The Dynamics of Energy in Pakistan

Syed Akhtar Ali

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Research on Economy & Politics (REAP)

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This book is based on a study that has been done under the auspices of Research on Politics and Economy of Pakistan (REAPP).Part-I of the study has been published earlier under the title: Pakistan *Energy Issues; Success and Challenges.* REAPP is a Think Tank which was established in 1984.It has organized many studies in the area of Energy, Governance and Technology.

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PREFACE

This is my fourth book on the subject of Pakistan's energy issues over a period of last ten years. I started writing at a time when we were suffering from energy deficit and now that I am writing, probably last book of my career, while we are suffering under an energy surplus situation that started prevailing even much before the advent of Covid. Covid has made it worst, not only for the energy sector but for all of the economy and society.

There have been subsidies of more than Rs3 Trillion over the last 12 years and the circular debt has reached a level of Rs 2 trillion and is growing. A supply cost of Rs.22.5 per kWh is clearly not payable by consumers. Even cross subsidies cannot support it. There are demands from the export industries of lowering tariff lest they become uncompetitive and not being able to export. Clearly, the current Power system is flawed and needs to be corrected. There are similar problems related to other sections of the energy sector. Other than the pricing issue, there are issues of quality and environment. There are issues of alternative technologies. There are institutional strengthening and policy issues as well. All of these have been dealt with varying details in this book.

This book has been divided in the following nine sections;

1. Introduction
2. Oil
3. Gas
4. Coal
5. Bio-fuels
6. Electricity
7. Renewable Energy
8. Environment and Recycling
9. Institutional and Policy Issues

Some parts of the book have been published in the form of articles. Many readers of my articles have been contacting me to provide more data and context on the subject. Hence these have been enhanced in substance and as well as data, tables and figures which could not have been published in articles. There is a justification of producing this book as it provides a composite view of the energy sector in one handy volume. And the continuity of discussion does enable the reader to develop a theme and understanding of his own. This book is aimed at a wide variety of stake-holders, investors, lenders, students and policy-makers and above the intelligent and concerned layman. Everybody is a layman except in his own field.

I am grateful to Dr. Shahid Rahim, Colonel (retd) Iqbal Cheema Dr. Khurram Kamal Ansari, Syed Ammar Ali, Syed Intesar Ali and Gul Hassan Bhutto and a lot of other colleagues and friends who provided assistance in various ways in writing and publishing this book. Finally, I am grateful to my wife Dr. Meher and my daughter Schanze for their patience in my occupying the living room. Additional thanks to my wife for providing editorial assistance in finalizing this book.

Syed Akhtar Ali

12th, April, 2020

1: Introduction

1: Introduction

There is Rs1.85 Trillion circular debt and Rs 3 Trillion worth of subsidies to the power sector in the last ten years and projected to increase further. Electricity and Gas tariff is on the rise.IPP Inquiry Report recently released has created uproar and controversy. IPPs have been in focus, although all involved are responsible for the state that we are in including IPPs. Regulators have issued unaffordable tariff and have not monitored the sector adequately. Distribution companies have been oblivious and neglectful of losses and under-recoveries despite announcements of initiatives and declaring successes. IPPs have profited from the situation and seem to be content and happy and would like that the same continue forever. This is not a sustainable situation. It cannot be allowed to continue. To be able to do this, all stakeholders and general public should acquire sufficient knowledge of the sector; hence this book.

Power sector argues that Pakistan is a risky destination for investments and hence the higher debt cost and still higher returns justified along with high selling prices and subsidies. Comparatively, Oil and Gas sector has been doing well. There is only 5% protectionary import duty on petroleum products. They refine Oil and sell at international prices. Oil prices have been traditionally lower in Pakistan than the other countries in the region. They have been able to borrow at affordable and sufficiently low rates, probably, to be competitive.

Certainly the issue is more complicated and complex than it may sound. We have dealt with most sides of the issue in adequate detail, although the style is different. It is focused on and around issues and not academic thematic chapters. It is both the strength and weakness of the book. In the following, we will have a brief tour of the issues to be followed by detailed analysis in the individual chapters.

Pakistan's electricity prices

Pakistan Electricity prices are 50 to 100 percent higher in the region and in some cases even more. India benefits from cheap local coal. Pakistani Thar coal unfortunately is as expensive as imported coal and twice as expensive if compared to similar lignite elsewhere including that in India. However, the Indian power sector is beset with almost the same problems as in Pakistan – high T&D losses including theft at 20 percent; accumulated debts and liabilities and poor liquidity; old inefficient GENCOs and stranded assets. Poverty is the common denominator.

Unlike Pakistan, power tariffs vary widely across India, where every state/province has an independent power system, from regulator to financial ownership and liability. The comparison with Gujarat is relevant from many angles: it is geographically contiguous; it has a textile focus; and it is a progressive and successful province. Most of the tariff slabs in India vary between IRs4, IRs5 per kWh which translates to Rs8-9 per kWh. The LESCO tariff correspondingly varies between Rs16 and Rs18 per kWh. We can roughly conclude that, overall, LESCO (Pakistan) electricity tariff is around 1.5 to 2 times or in some cases even more than twice that of Indian (Gujarat – GUVL) tariff.

Malaysia seems to have the lowest tariff at 6 USc for household and 10 USc 1 per kWh for industries. Malaysia's energy resource endowment and export-oriented economy seem to be the drivers in this respect. Similarly, Turkey has a low tariff of 9.19 USc for households and 7.66 USc per kWh as the industrial tariff. China seems to have a comparable tariff with the South East Asian region .Having reviewed the electricity tariff of relevant countries, we conclude that Pakistan's electricity tariff is twice as much as elsewhere and merits urgent considerations. Revolutionary changes and results should not be expected. However, there could be some scope for optimism.

As now under IMF tranches, any income reduction is unacceptable. In fact, they have encouraged indirect taxation, having seen lack of success in increase in direct tax collection. Some adjustments are, however, possible. There is a case for reducing GST in reciprocation with India's action. In India, VAT on electricity is 6 percent or even less in some states. Reduction in GST for residential consumers would be recommended since 17 percent GST is too much of an add-on on an already high tariff. Residential consumers do not get an input adjustment; 6 percent GST may be appropriate and may cause some palpable reduction in consumer bills. However, would it be affordable by the government?

Devaluation, increase in interest rates and activism on circular debt, all at the same time?

The government has shown more than due activism on reducing circular debt. However, along with devaluation and high interest rates shock, clearing the balance sheet and bringing all kinds of suspended payables and receivables into consumer tariff has increased electricity bills disproportionately. There should be a mid-of-the-road tempo. It is a cash-flow issue, not one of cost.

High tariff award to power projects in the reign of the previous government is a factor, but currency depreciation and increase in interest rates has given a major jolt to electrical tariff. The energy sector is highly dollarized, based on FDI and foreign debt. Interest on working capital has also increased due to rise in interest rates. Most renowned economists are crying hoarse that interest rates should be brought down. Early action in this respect will relieve power tariff stress to some extent as well.

High risk and accordingly higher financial costs have caused the power tariff in Pakistan to be twice as much as elsewhere. There is something fishy about it. Ethiopia, of all places, has been awarded higher credit worthiness than Pakistan. Undue or indecent haste by our politicians has also prevented adequate negotiations to bring down both CAPEX and financial terms. In fact, Nepra's upfront tariff preempted the scope of bilateral negotiations among companies. It is sometimes possible to renegotiate the lending terms after project implementation due to risk reduction. It may be possible to increase the repayment periods if not reduce the interest rates.

Sufficient time has to be given for macroeconomic adjustment to take place before launching other additional cost-push financial steps. The intention of the government to take steps towards reducing energy tariffs would be welcomed by a large sector of our society.

Electricity prices are subject to all kinds of anomalies, manipulations and profiteering. High capital and financial costs are largely responsible for this. Excess capacity created by investor pushed projects has put an extra load of capacity payments. It is alleged that capital padding and zero-equity syndrome has been more of a norm than exception, enhancing the supply costs and capacity payment.

The cost manipulation has been institutionalized and protected by the so-called up-front tariff system wherein the regulator takes unto itself to determine the costs as opposed to cost-plus or other systems wherein the investor has the legal responsibility and the latter can be punished for cost-fudging and manipulation. The vendorsinvestors-lenders combine manages to mislead the regulator, who participates in it knowingly or unknowingly. Admittedly, an up-front tariff system is fast-track and is generally liked by the investors but can play havoc with the consumer tariff.

The solution may be competition, a simple type and not the market exchange type, at least in the near future. Competition has considerably reduced electricity production cost, in all parts of the world, in case of solar and wind power. There are three kinds of competitions – EPC cost bidding; tariff-based bidding; and three, electricity market and exchange mechanism. EPC cost bidding has some good examples like the recent ADB-financed Jamshoro coal power plant tariff where significant cost reductions have been obtained as compared to the other comparable CPEC projects.

What is the way forward? Renegotiations of contracts, as argued by some, may not be feasible. Reforms can be done for new projects and must be undertaken. Fortunately, there is new leadership at Nepra (as well as in government) which has had no part in the mistakes of the past and may be able to correct the situation to some extent, if not all. A third party review of Nepra tariff policies and determinations may be organized by Nepra itself or in association with the government. The review should be conducted by credible consultants so that controversies are settled and corrective actions are identified.

Tariff incentives to improve load factor

There is a huge difference between winter and summer demand. Fixed charges are increasing due to increasing capacity and slower growth in demand. The government has introduced some demand-increasing incentives like decreasing winter tariff. It has to do more. There is perpetual under-utilization of capacity during night time, whether summer or winter. There is reduced night-time tariff for night-only industries in India. There is a night-time tariff of IRs2.60 for night-only industries vs IRs4.25 general industrial tariff. Some steps can be taken in this direction along with slowing down the induction of new capacity.

Petroleum Taxation

There is a case for taxing energy consumption, as it has externalities, harming other sectors in terms of health, pollution and climate change. There used to be excise duty in early days to cover these aspects, which continues to be the case in India. In Pakistan, it is called Petroleum Development Levy (PDL), originally meant for development projects of petroleum sector. A decade earlier, courts made quite some hue and cry on it, similar to the protestation that is going on today on GIDC. It is time, perhaps, to change the nomenclature. An appropriate name would be Carbon Tax which is being pushed increasingly by climate change circles.PDL may be divided into two parts, one Carbon tax which may remain as fixed component and the other variable to be called Petroleum Levy.

Petroleum has been traditionally considered a luxury deserving heavy taxation. It is no more a luxury but is a necessity, especially, Diesel which is used by public transport sector.40-50% of gasoline in Pakistan is used by poor motorcyclists and Loaders(Suzuki and others) also consumer petrol, the latter being used for intra-city transport of goods and even as a public transport vehicle. Europe continues to tax petroleum heavily. In Norway, despite being a petrol producer and exporter, current Petrol prices are Rs.250 per Liter or more, almost double or more than double of Pakistan prices. Similar is the case in other European countries like France, Germany, Italy and the U.K. etc. The U.S., however, indulges in moderate taxation and its petroleum prices are used as a benchmark by many.

WACOG?

There is a proposal of weighted average cost of gas in federal circles. A seller normally averages the cost of an item received from various sources and sets the price accordingly. It makes things simple, can help in gas planning and make supplies more manageable. The net effect would be the transfer of extra cost from Punjab to Sindh.

Keeping in view the federal subsidies to the energy sector, it is argued that Sindh should be ready to absorb this cost. A diluted solution would be keeping the prevailing gas allocations for the provinces and unwilling provinces may be asked to meet excess gas demand from LNG. Direct federal subsidies, partly replacing cross-subsidies, could lower the weighted average cost and make it more bearable for the unwilling provinces – domestic sector's lifeline customers and major exporters are already financed by the federal government. There may be an opportunity to generate some resources from the fertilizer sector.

Another possible solution is the marginal provincial taxation on corporate profits in the oil and gas sector and even in the case of minerals. This is not unknown in federations. This may remove a lot of heart-burning in provinces on sharing the income from natural resources, especially in Baluchistan. Admittedly, the federal government is facing a huge deficit. Negotiations may be possible around these options.

Imported Coal Power Plants vs Thar coal

Both local and imported coal electricity is priced the same, where coal is brought from thousands of miles away and Thar coal power plants are at the mine mouth. Lignite electricity generation cost in the US is 3 USc per unit and in Germany somewhat higher. Lignite electricity tariff in Gujarat is 4 USc and Nyveli is 6 USc per kWh. It is a double jeopardy in Thar – high mining cost and electricity generation (loaded of course). It may be noted that both the UAE and Egypt engaged international consultants who enabled them to get such low costs. In our case, both Nepra and PPIB and others did not bother to engage similar assistance and thus ended up with 100 percent higher tariff.

Coming to the local Thar coal and the comparative cost elsewhere, in India, for comparable mines (in terms of coal depth and stripping ratio) lignite is being produced and sold at $20 a ton. In Germany and the US, lignite price of similar mines are at the same rate. Pakistan's Thar coal price is $47 per ton levelised, and 25 percent more in the initial years of debt servicing. This is despite a lower interest debt at 3.5 percent, because there is sovereign guarantee. This interest rate should have been lower. Mining methods and technologies are also primitive as compared to the norm of continuous mining of today. Under the garb of scale economy, existing players are trying to monopolize this precious resource. Across the border in Gujarat, small mines are producing at lower cost than us.

It is argued by many that special tariff parameters should have been negotiated for as large an investment package as CPEC's $40 billion. Asad Umar (current minister for planning & development) petitioned against the coal tariff. His petition was rejected but he managed to raise the high cost issue and raised public consciousness about it too. After becoming finance minister, he went away too early. Had he survived, he might have taken some of the corrective steps that are still possible.

Renewable energy

It is now obvious that the time of renewable energy has arrived. Internationally, solar projects are being installed at 2-3 US cents. In Pakistan, due to credit rating and interest rate issues, solar and wind plants could be installed at 5-6 US cents. Hydroelectric power, however, has become expensive from the traditional one rupee to 10 US cents. Many hydel projects are in the pipeline. In the current circumstances, there is a case for installing at least 5,000MW of solar and wind plants, may be hybrid, in the next 10 years. This is a must for balancing the energy prices and reducing the fuel import bill.

Oil & Gas Resources: Has Enough of E&P effort been done?

It is a highly debatable and contestable question? Only 46 % of the total available basin area has been under exploration and around 3 exploratory wells have been spudded per thousand Sq.kms of exploration area. It is an average which can be misleading. Is this enough? Will more exploratory wells lead to more discoveries or enhancement of reserves? Should focus be on new frontiers or the existing play? It is objected that concession award activities are slow and not up to the mark? 36 concessions were awarded in 2005-6 and 43 in 2013-14 and now it has been announced that in 2020, bidding would be held for another 36 concessions. Provinces are eager on speeding up the processes and would like to get autonomy i.e. to have provincial concession authorities. On the other hand, industry would like to have independent concession regulator on the model of NEPRA and OGRA.

Major discoveries have been far and few in between. There are only 10 major fields having reserves of 1 TCF or more. In 1950s, it started with Sui with reserves of 8.72 TCF and has been almost consumed up. There is Sui Deep under of 4 TCF which is under political logjam with the locals. Then came Mari in Sindh ,the second largest field after Sui with original reserves of 8.2 TCF in 1950s.UCH with 4 TCF, low Btu gas on which two NGCC plants are operating also came around the same time; and Khandkhot with 2 TCF a bit later. After almost 29 years, a major worthwhile discovery came in 1989 with reserves of 7.2 TCF in Sindh which sustained supplies and continues to do so, although most of it has been consumed. Another bout of discoveries, although somewhat smaller of less than 2 TCF came around late 1990s with Zamzama, Chanda, Bhit, and Sawan etc all in Sindh. After 2000, KPK came on the horizon with smaller fields Manzalai, Nashpa and Makori. Some further potential appears to be there for which KPK is quite anxious. Thus it appears to be a story of glass half full and half empty. There is potential, however, probably not a great one. It would be an achievement, if local requirements of Gas are met. On oil, there is a consensus, that there wouldn’t be much of development.

It may be concluded that Pakistan is not rich in Oil and Gas resources. However, whatever can be done should be done to explore and develop economic resources. It appears that a mix of local and foreign imports would continue till Renewables take over. It would be a big achievement if current gas production level is maintained. Higher LNG prices as indicated by Qatar Gas contract had created incentives for increasing cheaper local production (3 USD per MMBtu vs 8-10 USD per MMBtu). However, development of LNG Spot market has created prospects for cheaper LNG at 4-5 USD per MMBtu in the short to medium terms. This would dilute the prospects and incentives of local exploration effort, especially, on difficult plays.

Finally, it is an open question whether it would be worth investing excessively when oil future appears does not appear to be very attractive, if not bleak, after another two decades. International Oil companies have not been much interested in Pakistan, another indication of lack of prospects. Whatever, progress in this area is to be done would come out of national companies. Oil people in the provinces have been talking of private-public partnerships in creating new E&P JVs.

Biogas can take some burden as well. Small-scale family units have been promoted with success and failure over the last few decades and there has not been much impact there. Elsewhere in Europe, USA and even in India, commercial biogas has met with quite some success. In Europe, biogas is being used in CNG and is being fed to gas networks after cleaning and processing. Bio-CNG, converting biogas to CNG, is being used successfully in Sweden in Buses and in India. Pakistan is one of the largest milk producers in the world and is an agricultural country producing surplus biomass, all of which can be utilized for producing commercial biogas. LPG-Air-Mix plants can be fed with biogas. Rural households can be supplied with biogas through isolated local gas networks.

Cheap Gas for Fertilizer Sector?

Profiteering of the Fertilizer sector is indicated by the Earnings per share (EPS) of major fertilizer companies having risen to Rs. 13.00; cheap gas, uncontrolled prices, and taxation loopholes and changes etc provided such excessive profiteering opportunities. It should be embarrassing to both the takers and the givers; the government ministries which enable such profits through its policies on the back of farmers and consumers.

The simple solution is to drop the semblance or pretence of market economy by putting the Fertilizer sector under regulation of an independent agency, may be OGRA, to avoid the expenses of yet another under-utilized bureaucracy. Alternatively, there is sufficiently experienced manpower available in public sector Fertilize outfits like NFC, NFML and NFDC which can be consolidated into an autonomous body-cum-regulator.

If inputs are controlled and even subsidized, how come outputs can be uncontrolled or unregulated? There is a basket price system in case of other regulated sectors such as Power and gas which is working more or less satisfactorily. Every producer gets his sales price according to the cost of inputs and production plus some efficiency incentives. Across the border in India, the regulated system is working satisfactorily. There would be issues of regulatory terms such as allowed RoE and IRR which can be negotiated or determined independently by the regulators; Cost-plus under fair terms should be acceptable to all except those who want to indulge in unfair profiteering. All gas based Fertilizers could be under regulation including Urea and DAP; usually Urea is focused upon.

It appears that if the profiteering (as being evident by an EPS of more than Rs 13/) by the Fertilizer sector is controlled by bringing in a regulatory regime, it should be possible to double the feed gas prices (from Rs 300 to Rs 600-700 per MMBtu as proposed by OGRA) without increasing the fertilizer prices***.*** Alternatively, if gas supplies are kept at the existing low level, regulated regime should be brought in, which should make sure that low gas prices are reflect in final product prices.

The difficult Case of LNG?

With respect to Qatar Gas, there is an ugly situation. At a 13.35 % of Oil prices per barrel, it has been costing us 8 USD at 60 USD/barrel Oil prices and at 85 USD per barrel, it has been costing as much as 11.34 USD plus an average of 2 USD overheads importing and gasification charge. At current, Oil prices of 30 USD or lesser, Qatar LNG should cost around 4 USD which appears to be pretty reasonable. However, these prices are not effective yet due to the formula involving last three months averaging. Last three months average is still high at around 50 USD. It will take another two months for Qatar LNG to be able at more or less affordable prices of around 4 USD/ bbl which is nearly comparable with our local prices.

Due to low energy demand in the context of Covid, GoP has been considering invoking *Force Majeure (FM)* .Reportedly, India has already given notice. Qatar has remitted one billion USD worth of take or pay liabilities from India, a report which could not be verified. It is a difficult situation. Pakistan is already suffering fewer than two international tribunal penalty decisions of Rekodiq Copper and Karkey rental power. However, FM may not be aimed at totally abrogating the Qatar LNG deal. It may be limited to temporary containment of lifting LNG. Negotiations are being urged by stakeholders in Pakistan. It is expected that the Qatar Gas would eventually be forced by the demands of the three countries (, India, Pakistan and Bangladesh who have similar contracts), to accept new terms compatible with the new market realities.

However, the current issue is complicated by lack of demand as well and not limited to prices alone.

It would be a wrong assessment that LNG has been introduced without justification and that local gas resources should have been developed. We have argued elsewhere that Pakistan gas potential is mediocre. In near future, there is not much chance that enough gas would be available from local resources.

Towards Cleaner Automotive Fuels

Sulphur has been a major culprit in automotive fuels which causes pollution, although there are other factors such as hydrocarbons and aromatics. The world community has established following targets for sulfur reduction in fuels – 50 parts per million (ppm) sulfur in motor fuels in most countries by 2020; 50 ppm sulfur in all countries by 2025 and 10-15 ppm sulfur in all countries by 2030.Almost all the Organization of Economic Cooperation and Development (OECD) countries have achieved 10-15 ppm sulfur level for new vehicles but they are beset by the existing population of older vehicles, which may take another decade, when full targets would be achieved.

In Pakistan, high sulfur fuels had been in the market – up to 5,000 ppm and even more – until recently. Euro-II has been adopted only recently which permits 500 ppm – but is too much which causes widespread air pollution and associated health issues. Smog, being one of the clear indicators, causes losses and attracts attention. Almost all developed countries have adopted Euro-VI standards (ultra-low sulfur at 10-15 ppm). Most Southeast Asian countries have adopted low sulfur (50 ppm or less) fuel standards. Even small East African countries have adopted low sulfur (50 ppm) fuels. Even Sri Lanka having no fuel standards has started importing ultra-low sulfur (10-15 ppm) fuel from Singapore. Other countries would follow gradually as the availability of high sulfur fuel becomes increasingly constrained.

Kuwait Petroleum from where most of the Diesel is procured under a long term contract has served a notice that from 2020 it would not be able to continue supply high sulfur Diesel and would be switching to clean Euro-V spec Diesel. Fortunately, GoP has also decided for switching to clean low Sulfur fuel. A detailed plan is required which has yet to be announced. The issue is of local outdated refineries which are reportedly planning the required investments.

Resource Competition; provinces have to facilitate than being difficult?

We are passing through interesting times which will grow more interesting as time passes. This no less true for Energy sector .Technology and competition has introduced new ways to produce and transport energy at prices falling every day; Solar, Wind, Battery Storage and even LNG. Solar and Wind are available at under 2 USc; multiply it by 2 for Pakistan, even then, it is not a bad deal. Battery storage has come down to 150 USD/MWh and will come under 100 USD in a few years.LNG is available at spot prices of 4 USD as against 10-12 USD per MMBtu only a few years earlier.

There appears to be some bad news for conventional technologies of Coal, Nuclear and Hydro, are at more than 8.5 USc today, although, there are people (including Chairman WAPDA) who continue to cite Hydro cheaper at one Rupee only. The O&M and Royalty today alone have taken it to Rs 4.0 these days. New NEPRA determinations are already at 7-8 USc. In 1970-80s, we made nuclear weapons behind our slogans for cheaper nuclear energy at Rs 1-2.IGCEP-47 could hardly induct any more nuclear energy at more than 10 USc and 4 Mn.USD per MW of CAPEX or even more. Even PAEC people are ashamed .Many wouldn’t like to push and peddle it any more. Sindh government wasted many years getting control on Thar coal, demanded 20% equity and eventually managed to make it as expensive as imported coal. Now, it may have to lobby to get Thar included, if NTDC/PLEXOs are allowed to pick up technologies based on merit. There are sentiments attached to Thar coal. But we delayed its utilization to a point, when world has started eschewing it. It was a chance that CPEC enabled its utilization.

On Hydro, KP nationalists are doing the same what Baloch nationalists did with Gas. Thru price, royalty and non price resistance, additional gas could not be explored and developed. And now, cheaper LNG has emerged which would reduce Balochistan gas prospects, unless they change. IP and TAPI project owners may have to change their pricing formula to be competitive with LNG; otherwise, prospects of their pipeline gas would be further reduced.

Hydro used to be the only local, cleaner and cheaper resource. No more, as explained earlier, it is at least twice more expensive, remotely located requiring massive transmission investments and is available in summers only. On the top of it, KP nationalists are demanding more and more NHP/royalty as much as Rs 4.00 per unit and even more, presenting bills of trillion of Rupees. Some have raised separatist slogans to pressurize. What will happen? They will price out hydro. Decision-makers would be shy inducting hydro. They would argue, as many people are already doing so, that we would be better off with distributed, solar and Wind Power, available at our door steps. Times have changed. Provincial resource owners would have to market and facilitate than monopolize and become difficult.

2: Oil

2.1: The Future of Oil

What is the future of oil and how does it affect us? Everywhere else, market analysts call it a declining industry. But people in Pakistan generally think that it is not true. For us who have only started developing, such forecasts create a dilemma – how to adapt to a change that is coming but has not come yet. The market may go away when we may be only halfway through recouping our new investments in oil.

An article in 'Financial Times' ('Oil must face its future as a declining industry', June 13, 2018) said: "After the coal industry, it is the sector most at risk…The time to stop investing is not today. But that time is coming. The industry needs to be clear that its future is one of long term decline. There is a possibility that the industry overinvests, as we reach that point of peak demand. Fighting for market share in a declining market would be even worse."

By year 2018, oil consumption was around 25 million tonnes per annum (mtpa); 6 mtpa of gasoline, 7 mtpa of diesel and 9 mtpa of furnace oil. Imports of furnace oil are banned now due to the emergence of LNG. The residual furnace oil consumption of 3 mtpa is continuing due to the product programme limitations of oil refineries resulting in continued expensive electricity production. Hopefully, in 3-5 years, this will go down to zero or near zero. If we assume doubling of gasoline demand in the next 7-10 yrs and 25 percent increase in demand of diesel, gasoline demand would be 14 mtpa, Diesel 10 and others one, leading to 25 mtpa. What does that mean? It means no increase or small increase in oil demand in the next 10 years, a startling projection.

We are already suffering from unwanted production of 3 mtpa of furnace oil and do not know what to do with it. It is quite possible that in 10 years, we have another shock. If gasoline and diesel demand goes down by half due to the possible influx of solar energy and electrical vehicles, oil demand may go down further and despite growth in the next 10 years may stagnate at 12-15 mtpa, almost the current level, a dire forecast for a sector which is used to a doubling period of 7 to 10 years.

This is a rough-cut back of the envelope analysis. Formal studies are required in this respect. However, it does indicate the nature of the problem and dilemmas faced by the energy planners and policymakers, if indeed they are aware of the prognosis and potentialities. The traditional energy paradigm is withering away. It is changing and it will force change. One should ride on the change rather than be ridden or even trampled upon. An average energy infrastructure item like oil refineries, pipelines, transmission lines etc has a life of 30-50 yrs. The change has not finally materialized in full but will be there – so what to do? This would require significant optimization work which must be initiated.

The reality on the ground is that energy planning in the country has remained fragmented for two main reasons – the oil sector never felt the need for serious work, and there were inter-agency rivalries. While individual sectoral or subsectoral planning may have different requirements and skill sets, there are issues of substitution and commonalities; one’s input is the other’s output. The power sector has been doing a better job; the crisis has not been due to a lack of forecast and planning but more due to the inaction of the political governments during 2000- 2013.

There have been several power demand and supply studies in the period between 2010 and now. Canadian consultants did a study for the NTDC which is being replicated or updated by the NTDC since then. There was a study by JICA recently and an aborted project of ADB-Planning Commission which attempted an integrated energy planning model, a much needed one. Why aborted? The Planning Commission itself may be largely responsible but no less are the machinations of the competing ministries. There was another attempt by the Planning Commission, by an agreement of cooperation with the world’s most credible energy sector body – the US EIA (Energy Information Agency). This linkage may have been a source of technology and know-how in energy planning. It is in limbo. Reportedly, there is a World Bank project working on it. So there is no dearth of advice and resources.

On the other side, one does not find any serious work and study in this in the oil and gas sector. Simplistic projections based on assumed growth rates have been made in the past. This may have worked in the past, but may not work anymore due to the evolving complicated situation that is developing in alternate energy, distributed and local focus and substitutions.

And then there is another vital aspect, the environment. Even if we forget the climate change issues being the burden of industrialized countries to bear, as argued by some, local environmental issues may force us to adopt less or non-polluting transport infrastructure. EVs are already on Pakistani roads in the form of imported hybrid cars. Hybrid does not displace oil, but actual EVs will. With the cheapening of electrical storage technologies, and further cost efficiencies in solar, the competitive prowess of EVs will be tremendous. The government of Pakistan has already started giving concession to the import and local production of EVs.

Why are Saudis investing in oil as they have promised $10 billion in investment in the oil refining sector? Their assumption possibly is, and perhaps rightly so, that change in this part of the world comes later than in market economies. It is riskier today to invest in long-cycle oil refineries in the West but not so much in the East. Fortunately, oil refineries – unlike power plants or LNG – are not installed under take or pay contracts; the risk in refineries are borne by themselves, unless some FDI clauses build in some contrary stipulations.

On the other hand, there is quite some controversy as to the decline of oil. Global oil demand is 100 million barrels per day and still growing at 1.5 percent. Earlier predictions of peak demand (after which decline starts) have been proven wrong. Environmentalists are predicting peak demand for 2023-2025, as they have motivations in this respect. However, lack of or slow actions on the carbon front as well as Trump's policies are proving such prognoses as wishful. Oil companies agree on peak demand occurring after 20 years. And after peak, there might be a plateau and not a bell curve. And if oil demand switches away from the transport sector, there would still be 40 percent of demand coming out of petrochemicals, fertilizers, chemicals and the cosmetic industry. The dilemma is stronger for poor countries that are short of capital and have other priorities waiting as well. The need for careful studies and forethought has never been more.

Table 2.1.1: World Energy Reserves Life

	Reserves	Annual Production	R/P Ratio-years
Oil-Billion tons	240	5	51
Coal-Billion tons	890	8	114
Natural Gas-Trillion CM	190	4	53

Source: BP Statistical Review 2015

2.2 Towards Clean Auto Fuels-EURO V

Smog and air pollution has emerged as a major urban issue in Pakistan. In Lahore, children could not go to school recently due to air pollution. Road traffic has been one of the major causes of air pollution in most countries of the world. Developed countries have been mostly successful in mitigating or reducing the impact of road traffic by gradually improving fuel quality and design of motor vehicles. Today, a normal advanced vehicle produces only one-50th of the pollution that used to be produced by earlier vehicles as late as 1970.

Sulphur has been a major culprit in automotive fuels which causes pollution, although there are other factors such as hydrocarbons and aromatics. The world community has established following targets for sulfur reduction in fuels – 50 parts per million (ppm) sulfur in motor fuels in most countries by 2020; 50 ppm sulfur in all countries by 2025 and 10-15 ppm sulfur in all countries by 2030.Almost all the Organization of Economic Cooperation and Development (OECD) countries have achieved 10-15 ppm sulfur level for new vehicles but they are beset by the existing population of older vehicles, which may take another decade, when full targets would be achieved.

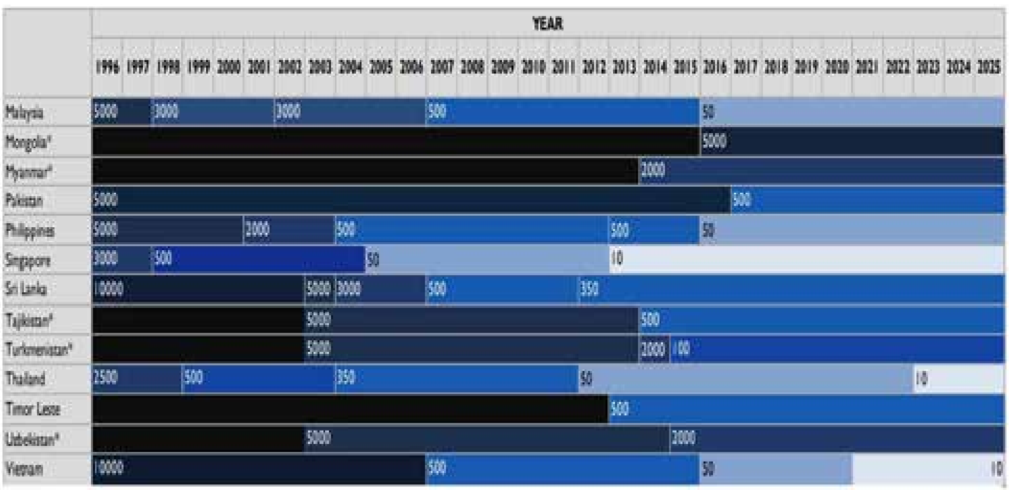
In Pakistan, high sulfur fuels had been in the market, up to 5,000 ppm and even more, until recently. Euro-II has been adopted only recently which permits 500 ppm but is too much which causes widespread air pollution and associated health issues. Smog, being one of the clear indicators, causes losses and attracts attention. Almost all developed countries have adopted Euro-VI standards (ultra-low sulfur at 10-15 ppm). Most Southeast Asian countries have adopted low sulfur (50 ppm or less) fuel standards. Even small East African countries have adopted low sulfur (50 ppm) fuels. Even Sri Lanka having no fuel standards has started importing ultra-low sulfur (10-15 ppm) fuel from Singapore. Other countries would follow gradually as the availability of high sulfur fuel becomes increasingly constrained.

India is already on Euro-IV level (50 ppm), although the implementation is variable at locations. India will adopt Euro-VI (ultra-low sulfur) fuel by 2020. The Supreme Court of India has mandated the adoption of Euro-VI due to the high level of congestion and pollution. India has a highly advanced oil refining industry, which is already exporting Euro-VI fuel to Europe, Southeast Asia and other parts of the world. India needs clean fuel badly and it can produce it as well.

Most of the oil producing Middle Eastern countries is switching to Euro-IV to Euro-VI for mainly two reasons. The market for their fuels requires low sulfur products. A major market is the OECD countries that require low or ultra-low sulfur fuels.

Secondly, in these countries, there is heavy influx of high-technology Euro-VI vehicles. A point may come, and is not very far off, when there would be few producers of high sulfur oil. The dirty oil may become more expensive than the clean oil due to market and supply reasons. We have experienced this already in the case of furnace oil. As a general rule, one should prefer to be in line with the ongoing trends and standards in the world market in order to be able to structure an industry that is able to export and a local market that is able to import and consume efficiently. The problem is much simpler for those countries who import both, fuel and vehicles. Such countries can benefit from technological changes in the advanced countries. Imports bring in latest technology. Most developing countries fall in this category.

Chart: 2.2.1 Sulfur levels in Diesels



However, there are some developing countries which import as well as produce both the fuel and the vehicles. Pakistan falls in this category to some extent. In Pakistan, there are oil refineries which produce diesel, gasoline and furnace oil but 50-70% of demand is met through imports. In case of diesel, 50% of demand is met through imports and in case of gasoline 67% of demand is met through imports. Normally, high sulfur fuels (500 ppm) are used by Pakistan's refineries.

Low sulfur fuels can be used by older vehicles, although with lesser benefit. But low-emission modern vehicles of Euro-VI category cannot use Euro-II high sulfur fuel. There are minor issues of lubricity of low sulfur fuels that can be handled by adding additives. Thus, introducing low sulfur fuels is much less complicated than introducing low-emission vehicles. High-end car assemblers and importers of Toyota, Honda and others in this category complain that they cannot introduce advanced-technology fuel-efficient and low-emission vehicles due to unavailability of low sulfur fuels like Euro-V or VI.

Chart: 2.2.2 Vehicle emission Standards

Oil refineries would require major investments in upgrading their facilities to be able to produce low sulfur (50 ppm) or ultra-low sulfur (10-15 ppm) fuel. Some of them may have economies of scale issues, some may be at the fag-end of their economic life and some may be short of capital, although the government has provided the incentive of 5% protection so that extra capital could be generated for the required investment. A compromise formula is possible – to let the oil refineries continue with the production of high sulfur fuels that could be provided to the low end of the market consisting of older and smaller vehicles. However, a time frame for switching to low sulfur fuel production should be provided.

Imported fuels could be provided to the high end of the market having low emissions and new vehicles – whether imported or assembled locally. It is, however, amazing that in India low-end vehicle producers like Maruti-Suzuki have already launched Euro-VI version of Alto, Baleno and WagonR. It appears that a differentiated local deletion policy may have to be adopted allowing import of built-up engines (Euro-IV to VI) for a considerable period of time. Interestingly, Kuwait Petroleum, which supplies almost 50% of diesel requirement of Pakistan under a long-term government-to-government agreement, has sent an advance notice that it would be able to supply only Euro-VI diesel from 2020. It has upgraded its refineries to produce Euro-VI fuels.

Kuwait Petroleum should not ask for higher prices as the cost-price premium on low sulfur fuels is minimal which is in cents only. One would certainly not like to repeat the Qatar LNG agreement where a high price formula has been agreed for a long period of time. Maximum sulfur of 50 ppm (Euro-IV) may be mandated for eventual local production while imports of 10 ppm fuels must be facilitated by 2020.

All new oil refineries must be on Euro-V or VI as doing otherwise would be to everyone's disadvantage. Urban areas may initially be considered as priority for low sulfur fuels. A clear policy in favor of clean low sulfur fuels must be announced without further loss of time.

2.3 : The Upper limits on Oil and Energy Prices?

If you are a consumer or an importer, you would like that oil and energy prices are as low as these days and remain at these levels for as long as possible. If you are a producer or exporter, you would like the reverse to happen. In Pakistan, purchasing power is so low that even low prices are not affordable, while governments want to extract as much from oil as it can. Oil and energy in general play a major role in people's lives and economies, never before this role was as paramount as it is today. People cooked their food on wood and shrubs, as they still do in most of Pakistan's rural areas. The tradable energy is what is new and that is why energy prices are so important and what these would be in future.

The dominance of Oil can be gauged from the fact that seven of the largest ten multinationals are oil companies, Royal Dutch Shell being the largest at $275 billion in sales and revenue. The two super powers are among the largest oil producers, and one (the US) is the largest importer and consumer of oil at one-fifth of all. Oil, gas, coal and electricity and to some extent renewable energy are the major elements in the energy mix of today. Prices are generally interdependent as one affects the other due to substitution effects and others. Oil prices being the most powerful driver would dominate our discussion.

Oil prices skyrocketed to $145 per barrel in 2008. They leveled out to around $100 in 2014, plummeted to a 13-year low in January 2016 at around $28 and then doubled to current levels of around $50.If shale oil producers go out of business and Iran doesn't produce what it says it could, prices could return to their historical levels of $70-100. OPEC is counting on it. So what would be the prices in 2020 and 2030?

It is easier and plausible to talk of energy prices in the long term than short term, which is based on pure speculation. Consumer and producer behaviors and aspirations determine the balance, which determines prices. Oil demand, as predicted by many credible international institutions, will continue to grow at least till 2035 and the supply would catch up accordingly. Oil supply has been constantly increasing since 2011 and will continue to do so. Shale oil and gas are a major threat to OPEC producers and have brought prices to the level that they are today. Otherwise, the prices would have been in the range of $70-100 per barrel. Higher prices may not always be in producers' interest. Demand may go down, the biggest weapon in the hand of consumers to fight prices is to reduce or avoid consumption.

It has happened many times in the past. That is why Saudis do not want to press for excessive prices that may boomerang to destructively low prices. Cost of production does have a basic role in prices in the long run, although in the short run, the role of demand and supply plays a higher role. In the long run, prices would asymptote (approximate) with the cost of production. But the cost of production in most countries is $20-25 per barrel. Why aren't producers satisfied with the current prices then? There is an interesting feature that is break-even prices.

Lightly speaking, I would term break-even prices to be the feel-happy prices. At these levels, the producer meets his cash flow requirements and is able to cover all extra cost and overheads over and above the direct production cost. Libya would require an oil price of $200 per barrel to meet its budgetary requirement and thus it would like to have oil price to be that much. But it won't, how can it be. But if Saudis and Russians say that they would require $100 per barrel to balance their budgets, it is important. They may not get it all, but this requirement would certainly influence the prices.

The producer-consumer USA brings its shale resources into the market and Europeans bring in renewable energy and conservation to balance. Then there are break-even prices of major oil companies such as Shell, Exxon and others. These prices of large companies used to be around $75-80 per barrel in 2014 as opposed to the production cost of $20-25 that we have been talking throughout. They have cut corners and have managed to bring prices down to around $40. No company would be able to borrow funds, if it is not able to prove that it would have its long-term break-even price under $40.

With this perspective, let us turn to the forecast of US Energy Information Administration (EIA). They have predicted a price of $92 per barrel in 2025 at constant prices of 2015 (excluding general inflation) and nominal prices of $112 per barrel (including general inflation). This is their reference or base case forecast. At real prices, oil prices are predicted to grow 3.9% per annum and at nominal prices at 6.1% per annum, a bit on the higher side for my taste and understanding.

In the next 10 years, my assessment is that prices should remain under $100 with a bottom of $70.Oil producers do not make a difference in oil or gas in terms of their production cost assessments. Gas prices corresponding to the $20-25 per barrel, are $3.63-4.54 per million British thermal units (MMBtu).Gas prices have varied widely in the three important market regions – the US, Europe and Asia – and the difference persists even now largely due to low shale prices and high supply in the US.LNG has brought tradability and thus some uniformity in prices. Earlier, LNG prices used to be $16 per MMBtu in Asia and $8 in Europe. I never understood it and wonder as to why Japan tolerated it. Partly, transportation costs explain the difference. Natural gas price predictions, as done by EIA, are for the US itself. US natural gas prices have been predicted to be in the range of $5-6 per MMBtu for 2025, as opposed to $2.62 currently. One may add $3 to cover liquefaction and transportation cost to Asia.

US prices will have a major effect on gas prices elsewhere in the future due to LNG factor and its tradability. LNG prices in the US have been predicted to grow at a rate of 2.5% per annum in constant prices and 4.77% per annum in current price terms, a substantial rate. It may be a sharp reminder to those who are arguing for a LNG-preponderant system in Pakistan. Coal at mine-mouth is being sold at $1.69 per MMBtu or $30 per tonne. Coal prices, understandably, have been projected to grow at 0.5% per annum only in constant terms and 2.6% in nominal terms. How do these compare with the current Thar coal prices estimates of $5.5 per MMBtu ($40-50 per tonne)? A food for thought for those who would like to keep Thar coal attractive and thus competitive

2.4 Petroleum Pricing in Pakistan

International oil prices (Brent crude) have come down to 36.79 USD/bbl (Monday 9th March 2020). By the time, readers read these lines, Brent crude may go down further. Highest peak in last days of February, Brent Crude was 56 USD. It is a 35% drop in international oil prices in less than a month. Highest peak within the current year was 70.25 USD/bbl. From that reference, it is almost 50% drop today. It is a God-send opportunity and concession for GoP and the people of Pakistan. In 2016-17, oil prices came down to this level which greatly consumer benefitted PML (N) government. GoP has reduced Petrol and Diesel prices by Rs.5 per Liter each. People are not happy, as they argue; full benefit has not been passed on to the people.

