it was 20 to 40% of household energy spending for the same quintiles. By FY08 the shares of kerosene and biomass had fallen to around 1.3% and 9-14% respectively. This reduction (totalling more than 25%) offset more than half the increase in the share of electricity; the balance is largely due to a lower share of natural gas in the households' energy mix, from 24 to 35% for various quintiles in FY02 to between 14 and 17% by FY08. Interestingly, petrol (used almost entirely for transport) remains a major component of household energy budgets – it was 57% of household energy expenditure (for the top quintile) in FY02; this share declined to around 48% by FY12.

2. (Note anomaly in Sindh electricity spending – listed above.) In Sindh, the enhanced share of electricity in household budgets (by 30 to 45%) between FY02 and FY08 was offset by reductions in the share of kerosene (3 to 4% lower share), biomass (reduction of 7 to 27% between various quintiles) and natural gas (reduction of 10 to 18%) in household energy spending. The share of petrol in household energy budgets was marginally higher than in Punjab – by FY12 it accounted for almost 52% of energy spending by the highest quintile.

[74] The top quintile (Q5) shows a much lower share of biomass use – in urban areas less than 5% of this quintile's expenditure on energy was for biomass in FY02, and in rural areas the share was 12%. By FY12 these shares had fallen to less than 0.5 and 4.3% in urban and rural areas respectively.

3. KP's energy spending has a larger share of biomass than Punjab and Sindh – even by FY12 it accounted for 15 to 22% of household energy expenditures for Q1 to Q4 (for Q5 the share was 6.5% in FY12). This result is to be expected, since KPhas the highest density of forests in the country – which ensures a better availability of fuelwood than in other provinces. Increased spending on electricity in KP was, however, offset by the same three fuels – kerosene from 12 to 15% in FY02 to around 2% in FY08, biomass from 25 to 40% (for Q1 to Q4) to well below 30%, and natural gas (by about 5% for the top quintiles – Q3 to Q5). Natural gas expenditure in KPK does, however, depict a trend not seen in other provinces – the share of expenditure on gas has risen for the lowest quintile across the four surveys.

4. In Balochistan also, the increased share of electricity was offset by reductions in the shares of kerosene (from 17 to 25% of energy spending in FY02 to below 3% by FY08) and biomass (from 43 to 48% in FY02 to 22 to 25% by FY08). However, spending on natural gas did not follow the trend observed in other provinces. In Balochistan spending on gas rose from 3 to 10% of household energy expenditure in FY02 to between 12 and 17% by FY08, and remained almost the same in later years. One explanation for this result (proportionately larger extensions of the gas network in Balochistan in recent years, implying continued growth in gas use in the province) has been discussed above.

Analysis of energy spending across rural and urban areas in various provinces depicts sharper differences in the energy mix. The most obvious (but not the only difference) is the share of natural gas in household energy spending. The key differences between energy spending across rural and urban areas in the provinces are discussed below.

1. In urban areas of Punjab the share of gas was between 35 and 52% of household energy expenditures during FY02, while in rural areas it was 4 to 8%. Similarly, the share of biomass was 11 to 23% in urban Punjab, but 44 to 53% in rural areas.[74] Spending on petrol also varied across urban and rural areas; it was the second largest component of household energy expenditures. While the share of petrol was higher in urban areas, it still accounted for 14 to 47% of rural household energy spending.

2. In Sindh, the share of gas in urban households' budgets declined throughout the four surveys – from 27 to 57% of energy expenditures in FY02 to 10 to 20% by FY12. The corresponding shares for rural areas were 5 to 13% in FY02, 2.6 to 4.5% in FY08, 1.7 to 4.4% in FY11, and 4.2 to 5.1% in FY12. Biomass spending also declined across urban and rural areas, but the average for all quintiles remains almost twice as high in rural areas (10 to 12% for Q2 to Q4 during FY12) than in urban areas (3 to 8.8%). Expenditure on petrol was the largest single item of household energy expenditures across urban and rural Sindh for almost all the years – in FY12 it accounted for more than 60% of energy spending for the top quintile (Q5) in rural areas.

3. In KP urban consumers spent 19 to 22% of their energy budget on gas during FY02, while in rural areas this percentage was 11 to 17%. By FY12, urban households in the province were again spending between 18 and 22% of their energy budgets on gas, while for rural consumers this share was between 11 and 15%. Expenditures on biomass in KPK declined across urban and rural areas but the fall was more pronounced in the former – in FY20 it accounted for 23 to 44% of energy spending in urban areas, and this share fell to 8 to 16% in FY12.[75] Similarly, kerosene accounted for 3 to 8% of energy expenditure in urban KPK in FY02, and 12 to 25% in rural areas; by FY12 the shares had fallen to almost zero in urban areas and 0.2 to 1.1% in rural areas.[76]

4. In Balochistan, in FY02 urban consumers spent between 20 and 28% of their energy budgets on gas; in rural areas the share was 1.8 to 6% for various quintiles. By FY12 these shares had moderately risen – to 25 to 35% in urban areas and 6.4 to 11% in rural areas. The increasing share of electricity is again offset by reductions of 8 to 10% in the share of kerosene (up to 20% in rural areas) and biomass. In FY02 biomass accounted for 50 to 60% of energy spending for Q2 to Q4 in urban Balochistan and 40 to 50% for the same quintiles in rural areas of the province; by FY12 the share of biomass was below 20% in urban areas and 32 to 36% in rural areas.[77]

[75] The top quintile (Q5) again represents the exception. The share of biomass in total energy spending was well below that of other quintiles.
[76] See footnotes above for Q5 spending in Punjab and Sindh. Essentially the same situation prevails in KPK.
[77] See footnotes above for Q5 spending in Punjab and Sindh. The same situation also prevails in Balochistan.

Key Conclusions and Recommendations

The key conclusion from this review of HIES survey results is that the **expenditures that households have to incur for meeting their energy requirements (particularly the share of energy in total spending) are very high.** A share of energy in total household expenditures in excess of 8.5 to 9% is generally considered high. Energy accounts for more than 10% of household expenditures – at least since 2008 – of most quintiles and across all provinces.

The high level of spending for energy is (or can be) indicative that:

a) Energy markets are not functioning properly
b) Energy price adjustments in recent years are starting to become unaffordable, or
c) The observed sharp growth in energy use (particularly electricity) is diverting resources from other household priorities.

The answer on the first point is obvious – severe shortages of electricity and gas clearly show that markets are not functioning properly. Overcoming the shortages is therefore a high priority for Pakistan. There is also a consensus on the second point – all stakeholders argue that energy (particularly electricity) prices are high. The main reason (as per those analyses and reports) for high electricity prices is the large share of thermal generation – particularly through liquid fuels – in total supply. Overcoming these constraints requires actions by the government and policymakers, the utilities, and investors. Some ideas are listed below.

Overcoming the shortages and reducing energy/electricity costs requires sustained actions.

- **In the short term,** perhaps the only avenue to increase supply and decrease costs is to reduce losses of gas and electricity. Programmes to reduce those losses therefore need to be prepared and implemented urgently. Such programmes can include smart metering and other investments, but these must run in parallel with strong administrative and judicial efforts to penalize theft.

- **The medium term** requires that future capacity additions be based solely or largely on low cost fuels. This approach – i.e. focus on hydroelectric and coal-based generation – is already incorporated in the July 2013 Policy. The public relations campaign should therefore aim to build support for the government's efforts under that Policy, and also to promote private investment along the same lines.

- **In the long term,** enhancing competition should be a high priority. This approach has worked well across the globe, and there is no reason to claim that it cannot work in Pakistan. The only word of caution is that the government should prepare adequately for this transition, and make its intentions clear to all stakeholders (particularly investors) well in advance.

Table I: Gas Statistics – Natural Gas Consumption by sector

Gas Statistics												
Natural Gas Consumption (by sector)										Units: Million Cubic Feet and Tons of Oil Equivalent (TOE)		
	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14
Domestic	153,508	155,174	172,103	171,109	185,533	204,035	214,113	219,382	232,244	261,915	291,917	269,135
TOE	3,592,094	3,631,072	4,027,210	4,003,955	4,341,475	4,774,412	5,010,247	5,133,540	5,434,507	6,128,822	6,830,868	6,297,770
Commercial	22,776	24,192	27,191	29,269	31,375	33,905	35,536	36,955	36,466	39,627	40,689	38,117
TOE	532,964	566,093	636,268	684,886	734,180	793,367	831,547	864,747	853,313	927,272	952,115	891,927
Industry	152,068	178,942	211,766	263,348	290,214	305,662	305,042	320,476	279,717	286,055	274,450	250,490
TOE	3,558,395	4,187,245	4,955,321	6,162,353	6,791,013	7,152,491	7,137,980	7,499,138	6,545,378	6,693,679	6,422,139	5,861,460
Steel Mill	12,900	14,453	14,350	15,498	16,386	16,901	13,961	13,032	11,951	10,125	9,827	8,542
TOE	301,860	338,200	335,790	362,653	383,432	395,483	326,687	304,949	279,653	236,925	229,952	199,883
Cement	3,445	7,711	13,383	15,335	14,686	12,736	7,305	1,944	1,378	1,266	586	522
TOE	80,619	180,437	313,164	358,834	343,646	298,025	170,927	45,490	32,240	29,629	13,720	12,215
Fertiliser - Feedstock	140,975	145,128	149,869	155,258	153,458	160,062	162,028	175,631	175,912	168,694	148,782	164,378
TOE	2,745,637	2,842,095	2,938,731	3,033,832	2,989,825	3,145,626	3,186,253	3,421,523	3,350,683	3,157,367	2,754,794	3,024,845
Fertiliser - Fuel	39,636	40,222	40,540	42,917	40,224	40,001	39,072	44,493	52,548	43,134	39,237	52,139
TOE	779,054	793,123	797,852	842,662	786,437	782,979	765,787	860,424	990,662	817,280	727,491	963,123
Power	335,636	469,738	503,983	490,142	432,607	429,892	404,140	366,906	337,401	358,381	362,262	349,535
TOE	6,439,339	9,462,986	10,305,897	9,978,369	8,640,208	8,491,536	7,830,065	7,106,962	6,493,766	6,732,876	7,084,177	6,602,422
CNG	11,320	15,858	24,443	38,885	56,446	72,018	88,236	99,002	113,055	119,000	100,228	87,634
TOE	264,885	371,075	571,961	909,908	1,320,841	1,685,232	2,064,722	2,316,646	2,645,493	2,784,591	2,345,331	2,050,646
Total:	**872,265**	**1,051,418**	**1,157,628**	**1,221,762**	**1,220,929**	**1,275,212**	**1,269,433**	**1,277,821**	**1,240,671**	**1,288,198**	**1,267,980**	**1,220,493**
TOE	**18,294,846**	**22,372,325**	**24,882,193**	**26,337,452**	**26,331,057**	**27,519,152**	**27,324,216**	**27,553,419**	**26,625,696**	**27,508,442**	**27,360,587**	**25,904,290**

Source: Energy Yearbook, Hydrocarbon Development Institute of Pakistan, Ministry of Petroleum and Natural Resources (Various Issues)

