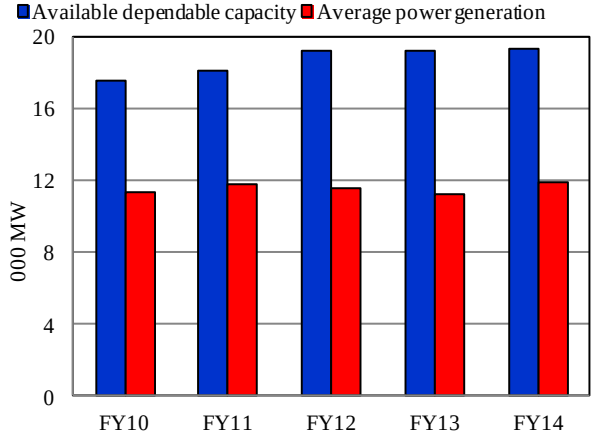
3 Energy

3.1 Overview

The last several years witnessed a policy emphasis to increase the country's power generation capacity. This has brought mixed results, as the existing distribution system is not in a position to supply more than 15,000 MW for an extended period of time. In effect, the more binding bottleneck at this time is distribution, not generation (**Figure 3.1**). Therefore, even if existing generating units are geared up to operate three-fourth of their capacity, the country simply does not have the infrastructure to distribute this power to end-users. Hence, greater policy focus is needed on distribution, which suggests early restructuring (and privatization) of distribution companies and public investment in distribution.

Figure 3.1: Power Generation and Capacity



Source: CPPA & NTDC

FY14 started on a positive note, with settlement of the circular debt in June 2013 (see **Box 3.1** for a list of initiatives taken by the government in FY14). Furthermore, the newly elected government was very clear and committed to resolve the root causes for the power crisis. Specifically, the government committed to implement a time-bound plan to tackle price distortions; inadequate collections; costly and poorly targeted subsidies; governance and regulatory deficiencies; and low efficiency in the supply and distribution of energy. Unfortunately, most of the needed reforms (e.g., privatization of distribution companies; increase in household tariffs; price rationalization of CNG; and lower priority to households in gas allocations) either could not be initiated, or made very slow progress.

In fact, the problems in the system have worsened as reflected in the persistence of load management, and the re-emergence of circular debt despite the settlement in end-FY13. Although FY14 witnessed fewer days when the demand-supply gap exceeded 4,000 MW (compared to the previous year), a comparison with the period before FY12, shows a marked deterioration.

While supply initiatives are a critical part of a long-term solution, energy conservation must be promoted to manage the demand-supply gap in the short-run. On the demand side, no policy initiative was implemented to rationalize power consumption. Although the government increased tariffs during Q1-FY14, its incidence was more on commercial users and industries (i.e. productive users), compared to household users who are less productive from an economic point of view. Given the need to rebalance power consumption between productive and non-productive users, these tariff revisions could have been better targeted. We believe that without bringing the consumption mix to a more optimum level, the likelihood of exiting the ongoing power crisis is not promising. Both natural gas and electricity tariffs for households, need to be rationalized to encourage households to invest in more efficient appliances and reduce wastage. Ultimately, sustainable economic development will depend on changing the mindset that cheap energy is a right, with a culture that encourages conservation and productive usage.

The problems in the energy sector are too perverse for quick fixes. In the short run, there is an urgent need to overhaul the existing distribution system on a war footing. Only then should the government focus on capacity that will be brought on-line in the coming years. Re-allocation of scarce gas to the power sector from fertilizer and transport, could have positive implications on power generation, which has strong spillover on the rest of the economy. This re-allocation will not only improve existing generation capacity in the country, but will also be cost effective; it could also allow the restructured Gencos and Discos to focus on their distribution bottlenecks.

The existing generation mix is inefficient, and may not be fixed in the short run. Increasing tariff rates is politically difficult in the backdrop of the public protests in recent months. Hence, there is a need to focus on shifting oil-based projects to coal, and to accelerate gas exploration to ensure smooth and adequate gas supplies. In effect, policymakers need to take on the structural and complex challenges facing the energy sector, and not focus only on short-term fixes that will surely throw up more problems in the future.

Box 3.1: Key Initiatives in the Energy Sector taken by the Government

Power related:

1. Settled the circular debt (Rs 342 billion payment on 28th June 2013, and a non-cash settlement of Rs 138 billion on 21st July 2013).

2. Increased end-user tariffs for commercial and industries, and revised the user slabs for households. This led to a reduction in the Tariff Differential Subsidy in FY14, compared to the previous year.

3. Legislated against power theft: 861 industrial and 6,900 household users, have been convicted in the last eight months of FY14.

4. Issued a Power Policy to support the current and future energy needs of the country. The main targets set for 2017 are: (a) to fully eliminate load shedding; (b) to reduce the cost of power generation from 12 cents/unit to 10 cents/unit; (c) to bring down transmission losses from 25 percent to 16 percent; and (d) to improve collection from bills to 95 percent.

Gas related:

1. Promulgated The Gas (Theft Control & Recovery) Ordinance 2014. This empowers the government to establish Gas Utility Courts at provincial and district levels, which will have the authority to decide cases against gas defaulters, similar to the Finance Recovery under Financial Institutions (Recovery of Finances) Ordinance.

2. Issued 50 new licenses for oil and gas exploration after a gap of four years. This initiative is likely to increase exploration and production activity.

3. Issued a license to Elengy Terminal of Pakistan Limited (a subsidiary of Engro Corp) to built an LNG terminal at Port Qasim.

4. An additional LNG terminal at Gwadar Port is planned, which will be connected through a 711 km pipeline to the SSGC network at Nawabshah. This pipeline has similar technical specifications as the proposed IP gas pipeline project, and can also be used for the IP project.

Coal related:

1. The Government of Pakistan has leased out the following coal blocks in Thar, Sindh:
   (a) Block-II to a joint venture of Government of Sindh and M/s Engro Powergen (Pvt) limited for a 600-1,000 MW power plant;
   (b) Block-III to M/s Cougar Energy UK limited for Underground Coal Gasification and establishing a 400 MW Power Plant;
   (c) Block-IV to M/s Bin Daen Group, UAE for developing a coal mine and installing a 1,000 MW Power Plant;
   (d) Block-V to the Planning Commission for a 50 MW Underground Coal Gasification project; and
   (e) Block-VI to M/s Oracle Coalfield Plc, UK for developing a coal mine and installing 300 MW power plant that can be upgraded to 1,000 MW.

3.2 Power

Load management is stubbornly high[1]

Pakistan has been suffering from an acute power shortage for the past several years. Instead of addressing core issues (e.g. price distortions; high cost of power generation; governance and regulatory deficiencies; low efficiency in transmission and distribution; etc.), policymakers appear to be more focused on increasing power generation (e.g. settlement of the circular debt; rental power project; adding more gas-based generation capacity). Furthermore, policy initiatives to rationalize power consumption are lacking. As a result, while there is no perceptible improvement in power generation (supply), demand continues to grow strongly (**Table 3.1**). Not surprisingly, the demand-supply gap is stubbornly high at around 4,000 MW for the last three years.

Table 3.1: Demand-Supply Gap in Power

	Average power generation		Average power peak demand	
	MW	% Change	MW	% Change
FY08	11,347	-4.6	13,420	8.4
FY09	10,982	-3.2	13,630	1.6
FY10	11,374	3.6	14,715	8.0
FY11	11,808	3.8	14,696	-0.1
FY12	11,580	-1.9	15,470	5.3
FY13	11,267	-2.7	15,266	-1.3
FY14	11,924	5.8	15,774	3.3
CAGR		0.03		3.53

Source: NTDC; Analyst estimates

Load management in excess of 4,000 MW on a given day, which used to be an exception in FY08, has become a norm in recent years (**Table 3.2**). [2, 3] Although FY14 recorded a slight improvement over the previous year, the prevailing level of load management is very high, even surpassing 7,300 MW in May 2014.

Table 3.2: Dynamics of Load Management

	Average load management (MW per day)	Max load management (MW per day)	No of days observing >4,000 MW load management
FY08	2,073	5,454	55
FY09	2,648	7,018	96
FY10	3,334	6,408	129
FY11	2,888	6,151	63
FY12	3,889	8,393	167
FY13	3,999	7,078	200
FY14	3,858	7,305	183

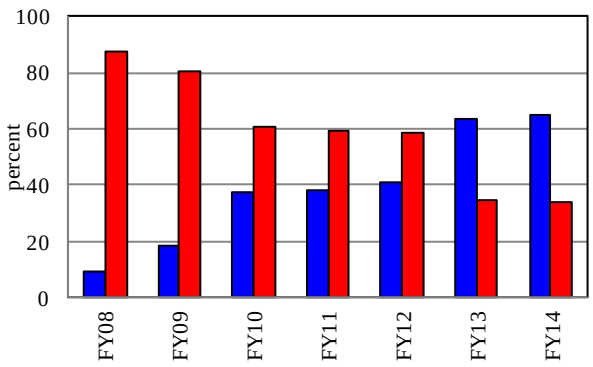
Source: NTDC; Analyst estimates

Distribution constraints are a key bottleneck:

In our view, it is the old and poorly managed power *distribution* network – not inadequate generation capacity– which is keeping load management at such high levels. The prevailing transmission & distribution (T&D) system can *reliably* handle loads of only 11,500-12,500 MW during a given period. In other words, any load beyond this increases the likelihood of a breakdown in the distribution network, which is becoming more common.