Further reduction would be due next month (April 2020) or could be even earlier. It is estimated that on the basis of today's price, new Petroleum product prices can go down by as much as Rs.22 and expected prices of Petrol would be Rs.89 per Liter and Diesel Rs.94 per. This assumes that GoP will maintain its taxes at current level of Rs.36 per Liter. This would be almost 100% taxation on landed or ex-refinery prices.

GoP should make due downwards adjustment in petroleum prices to save its political capital and boost economic growth and output through its taxation policies. GoP would have more reasons to be happy and relaxed on other counts as well. High interest rates and heavy currency devaluation have already taken its toll. However, international interest rates have gone down as well. LIBOR has come down to 1.5 % from recent rate of more than 2.5%. Most IPP agreements were based on LIBOR + 4.5% at a reference LIBOR of 0.5 %. With increase in LIBOR rates in earlier months, effective interest rates had exceeded 7% as opposed to a reference rate of about 5%. This had increased interest cost by 30%.LNG costs, even of the expensive Qatar contract, would be reduced by more than 50%. Thus Electricity cost and tariff should also come down. And accordingly, Circular debt should stabilize if not reduced. Hopefully, KIBOR will have to be adjusted down as well under this trend. Also imports would come down in dollar terms improving current account deficit by 4-5 Billion USD.

It should be noted that petroleum prices and taxation are still lower in Pakistan than in the region. In India (New Delhi, where the prices are cheapest in India), Petrol prices are Pk.Rs. 154.38(on 1st March) as opposed to prices in Pakistan of Rs.111.59 per Liter. Similarly, Diesel (HSD) prices in New Delhi are Pk.Rs.138.42 as opposed to Pakistan prices of Rs.122.26 per liter. In other areas in India, prices can be higher than, as high as 10 percent.

Under the current Petroleum prices as announced on 1st March, GoP would earn Rs.35.96 per Liter out of Petrol sales resulting in annual revenue earning of Rs.358.83 Billion, provided prices and taxation remain the same for one year, a big if. Similarly, on Diesel, GoP taxation earning is Pk.Rs.42.81/Liter, resulting in projected one-year revenue of Rs.461 billion. Together, Petrol and Diesel enable the GoP earn a revenue of Rs.820 billion. More realistic would be to put it in monthly terms which work out to be Rs.68 billion. Quite some help by the poor consumer to GoP. However, in a country where elite and businessman do not like to pay their due tax liabilities, there are few other options left.

There is a case for taxing energy consumption, as it has externalities, harming other sectors in terms of health, pollution and climate change. There used to be excise duty in early days to cover these aspects, which continues to be the case in India. In Pakistan, it is called Petroleum Development Levy (PDL), originally meant for development projects of petroleum sector. A decade earlier, courts made quite some hue and cry on it, similar to the protestation that is going on today on GIDC. It is time, perhaps, to change the nomenclature. An appropriate name would be Carbon Tax which is being pushed increasingly by climate change circles.PDL may be divided into two parts, one Carbon tax which may remain as fixed component and the other variable to be called Petroleum Levy.

6. Petroleum has been traditionally considered a luxury deserving heavy taxation. It is no more a luxury but is a necessity, especially, Diesel which is used by public transport sector.40-50% of gasoline in Pakistan is used by poor motorcyclists and Loaders(Suzuki and others) also consumer petrol, the latter being used for intra-city transport of goods and even as a public transport vehicle. Europe continues to tax petroleum heavily. In Norway, despite being a petrol producer and exporter, current Petrol prices are Rs.250 per Liter or more, almost double or more than double of Pakistan prices. Similar is the case in other European countries like France, Germany, Italy and the U.K. etc. The U.S., however, indulges in moderate taxation and its petroleum prices are used as a benchmark by many.

It has taken this scribe quite some time and effort to calculate taxation impact under the current price announcement. PMLN government stopped issuing price-build up data apparently for no good reason. The purported reason was, name-sake, competitive pricing at petrol pumps. The negative impact is that all kinds of inaccurate data circulate in the electronic and print media. It hurts government image amidst confusion. In our region in India, there is price competition as well; however, price-build-up transparency is maintained there. One would have more reliable Indian data available conveniently than one would have on Pakistan. One has to do backward calculations on the basis of widely dispersed data. Earlier, OGRA used to publish this data and continues to post historical price-build up data on its web-site. Serious consideration may be given by the GoP to eliminate this vestige of the past and announce its own well-considered policies.

Oil prices have gone down earlier benefitting temporarily. It may peak again as earlier to reach unaffordable levels. Issues and problems, however, remain. Realistically speaking, Pakistan may never become self-sufficient in Oil and Gas, however, dependence and imports can be reduced. Another problems the dollarization of the energy sector, where in the locally produced energy does not save much foreign exchange. We are an agricultural country having a lot of bio-resources. We have in this space drawn attention to the role of biogas and bio-CNG. Local resources and investments can play a major role in this respect. It can also play some role in boosting the economy and employment, especially, in rural areas. It may not be inappropriate to repeat the same suggestion again while we are having some sigh of relief at the reduction in oil prices**.**

It is pleasing to see that GoP is promoting Electrical Vehicles (EVs) and a policy in this respect is on the anvil to be passé by the ECC. With increasing share of Renewables like Solar and Wind, EVs will make our energy sector more independent and sustainable.

Table 2.4.1: Comparative Petroleum Prices in Selected Countries-2nd March, 2020

	Gasoline USD/L	**Diesel USD/L**	**LPG USD/L**	**Kerosene USD/L**
Pakistan	**0.72**	**0.79**	**0.4522**	**0.596**
Srilanka	0.89	0.57		0.38
India	1.03	0.92	0.7	0.41
Bangladesh	1.05	0.77	0.64	0.768
Turkey	1.12	1.04	0.64	0.86

Source:OGRA, IOCL, globalpetrolprices.com

Table 2.4.2: Petroleum Prices-1stt March 2020

	MOGAS		HSD	Kerosene	
	1st March	**1st February**	**1st March**	**1st February**	**1st March**
EX-Refinery Price	65.95	74.88		85.73	76.56
IFEM	3.17	3.22	0.97	1.17	2.46
Sub Total	69.12	78.1		86.9	79.02
OMCs Margin	2.81	2.81	2.81	2.81	1.58
Dealers Commission	3.7	3.7	3.12	3.12	0
Petroleum – Levy	19.75	15.05	25.05	15.94	12.33
Subtotal	95.38	99.66	104.50	108.77	79.02
				$	$
Sales Tax	16.21	16.94	17.76	18.49	13.43
Maximum Retail	111.59	116.6	122.26	127.26	92.45
Distribution Cost	9.68	9.73	6.9	7.1	4.04
Taxation	35.96	31.99	42.81	34.43	25.76
Distrb. Cost % Sales	8.67	8.34	5.64	5.58	4.37
Taxation % Sales	32.23	27.44	35.02	27.05	27.87

Source : Compiled SAA : data OGRA,PSO

Table 2.4.3: Comparative Petroleum Prices Pakistan vs India-Ist March 2020

	Gasoline		HSD	
	Pakistan	**India-Pk.Rs/L**	**Pakistan**	**India-Pk.Rs/L**
EX-Refinery Price	65.95	70.20	0	77.95
IFEM	3.17	0.69	0.97	0.62
Sub Total	69.12	70.89	0	78.58
OMCs Margin	2.81	0.00	2.81	0.00
Dealers Commission	3.7	7.64	3.12	5.36
Petroleum – Levy	19.75	43.01	25.05	34.08
Sub. Total	95.38	121.55	104.50	118.02
Sales Tax	16.21	32.83	17.76	20.41
Maximum Retail	**111.59**	**154.38**	**122.26**	**138.42**
Distribution Cost	**9.68**	**8.33**	**6.9**	**5.98**
Taxation	**35.96**	**75.84**	**42.81**	**54.49**
Distrb.Cost % Sales	**8.67**	**11.62**	**5.64**	**9.31**
Taxation % Sales	**32.23**	**105.76**	**35.02**	**84.74**

Exchange Rate-USD	155	155.00	2.15	0.00

Source : Compiled SAA : data
OGRA,PSO,PPAC India, IOCL India

Table 2.4.4 : Comparative Petroleum Prices Pakistan vs India-Ist March 2020

	Gasoline		**HSD**		**Total**
	Pakistan	**India-Pk. Pk. Rs./L**	**Pakistan**	**India-Pk.Rs/L**	
Maximum Retail-Pk.Rs/L	111.59	154.38	122.26	138.42	
Maximum Retail USc/L	71.99	99.60	$ 56.79	89.31	
Distribution Cost	9.68	8.33	6.9	5.98	
Taxation	35.96	75.84	42.81	54.49	
Distrb. cost % Sales	8.67	11.62	5.64	9.31	
Taxation % Sales	32.23	105.76	35.02	84.74	
Consumption - MTPA	7.39		9.04		
Taxation Revenue-Bn. Rs/a	358.83		461.25		820
Exchange Rate-USD	155	155.00	2.15	0.00	

Source : Compiled SAA : data OGRA,PSO

Table 2.4.5: Price Buildup of Diesel at Delhi effective 01-Mar-20

Elements		**Unit**	**Delhi**
Base Price		RS/Ltr	36.21
Freight etc		RS/Ltr	0.29
Price Charged to Dealers (Excluding Excise Duty and VAT)		RS/Ltr	36.50
Add : Excise Duty		RS/Ltr	15.83
Add : Dealer Commission (Average)	RS/Ltr	2.49	
Add : VAT (including VAT in Dealer Commission)	RS/Ltr	9.48	
Retail Selling Price at Delhi-(Rounded)		RS/Ltr	64.30

Source : ONGC India

2.5 : In Search of Cheaper Petrol for the Poor

In the context of evolving inflationary tendencies and increasing petroleum prices, GoP has been looking for a way out for reducing the difficulties of the poor created due to high petrol prices. Some proposals in this respect have been put forward by the experts including this writer. Some quarters in the petroleum industry have expressed their reservations or even opposition to these proposals. In fact more seems to have appeared on the opposition to the proposal than the proposal itself. It appears that there are some confusions and lack of understanding of the proposal that has been made. We would like to explain the proposal and try to assuage the concern or reservation of the opposing quarters.

The proposal is in the public domain and has some variants. We will describe here the more widely known version. The proposal is as follows: a separate petrol category is created, technically and in financial terms, which can be supported or subsidized through reduced taxation and lower cost of production. It has been found that a successful product can be produced by blending low-octane petrol. At present, regular gasoline is marketed as a RON-92 product. The proposal is to market a RON-87/82 product aimed at motorcycles. There are two rationales for this: a) motorcycles do not require high octane fuel that is consumed by cars, especially, the newer models introduced within the last 5 to 10 years; and b) motorcycle users belong to the low earning level group which may not be classified as poor under the prevailing statistical classification.

It would be easier and cheaper to market such a fuel product. Our existing refineries produce RON-87 Gasoline as a standard product. They add environmentally injurious additives like Manganese compounds to enhance the octane rating to 92 or higher, which costs more money and consumes vitally needed foreign exchange. All we are saying is to not add this injurious additive; the latter may be necessary for cars but is not required for motorcycles. Nothing extra has to be done. In fact, an environmentally more benign product will be there. What is so wrong about that?

It has been estimated that the market share of petrol consumption of motorcycles is around 50 percent. Pakistan is the fifth largest market of motorcycles after China, India, Indonesia and Vietnam. There are more than 20 million motorcycles and some 2.5 million are added every year – a huge market and political product. An Rs10-20 per liter, a cheaper petrol product can be targeted for motorcycles. Additives cost of Rs5 per liter or more can be done away with; also lesser taxation in the form of no petroleum levy and possibly reduced GST. The deemed duty of 7.5 percent can be shifted from diesel to conventional gasoline of RON-92 and upwards. This shifting of deemed duty would create a balance that is heavily tilted against diesel which is consumed by goods transport and public transport used by the poor.

Opponents argue that some motorcyclists may not like the low-octane fuel, as it would not provide the kick and the cranking. Our answer is that they will not be forced to buy the cheaper and low-octane product. They can have their cranking and the kick by continuing to buy the more expensive petrol. That is not the minority user class that is being aimed at. We are aiming at those who are finding it difficult to meet both ends and would thus welcome cheaper petrol and a motorcycle that can meet their daily needs.

The other objection is that it would be difficult to create storage and filling facilities. Our answer is that if facilities have been created for higher octane product, the same way facilities can be created for low-octane products. It is really a lame argument. I recall reading a book on the history of automobiles. When the idea of a car was introduced, skeptics said that it would require an impossible infrastructure; roads would have to be built and petrol pumps would have to be constructed. An impossible idea – was it that? Why should petroleum companies take this pain of coming up with a new product? They are already making money. It is the government which has social concerns. And the government can indeed induce them to do it, by offering a few paisa per liter of service charge or reducing the deemed duty; the latter they may not like. However, companies should also be sensitive about social concerns. If social tensions increase and a law and order situation develop, the first victim is the petrol pump.

So not only is cheaper petrol for motorcycles feasible, it will also help improve the environment and reduce manganese pollution by half, since the proposed product does not require manganese. The petroleum industry does not seem to be much bothered by the environment as we see the utilization of deemed duty. RON level has been enhanced by adding injurious additives and not by improving refineries technology for which the deemed duty has been awarded.

Let us utilize this opportunity by drawing the attention of the government and the other stakeholders towards another aspect of environmental insensitivity. Bio-fuels like E5 are an environmentally benign petrol product being blended almost elsewhere except in Pakistan. In fact, the whole world is moving towards E-10, a more advanced target. E-5 means that five percent ethanol is blended in petrol and E-10 means 10 percent blending of ethanol. Pakistan is a major producer of ethanol due to the sugar industry of which ethanol is a by-product. But Ethanol is exported with no net advantage as the equivalent amount of oil is imported. India is a much larger producer of ethanol due to its larger sugar industry. However, India does not export ethanol. India imports ethanol and blends both imported and locally produced ethanol in petrol, producing E-5 Petrol and is targeting to move towards E-10.

Although prices keep varying, ethanol is typically 25 percent cheaper in terms of international prices. In fact, E-5 and E-10 can reduce the cost of petrol and enhance octane rating resulting in a much more environmentally benign product. There are all kinds of excuses of one kind or the other being made against the present proposal of RON-87 petrol for motorcycles. Why should Pakistan not have E-5? Old vehicles, motorcycles and other issues are almost the same here as they are in India and other developing countries. If one is getting higher prices on inferior products, why would one bother?

These proposals address inflation, poverty and environment at the same time. All policy proposals have pros and cons. This writer does not subscribe to conspiracy theories and oil mafia perceptions. There are bound to be some affectees and consequences; one has to measure the severity of negative consequences and the possible remediation thereof. The petroleum division is supposed to put its foot down, as it has done recently in other cases. It is good to learn that the petroleum division is reportedly examining these proposals with open mind and that it will organize wider stakeholder consultation and will most probably not give in to the position of one group or the other.

Exclusive Pumps

At present, more facilities and attention is paid to cars by marketing companies and dealers. In fact, there is a case for introducing exclusive petrol pumps for this segment. Cheaper and less space consuming stations and filling points can be established. There are containerized concepts also, which can be shifted according to congestion and space availability.RON 87 product can be introduced at a substantially lower price and this price difference can be partly passed on to conventional and high RON petrol and partly covered through tax reduction. It is realized that a large subsidy or reduction is not feasible in the current circumstances. We are proposing only a small reduction in GST from 17% to 13% and shifting the petroleum taxation load to the conventional petrol.

It is possible to introduce the proposed product at a lower price of Rs96 per liter as opposed to the existing price of Rs112.68. Simultaneously, the price of higher RON product will go up to Rs131.6, which will be affordable by the higher income group having expensive cars. By comparison, the petrol price in New Delhi is Rs156 Pakistani per liter. This is the lowest price among all regions. In Mumbai, the price is Rs164 per liter.

The proposed scheme of things offers achievement of another desirable objective in petroleum pricing. In Pakistan, unlike many other countries, the diesel price has been higher. Diesel is consumed by public and goods transport, and affects the cost of products and competitiveness. If we leave the HSD price and its taxation the same, the difference between the two will go away and possibly HSD can be priced lower than petrol.

Poor Man's Fuel

Kerosene is consumed mostly by the poor. Its price can be reduced by charging less GST at 13% instead of the standard 17%. Also, the petroleum levy may also be exempted. The market of kerosene is much smaller than that of petrol and diesel and thus a major fall in government revenue may not occur due to this reduction. If the proposed is done, kerosene prices can be brought down to Rs86.6 per liter instead of the current Rs96.77.There is a case for subsidy to this sector which, however, may not be feasible under the present circumstances. However, it should remain on agenda till the circumstances permit.

Petrol and other fuel prices are increasing due to the recent rupee depreciation and other inflationary reasons. It is vital to bring policy innovations for reducing the burden from the lower income group and transfer it as much as it may be feasible to the higher income groups. All policy changes and innovations have consequences. Consequences should be measured and mitigation should be introduced. Inaction or rejection of new approaches is not an option.

2.6: Towards Cheaper Diesel Than Gasoline

Previous Petroleum Minister Ghulam Sarwar Khan, in his first meeting with his ministry officials, had said something very seminal about the current petroleum pricing policy. He said high-speed diesel (HSD) should be cheaper than gasoline (petrol). I have long held this opinion but did not speak vehemently due to revenue constraints faced by various governments.HSD consumption used to be much higher than gasoline in Pakistan and used to be a revenue earner as both higher taxes and high sales fetched more revenue. Things have changed over the years. It appears that time has come to change the pricing policy, making HSD cheaper or at least equal to gasoline prices.

Generally, HSD is priced lower than gasoline in most countries of the world because of the simple reason that public transport of people in buses and of goods in trucks use diesel, lowering transportation costs and prices. Same is the case in the countries selected for the table. Only five out of 20 countries have lower or equal gasoline prices than diesel which include Pakistan, the UK, USA, Indonesia and Australia. Even there, USA has equal prices and UK HSD prices are only 1.75% higher. In Pakistan, HSD prices are 16.30% higher than gasoline. In India, HSD prices are the opposite – 11.76% cheaper than gasoline prices. In Bangladesh, the difference is even higher at 35.90%. In Thailand, the difference is 27.78%.

In 84 countries out of a data set of 116 countries, Diesel is priced cheaper than Gasoline thru taxation policies. The difference is more pronounced in South Asia and other parts of Asia. Even in Europe, this differential is maintained despite general aversion to Diesel. In the adjoining Table, supporting data is provided.

Table 2.6.1: Comparative Gasoline vs Diesel Prices for some representative countries

	Gasoline-USD/L	Diesel-USD/L	Diesel % Gasoline
Pakistan	0.6	0.67	111.67
USA	0.57	0.65	114.04
India	0.95	0.85	89.47
Bangladesh	1.05	0.76	72.38
SriLanka	0.84	0.54	64.29
Thailand	0.76	0.55	72.37
Phillipines	0.79	0.59	74.68
China	0.83	0.72	86.75
Singapore	1.4	1.15	82.14
Brazil	0.7	0.57	81.43
Germany	1.24	1.11	89.52
Spain	1.17	1.07	91.45
Italy	1.5	1.38	92.00

Source: Global Petroleum Prices-27th April 2020

Typically, in Europe, the HSD-gasoline price difference varies between 6% and 23%. This is despite the fact that HSD is more polluting than gasoline and environmental considerations are at very high levels in European countries. However, it appears that social policy has traditionally been higher in the European agenda – very high taxes on petroleum and higher on gasoline than on diesel, the latter being predominantly used by personal cars. It may be noted that in Europe, on average, petroleum is twice as expensive as in developing countries.

It appears that there has been no particular long-term trend in the petroleum products pricing policy in Pakistan. HSD used to be cheaper between 2005 and 2008 by almost 27% to 50%.HSD in 2005 was priced at Rs26.21 per liter against Rs40.39 for gasoline. Similarly, in 2008, HSD price was Rs55.15 vs gasoline price of Rs75.69. However, reverse became the case in 2010 and onwards, when HSD became expensive by 10-16%.The reason for higher HSD prices is higher taxation. For example, in the last price announcement, the sales tax on HSD was Rs19.22 per liter. What is the solution for making HSD cheaper? Reverse the taxation gradually, though it may be politically very difficult as gasoline is consumed by a vocal and powerful consumer class consisting of rich, poor and the ones in between.

Another point is worth noting. Laymen generally complain that petrol prices are higher than those in India and Bangladesh, which is not true and probably has never been the case. At least, petrol prices have always been quite lower in Pakistan than in these two countries. Gasoline prices in Pakistan are 48% lower than in India and HSD prices are also lower. HSD prices are, however, higher in Pakistan than in Bangladesh by 15.22%. Gasoline price is way lower than Bangladesh's by 37%.

Sri Lanka appears to have what can be called a desirable balancing between HSD and gasoline prices and almost opposite to that of Pakistan – Rs116.69 for gasoline in Sri Lanka which is closer to Rs111.16 for HSD in Pakistan and Rs92.6 for HSD in Sri Lanka which is closer to gasoline prices in Pakistan of Rs96.88.Another trend is worth noting about gasoline vs HSD. Gasoline consumption has been growing very fast over the last decade and it continues while HSD consumption has almost stagnated. Gasoline consumption in 2007-08 was only 1.5 million tons, which is now more than 6.1 million tons. The gasoline growth rate has crossed the limit of 20% per year.

HSD consumption used to be 8.2 million tons and is almost the same now a decade later. Perhaps, the increase in motorcycles and Suzuki loaders has something to do with it and the industrial sector, inter-city movement and commerce have stagnated. One thing is clear now that revenue imperatives and impact are almost the same – one can tax either without losing revenue any significantly. What is the moral of the story? Firstly, there is a room for some increase in gasoline prices and decrease in HSD prices. Secondly, some more revenue can be generated from this sector so long as crude oil prices do not cross $100 per barrel.

However, there may not be a lot of space in price maneuvering as gasoline is also used in transportation in Pakistan and the low income group uses gasoline in motorcycles. However, there would be a positive effect on the economy and inflation if HSD prices are kept lower than gasoline. It may be noted that the consumption of HSD and gasoline has almost become equal and both can serve as a vehicle of revenue earning in equal terms.

The issue is quite complicated, however. In India, electricity prices are lower and quite lower than in Pakistan. There is lower electricity tariff for the low income group, despite that average selling prices are lower. Gas prices in India are higher than in Pakistan, although this is due to undue delays in gas price adjustment. After expected price adjustments, the gas tariff in Pakistan and India would become comparable.

The problem can be solved by introducing a cheaper gasoline product for two wheelers, three wheelers and locally produced vehicles of below 1,000cc. A RON-87 gasoline product with some other additive will meet the need. There should be a separate and cheaper tariff for this fuel. A gasoline product for newer vehicles driven by the affording and higher income group with RON-90 or above should be there with a tariff higher by Rs10 than the cheap gasoline proposed earlier. This will also make HSD cheaper than gasoline.

In Pakistan, there is a reverse policy, taxing Diesel more than Gasoline thru loading deemed duty exclusively on Diesel. Earlier, Diesel used to be cheaper in Pakistan as well. The policy was changed to extract more taxation from petroleum sector, the easiest way to generate revenue. Diesel market share was much higher; in 2008, Gasoline consumption was only 1.5 MTPA and HSD was 8.2 MTPA. By 2018, Gasoline and HSD market share are almost comparable; Gasoline 7.39 MTPA and HSD 9.038 MTPA. Thus revenue motivation is long gone now.

An argument has been given that Gasoline is also used in transport of goods. This is normally within city goods transportation like Suzuki loaders. Due to shorter distances, the share of Gasoline cost in total goods transport is not significant. However, Diesel is used in public transport within cities which is primarily used by the poor including factory workers. Also, Diesel is used in goods transport over long distances, especially, inter-city involving distances of hundreds of mks. The share of fuel cost as a percentage of goods value is significant affecting efficient businesses and exports. As to the poor using gasoline in motor cycles and small old cars, RON-87 gasoline could be introduced. If all these qualitative arguments in favour of cheaper Diesel are not convincing enough, a formal quantitative study may be commissioned to finalize the issue.

Time has come to bring innovative changes to the energy policy to include the above proposal. To meet the challenges of rising current account deficit and falling exports, the reduction in diesel prices can play a significant role in reducing the cost of production and make exports competitive, although many small steps would be required to achieve the goal. There is scope for a lot of innovation consistent with market. India has introduced mobile petrol pump and CNG stations. We may start with containerized petrol pumps for motor cycles which may solve many problems; vending of special and cheaper RoN-87 petrol for motor cycles; avoidance of rush on normal petrol pumps, as motor cycle share in petrol consumption has gone to as high as 40% but conventionally lesser space is allotted for them.

In related news, HOBC has been sold at unreasonably higher prices. HOBC prices are free(uncontrolled).There is a controversy whether Oil Marketing Companies(OMCs) created a shortage by importing less violating their license requirements of keeping 21 days storage or Petroleum division did not let IMCs to import. Both may be responsible and perhaps nothing else could have been done in the kind of corona circumstances affecting demand and growth. Estimations and timings could have gone wrong. It may be futile to continue discussing the issue.

However, reportedly, even poor motor cyclers had to buy expensive HOBC due to the shortage of the normal petrol. OMCs and even Oil refineries have been working reasonably well under a regulated regime, most of which multinationals cognizant of their reputation. Why did they resort to such practices? Perhaps, they got envious of IPPs, Sugar and wheat sectors whose consumer fleecing and excessive profiteering are a common narrative. Why shouldn’t they do it as well? Fortunately or unfortunately, their prices are controlled. HoBC was free in an open market regime. There is a wrong notion of free market. It does not allow price conspiracy and cartelling. The idea of free markets has to be possibly revisited and HOBC be brought under regulation also. As usual CCP (Competition Commission of Pakistan) has taken notice quite late in the day. It appears that they might not succeed in doing anything meaningful.

2.7: Hedging Oil and Gas Prices

Oil prices have touched zero and became even negative recently; post Corona and oil price war between Saudi Arabia and Russia. A debate has ensued in Pakistan that we should have bought cheaper oil. It is a different matter that around the same time, there was news of Diesel shortages. Petroleum division, probably, projected lesser demand due to Corona as it is we are always short of liquidity and foreign exchange and even storage. Buying more is not in our psyche or system. It was a unique situation. Prices do vary and there is a scope for saving money in buying or reducing price losses. After touching the lowest, the general perception is that prices would increase. Now, there are proposals for hedging crude Oil, Gasoline and Diesel etc. Assuming that it would be a safer bet as the general perception is of higher prices. We would like to make the reader understand as to what is involved in hedging and do not mean to support or oppose the hedging proposals that are circulating.

In recent history, Oil prices peaked in the year 2008 at USD 145 per barrel and a low in the same year at USD 30.Subsequently, Oil prices were higher than USD 100 in the years 2011, 2012, 2013 and 2014 when oil prices were respectively USD 113,109,111 and 108, while the lows in the same years respectively were relatively high, respectively at USD 75, 78, 87 and 53.In the current year 2020, high was at 63.27 USD and the low was as low as negative prices. Pakistan oil imports around 2008 and onwards were of the tune of 20 billion USD as opposed to 12 billion USD average these days despite increase in import volume.

Therefore, hedging is normal in oil both by the buyers and sellers and not in just oil but in other commodities as well. In the oil business, there is two sided hedging. Oil refineries hedge for crude oil and as well as finished products like gasoline and diesel, for both raw material and finished products prices may change and sometime in the opposite directions due to inventory and other reasons. Thus raw material crude oil may become expensive and finished products gasoline and diesel may become cheaper. In an extreme case, the price difference between raw material and finished product may be come zero or less than the cost of production. Oil refineries, therefore, hedge on both sides for which a hedging product is available, called Crack. For example, in some exchanges in the U.S., gasoline crack spread for May 2020 has been quoted as 11.93 USD/barrel. For December 2020, it has been quoted at 4.98 USD only.

Airlines usually hedge jet fuel. This quarter, they could not have hedged, for example, 10 USD or lower. Most hedged at 60 USD. The highest oil price within the year 2020 was 63.27 USD. Most successful airlines are in bankruptcy situation looking for government bailout. There are two reasons; lack of business and hedging losses. Air France-KLM group is facing a hedging loss of more than 1 billion USD of hedging loss. Another smart airline, Singapore's SAL, suffered a hedge price loss of 198 million SD(Singapore Dollars).There was additional loss due to lesser consumption than hedging contract amounting to S$ 710.Other airlines have similar stories. Even before Corona, in 2015 price plunge, Delta Airlines made hedging losses to the tune of 2.3 billion USD and united Continental Holdings lost 960 million USD. Trafigura, one of the world's biggest traders, posted a hedging loss of 254 million USD in 2018. So in hedging, one can lose and profit, although, it was an extra ordinary situation. Usually, hedging losses are manageable and enable avoiding catastrophic or unaffordable losses. In our case, for example, oil prices above USD 100 would be quite damaging, although we have borne such atrocious prices in the past.

Hedging is reducing the risk of loss and not making money. It is a risk management tool by which buyer or seller want to lock a price at which they would like to buy or sell at a future date. Buyer may buy a hedging instrument at lower prices but the prices become higher than his hedged price, in that case the buyer makes a profit and seller loses and vice versa. In case prices are lower than hedged price, buyer loses and seller earns a profit. In this particular situation which prevailed recently, both buyer and sellers lost. The price was below cost of production and even cost of storage, sellers lost. Nobody could have projected this kind of situation. Buyers who hedged lost money, but the buyers who did not hedge and had storage profited from the situation.

There are three hedging instruments; 1.Futures; 2. Forward; 3.Swap. Petroleum Division's proposal is based on Futures/call option. Futures are operated through an exchange, while Forward and Swap are OTC (Over-the Counter) bilateral instruments agreed to between the buyers and sellers. The agreement may be abused on exchange prices but may not be executed or guaranteed by the exchange. Forward contracts are at a fixed price and date and are usually flexible and as per bilateral agreement, while Futures are per standard contract and are traded daily. Margins may be consumed and additional deposits may have to be made depending on the price variations. Forward and Swaps are settled on the agreed fixed date and the contract expires on contract date. Physical delivery or cash for the difference may be taken.

Hedging or not?

Can you make or save a lot of money in buying Oil; assure low prices in future by paying a small fee only? Is it a free lunch? Is there anything in the world as a free lunch? Let us examine what are the risks involved and what are the potential benefits. We have to go into mechanics of hedging. Essentially, it is speculating about the future prices of the commodity; in this case it is oil. There is no way of knowing future prices or even trend of it, at-least for the ordinary investors and speculators. It is juwa or satta. Very big parties having large research organizations and deep pockets would have some idea or knowledge about it which they would not share with the ordinary. After all, it is a zero sum game in speculation; one person's loss is another person's profit. So step one is to speculate or estimate the future price(a near impossibility). You will have to pay a premium depending on how far is your time of speculation from (say)today; the longer the time horizon the higher the premium and vice versa; also the higher is the margin by which you are way from average market perception.

There are two diametrically opposite perceptions about the future oil prices. One view is that after Oil prices have touched low, there will be increase in oil prices in future and would acquire normalcy. This is the view that has perhaps created interest in Pakistan to start hedging oil. The other view is that things are quite uncertain as to how will Corona settle and what would be its impact on world economy. Oil prices may not increase but there is a chance that it may go down and have a crash once again. There are contenders for both the views; therefore, the future oil prices are a few dollars more than current prices. Had the higher prices view been the sole one, oil Future prices would have been quite higher. So, it is really mere speculation.

In actual, commodity future investing is much more complicated. There are many types and strategies. With deeper knowledge of the market and techniques, consultants and brokers can beat the ordinary and thus make money. If you are a simple investor having no background, it may remain a black-box. Thus it is vital that investor has some know-how even if he is getting advice from experts, as advice can be phony or motivated. The consultant might be working for other larger parties and collecting profit for them sacrificing the small parties' interest. And in government another level of uncertainty emerges in terms of the bureaucracies' level of integrity or lack of it. It is not as simple as one may tend to think. Then there is political cost of it in the perspective of many other controversies; LNG, Sugar, Wheat etc

Mercatus (Energy Advisors of repute) point out the following fallacies in hedging approaches which apparently make common sense but are fallacies;

- We decided to stop hedging because we never made money on our hedges
- We have to hedge but cannot incur any hedging losses.
- We don›t know whether prices are going to increase or decrease this year
- We do hedge, but not when we think prices are going to move in our favor
- We are going to wait and see what energy prices do over next few months
- Sometimes we hedge 100%; sometimes we don›t hedge at all. It depends on our view of the market
- We hedge when we see good opportunities
- We only hedge when we have a strong view on the market
- We are hedgers, not speculators (most people think they are hedgers but in-fact are speculators).

At the time of righting these lines, the Brent Crude Oil price is 35.00USD per barrel. And you are expecting and thus speculating that prices would increase as these reached the lowest (zero) and on recovery, you expect that it is bound to increase. Thus you may speculate that oil prices would gradually increase to somewhere around 45 USD the usual price level. So you may ask your investment broker to buy 20 million barrels at a price of, say, 45 USD. Without going into nitty gritty, you will pay a premium of (say, depending on the market prices) 3 USD/bbl. Why premium? Because you will get 20 million barrels at 45 USD even if prices go as high as 60 USD/bbl. Your premium would be 60 million USD. If the prices become 60 USD, you will still get oil at 60 USD/bbl. Thus you profit (60-45=15) fifteen USD per barrel and in total on 20 million barrels; your profit would be 300 million USD-a lot of money? Then why doesn't everybody do it? Invest only 60 million USD and get 300 million USD? Prices can swing the other way or may not go as high as 45 USD that you speculated. If the Brent oil prices reach only 38 USD as is indicated by current future prices on ICE (pls see adjoining figure), you would lose seven USD per barrel (45-38=7) plus premium cost of 3 USD/bbl making it 10 USD/bbl. Your total loss would be 200 million USD. This is a simple explanation, describing the speculator nature of commodity investing. It is more speculatory than buying company shares. In company shares it is the company profitability that is the basis of price .In commodity speculation, there is no basis at all.

Pakistan Context

Petroleum Division (PD) proposal involves call in Option which does not obligate the buyer to buy on losing terms: to buy against assumed price assumption. However, such no-loss hedging may be expensive and may have other strings attached. One has to examine the hedging proposals carefully and evaluate their risk characteristics. Competitive bids should be invited in a transparent manner quoting premium, fee and charges and other associated terms.

One would like to suggest that we examine other strategies like Forward and Swap with some of the Middle East oil countries and their nominated companies. We already have a Diesel supply contract with Kuwait Petroleum but are based on market prices without involving risk management. It may be explored with them on agreeing to some risk management arrangement. Reportedly, UAE's ADNOC has started using risk management tools. Exchange based contracts are more transparent and bilateral deals can be controversial, although may be cheaper. LNG contract with Qatar would not be a good example. All kinds of political controversies may develop, in case of losses as compared to spot prices.

All options would have to be examined. Such decisions cannot be based on generalities but would have to be based on concreted proposals which would have to be compared in terms of price-risk combinations and the costs and commissions.

In our case, there is no price risk to oil businesses, be it Oil refineries or OMC. It is a cost-plus regime here. Whatever be the cost are passed on to the consumer and the government. However, finished products prices are passed on with 5-7.5% taxes; apparently, there is no cover or protection against crude oil price fluctuations. However, time horizon is of 15 days, which reduces the risks. However, GoP budget and current account deficit may be affected by large variations in oil prices as has happened earlier. Also people standards of living and end-user business sectors are affected impacting their competitiveness.

There are other policy issues related to passing on the cost, benefit and risk. There are three parties; consumer, government and the company (in this case PSO).OMCs may not need it as their parent offices should already be doing it irrespective of

Chart 2.7.1: Last Update Time

CONTRACT	LAST	TIME(GMT)	% CHANGE	VOLUME
SEP20	36.220	5/20/2020 12:10 PM	2.259	29374
OCT20	36.650	5/20/2020 12:08 PM	2.032	12549
NOV20	37.150	5/20/2020 12:08 PM	1.865	6668
DEC20	37.730	5/20/2020 12:10 PM	1.945	20141

Chart 2.7.2: West Texas Intermediate Crude 12-Month Future vs. Spot Price by Contract Month

Source: NYMEX.

Pakistan policy. However, Oil Refineries issues appear to be open or PSO would be handling their trade as well. The beneficiary has to be the one who pays and assumes risks and gives guarantees. In this case, it appears to be spread among the company, government and consumers. A clear delineation of shares of cost and benefit may have to be developed.

Hedging is useful but highly complicated issue and has quite a potential for political controversy. Transparency requires neutral and preferably non-commercial institutional advice. World Bank has recently assisted Tunisia (and earlier Uruguay) which is an oil importer and has similar problems as Pakistan has. World Bank helped build technical and managerial capacity in risk management and helped develop risk management strategy. A competitive process was used to select the minimum price offers. Hedging is new for Pakistan. The local know-how is limited and is not institutionalized. We should do the same and involve World Bank on the same lines. Doing otherwise may prove to be controversial and not cost effective

ECC Proposal on Hedging Oil

- **Approving PSO to be the counterparty and the Finance Ministry to provide guarantee of its performance**
- **One-year call option for 15 million barrels of oil with division into 12 equal monthly amounts and USD 8 strike prices above the current Brent — given that fee remains within acceptable range**
- **Two-year call option for 15 million barrels of oil with division into 12 equal monthly amounts and USD 15 strike prices above the current Brent — given that fee remains within acceptable range**
- **Notifying a committee for finalizing call options with the selected banks, along with ECC to provide final approval on a short notice**
- **Providing OGRA with a policy direction about including the monthly price of the option in the oil product's cost when announcing the monthly price**
- **20% of Oil imports are being considered for Hedging to limit the risk**

2.8: Deregulating Oil

June prices were extraordinarily low in the company of 15 lowest price oil producing countries prices like Saudi Arabia, Qatar and Turkmenistan (and less than half the prices in India). In hind sight, it was perhaps not an optimum decision which caused price shock and created most of the problems faced by the market, government and the public. A better option could have been of passing on the surplus to the Ehsas programme and other victims of Corona. Admittedly, one is wiser in the hindsight. Everyone was confused as to how to manage the economic shocks of Corona. Is deregulation a solution or some other variant of it like price ceiling and not fixing? We will examine this difficult issue in the following.

Month of June has passed in controversy, oil shortages and black marketing in the wake of drastic cut in petroleum prices announced by the government. International oil prices plunged due to lack of demand due to Corona. Oil prices became even negative, although for a short while. GoP passed on most of the surplus, it could, to consumers. The political and welfare impact was marred by the subsequent market problems which would annoy any reigning government.

New Oil prices on Ist July 4, 2020 created quite some stir .A 34% increase in one go is unbearable for people in these hard economic circumstances commingled with Corona. Admittedly, price increase was due to 51% increase in international oil prices.

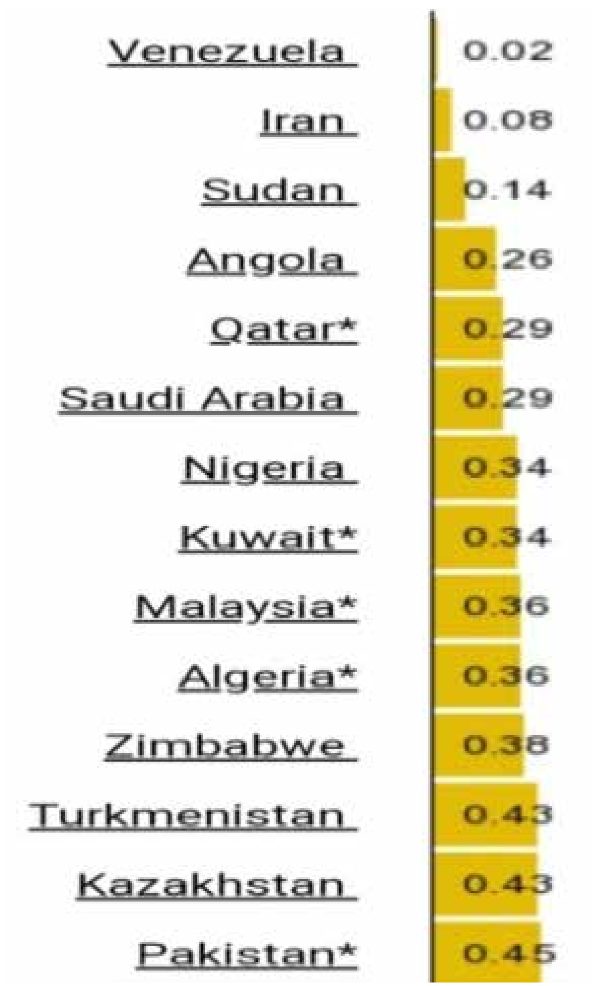
Government could have played with taxation, as is usually the case; Petroleum Levy could have been brought down from Rs.30 to Rs.20 and thus increase could have been limited. Reportedly, GoP is considering precisely this now and it is possible that by the time the readers read these lines, a taxation and price reduction would have already been made. However, it may be noted that price decrease is not taken lightly by OMCs and inventory and shortages issues may again emerge due to lowering the prices. It is indeed a difficult pricing policy terrain.

There is another issue that is still on the agenda; investigating the OMC's conduct last month when it, allegedly, resorted to hoarding and created an artificial short supply situation. OMCs blame D.G. Oil for stopping oil imports and even local production, which according to OMCs created the short supply situation. The counter argument is that OMCs did not maintain the required level of storage which could have smoothed out the short supply, if any. To be fair, the arguments appear to be on both the sides. Corona lock-down and smart lock-down did create confusion and unpredictability which may have contributed to the incorrect demand estimates. One can be wiser in the hindsight.

This does indicate a need of reducing government controls and let the market work on its own dynamism, although, it may look rather odd in the background of market manipulation by the Sugar, Flour and other sectors. OCAC (Oil Companies Advisory Committee) was created to bring more consultation and participation of the stakeholders in the decision making, especially, on prices and demand-supply management. Currently, the system works on a cost-plus system based on OGRA determinations. OGRA calculates 30-days average of international prices (and a premium covering import costs) of petroleum products; adds protective custom duty where applicable(currently 7.5% on Diesel and none on Gasoline) and adds local distribution cost components like IFEM(Inland Freight Equalization Margin),OMC's and Dealers' margin. These local cost components are around Rs.10.00 only. OMCs margin is under 3.00 Rs/Liter(varying between 3-% % depending on the prices; not a very big amount, admittedly, in absolute or comparative terms.