Table II: Gas Statistics – Consumer Gas Prices

Consumer Gas Prices (selected categories only)						Rupees per million BTU	
Date/Category	01/07/2004	01/01/2005	02/02/2005	01/07/2005	01/01/2006	01/07/2006	01/02/2007
DOMESTIC (Slab)							
I Upto 1.77 m.cu.ft./month				80.96	85.03	78.38	
II Upto 1.77 to 3.55 m.cu.ft./month	73.95	73.95	73.95	73.95	80.98	89.03	82.07
IV Upto 7.1 to 10.64 m.cu.ft./month	178.25	178.25	192.96	204.17	235.84	259.29	239.01
V Upto 10.64 to 14.20 m.cu.ft./month	231.88	231.88	251.01	265.59	306.79	337.3	310.92
COMMERCIAL	204.88	204.88	221.78	234.67	271.07	298.03	268.23
General Industry	182.09	182.09	197.11	208.56	240.91	264.87	238.38
Cement	209.78	209.78	227.09	240.28	277.55	305.15	305.15
CNG Station	182.09	182.09	197.11	208.56	240.91	264.87	238.38
Captive Power		197.11	208.56	240.91	264.87	238.38	
FERTILISER SNGPL SYSTEM							
(i) For Feed Stock							
Pak-American Fertilizer Ltd. (PAFL)	36.77	36.77	36.77	36.77	36.77	36.77	36.77
F.F.C Jordan	36.77	36.77	36.77	36.77	36.77	36.77	36.77
Dawood Hercules/Pak Arab	73.99	73.99	73.99	83.24	83.24	91.52	91.52
Pak China/Hazara	78.52	78.52	78.52	88.34	88.34	97.11	97.11
(ii) For Fuel Generation	182.09	182.09	197.11	208.56	240.91	264.87	238.38
POWER STATIONS - SNGPL & SSGCL'S SYSTEM	182.09	182.09	197.11	208.56	240.91	264.87	238.38
Liberty Power Ltd.	234.33	262.03	262.03	303.25	413.46	467.52	445.98

Source: Authors' computations from Gas Tariff Schedules (for various years) issued by OGRA and SNGPL and SSGC data

Table II (continued): Consumer Gas Prices (selected categories only)

Consumer Gas Prices (selected categories only)						Rupees per million BTU	
Date/Category	01/01/2008	30/06/2008	01/01/2009	01/07/2009	01/01/2010	01/07/2010	07/08/2011
DOMESTIC (Slab)							
Upto 1.77 m.cu.ft./month	78.38	78.38	82.3	80.65	95.01	95	107.87
1.77 to 3.55 m.cu.ft./month	82.07	82.07	86.17	84.45	99.48	95	107.87
3.55 to 7.1 m.cu.ft./month	149.4	149.4	156.87	153.73	181.1	190	215.74
7.1 to 10.64 m.cu.ft./month	239.01	313.1	332.12	325.48	383.42	190	215.74
COMMERCIAL	283.05	370.8	393.33	393.33	463.76	463.76	526.59
General Industry	251.55	329.54	339.43	324.3	382.37	382.37	434.18
Cement	335.67	428.89	454.95	454.95	536.42	536.42	609.1
CNG Station	291.36	388.32	427.15	427.15	503.64	503.64	517.88
Captive Power	251.55	422.6	339.43	324.3	382.37	382.37	434.18
Independent Power Projects			295.03	281.88	332.36	332.36	377.39
FERTILISER - SNGPL system							
(i) For Feed Stock							
Pak-American Fertilizer Ltd. (PAFL)	36.77	36.77	36.77	36.77	102.01	102.01	102.01
F.F.C Jordan	36.77	36.77	36.77	36.77	102.01	102.01	102.01
Dawood Hercules/Pak Arab	91.52	91.52	96.14	102.01	102.01	102.01	102.01
Pak China/Hazara	251.55	329.54	102.01	102.01	102.01	102.01	102.01
(ii) For Fuel Generation	251.55	329.54	339.43	324.3	382.37	382.37	434.18
POWER STATIONS - SNGPL & SSGCL'S SYSTEM	251.55	329.54	349.56	324.3	393.79	393.79	447.14
Liberty Power Ltd.	443.06	443.06	1060.39	526.84	882.39	980.61	1,260.34

Table II (continued): Consumer Gas Prices (selected categories only)

Consumer Gas Prices (selected categories only)						Rupees per million BTU	
Date/Category	01/01/2012	01/07/2012	01/01/2013	23/08/2013	01/01/2014	16/01/2014	01/07/2014
DOMESTIC (Slab)							
Upto 1.77 m.cu.ft./month	100	100	100	100	100	100	
1.77 to 3.55 m.cu.ft./month	122.95	n. a.	106.14	106.14	106.14	106.14	106.14
3.55 to 7.1 m.cu.ft./month	n. a.	n. a.	n. a.	n. a.	n. a.	n. a.	n. a.
7.1 to 10.64 m.cu.ft./month	245.89	200	212.28	212.28	212.28	212.28	212.28
10.64 to 14.20 m.cu.ft./month	1,035.34	500	530.00	530.69	530.69	530.69	530.69
COMMERCIAL	600.19	600	636.83	636.83	636.83	636.83	636.83
General Industry	600.19	460	488.23	573.28	573.28	573.28	573.28
Cement	694.22	700	742.97	742.97	742.97	742.97	742.97
CNG Station	651.8	618.55	656.32	656.32	656.32	656.32	656.32
Captive Power	494.86	460	488.23	488.23	488.23	488.23	488.23
Independent Power Projects	437.86	460	488.23	488.23	488.23	488.23	488.23
FERTILISER - SNGPL system							
(i) For Feed Stock							
Pak-American Fertilizer Ltd.(PAFL)	116.27	116.27	123.41	123.41	123.41	123.41	123.41
F.F.C Jordan							
Dawood Hercules/Pak Arab	116.27	116.27	123.41	123.41	123.41	123.41	123.41
Pak China/Hazara	116.27	116.27	123.41	123.41	123.41	123.41	123.41
(ii) For Fuel Generation	494.86	460	488.23	488.23	488.23	488.23	488.23
POWER STATIONS - SNGPL & SSGCL'S SYSTEM	480.86	460	488.23	488.23	488.23	488.23	488.23
Liberty Power Ltd.	1,450.85	1617	1,505.20	1,511.68	1,600.61	1,396.24	1,305.48

B. Technical Appendix – Estimating the Impact of Energy on Output

For a better quantification of this impact we used a simple econometric model. Our model estimates an energy elasticity of GDP at 0.27. In other words, a 10 per cent growth in energy availability[78] (consumption) will boost GDP growth by 2.7 per cent, ceteris paribus. This can be used to compute elasticities of each source of energy:

Liquid energy = 0.111
Natural gas = 0.130
Electricity = 0.026
Coal = 0.00002

To estimate the impact of energy on national GDP, a simple econometric model was specified and estimated. The fundamental equation of the model is the output relationship, which is specified as the following log-linear output equation:

$\text{Log(GDP)} = \beta_0 + \beta_1 * \text{log(EMP)} + \beta_2 * \text{log(INV)} + \beta_3 * \text{log(ENG)} + \beta_4 * \text{log(GDP(-1))}$ ------- Output Equation

Where: GDP = Real (in constant factor cost of 2005-06) national GDP
EMP = Employment (in million) in the economy
INV = Total real investment (a proxy for capital stock) in the economy
ENG = Total energy consumption (in tons of oil equivalent)
X(-1) = Lagged value of X, where X could be any variable of interest

However, the above equation should not be estimated as a stand-alone relationship, as (derived) demand for labour (EMP), investment and energy depend on real GDP. Hence, we also specified the demand equation as log-linear equations.

$\text{Log(EMP)} = \gamma_0 + \gamma_1 \text{ log(GDP)} + \gamma_2 \text{ log(EMP(-1))}$ ---------- Labour Demand Equation

$\text{Log(INV)} = \delta_0 + \delta_1 \text{ log(GDP)} + \delta_2 \text{ log(EMP(-1))}$ ---------- Investment Demand Equation

$\text{Log(ENG)} = \mu_0 + \mu_1 \text{ log(GDP)} + \mu_2 \text{ log(EMP(-1))} + \mu_3 \text{ log(PENG/PGDP)}$ --Energy Demand Equation

Where: PENG/PGDP = the relative price of energy (wholesale price index) to GDP deflator.

The above system of equations is estimated using the Three Stage Least Squares estimation technique. The results are given below:

Output Equation

Log(GDP) = -1.01649 + 0.1309*Log(EMP) + 0.1148*Log(INV) + 0.2665*Log(ENG) + 0.9049*Log(GDP(-1))
(-3.860) (2.7496) (2.5227) (3.5347) (19.966)

Adjusted R-Squared = 0.997181
Durbin-Watson Stat = 1.859133

Labour Demand Equation

Log(EMP) = -2.95072 + 0.4295*Log(GDP) + 0.0607*Log(EMP(-1)
(-9.3100) (15.554) (1.5746)

Adjusted R-Squared = 0.703363
Durbin-Watson Stat = 1.928113

[78] While the term "consumption" is also used here, it should be noted that the equation computes elasticity of GDP to energy availability – the latter represents energy supplied, not energy consumed or used.

Investment Demand Equation

Log(INV) = 1.2448 + 0.1010*Log(GDP) + 0.8011*Log(INV(-1)
(6.6433) (3.7079) (25.429)

Adjusted R-Squared = 0.970939
Durbin-Watson Stat = 1.769105

Energy Demand Equation

Log(ENG) = 1.3999 + 0.1623*Log(GDP) + 0.7774*Log(ENG(-1) - 0171*LOG(PENG/PGDP)
(6.7986) (3.4742) (14.976) (-0.371)

Adjusted R-squared = 0.995862
Durbin-Watson stat = 1.747009

Terms in parentheses are the t-Statistics.

To deconstruct the marginal effect of each source (liquid, gas, electricity and other) source of energy, we need to remember that:

$ENG = \alpha_l*LIQ + \alpha_g*GAS + \alpha_e*ELE + \alpha_o*COA$

Where: LIQ = Consumption of liquid energy (in tons)
GAS = Consumption of natural gas (in mm cft)
ELE = Consumption of electricity (in Gwh)
COA = Consumption of coal (in tons)

α_x is the conversion factor that coverts one unit of energy source X into TOEs (where X is LIQ, GAS, ELE or COA).

Therefore, GDP elasticity of source X, $\varepsilon_x = \beta_3$*average share of X in ENG.

Hence:

GDP elasticity of liquid energy = 0.2665*0.416 = 0.111

GDP elasticity of natural gas = 0.2665*0.486 = 0.130

GDP elasticity of electricity = 0.2665*0.098 = 0.026

GDP elasticity of coal = 0.2665*0.0061 = 0.026 = 0.00002

Household Demand for Energy:

To estimate the demand for different sources of energy, the study used data from Household Integrated Economic Surveys (HIESs). As one of the objectives of estimating demand relationships is to determine the effect of prices on household energy choices, data from different surveys were pooled to get a “panel” database. Price information was then added to the survey. These prices do not vary across households but only across years.

The following demand functions were specified:

Demand for Biomass Energy:

$\log(rexbio) = \phi_0+\phi_1*\log(rinc)+\phi_2*\log(size)+\phi_3*\log(pbiom)+\phi_4*\log(pelec)+\phi_5*\log(pgas)+ \phi_6*\log(pkoil) +\phi_7*urban$

Demand for Electricity:

$\log(rexele) = \eta_0+ \eta_1*\log(rinc)+ \eta_2*\log(size)+ \eta_3*\log(pbiom)+ \eta_4*\log(pelec)+ \eta_5*\log(pgas)+ \eta_6*\log(pkoil) + \eta_7*urban$

Demand for Gas:

$\log(rexgas) = \tau_0+\tau_1*\log(rinc)+\tau_2*\log(size)+\tau_3*\log(pbiom)+\tau_4*\log(pelec)+ \tau_5*\log(pgas)+ \tau_6*\log(pkoil) + \tau_7*urban$

Demand for Kerosene Oil:

$\log(rexoil) =\lambda_0+ \lambda_1*\log(rinc)+\lambda_2*\log(size)+\lambda_3*\log(pbiom)+\lambda_4*\log(pelec)+ \lambda\mu_5*\log(pgas)+\lambda_6*\log(pkoil) + \lambda_7*urban$

Where:

Rexbio = real household expenditure on biomass energy.
Rexele = real household expenditure on electricity.
Rexgas = real household expenditure on gas (piped and/or cylinder).
Rexoil = real household expenditure on kerosene oil.
Rinc = real household income.
Pbiom = consumer price of biomass energy (price of firewood was used as proxy).
Pele = consumer electricity price.
Pgas = consumer price of gas.
Pkoil = consumer price of kerosene oil.
Size = household size.
Urban = dummy variable; 1 if household lives in urban area, 0 otherwise.