This means the existing T&D network is a more binding constraint than generation capacity. This view gets further support from the fact that load management owing to a generation shortfall, has actually been *falling* over the years (**Figure 3.2**). The real problem

Figure 3.2: Sources of Load Management (share in total LM)



Source: NTDC

[1] Load management is controlling demand according to available power supply. In simple terms, it entails rationing available supply to much higher demand.
[2] In FY08, average load management was 2,073 MW which has swelled to 3,858 MW in FY14.
[3] Load management of 4,000 MW reflects almost 6 hour of nationwide load shedding. A load shedding of less than 6 hours in any region would imply a higher load management in other parts.

is the distribution constraint, which has been dominating the power sector since FY12. As shown in **Figure 3.2**, almost 65 percent of load management in FY14, was due to faulty distribution networks. [4]

The distribution network is especially vulnerable to failure when public pressure forces Discos to supply more power. For example, distribution faced frequent breakdowns during the period 23rd July 2013 to 1st August 2013, when the burden on distribution networks exceeded 15,000 MW for an extended period of time. As a result, electric feeders tripped from the overload, and it took almost 15 days for the repair work. During this period, nearly 80 percent of the load management was due to distribution constraints.

Without upgrading the existing distribution network, any addition to generation capacity (and even the settlement of the circular debt) could not ease load management on a sustainable basis. Unfortunately, despite this hard constraint, policy has mostly focused on generation. For example, the FY14 budget allocated Rs 212 billion to operationalize on-going power projects (with combined capacity of 1,344 MW). Of these projects, 85 percent were gas-based, despite the fact that almost 70 percent of existing gas-based capacity has remained under-utilized (during the year) due to on-going gas shortages. Hence, it is likely that new gas-based plants would also remain underutilized after completion.

A better policy option would have been to make more gas available to the power sector. The prime candidates for gas curtailment could be households and CNG, which are less productive compared to industry.[5] However, because of political commitments, it will be difficult for the government to divert gas to the power sector. One viable option is to divert gas from the fertilizer sector. According to our assessment, if we divert gas from fertilizer to power, this would allow additional generation of 1,900MW, using existing idle capacity (see **Special Section 3.1**).[6] In addition, the country will gain from lower imports of furnace oil (FO), which would compensate for the additional import of fertilizer.

The disconnect between the constraints facing the power sector, and the needed policy actions, is also evident in the National Power Policy and Vision 2025. These policy documents have mainly focused on *new* capacity to resolve the current power crisis. Although the National Power Policy acknowledges the importance of redesigning the national grid to minimize line losses, this document is silent about the need to up-grade the existing network. Similarly, Vision 2025 seeks to add a further 25,000 MW by 2025, without taking into account the need to improve transmission & distribution.

Reduce the cost of base-load as a priority

Financial sustainability of the power sector is strongly linked with the cost of generating the country's base-load.[7] However in Pakistan, the base-load has shifted from low cost hydel to more expensive thermal generation, especially using furnace oil (**Table 3.3**). There are several reasons for this suboptimal shift, but the

Table 3.3: Generation Mix (as a percent of total)

	Hydel	Thermal	Nuclear
1970s	52	45	3
1980s	53	46	1
1990s	39	60	1
2000s	30	67	3
FY14	31	64	5

Source: Planning Commission and CPPA

[4] Load management is done either due to generation constraints (Lack of generation capacity) or distribution constraints (non availability of transmission and distribution system due to faults despite having the generation capacity). As Pakistan is not having one grid system, both types of load management can occur simultaneously.
[5] One should also realize that the power sector gets low priority in gas allocation, which is one of the reasons for excessive idle capacity in gas-based power plants.
[6] Diversion of gas from fertilizer would be difficult because of existing sovereign gas supply contracts. There is an urgent need to revisit the gas supply contracts with fertilizer to ensure optimal utilization of existing natural gas in the country.
[7] Base load requirement (also base-load) is the minimum level of demand on a power supply system.

lack of long term vision appears to be the real culprit. For example, instead of expanding the hydel base or moving towards coal (both require long gestation periods), past governments wanted quick solutions.

Table 3.4: Thermal Generation Mix (percent of thermal)

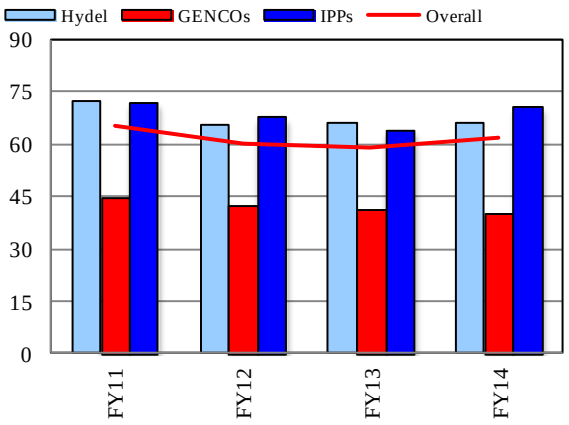
	Oil*	Gas	Coal
2008-09	39.4	60.4	0.2
2009-10	52.1	47.7	0.2
2010-11	55.1	44.7	0.2
2011-12	54.7	45.1	0.2
2012-13	56.0	43.9	0.1
2013-14	61.9	37.9	0.2

Source: Pakistan Energy Year Book and CPPA
*Furnace oil make up almost 98 percent of oil consumption in power generation.

The Power Policy of 1994 provided attractive tariffs to new plants that were operating on furnace oil (FO) and gas, with a bias towards the former.[8,9] Later on, with growing excess demand for natural gas,[10] FO evolved as the single most reliable fuel for thermal generation (**Table 3.4**). At the moment, 40 percent of the total power generated in the country is coming from FO (up from 32 percent in FY08). In comparison, this share is only 2 percent for Asia, and 5 percent glabally in FY13.

This transition towards expensive fuels has made Pakistan's external account more vulnerable. Not only have FO prices increased by 60 percent in global markets during the last seven years, import demand also increased in response to the conversion of existing gas-based plants, and the commissioning of new FO-based power plants. One must also factor in the impact from a depreciating PKR during these years. In a nutshell, the growing dependency on furnace oil, substantially increased the cost of domestic power generation.

Figure 3.3: Capacity Utilization (in percent)



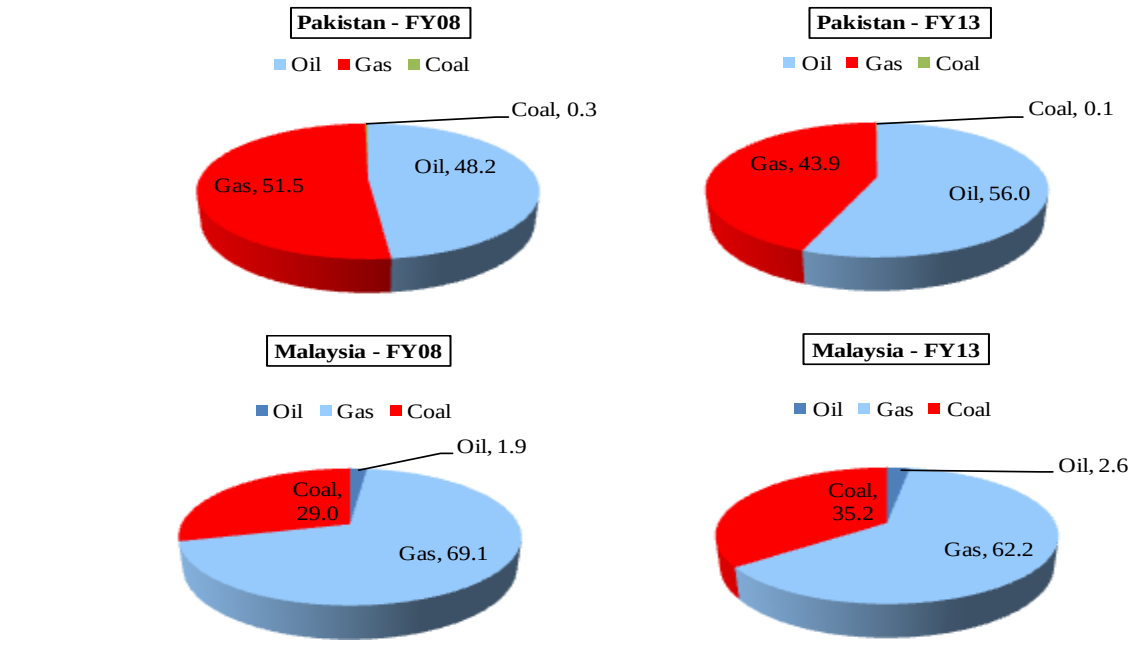
Source: CPPA and analyst calculations

To make matters worse, successive governments have hesitated in passing-on the higher cost of generation to end-users. Over time, as the power subsidy grew, the mounting fiscal burden created of circular debts, and an abnormally large idle capacity in the power sector (**Figure 3.3**). It appears as if reforms to balance the generation mix, or to pass-on the higher cost of generation to end-users, are low priority for policymakers. Instead, the focus is on settling the circular debt (an adhoc solution offering some breathing space), which means idle capacity re-emerges after a few months.[11]