There is a colonial type image of OMCs consisting of Mafiosi that is involved in unfair market manipulation. This writer has no brief or reason to defend OMCs. The fact is that there is a very low margin based on which OMCs work and that margin is determined by OGRA. The market share is small, except PSO. PSO, a government company, has a large market share of 50% and the rest is taken by 9-10 OMCs, non perhaps having market share exceeding 10%.PSO, being a government company, has been taking consumer friendly steps and has been suffering losses not on account of oil prices but also in terms of receivables from other government owned customers.PSO usually suffers from cash flow crisis due to non-payments.

Chart 2.8.1: Gasoline price, 22-June-2020



The second most important cost item is the import cost of Crude Oil and finished products like Gasoline and Diesel. Local oil refineries cater to some 30% of demand of the finished products while the rest is procured thru imports. OMCs import finished products and refineries import crude oil. There are long term import contracts such as with Kuwait Petroleum for Diesel and some credit arrangements with Saudi Arabia which are managed through P.S.O.As mentioned earlier, import costs are determined by OGRA based on bench-mark prices published by Platt, a credible price publishing company. Thus apparently, there is not much leeway ; everything is almost fixed and there does not appear to be much role of efficiency. The only competitive element is of market share; the more the sales, the more the profits, even if the gross margin remains the same.

Thus, there is no incentive for efficiency or quality; just sell more. OMCs, if market mechanism and competition, exist can procure oil more efficiently at lower price and better quality. They might be still doing it but such efficiency gains may be passed on the head-offices abroad. Under a competitive regime, such gains may be recycled in the local market in an effort to have a higher market share and net earnings. Admittedly, there are global accounting and pricing policies, yet there is a role of local cost centres. However, it may be risky to give a carte-blanche. There is always a risk of collusion. There are more than 50 sugar companies and only a few OMCs. There could be a price ceiling, allowing lower costs and prices; the price ceiling may continue to be determined by OGRA, however, may be done more frequently like weekly or even daily.

Clubbing of IFEM, OMCs and Dealers' margin may be done giving flexibility .And there could be a ceiling on this as well. This may promote distribution efficiency and may or may not result in unequal prices in various regions. However, the differences may remain very small. The unequal prices with a large margin in India are more due to varying taxation rates in Indian states. All of this would automate the pricing system and would reduce the inventory effect due to which OMCs and dealers have incentives to hoard.

Petroleum levy could be in percentage terms or even otherwise can be announced more frequently, say, weekly in coordination with OGRA input. GST is fixed in percentage terms at 17.5% and in extraordinary circumstances may be changed as well as it has happened in the recent past.

While OMCs are only few, Petrol pumps are many. Most petrol pumps are owned or tied to individual OMCs. There are some 8000 registered Petrol pumps in Pakistan while there are 1500-2000 pumps that operate illegally without OGRA license. Nevertheless, these pumps are catering to market needs. In most market economies, there are independent petrol pumps which are not tied to any particular OMC and are owned by individual owners or companies. These are called DODO-Dealer Owned Dealer Operated. DODOs may operate independently or may associate with OMCs and change their affiliations from one OMC to the other. DODOs can be a very good competition booster partner. Hundreds of pumps in a region may be competing in price and quality terms. The illegal petrol pumps may be converted to a DODO system through a proper regulatory process.

Oil market of Pakistan is large in the context of a rather small economy size; 25 million tons per year involving imports of 12-20 million USD, depending on the international price variations. And the market is growing. It would be difficult to continue to manage this market through government fiat. Some market mechanism will have to be brought in. Introducing market flexibility does not mean that regulatory requirements on quality, safety or supplies security and storage requirements would not be there. In market economies, such regulatory controls are usually tougher that controlled markets, as less effort goes into market management leaving time and space to implement genuine controls.

In conclusion, I have written these lines with a sense of trepidation; losing what one already has in the pursuit of higher efficiencies and gains. The growing market size may not let continuation of the existing control regime and various inefficiencies and problems are bound to emerge. Also market mechanism may attract investment not only in marketing and distribution but in Exploration sector as well, attracting vertically integrated companies. If this can be done without compromising consumer interest, then why not***?***

Towards a semi-regulated Oil market and pricing regime

Existing Pricing Regime	**Alternate Pricing Regime**
Ex Refinery Prices	
oil gram PLATT, PSO actual tendering or/and	OGRA - Ceiling Price not fixed
contracts - OGRA	one
Freight –OGRA	OGRA under Formula
Import Expenses - OGRA	OGRA - fixed percentage C.D. on imported Fuel only; 5%
Custom Duty-7.5% HSD	Gasoline;5% HSD
Monthly Determination by OGRA Approval - ECC	Weekly determination OGRA
Ex-Depot Sales Price	
Monthly	Weekly
Ex-Refinery Price as per Formula Others?	Weekly
	OGRA Proposal/ECC Approval-Weekly
IFEM - OGRA - OCAC	Unregulated
PLD - GOP	PLD announced Monthly, applied weekly
OMC _ OGRA	Market based unregulated
Dealers Commission - OGRA	Market based Unregulated
GST on Retail Variable 17.5%	GST on Ex-Refinery Price
OGA-Proposal/ECC Approval Retail	Retail Price Market -OMC/ dealers

no price ceiling required or announced-fixed price	Price Ceiling-area wise
Inventory Impact Inclusion in Pricing	
None	Moving average of three weeks;weighted average 15 inventory price+ 85 % new price
Retail Networks	
1500 unlicensed illegal Petrol pumps operating in rural areas	Independent Petrol Pumps to be allowed and existing licensed Independents may buy from any OMC
Risks	
non Uniform regional or locational variations in Pricing	competitive market regime partly
Quality Risks and issues are there even now	Quality Control risks may increase; HDIP/OGRA to be strengthened

Petroleum Storage in Pakistan

Table 2.8.1: Diesel & Petrol

	Diesel		Petrol	
	Avg.Sales/ day.MT	**Coverage-days**	**Avg.Sales/ day.MT**	**Coverage-days**
National	28000	11	25000	8
Punjab	18000	6	15000	5
Sindh	6000	12	6700	20
K-P	3300	3	2300	4
Balochistan	160	6	1000	6
G-B	160	5	100	4
data on 16th June,2020				

Source: DAWN daily, 21st june,2020

Towards a Competitive Oil Market Regime

New Oil prices have created quite some stir .A 34% increase in one go is unbearable for people in these hard economic circumstances commingled with Corona. Admittedly, price increase was due to 51% increase in international oil prices. Government could have played with taxation, as is usually the case; Petroleum Levy could have been brought down from Rs.30 to Rs.20 and thus increase could have been limited. Reportedly, GoP is considering precisely this now and it is possible that by the time the readers read these lines, a taxation and price reduction would have already been made.

There is another issue that is still on the agenda; investigating the OMC's conduct last month when it, allegedly, resorted to hoarding and created an artificial short supply situation. OMCs blame D.G. Oil for stopping oil imports and even local production, which according to OMCs created the short supply situation. The counter argument is that OMCs did not maintain the required level of storage which could have smoothed out the short supply, if any. To be fair, the arguments appear to be on both the sides. Corona lock-down and smart lock-down did create confusion and unpredictability which may have contributed to the incorrect demand estimates. One can be wiser in the hindsight.

This does indicate a need of reducing government controls and let the market work on its own dynamism, although, it may look rather odd in the background of market manipulation by the Sugar, Flour and other sectors. OCAC (Oil Companies Advisory Committee) was created to bring more consultation and participation of the stakeholders in the decision making, especially, on prices and demand-supply management. Currently, the system works on a cost-plus system based on OGRA determinations. OGRA calculates 30-days average of international prices (and a premium covering import costs) of petroleum products; adds protective custom duty where applicable(currently 7.5% on Diesel and none on Gasoline) and adds local distribution cost components like IFEM(Inland Freight Equalization Margin),OMC's and Dealers' margin. These local cost components are around Rs.10.00 only. OMCs margin is under 3.00 Rs/Liter(varying between 3-% % depending on the prices; not a very big amount, admittedly, in absolute or comparative terms.

There is a colonial type image of OMCs consisting of Mafiosi that is involved in unfair market manipulation. This writer has no brief or reason to defend OMCs. The fact is that there is a very low margin based on which OMCs work and that margin is determined by OGRA. The market share is small, except PSO. PSO, a government company, has a large market share of 50% and the rest is taken by 9-10 OMCs, non perhaps having market share exceeding 10%.PSO, being a government company, has been taking consumer friendly steps and has been suffering losses not on account of oil prices but also in terms of receivables from other government owned customers. PSO usually suffers from cash flow crisis due to non-payments.

The second most important cost item is the import cost of Crude Oil and finished products like Gasoline and Diesel. Local oil refineries cater to some 30% of demand of the finished products while the rest is procured thru imports. OMCs import finished products and refineries import crude oil. There are long term import contracts such as with Kuwait Petroleum for Diesel and some credit arrangements with Saudi Arabia which are managed through P.S.O.As mentioned earlier, import costs are determined by OGRA based on bench-mark prices published by Platt, a credible price publishing company. Thus apparently, there is not much leeway ; everything is almost fixed and there does not appear to be much role of efficiency. The only competitive element is of market share; the more the sales, the more the profits, even if the gross margin remains the same.

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In conclusion, I have written these lines with a sense of trepidation; losing what one already has in the pursuit of higher efficiencies and gains. The growing market size may not let continuation of the existing control regime and various inefficiencies and problems are bound to emerge. Also market mechanism may attract investment not only in marketing and distribution but in Exploration sector as well, attracting vertically integrated companies. If this can be done without compromising consumer interest, then why not?

3: Gas

3.1: Gas Demand and Supply

Present Gas consumption in Pakistan is around 5000 MMCFD. Over the past years, it has grown at a rate of 2.8% on the average. LNG has acquired a market share of 25% which is supposed to increase due to falling reserves and lack of any appreciable new gas discoveries. It would not be a sound professional or business practice to count on new discoveries, when the past record may not be indicative enough. There have not been major discoveries of the type of Sui or Qadirpur in the recent past. If discoveries do occur, these may be taken as an additive factor to the gas market in the country.

Pakistan is a federal state and it is important for a policy analyst or policy maker to understand the provincial demand and supply situation and the legal and constitutional provisions thereof. Province of Sindh is the largest gas producer in the country, having a market share of 55%.It provides gas to other provinces besides meeting its own needs .Punjab has very little gas but is the largest consumer having a share of 50 % in total gas consumption of the country.

There are three gas supply systems; SNGPL, SSGC, Independent producers and now LNG sector is emerging. SSGC transmits and distributes gas in Sindh and Balochistan. SSGC is supplied mostly by Sindh gas resources in addition some from Balochistan. SNGPL caters to the demand of Punjab and KPK and some Northern areas. SNGPL draws gas from all the three provinces and also consumes most of the LNG to meet its vast requirements. Independent sector consumes at source like Uch providing gas to nearby power plants and Mari Gas supplying gas to Fertilizer industry. The market share of SNGPL is 46.27% that of SSGC is 27.5% and of independent sector is 26.23% .Independent sector mostly produces low-Btu gas which may not be transported by the mainstream pipeline system.

Residential, Fertilizer and Power sectors are the major consumers with market shares as follows; Residential 17.88 %, Fertilizer 15.77 % and Power 42.44%.Residential, Commercial and Industrial sectors have suffered from lack of supplies in the recent past, while Fertilizer and Power sector have benefited from Independent sector and the LNG.

Punjab Consumption is 1515 MMCFD as against its meager production of 117 MMCFD, while Sindh consumption is 1163 MMCFD as against a production level of 1592 MMCFD. KPK is still not self-sufficient in Gas despite recent relatively large discoveries, having consumption of 386 MMCFD as against production of 265 MMCFD. Balochistan share in supplies has come down to only 354 MMCFD roughly equal to the KPK level. Its consumption is, however, very limited to only 64 MMCFD.

OGRA demand forecast

In the following, we evaluate OGRA gas demand projections and suggest some downwards adjustments.

1) Total gas consumption in the year 2017-18 was 4,357 MMCFD and in 2018-19 an estimated 5000 MMCFD. OGRA projected demand is 7055 for FY 2020, which appears to be quite exaggerated. However, in the next 5-10 years, OGRA gas demand projections are quite modest, reaching a level of 8119 MMCFD by the year 2030.

2) Based on a 3% growth rate in demand, our projections for FY 2025 are 5376 MMCFD and for FY 2030, 6232 MMCFD. There is a difference of 1887 MMCFD.

3) The reasons are not difficult to identify. OGRA projects 501 MMCFD demand for CNG for the year FY 2019-20 while the maximum demand in the past has been 240 MMCFD which consumption came down to 193 MMCFD last year. Similarly, Power sector consumption has been projected by OGRA to be 2496 MMCFD by 2019-20, which is to remain constant onwards. Last year (2017-18) consumption of power sector was 1470 MMCFD only. Similarly, demand projections of Cement sector have been taken to be 203 MMCFD, which appears to be unrealistic, keeping in view, an almost total substitution by Coal.

4) Assuming no further local gas finds and consequent falling production to reach a level of 1325 MMCFD only by FY 2030, a gap of 26 MTPA is projected by FY 2025 and 38 MTPA by FY2030.This means, a demand of 6 LNG terminals in FY 2025 and another 2 terminals by FY 2030.

5) However, there are two Pipe line projects, out of which TAPI appears to be going ahead with a committed supply of 1325 MMCFD And should come online before

FY 2025.Prospects of IP with committed supply of 850 MMCFD appear to be uncertain and may be assumed to be implemented somewhere after FY2025.The combined supplies from the two pipelines will be 2175 MMCFD. Based on this, one could reduce down the LNG demand by 1325 MMCFD by FY 2025. This would mean a reduction of 2 LNG terminals, from 6 to 4 terminals. And latter, only one LNG terminal may have to be added instead of two.

Table 3.1.1: LNG Imports/Consumption and Market Share

	2015-16	**2016-17**	**2017-18**	**2018-19**
MMCFt	97851	171353	283749	348622
MMCFD	268.08	469.46	777.39	955.13
MTPA	2.062	3.611	5.980	7.347154
Terminal Capacity - MTPA	4.5	4.5	10	10
Total Gas Consumption - BCft	1304919	1377307	1454697	
LNG Market Share-%	7.50	12.44	19.51	25

Source:EYB-18,OGRA-18

Table 3.1.2: WACOG LNG Estimates

WACOG - LNG-Oct 19	**Cargoes**	**DES-Price**	**Qty**	**Contract**
		USD/MMBtu	MTPA	
Qatar	6	8.3834	50.3004	3.75
Guvnor	2	7.2439	14.4878	0.75
Spot	1	5.2409	5.2409	
Total	9		70.0291	
WACOG LNG			7.781011	

Source: Pakistan LNG

Table 3.1.3: Estimated Demand of Private sector LNG-FY2020

	BCFA	Mmcfd	LNG-MTPA
CNG	70	192	1.475
Textile	91.25	250	1.923
Fertilizer	275	753	5.796
Total	436.25	1195	9.194

Source: Author's Estimate, OGRA, HDIP data

3.2: A Review of Gas Prices

OGRA has proposed 32% average increase in consumer gas tariff. Lifeline consumers and Fertilizer gas tariff will be severely affected, if OGRA determination is accepted. Cabinet has frozen the gas tariff. The discussion in the following is based on the old/existing tariff. This comes in the wake of food items price controversy. Energy sector is dollarized being very sensitive to international prices and the exchange rate. Recent heavy devaluation has abruptly increased the energy prices in Rupee terms and thus the need for some ameliorating measures. Lower income and poverty does not make international prices affordable and thus a rationale for looking into ways and means to reduce energy prices. We will in the following present a perspective of the sector and subsequently present some proposals to improve the sectors performance and alleviate the impact of the price shock.

Household Gas Prices

There is a huge cross subsidy to lifeline consumers who are practically given the gas practically free of cost, charging only T&D expenses. No other country provides such a relief. In Pakistan, there are six slabs in domestic gas tariff which is unprecedented anywhere in the world. The idea is to match the gas tariff with the pockets of various economic strata. Both in India and Bangladesh, there is one gas tariff slab in domestic sector. In India Domestic/Household gas tariff are quite high. There is no concession for the poor. The domestic gas price is 10 USD/MMBtu excluding VAT. Compared to this, highest gas tariff slab for domestic sector in Pakistan is 8.28 USD excluding taxation; in Bangladesh it is 4.25 USD almost the lowest among oil and gas importing countries. Ironically, the political narrative in that country is that gas prices are high. In European countries, domestic gas tariff is quite high, varying between 16 USD (lowest in UK) to 25 USD (highest in Italy) including VAT and other levies .Among the industrialized world, it appears that household tariff is the lowest in the U.S. at 12 USD.

Industrial Gas Prices

In Bangladesh, the industrial gas tariff is perhaps the lowest in the world at 3.61 USD; it competes with the tariff in the U.S. (the Shale gas country) where it varies between USD 3.70 in winters to USD 5.0 in summers. Pakistan zero-rated export sector should take this issue with ITC to encourage Bangladesh increase its gas tariff. It is an unfair advantage. It appears that it would be impossible for Pakistan to compete with Bangladesh in this respect at all. Pakistan gas tariff for general industries is at 6.9 USD excluding taxations and other levies .It should be competing very well with India, where industrial gas tariff is 18.23 USD. It may be possible that some direct or indirect subsidies may be there which we are outside the tariff schedules. Industrial gas tariff in Europe varies between 9.10 USD (UK-the lowest) to 12.19 USD (France-the highest).Incidentally, CNG retail prices in the three countries are broadly comparable; Bangladesh-14.5 USD/MMBtu;India-12.50-16.80 USD varying in different states; Pakistan-16.13 USD.

Well-head Gas Prices

Pakistan current well-head prices are at an average of 3.50 USD, 10% higher than that of India, and almost double than that of Bangladesh. There are separate prices for each one of the 55 gas fields. In July 2018, OGRA increased/adjusted well-head prices by 30%. In Pakistan, there is a local gas price setting formula, linking gas prices to that of Oil in the form of an S-curve, specifying floor and the ceiling.

Some circles argue that Pakistan well-head prices are unnecessarily high? As it is FDI in exploration has fallen very low? Some comparison with India may be in order .In India, there is an interesting formula. They compute some kind of weighted average of international gas prices prevailing at some leading five gas exchanges and subtract 0.5 USD per MMBtu wrt transmission and other overheads. Current locally produced gas prices in India are 3.23 USD per MMBtu; it was as low as 1.5 USD in 2017.Bangladesh well head prices have varied between 1.6-2.8 USD.

LNG Prices

High Qatar LNG prices have disturbed gas pricing in all the three countries of South Asia: India, Pakistan and Bangladesh. The three countries entered into contract with

Qatar at roughly the same time and almost the same pricing formula of 13.35% of Brent. Both in India and Bangladesh, heavy subsidies are being given in gas sector. In Pakistan, there is no subsidy on gas except the cross subsidies .i.e. one sector subsidizes the other. GoP is facing financial crisis and is not in a position to provide direct budgetary subsidies, although, there is a strong case for financing life-line consumers and Fertilizer sector out of budgetary resources.

Low LNG spot prices and its increase in the overall gas consumption are going to lead to reduction in gas tariff in Pakistan, if not in all the three countries. In Pakistan, LNG spot prices for **January 2020** were 9.5% of Brent (5.95 USD/MMBtu) as opposed to Qatar LNG prices at 13.35% of Brent (8.3479 USD/MMBtu).LNG prices are crashing internationally and are expected to remain low in the medium term.

Fertilizer and Power Sectors Gas Tariff

Fertilizer gas tariff has been set at Rs. 300 per MMBtu recently. For Engro, as per original contract with Exxon, the gas tariff has been even lower at USD 0.70(Pk.Rs.108) per MMBtu. This is even lower than the life-line customer tariff. 75% of Fertilizer sectors gas demand is met from low-Btu gas resources like Mari-field and 25% is met through pipeline gas of SNGPL and SSGC. Mari gas field's well-head price is Rs.272.84 per MMBtu. In that way, only 25% of fertilizer gas demand is subsidized actually. Very little LNG is consumed by Fertilizer sector. Two Fertilizer plants remain closed due to lack of gas supplies. There are proposals allowing them to import LNG at spot prices. This may do away with possible imports of fertilizers. In Bangladesh, gas tariff for Fertilizer is 1.50 USD and India at 6 USD; in India, it is pooled tariff (WACOG) computed of local and LNG prices.

Similarly, 25% of Power sector demand is met from LNG, 42% comes from pipeline gas of SNGPL and SSGC, while 33% gas supplies come from special fields like Mari, Loti and Khandkhot. Power Gas Tariff at 6.21 USD is approximately equal to the LNG spot prices. It can be said that, practically, there is no subsidy here. Zero-rated tariff for export industries is incidentally also 6 USD. A gas pricing policy principle appears to emerge suggesting LNG spot prices (plus transmission tariff) to be the given to Fertilizer, Power, and zero-rated sectors.

Increasing Access to Gas

Only 20% of people get gas, the rest is without it. Something would have to be done for the have-nots. Biogas is a viable solution for rural areas. Gas companies neither have the gas nor the network. Additional network expansion may be entrusted to new private sector companies or cooperatives ala India's CGD programme under which distribution franchises are auctioned. This may include Biogas as well.

Reducing GST on Domestic Consumers

In India, VAT/GST has been reduced from 12-15% in various states to 5% to compensate for the impact of high priced LNG. Levy of 17% GST on domestic sector may be reduced to 5%, as they are final consumers and no input adjustment is given to them. This may have a palpable impact on consumer bills. Increasing sectoral efficiencies and reducing T&D losses are medium to long term issues and thus no immediate hope can be tied to it in terms of price relief.

Some simplification of gas tariff mechanism ala power sector is still required. Unnecessary overheads like GIDC (and GDS eventually) are expected to go away. Spot linkages would eliminate arbitrariness and are a requirement for long term contracts in user sectors. WACOG (Weighted Average Cost of Gas) is a popular notion in federal circles, which is unlikely to be accepted by Sindh which is a major gas producer and produces more gas than it consumes. There are reports of India's pressure on Qatar to renegotiate prices which may benefit Pakistan as well. In the mean time, the burden would be borne by sectors other than the ones indicated earlier.

Reducing dependence on imported fuel

Oil prices have gone down earlier benefiting temporarily. It may peak again as earlier to reach unfordable levels. Issues and problems, however, remain. Realistically speaking, Pakistan may never become self-sufficient in Oil and Gas, however, dependence and imports can be reduced. Another problem is the dollarization of the energy sector, where in the locally produced energy does not save much foreign exchange. We are an agricultural country having a lot of bio - resources. We have in this space drawn attention to the role of biogas and bio - CNG. Local resources and investments can play a major role in this respect. It can also play some role in boosting the economy and employment, especially, in rural areas. It may not be inappropriate to repeat the same suggestion again while we are having some sigh of relief at the reduction in oil prices**.** It is pleasing to see that GoP is promoting Electrical Vehicles (EVs) and a policy in this respect is on the anvil to be passé by the ECC. With increasing share of Renewables like Solar and Wind, EVs will make our energy sector more independent and sustainable.

Table 3.2.1: Comparative Gas Prices: Europe, South Asia, USA

	USD/MMBtu Household	non-household
Germany	19.71	10.26
France	23.74	12.19
Spain	23.74	9.94
Italy	24.81	11.03
U.K.	15.90	9.10
Turkey	6.42	6.81
USA-Winter	10.00	5.00
USA-Summer	18.00	3.77
Bangladesh	4.25	3.61
India	12.10	18.23
Pakistan	8.28	6.59
Pakistan-Proposed	10.83	8.67

note: except Pakistan, prices elsewhere include VAT etc

Source: EU Gas, OGRA, IGL, BERC

Table 3.2.2: Comparative Gas Tariff-Pakistan, India, Bangladesh- USD/MMBtu

	Existing			New-Proposed	
Consumer Gas Tariff	Pakistan - SNGPL	Bangladesh	India	Pak-New - SNGPL	% increase
Domestic-0.5 hm3	0.7806			2.2804	192
Domestic-1hm3	1.9355			2.2804	18
Domestic-2hm3	3.5677			3.4205	-4
Domestic-3 hm3	4.7613			4.5607	-4
Domestic-4hm3+	9.4194	4.2378	12.1	10.8323	15
Commercial	8.2774	7.7356	18.23	10.8890	32
Gen. Industries	6.5871	3.5988	18.23	8.6654	32
Zero Rated Industries	5.0710			6.6709	32
Fertilizer	1.9355	1.4967	6	4.5607	136
Power	8.2387	1.4967		6.9934	-15
Average	8.2387			10.8381	32

Source: OGRA, BERC, Green Gas

3.3: Gas Producer Pricing Policies

There is uncertainty in gas sector these days from producers to distributers. Oil prices have come down and government has reduced Petrol and Diesel prices appreciably. GoP would like to reduce gas consumer gas tariff as well. It has postponed the impending increase but has not yet succeeded in announcing finally lower gas prices. Similarly, local Oil and gas companies are perturbed as to what would happen to their revenues, as their prices are linked to international oil prices. We will discuss in the following the Gas pricing policy issues that are there.

Gas Producers Pricing

The Locally produced Oil prices are linked directly with international prices being equal to the landed prices. However, there is an S-curve formula with floor and ceiling. Lowest gas prices (floor) under this formula are pegged at 30 USD/bbl and highest (ceiling) prices are 110 USD; In between the allowed gas prices increase only at a lower multiplier or additive than a 1:1 increase. In the adjoining we give an example. One would see readily that at 30 USD per bbl oil prices, gas prices are at par. At a ceiling of 110 USD/bbl landed prices, gas prices would be equivalent to only 54 USD/ bbl, almost half.

However, it is not as simple as it appears. There are three zones which have variations and there are 5 policy years having variations as well; 2001, 2009, 2012, TG 2011 and TG 2016.By TG is meant, Tight Gas for which incentives have been announced. There is hardly a country where such pricing policy variations may be there. However, one may argue that it is a differential policy allowing incentive for regions according to the potential and the type of fields and geology. And the policy years are there under which pricing commitments have been made according to which, E&P companies have made investments and GoP is committed to these formulae. And accordingly, there are incentives for Tight Gas with variations in 2 policy years. The impact is clear and rather mind boggling if one sees the three graphs showing the price variations. There are fields with under 3 USD to fields slightly over 6 USD per MMBtu. And there are tight gases which are eligible up to 7 USD or more.

This gas policy regime appears to be rather antiquated based on market conditions prevailing to Pre-LNG era.LNG has created a large market and spot market tends to offer very low prices, at-least currently. Expectations are that due to severe competition, Spot gas prices may remain lower and competitive, although not as low as these are at 2 USD. Although, one has to honor commitments that are there, there is a question on the pricing of new gas fields. The issue of low royalties to Balochistan has to be resolved as well, either offering higher gas prices or offering a fixed royalty rate unpegged with gas prices.

Have our gas pricing policies delivered or some changes are required. Bangladesh gas prices, both consumers and wellhead, are almost half that in Pakistan. It has benefited from low energy prices in being able to reduce cost of production, increase its exports and textile sector dislodging its competitor Pakistan. India has used a wellhead gas pricing formula averaging the wellhead prices of low gas prices market in the world. Pakistan has allowed high well-head prices up to 6 USD. However, effective prices have not been higher than 3.16 USD. Pakistan has used, Oil sector as a cash-cow be it wellhead pricing, and siphoning cash from PPL, OGDC. Although, it must also be acknowledged that retail oil prices in Pakistan has been low comparatively (generalization has its perils). Pakistan government requires more money comparatively and relatively. Pakistan has been facing a different set of problems of high security needs and the aristocratic and elitist style of governance requires more administrative expenditure. Leakages are another issue. And then, is it the geology that is a constraint or the foreign investment and technology or indigenization has been lacking. More research would be required if changes are to be suggested. We are passing through a transition, changing from perpetual deficits to unorganized surpluses. Recent oil pricing war and conflict and consequent disorder in oil pricing has laid bare the problems in continuing to keep in oil-gas pricing linkage intact. Gas storage creates stability, has been delayed for long and should be given attention. Perhaps, a gas market, open and competitive, is the ultimate solution. Regional cooperation could have been mutually beneficial in this respect, failing which, we may have to go it alone.

Table 3.3.1: Well head gas price illustration as oer pricing provision of policy 2012 for zone O (Ultradeep)

	$/BBL.
E. Weighted average imported Crude Oil C & F Price (Assumed RCP)	**140.00**
Floor Price C & F	**10.00**
Ceiling Price	**110.00**

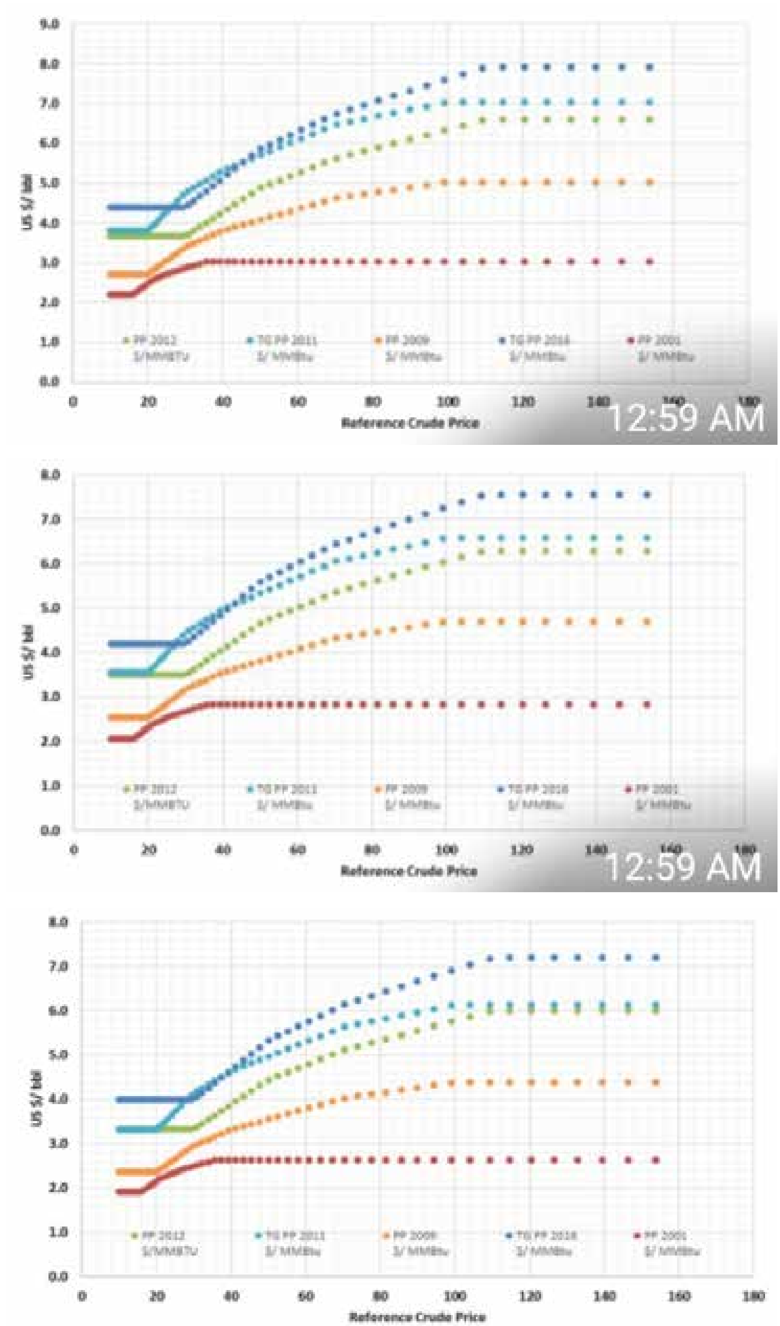
F. Apply sliding scale discounts to C&F crude oil price after floor & upto ceiling.

US$/BBL	Applicable % of C&F Price	US$/BBL
0 to 30	100%	30
Above 30 to 50	Plus 50% of incremental increase	10
Above 50 to 70	Plus 30% of incremental increase	6
Above 70 to 110	Plus 20% of incremental increase	8
Applicable C&F Price	(A+B+C+D)	54
Marker Price Onshore Zone III	95% of applicable C&F price	$51.3

Conversion Factor * assumed (MM Btu/bbl)	5.7
Zone I producer price for pipe line quality specification gas in US$/MMbtu	9

Source: MPNR

Chart 3.3.1: Gas Price Vs Crude oil Price- Zone I,II,III



Source: PPL

3.4: Oil & Gas: Resources & Exploration

There is considerable controversy that the oil and gas potential that may be sufficient to cater to the needs of Pakistan. More of gas has been indicated than oil. While imported LNG is doing well in meeting immediate needs and solving the energy crisis, almost a continuous and permanent reliance on it may create problems of trade deficit and may be of foreign debt as well.

Take-or-pay liabilities can also be treated as debt or near debt as they will result in payments abroad irrespective of the level of production. There has been almost exclusive focus on LNG, so much so that organizations are being floated unnecessarily. While Pakistan LNG Limited should have been enough for handling the supply chain of LNG, like PSO that deals with oil, another company named Pakistan LNG Terminals Limited has been floated, causing nothing but confusion and expenditure. This reflects the state of mind, a mind fixated on LNG exclusively.

It would be unfair to say that enough has not been done to promote domestic oil and gas production. Some effort, more as inertia and momentum of the past, has been made. Over the past three years, 319 wells have been drilled with 91 new finds. As compared to the past, this is a good record and performance, perhaps highest than ever before. But it is not enough compared to the demand challenge and supply potential that exists.

It does not match with progress in the power sector where installed capacity was 20,000 megawatts till 2013 and 10,000MW has been added after that. An initiative much larger in scope and strategy is required. OGDC and PPL have been full of money all these years. They are making profit even now under $50 per barrel of crude oil, not to talk of the profit made in the days of over $100 per barrel and consequent gas prices, although gas prices are lower in Pakistan due to price ceiling, but there is no such ceiling on oil. They have been so much flush with money that a separate company had to be made to park OGDC funds. The oil and gas sector has collected money under various heads such as Gas Development Surcharge and others.

Interestingly and amusingly, due to this money flush factor, the Ministry of Petroleum floated a proposal in 2014 to go into power production projects as well, a move that was rejected by all government institutions.

Ministry of Petroleum Division should actively consider creating one or two more companies like PPL and OGDC, oil drilling company and a joint venture in oil service area. Investment by smaller private sector companies may be promoted. In Pakistan, one discovery is made in every three wells, not a big risk. Unfortunately, service companies are leaving Pakistan as is evident from the recent exit of Baker Hughes. It may be due to overall restructuring and also because presence in the country is not considered necessary by service companies in the information age.

It costs $15-20 million to drill and complete an oil or gas well in Pakistan, which is on average three to four times more than elsewhere. It can be brought down by creating a market of supply chain in oil well construction and service industry. Well construction costs will come down by creating the infrastructure and the market. Rigs can be partly produced locally except for the drilling bit and rotary equipment. Local supply of rigs and installation knowhow can be promoted.

Ministry of Petroleum has to loosen its clutch on the sector. Provinces have demanded that they be allowed to have their own petroleum concession departments which, in their view, would promote efficiency and output and reduce time lapses in decision-making. The demand has been met by only federalizing the governance of the petroleum concession department inducting representatives from the provinces. No harm would have been done by provincializing the petroleum concession department. Baluchistan may have capacity issues which the Ministry of Petroleum can address by acting as a facilitator. The ministry can keep policymaking with itself and pass on implementation i.e. actual award of concession to the provinces. It is about awarding concession to explore and develop. All policies are in place.

A Review of E & P Sector

There has been a cycling trend of exploratory effort in Pakistan. From a peak of 77 wells drilled in the year 2002-03, it kept going down to acquire a new peak of 86 wells in 2008-09; it then started going down again in subsequent years and then acquired a new peak of 100 wells in 2013-14.Since then, it has been going down to a new low of only 79 wells in 2017-18.

It appears that there have been shifting sands so to say; gas exploration and production started and peaked in Balochistan, the scene shifted to Sindh subsequently and now new finds are mostly in KP. Efforts are being made to start exploration in Balochistan. Political settlement would have to be required both in terms of royalties and as well as non-royalty issues. Creative approaches may have to be applied. Following may be tried;

1. Fixing royalties at maximum in absolute terms 2.Recognizing tribal rights on Oil and Gas resources and a more generous formula for apportioning royalty income to local areas where the resource is produced. Provincial distribution is rather abstract and is not visible to the locals.

R/P Ratio: Reserve-to-Production Ratio (RPR)

R/P ratio indicates as to how many years the reserves of a resource (Oil, Gas, and Coal etc) would last assuming that there is no change in reserves or production. However, rarely is the case where the two variables do not change. Reserves increase or decrease depending on the new exploration and discoveries, existing reserves increase due to more drilling and assessment change due to price or non-price factors. Nonetheless, RPR does give signals to energy planners.

Pakistan gas reserves were by 2018 around 20 TCF. Based on a production rate of 1.4 TCF per year, RPR comes out to be 14.285 years. This number can increase or decrease depending upon the ratio of increase and decrease in reserves and production. Companies which own the resource normally would like to produce as much as they can in order to maximize the present value of their assets. Countries may think differently in terms of maximizing the life of their resources, conserving their own resource and prefer importing when and where feasible. Rich countries even build strategic reserves through imports and local production.

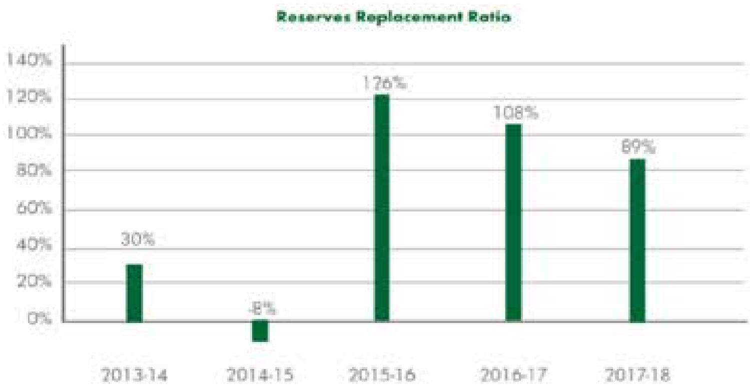
According to BP report, world gas reserves have a life of 54 years (RPR).The U.S. despite very large gas reserves has a very low RPR of slightly more than 10 years. However, the U.S. gas companies keep increasing their reserves depending on market conditions. The U.S. gas reserves are expected to last longer than the current RPR indicates. Highest reserve life (RPR) is of middle-east of 110 years. Next are CIS-80 years; Africa-60 years; South and Central America-50 years; Asia and Pacific-33 years; Europe-18 years, as read roughly from the adjoining Exhibit.

An older graph as given in the adjoining Exhibit puts Mari Gas reserves at 19 years, OGDCL 12 years, POL at 15 years and PPL at 10 years. OGDCL Annual Reports do not provide any data on its reserves. However, PPL has been quite explicit and transparent about it. According to the latest data as released by 2017-18 Report, PPL RPR for Oil is 2.53 years, for Gas 5.77 years and for LPG 5.237 years.

Reserve Replacement Ratio (RRR)

Here we introduce another term which measures the company performance and indicates new reserve creation trend; increase in reserves divided by production. If a company wants to keep its reserves life intact, it has to have a RRR of unity or more than unity; otherwise, the company moves towards extinction. Only PPL has revealed this data in its Annual Report. Adjoining graph indicates that only in two years 2015-16 and 2016-17 ,PPL RRR was above 100 %,and came down to 89% in the subsequent year 2017-18.In earlier years ,2013-14 and 2014-15,very small resource replacement is indicated. If PPL has to survive as a successful company, it has to gear up its RRR.

Chart 3.4.1: Reserves Replacement Ratio



Preference of Cash over Investment

Gas sector has been largely stagnant over a period of the last ten years or more. No gas discovery of more than 1 TCF has been made in this period. There are three public sector companies namely, OGDC, PPL and MPCL, which had a combined market share of 66% with OGDC having the highest market share of 29%, PPL 19% and MPCL 18%. OGDCL growth rate in production has been 1% and PPL 1.7%, practically stagnant, while MPCL growth in production has been significant at 4.3 %. The gas sector as a whole has been stagnant in terms of production and has been going down at the rate -0.42%. Foreign investment has been minimal with a market share of less than 32%, while most foreign companies have been winding up. Only one Chinese company has entered into the local gas market.

A simple analysis of PLS of the two companies of the year 2018-19-OGDCL & PPL- indicates good Gross Profit, respectively of 67% and 61 % of respective sales revenue.

Last year production cost of Oil was 18-22 USD/bbl as opposed to an average selling price ranging 60-65 USD/bbl. LPG cost of PPL was Rs 26802 per ton as opposed to an average selling price of Rs 68,000 per ton. For OGDC, similar figures work out; LPG production cost of Rs 20,000 per ton vs average selling price of Rs65512 per ton. Gas production cost of PPL was Rs 128 per mmcft as opposed to an average selling price of Rs 326 per mmcft. For OGDC, gas production cost was Rs 103.00 per mmcft as opposed to its average selling price of Rs 423 per mmcfd.

Also, the three companies have been earning good profits, with low gas production costs, giving good revenues to Government and selling gas at reasonable prices. PPL and OGDC cost of production has been 0.6-0.8 USD per MMBtu as against a selling price of 2.1-2.7 USD, at about 3.5 times the cost of production. Naturally, the profits have been high: OGDC earned Rs. 118 billions in terms of profits in 2018-19 with a ROE of 20% and EPS of Rs.27.53 .PPL earned a net profit after tax of Rs 61.6 Billion with a ROE of 20% and EPS of Rs27.18. Rs .Government also earned apart from GIDC, GDS and Royalties, Sales tax etc. OGDC paid corporate tax of Rs 58 billion and PPL Rs18.298 billion.

Has Enough of E & P effort been done?

It is a highly debatable and contestable question? Only 46 % of the total available basin area has been under exploration and around 3 exploratory wells have been spudded per thousand Sq. kms of exploration area. It is an average which can be misleading. Is this enough? Will more exploratory wells lead to more discoveries or enhancement of reserves? Should focus be on new frontiers or the existing play? It is objected that concession award activities are slow and not up to the mark? 36 concessions were awarded in 2005-6 and 43 in 2013-14 and now it has been announced that in 2020, bidding would be held for another 36 concessions. Provinces are eager on speeding up the processes and would like to get autonomy i.e. to have provincial concession authorities. On the other hand, industry would like to have independent concession regulator on the model of NEPRA and OGRA.

Major discoveries have been far and few in between. There are only 10 major fields having reserves of 1 TCF or more. In 1950s, it started with Sui with reserves of 8.72 TCF and has been almost consumed up. There is Sui Deep under of 4 TCF which is under political logjam with the locals. Then came Mari in Sindh ,the second largest field after Sui with original reserves of 8.2 TCF in 1950s.UCH with 4 TCF, low Btu gas on which two NGCC plants are operating also came around the same time; and Khandkhot with 2 TCF a bit later. After almost 29 years, a major worthwhile discovery came in

1989 with reserves of 7.2 TCF in Sindh which sustained supplies and continues to do so, although most of it has been consumed. Another bout of discoveries, although somewhat smaller of less than 2 TCF came around late 1990s with Zamzama, Chanda, Bhit, and Sawan etc all in Sindh. After 2000, KPK came on the horizon with smaller fields Manzalai, Nashpa and Makori. Some further potential appears to be there for which KPK is quite anxious. Thus it appears to be a story of glass half full and half empty. There is potential, however, probably not a great one. It would be an achievement, if local requirements of Gas are met. On Oil, there is a consensus, that there wouldn't be much of development.

