# 3 Energy

## 3.1 Overview

Energy availability in Pakistan has been declining over the last few years, as a result of low investment in the sector since FY03 (FY11 was an exception). The country faced a record shortfall of both power, and natural gas in FY12. Despite several measures taken by the government, prolonged and frequent power cuts not only affected production activities, but also disrupted daily life. Since a detailed analysis of the structure and issues in the energy sector was presented in the Annual Report for 2010-11, this chapter will look specifically at those factors that exacerbated the energy situation in FY12.

At its core, the energy crisis reflects the lack of a coherent policy.[1] Despite a significant increase in energy demand, supply remains a problem due to limited exploration of natural gas and oil; slow progress on Thar coal; meager investments in port infrastructure for energy imports; and insufficient fiscal resources to maintain Pakistan's generation capacity at optimal levels. On the demand side, subsidized energy has reduced incentives for conservation, and has actually encouraged inefficient consumption.

Although the government has undertaken several measures to encourage energy conservation over the last few years, these have focused primarily on electricity. In particular, energy audits were conducted in a few industries; a two-day weekend was introduced; daylight savings were implemented; and a media campaign was launched to conserve electricity. However, no efforts were made to encourage households to conserve natural gas; as a result, excessive consumption of gas by households continues unabated.

In the last couple of years, a continuous increase in international oil prices has seen power generation costs soar.[2] Meanwhile, delays in subsidy payments by the government, and inadequate recovery of electricity bills from consumers, have held the sector hostage to a growing *circular debt*. Despite a settlement of Rs 313 billion by the government in November 2011, net circular debt receivables reached Rs 382 billion by 27th July 2012. This forced power plants to remain idle due to lack of fuel supplies, and was the primary reason for the power cuts the country experienced. Inefficiencies of energy-related PSEs; mis-governance; theft; high transmission losses; and low recoveries (current as well as receivables), only added to the problem.

In the case of natural gas, a gross mispricing of the resource has led to excessive consumption and underproduction – resulting in the current shortage. Gas supplies to all sectors (industry, power plants and CNG stations) – with the exception of households – remained erratic throughout the year. This is largely because the current gas allocation framework, prioritizes households that consume almost double the amount of *energy* in the form of gas than electricity.[3] Most of this is simply wasted, and leaves behind little for other productive uses – notably power generation.

In our view, the current state of the energy sector is unsustainable. While years of suppressed tariffs and public sector control of the energy supply chain, have fostered a public expectation of *cheap* energy, the dominance of public sector firms and weak governance has undermined a transition to

[1] For instance, in the past few power policies, there has been a clear focus that the country must shift towards using indigenous resources such as hydel and natural gas. However, the subsequent pricing of these resources for alternate purposes (such as irrigation and household heating) does not appear to reflect this priority.
[2] Electricity tariffs were increased by an average of roughly 14.0 percent in FY12.
[3] Households consumed roughly 5.4 million tons of oil equivalents (TOE) of energy in FY11 in the form of gas, compared to only 3.0 million TOE in the form of electricity.

commercial viability. While the government must continue encouraging investments in alternative sources of power (e.g., wind, solar etc.), capacity expansion in conventional fuels is the only longer-term solution. In the meantime, energy conservation must be encouraged in order to manage the demand-supply gap. In our view, this would require rationalization of electricity *and* gas prices – particularly for households.

### 3.2 Electricity

While the power sector has been facing serious challenges over the past few years, FY12 proved to be particularly difficult. During the year, electricity supply was inadequate to meet rising demand: load-shedding worsened as the country experienced a record peak shortfall since the power crisis began.[4]

**Table 3.1: PEPCO Electricity Generation**

**GWh**

| Fuel | FY10 | FY11 | FY12 |
|---|---|---|---|
| Gas | 19,368 | 22,998 | 23,421 |
| HSD | 827 | 422 | 1,473 |
| Hydro | 24,915 | 31,958 | 28,462 |
| Nuclear | 1,883 | 2,930 | 4,413 |
| RFO | 30,913 | 31,253 | 30,631 |
| Others | 1,081 | 922 | 1,097 |
| **Total** | **78,987** | **90,482** | **89,688** |

**Source:** CPPA; Analyst estimates

This situation was worsened by circular debt related cash-flow problems that forced generation capacity in Independent Power Producers (IPPs) to remain idle; furthermore, a decline in hydel generation because of lower water availability in key reservoirs, added to the seasonal gap that hydel would otherwise have filled. In response to the seasonal shortage, the government has been taking several steps to augment hydel power generation in the country (e.g., the 4th extension of Tarbela, Mangla Dam Raising Project, as well as construction of a number of smaller dams, such as Gomal Zam Dam).