The coefficients represent income, own-price, cross-price and scale elasticities.

C. Summary Tabulations from HIES

Pakistan - Energy Expenditures FY02 (values and % shares)										
	FY02 - Expenditure by Quintile					FY02 - Expenditure Shares (%)				
	Q1	Q2	Q3	Q4	Q5	Q1	Q2	Q3	Q4	Q5
Petrol	606	128	239	710	4,152	31.87	10.96	12.92	25.40	56.56
Kerosene	205	234	334	286	223	10.78	19.93	18.03	10.23	3.03
Coal	0	2	3	8	5	0.01	0.15	0.16	0.27	0.06
Gas	353	237	455	821	1,733	18.55	20.26	24.60	29.40	23.61
Electricity	207	91	156	225	424	10.87	7.73	8.42	8.07	5.78
Biomass	531	480	663	744	804	27.93	40.97	35.86	26.63	10.95
Total	1,901	1,172	1,849	2,793	7,341	100	100	100	100	100

Pakistan - Energy Expenditures FY08 (values and % shares)										
	FY02 - Expenditure by Quintile					FY02 - Expenditure Shares (%)				
	Q1	Q2	Q3	Q4	Q5	Q1	Q2	Q3	Q4	Q5
Petrol	1,720	667	1,473	3,007	13,401	21.29	10.94	16.95	23.58	44.22
Kerosene	175	212	188	150	112	2.16	3.48	2.16	1.17	0.37
Coal	0	0	4	0	7	0.00	0.00	0.05	0.00	0.02
Gas	1,153	698	1,170	2,045	4,167	11.45	11.45	13.46	16.03	13.75
Electricity	3,912	3,175	4,210	5,731	11,176	52.08	52.08	48.43	44.93	36.88
Biomass	1,121	1,344	1,648	1,822	1,440	22.05	22.05	18.96	14.28	4.75
Total	8,081	6,096	8,693	12,755	30,303	100.00	100.00	100.00	100.00	100.00

Pakistan - Energy Expenditures FY11 (values and % shares)										
	FY02 - Expenditure by Quintile					FY02 - Expenditure Shares (%)				
	Q1	Q2	Q3	Q4	Q5	Q1	Q2	Q3	Q4	Q5
Petrol	2,049	1,373	2,442	5,767	18,334	18.35	14.17	18.54	28.70	41.53
Kerosene	192	282	298	325	249	1.72	2.91	2.26	1.62	0.56
Coal	0	2	0	1	6	0.00	0.02	0.00	0.01	0.01
Gas	1,290	999	1,625	2,650	5,193	11.56	10.31	12.33	13.19	11.76
Electricity	6,056	5,222	6,623	8,928	17,978	54.25	53.89	50.27	44.44	40.72
Biomass	1,577	1,812	2,186	2,420	2,391	14.13	18.70	16.59	12.04	5.42
Total	11,164	9,690	13,174	20,092	44,151	100.00	100.00	100.00	100.00	100.00

Pakistan - Energy Expenditures FY12 (values and % shares)										
	FY02 - Expenditure by Quintile					FY02 - Expenditure Shares (%)				
	Q1	Q2	Q3	Q4	Q5	Q1	Q2	Q3	Q4	Q5
Petrol	3,734	1,871	3,302	6,896	27,379	22.93	16.64	20.38	27.78	46.30
Kerosene	120	156	150	128	139	0.74	1.39	0.92	0.52	0.23
Coal	1	12	24	17	38	0.01	0.11	0.15	0.07	0.06
Gas	2,232	1,368	2,130	3,527	6,988	13.70	12.17	13.15	14.21	11.82
Electricity	8,291	6,274	8,481	11,791	22,478	50.90	55.80	52.35	47.50	38.01
Biomass	1,909	1,563	2,113	2,467	2,109	11.72	13.90	13.04	9.94	3.57
Total	16,288	11,244	16,200	24,826	59,131	100.00	100.00	100.00	100.00	100.00

Pakistan Urban - Energy Expenditures FY02 (values and % shares)										
	FY02 - Expenditure by Quintile					FY02 - Expenditure Shares (%)				
	Q1	Q2	Q3	Q4	Q5	Q1	Q2	Q3	Q4	Q5
Petrol	1,860	282	287	787	4,516	42.24	13.29	11.16	22.71	55.16
Kerosene	147	155	196	185	135	3.33	7.29	7.63	5.32	1.65
Coal	0	0	0	7	4	0.00	0.00	0.00	0.19	0.05
Gas	1,470	886	1,119	1,591	2,491	33.38	41.83	43.53	45.90	30.42
Electricity	311	139	240	266	407	7.07	6.56	9.32	7.68	4.97
Biomass	616	657	729	630	635	13.98	31.03	28.36	18.19	7.75
Total	4,404	2,118	2,571	3,466	8,188	100.00	100.00	100.00	100.00	100.00

Pakistan Urban - Energy Expenditures FY08 (values and % shares)										
	FY02 - Expenditure by Quintile					FY02 - Expenditure Shares (%)				
	Q1	Q2	Q3	Q4	Q5	Q1	Q2	Q3	Q4	Q5
Petrol	3,982	937	1,130	3,283	16,637	25.82	10.36	11.08	22.12	45.53
Kerosene	16	24	17	12	10	0.10	0.26	0.16	0.08	0.03
Coal	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00
Gas	2,583	1,884	2,267	3,034	4,656	16.75	20.82	22.23	20.44	12.74
Electricity	8,201	4,881	5,790	7,437	14,816	53.17	53.94	56.78	50.10	40.55
Biomass	641	1,323	993	1,079	420	4.16	14.62	9.74	7.27	1.15
Total	15,423	9,049	10,197	14,845	36,539	100.00	100.00	100.00	100.00	100.00

Pakistan Urban - Energy Expenditures FY11 (values and % shares)										
	FY02 - Expenditure by Quintile					FY02 - Expenditure Shares (%)				
	Q1	Q2	Q3	Q4	Q5	Q1	Q2	Q3	Q4	Q5
Petrol	3,999	1,966	2,495	6,144	21,367	22.10	14.71	16.30	27.62	41.80
Kerosene	42	77	63	73	59	0.23	0.58	0.41	0.33	0.12
Coal	0	8	0	0	3	0.00	0.06	0.00	0.00	0.00
Gas	2,919	2,261	2,850	3,863	6,572	16.13	16.92	18.62	17.37	12.86
Electricity	9,886	7,288	8,357	10,964	22,105	54.64	54.54	54.61	49.29	43.25
Biomass	1,248	1,761	1,537	1,200	1,007	6.90	13.18	10.04	5.39	1.97
Total	18,094	13,362	15,302	22,244	51,113	100.00	100.00	100.00	100.00	100.00

Pakistan Urban - Energy Expenditures FY12 (values and % shares)										
	FY02 - Expenditure by Quintile					FY02 - Expenditure Shares (%)				
	Q1	Q2	Q3	Q4	Q5	Q1	Q2	Q3	Q4	Q5
Petrol	8,084	2,017	2,751	6,929	30,456	28.56	13.74	14.94	25.47	45.77
Kerosene	27	30	41	46	51	0.10	0.20	0.22	0.17	0.08
Coal	4	11	20	18	14	0.01	0.07	0.11	0.06	0.02
Gas	4,444	2,749	3,385	4,807	8,268	15.70	18.73	18.38	17.67	12.43
Electricity	14,435	8,450	10,506	13,853	26,760	51.00	57.58	57.06	50.92	40.22
Biomass	1,312	1,419	1,709	1,551	992	4.63	9.67	9.28	5.70	1.49
Total	28,307	14,676	18,412	27,203	66,541	100.00	100.00	100.00	100.00	100.00

Pakistan Rural - Energy Expenditures FY02 (values and % shares)										
	Expenditure by Quintile					Expenditure Shares (%)				
	Q1	Q2	Q3	Q4	Q5	Q1	Q2	Q3	Q4	Q5
Petrol	269	82	215	642	3,484	21.91	9.28	14.45	29.12	60.24
Kerosene	221	257	403	375	383	17.94	29.03	27.10	17.00	6.62
Coal	0	2	4	8	6	0.01	0.26	0.29	0.38	0.10
Gas	53	42	121	147	340	4.27	4.72	8.12	6.67	5.88
Electricity	179	76	114	189	457	14.52	8.57	7.64	8.59	7.90
Biomass	508	427	630	843	1,114	41.34	48.14	42.39	38.25	19.26
Total	1,229	887	1,486	2,204	5,784	100.00	100.00	100.00	100.00	100.00

Pakistan Rural - Energy Expenditures FY08 (values and % shares)										
	Expenditure by Quintile					Expenditure Shares (%)				
	Q1	Q2	Q3	Q4	Q5	Q1	Q2	Q3	Q4	Q5
Petrol	1,163	595	1,652	2,981	10,196	18.66	11.39	21.11	26.37	42.93
Kerosene	216	256	259	244	243	3.47	4.90	3.31	2.16	1.02
Coal	0	0	6	1	0	0.00	0.00	0.08	0.01	0.00
Gas	697	351	580	1,130	2,873	11.17	6.73	7.41	10.00	12.10
Electricity	2,971	2,706	3,606	4,663	7,935	47.66	51.84	46.09	41.25	33.41
Biomass	1,187	1,312	1,721	2,285	2,503	19.04	25.14	22.00	20.21	10.54
Total	6,234	5,220	7,824	11,304	23,750	100.00	100.00	100.00	100.00	100.00

Pakistan Rural - Energy Expenditures FY11 (values and % shares)										
	Expenditure by Quintile					Expenditure Shares (%)				
	Q1	Q2	Q3	Q4	Q5	Q1	Q2	Q3	Q4	Q5
Petrol	1,402	1,128	2,407	5,415	13,559	15.82	13.80	20.45	29.94	40.85
Kerosene	241	366	454	561	547	2.72	4.47	3.86	3.10	1.65
Coal	0	0	0	3	12	0.00	0.00	0.00	0.02	0.04
Gas	749	479	815	1,519	3,023	8.45	5.86	6.92	8.40	9.11
Electricity	4,783	4,370	5,476	7,031	11,480	53.98	53.46	46.53	38.88	34.59
Biomass	1,686	1,832	2,616	3,557	4,571	19.03	22.41	22.23	19.67	13.77
Total	8,861	8,175	11,768	18,085	33,192	100.00	100.00	100.00	100.00	100.00

Pakistan Rural - Energy Expenditures FY12 (values and % shares)										
	Expenditure by Quintile					Expenditure Shares (%)				
	Q1	Q2	Q3	Q4	Q5	Q1	Q2	Q3	Q4	Q5
Petrol	2,139	1,811	3,689	6,860	21,668	18.01	18.40	25.18	30.75	47.75
Kerosene	155	207	226	215	301	1.30	2.10	1.55	0.96	0.66
Coal	0	13	27	16	83	0.00	0.13	0.19	0.07	0.18
Gas	1,420	804	1,249	2,172	4,613	11.95	8.17	8.53	9.74	10.17
Electricity	6,038	5,387	7,059	9,609	14,532	50.83	54.73	48.19	43.08	32.02
Biomass	2,128	1,621	2,398	3,435	4,182	17.91	16.47	16.37	15.40	9.22
Total	11,880	9,843	14,649	22,307	45,378	100.00	100.00	100.00	100.00	100.00