Finally, it is an open question whether it would be worth investing excessively when Oil future does not appear to be very attractive, if not bleak, after another two decades. International Oil companies have not been much interested in Pakistan, another indication of lack of prospects. Whatever, progress in this area is to be done would come out of national companies. Oil people in the provinces have been talking of private-public partnerships in creating new E&P JVs.

It appears that not enough has been invested in exploration and developmental activities. PPL spent only Rs.24.858 billion which comes out to be 16 % of sales;19 billion pertained to dry and abandoned wells and on current exploratory effort, only Rs5.86 billion were spent. Besides, this appears to be an extraordinary year. In the previous year 2017-18, only Rs 11.164 billion were spent out of which only Rs 3.984 Billion were spent on new exploration activities. Thus new exploration expenditure comes out to be only 3% of sales; similarly, OGDC Rs 12.5 billion being less than 5% of sales. There appears to be some anomaly in E&P expenses or these are not comparable? Why was enough investment not made in exploration? Was it government which wanted cash rather than investments? Was it treated as Cash-Cow, a mature industry having no prospects of growth in the context of perceived low geological potential and political and law and order difficulties against exploration activities in Balochistan**?**

Shale Gas-Futuristic?

There was initial enthusiasm about newly indicated Shale gas resources a decade ago. More realism is developing on the subject with the passage of time; although OGDC has commenced drilling a shale gas well in Kunnar Pasakhi in December 2019.It is more of a token R&D effort to see the process and impact of drilling. Shale drilling is water and chemical intensive with potential impact on water and agricultural resources.

USEIA has estimated indicated resources of 586 TCF of Shale gas including technically recoverable 205 TCF and economically recoverable 95 TCF of resources. Shale gas has not been developed outside the U.S., although China has started some work on it. Saudi Arabia has also developed plans for investments of 120 Billion USD in its Fujairah gas field which has indicated reserves of 200 tcf. ARAMCO has already drilled 130 wells since 2013.An output of Shale gas of 2.2 bcf per day is expected by 2036.Low cost desalinated water and sandy environment and a lot of capital has enabled Saudi Arabia to launch the project. Majority expert opinion is that for Pakistan's purposes, Shale may at best be considered a futuristic resource, keeping in view excessive water requirements and adverse environmental impact.

Table 3.4.1: Gas Producer Companies: Market share and Growth-2017-18

Companies	Production -MCft/yr	AGR-% p.a.	Market Share-%
OGDCL	418812	1	28.71
PPL	280744	1.7	19.24
MPCL	260594	4.3	17.86
Subtotal -OGDC,PPL,MPCL	**960150**		**65.81**
UEPL	183188	25.6	12.56
MOL	117311	3.3	8.04
ENI	85132	-14.1	5.84
OMV	50976	-15.2	3.49
POGC	11118		0.76
PEL	10088	5.2	0.69
OMV Maurice	6456	13.9	0.44
POL	5057	-1.3	0.35
Dewan Petroleum	3068	-18.4	0.21
OPL	2188	-14.9	0.15
OPPL	24203	-30.4	1.66
Subtotal-Pvt Companies	**498785**		**34.19**
Total	**1458936**	**-0.63**	**100.00**
Total - mmcfd	3997		

Source: HDIP Yearbook-2017-18

It may be concluded that Pakistan is not rich in Oil and Gas resources. However, whatever can be done should be done to explore and develop economic resources. It appears that a mix of local and foreign imports would continue till Renewables take over. It would be a big achievement if current gas production level is maintained.

Higher LNG prices as indicated by Qatar Gas contract had created incentives for increasing cheaper local production (3 USD per MMBtu vs 8-10 USD per MMBtu). However, development of LNG Spot market has created prospects for cheaper LNG at 4-5 USD per MMBtu in the short to medium terms. This would dilute the prospects and incentives of local exploration effort, especially, on difficult plays.

Table 3.4.2: Comparative Performance Data :OGDC vs PPL2018-19

		OGDCL	**PPL**
Gross Sales	Billion Rs	298.359	164
Deductions	Billion Rs	36.878	24.328
Net Sales	Billion Rs	261.481	136
Production			
Oil	Million BBL	14.555	5.868
Gas	Mmcf	372017	317457
LPG	Tons	294147	100284
Selling Price			
Oil	Rs/bbl	9105	8658.84
Gas	Rs/mcf	336.62	325.71
LPG	Rs/ton	65512	68050
Profit B. Tax		176	79.9
Corporate Tax		58	18.298
P.A. Tax		118	61.6
Dividend	Rs. Billion	35	4.535
EPS	Rs	27.53	27.18
RoE	%	20	21
G.P	%	64	
Net Profit as % of Sales	%	45	38
EBIDT -%	%	69	

Source: PPL,OGDC Annual Reports; Estimates by the Author

Table 3.4.3: Top Ten Gas Fields in Pakistan Reserves-TCF		
	Original Reserves	Current Reserves
Zamzama	1.775	0.15483
Bhit	1.68	0.078
Mari-SML	8.72	3.42
Mari-Deep	1.633	1.454
Pirkoh	1.08	0.02768
Qadirpur	4.5598	1.0858
Uch	3.6559	1.90053
Zin	1.777	1.777
Kandra	1.858	1.858
Sui-SML	11.318	0.97047
Sui Deep	?	?
Sub Total	38.0567	12.72631
All Other Fields	19.37994	6.81469
Total Reserves	57.43664	19.541

Source: HDIP Year Book

Chart 3.4.2: Exp. Wells & Discoveries / Years

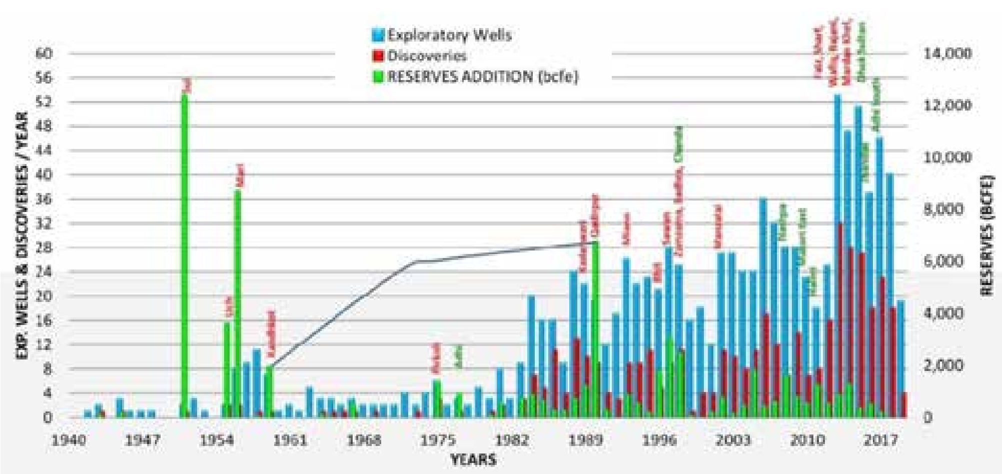


Table 3.4.4: History and Status of E& P Licensing Activity

	2005-06	2010-11	2013-14
No. of E& P licenses granted	36	1	43
E& P Licenses Sq. kms	66344	2475	89853
No Of Exp Wells drilled up to	609	758	1066
Exp Wells /1000Sq.kms Exp. Area	3.0028	2.7220	2.9484
Production Leases granted-No	4		14
Production Leases-sq kms	350		184
Total E& P licenses operating	100	134	176
E& P Licenses operating - Sq. kms	202814	278475	361556
Tot. Production leases-no	120	130	157
Total Production leases - sq. kms	11578	11884	12685
Total Sedimentary Basin -Sq. kms	827268	827268	827268
Exploration Area % Basin Area	24.5161	33.6620	43.7048
Success Ratio			1:2.87
Discoveries-Oil up to			93
Discoveries-Gas up to			278
Reserves- Oil - mmbbl			350
Reserves- Gas - tcf			19.5000
Oil Production-mmbbl-2018			32.5570
Gas Production-tcf-2018			1.5590

Source: MPNR Annual Reports, 2005, 10; monitoring report 2017,HDIP-2017-18

Chart 3.4.3: Reserve life ratio Pakistan and listed companies (Reserve/Production ratio in Years)

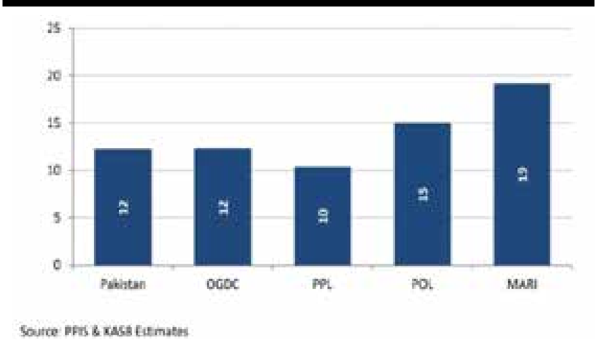


Figure 3.4.1: Map

3.5: Gas Consumer Tariff & Cost structure

Rupee devaluation and rise in interest rates have caused increase in consumer tariff. New Ogra determination has been postponed. And the government is looking for ways and means for reducing the projected increase in gas consumer tariff amidst high inflation. Gas sector losses, leakage and theft, have been a major factor among many other factors which have been considered to be a cause in high gas cost. We will examine the cost structure of gas and see what can be done about reducing the consumer gas prices.

Consumer Gas Tariff

Most of Pakistan's energy prices components are dollar based and dollarized and thus directly linked to exchange rate. Exchange rate devaluation and increase in interest rates have necessitated increase in gas prices. Inflation already being high, GOP finds an increase in consumer gas tariff to be politically difficult and unacceptable. In order to reduce consumer tariff, GoP would like that Gas companies reduce these losses and do not charge these losses in full, as it is the fault of gas companies themselves. It has also been proposed that their RoA (Return on Assets) be reduced from 17.5% to 15%. These two reductions combined may lead to decrease in consumer tariff. However, Gas companies have opposed it, arguing that it would damage the financial viability of the two gas companies.

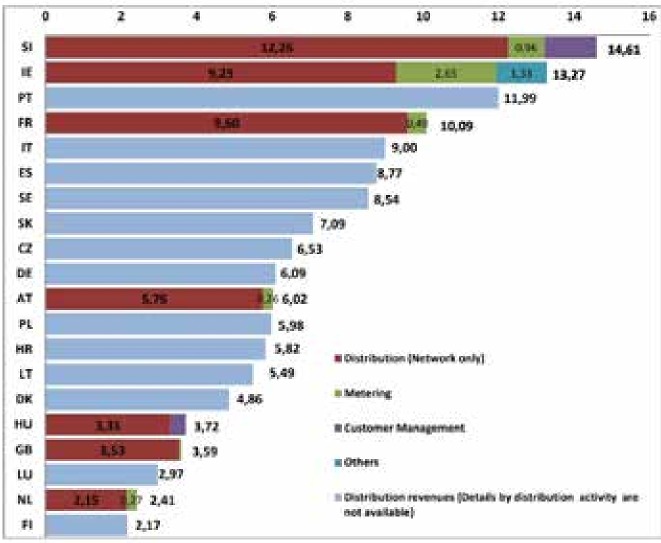
Gas Distribution Costs

RoA income of SSGC is Rs.6.693 Billion which forms to be 25% share of income. However, it is only a small part of the gas price- 2.5% only. Companies' margin- difference between selling price and Cost of gas- is Rs.74.81 per MMBtu, which comes out to be 10.14% of the selling price. An amount of Rs.19.278 billion is adjusted as disallowed expense, which forms to be 72.21 % of companies' margin, but is 7.3% of Sales revenue. Thus reduction of cost elements of SSGC may not make much of a difference in reducing the consumer gas tariff. Thus any meaningful reduction can come out of the producer prices, although, there are limitations there too. Government is earning a lot of revenue from the two major gas companies in the form of taxes and dividends. We have discussed the issue of producer pricing separately.

Comparative Distribution Costs

We would invite the attention of the reader to the adjoining graph showing gas distribution cost in European countries; median values varying between 5 and 9 euro per MWh. Based on 1 MWh is 3.412 MMBtu and 1 Euro 1.1 USD, these numbers are transformed to 1.6 -2.88 USD per MMBtu. By Comparison, in India Gas T&D cost is IRs 300 per MMBtu, which comes out to be 4.16 USD per MMBtu.0.6292 Pakistan T& D cost are only 0.6292 USD per MMBtu. The difference is too much to be true. More research appears to be required behind such data? Of course, there is an issue of gas losses and how these losses are treated in these data. It appears that in Pakistan Gas T&D cost data, gas losses are not included, while in European and Indian figures, losses are not included. Another could be the inflation effect. European cost data pertains to 2013, although fixed service costs do not vary as much. One may add 20% to European figures. If we add, gas losses of 13% at 5 USD, it adds another 0.65 USD. Thus Pakistan T&D cost are doubled to 1.28 USD/MMBtu.

Chart 3.5.1: Gas Distribution revenues per energy delivered across EU Member States in 2013. (Euros per MWh)



Source: Own elaboration on data provided by National Regulators.
Details and comments on the values for each country are summarised in Annex 8. Allowed gas distribution revenues across EU Member states in 2013.
Germany: Distribution Allowed revenues of DSOs under responsibility of BNetzA. Allowed revenues of other DSO under Federal States responsibilities are unknown.

Towards an alternative approach

Consumer gas tariff is based on a cost plus formula. There are cross-subsidies as well. Small and lifeline consumers are sold gas at less than the cost which GoP would like to maintain status–quo there. There are other cross subsidies like extremely low gas tariff for fertilizer companies. There are UFG (Unfunded Gas) the like of T&D losses of power sector. These consist of technical losses, receivables and theft as is the case in power sector.

One would like to propose a different via media consisting of the following three steps: 1. We have argued earlier that gas prices for fertilizer sector can be increased without affecting the fertilizer prices, if a regulatory price control is introduced in fertilizer sector;2.The new oil prices should lead to reduction in gas producer prices, although there is a floor pricing there on which there is controversy of 10 USD or 30 USD being the floor price; 3.Interest rates reduction and availing of concessional financing, as described in the following, would reduce costs and tariff.

Finally, downwards adjustment in local interest rates is overdue which is being demanded by all. If this is done, reduction in financial costs should result in consumer tariff reduction. Undue pressurization of the gas companies' management may not give desired results and should be avoided. After all, these are government controlled companies. If these companies suffer, GoP may have to put cash in them. Real gaps and issues should be addressed so that lasting improvements and impact are achieved. There is a reform package that has long been on the table which should be initiated to bring efficiency and cost reduction.

Table 3.5.1: Analysis of Cost Structure of Gas-SSGC-2019-20

SSGC	Million Rs	Cost Share-%
T&D(O&M) Cost	18853	70.62
Depreciation	5506	20.62
RoA	6693	25.07
UFG	-19278	-72.21
Other adjustments	-10011	-37.50
Prior Year adjustment	24933	93.40
Total-Income	26696	100.00
Cost of Gas	236551	
Sales Revenue-	263247	
Selling Price-Rs/MMBtu	737.65	
Unit Cost-Rs/MMBtu	662.85	
Unit Gross Margin-Rs/MMBtu	74.81	
Gas Volume - BBtu	356872	

Source: OGRA

3.6: Restructuring Gas Sector

The Pakistan-IMF agreement includes restructuring of the gas sector, involving integration of gas transmission and bringing about a number of gas distribution companies. The issue has been on the table for the last ten years but has acquired more importance and urgency recently. Bad performance of gas companies, leakages and losses has given a new rationale to reforms and restructuring.

Essentially, the gas sector is proposed to be reorganized ala the restructuring of the power sector, which has come along a long way from a monolith WAPDA to many companies and DISCOs. The central idea is that smaller companies may be better managed than larger companies and ultimate privatization may become easier to the local investors. A distribution company should not be spread beyond, say, 200 kms in diameter. Also, in terms of the number of customers, there is a reasonable upper limit which can be efficiently managed; there is a lower limit as well below which a company may suffer from lack of economy. From this point of view, MEPCO, PESCO and LESCO are ready candidates for sub-division into smaller companies; similar is the case with gas companies. Small gas distribution companies are common in Europe. In India, there is a district/city based gas distribution companies system.

In the gas sector in Pakistan, there are two integrated transmission and distribution companies, SSGC and SNGPL; the two companies own both transmission and distribution assets. Both companies handle a large number of customers spread across very wide and rather unmanageable geographical areas. There are several other differences between the power and gas sectors. Gas companies buy gas directly from producers and LNG importers. Gas companies pay directly to gas suppliers without the intervention of an intermediary single buyer like CPPAG in the power sector. Income and expense are balanced through a system of cross subsidies (somebody pays more to take care of others who pay less). The role of direct GoP subsidies is much less than it is in case of the power sector.

Simply speaking, the proposed restructuring for the gas sector aims at bringing it almost at par with the power sector. There are some variants among various threads in this respect. Basically, the common theme is to have one Gas Transmission Company and many Distribution companies. It could be one Provincial company each or could be like the power sector's many (10-12) DISCOs. However, a single buyer agency like CPPAG may have to be established which would buy gas from various producers and LNG importers and sell it to gas DISCOs at a weighted average (price) cost of gas (WACOG). Various gas-DISCOs would receive varying subsidies to cover their shortfalls or surpluses. It is feared that transmission companies may earn more profit due to their heavy capital assets and DISCOs may be in loss due to smaller capital investments. This may not be the case, as the single buyer may be able to balance the surpluses and deficits or different tariff approach may be adopted. The power sector is handling this problem in an adequate manner.

In the proposed restructuring, organizational issues are relatively simpler, although unions may oppose the status-quo. More difficult are political and legal issues. Punjab's share in consumption is very high and it is not a gas producer. All three provinces produce gas and their consumption is lower than their production. However, the supply scene has been changing; Balochistan was replaced by Sindh as the largest gas producer and now Khyber Pakhtunkhwa is emerging as a new challenger. And LNG is increasingly acquiring a larger market share, as local gas production dwindles.

There are constitutional issues which specify that the demand of the producer provinces be met first before exporting it to other provinces. That is easier said than done; gas is required for cooking needs and is almost a human rights issue; gas is used by the power sector which in turn is supplied to the whole country; gas is supplied to the fertilizer sector which is a common agricultural input. Political cleavages would make resolution of constitutional issues very difficult, although in three provinces, one party has formed the provincial governments.

Existing separate prices for locally produced gas and LNG are creating many problems including price disparities among the provinces. Pakistan's economy is based on a uniform pricing system in most areas which conflicts with the dictates of provincial priorities. With the advent of LNG and its increasing market share, the idea of WACOG (weighted average uniform price) is acquiring more legitimacy.

The two gas companies are not 100 percent owned by the federal government; their shares are floated in the stock exchanges. Corporate processes to merge the transmission assets of the two companies and split the distribution may be time-consuming and complicated. A long-standing proposal has been to follow a step by step approach; forming virtual gas - DISCOs. Legally, these may be part of the parent gas companies, SSGC and SNGPL, but several gas - DISCOs may be organized like an independent company. This may give an opportunity to study and learn the issues of a decentralized operation. Earlier administrations wanted to implement this virtual concept, but reportedly the companies' managements dragged their feet.

There are people who argue that, in the utilities sector, there is no competition and thus there wouldn't be much advantage in privatization. New market structures have been created to solve these problems like retail competition wherein electricity and gas producers directly sell to retail customers, small or large. Alternatively, marketing companies buy from producers and retail electricity and gas. In this scheme of things, DISCOs are reduced to providing distribution services companies.

There are other changes that have to be brought about; change from cost-plus to a fixed charge rate cum incentive based system ala KE. Currently, except for UFG reduction, there is no incentive to reduce costs on the part of the gas companies. After the initial bout of privatization in the 1990s, practically no significant privatization has happened. However, the pressure is great this time from IFIs, including the formidable IMF. High UFG losses and the falling capital base of the companies have created more incentives and pressures to implement reforms. It might be difficult to postpone it this time.

A Unified LNG Company

Make Pakistan LNG as Pakistan Gas Supplies Company dealing with both local gas and LNG; Pakistan LNG buys from local producers and sells to SNGPL and SSGC at a uniform weighted average price; it can later co-mingle LNG with local gas and announce a co-mingled price, as and when, it is decided; later on, other private sector gas suppliers can be added as gas and pipes are separated. Separate gas transmission ala NTDC as an independent company; merge SSGC and SNGPL; make it a holding company until privatization; smaller gas distribution companies proposed for power companies.

Replace annual revenue requirement by a three-year price cap on capacity charges ala electricity distribution companies, excluding losses; capacity charges can be different for different customer categories; consumer prices can be adjusted monthly ala fuel adjustment charge in case of distribution companies; only three tariff be retained in residential category; lifeline, middle and high-income; loss calculated and imposed separately for every district; gas price+ capacity charge+ loss%+ cross-subsidy adjustment.

There are two major peculiarities in the gas pricing system – SSGC and SNGPL buy gas from various gas fields owned by gas producing companies – private, public and international. All gas fields have been awarded gas prices under different systems prevailing at the time of discovery and development. There are about 50 gas fields, each having a different well-head price. This results in different gas prices for SNGPL and SSGC which are balanced in an obtuse manner. There are other issues as well. A better way of doing it is pooling at the national level like the CPPA - G which buys from more than 50 producers and sells to distribution companies.

Pakistan LNG can perform this function as it is already engaged in an allied business of LNG buying and selling. Presently, LNG is ring-fenced and being sold at international prices which are almost twice the locally produced gas. At some stage, if a decision is made to co-mingle the local gas and the imported one, Pakistan LNG, may be rechristened as Pakistan Gas Supplies Company, will be able to handle it.

This can be done almost immediately with some reorganization and transferring gas procurement personnel from SSGC and SNGPL to Pakistan LNG. This would also entail some changes in the tariff system.

A Unified Transmission Company

A separate Pakistan Gas Transmission Company is carved out and gas distribution companies are initially made part of the holding company. At least 20 distribution companies are proposed to enable management to look after the field affairs closely.

Privatization can be done later as the opportunity and consensus emerges. All this except for Pakistan LNG/Pakistan Gas Supply Company would require changes in the tariff structure and procedures. At present, annual revenue requirements are determined by application to Ogra, which if divided by gas sold, gives average prescribed gas prices for the forthcoming period.

Let us explore a constant distribution price system. Under this system, a distribution tariff per unit of gas sold is awarded for one to three years based on company accounts of the last three years and projections thereof. Periodic gas price, monthly or quarterly, is charged as it occurs. Currently, aggregate loss of gas is 12.5%. It hasn't been controlled largely due to the big empire syndrome implicit in large organizations. It is hoped that proposed fragmented smaller companies may be able to have success in this respect.

Except for LNG, ECC has indicated its willingness to go for reforms more or less on the same lines as discussed in the afore-mentioned. Actually, there is a standard market approach of unbundling; integrating transmission; appointing an independent system operator; separating Transmission from distribution and; carving out smaller and manageable DISCOs. There are implementation issues. The gas companies are listed companies. Their dissection is a very difficult job. There are privatization and Union issues. There are provincial issues as well. We reproduce here a summarized statement of proposed reforms from a MPNR document (Monitoring Report-2017).

Proposed Restructuring Plan by the Petroleum Division

Transmission

- Unbundling of Transmission and Distribution functions
- Merger of Transmission assets into one National Transmission Company(NGTC)
- Shareholders of SNGPL and SGC will own proportionate shares in NGTC based on asset evaluation
- NGTC will operate as common gas carrier on tolling fee basis
- NGTC will not be allowed to buy,sell or distribute gas
- SNGPL and SSGC to be split into 4 separate Distribution companies on Provincial basis

- Existing SNGPL and SSGC shareholding will remain intact in new distribution companies
- Provision will be made to provide option for purchase of shareholding by provinces in NGTC and new Distribution companies

<u>Distribution</u>

Phase I

- SNGPL and SSGC will complete accounting and operational unbundling of Distribution function on provincial basis
- Existing arrangement of revenue requirement determination to continue

Phase II

- Separation of SNGPL and SSGC Transmission assets into NGTC
- SNGPL and SSGC will be split into 4 corporate entities , each with jurisdiction to distribute gas within a province
- Separate revenue requirement determination of each entity
- Gas Sales agreements will be novated to new entities
- Gas Pricing agreements will remain intact

Source: Petroleum Division

3.7: Towards a Competitive Gas Market Exchange

Every winter, there are gas shortages despite induction of LNG. Our local gas resources and production are going down, or barely remain constant, while demand has been increasing steadily and is expected to double in ten years. There is LNG but it is costly and costs foreign exchange as well and has other procurement and contract issues, including take or pay contracts. Hence, it is vital that we do our best to find new local gas resources and increase production and availability. We will examine in this space how to do that. Although, the focus is on gas, some of the discussion is equally applicable to oil.

There are three possible ways to increase gas supplies — find new gas resources, increase existing resources output, and undertake demand management including finding alternatives to gas .Oil and gas production is heavily regulated and E&P companies have always complained about the delaying and growth-reducing aspects of the governmental and regulatory process. Although the new government, under its economy-wide programme of improving Ease of Doing Business rating, is taking steps to streamline the approval and permissions processes, inefficiencies are bound to persist. And then there is always a question of the right pricing, which one is never sure of.

Creating a gas market may be a part of the solution. The gas market has helped other countries find new gas resources and increase supplies. However, there are possible risks in opening the market and freeing the prices. The market may be manipulated by vested interests. Local gas has been produced under reasonably low prices. The other option is of using LNG, which costs almost twice the local gas. This is good and bad. It increases the average gas price but also enables policymakers to play with the situation and optimize its options.

The gas market can be created with some safeguards. Existing resources may continue to be regulated except some exceptions like marginal or depleting fields, tight gas, stranded gas fields etc. Not all but designated new areas may be put under gas market and the afore-mentioned exceptions. Band by the gas market, what we mean here is that gas prices would be free to be negotiated between the buyer and seller and a producer would be free to sell the gas to the customer of his choice.

Thus, between the existing cheaper rates and expensive LNG, a third mid-of-the way option may emerge in the short-to-medium term .And in the long run, if the market performs and resource geology permits, gas supplies may become even cheaper than today. Other safeguards and incentives can be built in, like limiting the gas market to the existing LNG volumes, and taxing the windfalls. Along with gas market creation, feasibility of a risk fund may be investigated. Such a fund may be financed through PDL/GIDC, which provision is already there. There is GIDC as well.

One of the major bottlenecks in oil and gas exploration and development activities has been the poor law and order situation in Balochistan (which has a lot of resource potential). Tribes in the province have a claim on natural resources found on their land and demand compensation and royalties. Under our laws, the resources belong to the government and no such claim is acknowledged. Our laws are consistent with majority international practices. However, there are exceptions. One may be able to undertake some legal innovation and settle these issues. Some controls can be built in on how the income is to be spent and shared with local governments. If successful, this can solve a major problem in exploring and developing oil and gas and other mineral resources, and can also boost national cohesion.

The government wants to reduce its exposure and liabilities, if not responsibilities, from the energy sector. Up to now, the government has been heavily involved giving sovereign guarantees, underwriting power purchase agreements (PPAs), buying at higher prices all what producers could offer and practically selling at a loss. The result is circular debt, unaffordable high prices hurting people, industries and exports. The Petroleum Division has announced its intention, if not a declared or written policy, that it would welcome investments in the liquefied natural gas (LNG) sector with least government involvement. It would not give guarantees and would not stop or delay investment proposals.

If investors think there is a market, they should go ahead and import or produce and sell to willing customers. If you are able to sell, well and good, and if not, our sympathies only – no financial support and no guarantees. This appears to be too good to be true. This may not be a fairytale. After all, the entire oil sector, refineries and oil marketing companies (OMCs) are working without guarantees. There is a policy that oil will be sold at international prices plus the local selling costs. The government adds some levy plus GST. This is enough to attract investments in this sector. The existence of sufficient demand and market are possibly the only yardstick for making investment decisions.

Unfortunately, there is no international price in case of electricity and gas. There are too many variants. Where simplified parameters have been set, competition has come almost everywhere. Look at solar and wind.LNG and extension of gas pipeline networks have made it possible that one may start thinking about markets (and not government) start working even in developing countries like Pakistan. Markets and prices are converging. There used to be wide price difference among regional markets, which is no more. Thus, the government has made it open, install as many terminals as you wish, if you think, you can sell. And investors are coming.

What prices? Would it be feasible to leave the LNG suppliers free to charge as much as they may wish? Is the market large enough to enable forces of competition to work? It has not happened in case of 94 sugar plants and an equal number of cement plants. Many people complain that there is some kind of price collusion? In Western countries, there are stock exchanges like gas market hubs, where prices are determined through howling or computer input. There are 11 gas hubs already in the European Union and more are coming under EU directives to every country to have its own hub. India and Turkey are mulling to have one. In Pakistan, in case of liquefied petroleum gas (LPG), there are sufficient conditions for quite a while to have a functioning market. It has not happened.

There are certain prerequisites for a market exchange that are to be met. These include an independent system operator(s) with an approved grid code, independent transmission companies, gas producers, importers and suppliers, distribution companies, and large and small buyers. Almost all ingredients are there in the power sector, but the market is still not there. The gas sector has not any of the aforementioned prerequisites. It can be done and should be done without any further delay. Initially, it may be done without privatization, the latter being the sole reason for the opposition by gas companies.

There is another, although, less efficient market mechanism that has often been practiced here in Pakistan with questionable and varying levels of success. That is, setting the upper price limit, for example in the LPG sector and to some extent in LNG. It appears that same kind of price fixing is in the mind of decision-makers, when they talk of the market. But then what is that upper limit and who sets it and what are the rules. Many people are suffering due to NAB investigations and inquiries in relation to LNG terminals. Can we have a pricing formula for setting a ceiling price for LNG? A possible formula could be based on one of the gas hub prices – averaging some of the spot prices like Jera and JKM.JKM is fast emerging as a credible index,

Figure 3.7.1: TAPI, NSGS and IP Pipeline Projects

although it is still not a gas hub, it is an assessment only. However, JKM spot could be the simplest linkage for the LNG ceiling price in Pakistan market. Mixing oil and gas linkage could also be an approach. It is a difficult and controversial task for which credible external consultancy would be required and must be commissioned without further loss of time.

It would be a mistake, however, to keep Ogra out of it, although they may be requested to work under a time-bound framework. For the LNG terminal tariff, what would be the benchmark price? Can the tariff of existing two terminals be taken as a yardstick? One may ask and then what is the merit of opening up the sector, if same prices are to prevail. Secondly, should LNG terminal companies be allowed to import LNG as well? According to established market principles, they should not be allowed. However, one can possibly drift from the pure theory in the beginning, provided there are adequate safeguards against blocking others from using the LNG terminals.

There are issues about the LNG terminal sites. It is claimed that the Port Qasim Authority (PQA) as such is not a very good and competitive port. LNG shippers have refused to pay its high tariff. Consequently, PSO and Pakistan LNG Limited (PLL) have been footing the bill, making LNG even more expensive, although marginally. There are dredging issues. LNG is already interfering with the normal goods traffic causing congestion and delay. LNG terminals are for 20 to 30 years. One has to think about the future as well. Can there be other sites outside of the PQA? There are other potential sites such as Jiwani/Somiani and Gawadar. There are network linkage issues.

Reportedly, many companies have shown eagerness in installing an underground gas storage plant. Existing transmission facilities are fully utilized. Gas demand is increasing and there are shortages in winter. Gas storage may help reduce the shortages and may also reduce the risk of 'take or pay' losses. Ultimately, it is the market exchange that would work. There are 53 gas fields owned by half of that number of companies. Ten-to-fifteen gas traders may be licensed and 8-10 gas distribution companies combined would provide sufficient number of players. The Competition Commission of Pakistan and the Securities and Exchange Commission of Pakistan (SECP) should prepare themselves to have the oversight function. Neither the stock exchange is without its share of faults, nor is the CCP an impressive organization. We manage to live in an imperfect world in which unscrupulous thrive due to inefficiency and collusion. Gas has to flow.

Prospects of a Gas Exchange in South Asia

There is a large gas market in South Asia (India + Pakistan) of 21 billion USD. India is currently importing 800 Bcft/yr of LNG and Pakistan imports 438 Bcft/yr. Pakistan Gas consumption is projected to 8 Bcft /day (3 TCF/yr) in less than next 10 years. Similarly, Indian gas market; surprisingly, despite population difference, gas consumption level as of today is quite comparable; India 1600 Bcft/yr and Pakistan 1838 Bcft. Gas consumption in the region is growing at a rate of 5% per year.

Gas supply competition is increasing by the day with the installation of LNG terminals in the two countries. Also Pipe line networks are expanding. There is IP and TAPI which can be allowed to merge by interconnection. Although, there are uncertainties due to international politics which may eventually be sorted out, eventually. The U.S. is already into Gas market of India with its LNG which may expand market diversity as well.

There was a Gawadar-Nawabshah LNG pipeline project that was almost approved. It was dropped under mysterious circumstances without public explanation. It is alleged that the US saw it as a precursor to the Iran-Pakistan (IP) pipeline project. It is unfortunate that the U.S. continues to oppose IP project so vitally needed by Pakistan's economy, while India continues to import 13 Bn.USD of Oil from Iran. India withdrew from IP under the U.S. pressure as well. Ideally, Gawadar could ultimately emerge as a gas hub, due to its closeness to the gas producers. There are two allied infrastructure elements which are vitally and urgently needed now – gas storage and a new gas transmission network. The government is currently working on both the projects. The North-South pipeline project is at an advanced stage and active consultations are under way with a Russian consortium.

Turkmenistan Afghanistan Pakistan India Pipeline Project

TAPI is an active gas pipe line project, unlike IP, connecting Turkmenistan Afghanistan, Pakistan and India. A special-purpose consortium company under the title as the TAPI Pipeline Company Limited (TPCL) has been incorporated in 2014 by Turkmengaz (Turkmenistan), Afghan Gas Enterprise (Afghanistan), Interstate Gas Service (Pakistan), and GAIL (India) to execute the US$7.5 billion project. Turkmengaz is the majority shareholder in TPCL. The pipeline would be of 42 inch dia and would have a throughput of ………. .The project has been delayed and was supposed to be commissioned by 2020 initially. TAPI is now up for gas price review. Earlier pricing formula was based on pre-LNG market regime.

A new situation has developed. It is hoped that a reasonable formulae will be agreed upon. A major development has been reported in the press that China has also expressed interest in joining TAPI as per Silk-Road Magazine. We quote:

"*China has expressed interest in joining the Turkmenistan-Afghanistan-Pakistan-India (TAPI) gas pipeline project, by building a link from Pakistan to China. This could act as alternative to Chinese plans to build a fourth China-to-Turkmenistan pipeline. The China-to-Turkmenistan line has to cross several mountain ranges, and it would be cheaper and easier for China to build a line from Pakistan across the Karakoram Range to its Western border…..TAPI may also be linked to the proposed Iran-Pakistan-India Pipeline. While the Iran-Pakistan portion is currently being constructed, India has yet to agree to continue it from Pakistan into India, citing security concerns. That may change given that China is prepared to use the TAPI route to divert gas from the Pakistan spur, and run that north-east into Xinjiang Province……..China already has gas distribution and processing facilities running into Xinjiang from Kazakhstan; however these are a lot further north. The implications here are that China could then develop an internal secondary, southern-based pipeline either skirting or passing through the Taklimakan and Gobi deserts to a more central based facility closer to Gansu Province."*

With China in TAPI, the prospects of a gas exchange are enhanced many times.LNG terminals in India and Pakistan importing LNG and local gas production and TAPI and IP and Gawadar would create a large market of demand and supply connecting various adjoining regions.

Despite problems, there is a great potential of establishing a Market Hub in the region, initially, with India and Pakistan and eventually China and Bangladesh included. In addition to price competition, the region can benefit from the elimination of expensive Take or Pay liabilities. It is hoped that sense would prevail in the region and constructive politics would enable cooperation in this sector along with progress in other avenues.

Table 3.7.1: South Asia Regional Gas Market

	India	Pakistan	Total
Local Gas production - Bcft/yr	800	1400	2200
LNG imports	800	438	1238
Total - Bcft/yr	1600	1838	3438
Projected Market 2025-Bcft/yr	2000	2200	4200
Projected Market 2025 Bn. USD @5 USD	10	11	21

Source: Authors Estimates, data OGRA, PNGRB

Table 3.7.2: Major Regional Gas Pipeline Projects

	TAPI	IP
Countries	Turkmenistan	Iran
	Afghanistan	Pakistan
	Pakistan	
	India	
Throughput - bcf/yr	1200	310
Length - kms	1814	2775
Dia - inch		
56		56

Source: MPNR Pakistan

3.8: Towards Federalism: Natural Gas and LNG?

Every winter, there is gas shortage and every winter. Sindh says that it produces more gas and it should get its due share. The scarcity, however, is equal throughout the country. One would have expected that with the advent of the LNG, the problem wouldn't be there. But the Sindh government does not want to buy expensive LNG. The issue is complicated and has many sides to it. We will in the following, present all sides of the issue, which may provide a basis for some kind of accommodation or settlement between the province(s) and the federation on the issue.

We have a cooperative federal system. It may be useful to see how such issues are dealt with in other federations. In federations, the energy sector as a whole is generally devolved to states or provinces. Minerals including oil and gas resources belong to the provinces generally. However, the political ownership of resources is diluted by the role of commercial companies. All commercial contracts are to be honored under law. Supply contracts cannot be undone by provincial or federal governments except under extraordinary and emergency conditions.

All major decisions regarding these resources are made by the provinces. However, companies operate the facilities which are generally independent. Political decisions have to respect the commercial contracts and requirements of the companies. It is a separate matter that scarcity is not there in those parts of the world and alternatives are generally available. And then there are gas storages, which help meet the variations in demand. We have paid attention to this quite late and a gas storage project is at a planning stage.

The Indian example may be more relevant and may enable us to understand the issue. In India, there is a provision of joint determinations in the form of the concurrent list. Pakistan used to have a concurrent list before the 18th Amendment. In India, states maintain the gas and power sector accounts and bear all deficits and provide subsidies and absorb losses, where required. Electricity regulators are in the state's domain. However, oil and gas regulation is in the federal domain (PNGRB-Petroleum and the Natural Gas Regulatory Board).

GAIL India – a federally owned and controlled corporation – deals with gas transportation. Mainly, gas distribution is in the private sector and its capacity charge is competitively determined through auctions. There are more than 100 gas DISCOs in India and more are coming. There are state electrical boards similar to our federal CPPAG. Most of the electrical DISCOs are owned by states. There are hardly many private DISCOs. There are IPPs but a large number of GENCOs are federally owned. Losses of the energy sector are taken on by the states – unlike Pakistan wherein the federation takes the responsibility.

The situation is complicated in Pakistan, as much of the energy sector is in the public sector, owned by the federation – for example: PPL, OGDC, SNGPL, SSGC, Pakistan LNG, ISGS etc. All DISCOs and IPPs are in the private sector, but governed by CPPAG, NTDC, Nepra, PPIB, and AEDB – all federal institutions. The federal government has all the liabilities of the energy sector. There is a circular debt of Rs200 billion which is a liability of the federal government. Similarly, gas sector deficits are there where applicable, although mostly cross-subsidies finance it.

The issue is more complicated than it appears to be. Thus, reasonableness, accommodation and economic efficiency arguments must also be considered in addition to the constitutional requirements.

Some of the issues are as follows: first, resources are developed by the federation. It is the federal market and finance that creates financial feasibility for resource development. At the time of Sui gas exploration and development, there was no market in Baluchistan. There was no export possibility, pipeline or LNG. Development of Thar coal is another example which may not have been possible without federal support and input. The Sindh government has given equity input. Further development of Thar coal would also depend on federal support.

Second, the energy sector is integrated. Gas is also used in the power sector which supplies electricity to all provinces. Third, electricity and gas losses are highest in

Sindh and have to be federally financed resulting in circular debt which is a federal liability. Fourth, commercial supply contracts, whether in the federal or the provincial domain, have to be honored with priority. Fifth, the country is mostly governed under a uniform pricing system and a federal development system. Industries have been set up without provincial considerations. Sixth, there can be a provincial pricing system for which much preparation and development work is required; if at all a consensus is reached on it. And finally, there is a moral question as well. Should the poor of one province suffer and not be able to cook their food, while in another province; people may have all kinds of usage including CNG. Thus, problems cannot be solved in isolation. Even PPP - led federal government could not solve this issue of producer-provinces' priority.

Gas demand in the domestic sector is higher in the winter. LNG is also expensive in the winter, costing money as well as foreign exchange. Sectoral diversion of gas from the power sector to the domestic and industrial sectors appears to be more feasible than ever before. There are proposals already to make adjustments in gas supply and operational provisions in RLNG-based new combined cycle power plants. There are three new coal power plants which could be utilized at full capacity in the winter. Furnace oil has become cheaper than RLNG. Furnace oil could be utilized more. Refineries are suffering on account of furnace oil. The Ministry of Energy should be aware of these issues, although some inertia is always there and is understandable.

Table 3.8.1: Gas Production and Consumption by Province-2017-18

	Punjab	**Sindh**	**KPK**	**Balochistan**	**Total**
Production - MMCft	53580	943644	151178	310535	1455936
Production-%	3.68	64.81	10.38	21.33	100.00
Consumption - MMCft	729648	513305	75605	136320	1458697
Consumption-%	50.02	35.19	5.18	9.35	100.00

Source: HDIP Year Book-2017-18

3.9: Towards Gas Pricing Reforms-WACOG

Local gas resources are dwindling and gas demand is increasing continuously creating need for expensive imported LNG. Currently there is a dual-separate pricing system for local gas and LNG creating many complications. Petroleum Division is trying to simplify gas pricing issues and has proposed an average wholesale and uniform gas pricing approach called WACOG. It is being discussed for almost a year now. Recently, a seminar was held on the issue of Gas Issues in Islamabad which the P.M. Imran Khan inaugurated. In the following, we will discuss various aspects of the WACOG issue including socio-economic and political implications. We will first present the background information and then attempt some analysis and develop conclusions and recommendations.

At present, there is a dual gas pricing system; local gas is priced separately and LNG is priced separately. Local gas is cheaper than LNG due to peculiarity introduced by Qatar LNG; otherwise LNG is cheaper than local gas. Local gas is at an average price of 4.5 USD/MMBtu, while LNG price including Qatar gas is 6.5 USD/MMBtu and LNG price without Qatar gas is between 2-3 USD/MMBtu. Although, LNG is imported by PSO (Qatar LNG) and PLL(non Qatar LNG) ,and SSGC and SNGPL are the retailers of all gas, GoP is the real buyer and seller of all sorts of gas, for it has to face the deficit that is created due to the difference between the gross selling and buying price of gas.