#### 3.2.1 Power Generation and Load Management

As *circular debt* continues to choke cash-flows across the power supply chain, liquidity constrained power plants were forced to remain idle (or produce below capacity) because of their inability to procure fuel (see *Circular Debt* below).[5] As discussed earlier, *peak load management* for the Pakistan Electric Power Company (PEPCO) system has risen sharply (**Table 3.1** & **3.2**).[6] According to NEPRA's annual report for FY12, at the height of the crisis, urban centers witnessed power outages of 9-10 hours in urban areas, and rural areas witnessed outages of 16-18 hours.

In Karachi, which is supplied by the privately-run KESC, generation was also lower in FY12 compared to last year; however, the situation was quite different from the rest of the country. KESC adopted the strategy of loss-segmented load-shedding, which means the duration of power outages in a particular area depends on the recovery of bills from that area. In effect, outages were minimized

**Table 3.2: Trend in Peak Electricity Demand, Generation and Load Management for the PEPCO System**

**MW**

| | FY07 | FY08 | FY09 | FY10 | FY11 | FY12 |
|---|---|---|---|---|---|---|
| Peak demand load | 15,838 | 17,398 | 17,852 | 18,467 | 18,521 | 18,940 |
| Peak generation load | 13,645 | 14,151 | 14,055 | 14,309 | 14,468 | 15,062 |
| Peak load management | 2,645 | 5,454 | 7,018 | 6,408 | 6,151 | 8,393 |
| *percent of peak demand* | *16.7* | *31.3* | *39.3* | *34.7* | *33.2* | *44.3* |

**Source:** NTDC; Analyst estimates

[4] The peak shortfall for the PEPCO system has risen from 2,645 MW in FY07 to 8,398 MW in FY12.

[5] Anecdotal evidence suggests that although the daily furnace oil requirement for power generation is in excess of 30,000 tons, at certain times during the year, oil companies were forced to ration less than a third of this amongst power producers; since circular debt had affected imports.

[6] Load management is the process of balancing the supply of electricity on a network with the demand by adjusting, or controlling, the *load* (demand) rather than output of the power station. Peak in this case, refers to the *maximum* adjustment made at a particular point in time.

for areas where bill collection was high. Furthermore, the fuel mix improved, as the share of generation from gas was increased (**Table 3.3**).

**Table 3.3: KESC* Electricity Generation**

GWh

| Fuel | FY11 | FY12 |
|---|---|---|
| Gas | 5,222 | 5,901 |
| RFO | 4,142 | 3,061 |
| **Total** | **9,364** | **8,962** |

* including IPPs
**Source:** KESC

KESC has also reduced transmission and distribution losses to 29.6 percent for Q3-FY12, compared with 31.2 percent last year. Going forward, capacity expansion projects, such as the recently commisioned 560 MW Bin Qasim (BQPS-II) Combined Cycle Plant, should improve the power situation in the city.

### 3.2.2 Circular Debt

As discussed, *circular debt* was the main cause of the lengthy power cuts the country experienced during the year. Essentially, the term refers to cash-flow problems in the power sector that arise due to the factors like non-payment of electricity bills by consumers (public and private), transmission losses, and delays in subsidy payments (see **Box 3.2** for details). This build-up of unpaid bills (or *receivables)* at the distribution stage, then cascades across the power supply chain and constrains the ability of power plants to make timely payments to fuel suppliers. Fuel shortages, in turn, result in idle power generation capacity, and exacerbate load-shedding in the country.