Punjab - Energy Expenditures FY02 (values and % shares)										
	Expenditure by Quintile					Expenditure Shares (%)				
	Q1	Q2	Q3	Q4	Q5	Q1	Q2	Q3	Q4	Q5
Petrol	455	122	225	806	4,593	27.48	10.35	12.50	26.68	57.29
Kerosene	177	192	226	221	199	10.71	16.35	12.55	7.31	2.48
Coal	0	1	0	0	0	0.01	0.09	0.00	0.01	0.01
Gas	404	314	573	1,072	2,161	24.43	26.65	31.79	35.51	26.96
Electricity	187	81	163	309	504	11.31	6.88	9.04	10.25	6.29
Biomass	431	467	615	611	559	26.06	39.68	34.13	20.24	6.98
Total	1,654	1,176	1,801	3,019	8,017	100.00	100.00	100.00	100.00	100.00

Punjab - Energy Expenditures FY08 (values and % shares)										
	Expenditure by Quintile					Expenditure Shares (%)				
	Q1	Q2	Q3	Q4	Q5	Q1	Q2	Q3	Q4	Q5
Petrol	1,835	815	1,481	3,040	15,132	22.11	12.04	16.23	23.59	45.66
Kerosene	110	96	81	67	48	1.32	1.42	0.88	0.52	0.15
Coal	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00
Gas	1,193	884	1,333	2,193	4,165	14.37	13.06	14.60	17.02	12.57
Electricity	4,389	4,013	5,079	6,402	13,001	52.88	59.29	55.64	49.69	39.23
Biomass	773	960	1,154	1,182	793	9.32	14.19	12.64	9.17	2.39
Total	8,300	6,768	9,128	12,884	33,140	100.00	100.00	100.00	100.00	100.00

Pakistan Rural - Energy Expenditures FY11 (values and % shares)										
	Expenditure by Quintile					Expenditure Shares (%)				
	Q1	Q2	Q3	Q4	Q5	Q1	Q2	Q3	Q4	Q5
Petrol	2,204	1,969	3,099	6,436	20,867	18.52	16.92	20.34	27.90	40.30
Kerosene	103	97	77	41	22	0.86	0.83	0.51	0.18	0.04
Coal	0	6	0	0	3	0.00	0.05	0.00	0.00	0.01
Gas	1,307	1,201	1,815	3,043	5,640	10.99	10.32	11.91	13.19	10.89
Electricity	7,029	6,731	8,652	11,946	23,922	59.08	57.83	56.80	51.79	46.20
Biomass	1,255	1,635	1,590	1,598	1,320	10.55	14.05	10.44	6.93	2.55
Total	11,898	11,639	15,233	23,064	51,774	100.00	100.00	100.00	100.00	100.00

Punjab - Energy Expenditures FY12 (values and % shares)										
	Expenditure by Quintile					Expenditure Shares (%)				
	Q1	Q2	Q3	Q4	Q5	Q1	Q2	Q3	Q4	Q5
Petrol	3,476	2,731	4,292	8,989	32,707	21.38	20.13	22.89	30.88	47.38
Kerosene	108	95	76	43	41	0.66	0.70	0.40	0.15	0.06
Coal	0	0	0	8	0	0.00	0.00	0.00	0.03	0.00
Gas	2,121	1,406	2,221	3,565	7,773	13.05	10.36	11.84	12.25	11.26
Electricity	8,991	7,978	10,332	14,590	27,530	55.30	58.80	55.10	50.12	39.88
Biomass	1,562	1,358	1,832	1,914	978	9.61	10.01	9.77	6.58	1.42
Total	16,258	13,568	18,753	29,108	69,029	100.00	100.00	100.00	100.00	100.00

Punjab Urban - Energy Expenditures FY02 (values and % shares)										
	Expenditure by Quintile					Expenditure Shares (%)				
	Q1	Q2	Q3	Q4	Q5	Q1	Q2	Q3	Q4	Q5
Petrol	1,389	216	263	897	4,585	35.43	10.56	10.24	23.92	53.80
Kerosene	192	176	206	209	174	4.91	8.62	8.02	5.57	2.04
Coal	0	0	0	1	1	0.00	0.00	0.00	0.01	0.01
Gas	1,611	1,065	1,309	1,797	2,938	41.09	52.08	51.02	47.94	34.47
Electricity	292	111	196	338	387	7.44	5.42	7.62	9.01	4.53
Biomass	437	477	593	508	439	11.13	23.33	23.10	13.55	5.15
Total	3,920	2,045	2,566	3,748	8,523	100.00	100.00	100.00	100.00	100.00

Punjab Urban - Energy Expenditures FY08 (values and % shares)										
	Expenditure by Quintile					Expenditure Shares (%)				
	Q1	Q2	Q3	Q4	Q5	Q1	Q2	Q3	Q4	Q5
Petrol	3,495	825	1,179	3,040	15,166	24.92	9.85	11.69	21.39	44.66
Kerosene	42	90	72	57	36	0.30	1.08	0.72	0.40	0.11
Coal	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00
Gas	2,638	1,636	2,128	2,958	4,903	18.81	19.53	21.09	20.81	14.44
Electricity	6,962	4,383	5,193	6,795	13,039	49.64	52.34	51.47	47.81	38.40
Biomass	888	1,440	1,517	1,362	816	6.33	17.19	15.04	9.58	2.40
Total	14,025	8,375	10,089	14,212	33,960	100.00	100.00	100.00	100.00	100.00

Punjab Urban - Energy Expenditures FY11 (values and % shares)										
	Expenditure by Quintile					Expenditure Shares (%)				
	Q1	Q2	Q3	Q4	Q5	Q1	Q2	Q3	Q4	Q5
Petrol	5,092	2,811	3,312	6,516	23,122	24.50	17.63	18.74	25.57	39.32
Kerosene	29	24	8	18	6	0.14	0.15	0.05	0.07	0.01
Coal	0	20	0	0	5	0.00	0.12	0.00	0.00	0.01
Gas	2,908	2,520	3,015	4,211	6,787	13.99	15.80	17.06	16.53	11.54
Electricity	11,747	8,896	10,068	13,839	28,219	56.52	55.78	56.97	54.32	47.99
Biomass	1,008	1,678	1,270	894	666	4.85	10.52	7.19	3.51	1.13
Total	20,784	15,948	17,673	25,478	58,806	100.00	100.00	100.00	100.00	100.00

Punjab Urban - Energy Expenditures FY12 (values and % shares)										
	Expenditure by Quintile					Expenditure Shares (%)				
	Q1	Q2	Q3	Q4	Q5	Q1	Q2	Q3	Q4	Q5
Petrol	8,256	3,103	3,458	9,134	36,909	28.63	18.28	16.60	29.05	47.38
Kerosene	17	7	9	6	0	0.06	0.04	0.04	0.02	0.00
Coal	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00
Gas	4,152	2,601	3,238	4,566	8,925	14.40	15.33	15.55	14.52	11.46
Electricity	15,366	10,172	12,626	16,602	31,712	53.29	59.94	60.62	52.79	40.71
Biomass	1,045	1,088	1,498	1,139	351	3.62	6.41	7.19	3.62	0.45
Total	28,836	16,971	20,829	31,447	77,897	100.00	100.00	100.00	100.00	100.00

Punjab Rural - Energy Expenditures FY02 (values and % shares)										
	Expenditure by Quintile					Expenditure Shares (%)				
	Q1	Q2	Q3	Q4	Q5	Q1	Q2	Q3	Q4	Q5
Petrol	174	88	202	692	4,613	17.87	10.18	15.15	32.80	67.98
Kerosene	173	198	239	236	261	17.72	22.82	17.87	11.17	3.84
Coal	0	1	0	0	0	0.02	0.16	0.00	0.00	0.00
Gas	42	47	123	168	272	4.30	5.41	9.21	7.98	4.00
Electricity	156	70	143	274	790	16.00	8.09	10.70	12.99	11.65
Biomass	430	463	628	740	850	44.10	53.34	47.07	35.06	12.53
Total	974	868	1,335	2,110	6,786	100.00	100.00	100.00	100.00	100.00

Punjab Rural - Energy Expenditures FY08 (values and % shares)										
	Expenditure by Quintile					Expenditure Shares (%)				
	Q1	Q2	Q3	Q4	Q5	Q1	Q2	Q3	Q4	Q5
Petrol	1,098	760	1,693	2,804	12,432	18.75	13.21	19.96	25.52	45.98
Kerosene	142	129	119	121	117	2.42	2.23	1.40	1.10	0.43
Coal	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00
Gas	717	440	769	1,380	3,285	12.24	7.64	9.06	12.56	12.15
Electricity	3,080	3,628	4,649	5,400	9,744	52.61	63.03	54.82	49.15	36.04
Biomass	819	799	1,251	1,282	1,462	13.98	13.89	14.75	11.67	5.41
Total	5,855	5,756	8,481	10,987	27,040	100.00	100.00	100.00	100.00	100.00

Punjab Rural - Energy Expenditures FY11 (values and % shares)										
	Expenditure by Quintile					Expenditure Shares (%)				
	Q1	Q2	Q3	Q4	Q5	Q1	Q2	Q3	Q4	Q5
Petrol	1,191	1,589	2,944	6,349	16,846	13.56	16.39	21.87	31.08	42.93
Kerosene	128	130	127	67	51	1.46	1.34	0.94	0.33	0.13
Coal	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00
Gas	746	606	943	1,766	3,595	8.49	6.25	7.01	8.65	9.16
Electricity	5,374	5,755	7,624	9,877	16,260	61.20	59.35	56.64	48.35	41.44
Biomass	1,342	1,616	1,823	2,367	2,486	15.28	16.67	13.54	11.59	6.34
Total	8,781	9,696	13,461	20,426	39,238	100.00	100.00	100.00	100.00	100.00

Punjab Rural - Energy Expenditures FY12 (values and % shares)										
	Expenditure by Quintile					Expenditure Shares (%)				
	Q1	Q2	Q3	Q4	Q5	Q1	Q2	Q3	Q4	Q5
Petrol	1,675	2,567	4,881	8,834	24,495	14.54	21.28	28.24	33.22	47.38
Kerosene	142	134	123	82	121	1.23	1.11	0.71	0.31	0.23
Coal	1	0	0	16	0	0.01	0.00	0.00	0.06	0.00
Gas	1,356	877	1,502	2,489	5,522	11.77	7.27	8.69	9.36	10.68
Electricity	6,589	7,007	8,711	12,424	19,357	57.20	58.08	50.40	46.72	37.44
Biomass	1,757	1,478	2,068	2,748	2,205	15.25	12.25	11.96	10.33	4.26
Total	11,519	12,064	17,285	26,593	51,700	100.00	100.00	100.00	100.00	100.00

Sindh - Energy Expenditures FY02 (values and % shares)										
	Expenditure by Quintile					Expenditure Shares (%)				
	Q1	Q2	Q3	Q4	Q5	Q1	Q2	Q3	Q4	Q5
Petrol	1,460	170	256	470	4,051	62.73	19.42	15.57	21.88	60.34
Kerosene	143	213	475	245	154	6.13	24.27	28.87	11.38	2.29
Coal	0	0	0	11	1	0.01	0.00	0.01	0.51	0.01
Gas	476	186	437	894	1,963	20.43	21.26	26.58	41.58	29.24
Electricity	13	6	15	24	63	0.56	0.73	0.92	1.11	0.94
Biomass	236	301	461	506	483	10.14	34.31	28.06	23.54	7.19
Total	2,328	876	1,645	2,150	6,714	100.00	100.00	100.00	100.00	100.00