There are all sorts of gas prices; of buying and selling. There are three major gas pricing issues causing problems; 1. Qatar gas prices which at times go to as high as 10-12USD,but are lower now at half the earlier level due to general low oil and gas prices;2. Low consumer tariff of category 300 M3 per month which has a share of ….

% in total gas sales; 3. Low gas tariff for Fertilizer sector, although share of fertilizer sector in gas consumption is less than 5%.

And there is provincial issue. Punjab does not produce gas, but has the largest consumption (1999 mmcfd).Sindh is the largest gas producer (2585 mmcfd) but consumes lesser gas (1403 mmcfd).KPK also produces more gas(414 mmcfd) than it consumes(206 mmcfd).Gas consumption in Sindh is growing faster and its production is going down. Although, it has currently surplus, it is being projected that it will be in deficit in a few years time.KPK has a different outlook.KPK is in surplus and may remain in surplus for the coming many years, as gas production in KPK is growing and is expected to continue to grow. It is a virgin territory and a large number of gas plays are expected to come on stream.

Due to gas surplus in Sindh and Balochistan, SSGC seems to be in comfortable mode, as it does not have to buy expensive LNG. However, SNGPL is in bad shape as it has 50-50 Local and LNG share and has to sell expensive LNG to domestic consumers due to gas shortage in its franchise area, although GoP is expected to bear this price deficit. In future, SNGPL (Punjab) is going to have more consumption and more deficit and will have to consume more LNG at expensive rate. Up to now, there was no problem or lesser problem due to low LNG share. This problem is going to be more severe (for SNGPL) both in terms of price and quantity. Gas consumption of residential sector doubles in winter .In Punjab, in winters, there have already been shortages so much so that in some parts, people could not cook their meal and breakfasts. A human rights issue and a moral issue going beyond the gas sector rules and regulation.

Constitution provides that the gas needs of the producer province have to be met first and then the surplus can be exported to other provinces. But the question that is being asked is that is this constitutional provision is limitless to even surpass the other constitutional provisions covering basic needs? All parties are akin to interpret constitutional provision in their own interest. An important question is the definition of needs, the gas needs. Some people tend to differentiate in it. They say that only residential sector needs are the genuine inalienable gas needs; some others add industrial sector and CNG to it. The Fertilizer sector caters to the common country wide needs and Power sector feeds to the common grid as well.

Another important aspect is that the gas infrastructure is not adequate to meet the growing demand. There have to be pipelines and import infrastructure (LNG Terminals)to meet the extra demand of 2000 mmcfd in the near future while the existing infrastructure can cater to only 4000 mmcfd. There are two LNG terminals only at the present moment and two or more LNG terminals would be required. North-South and South-North gas pipelines would have to be laid. Such an infrastructural investment requires market confidence and efficiency. Current political gas system is highly complicated and is impeding the development of a well functioning gas market which works without the ever present government intervention and fire-fighting.

Federal government as a(de-facto) gas seller would like to average out all gas cost including the cheaper local gas ,the cheapest LNG and the expensive Qatar LNG, as all gas traders would do. It has to sell the gas at differentiated prices to meet its socio-economic agenda and general economic policy. The two or three most important factors in this respect are; 1. The poor get the gas(and electricity) at an affordable prices and even lower than the production cost;2. General prices are uniform throughout the country for which industrial and power sectors have to have gas prices at uniform rates.

Federal government (Power Division to be exact) has found WACOG to be a solution; a partial solution at-least simplifying the complications of separate LNG and Local prices .Sindh and KPK are opposing it, arguing that they are in gas surplus with sufficient local and WACOG would increase their gas tariff. They say that the only beneficiary would be Punjab which as leader or elder brother should be making sacrifices rather than trying to seek undeserved advantages. It is not, however, as simple. There are larger political economy question and a full accounting of who loses and who gains is a highly complicated issue. It would be, however, worthwhile to initiate studies on regional inequalities.

All parties have their own arguments. Other free riders are emerging in the form of market supporters. They argue that they can import cheaper LNG and should be allowed to do so. CNG sector is leading this group. The fact is that government's PLL (Pakistan LNG Limited) is already importing LNG at cheap rates. Last LNG import prices by PLL were 2.20 USD/MMBtu (5.74% of Brent as opposed to 13.35% of Qatar gas contract; other bidders quoted at 7-8%) lower than Asian LNG prices of the corresponding period .It is argued that private sector may not have any special reason, tool or wherewithal to be able to import LNG at cheaper rates (Private sector is beset with transparency and price collusion issues as has been recently demonstrated by Sugar sector enquiry). They wouldn't like WACOG. But then how can government allow some selected group to have free or cheaper lunch? Fertilizer sector, being supplied at lower rates, may be required to import their own gas requirement .This would facilitate market based pricing policies by the fertilizer sector. Similarly, Power sector (RLNG Power Plants) may have a justification to be in this direct LNG import category for the same argument. GoP has very recently removed 66% mandatory purchase by RLNG power plants. It appears they would be allowed to procure their own cheaper LNG.

Sindh may eventually come round to accept WACOG as it approaches to consume its surplus; already, there are gas shortages even in posh areas like DHA Karachi. KPK has the least inclination or incentive to do so. However, KPK has an incentive to cooperate or comply .It has to export its gas and there are infrastructural requirements which have to be financed. There is an issue of disproportionate gas and electricity losses in KPK which cost is being borne by other provinces. Gas and electricity losses are the least in Punjab. In Karak, people drill into the pipeline and steal gas wasting gas into the air way beyond their actual needs. Factories are emerging in that area based on free gas.

If no consensus emerges on WACOG, what are the other options; 1. Qatar gas contract which is currently the source of all gas pricing problems may have to be sorted out while renegotiating prices has been tried and has failed. Even, India having similar contract has not managed to get any concession from Qatar. The price difference between Qatar Gas and locally produced gas may have to be pushed into the future by some financial and arithmetical contrivance. At present, this difference, comes out to be under 2 USD/MMBtu; 2. Residential sector gas tariff may be ring-fenced based on WACOG of locally produced gas. Local gas production may have to be even curtailed to maximize the life of local gas resources to be reserved for residential sector. All other

Table 3.9.1: Provision-Wise Gas Production & Consumption (MMCFD)

FOR THE PERIOD 2018

	Punjab	Sindh	Balochistan	Total	
Gas Production (2018)	147	2,585	851	3,997	
Share	3.7%	64.7%	21.3%		
Gas Consumption (2018)	1,999	1,403	361	3,969	100%
Share	50.4%	35.5%	9.0%	100%	
Power	658	504	330	1,492	38%
Domestic	418	235	25	767	19%
Commercial	53	26	2	87	2%
Transport(CNG)	55	64	3	193	5%
General Industry +	815	574	1	1,430	36%
Fertilizer	(57%)	(40%)	(0.06)		

Source: Petroleum Division

gas, residual local and imported LNG may be dealt with under a different formula-WACOG or otherwise. Implications of the two options should be worked out. Finally, a more rigorous Gas Planning initiative is called for including a Least-Cost Gas Plan as is done in the power sector replacing the current practice of an informal and less-structured approach. There are macro-economic, sectoral, inter-sectoral, provincial and socio-economic issues and constraints. A structured approach may facilitate political reconciliation on the issue as well. International LNG prices are expected to be cheaper than locally produced gas due to stiff competition and more economic and efficient gas sources.

Table 3.9.2: Annual Average Demand/Supply in Pipeline System

SSGCL

	FY 21	FY 22	FY 23	FY 24	FY 25	FY 26	FY 27	FY 28	FY 29	FY 30
Supply	1,109	1,094	1,081	1,068	1,057	1,046	1,036	1,027	1,019	1,011
Demand	1,244	1,270	1,297	1,325	1,353	1,383	1,413	1,444	1,476	1,509
Annual Avg Shortfall	(135)	(176)	(216)	(257)	(296)	(337)	(377)	(417)	(457)	(498)
Shortfall in Winter	(162)	(211)	(259)	(308)	(355)	(404)	(452)	(500)	(548)	(598)
LNG for KE new plant	(38)	(150)	(150)	(150)	(150)	(150)	(150)	(150)	(150)	(150)

SNGPL

	FY 21	FY 22	FY 23	FY 24	FY 25	FY 26	FY 27	FY 28	FY 29	FY 30
Supply	854	754	652	533	420	327	271	208	148	127
Demand	1,775	1,769	1,805	1,835	1,868	1,911	1,956	2,002	2,052	2,118
Annual Avg Shortfall	(921)	(1,015)	(1,153)	(1,302)	(1,448)	(1,584)	(1,685)	(1,795)	(1,903)	(1,991)
Shortfall in Winter	(1,059)	(1,167)	(1,326)	(1,498)	(1,665)	(1,822)	(1,938)	(2,064)	(2,189)	(2,290)
LNG need for Trimmu	(45)	(119)	(119)	(119)	(119)	(119)	(119)	(119)	(119)	(119)
Total Need for LNG	(1,304)	(1,647)	(1,854)	(2,075)	(2,289)	(2,495)	(2,659)	(2,833)	(3,006)	(3,156)

LNG capacity with GoP is 1200mmcfd, all contracted to SNGPL & used for supply to Punjab

In the meantime, Qatar gas contract prices may be renegotiated by the year 2025 and with this the issue would die its own death with new Qatar gas prices to be in line with international prices. Would sitting on the issue be a viable option?

KARACHI: State-owned Sui Southern Gas Company (SSGC) has warned the government of an imminent gas shortfall to double in the coming winters as supply from five fields comes to a halt, its spokesperson said on Wednesday.SSGC spokesperson told The News that supply from five gas fields, including Zargoun, Sinjhoro, Kunar Pasaki, Sujawal and Nurbagla stopped to cause 150 million metric cubic feet per day (mmcfd) gas shortage at present, “which would increase to over 350 mmcfd in winters”.

“Zagoun in Quetta and Sinjhoro gas field in Sindh have gone for the annual turnaround,” said spokesperson.“Supply from Kunar Pasaki is near zero due to technical issues while Sujawal and Nurbagla in Sindh have depleted.”The company apprised the government of imminent gas shortage requesting it to make arrangements for the additional supplies in the upcoming winter. “We have informed the government of the shortage,” said the spokesperson. “It is now up to them to arrange additional supplies through imports or whatever source deemed fit.”

SSGC is getting around 970 mmcfd at present against the demand of around 1.2 billion cubic feet per day. The gap would exceed 350 mmcfd in winters as the demand is expected to cross 1.4 billion cubic feet per day. Total gas demand is around 7.5 billion cubic feet/day, while the indigenous production is falling short by 3.5 billion cubic feet/day. Pakistan has already increased spot buying of liquefied natural gas (LNG) importing at least three cargoes a month. The gap between demand and supply is expected to increase to 2.7 billion cubic feet in FY2023 and 4.8 billion cubic feet by FY2028 without the imported gas, according to the Oil and Gas Regulatory Authority.

Table 3.9.3: Province Wise Sale-able Gas Production and Consumption (Actual Figures June 2020)

	Punjab	KP	Sindh	Balochistan	Total
Gas Available for Sale	92	366	2,025	651	3,134
Gas Consumption					
Dedicated	307	-	560	325	1,192
Pipeline System	643	217	1,002	80	1,942
Total	950	217	1,562	405	3,134
Surplus / (Deficit)	(858)	149	*463	246	

** SNGPL supplied 202 MMCFD gas to Fertilizer & Power Plants in Sindh net 261mmcfd going north into Punjab*

Source: Petroleum Division

The possible gap can be bridged through enhancement in indigenous gas exploration and production through incentivising the energy sector, import of inter-state natural gas through development of cross-country gas pipelines and increased import of LNG. There are currently two LNG terminals: Elengy Terminal and Gasport Pakistan Ltd having a re-gasification capacity of 600 mmcfd each.The country is turning into one of the fastest growing LNG markets in the world.It first started importing LNG in 2015, with imports rising to 8.4 million tons in 2019 from 6.8 million tons in 2018.

There is an urgent need to speed up import capacity expansions, which have been planned to absorb incremental inflows. Information provider S&P Global Platts forecasts LNG imports to rise to 9.3 million tons in 2021, "if Pakistan can bring in another FSRU (floating storage re-gasification unit) relatively quickly. Imports are expected to exceed 17 million tons by 2025," it said in a report. Source: The News

3.10: Cheap Gas for Fertilizer Sector?

In 2013, this scribe wrote an article; Cheap Gas and Expensive Fertilizer. As the title implies, the situation seems to pertain even now in 2020.85% or so of Fertilizer cost of production goes to the gas cost, hence, my credentials to opine on the issue. Profiteering of the Fertilizer sector is indicated by the Earnings per share (EPS) of major fertilizer companies having risen to Rs. 13.00; cheap gas, uncontrolled prices, and taxation loopholes and changes etc provided such excessive profiteering opportunities. It should be embarrassing to both the takers and the givers; the government ministries which enable such profits through its policies on the back of farmers and consumers.

Fertilizer: High on Economic Agenda

Fertilizer is on the agenda of government these days and being discussed in ECC, the Cabinet, Parliament and in the relevant department. Prime Minister Imran Khan has admonished CCP of not doing its job properly and in response CCP has issued notices to the Fertilizer companies. On the other hand, the classical stand of the sector is that it does not come under the purview of CCP; CCP is a regulatory body and the fertilizer sector is deregulated, a convoluted logic indeed. It is for the deregulated sectors that CCP is meant to monitor, otherwise, regulators like NEPRA and OGRA and others are there to oversee the regulated sectors of Electricity, Oil and Gas. Indeed the issue is that it ought to be under an independent regulator, for the reasons to be argued later in this space.

Why so much attention to the Fertilizer sector. Fertilizer sector influences food prices and the performance of the agriculture sector. Recently, there has been major price issues of Flour, Sugar, Tomatoes and other food products, hence increased sensitivity of the government on the issue, and obviously rightly so. There are three specific issues; the fertilizer sector resisted bringing down the prices in the backdrop of withdrawal of GIDC. This in the backdrop of wider allegations of profiteering by the sector; EPS of major Fertilizer companies have crossed Rs. 13.00; 2) poor Fertilizer sales indicating bad omen for the agriculture and food prices; 3) even Fertilizer sector itself and one major company in particular being under pressure of reduced sales demanding export permits and making unique proposals of direct farmers subsidy- the so called smart subsidy.

Anomalies in Fertilizer Pricing

The Fertilizer sector and the associated pricing issues are complicated for the following reasons; 1)Food prices are to be kept low due to low income levels and poverty; 2) agriculture sector has to be supported and promoted as it forms to be a major sector of the economy providing 19 % of GDP, 42 % of employment and 20.8 % of direct exports with a potential to double it in short to medium terms; 3)as international prices keep fluctuating, stable prices have to be maintained through various price and non- price interventions; 4)food prices and availability has to be maintained more or less uniform through various price and non-price instruments; 5)Fertilizers are produced of natural gas which sector has been traditionally beset with pricing and availability issues; gas being required in other vitally needed sectors as well.

Is Fertilizer Industry Appropriate for a Gas Scarce Country?

It has been argued, both in India and Pakistan, whether Fertilizer industry should have been installed and promoted and even pampered, as the basic raw material, Natural Gas, was a scarcity and has been expensive compared to, say, Middle East (Qatar, Iran, Oman etc) where wellhead cost of gas have been 0.5 USD per MMBtu as opposed to 3.5-6 USD per MMBtu in this region. There was, indeed, a point in time around 2010-14, when some of the industry players openly talked about shifting their plants abroad due to non-availability of natural gas. However, due to the sensitivities as discussed in the afore-mentioned, it was preferred to have one's own domestic production vis-à-vis more efficient producers abroad. It is, however, clear that having established a sufficient basic capacity(6 MTPA as opposed to 24 MTPA that of India, the latter being more than 6 times more populous) there should be no overriding policy reason to offer undue and unreasonable incentives or protection for further investments or maintaining the existing ones. Being a gas short country, the laurels of being among top 10 producers of Fertilizers in the world seems to be undeserved and unjustified. All others in the top 10 list are gas exporters' surplus countries, except India and Pakistan. A better option could have been, it is argued, that Fertilizer plants were installed, possibly as JVs with Pakistan's investors equity , in the nearby gas export countries like Iran, Iraq, Oman and Saudi Arabia, which could have offered price stability and as well as supply security. However, this is not a lone case. Sugar industry has been allowed to expand disproportionately despite lack of competitiveness and water shortages.

Gas Supply Issues:

Fertilizer sector's gas consumption (20117-18) was 248 Bcft per year, mostly coming out of Mari Gas fields (MGF).MGF annual production has been at 260.594 Bcft per year. New reserve estimates of MGF are estimated at 5.3 TCF with an estimated reserve life of 22 yrs. This appears to be a secure gas supply situation as opposed to the national average of 10 years of gas supplies. Wellhead gas cost of MGF is at 1.5-1.6 USD/MMBtu, which is almost 40% of the average wellhead prices in the country. From this price and supply perspective, it appears that the Fertilizer sector can be supplied low priced gas provided such low gas prices are reflected in the final product prices.

Gas Prices:

Most Fertilizer plants get gas at Rs300 per MMBtu for fed gas and Rs. 1021 for electricity generation component. Based on 25 % share of electricity gas, the effective WACOG comes out to be Rs. 492.7 or 3.1787 USD/MMBtu. There is, however, a special price for old Engro plant getting gas at old and fixed contract rates with parent EXXON company ;USD 0.70 /MMBtu practically free of cost. It would be rather shameful on the part of company not to reflect it in the final product prices. The market prices do not indicate that it is being done.

Fertilizer Sector in India

It should be noted that in India under a regulated policy, Urea price in India are IRs 276(Pk.Rs.594.00) per 50 kg bag, while Urea prices in Pakistan are Pk.Rs1680 per 50 kg bag, almost three times that in India.DAP price in Pakistan is Rs.3290 per 50 kg, as opposed to IRs 1125(Pk.Rs.2422) per 50 kg bag;36 % higher. International Prices of Urea are around 266 USD/t or Pk.Rs.2061 per 50 kg; international Urea prices are 22.7% higher than in Pakistan. International Prices of DAP are in the vicinity of 250 USD/t, being 50% of Pakistan prices. However, these prices are not exactly comparable as there are daily variations, marine transport and taxation issues. However, Indian system is not comparable. She spends 2% of GDP in Fertilizer, food and fuel subsidies. About 61% of the budgetary expenditure goes to all kinds of subsidies. Fertilizer subsidies amount to 12 billion USD annually. Against a production cost of IRs.900 per bag, farmer gets it for IRs.242 per bag.

In India, gas is supplied to Fertilizer sector at 6.5 USD per MMBtu at a consumption norm of 22 MMBtu per MT of Urea, resulting in regulated price varying between 245-310 USD/MT of Urea. Gas cost share in Fertilizer price comes out to be 143 USD/MT or 46-58%.It may be noted that in India Fertilizer prices have been maintained rather stable and allowed to increase by 25% only over a period of 20 years. Another cost estimate is from Yara, a major and credible international fertilizer multinational with world market share of 20%, which provides Urea production cost at 146 USD/t based on a gas price of 4 USD/MMBtu. By comparison, Pakistan Urea price at half the gas prices of Rs.300 (1.93 USD) per MMBtu are 217 USD /t. To be fair, taxation effect has not been included in it which may make the difference a bit less glaring. However, both, Indian and Yara estimates indicate appear to be compatible with each other. In Pakistan, gas cost in Urea comes out to be 42.46 USD/t. Thus overhead cost/margin in India is 100 USD per ton vs 174.54 USD per ton in Pakistan .This appears to be the explanation of Rs.13.00 EPS and not efficiency. Producers profit is consumers' loss.

It should be noted that in order that a competitive regime functions, there has to be a reasonable surplus for demand, supply and pricing linkages to operate adequately. It is inappropriate for the industry to demand export licenses instead of lowering prices for increasing the demand and balance the market. Instead of doing that all kind of semi-revolutionary proposals are being made.

Fertilizer Pricing: Regulation or Free Market?

Several proposals are under circulation including the one presented by the most important actor ,Mr. Asad Umar, currently , Minister of Planning and Development and more significantly the former CEO of Engro ,who succeeded in getting the sector unregulated possibly under pressure of lenders and investors. We have argued in this space that pseudo-competitiveness policies should be avoided. If there are genuine market conditions, competition and deregulation increases efficiency and welfare, otherwise, it may be a prescription of disaster and difficulties as we have seen in many other sectors. Minister Asad Umar, reportedly, favors free fertilizer imports without duties and taxation and price intervention and subsidies through TCP imports. This is more or less the current situation and in keeping with the pure capitalistic and market principles. However, the most important flaw in this is that various fertilizer plants get gas at various prices; some from low priced Mari Gas, some from locally produced gas from SNGPL and some are charged LNG prices, which until recently were very high at 10-12 USD per MMBtu, as opposed to subsidized local gas tariff at around 2-3.1787 USD .The gas price subsidy to fertilizer industry along with subsidized prices for residential gas users has created many financial and operational problems for the gas sector. Gas sector opposes such subsidies and argues for selling at average cost of production; any subsidy to be provided out of government budget, either directly to farmers or indirectly to the fertilizer producers and marketers.

The simple solution is to drop the semblance or pretence of market economy by putting the Fertilizer sector under regulation of an independent agency, may be OGRA, to avoid the expenses of yet another under-utilized bureaucracy. Alternatively, there is sufficiently experienced manpower available in public sector Fertilize outfits like NFC, NFML and NFDC which can be consolidated into an autonomous body-cum-regulator. If inputs are controlled and even subsidized, how come outputs can be uncontrolled or unregulated? There is a basket price system in case of other regulated sectors such as Power and gas which is working more or less satisfactorily. Every producer gets his sales price according to the cost of inputs and production plus some efficiency incentives. Across the border in India, the regulated system is working satisfactorily. There would be issues of regulatory terms such as allowed RoE and IRR which can be negotiated or determined independently by the regulators; Cost-plus under fair terms should be acceptable to all except those who want to indulge in unfair profiteering. All gas based Fertilizers could be under regulation including Urea and DAP; usually Urea is focused upon.

An alternative is of free market system for which recently evolved international LNG spot prices offer opportunity.LNG spot prices are getting increasingly divorced of oil price linkages. Pakistan LNG terminal policies do offer LNG imports by private parties or groups.CNG association had been earlier allowed to import its own LNG requirements. Same can be done by Fertilizer sector; international input and output prices. GoP may have to work out a pricing coordination framework with locally produced gas prices. It can be done. It would be much better than *adha teetar adha batair* system as it prevails today. However, it would be quite a risky and destabilizing enterprise. Fertilizer prices fluctuate rather wildly (from 600 USD per ton to 250 USD) within a year and over medium terms as well. Such fluctuations may unnecessarily hurt both the fertilizer companies and the government which has to under write stable and affordable fertilizer prices. And Fertilize companies may get a wind fall at one time and face severe losses at other time requiring expensive hedging arrangement. Won't it be better to agree to a reasonable pricing formula? The current happy ride cannot continue for long, although it has continued quite long already?

It appears that if the profiteering (as being evident by an EPS of more than Rs 13/-) by the Fertilizer sector is controlled by bringing in a regulatory regime, it should be possible to double the feed gas prices (from Rs300 to Rs600-700 per MMBtu as proposed by OGRA) without increasing the fertilizer prices**.** Alternatively, if gas supplies are kept at the existing low level, regulated regime should be brought in, which should make sure that low gas prices are reflect in final product prices.

Table 3.10.1: Comparative Fertilizer Data :India vs Pakistan-2019

		Pakistan	India
Population	Million	220	1339
Fertilizer Production Capacity	MTPA	8.3	24.6
MRP-Urea-Subsidized			76.645
Production cost/price-UREA	USD/t	217	245-310
Production Cost Urea Yara @4 USD/MMBtu			146
Subsidy Urea	USD/t		168.355
MRP-DAP	USD/t	425.51	312.51
International Price -Urea-FOB	USD/t	266	266
International Price-DAP-FOB	USD/t	250	250
Input gas Price-	USD/MMBtu	3.1787	6.5
Unit Gas consumption Urea	MMBTU/t	22	22
Gas cost per ton Urea	USD/t	69.9314	143
Overhead Cost-Urea	USD/t	147.0686	102
Gas Cost difference over Pakistan	USD/t		73.0686
1 USD	Rs/USD	155	72

Source: Authors'(SAA) Estimates

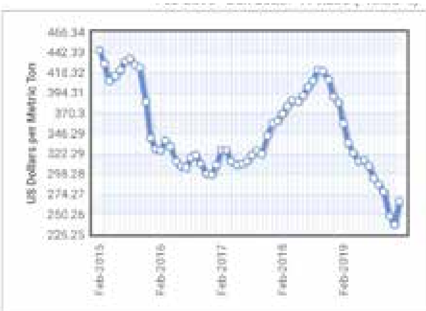
Table 3.10.2: Example of production cost for urea

Natural gas price	4 USD/MMBtu
x Gas consumption	36 MMBtu/t ammonia
= Gas cost	144 USD/t ammonia
+ Production costs	29 USD/t ammonia
= Cost for ammonia	173 USD/t ammonia
*Ammonia use for conversion to urea	0.58 t ammonia/t urea
= Ammonia cost for urea	100 USD/t urea
+ Process gas	21 USD/t urea
+ Other production costs	25 USD/t urea
= Total cost for urea	146 USD/t urea

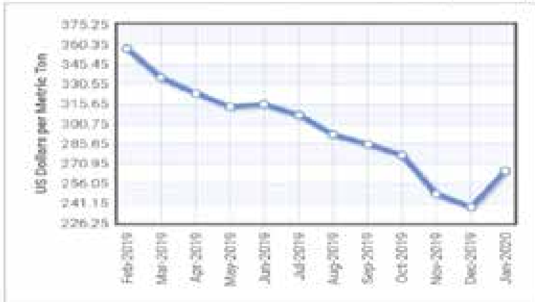
Note: example from a mid-size plant in the US in 2016

Source: Example from Yara international

Charts 3.10.1: Fertilizer Monthly Prices and Profitability of Fertilizer Companies



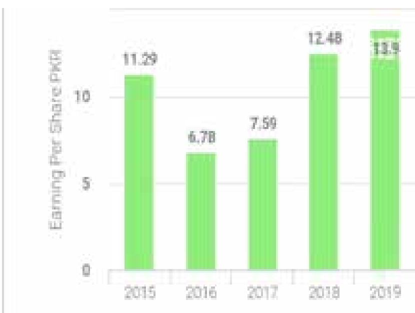
Description: DAP (diammonium phosphate), standard size, bulk, spot, f.o.b. US Gulf



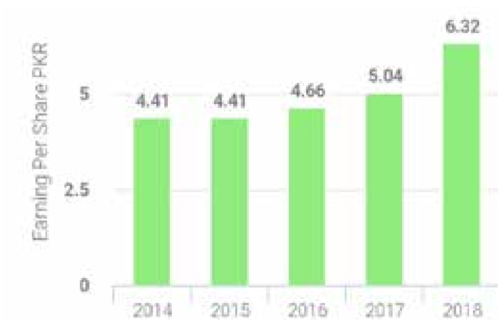
Description: DAP (diammonium phosphate), standard size, bulk, spot, f.o.b. US Gulf

Engro EPS

Description: Urea, (Black Sea), bulk, spot, f.o.b. Black Sea (primarily Yuzhnyy) beginning July 1991; for 1985-91 (June) f.o.b. Eastern Europe



FFC EPS



Fatima Fertilizer EPS

3.11: LNG from Qatar and Terminals?

LNG prices have come down and are doing so continuously. Although current summer prices have a seasonal effect, there appears to be a constant component trend as well. Several policy issues have developed in importing countries in the region; whether, Long term LNG supply contracts are advisable; is there a scope for renegotiation existing contracts both in price ad non-price terms. In the following, we will present a review of LNG prices and the way these are affecting the regional and international market.

In Pakistan, July Spot prices in last July were 4.7 USD per MMBtu as compared to typical OGRA average of 10-12 USD. However, the lower prices are Spot prices (on competitive basis). Long term contract prices, e.g. from Qatar at 13.37 % of Brent in July were 8.54 USD per MMBtu. Thus prevailing Spot prices both in India and Pakistan are almost 50% of Qatar LNG contract prices. In Pakistan, 5-year contract prices from Eni and Guvnor are around 6.84-7.15 USD /MMBtu. Qatar LT prices are becoming extremely unaffordable. Both in India and Pakistan, Qatar LNG prices are the same, higher than international spot market and there is discontentment over this issue in both the countries. However, both are constrained by contract conditions. One is not sure what is the price opening period in India-Qatar contract, in Pakistan, it is 10 years.

Last September JKM-Japanese LNG prices varied between 4.50-4.90 USD per MMBtu. Less than a decade ago, LNG was at 16-20 USD, part of which was due to higher crude oil prices. Gas prices have been traditionally linked to Oil prices. Although Gas-on-Gas competition has emerged lately, still LNG to Oil price linkage is quite common. In India, the import prices of LNG are around 3.5-4 USD/MMBtu. Spot market is a relatively new phenomenon in LNG. Spot prices used to be higher than L.T. contract prices until 2014.But as Spot market developed and its share increased, Spot prices decreased and are now lower than L.T. prices. It is worth exploring as to why Japanese L.T. contract prices are nearly approximating spot prices and in 2019 L.T. contract prices have become lower than spot prices !(pls see METI data Japan).

Table 3.11.1: Comparative Seasonal SPOT LNG Prices-Pakistan vs Japan-USD/MMBtu

	Jan-18	Jul-18	Jan-19	Jul-19
Pakistan	11.2255	11.8244	8.555	4.6127
Japan	10.1	10.3	10.5	4.7
Brent-USD/bbl	69.18	74.25	59.41	63.92

Source: Pakistan PLL,METI Japan

LNG market has become very competitive with the entry of the U.S. with its cheap shale gas resources and general supply increase elsewhere. The U.S. gas is competing with Qatar gas despite a considerable difference in distances. India is lifting 50% of is LNG demand from the U.S. The U.S. used to be a net importer suffering from short supply .It is now a big exporter. Russian gas has also come into the regional markets creating a highly competitive environment creation price and non-price pressures.

Another trend seems to be emerging; however, it is not sure if this would persist with the same intensity in future. Winter Jan 2019 LNG spot prices were 8.555 USD which has come down to 4.5 USD in July(summer).Is it a seasonal effect due to lower summer demand in the West or it is a part of the long term decline or price adjustment in LNG. Will winter prices approach Qatar LT price level or even higher is yet to be seen? Lower prices would heighten the pressure to renegotiate prices. It would mean that lower price trend is permanent.

Reportedly, there have been behind the door negotiations to renegotiate LNG L.T. prices as a part of which Pakistan offered to have another L.T. contract of 200 mmcfd. In the meantime, Pakistan LNG limited decided to float tenders for L.T. contract, which have been decided not to be opened .The purported reason and the actual one is that LNG demand is not there to warrant this purchase at-least in this season. Power production is at its highest due to increased cheaper and hydro and coal capacity. RLNG based electricity is expensive due to expensive LNG from Qatar at 10-12 USD per MMBtu. Had Spot LNG been there at 4-5 USD/MMBtu, RLNG based electricity would have been competitive and LNG demand would have been there. Knowledgeable people had opposed installation of LNG and as well as imported coal power plants, predicting excess supply in this period. Had economic turndown not been there, even then, it is inconceivable that electricity volume could have been absorbed. Another problem in demand and supply of electricity is a significant difference between winter and summer demand. Summer demand is higher than the winter demand (opposite to what is there in the West).We has proposed in this space earlier that winter demand should be encouraged under a lower seasonal tariff.

However, the question is; is long term contract under take or pay terms in our interest. Apart from a competitive and affordable price, one would want to be without the constraint of take or pay in a variable demand environment as we have discussed earlier. LT Take or Pay contracts are feasible for a constant unchanging demand so as to be able to honor take or pay clause without suffering a loss under non-utilization. In that case, it appears that, the scope for forwarding incentives to Qatar for price renegotiation appears to be low or constrained. If the LNG demands increases, the savings under a free market regime and spot market may be more than what may be saved due to decrease in LNG price of Qatar. One has to do actual calculations to get an answer in this respect. The recent cancellation of LNG bid-opening should be seen in this context, apart from seasonal lower demand.

An interesting situation has developed in the LNG and domestic gas comparative situation. In India, local gas is priced at 3.69 USD/MMBtu which is less than or equal to LNG spot prices. And in Pakistan, local gas prices are of the order of 5-6 USD per MMBtu, which are almost half that of LNG price. However, India has priced its tight gas is 9.32 USD per MMBtu, more than LNG price. There is always a question in the policy circles in Pakistan: why not pay higher local gas prices comparing to imported LNG prices? The answer is that the cost of production of local gas is 2-3 USD per MMBtu. There is no logic for paying more. However, what becomes clear is that there is a scope for giving incentives for tight gases or difficult areas. However, 0.5 USD / MMBtu do not seem to be enough for difficult areas? Should cost-plus be a viable approach? These are the questions that lay open in our E&P policy?

In addition to prices, it may be equally or even more important to negotiate contract flexibility.LNG contracts have been traditionally very rigid, mostly in favor of suppliers. Now with an increasingly competitive and versatile technology, it is feasible to negotiate contract feasibility; right to resell to a third party, take or pay dilution in terms of yearly adjustments, balancing of non-supply and non-lifting and other similar flexibilities. Regional gas-users market consisting of Pakistan-India and Bangladesh could also play role in mutual gas overflow adjustments etc.

Finally, it is said that due to PEPRA rules, there are some inefficiencies in LNG procurement prices. It is a difficult issue; transparency vs efficiency. There are many market operations which private sector can indulge in as opposed to a government officer who can only organize a tender activity. The only solution appears to be privatization and competition, which the policy makers are apparently moving forward. New LNG terminal policy is a step in this direction.

Table 3.11.2: Pakistan LNG Prices vs International(USD/MMBtu)

	Jul-19	Aug-19	Sep-19	Oct-19
Pakistan-Qatar-%B	8.55	7.89	8.40	7.88
Pakistan-Guvnor-%B	7.43	6.86	7.30	6.85
Pakistan-ENI-%B	7.76	7.17	7.63	7.15
Pakistan-Spot-%B	4.55	4.49	5.13	0.00
Japan-METI-USD	4.70	5.50	4.90	0.00
JKM-USD			4.50	5.50
Brent Crude-USD/bbl	63.92	59.04	62.83	58.92

Source: Various, PLL, METI, JKM, ICE

Table 3.11.3: Pakistan LNG Bidding Results compared Qatar Gas and METI Japan

Month	Bid-% Brent %	Bid Price estimate USD/MMBtu	Qatar Gas Price USD/MMBtu	Brent -USD/bbl USD/MMBtu	METI-Japan USD/MMBtu
Jan-18	16.4694	10.9077	8.841705	66.23	11.0
18-Feb	15.5725	9.8823	8.47191	63.46	10.6
18-Mar	14.5183	9.3164	8.566695	64.17	8.8
18-Apr	11.8186	8.1300	9.183465	68.79	9.1
18-May		NA	9.802905	73.43	8.2
18-Jun			9.60933	71.98	9.3
18-Jul	16.3274	11.8651	9.701445	72.67	10.0
18-Aug	16.5222	11.7440	9.48918	71.08	10.7
18-Sep	14.2769	10.7591	10.06056	75.36	10.6
18-Oct	14.4184	11.0632	10.243455	76.73	10.7
18-Nov		0.0000	8.31972	62.32	10.8
18-Dec		0.0000	7.20366	53.96	9.2
19-Jan	14.4	8.1475	7.55343	56.58	8.2
19-Feb	15.2839	9.3430	8.160855	61.13	8.1
19-Mar	12.2008	7.7829	8.515965	63.79	6.4
19-Apr	11.9811	8.2166	9.15543	68.58	5.2
19-May	9.5264	6.3665	8.921805	66.83	5.4

19-Jun	9.8468	5.8844	7.97796	59.76	5.5
19-Jul	7.1263	4.3955	8.23428	61.68	4.7
19-Aug	7.6005	4.3832	7.698945	57.67	5.3
19-Sep	8.379	5.0308	8.01534	60.04	5.4
19-Oct	8.8601	5.0742	7.645545	57.27	5.5
19-Nov	9.365	5.6565	8.0634	60.4	×
19-Dec	10.3617	6.5641	8.457225	63.35	6.4
20-Jan	9.5987	5.9157	8.227605	61.63	5.9
20-Feb	8.594	4.5849	7.122225	53.35	3.4

Source: Pakistan LNG,METI Japan, Index-Mundi

Complexities of LNG - Spot vs Long-Term Pricing

Pakistan imported 6.7 million tons of LNG in 2018. Traditionally, furnace oil consumption has been nine million tons per year, which has come down to 4.2 million tons. At present, there are no imports of furnace oil. Only domestic oil refineries are producing furnace oil due to their product programme compulsion. Local gas resources are going down. Gas shortages have been there in the winter and another LNG-based power plant is to be inaugurated soon, which will increase LNG demand.

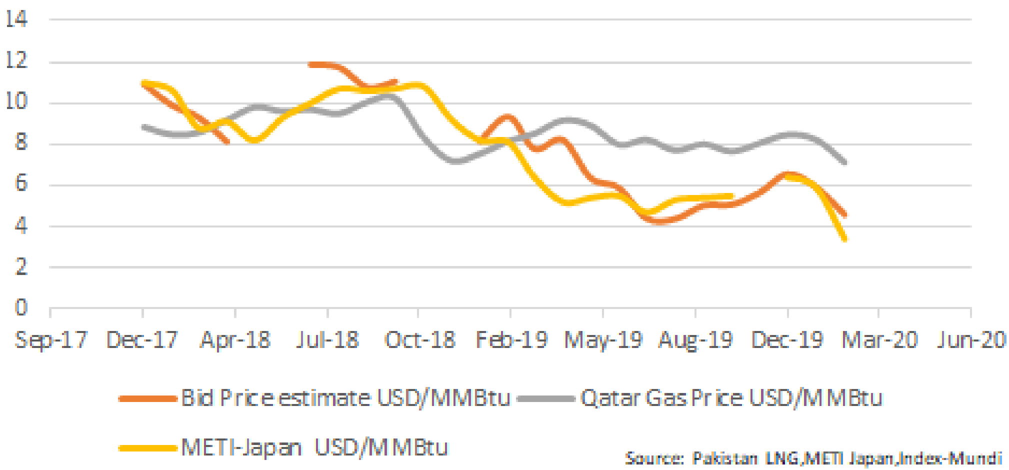
The alternative of long-term contract can be very expensive under ‘take or pay’ clauses, if demand does not come as per plan. We have earlier pointed out the need for setting up gas storage facilities to deal with the problem. Gas storage has been discussed in official circles and a study had been done earlier. Lately announcements have been made. It is suggested that faster action be taken in this respect.

In a regulated and controlled market largely governed by the government, it should not be very difficult to make dependable forecasts and avoid unnecessary extras in spot contracts. Procurement plans and projections do not come out to be true exactly. In view of the experience with spot procurements, there appears to be a case for preference for long-term contracts, but based on open tendering, although spot purchases cannot be totally eliminated. Also spot contracts are more amenable to private sector, which can manage to have better deals through its quick decision-making and independence.

LNG has been traditionally bought under long term contracts. Later on Spot market developed. Spot prices in Asia came down to its lowest in the past eight months at $8.5 per million British thermal units (MMBtu) in February 2019. In Pakistan, the February spot procurement prices were $9.06 and $9.6718 per MMBtu. There are three long-term LNG contracts in place in Pakistan – one with Rasgas of Qatar, second with Guvnor of Switzerland and third with Eni of Italy. LNG has also been bought in the spot market through open tendering. Pakistan's LNG spot procurement experience has not been profitable. Spot procurement prices have been higher at 15-16% of Brent crude as opposed to Guvnor's long-term contract price of 11.42%.

In the Japanese market, LNG spot prices have been lower than the long-term contract prices over the past three years. Pakistan's spot purchases in 2018 had been at higher prices than Japan's spot rates, which are traditionally the highest in the market. All spot purchases have been the result of open tenders and thus no misgivings should arise.

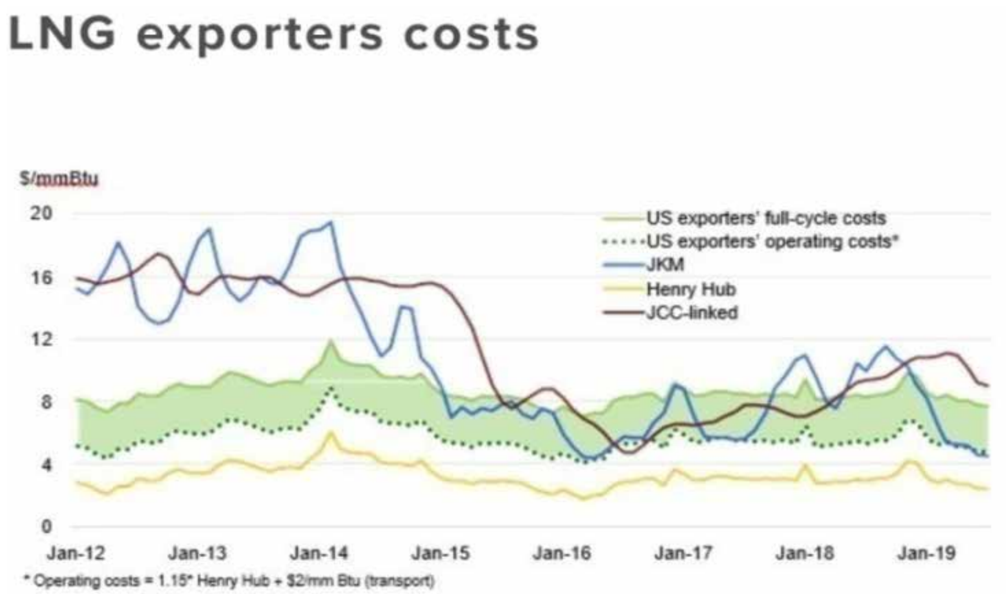
Charts 3.11.1: Pakistan LNG Bidding Results Compared Qatar Gas & METI Japan



Source: Pakistan LNG,METI Japan,Index-Mundi

One may have to review the reasons as reportedly the participation in tenders has not been as much as required or expected. Otherwise, the popular expectation that spot purchases may lead to better prices does not seem to hold. Perhaps, competition works better in larger and credible markets; another reason being policy continuity and keeping politics out of economic domain. It is even more significant to study the recent LNG spot prices, which have been quoted at half of Brent crude as against a generally accepted ratio of 0.8. It would be interesting to quote from a recent ICIS report. It says, "Global LNG prices were increasingly competitive against oil. At the end of 2018, gas and oil briefly reached price parity at around $9 per MMBtu, but since then oil has been on an uptrend with gas steadily falling. Brent crude oil averaged around $11.478 per MMBtu over the last four weeks, almost double the spot LNG levels. If gas can maintain a wide spread to oil, it could open up new demand markets, displacing the more expensive oil, including in countries such as India."