**Table 3.4: Distribution of Circular Debt Receivables**

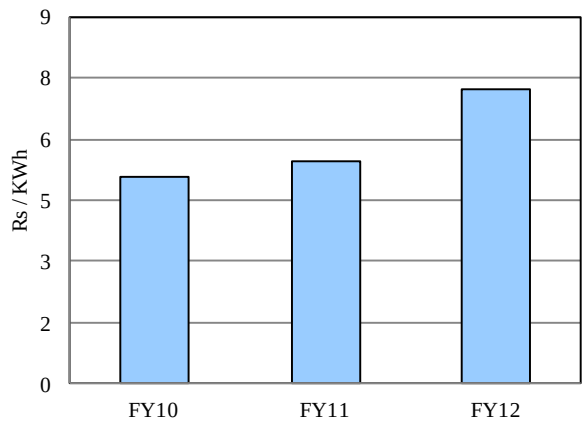
billion Rupees

| Company | Receivables | Payables | Net Position | | Change |
|---|---|---|---|---|---|
| | | | 27-Jul-12 | 29-Jul-11 | |
| PSO | 189 | 51 | 138 | 57 | 81 |
| SSGCL | 74 | 47 | 27 | 8 | 19 |
| SNGPL | 36 | 11 | 25 | 7 | 18 |
| PEPCO | 383 | 478 | -95 | 38 | -133 |
| OGDCL | 174 | 0 | 174 | 101 | 73 |
| PARCO | 25 | 0 | 25 | 22 | 3 |
| KESC | 115 | 69 | 46 | 19 | 27 |
| GHPL | 12 | 0 | 12 | 9 | 3 |
| PPL | 32 | 0 | 32 | 16 | 16 |
| KW&SB | 7 | 8 | -1 | -1 | 0 |
| **Total** | **1046** | **664** | **382** | **275** | **107** |

Note: Figures may not sum due to rounding.
**Source:** Ministry of Finance

These problems worsened in FY12. By 27th July 2012, net outstanding receivables in the power sector had increased to Rs 382.5 billion from Rs 275.1 billion a year ago (**Table 3.4**).[7] Non-payment of their dues for the sale of electricity prompted some IPPs to invoke sovereign guarantees under their Power Purchase Agreements (PPAs), and approached the Supreme Court in June 2012 for a resolution of their overdue payments.[8] This was despite government efforts to ease liquidity constraints in the sector by swapping power sector debt held by commercial banks during the year (see *Management of Circular Debt* below).

**Figure 3.1: Fuel Costs for Electricity Generation**




**Source:** Central Power Purchase Agency; Analyst estimates

[7] The net outstanding position refers to the difference between total receivables and payables.
[8] These include eight IPPs set up under the 2002 Power Policy. Sovereign guarantees were provided by the government in order to promote private sector participation in the power sector. Essentially, these are undertakings by the guarantor (the government) to pay if the creditworthiness of the institution (e.g., PEPCO/NTDC) deteriorates.

In addition to the above factors, delays in the notification of monthly Fuel Price Adjustments (FPAs) added to financial pressures in the power sector (for details on FPAs, see **Box 3.1),** as average fuel costs of electricity generation rose by almost a third compared with last year (**Figure 3.1**).[9]

**Box 3.1: How are Power Tariffs Determined?**

Keeping in view the recent public reaction to tariff changes, we find it useful to provide an overview of the determination of tariffs in the power sector. In order to understand electricity tariffs, consider the three main stages in the power supply chain: (i) generation; (ii) transmission; and (iii) distribution. Electricity tariffs paid by consumers are essentially a sum of production costs incurred and a fixed rate of return (margin) for firms at each stage. These are approved by the power sector regulator, the National Electric Power Regulatory Authority (NEPRA). At the end of the supply-chain (distribution), the government provides a subsidy to ensure uniform tariffs across the country (PEPCO system), and notifies the final consumer tariff. The following provides a generalized overview of this process:

**Generation**

Power plants that produce electricity (e.g., IPPs, private; and GENCOs, Wapda Hydel, etc., public), have Power Purchase Agreements (PPAs) with a single purchaser, the National Transmission and Dispatch Company (NTDC). This PPA specifies a two-part tariff structure which includes (i) *Capacity Charge*: to cover the fixed costs of maintaining power plant capacity (e.g., operating and maintenance expenses (O&M), debt servicing, and return on equity, etc.) that are to be paid regardless of dispatch; and (ii) *Energy Charge*: to cover variable costs, mainly fuel (based on a benchmark for fuel prices by NEPRA), and variable O&M costs, that depend on the amount of electricity actually sold. Fuel costs above or below the NEPRA benchmark are passed onto consumers as *Fuel Prices Adjustments* (*FPAs*) (see *Distribution* below).