If country experiences are a useful guide, Malaysia provides an excellent example, as it has been substituting gas with coal despite being a coal importing country (see **Figure 3.4**).

[8] About 75 percent of these plants operate on furnace oil, whereas the remaining plants require natural gas for generation of electricity.
[9] One can understand the intricacies of policy making to deal with the power crisis, but this should not allow us to overlook the options that we missed in the past when we had comfortable space to undertake long-term policy decision. In retrospect, one can argue that had such generous tariffs offered to IPPs, were also available to hydel, the country would have been in much more comfortable position in view of low cost of power generation.
[10] Gas supplies to power sector peaked in 2005, since then there is a consistent decline.
[11] Following the end-June 2013 settlement of the circular debt, the capacity utilization of furnace oil based power plants rose from an average of 56 percent (prior to the settlement of the circular debt in H2 FY13) to 73 percent (Jul-Oct FY14), before declining again to 63 percent (Nov-Jun FY14) as the circular debt starts constraing cash flows to power generation companies.

Figure 3.4: Substitution of Generation Source from Natural Gas-Disaggregation of Thermal



Source: International Energy Agency

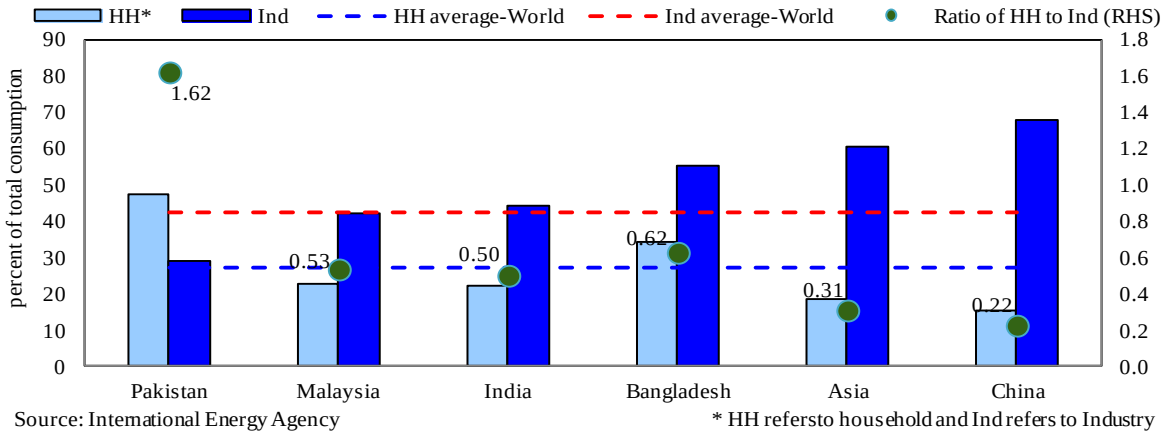
In Pakistan, the issue of replacing FO with cheaper substitutes (e.g. hydle or coal) does not appear to have much traction (see **Special Section 3.2**).[12] On top of this, Pakistan continues to encourage inefficient use of scarce natural gas (see **Section 3.3**).

Consumption mix is skewed towards less productive users

So far, we have explored supply-side issues like the growing distribution constraints and costlier base-load. An understanding of demand-related factors is also essential to get a better handle on the ongoing power shortages in the country.

In this context, the key issue is the skewed consumption mix towards less-productive users like households. Specifically, Pakistani households consume around 47 percent of the power generated,

Figure 3.5: Demand Side of Power Sector



Source: International Energy Agency

* HH refers to household and Ind refers to Industry

[12] Hydel generation remained almost constant during 1990s and 2000s (share in total declined from 53 percent in 1980s to 30 percent in 2000s). Moreover we could not exploit Thar coal despite the fact these reserves were found in 1994 (Source: US Department, Geological Survey Open-File Report).

whereas industry only gets 29 percent – this contrast sharply with Bangladesh, where industry consumes 55 percent of electricity supplied and households only get 34 percent (**Figure 3.5**). This consumption pattern has severe implications, as households are not only subsidized, they also contribute more to transmission and distribution losses (e.g., theft and technical line losses).[13]

Subsidized households monopolize consumption

We have mentioned earlier that successive governments have subsidized power to households. Currently, against the average cost of generation of Rs 14.95/KWh, the realized tariff from *all* end-users is only Rs 11.21/KWh while households pay Rs 8.66/KWh against the NEPRA determined household tariff of Rs 13.76/KWh. Thus, the government provides a subsidy of Rs 3.74 on each unit of power consumed in the country, with households getting Rs 5.10 per unit.

One should realize that unless tariffs cover the cost of providing electricity to consumers, the power sector will continue to remain financially unviable. Although the government has increased effective tariffs during Q1-FY14, the bulk of the incidence is on commercial users and industry (productive users), compared to households (less productive).[14] As mentioned earlier, these tariff revisions are not well targeted; subsidized power has encouraged households to consume more, which in turn, adds to the government's fiscal burden. Hence, as shown in **Table 3.5**, the actual expense on subsidies always exceeds the budgetary allocation by a wide margin. During the last five year, the government has spent, on average, Rs 304 billion every year to subsidize power consumption, and most of it goes to households.[15]

Table 3.5: Power Sector Subsidies[1]
billion Rupee

	FY10		FY11		FY12		FY13		FY14	
	Allocated	**Released**	**Allocated**	**Released**	**Allocated**	**Released**	**Allocated**	**Released**	**Allocated**	**Released**
A. Pepco										
Tariff differential	10	93	30	285	50	412	120	250	150	230
Others	53	53	54	14	73	7	15	15	15	15
Sub-total (A)	**63**	**147**	**84**	**299**	**123**	**419**	**135**	**265**	**165**	**245**
B. KE										
Tariff differential	2	32	2	46	24	45	50	64	55	64
Others	2	0.5	1.3	1.3	0.6	0.0	0.3	0.3	0.0	0.3
Sub-total (A)	**4**	**32**	**3**	**47**	**25**	**45**	**50**	**64**	**55**	**64**
Grand Total (A+B)	**67**	**179**	**87**	**346**	**147**	**464**	**185**	**329**	**220**	**309**
Tariff differential	12	125	32	331	74	457	170	314	205	294

Note: Allocated amount is the one decided at the time of budget announcement, while released amount is the one which got actually
1. In FY13, the government settled Rs 480 billion under the outstanding circular debt. In the first phase, an amount of Rs 342 billion was paid on 28th June 2013, whereas the second phase involved the non-cash settlement of Rs 138 billion as on 21st July 2013. This settlement was reflected in net lending to PSEs (this was different from the earlier practice when payment of the circular debt was part of power subsidies).
Source: Budget Documents, several issues

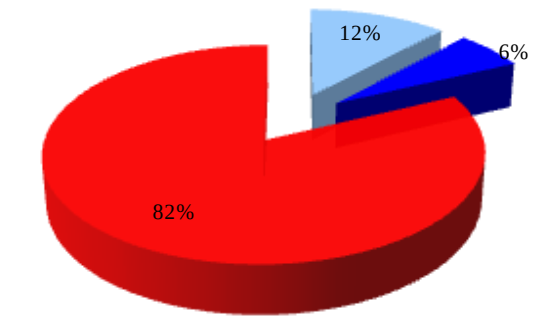
In principle, protecting poor and small (lifeline) users that consume up to 100 KWh/month, should be encouraged. But our assessment identifies some basic problems in this 'untargeted subsidy' (see

[13] It is pertinent to note here that 11kV and below feeders (which primarily caters to the household power needs) contributed almost 94 percent of the *unplanned* outages and accounted for almost 88 percent of distribution losses to Discos during FY13.
[14] In August, 2013, government increased the end-user tariffs for commercial and industries, and revised the users slabs for households. Household tariffs are kept below what industrial and commercial users pay: when commercial and industrial tariffs were increased by 39 percent and 41 percent respectively, in August 2013, effective tariff on household were increased by 30 percent.
[15] Encouragingly, the power subsidy has declined in FY14, compared to the previous year.