Charts 3.11.2: JKM vs oil-linked gas price and US



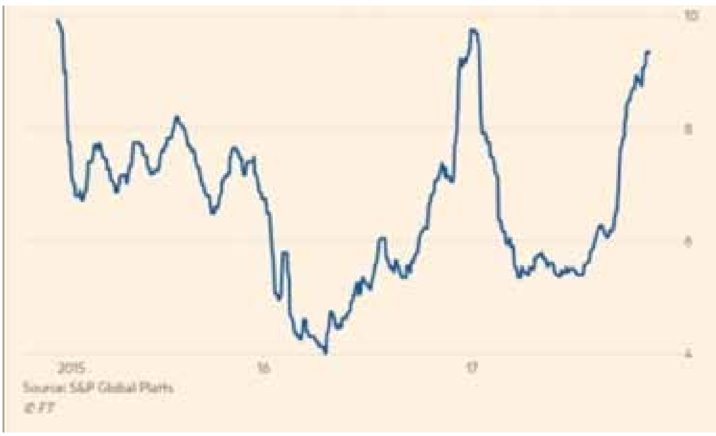
Spot prices have not been stable and possibly varied more than Oil. Secondly, Spot markets of LNG are not as deep and liquid as these are of Oil. Around 2015,LNG Spot prices had a steep fall from 10 USD per MMBtu to 7 USD/MMBtu and continued fluctuating between 7 and 8 USD/MMBtu for the major part of 2015.By the end of2016,there was again a steep decline and briefly touched 4 USD/MMBtu and then kept increasing to reach a new peak at10 USD/MMBtu in the beginning of 2017.Prices started going down again to remain at around 5.5 USD in the middle of the year and then again acquired a peak at 9.5 USD by the beginning of 2018.It then kept increasing to acquire a new peak at 11 USD by the end of the year. It then kept going down and has bottomed at 3.25 USD under Corona circumstances.

Comparison of Qatar Gas Prices vs Pakistan LNG Bids

Pakistan LNG (PLL) has been inviting bids for spot LNG since 2018.We have provided their data in the adjoining Table ..,as reported on their website. We have tried to compare it with Qatar LNG prices and Japan METI Spot. We find that Qatar Gas prices were lower than PLL Bid prices in 2018(14.4-16.4 % of Brent of PLL bid prices as opposed to 13.35 of Qatar Gas) and were higher in 2019.Japan METI prices were also lower in 1018.Brent Crude prices increased slightly in the second half of 2018,but since then have been coming down. At 30 USD per barrel current Brent prices, Qatar Gas prices become a bit more affordable at 4.00 USD per MMBtu as opposed to twice that much in 2018.Recent LNG prices announced by OGRA are 6 USD. It takes a while in Pakistan to reflect the price change, as last three months average rounds it up and delays the change by three months gradually. If Brent prices stabilize at 30 USD, Qatar Gas prices would stabilize at 4 USD. It is more or less comparable with 3.25-3.75 USD quoted in the recent spot market.

LNG Prices Update:2019-20

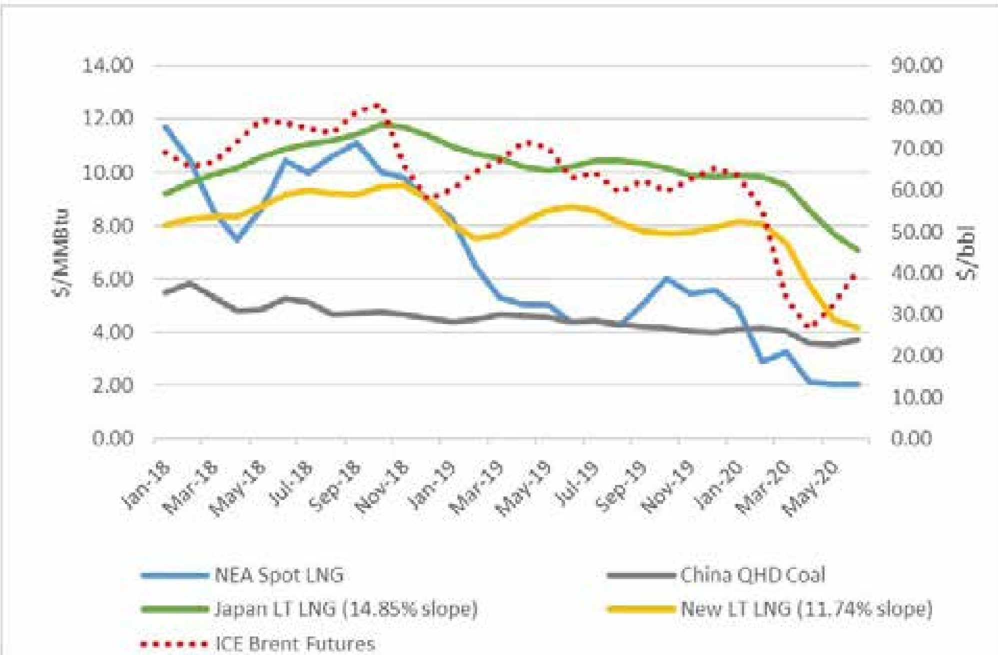
Charts 3.11.3: Asian LNG Prices, Platts JKM ($ per MM BTU)



A comparative analysis of the trends in daily gas and LNG prices in 2020 compared to the previous year illustrates how the market has responded to these events (see Figure 1). At the start of 2020, prices were relatively weak with daily prices hovering in the range US$2.00-5.50/mmBtu. The Northeast Asia (NEA) Spot LNG price was at a premium to European LNG prices in January 2020, however, this quickly deteriorated and it slumped to record lows of US$1.68/mmBtu on 30 April 2020. Over the period 22 April – 8 May 2020, daily spot and LNG prices converged to below US$2/mmBtu. Another anomaly observed was the fact that Henry Hub (HH) became the most expensive gas on 23 April 2020 at US$1.86/mmBtu whilst the National Balancing Point (NBP), Title Transfer Facility (TTF), and NEA Spot LNG were US$1.47/mmBtu, US$1.80/mmBtu, and US$1.81/mmBtu respectively, making even the margin to markets negative, and thus shrinking export opportunities for the U.S. LNG. In the first half of 2020, gas and LNG prices in Asia and Europe plunged by more than 50% y-o-y with the average NBP, TTF, and NEA Spot LNG prices declining by 57%, 53%, and 50% respectively.

In comparison to the previous year, European and Asian spot gas and LNG daily prices ranged from US$7-9/mmBtu in January 2019, after which they sharply declined over Q1 2019 and converged between US$4-5/mmBtu at the end of May 2019. Notwithstanding the current situation, market forces will react to find its equilibrium, and prices are expected to slowly recover as this happens. However, the average gas and LNG prices in Asia and Europe are not foreseen to be higher than US$3/mmBtu in 2020.The U.S. Energy Information Administration expects HH spot prices to average US$1.93/mmBtu in 2020 and US$3.10/mmBtu in 2021 according to their Short Term Energy Outlook July 2020 .

Charts 3.11.4: LNG Prices



Sustained low oil prices would definitely boost the price competitiveness of natural gas compared to coal in Asia. …..estimates for oil-indexed contracts, Japan LT LNG and New LT LNG, have steadily declined since January 2020. The average Japan LT LNG price in H1 2020 was US$8.77/mmBtu, 16% lower y-o-y. The New LT LNG price experienced a steeper decline, as it is based on a 3-month historical average of Brent, and averaged US$6.34/mmBtu in H1 2020, 22% lower y-o-y. Based on this trend, the New LT LNG price may even dip below the China QHD coal price in the coming months.

Note: Japan LT LNG price assumes a 14.85% slope and 6-month historical average of Brent. New LT LNG assumes a 11.74% slope (average for 2015-2019) and 3-month historical average of Brent. Data as of 30 June 2020 Source: GECF Secretariat based on data from Argus and Refinitiv Eikon.(Source: Expert Commentary: Update on Global Gas and LNG Prices in 2020: How has it Coped with Recent Market Dynamics? in Oil & Companies News 07/08/2020,reproduced by Hellenic Shipping News.)

Pakistan Update on LNG Prices

SINGAPORE, July 28 (Reuters) - SOCAR Trading has placed the lowest offer into a spot buy tender by Pakistan LNG Ltd for a liquefied natural gas (LNG) cargo for delivery in late August, according to a notice posted on the Pakistani company's website. *SOCAR's offer for the cargo is about 5.74% of Brent crude oil prices, according to the document.* This works out to about $2.20 per million British thermal units (mmBtu) for the cargo to be delivered over Aug. 27 to 28 and is a record low LNG price secured by the Pakistani company, Pakistan LNG said on its Twitter account. This is lower than the Asian LNG spot price LNG-AS for August which on Friday was estimated to be about $2.35 per mmBtu. Three other companies who had technically qualified for the tender placed offers ranging from 7.8% to 10.4% of Brent crude oil prices. They are Guvnor Singapore, Petro-China International Singapore and Trafigura, according to the notice.

LNG Terminal Controversy

The adjoining Table provides a comparison of LNG terminal tolling tariff in Pakistan, India and France.PML (N) government had been claiming that it managed to obtain the lowest terminal tariff in the world. Actually, they were not making apple to apple comparison. They were comparing levelised tariff at 90-100% capacity utilization of Engro LNG terminal with the running tariff which could have been at any lower capacity utilization. In Europe, most LNG terminals and possibly elsewhere, capacity utilization of LNG terminals hardly exceeds 50% and is usually lower leading into higher tariff. If we examine the table, we find a large variation in French LNG terminals from 23 USc to 45 USc; and in India from 68.4 to 83.58 USc. The low terminal tariff in France may be emanating from old depreciated plants despite low capacity utilization. In case of India, higher tariff also emanated from low capacity utilization and relatively newer plants. The harsh truth and reality is now making itself known but solving the confusion and controversy. Due to low capacity utilization in Feb-march, the LNG terminal tariff calculated on monthly basis and actual capacity utilization has exceeded 1 USD. However, comparing with other similar projects implemented around the same time and same technology, configuration and mode of financing, the tariffs are comparable. It is argued, however, that if mode of financing is changed from usually expensive leasing mode to debt financing, lower tariff are possible. Lower European tariffs are explained in this perspective. However, debt finance may not offer 15 years term. It comes with 30 years FSRU ownership liability. It would also be questionable if non-leasing FSRU would be available in a certain time window.

Table 3.11.4: Comparative LNG Terminal Tariff: France, India & Pakistan

	Euro/MWh	**IRs/MMBtu**	**USc/MMBtu**
Montoir-France(1)	0.81		26.3511
FosTonkin-France(1)	1.21		39.3640
Cavou-France(1)	1.39		45.2198
Dharma-India(2)		60.18	83.5833
Ennore-India(2)		57.38	79.6944
Dhabol-India(2)		49.28	68.4444
Engro(3)			45.0000
Pakistan Gasport			45
1 MWh-MMBtu	3.412		
Euro-USD	1.11		
Irs-USD	72		
Pk.Rs-USD	155		

1.does not include Port charges; 2.includes Gasification, Port charges and 60% LFs; 3.basic rate at 100% L.F. includes gasification but excludes port charges

Source: French Energy Regulatory Commission (FERC), Economic Times India, OGRA

3.12: LNG Technology Options

In Pakistan, gas demand is increasing and production contracting, creating supply gaps and shortages.

Gas is a convenient, clean and non-polluting fuel. At present, there is no substitution of gas in the domestic and industrial sectors. The fact is that 60% of Pakistan's gas needs emerge out of the non-power sector. There can be different views on the use of gas or liquefied natural gas (LNG) in power production, where substitutions are possible like coal, hydro or renewable energy such as solar or wind. Currently, the LNG market share is 25% out of gas sales of about 5 billion cubic feet per day (bcfd). If local production does not increase or does not at least maintain its current level, LNG imports will acquire a level of 4-6 bcfd.

In such a big and evolving market, a monolith LPG regime cannot meet the emerging and diverse needs. There would be site and draft issues, port congestions, short-term shortages, transmission bottlenecks, diversification, safety and security issues apart from political issues. A variety of options may be required to meet the varying requirements and challenges. Following options are available that can be utilized in specific situations that are emerging and will emerge in future.

In this type, there is an LNG jetty wherein an LNG ship parks. Liquid LNG is pumped from the LNG ship to the LNG cylindrical tank storages built near the jetty. LNG storages are built in Ni-steel lined concrete vessels, double-walled; insulation material is filled within the two vessel walls.

Thus, LNG is pumped through the vacuum insulated and lined LNG pipes into these cement-steel vessels. The re-gasification system is similar to that of a Floating Storage and Re gasification Unit (FSRU); as many vessels can be built as required or the space may allow.

Typical volume of the storage vessel is 150,000-180,000 m3 as against the LNG carrier ship volume of 260,000 m3. Two or more vessels are routinely constructed to match the capacities. Re gasification may be done through sea water open rack vaporizers as used in FSRUs or heat exchangers may be utilized for capturing waste heat from nearby power or other plants, reducing energy consumption.

All initial LNG terminals built in Europe, Japan and India were land-based and FSRUs are a later day invention; and FSU even later. Bangladesh has floated a tender recently for a land-based LNG terminal with capacity of 7.5 million tons per annum (MTPA), expandable to 15 MTPA (FSRU is normally of a capacity of 5 MTPA).

Figure 3.12.1: LNG Technology Options

India has most of its LNG in the form of land-based terminals. Its Dahej terminal has a capacity of 15 MTPA or 2 bcfd. Pakistan can also have a land-based terminal starting at 7.5 MTPA and expanding to 15 MTPA. Countries are building all types, land-based and FSUs, depending on the individual situation and circumstances. Main advantages of land-based terminals are local labor and material usage, gradual expansion possibilities and larger storage, and higher safety and security. Cheaper debt financing possibility for land-based terminals at 4% as opposed to leasing rate of 12% for FSRU makes it quite competitive as well.

Normally, used LNG tankers are used for this purpose. Such vessels may be 5 to 15 years old and usually have structural integrity, although engine may be out of order. Such vessels are normally available at a cost of around $50 million or at a charter rate of $20-25,000 per day. These vessels can be used in consonance with existing FSRU depending on the availability of excess regasification facilities. Alternatively, separate regasification facilities can be built either on land or on a barge or on the jetty itself. It is the cheapest option both in terms of initial capital expenditure or leasing. There are, however, issues limiting the use of this option.

Small capacity LNG carriers with lower draft requirements are available along with the availability of regasification facilities on barge (FSRB). These facilities have smaller implementation times and can be installed in difficult site circumstances such as lower draft, space, safety, etc. These can also be shifted to different sites. An independent LNG network can be built for bulk users of Port Qasim areas based on small-scale LNG, releasing substantial transmission capacity for the north. Also, an LNG/CNG system can be associated with an independent small-scale LNG supply system. FSU can also be considered for these cases.

Figure 3.12.2: Recent milestones on the project include raising the 180,000-cbm LNG tank's roof

These systems do not require a jetty use a four-point mooring system and utilize a self-propelled Floating Transfer Terminal that is attached to the moored LNG carrier. The system is of special interest when used in consonance with FSUs. It is used in small to medium-sized LNG operations. It is especially suitable for low draft applications and short lead time requirements.

If there is a gas transmission limitation either in terms of capacity or non-coverage, truck-based LNG transportation can be used and regasification facilities can be installed at the users' premises.

Bulk users such as power plants, large industries like fertilizer and chemical can benefit from the truck-based LNG transport. Also, in many jurisdictions, CNG plants have LNG storage and regasification facilities. Such CNG stations are called LNG/CNG stations. Such systems can be coupled with all types– land-based terminal, FSRU and FSU.FSUs are of particular relevance as no regasification is required at the terminal.

In terms of daily equivalent cost (including capital and operating cost), the land-based LNG terminal costs $100,000 per day. FSRU, of comparable capacity, may cost $140,000 per day and FSU $60,000 per day. Pakistan is in need of gas storage due to imported LNG and ‘take or pay’ contracts. FSU can be a low upfront cost solution.

All gas-consuming countries of the size of Pakistan gas market have gas storage of one kind or the other. Conventional gas storages are expensive and consume a lot of time. Immediate storage requirements can be met through FSU by converting the LNG carriers into FSU with small alterations. One LNG ship carries LNG worth $25-30 million. The prospect and risk of losing part of it may be equal to the charter fee of a FSU of one year.

Figure 3.12.3: FSRU - Schematic

Finally, seasonal demand and pricing issues need to be considered in gas supply planning. LNG prices are seasonal – low in summer at around $5-6 per MMBtu and high in winter exceeding $10 (as a comparison, furnace oil prices are at $12 per MMBtu and are not that sensitive to seasonal factors).Lower consumption of LNG is advised in winter to save costs. The only possibility of lesser consumption is in the power sector. There are coal-power plants which may be utilized in full and RLNG plants may be utilized lesser in winter. The merit order itself might push these plants quite later at $10-12 per MMBtu. The must-run status of RLNG plants may have to be reconsidered. We are already observing lesser utilization of one of the RLNG plants at 20%.The available gas may be diverted to the domestic sector where demand increases due to heating requirements in winter.

3.13: Virtual Pipelines for Gas Transportation

Oil whether crude or finished products has been transported with ease in normal bowsers and trucks. This has not been the case with natural gas as it is too light. Gas pipelines have been used for transporting gas. Often there are far-off areas with lesser demand to which expansion of gas network may not be economical. Also, there are small gas resources in far-off areas including biogas which are not transportable through the gas network.

There are non-pipeline methods of gas transportation, now being widely used in many countries. There is a potential to introduce the same in Pakistan, which is the subject of discussion in this space. Liquefied natural gas (LNG) and compressed natural gas (CNG) have high energy densities, which are 600 and 200 times respectively of the ordinary natural gas at normal temperature and pressure, and thus are good candidates for road and rail transportation through trucks and wagons.

LNG is a chilled gas (at minus 160 degree Celsius) and requires heavily insulated tanks/tubes that are mounted on trailers. Fortunately, highly efficient and effective material and methods are now available, which make this possible without causing energy loss or creating insurmountable safety issues. LNG can be transferred directly in liquid form without regasification to LNG bowsers and transported to points of consumption. Regasification facilities, however, have to be installed at the user end. This requires space and capital, which is not normally excessive.

CNG stations in many countries have installed such facilities and have become independent of the gas utility or CNG stations have been set up in far-off places where the gas network is not available. There are heavy-duty trailers, which run directly on LNG, for which LNG-CNG stations have built underground insulated LNG tanks and have installed LNG dispensers for the LNG-fueled trailers. There are proposals in Pakistan by private parties to introduce this system for CNG and industrial users. Expensive LPG currently being used in LPG-air mix plants can also be substituted by LNG.

Figure 3.13.1: CNG Truck carrying long CNG Cylinders

Conversely, some gas resources and fields are too small and thus remained stranded. In oil fields, there is associated gas which is flared into the atmosphere, causing environmental damage and resource loss. Such gas resources are liquefied through mobile skid-mounted or even stationary liquefaction plants and the chilled gas is transported to end-users directly or supplied to the gas utility.CNG transportation through trucks has been in vogue for a longer period than LNG transportation. CNG cylinders of the same size as are installed in CNG stations or even large ones are interconnected and a booster is installed as well. There are even longer tubes of truck length that are utilized.

The limitation is on diameter and not on length. CNG is filled in cylinders at some suitable station (called mother stations) and transported to CNG stations (called daughter stations), which do not have gas supply. Such CNG trucks themselves are used as mobile CNG stations in which dispensers are also installed.CNG can also be transported to areas where gas supply is not available. Local grids are connected directly to these CNG trailers and gas is released as per requirement.

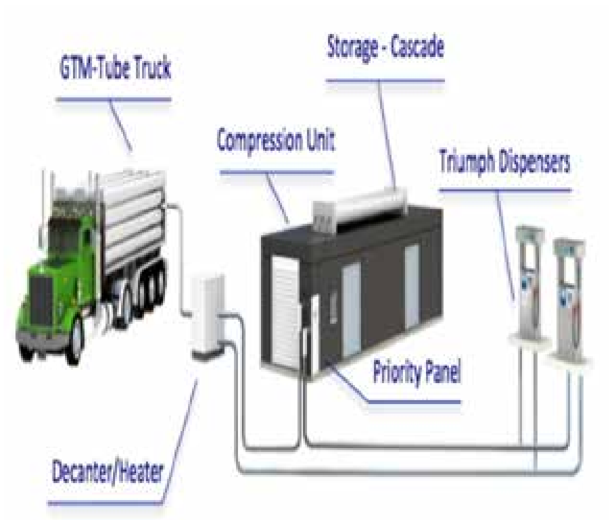
CNG has been under controversy as CNG station owners have been perceived to be big stealers of gas. It may or may not be true. Gas stealing by CNG stations and other large commercial consumers can be controlled through mother-daughter concept, although there are other ways to control the same. In Pakistan, such mother-daughter system has not been installed yet. This system can bring in a wholesale CNG supply business. Commercial land cost in busy areas is high. Daughter stations not requiring compression facilities need much less space. Mother stations can be set up in cheaper land areas and possibly connected with high pressure pipelines, thus providing a cheaper solution. However, transportation cost is an addition, which will determine the suitability of this system. In India, this system is very popular. Public transport or large fleet operators can benefit from this system. High pressure stations called SMS in our terminology have high pressure gas at 1,000-1,500 psi. CNG is at 3,000 psi. A compressor with a doubling or tripling ratio can be installed at such stations and CNG can be filled with very economical electricity consumption and thus lower cost.

Charts 3.13.1: Virtual Pipeline Concept

Normal CNG compression requires 20 times compression and this only 2 or 3 times compression. It should result in proportionally lesser electricity consumption. Large urban areas in the country like Karachi, Lahore, Rawalpindi, Multan, Peshawar, etc can benefit from such a system; needless to say that a high political dividend can be reaped through the installation of such systems. Pakistan is an agricultural country producing abundant bio-waste. Also, it is the fifth largest milk producer with proportional ranking in the population of milk animals, which produce dung – an ideal ready material for bio-gas.

In Pakistan, programmes for small family-size biogas plants have been promoted, which should continue. However, much waste material still goes unutilized or under-utilized. Commercial-scale biogas can be produced in far-off agricultural areas. Local grids can be installed where feasible. Local bio-CNG stations can be installed. Also bio-CNG stations can be set up in mother-daughter mode, should the production scale justifies it.

Charts 3.13.2: CNG- Virtual Pipeline System



Commercial biogas production is common in many countries of Europe and is even pumped into the standard gas grid after necessary processing. There is a target in Europe to supply 20% of gas requirements through biogas. In India, bio-CNG has become popular and is cheaper than normal CNG.

Biogas and bio-CNG have become generally competitive in the wake of high LNG prices. Landhi Cattle Colony in Karachi appears to be an ideal location for installing mother CNG supply stations.

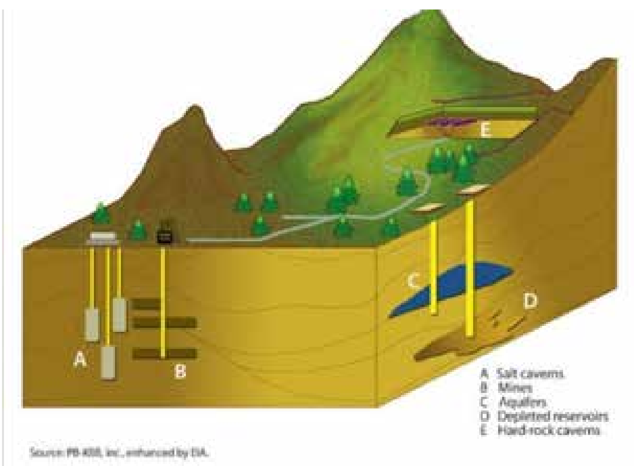
Oil fields produce associated gas which sometimes is not in industrial quantities and is normally flared. There may be opportunities to utilize this waste. There is a flared gas utilization policy issued lately in 2016. In certain situations, where no commercial use or user is found, the flared gas can be diverted and put at the disposal of the government free of cost.

Flared gas can be used in direct burning, possibly without much processing, if it is not required to be pumped into the gas grid. Industrial boilers and possibly home cookers can use this gas. Above virtual pipeline methods can be used in this case. CNG can be made more competitive through methods discussed above. With the new gas tariff and rupee depreciation, economics has become topsy-turvy. One has to wait until things stabilize to make final judgment in this respect.

3.14: Building Oil & Gas Storages

It is time to discuss the allied infrastructural issues pertaining to the oil and gas sector, of which storage appears to have been neglected. Some would argue that in a situation where the country does not have money to pay for current consumption, how will storage and inventories be financed? That would be a legitimate question and we would take it up and other allied issues in the following space.

Figure 3.14.1: Gas Storage Systems



Storage and inventories are required for all materials that are consumed. They are required in case of sudden or expected increase in demand or interruption in supply. We have recently witnessed a recent gas emergency and are passing through a gas shortage period, in which storage could have played an important mitigation role. There is no gas storage in Pakistan. It is difficult to build gas storage, but it is not impossible. Most gas-consuming developed countries have built gas storages. Even developing countries like Turkey, Iran, and Brazil have built them and India is building them now, although LNG terminals are providing some cover there in this respect. Among gas consumers, Pakistan has a ranking of 23 – ahead of France, Australia and Spain, all of the latter having gas storage. Thus, we should explore the possibilities of gas storages and inventories.

On the oil front, the situation is not that bad but there is still a lot to be desired. Reportedly, oil marketing companies (OMCs) have maintained storage of up to 11-13 days of consumption as against a standard of 21 days. A requirement of 45 days has been indicated by security institutions. India has launched a government-owned storage company to build strategic reserves which may enable it to have aggregate storage of some 100 days, closer to the 120-day IEA recommendation for its member countries.

Pakistan has a consumption of 25 mtpa (million tonnes per annum) of finished products and 12 mtpa of crude oil, which partly meets the aforementioned requirement of the finished product. Thus, the storage and inventory requirement is tilted in favor of finished products, while elsewhere in countries that are self-sufficient in local refining capacity, the storage requirement is more for crude oil for which strategic reserves are built and advised. It is relatively easy to build underground storage for crude oil.

Finished product storage is usually built in conventional steel storage tanks, in diversified places, at sources of supply, alongside transport network and pipelines to the consumption points in geographically dispersed areas to enhance and provide for country-wide fuel availability. Used or rented oil tankers are also being used to store oil and oil products, mostly for market operations. In Pakistan, it is called black marketing, but elsewhere, it is a legitimate capitalist activity, of course operating without cartels and anti-market conspiracy.

There are two aspects of costs required in storage – construction cost and filling cost, the working capital. Fortunately, we live in a region close to the major oil producing and oil shipping lanes. Producers always have some surplus oil left out of business operations, in addition to planned inventories they would like to keep. The Gulf States have special problems of diversifying the placement of cash or in-kind inventories. Such actual or planned inventories can be utilized, mutually, both for the producer/owner and the consumer.

A similar arrangement has been made by India with ADNOC of Abu Dhabi, wherein ADNOC's oil would be kept in storages in India under the ownership of ADNOC, which means India does not have to pay for it. India only pays, when it procures from this storage on an emergency basis or otherwise. The latter has first right of use. This is good for both. Such storages can be built around Gawadar, along the other areas on the Baluchistan coast or around Karachi. It can serve the storage needs of China as well, as an oil pipeline is being built from Gawadar to China to meet the needs of its western regions. Iran may be encouraged to build oil storage within its own boundaries, closer to Gawadar, to participate in the regional storage initiative, if and when its problems with the US are resolved. Even otherwise, an exemption from sanctions may be possible, as it is an emergency-preparedness measure. The Gulf States would have a diversified place away from Hormuz.

Do we need Oil Storage?

Oil storages are of two types; strategic reserve storage and Commercial Storage. Strategic storage are meant for meeting emergency and are designed for a predetermined period of demand. Commercial storage is usually for short term needs and pricing advantages. Commercial storage is usually in steal cylinders, while strategic storage is under-ground in hard rock or salt caverns. Salt Caverns are ten times cheaper than steel tanks. However, Salt Caverns or hard rock storage may not store refined products for a variety of reasons.

It also depends on the site of storage. If the site is close to the sea, the storage may be utilized and designed for international market. If the site is away from coast, the storage has to be designed for the internal use of the host country. For a variety of reasons, middle-eastern oil producing countries are interested in having storages abroad and near the market. It gives security as well as market access.

Pakistan local refining capacity is limited which defines the crude demand.25 Million Ton Oil products are consumed out of which 14 million tons are produced by Oil refineries which means crude demand is of 14 million tons and 10 million tons petroleum products are imported. For strategic crude storage, say, for three months, a crude storage capacity of 42 million tons would be required. For 25 million tons of annual consumption, one-month storage may require steel tank storage of about 2 million tons and 1 million tons for 15 days storage.

Reportedly, the commercial storage volume in Pakistan is limited of 8 days. Pakistan could not take much advantage of Oil market crash in the context of Corona. Storage capacity may have to be doubled. OMCs are required to keep a minimum storage volume. OMCs normally do not own the storage but hire the commercially available storage. A policy framework may be required for Oil Storage. It may not require any protection. If commercial importers are allowed to import and store petroleum products and keep in their own storage, they may be able to sell in the local market at landed cost, through competitive tenders or pricing formula mechanism. Companies may shift and locate their storage depending on market expectations. Will OMCs accept commercial importers and storage? It is a question that may have to be pursued.

Gas Storage Issues

Pakistan is among top 20 countries of the world in terms of natural gas consumption ahead of Australia, France and Spain among advanced countries and Indonesia, Malaysia and Singapore in Asia. Gas market in Pakistan is growing with the introduction of liquefied natural gas (LNG) and is expected to double in the next five to seven years at 8 billion cubic feet per day (bcfd).In a market this size, consisting of both local production as well as imports, the issue of gas storage becomes important. LNG imports under the 'take or pay' contract have further enhanced the need for building gas storages in Pakistan. While local production can vary according to demand, imported LNG has to be consumed as per contractual conditions from exporting companies and countries.

However, under the current market liquidity, it may be possible to negotiate more lenient and flexible gas scheduling conditions. Khyber-Pakhtunkhwa government has recently complained that the province had to suffer what it terms heavy losses due to reduction in the production of oil and gas necessitated due to the advent of LNG. The gas problem can be handled by building storages while oil problem can be handled by installing conversion facilities in the country's large refineries. It may be appropriate here to point out that a greater role be assigned to spot purchases in order not to have constraints created by the 'take or pay' contracts usually found in long-term LNG contracts.

If new long-term contracts are negotiated, it should have flexible delivery conditions; otherwise, spot arrangements are to be preferred in case LNG suppliers are not ready to enter into such contracts. Gas can be stored in three types of reservoirs underground and another as LNG in steel tanks, underground or above ground. The three are depleted gas fields, water aquifers and salt caverns. All have different characteristics and have been employed by major gas producer and consumer countries. Depleted gas field types are most popular almost everywhere where all infrastructures like gas facilities and pipelines are usually available and only renovation and incremental facilities have to be installed. Salt caverns, if available, are employed near markets.

There are 400 gas storages in the US in 31 states with storage of 8.4 trillion cubic feet (tcf). Bulk of these storages has been built in depleted gas fields. Total gas storage in Europe is 2.730 tcf, 59% of which is accounted for by three countries (France, Germany and Italy). In France, most of the storage is of aquifers' type at a depth of 400-1,400 meters. Most storage is in the range of 7-20 billion cubic feet (bcf) and only one is of a large size of 132 bcf. In Italy, all storage is in depleted gas fields with a total capacity of 528 bcf covering 21% of annual demand. In Spain also, depleted gas fields are most popular, although other types are also there. Total storage capacity is 256 bcf covering 14-20% of annual demand.

In central Europe, in Poland, Bulgaria, Romania, etc, there are depleted gas field storages with total capacity of 79 bcf. In Pakistan, all possible types can be built theoretically speaking as all the three resource types are there. There are depleted salt mines in Khewra which is close to markets also. There are many depleted gas fields as well. At a conservative rate of 10% of annual demand, a storage capacity of 150 bcf would be required. If one storage is of 10 bcf, 10-15 storages would be required initially at various depleted gas sites. An investment of $50-75 million would be required per site on the average.

A few FSUs (floating storage units) could also be considered. Old LNG shops or FSRUs could be utilized for these purposes. These could be permanently moored alongside a jetty or an equivalent arrangement. An FSU may cost half of the FSRU. However, compared to the aforementioned options like gas fields type, it would be many more times expensive. Unless there is technical necessity, such storage may not be advisable. Ultimate economies of storage depend on the type of usage and storage in terms of cycling. A day-to-night or weekly or biweekly cycling injection and evacuation can have a different revenue cycle than a seasonal storage. This would create a scope for IPP-type investment. A policy may be prepared for gas storage and floated for the consideration and input from stakeholders. A feasibility study had been done earlier in 2004-2007 on the subject which may have to be revised keeping in view the new circumstances created by LNG.First few storage projects may be undertaken by major gas producers in the public sector such as OGDC and PPL.

Table 3.14.1: Natural Gas Storage Data-USA 2009

	Depleted Reservoir	Salt Cavern	Aquifer
Numbers in USA	331	35	43
Working Gas Capacity-TCF	3.7	272	396
Max. Daily Delivery-bcf	70	20	9
Development Cost new	8.6 Mn.USD/bcf	10.9	17.2
Development Cost expansion	6.3 MN.USD/bcf	8.7	14.2

Source: Oil Price.com

3.15: Reducing Gas Sector (UFG) Losses

Gas distribution sector UFG losses currently account for around Rs.45 billion per year. For SSGC, these are 13.98 % and for SNGPL at 10.87 %.Some sources put SSGC losses higher at 16%.SSGC losses become more pronounced in view of its smaller network both in terms of length, area, number of consumers and sales. The situation is of continuous deterioration. SSGC used to have a better performance in this respect in earlier days. In 2007-8, SSGC losses were at 6.63% and SNGPL losses were higher at 8.04 %.Since then, SSGC losses have doubled. However, SNGPL losses have increased by 35%.Thus deterioration in SSGC is much higher than in SNGPL. In fact SNGPL losses have slightly decreased last year, unless it is a result of error or manipulation of numbers.

UFG reduction is a long term issue. OGRA has prescribed an incentivized formula based on a programme of corrective steps to be taken by the gas distribution companies. Some of the losses are due to law and order situation. In Balochistan and KPK, there are areas where gas is stolen openly and forcibly and bills are not paid. There is nothing, Gas companies say, they can do about it. There are settled and urban areas where Gas companies should focus. Not much progress has, however, been done in this respect.

Figure 3.15.1: SMART BALL for Leak Detection and Illegal Tapping

In SSGC, there is a UFG of 73.25 BCft which forms to be 16.50% of total gas. This percentage is variable across regions; Karachi-12.32%; North Sindh-13.79%; Balochistan-44.91%.Balochistan losses are of 23.848 Bcft which constitute 32.55% of the annual company losses. In its annual program, the company plans to reduce its UFG to 12.20% from its current (last years) level of 16.5%. OGRA does not allow all of the UFG losses to be part of the tariff but make a sizeable reduction as indicated earlier. OGRA has devised an incentivized framework for UFG reduction. Following are the components of the programme;

- Network Segmentation
- Network Rehabilitation
- Leakage Surveys
- Theft Reduction

Figure 3.15.2: Dogs sniffing Gas

Input-output Accounting is a Must

Input-Output Accounting is a must for UFG/ loss control. It is not enough to know losses at company or zonal level. One has to zero it down to a Moholla level consisting of 1000-5000 customers. In the case of electricity, DT (Distribution Transformer) is the right level of accounting. In the case of gas, there is a substation. The utility, gas or electricity, should know exactly as to how much electricity/gas was sent through a station/DT and how much is the billing and how much payment has been received. The difference would enable to work out how much loss is there in physical and monitoring term.KE has done a wonderful job in this respect. They have managed to complete a system as has been described in the foregoing.KE has been able to collect very useful data to be able to identify defaulting areas based on which they would be devising a differentiated strategy as to how to deal with defaulters/stealers. It would enable them to prioritize installation of smart meters and thus optimize upfront investments.

Unfortunately, gas companies have not been able to do something similar. They are not sufficiently organized proportional to the challenge they are facing. Their regional organization is week. Substation coverage varies from 2000 consumers to 150,000 consumers. Meter reading is not organized to accurately estimate input and output .Piping is mixed up. Although, they had all the equipment and infrastructure available much better than electricity DISCOs, they have made a very poor use of it. They already have smart meters installed at substations and at large consumers' premises, which KE has now managed to acquire, while EX-WAPDA DISCOs do not have it still. It is simply mismanaged.

Use of New and Unconventional Technologies

A wide spectrum of technologies is available from dogs to drones for detecting gas leakages. Dogs are very good at sniffing gas leakages and are routinely employed by gas companies in Europe and the U.S. Dogs smelling sensitivity is of the order of billionth vs equipment of millionth. Pakistan has kennel training facilities which can be utilized for training dogs for this purpose. Similarly, large scale smart-pig technologies which used to be expensive have been transformed into Smart-Ball devices which help locate leakages and even unauthorized diversions swiftly and at fraction of an expense. Infrared cameras are routinely employed to monitor above-ground installations. SCADA, GIS, Cathodic Protection and implementation of ASME pipeline standards have to be utilized.

Thus, there is no dearth of low cost technologies which can help detect losses, both theft and leakages. Our gas companies have required some instruments but are not utilizing it objectively and at a scale that may give reliable results in required time. Ministry and the BoDs should see to it that the gas companies organize themselves as discussed in the foregoing and give results, reducing losses to 5% in less than 3 years.

It is said that the situation has become worse with CNG pumps. However, theft has been caught in industrial and residential sector as well. Even residential colonies and projects have been found to be having illegal tapping. This cannot be possible without collusion, mostly at lower level but also at higher levels. Adequate punishment has not been visible as compared to the volume of the problem. It is a difficult job monitoring a network of 140,000 kms. There are issues of corruption, collusion and political meddling at local levels. Under these circumstances, this is even more important that a vigilant system under new technologies is maintained.

Financing UFG Reduction Projects

Leakage removal capex can be financed under a concessional financing programme. Methane emissions are 35 times more injurious to climate warming than traditional CO2.There is concessional credit lines available to finance such remediation activities. Several developing countries have benefitted from it. However, problem is that GoP eats up the cream in concessional rates by charging an overhead fee on such loans. Gas companies, therefore, lose incentives to avail such schemes. It is proposed that GoP does away with this practice which would have an impact on the financial cost of these companies and would reflect in reduced tariff. Involvement of multilateral funding would also facilitate induction of innovative technologies and expertise for fixing the leakage issues. Current practices in the gas companies are ineffective and deficient.

Current government had ambitious plans for making these companies improve their performance. They wanted them to reduce UFG by 50% in two years. Replacement of old network will, however, consume time and money, say 5 years, which would enable reduction of leakages. The issue is that the companies could not yet determine the share of theft and technical losses (leakages and metering error), although the customers complain that it is the other way round; SNGPL is accused of overbilling and over-metering. As discussed above, the companies have to introduce new technologies to quantify nature of losses and prioritize. Currently, they are groping in the dark or are moving slowly, if at all, towards sorting out their problems. External monitoring and evaluation of the companies by credible foreign gas utility specialists may be ordered by GoP. Also technical and financial assistance of donor agencies should be sought for introducing new technologies. Such assistance is readily available under various bilateral and multilateral programmes**.** Something new has to be done.

Recommendations

1. Isolating the loops
2. Segmentation-circuits of a maximum of 5000 meters
3. Input-output Accounting/reconciliation at TBS level-Meter reading synchronization
4. Use of Smart Balls and Sniffing Dogs in leakage and theft detection
5. Fast track use of other detection technologies
6. Operationalisation of GIS
7. Implementation of ASME Standards
8. Induction of Flow Simulation software
9. External technical and financial assistance

Table 3.15.1: Comparative UFG Losses: SNGPL vs SSGC

	SNGPL-%	SSGC-%
2007-08	8.04	6.63
2008-09	8.61	7.93
2009-10	9.63	7.95
2010-11	11.21	9.43
2011-12	10.35	10.39
2012-13	11.17	8.43
2013-14	10.57	13.82
2014-15	10.97	13.62
2015-16	9.21	13.73
2016-17	8.07	13.29
2017-18	10.93	13.23
2018-19	10.87	13.98

Source: OGRA,SSGC,SNGPL

Table 3.15.2: International UFG Data

Country	Network length	Consumption	UFG
	Kms	BM3	%
USA	2225032	759.4	1.41-5%
Canada	100000	104.4	2.65
Germany	34327	77.5	2.16
United Kingdom	39778	70.2	1
Russia	259913	409.2	5
Australia	580000	38.8	0.5-4.03
Turkey	15641	48.5	4.2
Bangladesh	20804	22.9	5
Pakistan	141190	41.2	10.87-13.98

Source: KPMG Report –Pakistan

3.16: Affordable Fuels for the Rural Poor

Only 20% of Pakistan's population has access to clean piped natural gas (PNG) while the rest use biomass in the form of Uplah and shrubs or even trees, which causes deforestation. Most of the biomass, in the manner it is used, causes health issues as smoke and carbon dioxide create lung and eye syndromes and uplas involve bad hygiene. A smaller percentage uses expensive liquefied petroleum gas (LPG) or kerosene. If rural migration is to be discouraged, lives in these areas have to be improved.

The PNG network cannot be extended to these areas. LPG, biogas and kerosene are the alternative clean fuel options. Already, small and poor consumers in urban centers are being offered PNG at highly subsidized rates. However, the poor in rural areas are without any subsidy in this respect. According to the Oil and Gas Regulatory Authority (Ogra) report (2016-17), annual LPG consumption stood at 1.2 million tons, with share of domestic, industrial and commercial sectors at 37%, 36% and 27% respectively. The LPG's share in gas market stands at less than 8% and 58% of LPG demand is met through local production and the rest is imported.

LPG is almost as expensive as petrol. LPG in February 2019 was sold for Rs121 per kg at Ogra-controlled rates and Rs150 per kg in the black actual market. In terms of British thermal units, which enable us to compare prices across fuels, this boils down to Rs2, 669 per million British thermal units (MMBtu) at controlled rates and Rs3, 309 in the actual market. Compare it with the PNG tariff of Rs142, LPG prices are 19 times higher and comparing with the highest PNG tariff, which is being contested, LPG prices are 83% higher. Only 20% of people have access to the PNG network while the rest are consuming biomass and the wealthier ones use LPG. Clearly, some reforms are required in LPG prices.