**Transmission**

NTDC acts as an intermediary: it purchases power from generation companies to sell it onwards to distribution companies (DISCOs). For providing this service, it receives a *Transfer Charge*. This too includes a fixed component (which depends on a particular DISCO's maximum power demand during a billing period); and a *variable charge* which is the average price of electricity procured from the generation companies (adjusted for NEPRA approved power losses incurred during transmission).

**Distribution**

Each DISCO has a separate tariff approved by NEPRA. This is because in addition to the cost of power procured from NTDC, it includes a *Distribution Margin*. This margin covers the costs associated with use of the DISCO's infrastructure (e.g., O&M expenses, depreciation, return on assets, etc.), and an adjustment for power losses incurred during distribution. Since these losses vary widely across DISCOs, this would mean that consumer tariffs too would vary across the country. However, in order to ensure uniform consumer tariffs across the PEPCO system, at this stage the government provides an *Inter-Disco Tariff Differential Subsidy (TDS).* Therefore, while DISCO tariffs are determined by NEPRA; the rates that consumers pay are notified by the government and were most recently revised in May 2012.

**Fuel Price Adjustments (FPAs)**

In addition, consumer tariffs are adjusted monthly by NEPRA for variation in generation fuel costs, against approved benchmarks through *Fuel Price Adjustments (FPAs).* These can be driven by variation in the *actual* fuel mix versus NEPRA's *reference* mix (e.g., gas shortages that force power plants to substitute gas with more costly High Speed Diesel); and/or changes in fuel prices on global markets (e.g., furnace oil). Either of these can automatically increase (or decrease) generation costs, and is passed on to consumers through FPAs. These charges appear on consumers' electricity bills separately based on units consumed in the previous month. It was the pass-through of these adjustments that experienced delays during FY12.

Source: NEPRA.

### *Management of Circular Debt*

In order to incentivize banks to continue lending to power sector clients – and keep the supply chain running – the government struck two key deals with commercial banks in FY12. These deals reduced banks' *outstanding* power sector exposure by swapping it for government securities. Essentially an asset adjustment on banks' balance sheets, this entailed a significant cost: the first swap increased the

[9] This was mainly because of the rise in global oil prices (RFO-based generation accounts for around 35 percent of the fuel mix, and its cost rose from around Rs 12/kWh in FY11 to nearly Rs 16/kWh in FY12); a decline in hydel power generation (the cheapest fuel source) due to lower water availability in the dams; and gas shortages due to which some plants shifted to costly alternatives, e.g., HSD.

fiscal deficit by around 1.5 percent of GDP.[10] This swap alone accounts for nearly 45.0 percent of total government borrowings from commercial banks in FY12.

*Deal 1:* Banks had been lending to PEPCO under government guarantees to offset unpaid tariff differential subsidies. In 2009, the government set up the Pakistan Power Holding Company (PPHC) to acquire PEPCO's outstanding debts. By FY12, banks' exposure to PPHC had risen considerably. In order to encourage banks to continue lending to the power sector, these assets were swapped for sovereign debt. In effect, the government borrowed Rs 391.0 billion from commercial banks by issuing MTBs and PIBs in November 2011, and swapped Rs 313.0 billion (around 1.5 percent of GDP) worth of government securities for PPHC's liabilities. This cleared banks' balance sheets of exposure to the publicly owned power sector and converted it into direct lending to the government.