SBP's Annual Report FY13, for a more detailed discussion). According to our findings based on K-Electric data, almost 51 percent of the household subsidy is realized by customers who are using (on average) more than 301 KWh/month; lifeline users, on the other hand, get only 1.6 percent of the total household subsidy. In nominal terms, the heaviest household users (consuming more than 700 KWh/month – who use more than two air conditioners) get Rs 6,631 per month as subsidy, whereas lifeline users receive only Rs 420. There is a dire need to correct this anomaly.

We realize that phasing out subsidies is not easy, as beneficiaries would resist such a move. After years of suppressed tariffs, people in general consider cheap power as their state-given right. This view was well reflected in the response to a specific question *Will households pay if power cuts are eliminated and tariff is increased by 10%?*, which was asked in a recent survey conducted by Sustainable Development Policy Institute (SDPI).[16] Alarmingly, more than 80 percent of those surveyed, revealed their unwillingness to pay the higher price, even with the elimination of power cuts (**Figure 3.6**).

Figure 3.6: SDPI Survey Results



Source: SDPI

Although we do not have hard data on unpaid household power bills, according to the Ministry of Water and Power, the private sector (which also includes industries) make up over 65 percent of the total outstanding receivables of distribution companies as of end-May 2014.[17] In fact, the bill recovery rate has fallen to 87.8 percent in Jul-May 2014, from 92.1 percent during the corresponding period of the previous year.

In addition, unreliable and old generation plants; low-voltage transmission and distribution lines; weak grid infrastructure and its inappropriate location (see **Box 3.2**); inaccurate metering and billing; un-metered supplies; and theft from illegal connections, explain the exceptionally high T&D losses in Pakistan. Depending on the efficiency of the relevant Disco, distribution losses in Pakistan range from 9.5 to 34.3 percent, which compares poorly with Bangladesh (11.8 percent), China (5.8 percent), and Asia (7.9 percent).

Nepra punishes inefficient Discos, by allowing only 10 percent distribution losses, with additional losses eating into the Discos' earnings. However, since the government assumes all losses of inefficient Discos, efficient Discos subsidize inefficient ones, which effectively penalizes better performance.

Encouragingly, the government has introduced legislations to convict individuals/entities involved in power theft. During the last eight months, a total of 9,393 consumers (industrial, commercial and households) have been convicted for power theft. Out of these, 6,900 were households, 1,632 commercial, and 861 were industrial consumers.

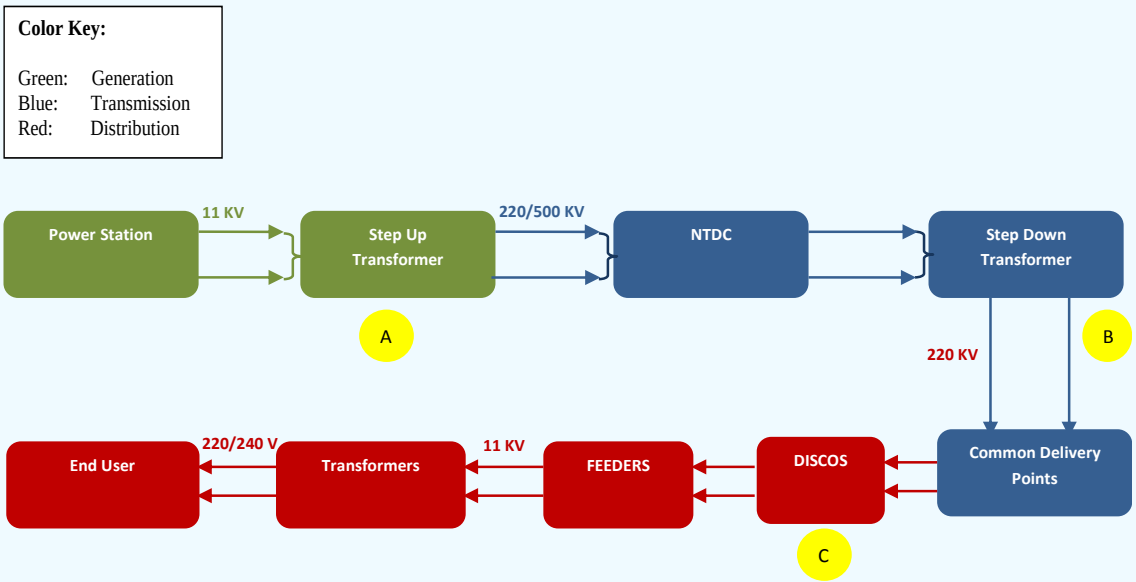
[16] Source: How to Solve Pakistan's Power Crisis? A Brief Prepared for Policy Symposium on Energy Reforms in Pakistan http://www.sdpi.org/publications/files/Final%20Policy%20Brief-Energy.pdf .
[17] Out of the total receivables of Rs 520 billion as of end-May 2014, private sector contributed Rs 352.1 billion.

Conclusion

Adding generation is not the solution; the immediate solution lies in overhauling the existing transmission and distribution system on a war footing, and lowering the cost of generation by reducing reliance on FO. In terms of the latter, the policy option to re allocate natural gas from unproductive uses to the power sector, could be considered in the short-term. The government should not only address financing issue (settlement of circular debt or meeting power subsidies), but also focus on the fundamentals of power demand and supply in the country. There is an urgent need for well thought out plans and calibrated efforts, to pull the economy out of the ongoing power crisis.

In the next few years, encouraging the use of coal, incentivizing gas exploration, and exploring renewable sources of energy (e.g., wind and solar) should be considered. Furthermore, the LNG import project need to be expedited. While the proposal to direct this gas to CNG users makes sense, it would be more efficient if the indigenous gas saved from CNG usage, is diverted to the power sector, instead of the households. Lastly, long term hydel projects should be pursued to enhance the long term sustainability of the power sector.

Box 3.2: Power Network in Pakistan



Loss of energy between point A and point B is technically called "transmission losses". Previously, National Electric Power Regulatory Authority (NEPRA) allowed NTDC to permit up to 2.5 percent for transmission losses in end-user tariffs. NTDC breached this limit for years and surprisingly, rather than asking NTDC to resolve the issue, NEPRA increased the permissible allowance to 3.0 percent in September 2013. Loss of energy from point B onward, is called "distribution losses". NEPRA allows up to 10 percent loss (as distribution losses) in determining end-user tariffs, it is pertinent to mention here, that in this era of technological advancement, there is no means in Pakistan of getting meter readings at point B and C in real time.

Another point to flag is that NEPRA recommends a tariff structure that rewards efficient Discos and punishes more inefficient ones, to incentivize the latter to reduce T&D losses. Technically, the entire T&D loss is covered by NEPRA allowed tariffs in Discos, posting less than 10 percent losses (efficient Discos), while Discos making more than 10 percent losses, are forced to carry these on their books. However, the unified tariff structure notified by the federal government, disregards this incentive; as a result, the combined losses of the Discos have to be borne by the federal government.

3.3 Natural Gas[18]

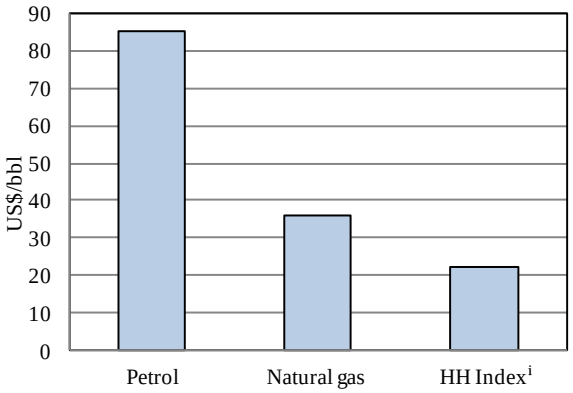
While low wellhead gas prices do not incentivize production, low end-user tariffs continue to increase consumption. FY13 was no exception, as the 1.6 percent fall in consumption was much lower than the 3.4 percent decline in gas production. In the meanwhile, as the government is allocating scarce gas to competing users on an *ad hoc* basis; CNG, Industrial, and Commercial users are lobbying policymakers to get a larger share in gas supply. In the transport sector, load management finally led to a fall in CNG consumption, but CNG tariffs continue to remain at a discount compared to alternate transport fuels. At the same time, curtailing the volume of Unaccounted for Gas (UFG) by gas utilities, remains a serious operating challenge in promoting the efficient use of this natural resource.[19]

3.3.1 Gas Reserves and Wellhead Price

Despite the fact that the Petroleum Policy 2012 has increased gas wellhead price, the offered price on gas production is still less than half what is paid for domestic oil production (**Figure 3.7**).