Sindh - Energy Expenditures FY08 (values and % shares)										
	Expenditure by Quintile					Expenditure Shares (%)				
	Q1	Q2	Q3	Q4	Q5	Q1	Q2	Q3	Q4	Q5
Petrol	2,832	784	1,473	4,173	15,717	42.96	17.60	21.25	33.49	49.77
Kerosene	251	252	197	127	41	3.81	5.65	2.85	1.02	0.13
Coal	0	0	0	1	0	0.00	0.00	0.00	0.01	0.00
Gas	679	439	947	1,629	3,629	10.30	9.86	13.66	13.07	11.49
Electricity	2,627	2,629	3,867	6,042	11,707	39.85	59.02	55.80	48.48	37.07
Biomass	203	351	447	490	484	3.08	7.87	6.44	3.93	1.53
Total	6,592	4,455	6,931	12,462	31,578	100.00	100.00	100.00	100.00	100.00

Sindh - Energy Expenditures FY11 (values and % shares)										
	Expenditure by Quintile					Expenditure Shares (%)				
	Q1	Q2	Q3	Q4	Q5	Q1	Q2	Q3	Q4	Q5
Petrol	3,194	1,023	2,459	7,274	21,864	36.29	14.69	22.79	37.98	48.24
Kerosene	265	224	155	183	71	3.01	3.22	1.43	0.96	0.16
Coal	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00
Gas	413	663	1,263	1,928	4,065	4.70	9.52	11.71	10.07	8.97
Electricity	4,341	4,258	5,940	8,571	18,311	49.33	61.13	55.06	44.75	40.40
Biomass	588	797	972	1,197	1,014	6.68	11.45	9.01	6.25	2.24
Total	8,801	6,966	10,789	19,153	45,325	100.00	100.00	100.00	100.00	100.00

Sindh - Energy Expenditures FY12 (values and % shares)										
	FY02 - Expenditure by Quintile					FY02 - Expenditure Shares (%)				
	Q1	Q2	Q3	Q4	Q5	Q1	Q2	Q3	Q4	Q5
Petrol	6,248	1,343	3,306	7,712	31,935	40.54	19.85	26.86	35.98	51.95
Kerosene	148	162	132	64	54	0.96	2.40	1.07	0.30	0.09
Coal	6	0	5	0	0	0.04	0.00	0.04	0.00	0.00
Gas	1,199	678	1,337	2,375	4,537	7.78	10.01	10.86	11.08	7.38
Electricity	7,424	3,875	6,497	10,168	24,174	48.18	57.27	52.78	47.44	39.32
Biomass	385	709	1,032	1,115	776	2.50	10.47	8.38	5.20	1.26
Total	15,410	6,766	12,309	21,434	61,476	100.00	100.00	100.00	100.00	100.00

Sindh Urban - Energy Expenditures FY02 (values and % shares)										
	Expenditure by Quintile					Expenditure Shares (%)				
	Q1	Q2	Q3	Q4	Q5	Q1	Q2	Q3	Q4	Q5
Petrol	4,420	740	319	605	5,016	66.94	32.44	13.53	21.24	61.57
Kerosene	36	66	189	120	65	0.54	2.89	8.01	4.22	0.79
Coal	0	0	0	22	1	0.00	0.00	0.00	0.78	0.01
Gas	1,839	792	1,145	1,617	2,620	27.85	34.74	48.59	56.79	32.16
Electricity	0	22	31	33	57	0.00	0.96	1.33	1.14	0.70
Biomass	308	661	673	451	388	4.67	28.97	28.54	15.82	4.76
Total	6,603	2,280	2,356	2,848	8,147	100.00	100.00	100.00	100.00	100.00

Sindh Urban - Energy Expenditures FY08 (values and % shares)										
	Expenditure by Quintile					Expenditure Shares (%)				
	Q1	Q2	Q3	Q4	Q5	Q1	Q2	Q3	Q4	Q5
Petrol	4,035	1,033	1,236	3,421	16,770	34.48	14.06	14.34	25.21	47.92
Kerosene	85	150	47	47	13	0.72	2.05	0.54	0.35	0.04
Coal	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00
Gas	2,207	1,460	1,982	2,502	4,703	18.86	19.87	22.99	18.44	13.44
Electricity	5,029	4,165	5,022	7,199	13,363	42.97	56.69	58.26	53.05	38.19
Biomass	348	539	332	401	146	2.98	7.34	3.86	2.96	0.42
Total	11,704	7,347	8,619	13,570	34,994	100.00	100.00	100.00	100.00	100.00

Sindh Urban - Energy Expenditures FY11 (values and % shares)										
	FY02 - Expenditure by Quintile					FY02 - Expenditure Shares (%)				
	Q1	Q2	Q3	Q4	Q5	Q1	Q2	Q3	Q4	Q5
Petrol	3,985	823	2,534	7,680	24,070	30.72	8.57	19.00	36.18	47.21
Kerosene	47	89	19	9	10	0.36	0.93	0.15	0.04	0.02
Coal	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00
Gas	1,426	1,757	2,366	2,999	5,268	10.99	18.30	17.74	14.13	10.33
Electricity	6,499	5,984	7,654	10,141	21,408	50.11	62.32	57.40	47.78	41.99
Biomass	1,013	949	760	395	230	7.81	9.88	5.70	1.86	0.45
Total	12,970	9,602	13,334	21,224	50,985	100.00	100.00	100.00	100.00	100.00

Sindh Urban - Energy Expenditures FY12 (values and % shares)										
	FY02 - Expenditure by Quintile					FY02 - Expenditure Shares (%)				
	Q1	Q2	Q3	Q4	Q5	Q1	Q2	Q3	Q4	Q5
Petrol	11,836	1,031	2,736	7,317	33,804	35.77	10.63	18.32	30.37	49.70
Kerosene	16	37	15	7	6	0.05	0.38	0.10	0.03	0.01
Coal	23	0	12	0	0	0.07	0.00	0.08	0.00	0.00
Gas	3,327	1,973	2,517	3,480	5,516	10.06	20.34	16.85	14.44	8.11
Electricity	17,338	5,808	8,671	12,582	28,351	52.40	59.86	58.05	52.21	41.68
Biomass	547	853	986	711	343	1.65	8.79	6.60	2.95	0.50
Total	33,087	9,702	14,937	24,097	68,021	100.00	100.00	100.00	100.00	100.00

Sindh Rural - Energy Expenditures FY02 (values and % shares)										
	Expenditure by Quintile					Expenditure Shares (%)				
	Q1	Q2	Q3	Q4	Q5	Q1	Q2	Q3	Q4	Q5
Petrol	551	40	227	341	1,695	54.30	7.27	17.28	23.05	52.69
Kerosene	176	246	609	364	371	17.31	44.25	46.40	24.57	11.54
Coal	0	0	0	0	0	0.04	0.00	0.02	0.00	0.00
Gas	57	48	106	200	359	5.60	8.66	8.08	13.53	11.17
Electricity	17	3	8	16	77	1.69	0.52	0.57	1.06	2.39
Biomass	214	219	363	560	714	21.06	39.30	27.65	37.78	22.20
Total	1,014	556	1,312	1,481	3,217	100.00	100.00	100.00	100.00	100.00

Sindh Rural - Energy Expenditures FY08 (values and % shares)										
	Expenditure by Quintile					Expenditure Shares (%)				
	Q1	Q2	Q3	Q4	Q5	Q1	Q2	Q3	Q4	Q5
Petrol	2,478	699	1,632	5,215	12,822	48.70	20.17	28.16	47.72	57.79
Kerosene	300	286	299	237	121	5.90	8.26	5.15	2.17	0.55
Coal	0	0	0	3	0	0.00	0.00	0.00	0.02	0.00
Gas	230	90	251	421	677	4.51	2.61	4.33	3.85	3.05
Electricity	1,921	2,105	3,091	4,440	7,156	37.75	60.71	53.33	40.63	32.25
Biomass	160	286	523	612	1,413	3.14	8.26	9.03	5.60	6.37
Total	5,089	3,467	5,796	10,929	22,189	100.00	100.00	100.00	100.00	100.00

Sindh Rural - Energy Expenditures FY11 (values and % shares)										
	Expenditure by Quintile					Expenditure Shares (%)				
	Q1	Q2	Q3	Q4	Q5	Q1	Q2	Q3	Q4	Q5
Petrol	2,976	1,102	2,399	6,768	16,461	38.89	18.57	27.37	40.82	52.31
Kerosene	324	277	262	400	222	4.24	4.67	2.99	2.41	0.71
Coal	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00
Gas	134	235	385	597	1,121	1.75	3.96	4.39	3.60	3.56
Electricity	3,747	3,582	4,577	6,621	10,729	48.97	60.36	52.23	39.94	34.10
Biomass	471	738	1,140	2,193	2,933	6.15	12.44	13.01	13.23	9.32
Total	7,652	5,935	8,764	16,578	31,466	100.00	100.00	100.00	100.00	100.00

Sindh Rural - Energy Expenditures FY12 (values and % shares)										
	Expenditure by Quintile					Expenditure Shares (%)				
	Q1	Q2	Q3	Q4	Q5	Q1	Q2	Q3	Q4	Q5
Petrol	4,174	1,447	3,715	8,232	26,761	47.16	24.98	35.66	45.92	61.71
Kerosene	197	204	216	140	184	2.23	3.52	2.08	0.78	0.42
Coal	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00
Gas	409	248	488	919	1,830	4.62	4.27	4.68	5.13	4.22
Electricity	3,745	3,234	4,933	6,989	12,615	42.32	55.83	47.36	38.99	29.09
Biomass	325	661	1,065	1,647	1,975	3.67	11.41	10.22	9.19	4.55
Total	8,850	5,793	10,417	17,927	43,365	100.00	100.00	100.00	100.00	100.00

KPK - Energy Expenditures FY02 (values and % shares)										
	Expenditure by Quintile					Expenditure Shares (%)				
	Q1	Q2	Q3	Q4	Q5	Q1	Q2	Q3	Q4	Q5
Petrol	386	103	211	483	2,664	19.57	6.67	9.72	16.44	44.04
Kerosene	243	288	227	260	175	12.32	18.72	10.43	8.85	2.89
Coal	0	1	0	0	1	0.00	0.07	0.01	0.00	0.01
Gas	206	186	437	714	1,307	10.43	12.09	20.11	24.32	21.61
Electricity	337	265	489	500	952	17.07	17.23	22.47	17.01	15.74
Biomass	802	696	810	980	950	40.63	45.22	37.24	33.38	15.70
Total	1,975	1,539	2,174	2,937	6,049	100.00	100.00	100.00	100.00	100.00

KPK - Energy Expenditures FY08 (values and % shares)										
	Expenditure by Quintile					Expenditure Shares (%)				
	Q1	Q2	Q3	Q4	Q5	Q1	Q2	Q3	Q4	Q5
Petrol	1,132	191	820	858	7,968	12.73	2.61	8.26	6.99	31.86
Kerosene	178	165	127	104	103	2.00	2.26	1.28	0.85	0.41
Coal	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00
Gas	1,460	1,027	1,582	2,515	4,437	16.41	14.06	15.93	20.50	17.74
Electricity	4,252	3,868	4,987	6,041	9,679	47.80	52.96	50.22	49.25	38.70
Biomass	1,874	2,053	2,413	2,749	2,822	21.07	28.11	24.30	22.41	11.28
Total	8,896	7,303	9,929	12,267	25,009	100.00	100.00	100.00	100.00	100.00