*Deal 2:* Even after this, banks still had significant exposure to the IPPs, which had been borrowing from banks for working capital requirements. However, as IPPs exhausted their assigned credit limits (due to delayed payments for the sale of electricity; see **Box 3.2**), banks were unwilling to extend additional loans. As a result, cash-strapped IPPs were finding it difficult to procure fuel to maintain power generation. To address banks' reluctance, in February 2012, PPHC-issued securities worth Rs 136.0 billion, were swapped for bank loans. By freeing used-up credit lines, this created room for fresh bank lending to IPPs. [11,12]

Notwithstanding these efforts, the power sector remains vulnerable to global oil prices given a heavily skewed fuel mix towards thermal generation – particularly imported furnace oil. This burden will have to be borne either by the government through subsidies, or consumers through higher tariffs. Since the government has already spent a total of Rs 464.3 billion (or 2.2 percent of GDP) on power sector subsidies and swap deals in FY12, further financial support in the form of subsidies, is unlikely.[13] Furthermore, as discussed earlier, the bulk of this spending was financed by borrowing from banks. Such borrowings, to keep the power sector running, have implications for commercial banks' operations – it has skewed their balance sheets towards sovereign debt.

As will be discussed later, a possible short-term solution would be to change the fuel mix by diverting some natural gas (as hydel capacities can only be increased in the medium-to-long-term) for power generation. More specifically, we believe there is significant potential for conserving natural gas from other sectors, especially households, and using it for power generation.

The long-run, however, will require a more structural fix, with better governance and management of the power production chain. A few steps have already been taken in this regard, particularly with the formation of new boards of directors in the Central Power Purchasing Authority (CPPA), Quetta Electric Supply Company (QESCO), Sukkur Electric Power Company (SEPCO) and the GENCO holding company. The dissolution of PEPCO was also finalized during the year, and there were management changes in the DISCOs.

**Box 3.2: What is Circular Debt and Why Does it Remain Unresolved?**

*Circular debt* in the power sector has emerged as a serious issue in recent years. Despite policymakers' efforts, it continues to pose financial challenges for entities across the power supply chain. It is therefore important to understand what exactly it is; who the key players are; how it affects power generation and load-shedding; and finally, why it appears insurmountable.

[10] See Deal 1.

[11] This section is based largely on discussions with commercial banks. The total amount of the swap was set at Rs 160.0 billion, of which Rs 136.0 billion had been arranged thus far, according to a statement by the Minister for Water and Power, during the 40th Session of the National Assembly held on 14th March 2012.

[12] However, these measures only served to ease liquidity constraints in the power sector temporarily. By March 2012, the situation worsened to the point where IPPs served legal notices to the government for non-payment of their dues.

[13] This includes the Rs 313.0 billion swap in November 2011 as part of Deal 1 mentioned earlier.

Circular Debt is a manifestation of operational inefficiencies and mis-governance.[14] It stems from: (i) higher transmission losses than allowed by NEPRA; (ii) low recoveries from billed amount; (iii) non-payment by public sector entities; (iv) high differential between generation cost and notified tariff; (v) delays and lag in determination of Fuel Price Adjustment by NEPRA, and recovery by DISCOs; (vi) payment of GST upfront on the billed amount; (vii) theft and distribution parked against TESCO and other DISCOs; (viii) delay in release of Tariff Differential Subsidy; (ix) non-recovery of receivables; and (x) abrupt disruptions in gas supply, which increases the cost of generation. Put simply, circular debt refers to a situation where one entity in the power supply chain – having inadequate cash-flows – is unable to discharge its obligations to its suppliers, and withholds payments. This results in cash-flow problems for other players in the sector, none of whom are then able to function at full capacity, causing unnecessary load shedding.

As discussed in **Box 3.1**, payments received by CPPA for the sale of electricity by DISCOs comprise of two parts: (i) consumer bill payments; and (ii) Tariff Differential Subsidies (TDS) by the government. Therefore, if DISCOs do not receive *full* payment for the sale of electricity (due to non-payment of bills by power consumers and/or delays in government subsidy payments) this leads to a buildup of *receivables* at the distribution stage. These receivables then cascade as *circular debt* across the power supply chain (since one firm's payables are its supplier's receivables), constraining electricity generation. To see how, consider a DISCO that is unable to pay NTDC for the electricity it had purchased. This means that NTDC, in turn, is unable to keep up payments to power producers (e.g., IPPs), from whom it purchased the electricity. Consequently, IPPs are forced to delay or withhold payments to Pakistan State Oil (PSO), the fuel supplier.