Having said this, compared to Henry Hub (the international gas price index), the wellhead gas price offered in Pakistan is at a premium.[20] It therefore appears that the margin offered by the government is not enough to attract foreign investment in this sector given the prevailing law and order situation in the country. Perhaps investors are looking for an additional security premium to invest in Pakistan.

Figure 3.7: Comparison of Wellhead Prices*



*based on August 2014; [i] Henry Hub International Gas Price Index
Source: OGDCL, Bloomberg

More importantly, inadequate wellhead prices explain the low gas discovery rate in the recent past, which has led to a steeper decline in existing gas reserves.[21] Specifically, low prices require the gas discoveries to be large enough to make it commercially feasible. As smaller gas fields make the net present value (NPV) of the investment negative, firms prefer to temporarily close such fields, only to re-open them when higher wellhead prices make the smaller fields viable.

3.3.2 Gas Tariffs and Consumption Demand

Low gas tariffs and large subsidies: According to estimates by the International Energy Association (IEA), Pakistan provides more gas subsidies compared to regional gas *exporting* countries (see **Box 3.3** for details).[22] To put this in perspective, the gas subsidy bill in Pakistan is comparable to Uzbekistan, which is a significant gas exporting country for its size.[23]

[18] Data on gas consumption is based on Energy Year Book 2013, which covers time period up to FY13.
[19] According to OGRA, the aggregate value of *permissible* UFG of the two utilities [i.e., SSGC (7 percent) & SNGPL (4.5 percent)] was Rs 14.5 billion for FY14.
[20] A higher wellhead gas price compared to Henry Hub gas price Index shows a potential opportunity for the foreign investor in this sector.
[21] By end of FY 13, the recoverable gas reserves was estimated at 24.74 trillion cft, down by more than half from the initial estimate of 55.66 trillion cft.
[22] IEA estimate shows implicit subsidies as Pakistan does not directly subsidize gas to end-users.
[23] We understand that estimates on subsidies, particularly in the gas sector, are sensitive to reference prices. But whatever benchmark price we use, the fact that Pakistan is comparable to Uzbekistan is quite alarming.

Box 3.3: Comparative Impact of Gas Subsidy

The International Energy Agency (IEA) evaluates gas subsidies provided in the various countries, using international reference prices (for details, see World Energy Outlook 2011). IEA calculates reference prices, and therefore subsidies on gas as per energy trade of a country.

If a country is a net gas importer, the reference price of gas is calculated using the nearest international hub after adjusting for quality differences, plus the cost of freight and insurance, and the cost of internal distribution and marketing, and any value-added tax (VAT) that is imposed. The subsidy measured in this case is based on the price-gap approach which represents budget expenditures from the domestic sale of imported energy at subsidized prices.

For countries that are net exporters, the reference price is also calculated using the nearest international hub, adjusted for quality differences, minus the cost of freight and insurance, plus the cost of internal distribution and marketing, and any VAT. Subsidies in this case, show the opportunity cost of pricing domestic energy below international levels.

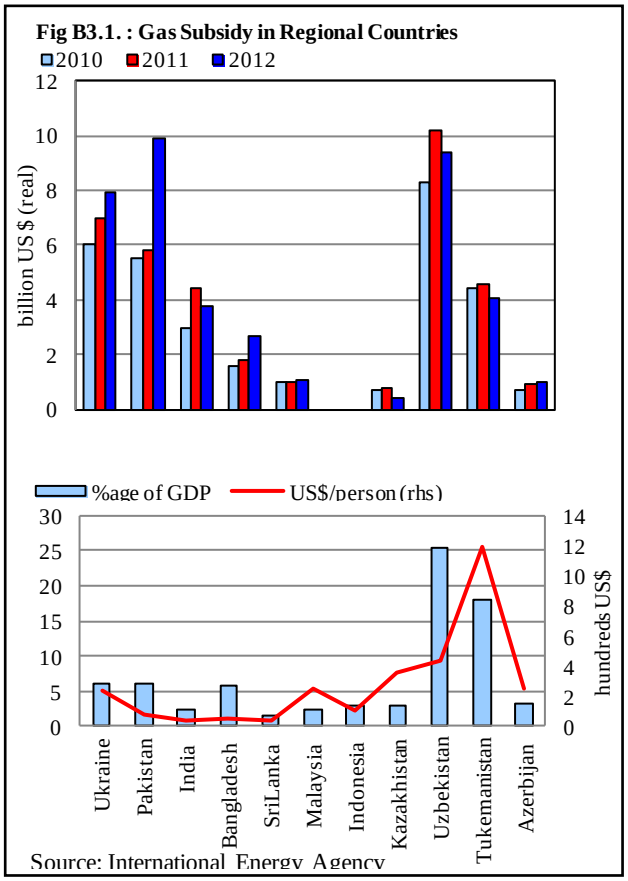


Figure B3.1 shows the macroeconomic impact of gas subsidies for a pool of regional developing countries as per IEA benchmark. Surprisingly, IEA estimates suggest that Pakistan has provided almost US$ 10 billion in gas subsidies in 2012. This figure is quite high because of the benchmark price used in these estimates. However, the fact that Pakistan is comparable to Uzbekistan (which is a gas exporting country) in terms of subsidy provided, is alarming (see **Figure B3.1**). In quantum, this amount was equivalent to 6 percent of GDP or US$ 78.6 per person. These outlays are substantially higher compared to regional countries like India, Malaysia or Bangladesh (see **Figure B3.1**).

The key takeaway from these discussions is that Pakistan is a net importer of energy, and yet subsidizes domestic consumers to the same extent as established energy exporters. This is a fiscal burden the government can ill afford.

Our assessment indicates that households – a major consumer of natural gas – are getting subsidized gas (**Figure 3.8**), which is being funded by CNG users and the commercial sector that pay much higher prices compared to households.[24,25]

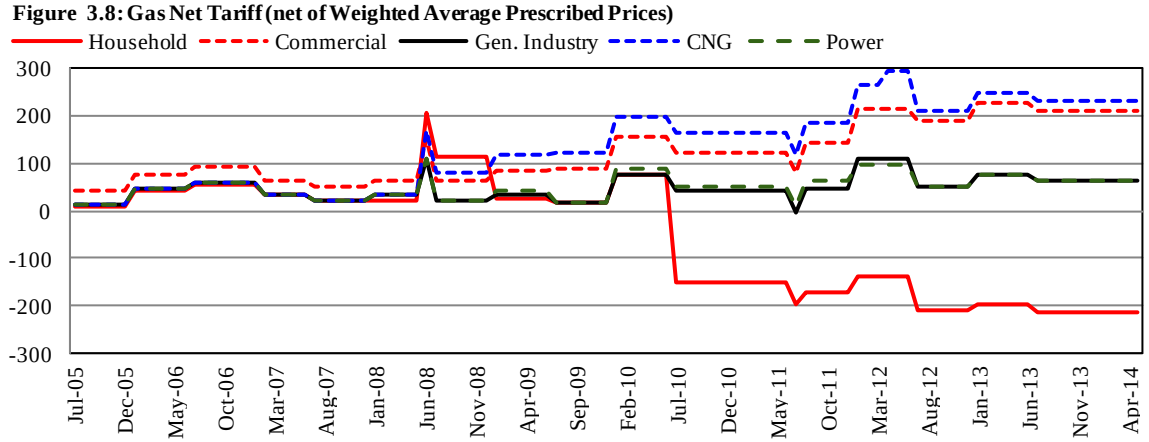
Gas Consumption by Households

The household sector not only gets subsidized gas, but it also has priority over other users, which exempts it from gas load shedding.[26]

[24] The net gas tariff that is price of per unit of gas paid by the end users over the cost of providing the gas to the end users, i.e., the Average Prescribed Price (APP). Negative values represent the subsidy that the user is getting on each unit of gas consumed, whereas positive values show revenue collected by the government under Natural Gas Development Surcharges (NGDS), which is part of the divisible pool. In FY14, the Federal government collected Rs 39 billion under the Gas Development Surcharge compared to Rs 16.2 billion in FY13.

[25] Average Prescribed Price (APP), recommended by OGRA, shows the revenue requirements of the two utilities (SSGCL and SNGPL) to conduct their operations smoothly. Revenue requirements cover fixed and operating cost of the utilities and the government of Pakistan's guaranteed return on their investment (See for details, OGRA Annual Report FY2012-13).