KPK - Energy Expenditures FY11 (values and % shares)										
	Expenditure by Quintile					Expenditure Shares (%)				
	Q1	Q2	Q3	Q4	Q5	Q1	Q2	Q3	Q4	Q5
Petrol	1,030	1,239	871	1,509	11,020	8.72	10.72	6.51	8.86	32.67
Kerosene	201	218	145	152	105	1.70	1.89	1.09	0.89	0.31
Coal	0	0	0	0	29	0.00	0.00	0.00	0.00	0.09
Gas	1,915	1,356	2,087	3,362	6,030	16.22	11.74	15.62	19.74	17.88
Electricity	5,888	5,898	6,624	8,321	12,714	49.86	51.05	49.56	48.86	37.70
Biomass	2,776	2,842	3,638	3,685	3,829	23.51	24.60	27.22	21.64	11.35
Total	11,810	11,553	13,365	17,029	33,727	100.00	100.00	100.00	100.00	100.00

KPK - Energy Expenditures FY12 (values and % shares)										
	FY02 - Expenditure by Quintile					FY02 - Expenditure Shares (%)				
	Q1	Q2	Q3	Q4	Q5	Q1	Q2	Q3	Q4	Q5
Petrol	2,608	1,110	1,475	2,894	15,041	15.40	8.10	9.08	13.12	35.41
Kerosene	59	94	21	38	47	0.35	0.69	0.13	0.17	0.11
Coal	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00
Gas	3,056	2,280	2,657	4,289	7,331	18.05	16.64	16.36	19.44	17.26
Electricity	7,957	7,216	9,025	11,328	17,296	47.00	52.67	55.59	51.35	40.72
Biomass	3,250	3,001	3,058	3,509	2,757	19.20	21.90	18.83	15.91	6.49
Total	16,930	13,701	16,236	22,058	42,472	100.00	100.00	100.00	100.00	100.00

KPK Urban - Energy Expenditures FY02 (values and % shares)										
	Expenditure by Quintile					Expenditure Shares (%)				
	Q1	Q2	Q3	Q4	Q5	Q1	Q2	Q3	Q4	Q5
Petrol	1,357	48	407	529	3,259	34.27	2.13	12.47	14.44	46.02
Kerosene	110	171	162	216	114	2.79	7.59	4.95	5.89	1.61
Coal	0	0	0	0	1	0.00	0.00	0.00	0.00	0.02
Gas	917	670	968	1,545	1,868	23.14	29.81	29.68	42.19	26.38
Electricity	520	363	752	507	1,028	13.14	16.14	23.06	13.85	14.52
Biomass	1,056	996	973	865	812	26.66	44.33	29.84	23.63	11.46
Total	3,960	2,247	3,262	3,662	7,082	100.00	100.00	100.00	100.00	100.00

KPK Urban - Energy Expenditures FY08 (values and % shares)										
	Expenditure by Quintile					Expenditure Shares (%)				
	Q1	Q2	Q3	Q4	Q5	Q1	Q2	Q3	Q4	Q5
Petrol	2,442	249	508	762	10,267	19.25	2.89	4.38	5.95	36.02
Kerosene	49	69	67	45	52	0.39	0.80	0.58	0.36	0.18
Coal	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00
Gas	2,903	1,692	2,578	3,639	5,183	22.89	19.63	22.24	28.45	18.19
Electricity	5,836	4,499	5,997	6,359	11,047	46.01	52.21	51.74	49.72	38.76
Biomass	1,453	2,109	2,442	1,985	1,952	11.46	24.47	21.07	15.52	6.85
Total	12,683	8,618	11,591	12,790	28,501	100.00	100.00	100.00	100.00	100.00

KPK Urban - Energy Expenditures FY11 (values and % shares)										
	Expenditure by Quintile					Expenditure Shares (%)				
	Q1	Q2	Q3	Q4	Q5	Q1	Q2	Q3	Q4	Q5
Petrol	2,216	2,682	692	1,492	15,879	13.04	17.19	4.63	7.89	38.29
Kerosene	41	38	38	22	15	0.24	0.24	0.25	0.11	0.04
Coal	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00
Gas	3,884	2,391	3,208	4,428	7,513	22.86	15.32	21.45	23.41	18.12
Electricity	8,956	7,601	7,939	10,018	15,604	52.71	48.71	53.09	52.96	37.63
Biomass	1,894	2,891	3,076	2,957	2,457	11.15	18.53	20.57	15.63	5.93
Total	16,991	15,603	14,953	18,917	41,468	100.00	100.00	100.00	100.00	100.00

KPK Urban - Energy Expenditures FY12 (values and % shares)										
	Expenditure by Quintile					Expenditure Shares (%)				
	Q1	Q2	Q3	Q4	Q5	Q1	Q2	Q3	Q4	Q5
Petrol	5,598	1,386	1,456	3,176	17,600	22.82	8.14	7.78	12.69	36.19
Kerosene	4	2	0	1	12	0.02	0.01	0.00	0.00	0.02
Coal	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00
Gas	5,520	3,713	4,195	5,868	8,789	22.50	21.81	22.41	23.44	18.07
Electricity	11,415	9,165	10,453	13,362	20,633	46.53	53.84	55.84	53.38	42.43
Biomass	1,994	2,757	2,614	2,627	1,595	8.13	16.20	13.97	10.49	3.28
Total	24,531	17,023	18,718	25,034	48,629	100.00	100.00	100.00	100.00	100.00

KPK Rural - Energy Expenditures FY02 (values and % shares)										
	Expenditure by Quintile					Expenditure Shares (%)				
	Q1	Q2	Q3	Q4	Q5	Q1	Q2	Q3	Q4	Q5
Petrol	183	120	105	450	1,760	11.74	9.20	6.65	18.60	39.33
Kerosene	271	326	262	292	267	17.39	24.92	16.58	12.04	5.96
Coal	0	1	0	0	0	0.00	0.11	0.03	0.00	0.00
Gas	57	29	148	123	452	3.66	2.23	9.36	5.09	10.11
Electricity	299	234	345	494	836	19.16	17.84	21.81	20.40	18.69
Biomass	749	599	721	1,062	1,160	48.06	45.71	45.57	43.87	25.92
Total	1,559	1,309	1,581	2,421	4,475	100.00	100.00	100.00	100.00	100.00

KPK Rural - Energy Expenditures FY08 (values and % shares)										
	Expenditure by Quintile					Expenditure Shares (%)				
	Q1	Q2	Q3	Q4	Q5	Q1	Q2	Q3	Q4	Q5
Petrol	760	167	1,011	932	4,962	9.72	2.47	11.34	7.85	24.27
Kerosene	214	203	164	149	168	2.74	2.99	1.84	1.26	0.82
Coal	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00
Gas	1,049	763	975	1,653	3,462	13.42	11.25	10.93	13.93	16.94
Electricity	3,802	3,617	4,372	5,798	7,890	48.63	53.34	49.03	48.86	38.60
Biomass	1,993	2,031	2,395	3,335	3,960	25.49	29.95	26.86	28.10	19.37
Total	7,818	6,781	8,916	11,867	20,442	100.00	100.00	100.00	100.00	100.00

KPK Rural - Energy Expenditures FY11 (values and % shares)										
	Expenditure by Quintile					Expenditure Shares (%)				
	Q1	Q2	Q3	Q4	Q5	Q1	Q2	Q3	Q4	Q5
Petrol	626	579	966	1,521	5,496	6.23	5.97	7.72	9.65	22.05
Kerosene	255	301	203	240	206	2.54	3.10	1.62	1.52	0.83
Coal	0	0	0	0	62	0.00	0.00	0.00	0.00	0.25
Gas	1,245	883	1,488	2,643	4,345	12.39	9.10	11.89	16.78	17.43
Electricity	4,842	5,119	5,920	7,176	9,428	48.20	52.77	47.30	45.55	37.83
Biomass	3,077	2,819	3,939	4,176	5,387	30.63	29.06	31.47	26.51	21.61
Total	10,045	9,701	12,515	15,756	24,924	100.00	100.00	100.00	100.00	100.00

KPK Rural - Energy Expenditures FY02 (values and % shares)										
	Expenditure by Quintile					Expenditure Shares (%)				
	Q1	Q2	Q3	Q4	Q5	Q1	Q2	Q3	Q4	Q5
Petrol	1,574	982	1,488	2,670	11,331	11.01	8.07	10.24	13.55	33.78
Kerosene	78	137	35	68	98	0.55	1.13	0.24	0.35	0.29
Coal	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00
Gas	2,204	1,614	1,605	3,037	5,217	15.41	13.28	11.04	15.42	15.55
Electricity	6,761	6,311	8,047	9,715	12,458	47.28	51.91	55.35	49.32	37.14
Biomass	3,684	3,114	3,362	4,209	4,443	25.76	25.61	23.13	21.37	13.24
Total	14,301	12,158	14,537	19,699	33,547	100.00	100.00	100.00	100.00	100.00

Balochistan - Energy Expenditures FY02 (values and % shares)										
	Expenditure by Quintile					Expenditure Shares (%)				
	Q1	Q2	Q3	Q4	Q5	Q1	Q2	Q3	Q4	Q5
Petrol	1,264	88	269	1,005	4,556	45.97	6.77	13.14	31.87	56.88
Kerosene	373	412	454	486	414	13.58	31.63	22.23	15.41	5.17
Coal	0	13	17	22	22	0.00	1.02	0.85	0.70	0.27
Gas	413	87	201	307	856	15.03	6.66	9.82	9.75	10.69
Electricity	103	39	88	160	478	3.74	3.03	4.29	5.09	5.97
Biomass	596	663	1,015	1,173	1,683	21.68	50.90	49.66	37.19	21.01
Total	2,750	1,303	2,044	3,154	8,009	100.00	100.00	100.00	100.00	100.00

Balochistan - Energy Expenditures FY08 (values and % shares)										
	Expenditure by Quintile					Expenditure Shares (%)				
	Q1	Q2	Q3	Q4	Q5	Q1	Q2	Q3	Q4	Q5
Petrol	740	539	2,047	3,242	9,432	12.70	8.75	21.66	24.05	40.27
Kerosene	515	432	451	445	495	8.84	7.01	4.78	3.30	2.11
Coal	0	0	22	0	0	0.00	0.00	0.23	0.00	0.00
Gas	537	430	807	1,892	4,702	9.22	6.98	8.55	14.03	20.07
Electricity	1,489	1,555	2,250	3,210	5,061	25.55	25.24	23.81	23.81	21.61
Biomass	2,547	3,205	3,871	4,693	3,734	43.70	52.02	40.97	34.81	15.94
Total	5,829	6,161	9,449	13,482	23,424	100.00	100.00	100.00	100.00	100.00

Balochistan - Energy Expenditures FY11 (values and % shares)										
	Expenditure by Quintile					Expenditure Shares (%)				
	Q1	Q2	Q3	Q4	Q5	Q1	Q2	Q3	Q4	Q5
Petrol	1,561	670	2,315	5,682	13,842	19.28	8.31	18.72	31.29	43.70
Kerosene	998	923	1,144	1,209	1,255	12.32	11.46	9.25	6.66	3.96
Coal	0	0	0	7	0	0.00	0.00	0.00	0.04	0.00
Gas	904	767	1,403	2,371	4,614	11.16	9.51	11.34	13.06	14.57
Electricity	2,347	2,553	3,294	4,141	6,190	28.98	31.68	26.63	22.80	19.54
Biomass	2,288	3,147	4,213	4,750	5,773	28.25	39.05	34.06	26.16	18.23
Total	8,098	8,059	12,369	18,160	31,674	100.00	100.00	100.00	100.00	100.00