Faced with persistent delays in payments for the sale of electricity, IPPs become heavily reliant on bank borrowings to maintain plant availability (as required under their Power Purchase Agreements (PPA) with NTDC). However, banks are reluctant to increase their exposure to power sector clients beyond assigned credit limits. This leaves IPPs faced with severe liquidity constraints (as was the case in FY12), and ultimately means that PSO is unable to procure sufficient furnace oil to meet the requirements of the power sector. These fuel shortages, as a result, force power plants to remain idle or produce below capacity. Unsurprisingly, this situation translates into lower power generation, and adds to load-shedding in the country.

During the last 4 years, the government has paid over Rs 1 trillion, and the Ministry of Finance is now current in discharging its obligations towards Tariff Differential Subsidy upto end-August 2012. However, the challenge of circular debt continues because of the structural issues highlighted above. This explains why, even though one-off settlements as seen during FY12 did ease liquidity constraints in the power sector temporarily, the circular debt issue continues to persist.

### 3.3 Natural Gas

The problems in the power sector can be traced, to a large extent, to issues in the natural gas sector. Predictably, the shortfall of natural gas worsened in FY12, crossing the one billion cubic feet per day (bcfd) mark. At its peak during the winters, gas supply to industry in Punjab had been completely shut off;[15] power plants were receiving less than half of their allocated supply; CNG stations in Punjab remained closed for longer than they were open; and residents complained of frequent gas outages and low pipeline pressures (according to our discussions with gas distribution companies). This year was also the first time that gas supply to CNG stations in Sindh was interrupted due to shortages.

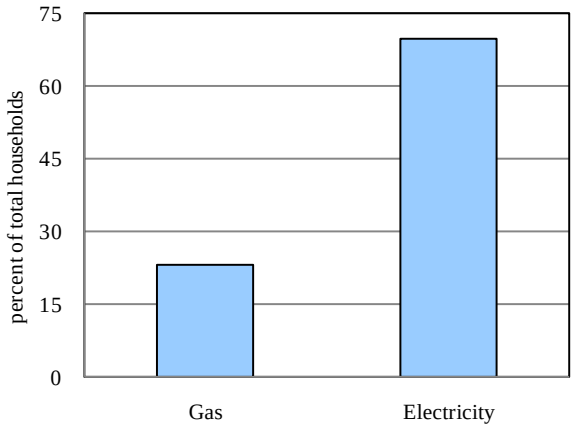
As expected, various industry groups and firms lobbied for natural gas supplies. The current gas allocation framework prioritizes consumers in the following order: (i) households; (ii) fertilizer manufacturers; (iii) power plants with gas supply agreements; (iv) the industrial and CNG sectors; (v) power plants without firm supply commitments (including captive power plants); and lastly, (vi) the cement sector.[16] Gas supplies to all these sectors, except for households, remained uncertain throughout the year as the government attempted to balance demand with existing supply.

[14] According to the Ministry of Finance, the cost of DISCOs inefficiencies is approximately Rs 200 billion, and the value of transmission and distribution losses is around Rs 220-240 billion annually.
[15] This is based on the load management schedules provided by SNGPL on its website. While the decline in industrial production is an obvious consequence, the inability of the government to ensure the stability of contract provisions, especially those backed by sovereign guarantees, has negative implications for attracting investment into the industrial sector.
[16] Natural Gas Allocation and Management Policy, 2005.

### 3.3.1 The short-term fix: increase households' gas tariffs

In our opinion, the very reason a formal allocation policy exists *is* because of the shortage of natural gas. Like any other shortage, this is, *fundamentally*, due to mispricing. Natural gas has been too cheap for too long, and this has led to overconsumption and underproduction. The most wasteful of natural gas consumers appear to be households.