Figure 3.8: Gas Net Tariff (net of Weighted Average Prescribed Prices)



Source: EYB-2013, OGRA-2013

Thus, while other sectors have shown a decline in consumption due to load management, household consumption has consistently grown since 2005 (**Figure 3.9**). In FY13 alone, household consumption increased by 11.5 percent.

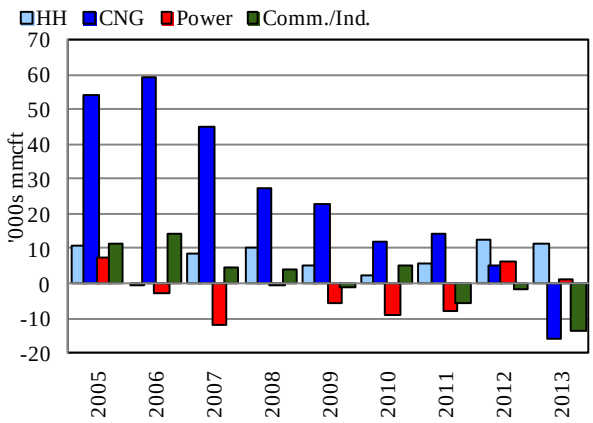
The priority given to households is somewhat surprising, as they are the least productive users because of limited downstream linkages. In our view, it makes more sense to give higher priority to power or industry, which have extensive economic linkages, and contribute directly to employment generation.

The uninterrupted gas supply to households, creates further inefficiencies. For example, households switch to inefficient gas-fuelled generators when power from the grid is interrupted.[27]

Additionally, a large number of cottage industries, in relatively industrialized areas of Sindh and Punjab, are registered as household consumers. Thus, informal economic activity not only increase household consumption, but also extends the gas subsidy to the informal sector.

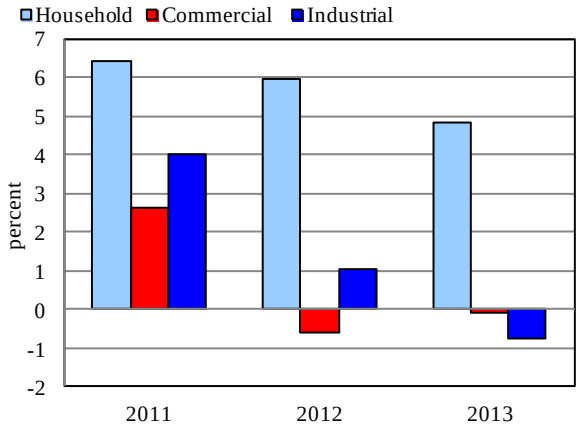
The government's pricing policy also contributes to excessive household gas consumption. Gas utilities like SNGPL and

Figure 3.9: Gas Consumption Growth



Source: EYB 2013

Figure 3.10: Growth in No. of Gas Consumers



Source: EYB 2013

[26] Ministry of Power & Natural Resources notification, No. NG (1)-7(158)/12-LS-Vol-IV, of 6th February 2013 Islamabad.
[27] SBP import data suggest that Pakistan has spent UD$ 54.44 million in FY14 and US$ 57.34 million in FY 13 on import of generators.

SSGC, are promised a 17 percent guaranteed return on their fixed assets, which means new connections (especially to households) increases their fixed assets, which improves their absolute returns.[28] Not surprisingly, these companies encourage the expansion of household connections, compared to other users. In FY13, the number of household consumers increased by 4.8 percent, in contrast to a decline in the number of commercial and industrial consumers (**Figure 3.10**).

Table 3.6: Comparison of CNG with Other Motor Fuel Prices

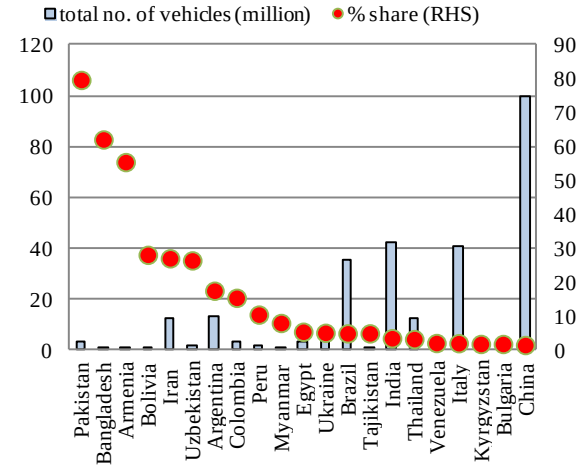
	Price (Rs. per liter/Kg)	Energy content (Kwh/unit)	Rs. per Kwh	CNG price to others
Petrol super	107.95	8.8	12.27	42.70
HS diesel	109.34	9.85	11.10	47.19
CNG	71.50	13.65	5.24	-

Technical details: 100 Cft= 2.04 Kg assuming density of methane is 0.72Kg/ Cubic meter, 950 BTU Energy assumed in 1CFT of natural gas, 1kwh=3412 BTU.
The calculation of this table is based on the August 2014 fuel prices.

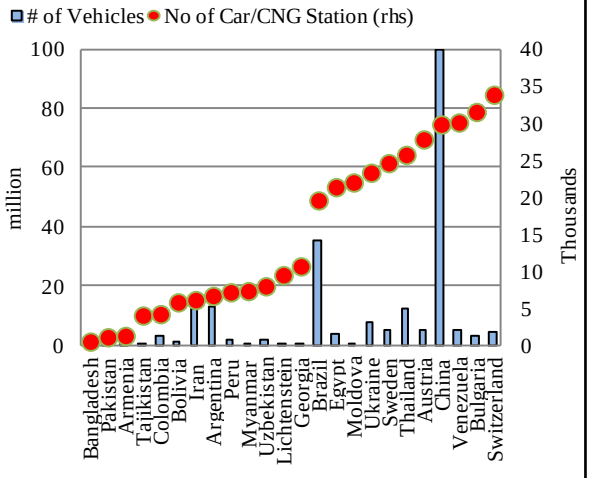
Furthermore, the gas pricing framework for these distribution companies, inadvertently relegates maintenance of existing infrastructure to a lower priority. As a consequence, the loss of gas (whether theft or leakages), that is generally known as Unaccounted For Gas (UFG), has been increasing over the past several years.[29]

Gas Load Management and Transport Sector:
For the first time, CNG consumption posted a (demand management led) decline of 15.8 percent in FY13 (**Figure 3.9**). This is much lower than the extent of load management the CNG sector is currently experiencing. According to media reports, CNG stations on SSGCL's network, were closed for 45 percent of FY13; and load management is even higher on the distribution system of SNGPL.[30] Anecdotal evidence suggests that consumers fill their fuel tanks a day before the announced gas holidays, which dilutes the impact of load management. Low CNG prices largely contribute to high demand; as shown in **Table 3.6**, CNG is available at a 42.7 percent discount compared to petrol (and 47.2 percent in terms of diesel).

Figure 3.11: Top Countries with CNG Vehichles



Countries with Lowest No of Cars/CNG Station



Source: Natural & Bio Gas Vehicles Association

[28] *Prescribed return per Government's policy decision, which currently is 17.5% in case of Sui Northern Gas Pipelines Limited and 17% in case of Sui Southern Gas Company limited of the value of their average net operating fixed assets* - OGRA Annual Report 2012-13.
[29] **Section UFG** deliberates further on this issue.
[30] SSGCL enforced 145 gas holidays in a year on the CNG station on its network.

Moreover, the promotion of CNG use in the past, thanks to a myopic gas policy, has encouraged people to switch to CNG. As a result, Pakistan has the least number of cars per CNG station in the world, only above Bangladesh (**Figure 3.11**).

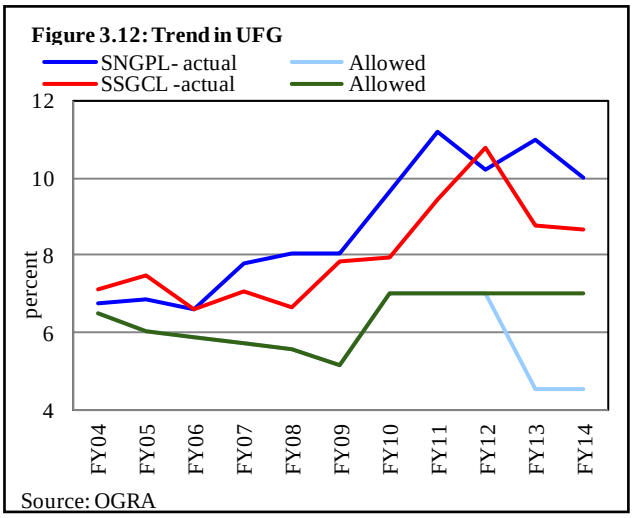
Cheap fuel and supportive infrastructure has promoted CNG use to unprecedented levels. Almost 80 percent of the three million vehicles currently operating in Pakistan run on CNG, which is again the highest in the world (**Figure 3.11**).