LPG is subsidized in India for the poor and the subsidy is transferred directly to the accounts of LPG consumers to avoid misuse. On February 8, the subsidized LPG price was IR493.53 per cylinder of 14.2 kg. There is a subsidy of around IR200 per cylinder. In Pakistan, the Ogra controlled/suggested price is Rs1, 427 per cylinder of 14.2 kg, which is 30% higher than the corresponding price in India. However, India is trying to substitute LPG with PNG. Possible motivation could be convenience, safety and price. In Pakistan, the retail LPG price of Rs2,669 ($19.34) includes 23.3% of GST and other taxes per MMBtu as opposed to the highest gas tariff of Rs1,460 against which there is a lot of hue and cry.

LPG prices are almost equal to gasoline prices and twice those of compressed natural gas (CNG). Thus, it appears that, there is practically no advantage in using LPG as a substitute of gasoline. However, CNG prices are almost 50% of LPG and gasoline prices, a clear substitution case. Kerosene at Rs82 per liter is 77% of high-speed diesel (HSD) price and 91% of gasoline price. The incentive for adulteration is there by mixing cheaper kerosene with expensive HSD and is reportedly being done.

In India, kerosene is sold for PKR56 per liter as opposed to Rs82 per liter in Pakistan. In some states like Chennai, it is sold at 50% of the price elsewhere. India is moving towards PNG and LPG and kerosene demand is going down there. There has been and continues to be a major adulteration problem in India of mixing cheaper kerosene with expensive gasoline and HSD. Kerosene subsidies are going down in India. Kerosene and LPG rates are almost equal there in terms of MMBtu.

There is a general case of subsidies on LPG, if LPG prices are compared with PNG prices. At a minimum, exemption from all taxes may be considered – after all largesse and support should not be restricted to the areas on PNG network. LPG-air mix plants have been set up keeping this in view. However, these plants benefit the rich who live in the developed network areas. Poor invariably lives in remote and least developed areas.

As a reference, the gas tariff of LPG-air mix plants of Rs600 per MMBtu may be kept in mind. However, it may be too much of a subsidy, if extended to the LPG cylinder. LPG-air mix and LPG cylinder should have some comparability, if not equality. In northern areas, there is a humanitarian case as well as environmental one to provide cheaper alternative fuel. Poverty is widespread there and trees are cut for household fuel needs. LPG is sold in the black market at much higher prices than in lower areas.

There is a strong case for providing subsidies both for kerosene and LPG in these areas. The minimum subsidy is the waiver of petroleum levy and GST. This subsidy can be a general one and additional subsidies out of the budget should be provided to the poor. Although reference to India is not liked, one is prone to suggest Indian subsidized LPG pricing. On the same argument, there is a case for subsidy on kerosene. So long as poverty and inequality persists, there will be a strong argument for subsidies to the poor, be it in fuel or elsewhere.

Subsidies are always misused and opposed by the International Monetary Fund (IMF). Cheaper LPG meant for northern areas may be sold in lower areas or for commercial vehicles. No perfect safeguard is available against malpractices. However, solutions can be explored and implemented. Involvement of public-sector companies in distribution, special cylinders, etc can be adopted as a safeguard. Eighty per cent of the population is using LPG, kerosene or biomass. Biogas can be cheaper and competitive in agricultural rural areas, requiring attention of the policymakers. LPG-air mix plants have been installed and the present government has not cancelled those schemes.

Biogas may substitute LPG in agricultural areas. Biogas-based small distribution networks are feasible. Provincial governments and local bodies may be encouraged and facilitated in establishing these plants.

Biogas is not a new concept. It has not acquired a market share as it could have. Most of the biogas schemes have been for small family-sized production for individuals. There has not been much of a movement for community-based production and distribution.

Public-sector companies like SSGC and SNGPL are in best position to play a facilitating role. A policy is required to encourage and finalize such systems. Technical assistance, demonstration projects, cheaper credit and loans can go a long way in increasing the role of biogas and improving living conditions in rural areas. Punjab and Sindh are adequately positioned in this respect. Community solar and biogas is the name of the new order.

Table 3.16.1: Gas Prices India-2019

	CNG USD/MMBtu	**Domestic USD/MMBtu**	**Commercial**	**Industrial**
IOC				
Agra		12.10	18.23	18.23
Lucknow		11.90	17.86	17.86
IGL				
Delhi	12.56	11.94		
Noida	14.26	11.94		
Ewari	16.25	11.96		
Karnal	15.40	0.00		
Muzaffarnagar	16.86	0.00		
Gujarat Gas				
Gujarat	13.19	9.52		
Palgar	13.82	10.11		
USD to Irs	72			
CV-USD/MMBtu	50			
Prices include VAT				

Source: GAIL India

3.17: LPG Subsidies for the Poor?

The liquefied petroleum gas (LPG) policy could not be streamlined over the past few decades. There has been stranglehold of the powerful people who earned undeserved income due to a constrained supply situation. There have been intractable LPG pricing issues which led to closure of a LPG import terminal soon after its commissioning. LPG quotas have been used frequently to bribe or please powerful interests and individuals. Alternatively, LPG quotas have been sold by competent authorities to market intermediaries. Both sincere and half-hearted attempts have been made to solve the problems, but no meaningful effect has emerged.

The End of Quota System?

PML (N) Government in 2017 theoretically eliminated the quota system and authorized LPG producers like refineries and oil and gas exploration and production companies such as Pakistan Petroleum Limited (PPL) and Oil and Gas Development Company (OGDC) to sell LPG independently to those who gave the higher price. There is a limit, however, to which LPG prices could be increased as all producers are in the public sector. LPG is used by the poor and people living in northern areas for domestic heating purposes. Resultantly, the policy is a mixed and confused one.

The net situation is that only 20% of LPG (cylinder filling) companies out of a total of 104 manage to receive supplies from the producers and the remaining 80% are probably buying from the 20%, which adds to the selling price. The capitalist solution is to auction the LPG and sell to the highest bidder, which is likely to push prices up. As demand is normally higher, especially in winters, LPG prices skyrocket in this season, particularly in the northern areas. The Ministry of Petroleum and Natural Resources allows imports to deal with the situation and keep the prices under control. Also, the under-supplied 80% of companies get a chance to come into action during winters by getting imported supplies.

The association of LPG distributors has been protesting as reportedly some curbs have been put on LPG imports. As natural gas supplies have improved due to liquefied natural gas (LNG) imports, the LPG demand is expected to be lesser in the coming month. Import curbs are going to affect the business of 80% of companies which do not benefit from direct LPG supplies. The rent income of 20% of LPG companies may also go down due to lesser demand. It is being alleged that LPG curbs are meant to profit this group of 20% companies.

This problematic situation has provided corruption opportunities for the dishonest management and executives of public sector LPG producing companies. For the honest ones, it has created major difficulties and problems of dealing with the powerful that create all kinds of pressure from politically, administratively and socially powerful persons at all levels of the hierarchy. One of the CEOs told me that LPG is only 1% of his company's business, but consumes 90% of his time in attending to the LPG issues and entertaining the powerful people. Resultantly, they mulled over the idea of retailing LPG themselves.

The Two Options: Regulation vs Chaos?

There were two solutions – one is to regulate (control) the LPG retail price, but allow and organize LPG auction in the existing commodity exchanges. This would prevent the highest bidder from quoting prices that would increase the retail price. In fact, the highest bidders would be bidding within the constraints of the LPG controlled price. The Petroleum Division could examine these submissions for a lasting solution. Also, the import curbs on LPG should not be allowed under the excuse of foreign exchange constraints.

The other solution is to completely regulate the LPG sector by controlling prices at all levels down to the retail stage. That may solve the price problem to a reasonable extent, but would not eliminate the LPG quota. The LPG association says all 104 LPG bottlers should be supplied with the gas instead of restricting supplies to 20% of them.

The latter one has been finally accepted by the present (PTI) government; 1)both producer and consumer prices are announced by OGRA;2)LPG is to be supplied equally to all LPG marketing companies, accepting an old demand of LPG association while solving one of the most intractable problem of the energy sector. Thus, there would be no need of LPG quotas and corruption thereof and nor would be artificial measures like production bonuses to LPG producers which unnecessarily jacked the LPG price. The artificiality of the so-called competitive would be done away with. Either, there should have been complete and effective regulation as has been adopted recently or there should be a commodity market that determines the price.

The Social Benefit of Clean Fuel

Piped gas is available to only 20% of the people of Pakistan living largely in urban areas where gas network is available. Rural areas do not get any benefit of gas subsidies that are otherwise available to the piped gas consumers. Lifeline consumers get gas at very low rates which hardly cover distribution costs. In India, LPG is available to eligible poor consumers at highly subsidized rates.

Some very interesting research has been done in neighboring India on the subject of LPG. Following are its two very important and interesting conclusions; 1) Cooking fuel prices/expense should not be more than 4% of the monthly income of a poor household; 2)the social value of LPG cylinder has been estimated to be varying between IRs.3800 and IRs.18000 which is equivalent to the health consequences of otherwise using biomass and other unclean fuels. Theoretically, this indicates the scope of offering LPG subsidies to the poor household and should be applicable, more or less, to Pakistani conditions as well. Preventing deforestation is yet another benefit of LPG which probably has not been included in the afore-mentioned estimates.

India has tried various LPG subsidy schemes. There was one LPG free cylinder scheme per month for deforestation prone area. One is not sure whether it continues to be there. Currently, there is a direct bank transfer of LPG subsidy into the eligible registered LPG consumers account; earlier cheaper LPG cylinders were available to the registered eligible consumers. In January 2020, LPG cylinder price for targeted customers was IRs 530/- as opposed to IRs 714 per cylinder of 14.2 kg. One cylinder per month is available under the subsidy scheme.

Applying the formula of 4% limit on cooking fuel expense and assuming an average income of Pk.Rs. 15000/- per month, and assuming that one LPG cylinder per month is required by the poor households per month, LPG cylinder price in Pakistan should not exceed Rs.600 per cylinder. Alternatively, this yardstick, if applicable, also provides guidance on monthly natural gas bills of lifeline consumers in Pakistan. Currently, minimum monthly gas bill charged to lifeline consumers is around Rs.500 which was proposed to be more than doubled under the suspended tariff.

Strong Case for LPG Subsidies to the Poor

Currently (March 2020 prices announced recently passing on some benefits of fall in international oil prices), a LPG cylinder of 11.8 kg will cost RS 1530/-, if available at controlled rates, which is highly improbable. This is 250% of the 4% formula. Currently, PLD and GST is levied on LPG, yielding a per ton revenue of Rs.23511. In terms of monthly revenue, this amounts to Rs.2.065 billion. The least one would expect is a waiver of PLD and possibly 50% reduction in GST. The financial impact of this concession would not be more than Rs.1.238 billion per month loss of revenue in the current estimated revenue potential of Rs.2.065 billion per month. An alternative is to pass on the benefit created by tax waiver to eligible poor LPG users only. It can be done through a Ration Card scheme, as is being proposed for food subsidies. Ration Card system functioned successfully in 1960s, when there was no IT. With IT, its feasibility should have increased many times more. IMF encourages direct subsidies to the target group as compare to untargeted subsidies.

This would mean that there would be saving of Rs. 333 in one LPG cylinder per month sold to the targeted LPG consumers under the proposed Ration Card scheme. Actual impact would be even higher as LPG is almost never available at controlled rates. Current rate in Islamabad is Rs.1700 per 11.8 kg cylinder as compared to the controlled rate of Rs. 1530. Thus net saving would be Rs 503 per cylinder (33% benefits). An estimated 3.7 million LPG consumer households (poor) would benefit. (There are only 9 million domestic consumers of piped gas despite all the investments and support and years.) This is no cash subsidy but is a result of some waiver in taxation as proposed earlier. Wouldn't it be better than the wasteful LPG-Air-Mix project wherein actual cost is several times higher than normal cost?

Table 3.17.1: Pakistan LPG Prices, Taxation and proposed subsidies

	LPG-Rs/ton		
	Mar-20	Feb-20	Apr-19
Producers Price	71165	82033	73610
Marketing Comp Margin	35000	35000	35000
Petroleum Levy	4669	4669	4669
Sub. Total	110834	121702	113279
GST 17%	18842	20689	19257
Final LPG consumer Price	129676	142391	132536
Taxation	23511	25358	23926
Taxation % of Sales Price	18.13	17.81	18.05
Monthly Consumption-MT	87834		
Monthly Revenue-Mn. Rs	2065	2227	2102
Liters/t	1850		
LG price USD/L	0.452225258		

Source: Compiled by the Author, price data OGRA

Table 3.17.2: LPG Subsidy Estimates and Price Impact

PLD waiver	4669
50% GST waiver	9421
Total Tax waiver	14090
Revenue Impact-Mn. Rs/m	1238
Average LPG consumption-kg/m	11.8
Number of LPG households	3721773
LPG consumption household MT	43917
Targeted subsidy of LPG/t	28180
Subsidized Price LPG/t	101496
Subsidized Price LPG/cylinder	1198
Current LPG Price/Cylinder	1530.17
Subsidy per Cylinder	333

Source: Compiled by the Author, price data OGRA

3.18: Cooking Fuel and Fertilizer for All

Rural life is difficult and dangerous, especially for the poor. The WHO has estimated 50,000 premature deaths occurring annually due to indoor pollution caused by uncontrolled burning of bio-mass for cooking and heating. More than 50 percent of the population, mostly of rural areas, relies on biomass. Rural poor households suffer an iniquitous price regime; they have to spend 25 percent of their income on buying fuels like kerosene, LPG, charcoal and wood. Most of the poor are off the gas grid and are forced to buy expensive fuel that costs 10 times the lowest domestic piped-gas slab. Biogas did not fulfill its promise due to the high initial cost.

For households fuel and fertilizer needs, biomass gasification based Gasifier stoves offer a much cheaper and viable solution. Bio-stoves are a major technical development. Bio-stoves utilize ordinary biomass waste like crop residue, shrubs and tree branches which are crushed or reduced in size. Biomass briquettes are also used. There is nothing new in burning shrubs and other agricultural wastes in rural stoves. However, conventional stoves waste biomass, consuming twice as much as efficient Gasifier stoves. Conventional open stoves causes immense indoor pollution and are injurious to women, who have to cook daily.

What is new in bio-stoves and how are they different? Bio-stoves utilize pyrolitic gasification which used to be the domain of larger plants at the commercial and industrial scale. There are two chambers in bio-stoves; the lower one converts biomass into biogas and the upper chamber burns it in a cleaner fashion, producing no soot. The efficiency of ordinary biomass stoves is under 20 percent, while Gasifier stoves have efficiency of more than 40 percent.

The WWF, UETL (University of Engineering and Technology, Lahore) and SNGPL have combined in a project to popularize Bio-Stoves around the Lahore area initially. They have developed a local version employing forced draft by electric fan (which may only be used in urban and semi-urban areas with electricity), and have distributed 500 Bio-Stoves free of charge to rural communities in the area .A similar product that is being marketed commercially is priced at Rs5000, which would be clearly unaffordable. The price has to be under Rs 1000. In rural areas, raw biomass is readily available. In urban areas, biomass briquettes can be used. A market will eventually emerge of biomass briquettes. At present, biomass briquettes are available at around Rs20 per kg as opposed to charcoal with a price tag of Rs75-95 per kg.

Gasifier stoves produce Biochar as waste. Biochar is a bio-fertilizer produced out of constrained burning (pyrolysis in technical language). It has been produced at the commercial and industrial level. It is being marketed in India at a price of IRS9-13 per kg. Biochar is a soil conditioner improving soil fertility. It sequesters carbon and has a life of three years. There are reports of 30-80 percent increase in crop yield due to its usage.

There are many applications of Biochar. It can be used as heat insulator in walls and roofs. It is a near replacement of activated carbon and can be used in rural water supply systems easily and economically. What is new in Biochar is that it can be produced in rural household bio-stoves as a byproduct. Internationally, the International Biochar Initiative (IBI) is developing the technology and socializing of this product. In Pakistan, it is still in an embryonic stage, known to enthusiast circles and a limited class of green and organic farmers.

There are many SMEs producing and marketing Biochar in the US. Companies like GE, ConocoPhillips and Google have put money into a Biochar joint venture, Cool Planet, which is reportedly building a plant that would produce gasoline as well as Biochar. These investors are the owners of synthetic gas technology, which uses coal to produce gasoline, diesel, fertilizers and chemicals from partial burning of coal. What is new is that instead of coal, biomass is being used as feedstock and the waste that results is Biochar. A lot of product differentiation is coming in, preparing formulations by mixing other substances. A product has been introduced by mixing Biochar with humates which should be of some commercial interest to our Thar coal mining companies wherein humics are found in the overburden.

In the US, a $56 million production facility is reportedly to produce 10 million gallons of gasoline and an unspecified amount of Biochar. The target selling price is $1.5 a gallon as opposed to a spot price of $1.67 per gallon at Nymex currently. They want to bring down CAPEX to $20 million. Also there are plans to market modularized containers for small plants. There are plans in Europe to produce Bio-DME (DiMethyl Ether) to replace 50 percent of their diesel requirements by 2030.

Our agriculture universities have a great opportunity and the potential for R&D in Biochar, developing locally compatible formulations and supporting local start-ups. Large companies may also like to consider it. They can produce both Biochar and urea from the same plant. Currently, our plants are utilizing gas. They can use biomass as feedstock in new synthetic gas facilities, and produce both urea and Biochar. It has to be studied whether Thar coal can also yield Biochar. There are limitations on the availability of biomass, although currently there is surplus. Thar coal is almost limitless. Fertilizer production can also be a soft alibi for utilizing Thar coal in a world environment which is going against coal.

Both the rich and the poor can benefit; the rich from large-scale commercial production and the poor from their open stoves and smaller Biochar production facilities. This is not hyperbole. We are burning rice stubble and causing air pollution and smog. Children are not permitted to go to school and others are suffering from many injurious health issues. Biomass waste has great potential for improving the quality of rural life for the poor, meeting fuel and fertilizer needs apart from subsidizing agriculture, solid waste disposal and sewage disposal. There are other applications of Biochar as well substituting active carbon which is a filter material that can be used in rural water supply and sewerage schemes.

For Improved Cooking Stoves (ICS), a subsidy programme would be required. A major difference can be made by a project distributing/marketing one million stoves, a subsidy per piece which will result in a total budget of Rs1.5 billion. Spread over two to three years, it is quite manageable. International grant funding may also be available. Once the market is developed, the cost would come down automatically and the subsidy requirement may be reduced significantly.

In the past, much more subsidy per unit has been given. This would be the cheapest deal to handle the issue. For a large scale, fertilizer companies are big enough and organized enough to go ahead, if they find it feasible. SMEs may require some facilitation by organizations like SMEDA.

3.19: Case for an Energy & Minerals Sectors Tribunal

Supreme Court has recently ordered the federal government to establish Electricity Tribunal forthwith. Appellate Tribunal for Electricity sector has been provided in the Electricity Law 2015.It could not be implemented partly due to active and passive opposition of NEPRA itself. Such opposition was actually ill-placed, for NEPRA itself suffered due to lack of an intermediary fast action institution like a tribunal. Under current situation, the affected parties file petitions in higher courts where cases remain pending for years and NEPRA determinations and punitive actions remain unimplemented diluting its image and authority. A classic case is KE which succeeded in evading many NEPRA edicts which the honorable Supreme Court took cognizance and had to intervene to order on Appellate Tribunal.

Apparently, the Appellate Tribunal will dilute some authority of NEPRA by providing for a review institution, which is the requirement of fairness and justice. No institution except the Supreme Court can be given absolute powers without recourse for a fair review by a third party. Regulatory review by Tribunal or equivalent institutions is almost a universal practice. It does not pertain to only electricity but also covers Oil and Gas , Competition institutions and others. Oil and Gas Commission in Canada and Electricity Tribunal in India and similar institutions in Europe are ready examples.

This scribe has the honor of initiating the proposal for Electricity Tribunal in the year 2014(when electricity crisis was at its peak) while holding the position of Member Energy at Planning Commission. Actually, a combined institution should have been proposed. To include Oil and Gas sector which also suffers from the same regulatory issues as electricity sector does. The role of tribunals may differ from country to country varying with the degree of economic controls, role of the market etc. In developing economy, pricing is a major issue while in developed counties safety, environment, Right-of-Way, etc are the major issues.

In Pakistan, tribunal system is working fairly well in the taxation sector, general taxation sector issues notwithstanding. Competition Commission of Pakistan is suffering from the same syndrome whereby the affected parties resort to higher judiciary to delay and dilute the CCP determinations and actions. A classic case is of the Sugar sector which has managed to maintain cartels, despite CCP interventions, as has been evidenced by recent enquiries; a sugar industry case is pending with Sindh High Court since 2009. Competition Tribunal may have reduced the intensity of the issue if not totally eliminate it. There is an appellate procedure within the CCP as it is in NEPRA. However, it is within the organization and does not offer much efficacy and satisfaction to the appellant which compels them to go to High Court. It is a separate but a matter of concern that the existing tribunal has been inactive as well due to the lack of the required appointments at Members level. Tribunals have to be independent of the authority issuing orders, as the case is in India of Competition Appellate Tribunal (COMPAT) and Competition Appellate Board(CAB) in Singapore.

Tribunals do offer fast and effective justice and redressal of complaints and grievance and also facilitate effective implementation of regulatory decisions. Higher judiciaries in many countries reject unnecessary litigation by affected parties and do not generally admit applications against tribunal decisions. Mineral sector also require a tribunal system .Had it been there, perhaps, Rekodek complications could have been avoided, although in that case unjustified activism by higher judiciary and a misplaced ultra-patriotism of a section of our elites created the mess that we find ourselves in. In Oil and Gas E&P licensing, there are similar issues of grievance handling which may benefit from a tribunal, in addition to other Oil and Gas sector companies issues.

However, there is an intimidating cost aspect. Countries have combined regulatory institutions. In most countries, there is one regulator for electricity and Gas sector, as these are interrelated. Same specialists cannot possibly adjudicate in these highly specialized institutions. Only legal, administrative and some other skills may be common and over-head costs can possibly be reduced.

Gas companies are suffering from slow processing, delays and at times controversial and arbitrary decisions. There is a great need of a tribunal in Oil, Gas and Mineral sector. While there is a case for strengthening OGRA, an independent appellate tribunal is required to check the exercise of arbitrary powers. If NEPRA is being constrained and controlled through a tribunal, same measures are required in case of OGRA. Consideration should be given to add these Energy sub sectors to the already legislated Electricity Tribunal by renaming it as Energy Tribunal or Energy & Minerals Tribunal. Alternatively, a new tribunal for the residual uncovered energy sub-sector may have to be established. Tribunals cost money but high court proceedings cost money as well as time affecting and overloading the normal justice system.

Table 3.19.1: Summary of Cases Filed by Consumer (Delaratory Suits Etc During 2014-2020

Nature of Suit	Filed	Decided in favour of SNGPL	Pending
Suit filed by Consumer (including Gas Utility Court, High Court / Supreme Court)	16007	14599	4396

Table 3.19.2: Summary of Cases Filed by SNGPL (Recovery Suits) During 2014- 2020

Nature of Suit	Filed	Decided in favour of SNGPL	Pending
Suit filed by SNGPL including (Recovery suits, Execution Petitions)	30239	12849	17469

Source: SNG PL

4: Coal

4.1: Towards Thar Coal Competitiveness?

Thar coal costs around twice that of international and regional prices, including in India's Thar Desert area, for lignite under more or less identical conditions. Similarly, Thar coal-based electricity is more than 50% pricey than lignite-based electricity elsewhere. People had thought that Thar coal would address their difficulties and make cheaper electricity available, but they were disappointed as were in the case of hydroelectric power. Most still believe that hydroelectric power is the cheapest energy source, when actually it is the most expensive, forgetting the case of Neelum-Jhelum power plant. There are some avoidable measures which can reduce the cost of generation in Pakistan. Although we will be discussing a particular case, the lessons from it will mostly be applicable to other cases generally. Let us discuss the new Thar coal tariff application.

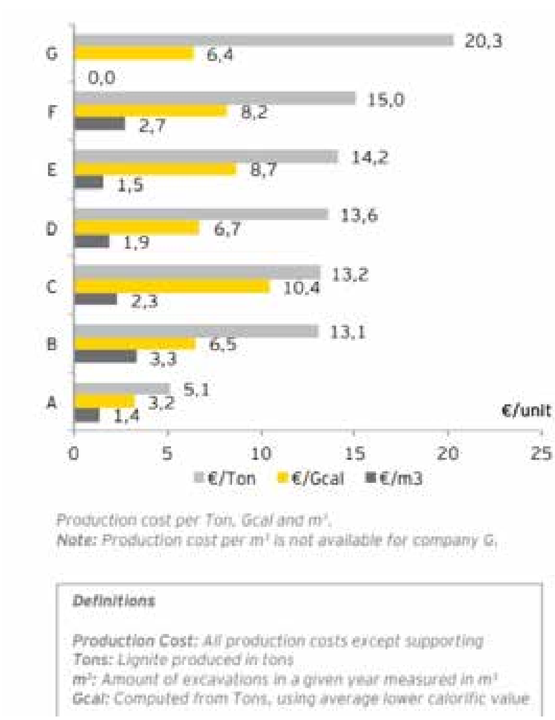
Financial cost plays an important role in project and product costs. About $1 billion of investment in coalmine is involved and an equal amount for the power plant, making it $2 billion. Interest rate of Libor plus 4% has been allowed by the National Electric Power Regulatory Authority (Nepra) under project recourse guarantees and not sovereign guarantees. Under the China-Pakistan Economic Corridor (CPEC), sovereign loans for the transport sector have been given at 2%.There is no reason Thar coalmine loan of $700 million should not be at the same rate. Libor at the time of loaning was 0.5% which has now gone beyond 2% and may cross 3% in the near future. This will greatly upset the tariff which will become unaffordable and unsustainable.

The least that could have been done was to negotiate a longer repayment period of 20 to 25 years which is not uncommon in such projects. The longer period would have led to a smooth unit product cost along with a reduction in foreign exchange outflow. It is suggested that possibilities of renegotiation and refinance in this respect under the CPEC framework be pursued. There are other issues in CPEC terms and practices that the federal government has been urged to take up with the Chinese government.

Return on equity

Even initially, an internal rate of return (IRR) of 20% was unwarranted. Now that lignite has been found to be of the required quality and no major episode has happened, there is an extra case of bringing down the IRR on equity as risk has gone down .A good rate is 14-15% which is a normal rate in the industry and in the region, for instance the Gujarat lignite mines and NLC lignite mines, Tamil Nadu. Both in the region as well as in Europe, lignite prices are around $25 per ton while in case of Thar coal, the cost/prices are almost double than this benchmark.

Charts 4.1.1: Production cost per unit



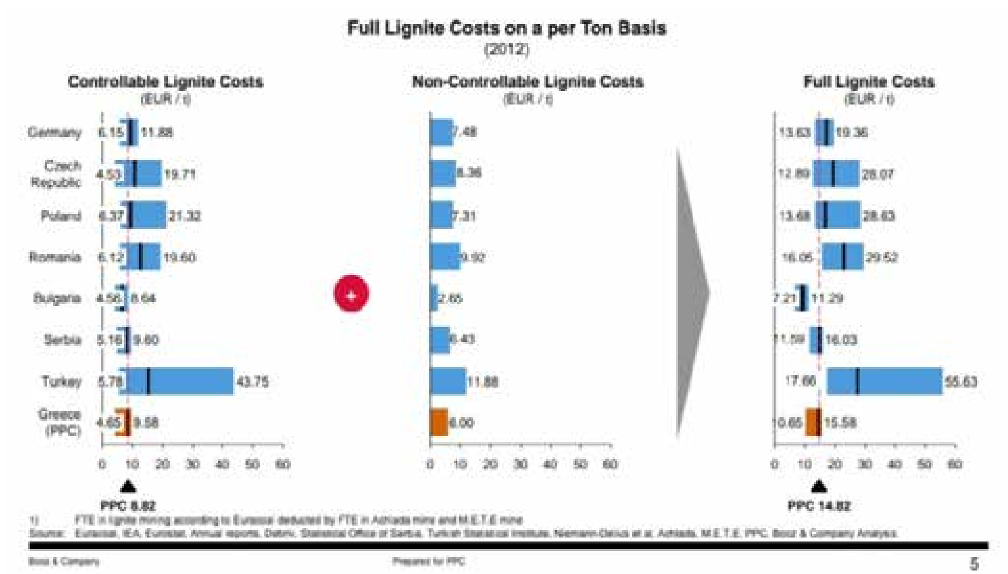
A related issue is whether there is a scope for another project under these circumstances as several blocks have been awarded letter of intent and one project SINOSSRL has been issued tariff by the Thar Coal and Energy Board (TCEB), which is the same as that for the pioneer Sindh Engro Coal Mining Company (SECMC).Should new projects get the same terms such as IRR of the pioneer that took more risks. These issues should be examined in more detail.

A third-party study comprising independent foreign experts as the country lacks experience may be commissioned for investigating the underlying issues including the possibility of additional funding that has been sought by developers. Such an important issue of resource sustainability must be examined independently outside the purview of individual corporate interests. If the current cost trends continue in Thar coal and measures are not taken to control them, there is a great risk that the coal will become uncompetitive. This resource may go unexploited as we have already started late when coal appears to be ending its market lifecycle.

Local cost and foreign exchange savings argument may not apply as well, as most of the costs – diesel, equipment, spares, tyres, etc – appear to be in foreign currency. Thar coal electricity will be costing twice as much as wind and solar. With mounting domestic and international opposition to coal, Thar coal activity may not go beyond 10,000 megawatts at most. It is, therefore, urged that keen attention be paid to bringing the capital expenditure (capex) and variable costs down. One wonders, why SECMC's production cost is high, much higher than elsewhere.

Right Technology

Charts 4.1.2: Full Lignite Costs on a per Ton Basis



There is the remaining issue of technology. They say they did not have the time and money for right technology. They might have had a cash flow problem due to the transitional issue of the project ownership structure, but certainly no dearth of capex budget. We have proved elsewhere that the Thar project has more capex provision than in India on a per ton basis. It is difficult to believe and understand that the investment of $1 billion for a modest capacity of 7.6 million tons per year does not leave money for buying adequate machinery and equipment. India started mining with advanced equipment like BWE some 50 years ago and now it has 34 BWE, 15 spreaders and 250 kms of conveyors with 25 million tons per annum of output with unit cost half that of the Thar project.

Sometimes technology is cheaper. It is cheaper and faster today to use Suzuki loaders than donkey carts. These days, it is not uncommon and impossible to dig out a comparable mine in 15 to 18 months with adequate investment which survives for 50 years as against trucks and shovels which do not go beyond 10 years. More time and money seems to have been lost in inferior technology. It is not yet late.

However, it appears that we would remain victims of the low technology syndrome for a long time under a regulated non-competitive regime. Perhaps competition can make a difference. Although the current project has been able to make Thar coal a reality which may be its lasting but expensive contribution, the dream and ambitions of a cheap local energy source remain unfulfilled and may remain so. Let competition be given a chance. Earlier, the Pakistan People's Party government had

Table 4.1.1: Comparative Tariff Determinations of Thar Coal Mining Projects

		Engro	SinoSSRL	Sindh Carbon
Capacity	MTPA	6.5	7	4
Capacity Power	MW	660,1320MW	2x660=1320	2x300=600 MW
CAPEX	MnUSD	839.63	1049	672.56
Unit CAPEX	USD/ton	129.18	7.86	168.14
Stripping Ratio				8.21
Water Withdrawal	Cusecs	30		81
Production Tariff	USD/ton	13.64	26.94	29.01
Capacity Charge	USD/ton	32.49	17.45	31.11
Total Tariff(levellised)	USD/ton	46.133	44.36	60.23
Equity Returns	USD/ton	7.8387	8.81	18.96
incremental CAPEX	USD/ton	40.278		
Royalty	%	7.5	7.5	7.5
ROE	%	20	20	20

Source: Compiled by the Author, Data Thar Coal

plans to launch 5,000MW of projects on Thar coal. It may not be a bad idea to revive this.

LEVELLISED TARIFFS

Air cooling with foreign currency financing

7.1318 US cents per kWh for two units
7.2228 US cents per kWh for single units

Wet cooling with foreign currency financing

7.2275 US cents per kWh for double unit
7.3356 US cents per kWh for single unit

Source: NEPRA

A 5,000MW concession-type project to be implemented phase-wise in seven to 10 years will attract bidders. It is highly likely that tariff-based bidding would be able to get a fixed price of 5 US cents per kilowatt-hour (kWh).One would like to utilize this opportunity to recommend to the TCEB for exploring further options of promoting and expanding the utilization of Thar coal. A large quantity of coal is imported, resulting in foreign exchange drain. Cement, bricks, tiles and ceramics industries use coal. End-users can be broadened through local availability. Also, there are environmental and congestion problems at Karachi Port and the Supreme Court have ordered the shifting of coal unloading to Port Qasim, the latter itself has issues reportedly.

Pulverization of coal at mine mouth may enable Thar lignite to be used by the general industry. Also briquetting may offer a cheaper fuel for rural areas. Concluding, the Sindh government and the TCEB should explore the possibilities of introducing alternative institutional and market structures. Instead of project-based resource management, one could examine floating a commercial organization under the Sindh government like Pakistan State Oil (PSO) and Pakistan LNG.

Also, competition should be introduced in mining and regulations replaced. It is wrong to say that nobody was interested. Senhua (a Chinese Company) was and many European companies closing coal businesses in Europe may like to shift to this region with their equipment. Invitation of bids for future projects on coal price basis may be an idea worth considering.

Current Thar Coal Economics?

Thar Coal Power Plant ETCPP stands at 3rd rank with total variable cost of Rs.3.13880; fuel cost Rs.2.07150 and O&M cost of Rs.1.0673 per kWh. Here variable O&M cost component appears to be rather high. Thar coal variable cost comes out to be 55.8% that of Port Qasim CPP and 37.47 % that of Sahiwal CPP.

Table 4.1.2: Thar Coal Fuel Costs-March 2020

Fuel Cost -Rs/kWh	2.0715
CV-Btu/lb	6000
CV-MMBtu/t	13.2
Thermal Efficiency-%	30
Heat Rate-Btu/kWh	11373.33
Coal Cost-Rs/MMBtu	182.1366
Coal Cost-Rs/MMBtu	1.175075
Coal Cost-USD/t	
Source: NTDC, NEPRA Merit Order	

Table 4.1.3: Lignite and Black Coal Power Plant Tariff-India

	Capacity-MW	Tariff-Irs/kWh	Tariff-USD/kWh
Lignite Power Plants			
NLC TPS-I Lignite Tamil Nadu	600	3.45	4.7917
NLC TPS-II-I Lignite	630	3.05	4.2361
NLC TPS-II-II Lignite	840	3.08	4.2778
NLC Barsinagar Thar Lignite	250	3.23	4.4861
Non-Pithead Black Coal Power Plants			
Inter-State Indra Gandhi Coal	1500	3.87	5.3750
Inter-State Valur Coal	1500	3.56	4.9444
Pit-head Black Coal Power Plants-NTPC			
Rihand	1000	2.18	3.0278
Farraka	1600	3.23	4.4861
USD-Irs	72		
Source: CEA-India			

4.2: Despite Revision, Thar Coal Tariff Still High

The National Electric Power Regulatory Authority (Nepra) announced the new Thar coal tariff on July 27, 2017. It will be valid for two years or until the production of 5,000 megawatts, whichever occurs earlier. The earlier tariff remained applicable for 2,640MW comprising Engro Power (660MW – two units of 330MW each), Thal Nova (330MW), Thar Energy (330MW) and Thar coal Block-I (1,320MW). We keep hearing about the first two projects and not much about the latter two. The new thing is that Nepra has introduced two tariff systems – one based on wet (water) cooling and the other on dry (air) cooling. Normally, wet cooling is used and all coal power plants are based on water cooling.

Most of us are skeptical about the dry technology on account of its lower efficiency, higher capital expenditure (Capex) and higher operating expenditure (Opex). I was also among the skeptics. However, data provided by the Chinese (Shanghai Electric), who have the right experience, shows something different. They have argued that, in fact, there is not such a formidable difference in case of dry cooling so as to be totally excluded from consideration. This, in fact, was proved in results of the tariff determination released by Nepra. There is a 2% difference in efficiency and a difference of 0.11 cent in the cost of generation. This is good news for Thar coal as it was being thought that there would be an upper limit on electricity production from this source. The resource is large, but water availability is a major constraint.
SOURCE: TCEB

The upper limit was calculated by some experts at 10,000MW. Now, with the air cooling technology and it not being uneconomic as well, one could look forward to much higher production levels.

It is a separate matter that due to worldwide opposition to coal and some of the local policies, Thar coal production and financing may be discouraged.

Rate of Return

A major issue in the Thar coal tariff was the allowed internal rate of return (IRR) of 20% on equity which translated into 35.4% return on equity (ROE) in operational years. Nepra has reduced the IRR to 18% and has dropped the term ROE, which had created a lot of confusion. The Sindh government kept insisting on an IRR of 20% thinking that it would be good for Thar coal. But many, including this writer, thought that the opposite was true. The argument of the latter group is that Thar coal has to compete with other sources of energy, even within Sindh, including wind and solar energy. There has been a tremendous drop in international and regional prices of wind and solar power, which have reached 4 to 5 cents.

Nepra has rightly decided on competitive bidding, which will help resolve the controversy spread by vested interests in favor of higher tariff. The 20% IRR was really high, but it was justified for the risk of first few projects and when local interest rates were high at 14%, giving a margin of 6%.Interest rates today are around 6% and with addition of 6% margin, the IRR comes out to be 12%. Zorlu has submitted a tariff application for a solar power project based on 12% IRR.

Political Considerations

Investments are driven by political considerations. Some investors of the western countries will not be attracted by even 20% as proved already in most of the power projects including Thar. Chinese would have considered 12-14% as good enough and would have been attracted. There is not much market to sell coal power plants any way. It is a mistake to award an IRR of 18% under pressure from the Sindh government, which has not given much thought to the issues explained above.

The real beneficiaries and vested interests that appear to be behind the higher IRR are local parties. But they will see, it would hurt them and hurt us all. Another good thing introduced by Nepra in the new Thar power tariff is the reduction in interest rate margin from 4.5% in the case of Sinosure fee application to 4% in case where the company's insurance rates are not applicable. This was long overdue. When hard times come to pay in future, one may make a case for downward reduction in other cases retrospectively. It was, in fact, unreasonable to charge a heavy Sinosure insurance of 7% on debt and charge normal commercial rates as well.

Under the non-competitive bidding cases as most of the Chinese CPEC projects are, there is a case of negotiated lower rates of financing under government-to-government arrangements. The logic being that there is higher Capex in such situations. Let us be honest, the upfront tariffs are not that independent. In India, lignite coal tariff is 6.6USc, which in levelised terms may still be lower. The higher Thar energy tariff is also due to apparently higher coal prices dictated by Thar Coal Energy Board (TCEB). I suppose they are still using the 20% IRR.

Is provincial autonomy such a bad thing so as to preclude transparency and public consultation and oversight? Some reform is required in this respect? If unilateralism prevails, then tomorrow, KPK may ask for an exclusive role in pricing its electricity. In the first year, the Thar coal cost/price, as expressed in Nepra determination, is $14.75 per ton variable with an unduly high fixed component of $56.43 to give a total of $71.18 per ton. In later years, the variable component goes down to $10.64 per ton and fixed cost to $19.41 per ton to give a total of $30.05. Accordingly, the levelised cost is $46.50 per ton.

Engro keeps saying that once optimum production level is reached at its mine, the production cost will come down. On the other hand, one keeps hearing of new coalmine investments, all of them submitting similar cost schedules.

If all such new proposals keep coming and are approved, how will that purported optimum level be reached? Under similar conditions in central Europe, lignite is being sold at $20 per tonne or even lower. In the US, it is as low as $10 per tonne. In India, it is IR 1,500 ($24) per ton. Reportedly, international consultants had been hired by the TCEB based on which such pricing policy has been prepared. One wouldn't mind some good royalty payments going to the Sindh government, which it would hopefully spend on the social sector, especially in Thar. One should look into the possibility of some kind of competition among coal mining companies in order to bring down the cost.

Why are Thar coal prices so high as compared to elsewhere? Firstly, regulated tariffs are almost always high. If competitive bidding is adopted, it is hoped that the prices would come down. We have provided a comparative table of the three coal tariffs that have been issued by TCEB from which it can be easily seen the rising cost trend, while the opposite ought to have been the case. What is the logic of entertaining other coal tariff applications, when optimum levels of existing tariff commitments have not been achieved yet, as indicated by Engro figures?

Tying up, coal mining projects with power appears to be the reason, which should have been delinked by now. Old technology such as shovel and trucks might also be the reason for higher costs. One cannot move millions of tons with shovels and trucks. It takes more time and energy. In India and Europe, where most of the lignite mining is being done, bucket wheel excavators have been used. Admittedly, these are expensive and heavy on upfront cash; the unit product cost is lower than that in the case of shovels and trucks.

In Engro's tariff determination, $161 million of diesel consumption has been shown as Capex.

The cash flow-based tariff calculation model as applicable to electricity tariff has been applied to coal/lignite mining as well. It is unprecedented and not found almost anywhere in the world.

Not only that, very high cost of coal production has resulted due to this and even more importantly, lignite costs as high as $71.18 per ton in the first year results, pushing the first year tariff very high and making it almost unaffordable.

4.3: Coal Pricing for Imported Coal Power Plants

Unfortunately, we have three imported coal power plants now with a combined capacity of 3960 MW and a fourth one that has yet to be installed, taking the total to more than 5000 MW. More than $1.5 billion of foreign exchange is spent in coal imports and is slated to increase. There was no justification of installing so many power plants based on imported coal, except maybe one plant at Karachi or Sahiwal. Moreover, it is argued by some that vested interests (or, to put it mildly, inadequate deliberation) have led to the adoption of inappropriate technology; otherwise alternative technologies could have enabled utilization of local Thar coal on its eventual availability.

Apart from straining foreign exchange resources, these unnecessary plants have created a capacity surplus. There is an interesting, in fact deplorable, situation of excess capacity; if coal power plants are run to full capacity, gas plants remain under-utilized and vice versa. Also, 1000 MW of wind power plant capacities cannot be utilized. And there are issues now of fixing coal prices.

Thermal Power has three components – capital costs; O&M and fuel component. All three components vary with time, but fuel prices vary more; it is impossible to be able to forecast fuel prices and thus fix fuel cost component in a regulated power generation tariff. For fixed cost components, escalation formulae have been provided in the Nepra tariff which, however, went to the other extreme of providing escalation on local and foreign equity component.