Balochistan - Energy Expenditures FY12 (values and % shares)										
	Expenditure by Quintile					Expenditure Shares (%)				
	Q1	Q2	Q3	Q4	Q5	Q1	Q2	Q3	Q4	Q5
Petrol	3,890	723	2,440	2,440	18,217	24.67	7.49	14.09	20.67	40.27
Kerosene	833	701	764	764	720	5.28	7.27	4.41	2.88	1.59
Coal	0	182	235	235	278	0.00	1.88	1.36	0.46	0.61
Gas	2,346	1,762	3,233	3,233	8,579	14.88	18.26	18.67	20.38	18.96
Electricity	4,539	3,424	5,701	5,701	10,160	28.79	35.48	32.93	31.91	22.46
Biomass	4,158	2,860	4,941	4,941	7,286	26.37	29.63	28.54	23.70	16.11
Total	15,766	9,652	17,314	17,314	45,240	100.00	100.00	100.00	100.00	100.00

Balochistan Urban - Energy Expenditures FY02 (values and % shares)										
	Expenditure by Quintile					Expenditure Shares (%)				
	Q1	Q2	Q3	Q4	Q5	Q1	Q2	Q3	Q4	Q5
Petrol	2,537	0	147	1,044	4,258	43.52	0.00	6.75	28.39	50.92
Kerosene	126	221	221	216	221	2.15	12.18	10.18	5.86	2.64
Coal	0	0	0	0	23	0.00	0.00	0.00	0.00	0.27
Gas	1,659	379	470	838	1,464	28.46	20.94	21.61	22.80	17.51
Electricity	333	101	232	319	749	5.70	5.57	10.66	8.68	8.95
Biomass	1,176	1,110	1,105	1,260	1,648	20.17	61.31	50.79	34.27	19.71
Total	5,830	1,811	2,176	3,677	8,362	100.00	100.00	100.00	100.00	100.00

Balochistan Urban - Energy Expenditures FY08 (values and % shares)										
	Expenditure by Quintile					Expenditure Shares (%)				
	Q1	Q2	Q3	Q4	Q5	Q1	Q2	Q3	Q4	Q5
Petrol	1,945	775	1,835	3,850	11,279	16.26	9.62	16.60	25.13	41.89
Kerosene	215	210	245	207	194	1.80	2.61	2.22	1.35	0.72
Coal	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00
Gas	3,132	1,127	1,650	3,056	6,166	26.19	14.00	14.93	19.94	22.90
Electricity	4,285	3,071	3,419	4,659	6,584	35.83	38.14	30.94	30.40	24.45
Biomass	2,383	2,868	3,902	3,551	2,702	19.92	35.62	35.31	23.17	10.04
Total	11,960	8,051	11,051	15,323	26,925	100.00	100.00	100.00	100.00	100.00

Balochistan Urban - Energy Expenditures FY11 (values and % shares)										
	Expenditure by Quintile					Expenditure Shares (%)				
	Q1	Q2	Q3	Q4	Q5	Q1	Q2	Q3	Q4	Q5
Petrol	1,350	807	1,727	5,831	15,560	14.58	7.81	13.07	31.50	46.73
Kerosene	204	279	344	403	401	2.21	2.69	2.60	2.18	1.20
Coal	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00
Gas	2,389	2,368	3,129	4,299	7,290	25.80	22.90	23.68	23.22	21.89
Electricity	4,368	4,550	5,393	5,721	7,841	47.17	44.00	40.82	30.91	23.55
Biomass	949	2,337	2,620	2,256	2,206	10.25	22.60	19.83	12.19	6.63
Total	9,260	10,341	13,213	18,510	33,298	100.00	100.00	100.00	100.00	100.00

Balochistan Urban - Energy Expenditures FY12 (values and % shares)										
	Expenditure by Quintile					Expenditure Shares (%)				
	Q1	Q2	Q3	Q4	Q5	Q1	Q2	Q3	Q4	Q5
Petrol	5,200	224	2,101	4,067	15,235	20.87	2.01	11.41	16.45	34.50
Kerosene	522	247	344	345	421	2.09	2.22	1.87	1.39	0.95
Coal	0	163	177	149	125	0.00	1.46	0.96	0.60	0.28
Gas	6,430	3,940	5,344	7,623	11,932	25.80	35.46	29.02	30.84	27.02
Electricity	8,320	4,631	7,150	8,935	12,167	33.39	41.67	38.83	36.15	27.55
Biomass	4,448	1,908	3,300	3,601	4,282	17.85	17.17	17.92	14.57	9.70
Total	24,920	11,113	18,416	24,719	44,162	100.00	100.00	100.00	100.00	100.00

Balochistan Rural - Energy Expenditures FY02 (values and % shares)										
	Expenditure by Quintile					Expenditure Shares (%)				
	Q1	Q2	Q3	Q4	Q5	Q1	Q2	Q3	Q4	Q5
Petrol	952	108	306	989	4,812	47.72	9.09	15.25	33.76	62.45
Kerosene	434	455	525	602	581	21.75	38.30	26.22	20.55	7.54
Coal	0	16	23	32	21	0.00	1.36	1.13	1.08	0.27
Gas	108	21	119	80	334	5.43	1.76	5.91	2.72	4.33
Electricity	47	26	44	92	246	2.34	2.16	2.19	3.15	3.19
Biomass	454	563	988	1,135	1,712	22.76	47.33	49.30	38.75	22.22
Total	1,996	1,189	2,004	2,929	7,705	100.00	100.00	100.00	100.00	100.00

Balochistan Rural - Energy Expenditures FY08 (values and % shares)										
	Expenditure by Quintile					Expenditure Shares (%)				
	Q1	Q2	Q3	Q4	Q5	Q1	Q2	Q3	Q4	Q5
Petrol	532	479	2,164	2,725	7,384	11.16	8.44	25.28	22.87	37.79
Kerosene	567	488	565	647	828	11.89	8.59	6.61	5.43	4.24
Coal	0	0	34	0	0	0.00	0.00	0.40	0.00	0.00
Gas	89	253	340	902	3,078	1.87	4.46	3.98	7.57	15.75
Electricity	1,006	1,171	1,602	1,977	3,372	21.09	20.61	18.71	16.59	17.26
Biomass	2,575	3,291	3,854	5,665	4,878	53.99	57.91	45.02	47.54	24.96
Total	4,769	5,683	8,560	11,915	19,540	100.00	100.00	100.00	100.00	100.00

Balochistan Rural - Energy Expenditures FY11 (values and % shares)										
	Expenditure by Quintile					Expenditure Shares (%)				
	Q1	Q2	Q3	Q4	Q5	Q1	Q2	Q3	Q4	Q5
Petrol	1,628	626	2,590	5,596	12,261	21.06	8.54	21.63	31.16	40.63
Kerosene	1,249	1,130	1,517	1,675	2,041	16.16	15.42	12.67	9.33	6.76
Coal	0	0	0	12	0	0.00	0.00	0.00	0.06	0.00
Gas	434	254	595	1,257	2,150	5.61	3.46	4.97	7.00	7.12
Electricity	1,707	1,913	2,312	3,227	4,669	22.08	26.10	19.31	17.97	15.47
Biomass	2,712	3,406	4,958	6,192	9,056	35.09	46.48	41.41	34.48	30.01
Total	7,730	7,328	11,972	17,959	30,177	100.00	100.00	100.00	100.00	100.00

Balochistan Rural - Energy Expenditures FY12 (values and % shares)										
	Expenditure by Quintile					Expenditure Shares (%)				
	Q1	Q2	Q3	Q4	Q5	Q1	Q2	Q3	Q4	Q5
Petrol	3,390	925	2,664	5,724	21,612	27.61	10.20	16.06	25.05	46.51
Kerosene	952	885	1,042	1,011	1,061	7.75	9.77	6.28	4.42	2.28
Coal	0	189	274	71	452	0.00	2.09	1.65	0.31	0.97
Gas	791	882	1,834	2,175	4,761	6.44	9.73	11.06	9.52	10.25
Electricity	3,099	2,937	4,741	6,286	7,875	25.24	32.41	28.59	27.51	16.95
Biomass	4,048	3,244	6,029	7,586	10,705	32.97	35.80	36.35	33.19	23.04
Total	12,279	9,062	16,584	22,853	46,466	100.00	100.00	100.00	100.00	100.00

D. Gas Consumption Over the Years

Between FY72 and FY98, gas consumption increased at a significant but steady rate of 6.7 per cent per annum. The domestic sector's consumption increased by a huge 17 per cent per annum and the share of households in total gas use increased from a mere 2 to 22 per cent. As indicated above, this was a result of the government's policy of supplying gas to households, where its net benefits (vis-à-vis using other fuels such as kerosene oil or wood) were the highest. This was made possible through a rapid expansion of the gas network, under donor-financed projects.[79] On the production side, however, the "cost plus" formula for determining producer (well-head) price gave little incentives for exploration and development of new gas fields. In the early 1990s, the producer price of gas was linked to landed price of fuel oil but with discounts (for details see Section 3).[80] As these discounts were determined by the government in a non-transparent way, the new formula evoked only nominal increases in gas supplies. Subsequently, the discounts were eliminated.

The period between FY98 and FY06 represents another and more significant change in the price formula. The well-head gas price was linked to crude oil prices. The improved return for producers was followed by a sharp increase in gas supplies (by almost 10 per cent per annum). As a result, gas consumption also surged. Although a significant improvement over its predecessor, the new formula also developed some problems as it was modified and the gas price was in effect capped. Over time this eroded the incentives for gas producers, especially once oil prices spiked sharply in FY08.[81] During the final period (FY06 to FY14), both supply and consumption of gas stagnated.[82]

There was also another important development during this period. The government allowed the use of natural gas in the transport sector as compressed natural gas (CNG). In prior years, CNG had a negligible share in total gas use. Yet by FY06 it rose to 3.2 per cent, which was higher than the commercial sector's share (at 2.4 per cent).

E. Evolution of Gas Pricing Formula

Initially, this benchmark was a percentage (two-thirds or 66 per cent) of the Cost, Insurance and Freight (CIF) price of fuel oil, with discounts (which were negotiated between the producer and the government) for the geological and other conditions of the area.[83] While this formula provided the bidders an element of certainty about their returns from any investment, negotiating the discount proved to be problematic. The industry still felt the formula was not transparent, as negotiating the discounts with the government or gas companies continued to cause delays.

In the early 1990s, therefore, the government eliminated the provision for discounts and announced the gas producer price as a percentage (normally two-thirds) of the landed cost of fuel oil. It also allowed the linkage (which was set at 66 per cent) to vary, and some firms concluded gas sales agreements with the Suis at almost 100 per cent of the world market price of fuel oil. Exploration activity expanded again and with a lag gas production rose to around 2.5 Billion Cubic Feet/Day (BCF/D).

In the late 1990s, the government further improved the incentive for E&P activities and for gas production, by linking the gas price to a percentage of the international price of crude oil. Three Zones (based on the geological characteristics, ease or difficulty of exploration, drilling and other activities in the area, etc.) were established and the producer price was fixed (66 per cent, 70 per cent and 75 per cent) at the world market price of oil for these Zones. The response of the industry was again fairly positive and, following enhanced exploration efforts, gas production rose to about 4 BCF/D.

In the late 1990s, the government agreed to amend the formula to allow producers to share the benefits of windfall increases in international prices with the government.[84] Therefore, if oil prices rose above US$ 25 per barrel the producer would get only 75 per cent of the excess over US$ 25. Once oil prices hit US$ 30 per barrel, the producer would get only 50 per cent of the incremental price. For oil prices in excess of US$ 35 per barrel, the producer was entitled to only 25 per cent of the increment. The remaining premium in international oil prices therefore became a discount in the gas price for the government.