Perhaps linking CNG availability with the vehicle's engine size, would be more effective in managing domestic demand. For example, the CNG stations could be restricted to vehicles below1,000cc, as owners of bigger vehicles should have the ability to pay more for petroleum fuels. On a positive note, the recent increase in use of three wheeler CNG rickshaws for commercial transport, has provided much needed employment in some part of the country. Barring an outright ban on CNG usage in the transport sector, more judicious use is the need of the moment.

3.3.3 Unaccounted for Gas

The Unaccounted-for Gas (UFG), in Pakistan started increasing rapidly since FY06 reaching 11 percent by FY12 (**Figure 3.12**).[31,32] A number of factors are responsible: decaying pipelines, poor quality of meters, gas theft by meter-tampering, illegal connections, and leakages resulting from higher than required pressure in the distribution pipelines. In recent years however, the rise in theft has become a source of growing concern for gas utilities. To arrest this pilferage, the gas regulatory authority fixed the overall UFG target at 4 percent in FY12, which was soon increased to 4.5 percent. As any violation of this target triggers substantial penalties, this led to some improvement in the reported UFG since FY12.[33] However, as shown in **Figure 3.12**, actual UFG is much higher than the permissible maximum.

Figure 3.12: Trend in UFG



Source: OGRA

According to distribution companies, high UFG is due to: (i) the prevailing law and order situation in some part of the country; (ii) meter errors; and (iii) pilferage by users who are not registered consumers. Using this excuse, gas distribution companies are seeking regulatory relaxations, instead of reducing pilferage. Given the global norm for UFG is 4 percent maximum, the high UFG in Pakistan must be sternly checked.[34]

[31] Oil and Gas Regulatory Authority (OGRA) defines, unaccounted for gas as the difference between the total volume of gas purchased and the volume of metered gas supplied during a financial year by gas distribution companies to its consumers; excluding metered gas used by the companies themselves.

[32] According to World Bank Report, UFG in the OECD countries is around 1-2 percent.

[33] In FY11 and FY12, both utilities were allowed to account UFG at 7 percent by provincial Courts. Later on, Lahore High Court decided against the SNGPL's plea of increasing UFG limit from 4.5 percent to 7 percent. Sindh High Court's decision on similar SSGCL's plea is awaited. Hence, **Figure 3.12** show 4.5 percent UFG allowed to SNGPL from FY13 while 7 percent to SSGCL from FY13 onwards.

[34] Government has recently promulgated The Gas (Theft Control & Recovery) Ordinance 2014. This ordinance empowers government to establish the Gas Utility Courts at the provincial and district levels. These courts will have capacity to decide the cases against the gas defaulters similar to that of the Finance Recovery under Financial Institutions (recovery of Finances) Ordinance.

OGRA states that a one percent UFG of the two gas utilities, translates to a revenue loss of Rs 3.55 billion per year, at FY13's price.[35] Our calculations show that gas utilities can save up to 52.6 billion cft of gas, by restricting themselves to OGRA's UFG limit. This could reduce diesel and furnace oil import by 15 percent, and is equivalent to 20 percent of the gas expected to be imported through the IP gas pipeline agreement.[36]

Conclusion

As discussed earlier, there is a need to revisit the gas allocation policy, to focus more on productive users (power and industrial); furthermore retail prices should reflect the growing excess demand in the country. The revenue loss from abnormally high UFG (which is basically organized theft); the overuse of subsidized gas by households; and the country's CNG policy, must be addressed. Furthermore, domestic exploration and production should be stepped up to ensure the existing supply of domestic gas, is not allowed to fall.

Given the growing demand, Pakistan would need to import natural gas, either in gaseous form or as Liquefied Natural Gas (LNG). Both options require significant investment in infrastructure. To meet this financing need, the government imposed a Gas Infrastructure Development (GID) Cess in 2012. This fund will be used to build LNG terminals for nationwide supply; to build the Iran- Pakistan (IP) pipeline; and to finance the Turkmenistan-Afghanistan-Pakistan-India (TAPI) pipeline.

Progress on the Iran Pakistan pipeline has stalled due to financial sanction imposed on Iran. If realized, the IP pipeline will supply Pakistan 750 – 1,000 million cft of natural gas daily, which is enough to meet the current demand from the power sector. However, studies on the IP gas pipeline suggests that Pakistan will be paying more for Iranian gas compared to international prices. As a result, the electricity produced from Iranian gas will be more expensive, perhaps as high as furnace oil based power generation.[37]

When initially negotiated, gas prices were indexed with crude oil, which is about US$ 13 per mmBTU at current crude oil prices. Globally, prevailing gas prices are much lower compared to crude oil. Iran itself is purchasing gas from Turkmenistan at US$ 4.0 per mmBTU, as the negotiated gas price was not indexed to crude oil.

It was normal practice till the early 2000s, to index gas prices to crude oil for trade. However, the recent production boom in the shale gas industry in US, has decoupled natural gas prices from crude prices. This global decoupling has led to a revision in gas tariff between exporting and importing countries. In our view, Pakistan should also renegotiate IP gas prices as some reports suggest, which will make IP gas more viable for Pakistan.[38]

Without much clarity, government has encouraged the private sector to build LNG terminals at Port Qasim, and to undertake LNG import activity. LNG is likely to cost Pakistan much more compared to the IP pipeline.

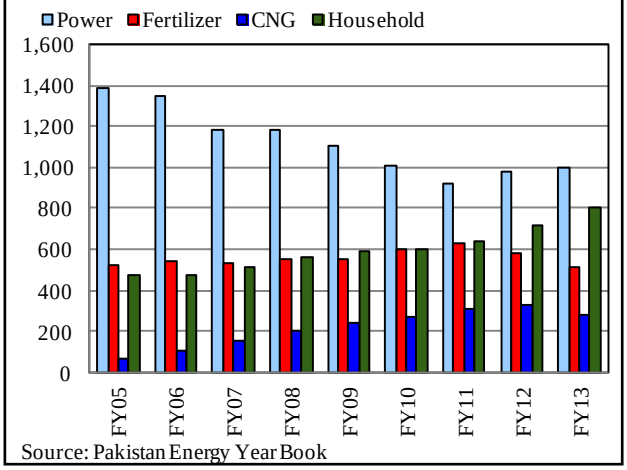
[35] OGRA's Annual Report 2012 -13.
[36] The calculations are based on Tonnes of Energy Equivalent (TOE).
[37] The gas price is indexed with simple average Japan Crude Cocktail (JCC) price index.
[38] Sustainable Development Policy Institute (SDPI) report, "Rethinking Pakistan's Energy Equation: Iran Pakistan Gas Pipeline".

Special Section 3.1: Gas Allocation: Power vs Fertilizer[39]

Inadequate gas supplies and rising demand, compelled the government to allocate scarce gas among competing users on the basis of the Gas Allocation and Management Policy of 2005. This prioritized households and the fertilizer sector, resulting in the curtailment of gas supply to the power sector (**Figure S3.1**).[40]

FY14 witnessed improved gas supplies to the fertilizer sector while power sector only received 50 percent of its demand. As a result, most of power plants had to rely on expensive furnace oil or HSD, whereas plants which could run only on gas, remained idle most of the time.

Figure S3.1: Gas consumption by Different Sector (in mmcfd)



Source: Pakistan Energy Year Book

Table S3.1: Impact of diverting gas from fertilizer to power

	Savings in imports (in US$ billion)			Savings on subsidy (in Rs billion)				
	FO imports[1]	Urea imports[2]	Net savings	Saving on power subsidy[3]	Subsidy on urea[4]	Gas revenues from fertilizer[5]	Gas revenues from power[5]	Net Fiscal Savings
	(1)	(2)	(3)=(2)-(1)	(4)	(5)	(6)	(7)	(8)=4-5-6+7
FY12	3.89	2.65	1.24	172.56	77.34	28.1	69.61	136.72
FY13	3.29	2.31	0.98	150.72	79.04	25.27	62.6	109.01
FY14	3.69	2.28	1.41	173.41	53.65	29.6	73.33	163.49

Assumptions:

a. 100 percent gas diverted from fertilizer sector to power sector.

b. One tonne of urea needs 32.85 MMBTU of gas. (Source: Huang, W. (2007) "Impact of rising natural gas prices on the US ammonia supply", United States Department of Agriculture.)

c. One MMBTU gas produces 102 KWh of electricity; one barrel of furnace oil generates 470 KWh electricity (Source: Technical Audit Study of GENCO Power Plants by Hagler Bailly Pakistan).

d. Local production of urea is almost 5 million metric ton, which needs to be imported.