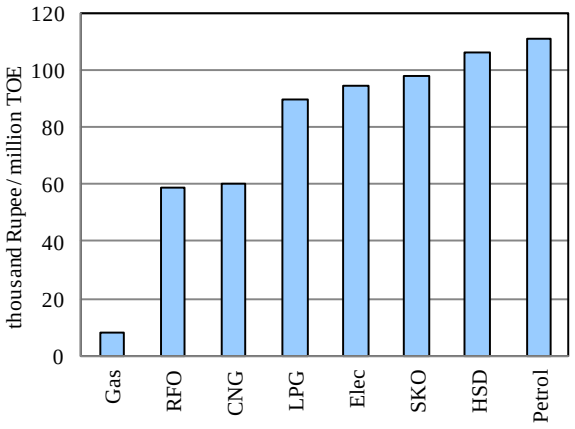
**Figure 3.2: Connections in FY11**




**Source:** Energy Yearbook FY11; HIES FY11

In FY11, households consumed 5.4 million tons of oil equivalents (TOE) of energy in the form of natural gas. This is 72 percent *higher* than the amount of energy that households consumed in the form of electricity during the same period.[17] The amount of energy consumed by households in the form of natural gas is equal to roughly 63.2 thousand gigawatt hours (GWh); putting this in perspective, the *total* amount of electricity generated in the country during FY11 was 99.8 thousand GWh. Natural gas consumers also represent a minority in Pakistan: only 23 percent of households have a natural gas connection (**Figure 3.2**).

**Figure 3.3: Prices of Various Fuels (July 2012)**




**Source:** NEPRA; OGRA; Analyst calculations

The reason that households use so much gas is straightforward: natural gas is grossly underpriced when compared to other fuels that households consume (**Figure 3.3**). Most consumers do not switch off their geysers after using hot water because the disutility incurred from switching off the geyser is actually greater than the marginal cost of keeping it on (**Box 3.3**).

**Box 3.3: Household Heating and Profligate Geysers**

Any heating process requires a significant amount of energy. While natural gas heats water directly using a flame, electric geysers work on the same principle as an iron does. Solar heaters simply use the sun's energy to warm water. Electric heaters are the most efficient since all electric energy is transferred to the water, while there are heat losses in solar and gas geysers.

According to industry experts, a 35 gallon gas geyser uses 29,000 BTU/hour. A 1.5 ton air conditioner uses 18,000 BTU/hr. Both appliances, however, have a thermostat, that switches the appliance off when the water/room has reached a certain temperature. A faulty thermostat can result in excess usage of energy. Consumers invest a considerable amount of money to buy energy-efficient air conditioners, but there are no such concerns when it comes to the geyser. In the absence of any quality standards, the informal sector has captured a significant share of the geyser market. Such geysers have insensitive thermostats and are scarcely ever serviced.

The energy wastage here is immense. Once again, consumers do not invest in energy-efficient geysers and are indifferent to quality due to the price of gas. The price of gas must be raised to encourage conservation, and quality standards for appliances must be formulated and strictly enforced.

[17] While electricity is used to power almost all household appliances, natural gas is only used for heating purposes.

In effect, the gas bill for households receiving piped gas is effectively irrelevant – the cost of gas does not impact consumption behavior in a significant manner. This arbitrage has encouraged the use of gas generators in households to the point where it is actually cheaper to power a house using a gas-fuelled generator, than keeping it on the grid. In effect, households take a rational decision by exploiting the differential between gas and electricity tariffs. In the absence of a proper price incentive, efforts to conserve gas by households will simply not happen.

Therefore, from a purely economic point of view, the price of gas to households needs to be increased sharply. Currently, households can reduce their natural gas consumption substantially, without a measurable impact on welfare, just by switching off heating appliances when not in use. The argument is made even stronger by the fact that natural gas is used only by urban households with above average incomes – *not* the common man.[18] Such households are also more likely to be able to afford investments in conservation. In fact, household budgets can actually improve in areas that have the most potential for conservation.[19] Each unit of gas saved by this measure can be diverted to power plants to alleviate the power shortage, decrease the cost of generation and power tariffs, and in turn, improve household budgets.

In our view, a rise in gas prices is not only needed, but also inevitable. As indigenous supplies dwindle, Pakistan will be forced to either import gas or shift away from this energy source altogether. Imported natural gas (through either the pipelines, or LNG) is significantly more expensive than indigenous gas.[20] As the average cost of piped gas increases, the government will have to pass that increase on to consumers – if it does not, it risks the formation of another circular debt scenario in the natural gas supply chain.

### 3.3.2 The long-run fix: restructure incentives along the value chain

While rationalizing the price of natural gas may re-allocate this resource more efficiently in the short-term, a more sustainable solution will require structural changes. Incentives across the value chain have to be aligned in such a way that encourages exploration and production (E&P), discourages wastage, allocates the resource amongst competing consumers most efficiently, and improves access to the resource.