This formula worked quite well for roughly 10 years, particularly because international oil prices were approximately US$ 12 to 15 per barrel for much of the 1990s. In addition, the exploration industry across the globe had adjusted to those trends. However, the sustained and sharp spike in world oil prices between 2005 and 2008 changed the scenario. The gas explorers saw US$ 35 per barrel as a ceiling price and could not benefit from the boom in oil and gas prices all over the world. Therefore, the industry asked

[79] While one could question the donors' preference for funding large-scale gas supply to households (rather than productive sectors), it needs to be noted that: (a) donors do not determine a country's priorities; they are set by the government; (b) Pakistan's priority was to replace expensive and imported fuels (kerosene and diesel) with an abundant domestic resource; and (c) the Netback Value of gas use in households may be higher than in industry and power plants, as gas replaces a much lower value product in those sectors.

[80] The producer price of gas is adjusted at intervals, mainly because the government needs to gauge the industry's reaction (additional exploration) to an announced price. Frequent changes in producer prices would also have required regular adjustments in consumer prices, since the cost of gas is always passed on to consumers. It may have been difficult to adjust household prices very often; the government could face a backlash from consumers. However, this situation could emerge irrespective of which sector's gas price was being raised – industry and power plants would have opposed price increases just as much as residential users. Nevertheless, one cannot discount the political economy challenges that arise when producer or consumer prices have to be increased.

[81] The formula linked the price of gas to a basket of Arabian/Persian crude oils. However, the reference price of crude was capped at US$ 35/barrel. In 2007-08, the international price of crude oil crossed US$ 160/barrel mark, eroding returns to investment in the gas sector (vis-a-vis the oil sector). Moreover, almost 50 per cent of the gas revenue from higher prices is siphoned by the government as windfall levy.

[82] Gas demand continued to expand in response to rising incomes, but a slowdown in new connections and extension of supply to new cities and towns (and stagnation of supply at slightly less than 4 BCFD since 2008) would have reduced the growth rate of consumption of gas.

the government to remove the ceiling prices, or to at least align them with current realities, i.e. oil prices in the range of US$ 100 to 150 per barrel, not US$ 30 to 35 per barrel. If the ceiling prices continued, the industry was clear that the outcome would be a significant downturn in exploration activity. As a result, many international firms would cease operations in Pakistan. The exit of many international firms from Pakistan in the past 5 to 10 years essentially confirms that, while the government has now recognized the need to adapt the producer pricing formula to current realities,[85] the delay in making this change has cost the country.

F. Key Features of Gas Tariffs

Key features of the tariff levels and adjustments include:

a. Tariffs for household consumers are well below those for industry, power plants, or commercial users.[86] Tariffs for the gas used by fertiliser plants to manufacture nitrogenous fertiliser are also lower than for all other users.

   i. The practice of keeping gas prices for fertiliser producers lower than for other industries and power plants has been in vogue since the 1970s, when large plants to manufacture urea were installed in Pakistan.

   ii. The government consistently uses the food security argument. Fertiliser prices must be kept low in order to increase the production of food grain and fertiliser prices can be kept low by providing cheap gas to the plants – a justification for maintaining a low price of gas for fertiliser production.

   iii. It is unclear whether the policy/practice achieves the intended results. Prices of fertiliser in Pakistan are not always below the CIF cost of imports, so the gas pricing policy is not always achieving its goal. Fertiliser manufacturers are, however, very profitable, as confirmed by the very sharp increases in capacity and production in the 1990s, for example.

   iv. This policy reduces SNGPL's and SSGC's revenue, which then has to be made up through higher prices from other consumers.

   v. However, the policy does not appear to promote inefficient gas use in the plants as the quantum of gas allocated to each plant is fixed. Owners/managers cannot benefit from being lax on how they use the allocated amount(s) of gas.

b. Gas prices for most consumer categories have risen threefold since 2004. This trend is not too far off from overall inflation in the country. It also corresponds broadly with movements in producer prices. During this period, oil prices (the key reference point for gas producer prices in Pakistan) have also risen by about three times (from US$ 25 per barrel in 2004 to roughly US$ 150 per barrel in 2008, remaining above US$ 100 per barrel for the next 2 to 3 years) and falling to approximately US$ 50 per barrel in the last 2 years. The rate of increase in gas consumer prices has been much lower since FY13, in part because oil prices have been falling or stagnant over this period. However, there may not be substantial reductions in consumer gas prices in Pakistan even if international oil prices remain low. Under the 2012 Petroleum Policy, the government has updated the ceiling to US$ 100 per barrel, from US$ 35 per barrel. Therefore, the actual price of oil (and not the ceiling price of US$ 35 per barrel) will become the reference for determining the gas producer price.

c. Exceptions to this general trend include: (a) the first slab of domestic consumers and (b) fertiliser plants, particularly for gas used as feedstock.

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[83] These "conditions" were supposed to represent the ease or difficulty of exploring in the area and distance of the field from the nearest pipeline network – the latter representing the cost that the government or gas utilities would have to incur in order to connect the field to the gas network.

[84] This proposal was in fact prepared by the industry (and presented to the government) as a way to overcome delays in finalizing gas sales agreements for gas discoveries in the mid- to late 1990s. The government asked the producers to find their own customers for the gas that they expected to produce. This stance was based on a provision in the then applicable Petroleum Policy, under which producers got the option to sell their gas to any interested consumer, rather than being constrained to sell it only to one of the Suis.

[85] Under the 2012 Petroleum Policy, the ceiling has been re-aligned (to US$ 100 per barrel instead of US$ 35 per barrel) and the level of discounts has also been adjusted.

d. Consumer prices for gas used in motor vehicles (as Compressed Natural Gas – CNG) have increased faster than for other users. However, since CNG is a direct substitute for petrol and diesel, its absolute price level is not really relevant. One should consider whether CNG price adjustments were based on any link with petrol and diesel prices or not. As CNG prices remain well below those of petrol and diesel (in thermal equivalent terms), the pricing policy provides explicit subsidy to vehicle owners and users. The largest benefit of the policy therefore accrues to the rich. This regressive outcome further reinforces the point that a very low price for gas used as CNG in motor vehicles is not warranted.

G. Pricing Policy and Gas Supply

Donor assistance and changes in the government's pricing policy had been the two noticeable factors contributing to spurts in gas supply. Until the mid-1980s, the producer price of gas was determined on a "cost-plus" basis. This provided low (and falling) incentives to investors to make additional investments to cover for the increasing risks. In the mid-1980s, the producer price of gas was linked to the landed price of fuel oil but with discounts. As the discounts were negotiated on a case-by-case basis between the government and the applicant for any concession, the procedure was felt to be non-transparent. The change in the pricing formula therefore contributed only nominally towards increasing gas supply. Subsequently, the government removed the discounts from the formula and a number of new gas fields were discovered in the early 1990s. In FY98, the government shifted the benchmark price from furnace oil to crude oil. This significantly improved sector incentives and, during the next 8 years, gas supply increased at roughly 10 per cent per annum. Nonetheless, problems in determination of producer price remained.

Part of the explanation for why gas exploration and development activities have remained rather subdued during the last decade[87] is that, while the producer price of gas is linked to world market prices of crude oil, increases in the reference crude price that are passed on to investors are subject to a ceiling.[88] Only a fraction of the increase in oil prices is transferred to producers; the remainder accrues to the government as a discount in the gas price. As oil prices rose sharply in FY08, the advantageous provisions of the price formula significantly diluted due to these additional provisions and ceilings. It is, however, premature or presumptuous to say that increases in gas producer prices in line with the spike in world market prices of oil would definitely have led to increased gas production. Exploration for oil and gas is, after all, a risky business. A high level of drilling (and the use of the best equipment and techniques available worldwide) offers no guarantee that the exploration effort will actually discover oil or gas.

Policy-induced distortions in the gas sector continue in downstream activities. Gas prices are maintained at a uniform level throughout the country, for which the different costs of transmission and distribution are built into gas pricing notified by the Economic Coordination Committee (ECC).[89] Consumer prices carry a significant economic subsidy (as gas prices are well below those of substitute products), especially for residential consumers and fertiliser plants.

The levels of consumer tariffs and connection charges were reviewed mainly to determine whether these decisions had restrained the poor from access to and use of gas more than the implied restraint on richer households.

- The conclusion regarding gas tariffs is straightforward: the tariff for the first slab of gas consumption by households (currently up to 100 cubic metres per month) is very low. This tariff is normally not raised when rates for other consumers are increased. Hence, the tariff schedule clearly provides a subsidy to poor households.

- The key portion of the notification regarding connection charges is the rate for a new service connection.[90] This rate is Rs

[86] The rationale for this pricing policy can be to deliberately encourage households to use more gas. This runs counter to the argument that the cost of supply is higher for small and dispersed consumers, so gas prices for industry, power and other large users should be lower than for households. However, it also has an economic rationale as the substitute fuel for most household uses of gas is kerosene, while for the large consumers it is fuel oil. The former is more expensive than the latter and both are imported. Promoting larger gas use in households may therefore yield larger economic benefits to the country. In addition, households cannot pass on the cost of gas to the next stage/consumer, while for industry/power etc. gas is an intermediate input in the production process. They can pass on changes in prices to consumers of the product that they manufacture or supply.

1,500 for small plots and Rs 3,000 for larger plots. The HIES data for 2011-12 show that the expenditure on gas for the lowest quintile was Rs 2,232 per annum for the country as a whole. The expenditure ranged from Rs 1,199 per annum in Sindh to Rs 3,056 per annum in KPK. A connection charge of Rs 1,500 is a large amount of money for this quintile. It amounts to six months of gas consumption even in KPK. Mobilizing this amount just to pay for a gas connection can be a challenge. As connection charges are a constraint for the poorest households' access to gas, SNGPL/SSGC and OGRA should consider introducing monthly instalments (or other forms of deferred payments) to recover connection charges from poor households.

- The most binding constraint for access to gas by the poorer segments of society stems from the overall shortage of gas:
  - Since gas availability/supply is limited, the Sui companies are not providing new connections promptly.
  - There is a waiting period (many years, in all provinces) for new connections.
  - This creates opportunities for people to intervene with SNGPL/SSGC staff through bribes/under the counter payments for expediting their own gas connections.
  - The rich and affluent households can afford to make such payments but it is unlikely that poor households can do so.[91]

[87] Clearly, the low level of E&P (and stagnation in supply from 2008 onwards) has contributed to the crisis. Gas is a major source of commercial energy and a reduction or stagnation in its supply enhances the overall energy shortage. However, the shortfall also reflects other constraints such as lack of consensus on low-cost generation sources (hydro, coal, etc.); the resulting high dependence on oil for generating electricity and the spike in world market prices of oil; a severe decline in investments (public and private) in energy; slow pace of reforms (including unbundling of WAPDA) and mixed and at times lacking policy directions from the government.

[88] The 2009 Petroleum Policy specifies the reference for producer price of gas as the basket of Arabian/Persian crudes. For calculation of gas price, the reference price is capped at US$ 100/barrel. Moreover, the adjustment in producer price is made only twice a year, depriving investors of benefits of short-term increases in crude prices.

[89] Gas prices are determined based on annual revenue requirements submitted by SNGPL and SSGC. These calculations include the cost of gas, transmission/distribution costs, a benchmark level of losses (UFG) and wastage and a fixed return on assets (17.5 per cent for SNGPL; 17.0 per cent for SSGC). Hence, companies have an incentive to expand the distribution network, although only a weak incentive to do so efficiently since T&D costs are included in gas pricing, and the ultimate cost of breaching UFG benchmarks (4 per cent for SNGPL; 5 per cent for SSGC) must be borne by the exchequer.

[90] The Notification includes a host of charges and rates, for example: for new connection, for urgent connection, meter rental, shifting the tariff from commercial to residential (in case the premises was also being used for commercial purposes also but is now only a residence), charges for shifting the connection point, etc. Some of the rates are fixed amounts; others are on a per month basis.

[91] There is no documentary evidence to confirm this, but such "informal/under the counter charges" are reported to be as high as Rs 200,000 to 300,000 per connection.