Explanation:

[1] Improved gas availability to power will reduce import of furnace oil.

[2] Annual average domestic demand of urea is approximately 6 million metric ton, whereas domestic production is almost 5 million metric ton. Diversion of gas away from fertilizer sector would require additional import of 5 million metric ton.

[3] Substitution of furnace oil with gas will reduce the cost of generation, and also the spending on subsidy.

[4] Higher international prices of urea as compared to domestic and to protect farmers, government would have to provide subsidy.

[5] Since gas tariff for fertilizer sector are lower (Rs 197 per mmbtu) compared to the power sector (488 per mmbtu), the re-allocation of gas would yield more revenues from the sale of same quantum of gas.

Almost 70 percent of gas-based capacity remained idle and only 2403 MW (almost 20 percent of total) electricity was produced from gas.[41]If we had diverted the entire gas supplied to fertilizer (in FY14) to the power sector, this would have generated an additional 1,943 MW of electricity in that year (16 percent of total).[42] Consequently, FO imports would have declined, and imports of urea

[39] This section was authored by Nasir Hamid Rao, Deputy Director, Economic Policy Review Department, SBP.

[40] As things stand, 8086 MW of capacity requires natural gas for generation. Of which, 39 percent (3153 MW) of capacity cannot run on an alternative fuel; 33 percent (2668MW) can substitute gas for furnace oil as fuel, whereas the remaining capacity can switch to HSD.

[41] On average 65 percent gas-based capacity remained idle in last three years.

[42] We understand that provision of sovereign guarantee makes any diversion of gas, from fertilizer to power sector, quite difficult.

would have increased. Finally, the fiscal burden would also have been lower due to the lower cost of power generation based on gas, compared to furnace oil **(Table S3.1)**.[43]

As shown in **Table S3.1**, the allocation of gas from fertilizer to power could have saved Pakistan almost US$ 1.4 billion during FY14. On the fiscal side, subsidies would have been reduced by Rs 120 billion, while an additional Rs 43 billion could have been generated on account of higher gas prices charged to the power sector compared to fertilizer. This simple analysis proved the need to revisit the existing gas allocation policy. It also states that higher priority should be given to the power sector, which is the backbone of the economy.

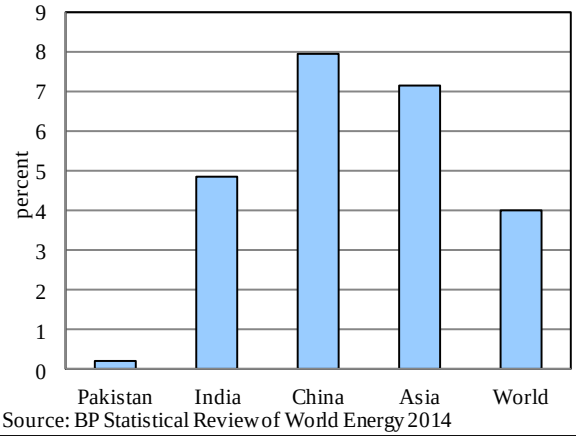
[43] Due to relatively lower prices of urea as compared to furnace oil, net impact on imports will be positive.

Special Section 3.2: Coal: the Potential Game Changer[44]

Despite having the seventh largest coal reserves in the world, exploration and development of domestic coal remained out of policy focus for many years. [45] While the rest of the world was aggressively exploring and producing coal, Pakistan remained an outlier (**Figure S3.2**).[46]

More surprisingly, even though coal is one of the cheapest generation fuels after hydel, this has not been recognized as a desired energy source! Only 0.01 percent of available coal (domestically produced and imported) is being used by the power sector, at a time when Pakistan is facing a persistent and severe shortage.

Figure S3.2: Compound Annual Growth Rates of Coal Production (2001-2013)



Source: BP Statistical Review of World Energy 2014

Table S3.2: Benefits from Replacing FO with Coal - A Case of Jamshoro Power Plant (675 MW)

	Saving on imports (million USD)				Saving on power subsidy (billion Rs) from imported coal[3]
	Fall in furnace oil imports	Coal imports	Net savings on imports[1]	Import savings with local coal[2]	
	(1)	(2)	(3) = (1) - (2)	(4) = (1)	(5)
FY12	354	164	190	354	19
FY13	399	172	227	399	24
FY14	716	297	418	716	45

Assumptions for Jamshoro Plant:

a. One barrel of furnace oil produces 470 KWh; one tonne of imported coal (Kcal value ranging from 5500 to 6500) produces 1570 KWh; and one tonne of indigenous coal (Kcal value ranging from 2700 to 3500) generates 950 KWh.

b. The entire furnace oil requirement (computed on the basis of actual power generated during the year) is met through imports. The sharp increase in FY14 was on account of increase in the capacity utilization.

c. Average international price for imported coal is US$ 80 per tonne; while the local coal is US$ 65 per tonne.

Explanation:

[1] Conversion to imported coal would replace FO imports with the coal. The net savings will be the difference between their import bills.

[2] Conversion to indigenous coal means complete savings on the import of furnace oil.

[3] Lower tariffs on imported coal, than on the furnace oil, would save power subsidies. Since the upfront tariff (determined by NEPRA) for local and imported coal are very close, the fiscal savings remain almost the same whether we use local or imported coal.

As discussed earlier, the key challenge facing the power sector, is the growing cost of thermal generation, which the government is unable to pass on to end-users. As a result, the power sector (and the entire energy sector) has reached a point where frequent financial support from government is necessary for the smooth functioning of the power supply chain. In this situation, it makes more sense to replace furnace oil with coal for power generation due to its clear advantages: one, since imported

[44] Ownership of this section goes to Nasir Hamid Rao and Syed Zulqernain Hussain, Deputy Directors, Economic Policy Review Department, SBP.
[45] According to Pakistan Energy Year book, Pakistan's total coal reserves stand at 186 billion tonnes. Out of total reserves, 175.5 billion tonnes are located in Thar.
[46] Pakistan imports almost 50 percent of its domestic demand of 6.9 million tonnes (source: Pakistan Energy Year Book).

coal is cheaper than FO (in terms of generating one unit of power), this would reduce the import bill – the savings would be much higher if we use indigenous coal; and two, the resulting gains from the lower cost of power generation, would generate fiscal savings by reducing subsidies.

The government is already considering converting the Jamshoro Power Plant from FO to coal. Using this plant as a benchmark, **Table S3.2** computes the potential savings on imports and subsidy payment with a successful conversion. According to our assessment, if the plant had been converted earlier, this would have saved US$ 418 million on import payment in FY14, with benefits reaching as high as US$ 716 million if indigenous coal had been used. Furthermore, the government would have saved Rs 45 billion on account of reduced subsidy payments. Even if we add the allied costs of shifting to coal (e.g., mine development; enhancement of import infrastructure; and development of transportation network), the payback period of the project appears to be quite attractive.[47] This means, even the use of imported coal would help the country.

The government has recently decided to use indigenous coal for new and converted power plants. This decision involves many trade-offs, which are summarized in **Table S3.3**. So far, the government has initiated an ADB-funded conversion process of Jamshoro Power Plant to coal-fired, though progress has been slow.[48] Since developing coal mines at Thar would take time, the government is considering imported coal, until indigenous coal becomes commercially available. However, as the specifications of indigenous coal varies significantly from imported coal, this raises some concerns that the needed technology for converting coal into steam, would vary with coal quality.[49] These issues can only be resolved by serious technical assessments which are only possible if the government's coal policy is credible and long-lasting.

Table S3.3:New Project vis-à-vis Conversion

	New project	Plant conversion
Cost per MW (US$ million)	1.4-1.5	0.6-0.7
Gestation period (years)	4-5	2.0-2.5
Project life (years)	30	15
Efficiency	Relatively high	Lower
Tariffs[1]	Same	Same
Capacity[2]	New capacity	Use of idle capacity

1. Conversion entails lower cost compared to new project. However, its resulting benefit in terms of lowering power tariffs would be offset by a shorter life of the power plant.
2. The capacity utilization of furnace oil based projects is 50 percent; and for gas-based project, it is 30.0 percent. Conversion would revive the existing idle capacity (either in FO-based projects or in gas-based plants).

[47] According to experts working on coal, the cost for mine development of 3.8 million tonne/per annum is roughly US$ 2.0 billion.
[48] ADB approved the funding of US$ 900 million in February 2014; but nothing has been disbursed as on 30 June 2014.
[49] Since the indigenous and imported coals varies in the wide range of 3000 Kcal to 6500 Kcal, this means the technology would not be compatible as it works with variation of up to 15 percent in the coal quality.