*Incentives for exploration and production*

The single most important incentive for E&P companies is the well-head price of natural gas. One of the reasons for the current level of underproduction is the low price that E&P companies realize for their commercial activities.[21] The recently introduced Petroleum Policy 2012 has addressed the issue by raising prices to roughly US $6/mmbtu, but the risk-reward tradeoff may still not be attractive enough to secure meaningful foreign investment. The risks that E&P companies cite as deterrents include security; policy uncertainty;[22] and contract enforcement.[23] Finally, there is no authentic third-

[18] The choice of heating fuel for poorer households is either LPG or firewood. Both are more expensive per unit of energy than natural gas.

[19] Sindh, for instance, accounted for 34 percent of gas connections in FY11 and presents the greatest potential for conservation, given its relatively milder and shorter winters.

[20] The pricing of the pipelines is linked to basket of crude oil. Iran-Pakistan (IP) is priced at 80 percent of a basket of crude oil, while Turkmenistan-Afghanistan-Pakistan-India (TAPI) is priced at 70 percent of a basket of crude oil. To put this in perspective, furnace oil usually trades at a 20 percent discount to crude oil. Thus, the price of imported piped natural gas will be subject to the volatility of oil prices. LNG prices, meanwhile, are trading at an all-time high right now: current prices are slightly below US $20/mmbtu, as compared to tariffs for households, which are currently at US $1-3/mmbtu.

[21] E&P costs in Pakistan are relatively high given that the country's natural gas reserves are found at a greater than average depth, and given problems of terrain and infrastructure.

[22] Petroleum policies have been revised in 1994, 1997, 2001, 2007, 2009 and in 2012.

[23] The last point is particularly relevant for E&P companies, which have to operate on a much longer investment horizon than most other investors.

party estimate of Pakistan's natural gas reserves, which keeps Pakistan under the radar for foreign investors.

*Transmission and distribution companies*
The incentives for transmission and distribution companies must also be aligned with the long-run needs of the country. Currently, the two gas utility companies, SSGC and SNGPL, are compensated on a return-on-asset basis, after adjusting for gas losses and theft. Thus, these companies have an incentive to expand their network beyond what may be economically feasible. Under the current incentive structure, the utility companies will find it more profitable to serve multiple households than just one bulk consumer, e.g., a power plant. This skewed incentive has worsened the gas crisis as utility companies have increased the number of connections without a commensurate increase in the amount of gas in their pipelines. Therefore, the country needs to move towards a more market-based mechanism for the allocation of natural gas.

While transmission companies may be considered natural monopolies, distribution companies are not, and should be made to compete with each other. Companies along the value chain should be allowed to transact directly with each other, and the government's role in setting prices and quantities needs to be reduced. In fact, given the need for greater energy security, the government should prioritize natural gas conservation, impose efficiency standards for heating appliances, enforce production standards in industries, and facilitate investment by strengthening regulatory institutions.

### 3.4 The final word: Pakistan's energy mix and the government's role

The current energy situation is not sustainable. Years of suppressed tariffs and public sector control over E&P companies, power producers and utilities, have inculcated the mindset that the government *must* provide access to cheap energy. Unfortunately, energy is anything but cheap in the modern age, and the country is, and should be, transitioning towards less government control in the energy sector.

However, the government's role in guiding the evolution of the energy sector remains paramount. On the supply side, the country's energy mix needs to be based upon an indigenous fuel source (e.g., coal, natural gas or hydel) or, a robust and secure source of imports. However, with our dwindling natural gas supplies and the uncertain feasibility of Thar coal, incentives for exploration and production must be formulated and regulators need to be empowered. Similarly, the government must continue to play a facilitating role in encouraging investments in alternative and renewable energy – particularly in hydel-generation using both large and small dams.

While supply initiatives are a critical part of a long-term solution, energy conservation must be encouraged to manage the demand-supply gap in the short-run. Both natural gas and electricity tariffs for households need to be rationalized to encourage households to invest in more efficient appliances and decrease wastage. Ultimately, sustainable economic development will depend on replacing the mindset of a *right* to cheap energy, with a culture that encourages conservation.