Price of Coal

(1) The following reference coal price has been used for determining the upfront tariff;

Imported coal (sub-bituminous)

Richard Bay (South Africa)-FOB	40%	US$93.40/M.Ton
Newcastle -Australia-FOB	20%	US$89.00/M.Ton
Newcastle -Indonesia-FOB	40%	US$87.55/M.Ton
Marine Freight		US$20.00/M.Ton
Marine Insurance		0.10% of FOB price
Other Costs		10% of FOB price
Weighted Average CIF Price		US$119.60/M.Ton
Cost of common Jetty facility		US$ 9.46/M.Ton
Total Imported Coal Price		US$129.06/M.Ton

Note: *The above figures will be replaced with the actual numbers to arrive at actual fuel cost component. Since the project is based on dedicated jetty, the cost of common jetty facility shall be excluded from the price of coal and the cost of dedicated jetty will be added to the respective components of tariff at the time of COD.*

Local Coal (sub-bituminous)

(22,046 BTU / 25,555.98 BTU *US$119.60/M.Ton) US$103.17/M.Ton

Source: NEPRA

In Pakistan, there have been attempts to prescribe formula frameworks for dealing with the variability in fuel prices. Furnace oil fired power plants have operated for more than two decades; the public-sector PSO used to announce furnace oil prices for a long time. It does not import furnace oil anymore and there is no furnace-oil based electricity generation either.

There are furnace-oil plants which, if need be, would operate on locally produced oil. Furnace oil pricing issues would emerge, as private sector price-setting may not be credible for a variety of reasons. There are problems with RLNGCC power plants as to the RLNG cost. As long as the RLNGCC power plants are in the public sector, there may not be problems in the acceptability of RLNG prices. Potential bidders are demanding that the fuel cost component be linked with some sort of LNG spot price index, while cost-plus can be a cart blanche for IPPs and may be controversial.

In case of coal, IPPs are somehow not able to agree on any formula. The first pricing formula was issued in June 2014. The coal reference price formula was announced by Nepra based on the weighted average of three coal price Indices – of South Africa, Indonesia and Australia in a ratio of 20:40:20. The problem is that there are all kinds of coal with varying energy content (CV), while oil or gas have almost fixed CV, although in both cases there is variability in other parameters such as sulfur content etc.

In 2016, some changes in coal pricing formula were made. The weighted average of coal price indices was eliminated and was replaced by an actual applicable index. Nepra managed to draw some conclusions despite wide differences in the inputs provided by the IPPs. Everyone wanted to have a formula according to their perceptions and which would benefit their interests.

Reportedly, a consultant was appointed by Nepra to offer some advice in this respect. However, it was decided that the formula would be reviewed after three years, which is due now. As a starter, the issue was preliminarily discussed in a recent energy conference organized by Nepra. Quite amazing and amusing statements were made.

At the conference, an IPP representative said that that his company was running in loss and has by now accumulated losses of $100 million. That was odd or probably he could not communicate it properly. Maybe it was loss in profit. They are getting a tariff of around 8.5 USc against a typical rate of 5-6 USc almost everywhere on new investments in the UAE, Egypt and elsewhere. Is their net share in profit is too low? This is something our relevant agencies should investigate.

It is quite possible that they may be having losses in buying coal. They might have entered into a large supply contract pooling demand on other projects and may be losing money on that. It is not for the first time that such mistakes in assessment have been made by shrewd and experienced coal buyers. It has happened in India, as mentioned earlier, where several plants of billons of USD investment went stranded due to coal price difficulty. We were expecting some cooperative attitude from coal IPPs for a price opener bringing the cost down to competitive international level. The reverse seems to be happening.

Coal has a market share of 40 percent in global electricity generation. Prices peaked in 2018 crossing $100/t in most markets and have since come down by 25-33 percent. IEA forecasts stable demand and prices in the coming five years. Contrary to popular notions, a coal price collapse does not appear to be on the horizon. Some solution has to be found – a solution which more actually reflects the market and matches the local conditions. Ideally, actual costs are to be paid with some incentives for creativity, enterprise and innovation – easier said than done. There are transparency issues; IPP claims cannot be accepted.

It is wondered if the coal IPPs have some kind of formal or informal arrangement for pooling the coal demand and placing joint orders. They have proposed to Nepra to launch a SPV (Special Purpose Vehicle) for the same. There is a rationale for demand and procurement pooling of small buyers of cement and other sectors. Commercial agents or importers may be doing some kind of pooling. Commercial rivalries normally prevent such coordination.

Reportedly, Malaysia has mandated pooled buying for coal in an arrangement like our TCP, the Trading Corporation of Pakistan. Deliberations should be initiated on the subject of involving the TCP. The TCP can serve a third-party role acceptable to the government of Pakistan and the IPPs. TCP imports many commodities on behalf of the government. IPPs can submit their demands and specs and a common spec platform would have to be agreed to.

Nepra, in its forthcoming suo-motu meeting, may try to develop some required commonalities, although there need not be just one spec; there can be two. Price advantages would be diluted as the number of specs increases. In all probabilities, imported coal power plants will continue to be a burden on consumers and countries' foreign exchange resources, while Thar coal remains buried where it is. Thar coal has its own sad story.

There is sufficient procurement data available now after three intervening years which should enable objective analysis that may lead to a mutually acceptable formula that reduces generation costs and helps IPPs recoup their genuine costs as well, a win-win indeed is required. Sound professional analysis and advice would be required the likes of which may not be available locally.

4.4: Jamshoro Plant's Low Bid: Power of Competition

Recently, the Power Division secretary signed an engineering, procurement and construction (EPC) contract in Islamabad for the Jamshoro Coal Power Plant. The plant with 1,320-megawatt power generation capacity is being built in two phases of 660MW each. The EPC contract has been signed at an extraordinary low price, almost half that of China-Pakistan Economic Corridor (CPEC) projects.

This is the power of competition. CPEC projects are being built without holding competition while Jamshoro Power Plant is being built under the Asian Development Bank (ADB) financing and it is necessary to hold competitive bids. One cannot remain without saying, hats off to the ADB and to the government of Pakistan as well as after all the latter is the owner of the project.

Let me clarify that the aim of this article is not to defame CPEC or embarrass the government, but to discuss the problems and issues in order to make CPEC more useful and beneficial for both sides. The price difference is shocking – $0.587 million per MW for the ADB project vs $1.21 million per MW for CPEC projects (including Sahiwal, Port Qasim and Hub Power). The consequence is that the cost of generation will be 8.34 cents per unit for CPEC projects vs about 6.38 cents for the ADB project. In fact, the cost of generation in other countries for new coal power plants varies from 5 to 6.5 US cents.

Reasonable Tariff

Senhua, one of the largest companies in China in this field, had offered a tariff of 5.35 US cents for Thar coal. It was not a charity but a fair and reasonable price. Many knowledgeable people are uncomfortable with the high CPEC coal generation tariff. For the first 660MW, the EPC cost of Jamshoro project is $562 million while for another 660MW; it would be much lesser at $313 million. If only first phase is implemented, the cost difference may not be as startling as it currently is. The EPC cost for the first phase comes in at $0.852 million per MW whereas the second phase will cost only $0.474 million per MW, giving a composite total of $0.663 million per MW.

It would be unwise not to go for the second phase. However, some people are reportedly wishing to have only one phase. This would reduce the embarrassment for CPEC. The fact, which is now established, is that coal power plants elsewhere are being built at a cost of less than $1 million per MW and the ADB project results are not untypical but are representative. CPEC costs are about 50% higher than the norm. It is said that the government of China holds competition in China and then nominates the lowest bidding company. Now, the National Electric Power Regulatory Authority (Nepra) has also made competition a necessary condition.

Competition either under Nepra conditions or under Chinese government supervision, however, has not yielded required results of reasonable and fair costs. All companies are maximizing profits, even if the buyer is not simple or careless and what to talk off when the buyer may be otherwise. Some people may blame the regulator Nepra and hide behind it, that it is Nepra which gave this cost and tariff. What can we do? Nepra allowed capital expenditure (capex) – total project cost – of $1.1 million per MW prior to the advent of CPEC which was probably right. The government under CPEC guidance or pressure lobbied for enhanced costs which are documented in Nepra proceedings.

I wondered then and wonder now why the government or its institutions like Private Power and Infrastructure Board (PPIB) or Central Power Purchasing Agency-Guarantee (CPPA-G) should represent CPEC companies and lobby with Nepra for higher costs. The companies should have represented their own case. The government's involvement puts unnecessary pressure on Nepra, even though pressure may not have been applied.

Project Quality

Some people may suspect that there might be quality difference. But the reality is that the winner is a reputed company like Siemens and no lesser. Even other competitors who quoted slightly higher were also credible companies like GE. Additionally, the ADB Jamshoro project will utilize 20% local Thar coal which is a big plus and might have involved some additional costs as well. Also efficiency of the project is one percentage point higher. I am sure the Chinese government would have a larger perspective including political and strategic considerations which may force it to be more considerate towards the poor people and the government of Pakistan, unlike the commercial companies which are usually profit maximizing. Pakistan and Chinese governments should undertake a review of the situation and take steps to correct it. There are other ways in which the Chinese government may be helpful and that is by asking banks to offer a little concession on interest rates as has been done in the case of Bangladesh and Malaysia wherein lower interest rates of 2% to 3.5 % have been charged.

It is true that we were and are suffering from energy crisis and the usual adage that beggars cannot be choosers. China is also benefitting from a large market of 20,000MW without facing any competition and would be considering this, if our decision-makers negotiate with intelligence and data. We have to politely and tactfully present these facts. I would also advise political activists not to scandalize it and launch a vicious campaign against CPEC.

Table 4.4.1: Comparative CAPEX and COGE of Coal Power Plants in Selected Countries

	Capacity MW	CAPEX Mn.USD	Unit CAPEX Mn.USD/MW	COGE. USc /kWh	Completion year
NEPRA-Upfront Tariff	1320	1463	1.45	8.45	2018
Jamshoro Coal -ADB-bid based	1320	1181	0.895	6.2361	2020
Hassayan-UAE	1200			5.5	2021
Egypt-Dongfeng Shanghai	6000	4400	0.73(EPC)	5.4	2022
Malaysia-Tanjung-4	1000	1100	1.1	5.695	2015
Malaysia-Manjung	1000	1200	1.2	5.695	2016
Kudgi-SSTP-India	2400	2300	0.9		2017
Khargon-SSTP-India	1300	1500	1.1		

Source: IEEFA, NEPRA, CERC India, Power Mag

4.5: The add-ons in Imported Coal Power Tariff

The National Electric Power Regulatory Authority (Nepra) has come a long way improving its performance and capacity. However, it is an issue of glass being half full and half empty. We would like to raise and discuss some issues in Nepra's tariff procedures and present a case study of coal power tariff, particularly of coal jetty costs that have been approved recently. It has been apprehended that a cheap energy source may lose its attractiveness, if add-on costs are not handled properly. Fortunately, the tariff is due for renewal after completing its two years; it is perhaps the right time to have discussion on some limited aspects.

Coal power tariff for 1,300MW plants, being built these days in Sindh and Punjab, as per Nepra determination in 2014 is Rs8.01 per unit. This tariff was based on free on board (fob) coal rate of US$90 per tonne and an exchange rate of Rs97 per US dollar. These days, the coal cost is around $50 per tonne, which will reduce the energy cost component from Rs4.3013 per unit to Rs2.967. Thus, adjusted new tariff would be around Rs6.37 per unit; may be slightly more due to exchange rate difference of 11%.This should be good news for consumers and the economy. Low coal prices are expected to prevail in the medium term, say 10 years, along with low oil prices. Decrease in coal demand and increase in renewable energy is going to put additional pressure on coal prices.

Coal Jetties

However, there is a threat that additional add-on costs may nullify or reduce these gains and spoil the tariff. There are add-ons like cost of railway transportation to Punjab, port charges and jetty cost .A difference of one paisa in tariff results in an additional payment of $1 million per year in case of one plant only. Coal jetties are required to unload imported coal from ships. Jetties/terminals are required even in surface transportation of coal. There are three issues (one already discussed above) on which there still is confusion or controversy. One still does not know as to what would be the impact of railway transport of coal on the tariff. In a public hearing, Pakistan Railways (PR) maintained that Nepra did not have jurisdiction on the railway transport tariff.

Reference Tariff

Nepra based its reference tariff of $9.86 per tonne by extrapolating the AES Jetty data of 2009. It was a totally different type of offshore jetty in which 5-7 km of trestle had to be made under water foundations, which is always very expensive. Also, AES Jetty was designed for very large ships, carrying three times the coal carried by Panamax vessels.

Table 4.5.1: Merit Order Based Revised Fuel Prices, Effective From 04-03-2020

Sr. No.	Plant Groups	Fuel Type	Other Cost Rs/kWh	Fuel Cost Rs/kWh	Vo&M Cost Rs/kWh	EPP Rs/kWh	Status in Last Merit Order
1.	UCH(Upto 152.375 MWh)	Gas	0.96	0.76960	0.382314	2.11595	1
2.	liberty Power (Upto 61,904 MWh)	Gas	-	1.85117	0.530530	2.38170	2
3.	Engro Power Thar	Coal	-	2.07150	1.067300	3.13880	3
4.	UCH (above 152, 375 MWh)	Gas	0.96	3.40788	0.382314	4.75423	4
5.	China Power HUB Gen CO	Coal	-	5.068800	0.497200	5.56600	6
6.	PORT QASIM	Coal	-	5.41970	0.15270	5.60240	5
7.	747 MW GUDDU (CCP)	Gas	-	6.40990	0.511800	6.92170	7
8.	UCH-II	Gas	-	6.867174	0.331500	7.19867	9
9.	KAPCO B-I	Gas	-	7.34081	0.42471	7.76552	10
10.	Gudu (CCP) B-I (Unit 11-13)	Gas	-	7.88440	0.068900	7.95330	11
11.	Foundation Power	Gas	-	7.40125	0.571800	7.97305	12
12.	Sahiwal Power	Coal	-	8.19640	0.179800	8.37620	8
13.	Engro PowerGen	Gas	-	7.93447	0.505200	8.43967	13

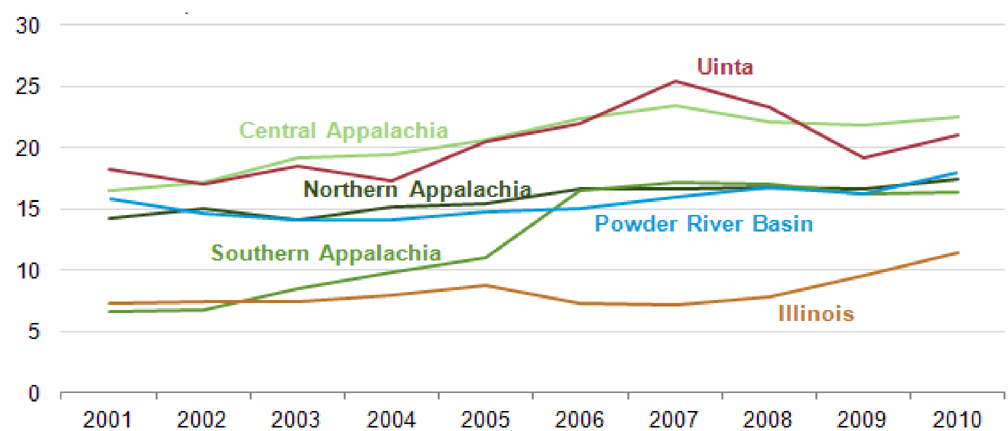
Source: NTDC

No one could imagine that Nepra would take a highly ill-advised (to put it mildly) step of allocating the same costs as these would occur in AES and Gadani. The coal jetty being built as part of the power plant is a much simpler and cheaper version. Nearby, PIBT is in the process of commissioning a common purpose bulk terminal, which will provide coal handling services to other power plants. For strange reasons, Nepra ignored data from this actual and comparable plant and used the inappropriate and irrelevant AES project data which was also out of date. PIBT terminal, which is four times the size of Sino-Hydro Coal Jetty (16 million tons per annum (mtpa) vs 4.5 mtpa), is being built at a cost of $285 million vs $240 million for Sino-Hydro. Reportedly, PIBT tariff is $4 per tonne as opposed to $9.86 per tonne for Sino-Hydro.

In India, coal terminals of twice the size of Sino jetty have been made in $30-60 million range. In the kind of budgets approved by Nepra, very large coal terminals in the range of 30-40 mtpa, 6 to 10 times larger in output and capacity, can be built. Adani and Essar have built these kinds of projects for 5,000MW or more coal power plant complexes. In India, tariff for a typical coal terminal is $4 per ton (total including fixed and variable), out of which 40% ($1.6) is the capital charge rate and $2.5 is the O&M cost. International rates of coal terminal are around $2-4 per tonne. Railway coal terminal tariff in India is $1 per tonne each on dispatch and receipt. These are all comparable numbers. However, Nepra is awarding or has awarded $9.86 per ton as capital charge ($240 million capex) of jetty and $9.34 per ton as O&M costs, totaling a hefty $19.20 per tonne. The difference is too much to be left unexamined thoroughly, once again.

Excessive Inland Coal Transport Cost-Sahiwal

Charts 4.5.1: Average rail transport cost of coal to the power sector by major coal basin real 2011 dollars per short ton



For Sahiwal Coal Power Plant, the fuel cost is the highest; Rs.8.1964 per kWh as opposed to Port Qasim of Rs.5.4197; the reason being high inland rail transport component of USD 52.25 /ton, more than twice the regional or international average for comparable distance.

When one examines the merit order, one finds that Port Qasim Electric Power Plant (PQCEPP) comes at step 6 with unit fuel & O&M cost of Rs.5.566 vs. Sahiwal CPP at step 12 with fuel & O&M cost of Rs.8.37620 per kWh. The technology, fuel and CAPEX are the same. The difference in fuel cost of the two plants is Rs. 2.7738 per kWh which is 49.5 % higher for Sahiwal over PQCEPP. If the difference is genuine, it should be the inland coal transportation component. Based on a CV of 25.556 MMBtu/ton and a Heat Rate of 8749 Btu/kWh-(Thermal Efficiency -38.9 %), it is estimated that one tonne of coal produces 342 kWh of Electricity. Inland transport cost per ton comes out to be about Rs.8099 per ton (52.25 USD/ton-Rs 155/USD) as opposed to the coal cost of Rs.11159 per ton. For an equivalent distance, Coal transport cost in India would be 27.77 USD/ton. Thus coal transport cost in Pakistan turns out to be almost twice than that of India.

Table 4.5.2: Coal Transport Cost Sahiwal CCP

Coal Transport Cost Sahiwal CPP	20-Mar	19-Mar
KHI-Sahiwal Rail Distance - kms	1047	1047
Heat Rate-Btu/kWh	8749	8749
CV - MMBtu/ton	25.556	25.556
Coal Cost -Rs/MMBtu	619.4651	
Coal Cost-Rs/ton	11159	11159
Transportation Cost-Rs/kWh	**2.7767**	**2.599**
Port Qasim CPP Fuel Cost-Rs/kWh	5.4197	5.016
Sahiwal CPP - fuel cost-Rs/kWh	8.1964	7.615
China Hub CPP - Rs/kWh	5.0688	
Engro Thar CPP fuel Cost-Rs/kWh	2.0715	
Electricity per kg-kWh/kg	0.342	
Coal Transport Cost-Rs/t	8099	
Coal Transport Cost-USD/tkms	0.049906	
Coal Transport cost -USD/t	52.25161	
Swl. CPP coal transport cost - USD/MMBtu	2.044593	
Equivalent cost for Thar Coal-USD/MMBtu	4.089186	
India Coal Transport -Cost data		
India Coal Transport IRS/kWh-1100 kms	1.2	
India Coal Transport -Irs/t 1100	2000	
India coal transport-1100 km-USD/t	27.77778	
1 USD-Pk.Rs	155	
1 USD-IRs	72	

Source: NEPRA, NTDC, Brookings Institution Report on Coal India

Table 4.5.3: Comparative Fuel and O&M Cost Coal Power Plants-March 2020

	Fuel	O&M	Total
	Rs/kWh		
Port Qasim CPP	5.4197	0.1627	5.5824
Sahiwal CPP	8.196	0.1798	8.3758
China Hub CPP	5.0688	0.4972	5.566
Engro Thar Lignite PP	2.0715	1.0673	3.1388
Sahiwal Transport Cost	2.7767		
Sahiwal Net Fuel Cost excl Transport	5.4193		

Source: NTDC

Table 4.5.4: Comparative Coal Transportation Cost-USD/ton

	PQ	Sahiwal	Reference
Marine Transport	12.67	12.67	20
Jetty/unloading	9.46	9.46	9.46
Inland Rail Transport		52.25	
Total	22.13	74.38	29.46
Coal CIF WA			119.6
Total Imported Coal Price			129.06

Source: NEPRA

Table 4.5.5: Coal Freight Cost India-2016

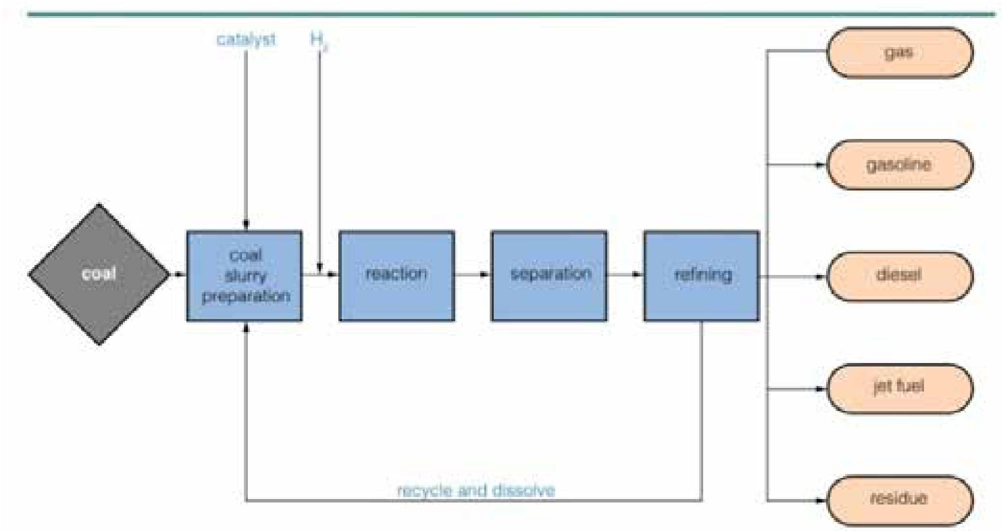
Coal Rail Freight Cost India-2016		Slab-I	Slab-II
Distance	kms	497	1807
Rate-	Irs/ton	712	2138
Coal Terminal Charge	Irs/ton	110	110
Total	Irs/ton	822	2248
Rate per ton-kms		1.653924	1.244051
Rate -	USD/ton	11.41667	31.22222

Source :NDTV India

4.6: Thar Coal Potential for New Power, Fuel, Urea Projects

Thar coal has been in the limelight these days. The Sindh government is in negotiations for a large project on Thar coal with 1,320-megawatt power generation capacity and production of associated energy products like gasoline and diesel. While there is nothing new about electricity from Thar coal as one project is already in production and several others are at various stages of implementation, projects of fuel and fertilizer production are new and a welcome development.

Chart 4.6.1: Simple flow scheme for the direct coal liquefaction process



Apart from the Oracle project, Chinese companies are on trips to Karachi and Islamabad to explore and discuss such projects. Fertilizer production with the help of Thar coal and gasification thereof is being debated for a long time in Pakistan. There are, in fact, a variety of products including gasoline, diesel, gas and different chemicals that can be produced out of coal. Syngas is produced by burning coal under high pressure and temperature with low oxygen. There are then two routes – one is Fischer-Tropsch process under which Syngas is converted into gasoline and diesel, and the other is a more versatile methanol route in which Syngas is converted into methanol and then there are wider possibilities of producing gasoline, diesel and chemicals including plastics base material.

There has been, however, considerable skepticism about the suitability of lignite for gasification. It has been successfully proved in China and the US that lignite (Thar coal type) can be gasified and subsequently converted into various products such as fertilizer, gasoline, diesel and chemical products.

In case of urea, fertilizer plants are located far away from Thar coal fields as the closest are 400 km away on Sindh and Punjab borders. Either Syngas has to be transported there, which is not easy, or fertilizer plants may have to be shifted from their present locations to Thar or coal may have to be transported to the fertilizer plants at their existing locations in Sindh.

The latter may be a costly operation adding $20 per ton to the coal cost, which is already high under the current production scheme in Thar. However, new urea fertilizer plants can be installed without such problems. Negotiations are going on for producing diesel from Thar coal. China has been producing diesel from coal since 2008. Financial Times reports production cost of converting coal into diesel in China at $446 per ton as opposed to the spot diesel price of $578 per ton, which shows a 23% cost advantage. Reportedly, Sasol (South Africa) is producing even at a lower cost. According to a Chinese publication, coal to diesel is feasible at $50 per barrel of crude oil prices. Current Brent crude price is $64 per barrel. About 3.5 tons of coal (sub-bituminous probably) is required to produce one ton of diesel. Thar coal CV is on the average half that of normal coal.

Pakistan's annual diesel demand is 7.2 million tons. There should be good chances for developing a feasible project for producing one to two million tons of diesel per year, meeting 20% of the annual requirement. By comparison, a 200,000-barrel-per-day oil refinery produces five million tons of diesel. Methanol can also be the initial product at the Thar site, having physical and technical feasibility whereas economic feasibility calculations are awaited. China is the largest consumer of methanol globally, consuming seven million tons annually. China is a net importer despite a considerable local production.

Thus, there is scope for designing an export-based methanol project on Thar coal. Other products such as urea, gasoline and diesel may be added later. Methanol can be converted into gasoline as well under an Exxon Mobil MTG process. Simply speaking, methanol (CH3OH) is a colorless liquid form of methane (natural gas). It is the simplest form of industrial alcohol being used both as fuel and chemical input.

Methanol has many applications. It is safer than liquefied petroleum gas (LPG) gasoline and diesel. Its risk rating is 15 vs 36 for LPG. Its (M15) emissions are also lower than RON-95 gasoline. Methanol is non-pressurized unlike LPG. It can be mixed into LPG with a 20% share to make LPG cheaper. It can replace LPG altogether, or to the extent LPG is imported. More than 500,000 tons of LPG is imported annually.

Methanol can also be mixed with gasoline as an octane enhancer in place of injurious metallic compounds based on manganese. Methanol can be added to gasoline in the proportion of 12% to be marketed as M15 gasoline. Methanol can replace diesel in modified truck engines. Another application is in marine transportation, where methanol can replace dirty furnace oil. In China, all such applications are being utilized. India and Egypt have launched projects for M15 gasoline and LPG mixing. Methanol is cheaper than LPG and gasoline. The current spot price of methanol is $1.03 per gallon vs $1.65 per gallon for gasoline at the New York Mercantile Exchange. Diesel is priced at $586 per ton vs methanol at $342 per ton.

However, it has to be noted that one liter of methanol is thermally equivalent to 0.65 liter of gasoline. It can be manufactured from a wide variety of raw material like biomass, natural gas, oil, coal and various wastes. In Pakistan's case, it would save foreign exchange, if nothing else – if local methanol production is even equal to gasoline or diesel prices. Comparative cost calculations are to be done. Synthetic natural gas (SNG) appears to be a possible option due to the location and transportation issues. It is, as the name implies, is natural gas but is produced synthetically as opposed to being dug out from gas fields. It is methane (CH4) as opposed to syngas (a mixture of CO, H2, CH and others).

Chinese are facing similar problems with their coal and lignite resources buried in the Mongolia desert. A number of SNG projects have been implemented and more are in the process. Following production possibilities may be considered: methanol 1.4 million tons per annum, SNG 600 million cubic feet per day (mmcfd), urea one million tons per annum and diesel one to two million tons per annum. Individually, these quantities may not be very high but when combined this may become quite a large volume. The integrated power and petroleum/chemical products production may offer many opportunities of cost reduction, especially, through the utilization of waste heat, improving yield and thermal efficiency.

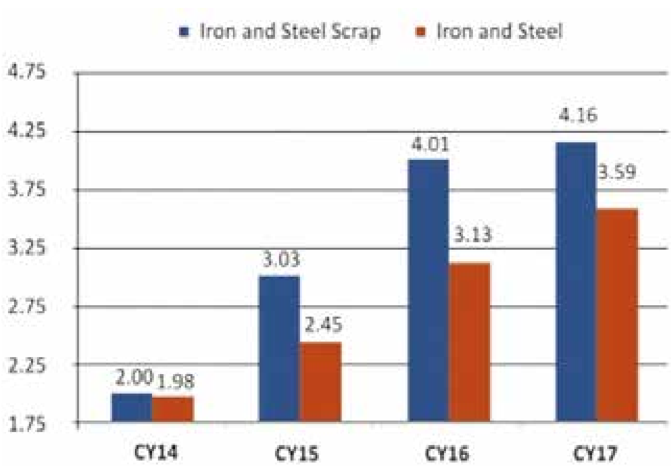
However, the capital expenditure requirements would be high. Individual coal projects of 1,320MW have a capital expenditure of $2 billion each. These are capital and technology-intensive projects having longer gestation periods. Many companies may not be interested. Such projects may only be financed through Chinese cooperation under CPEC or otherwise. There is no free lunch. Investors expect good return. It has to make economic sense for the recipient as well. It is hoped that competitive, fair and mutually beneficial project schemes will be worked out eventually.

Fortunately, for traded goods like methanol, gasoline and diesel there are known international prices around which agreements are possible. Even gas has become tradable in the form of LNG. The weighted average import price of LNG in Pakistan is estimated at $7.5 per MMBtu and local gas at around $6 per MMBtu. Concluding, there is a need for developing some kind of a policy. However, it is good to see interest and activity. Let this does not wane away.

4.7: Gas and Coal: Case of Tuwairqi Steel Mills

Tuwairqi Steel Mills Limited (TSML) had been established in Pakistan in 2008 and could not be put into operation due to a gas supply dispute. TSML expected gas supply at an extraordinarily low rate of $1.23 per million British thermal units (MMBtu) – a price that is offered to priority sectors like fertilizer producers. There is no evidence or contract to that effect. Many people object to even the fertilizer industry being given such a low tariff rate, not to talk of the steel sector. Recently, the zero-rated export sector was promised gas supply at a low rate of $6 per MMBtu, but it could not be sustained.

Chart 4.7.1: Imports Iron and Steel (In MT)



There was no case for TSML to get gas supply at such a low rate. In the meantime, there were gas shortages in Pakistan, which prevented any arrangement in this respect. With the arrival of liquefied natural gas (LNG), gas availability has increased, although gas prices have also increased. TSML claims an investment of $350 million which remains stranded due to the gas price dispute. It has knocked the doors of international arbitration. One cannot expect a favorable result (for the government of Pakistan) from the international tribunal as has been seen in the case of Reko Diq copper and gold project where a fine/settlement of $6 billion has been slapped on Pakistan for a mostly planning cost of $350 million.

Eminent economist Jeffery Sachs has recently criticized the judgment of the tribunal on several grounds. However, nothing seems to have happened except that the government of Pakistan tried to wriggle out of the difficult situation through mutual negotiations with Tethyan Copper and Gold Company. An out-of-court settlement has been agreed after the tribunal awarded the compensation against Pakistan. It appears that one would be well advised to try a negotiated settlement instead of going into the risks of fighting cases and claims in arbitration. Perhaps, it is in this perspective that the Ministry of Industries has submitted a proposal seeking a subsidized gas price of $4.65 per unit for TSML over 10 years.

In comparison, local gas production costs $6 per unit. This would amount to a subsidy of $1.35 per MMBtu. As annual gas demand of TSML is 12 billion cubic feet (32.877 million cubic feet per day), it would mean a subsidy of $16.2 million per annum and $162 million for 10 years. If the opportunity cost of LNG is assumed at $10 per MMBtu, it would mean a subsidy of $48 million per year, the critics may argue.

Direct Reduction of Iron (DRI) replaces scrap and its price is assumed to be equal to the scrap price. TSML has adopted a gas-intensive production process called DRI where gas is used to reduce iron oxides and other ores to produce iron in the form of iron sponge as opposed to the pig iron that is produced in blast furnace where iron ore and coke are burnt together – the like of which has been installed in Pakistan Steel. In Pakistan Steel, pig iron is converted into steel in a converter/open hearth by blowing oxygen into it. In the TSML Midrex process, iron pellets are processed in the electric arc furnace at the end of which steel billets are cast through continuous casting machines.

The DRI vertical shaft process has been adopted by gas-rich countries like Iran, Qatar, Oman, Saudi Arabia and other Middle Eastern nations, some of which have both cheap and abundant gas and iron ore as well. Most advanced nations having iron ore and coal as well as high steel demand like China, Russia, the United States, and Europe have adopted the blast furnace route .However, India having both iron ore and cheap coal did initially adopt the DRI shaft process but later abandoned it in favor of the Rotary Kiln process, which is a DRI but is produced through coal and not gas.

There are many other countries that have abandoned the Midrex gas process and have shut down these plants. Some, including India, have converted the gas process into the coal gasification process. One finds it very difficult to understand the rationale behind TSML adopting a gas-intensive process. Jindal Steel and Power (JSPL) of India seemed to have faced a similar problem as TSML is facing. JSPL went for coal gasification and has successfully added a coal gasification facility to its shaft-type plant, which remained closed in the meantime. It appears that for small markets like Pakistan; the scrap-based arc furnace route is good, which obviates the need for large blast furnace projects like that of Pakistan Steel, as we are facing problems these days.

Pakistan Steel is an integrated facility that produces a variety of finished steel products like hot and cold-rolled sheets and plates of many thicknesses, composition, properties and finish. There are proposals of co-production or integration of the two projects – TSML and Pakistan Steel, although both suffer from the unique issues of operating and reviving their main pieces of equipment. There is potential for synergy and cooperation between the two projects. The Rotary Kiln DRI process offers many opportunities for broadening and deepening the steel sector in Pakistan, as it has done in India. More than 300 such plants operate in India.

Rotary Kilns operate on coal and have a smaller capacity which matches the structure of the downstream steel industry in Pakistan. A typical Rotary Kiln DRI plant has a capacity of 60,000-200,000 tons per year as opposed to 1-1.5 million tons per annum for the shaft-type and 3 million tons per annum for the blast furnace. Local Thar coal may be used in such a process. There is a good level of the technical base in the country to fabricate Rotary Kilns as well.

There are other possible solutions in addition to the subsidized gas supply to TSML. Coke-oven gas from Pakistan Steel can be transported to TSML as well. Thar coal could be utilized in coal gasification for TSML and for producing coke for Pakistan Steel. Initially, Thar lignite may be transported to Pakistan Steel for installing coking and gasification facilities. There should be either ore or coal for economic operation of a steel mill.

Thar can be a good location for organizing future steel, fertilizer and chemical industries. The government is already considering a project of producing diesel out of Thar coal. However, Thar coal prices will have to be corrected. At current prices of $47-60 per tonne, nothing useful can be done. Elsewhere, lignite is being sold below $30 per tonne. Federal and Sindh governments would be well advised to cooperate in correcting the situation. It is hoped TSML will be able to make downstream investments. Its economics and profitability will improve due to the integration and hopefully no further gas price concessions would be required. There is enough land around to expand.

It should, however, be understood that no competitive and profitable industry could be sustained on the crutches of subsidies. Projects should be designed keeping in view the resource endowment and comparative advantage. The government has no money. Money has to come out of corporations and the people earning money.

4.8: Energy and Steel_ Revival of Pakistan Steel

Despite a sizeable and fast-growing market of 9-10 million tons per annum, Pakistan is beset by the closure of two big steel projects – Pakistan Steel Mills (PSM) in the public sector and Al Tuwairqi Steel in the private sector. With PSM, the issues involved are accumulated losses and liabilities, continued payment of salaries to employees and other expenditures. In the case of Al Tuwairqi Steel, Pakistan faces litigation connected with gas supply and its prices.

PSM is being revived. If it is feasible to revive, why was it closed down in the first place? Corruption and over-employment have been cited as the major reasons, which caused indiscipline and losses. Cheaper Chinese steel, available in the market, has also been blamed for the PSM's closure in addition to the lack of economies of scale. PSM had been privatized earlier but the Supreme Court overturned the move, as was the case with the Reko Diq copper and gold project. The Sindh government has also opposed privatization, albeit due to a different reason. There are some genuine questions and issues.

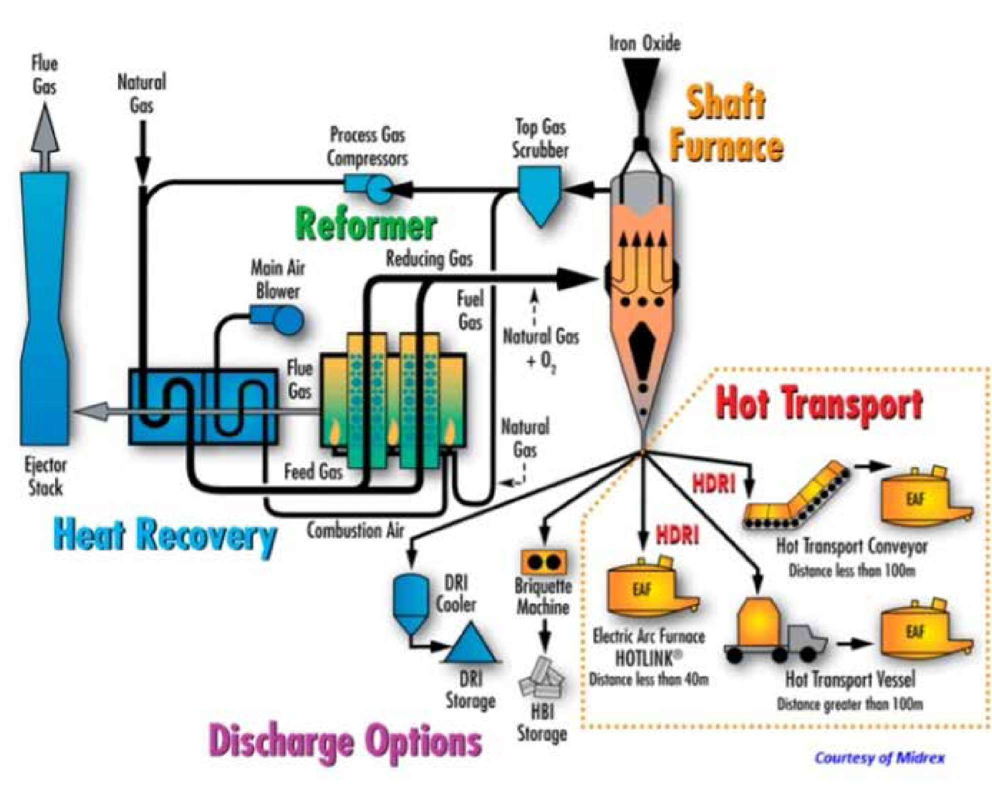
Any steel sector strategy cannot do wonders without involving PSM. The production capacity of PSM is 1.1 million tons per annum. However, it has the capacity of producing a wide variety of steel products including raw blooms and slabs, hot-rolled and cold-rolled sheets and plates of a variety of thicknesses.

In terms of today's consumption levels, PSM's capacity is rather limited that can meet only 10-12% of demand. Its revival or closure will not make much difference in the market.

However, it has the potential of being upgraded with a production capacity of 3-5 million tons per annum, which turns it into an important market player worth revival. The utilization of 18,000 acres of land and the establishment of a downstream industry is another attraction. However, the main driver for its revival appears to be the accumulated liabilities of Rs470 billion and a continuing salary bill of more than 10,000 employees. During his recent visit to China, Prime Minister Imran Khan requested Beijing to take over PSM under some reasonable arrangement. China has earlier bailed out Pakistan in a similar project called the Saindak Metals project of copper and gold in Baluchistan.

Saindak Metals was built by China as it needed copper but it had surplus iron and steel. Thus, PSM may be a difficult issue for China to decide on. However, there is a market potential of 5-10 million tons per annum which PSM can help to acquire. On the other hand, China would have the market in any case as it is the largest and lowest-cost steel producer in the world. Al-Tuwairqi Steel, a Saudi-Korean joint venture located near PSM, is yet another thorny issue. Altuwairqi was a DRI (Direct Reduction Iron) project based on gas and imported iron ore. It became uneconomical due to rising gas prices and could hardly run beyond one or two months. It has remained closed and has gone to the international tribunal as well. Its case appears to be weak as many other plants in gas-poor countries have been shut down. However, risks remain as the tribunal has not been inclined towards countries and governments and has decided in favor of investors.

Chart 4.8.1: Midrex process



Al Tuwairqi had invested around $250 million and had planned to invest $800 million in three phases. It is highly desirable that some technical and financial solution is arrived at under an out-of-court settlement. It may be possible to develop a combined package that revives both PSM and Al Tuwairqi.

In case China does not show interest in reasonable terms, an attempt can be made to revive PSM and Al Tuwairqi as a package under a government-to-government arrangement or otherwise with Saudi Arabia. There is a potential synergy between the two projects. Coke oven gas of PSM can be used to run the nearby DRI plant of Al Tuwairqi. At the same time, Al-Tuwairqi's output can go to PSM for conversion into various steel products.

The PSM revival plan, as proposed by China Development Bank, will require an injection of $885 million in three phases. The number matches the intended Al Tuwairqi investment which has been withheld.

We are in need of a strategy to come out of the impasse and promote the iron and steel sector. The strategy should be consistent with resource endowment. Pakistan neither has iron ore, nor the coal of quality required in the conventional blast furnace process employed in PSM.

Neither were the economies of scale available, especially at the time when PSM was constructed in the 1980s. Even Al Tuwairqi in the private sector did not plan the project well. It based its design on the vertical shaft type plant which required gas. In India, most of the DRI plants utilize coal because of their Rotary Kiln design. Jindal Steel of India has recently commissioned a coal gasification plant, which will supply coal gas (syngas) to its shaft type DRI plant, which is similar to that of Al Tuwairqi. The latter could do the same and the government of Pakistan should encourage it.

Another development is of high interest in this respect. In North Dakota, a lignite/ coal gasification plant has been successfully commissioned which supplies syngas to a urea plant. We have similar lignite at Thar with deposits that could last for centuries at the probable rate of consumption. There was always a question about lignite being useful in gasification. Doubts were created by an underground coal gasification project, which failed and stirred some controversies. Thar lignite should be examined for producing coke and fertilizer.

In general, except for the fait accompli in the case of PSM, the blast furnace process may not be appropriate for Pakistan, both in terms of economies of scale and lack of raw material – iron ore and coke/coal. Smaller DRI-type plants with a capacity of 200,000 tons per year may be appropriate. Lignite can possibly be used in Rotary Kilns of the DRI plants. Despite having substantial iron ore and coal resources, India has adopted the DRI process in a major way. There are 125 DRI plants in India, producing 25 million tons of DRI per annum and associated steel. Total steel production in India is 106 million tons per annum. Thus, the Pakistan industry should adopt DRI (Coal-Rotary Kiln) as a mainstream process with government facilitation.

Finally, and perhaps more importantly, some German firms have started producing high-strength special coke out of lignite. This may be extremely useful for PSM if the same could be done with Thar lignite. Lignite coke could be used in the blast furnace of PSM. A packaged approach for reviving PSM and Al Tuwairqi Steel should receive serious consideration to avoid the risk of an adverse verdict by the international tribunal. There are alternative ways of selling individual finished steel plants of PSM, separately, while waiting to sell or revive the raw steel unit later. Should PSM be revived, in its original form or otherwise, is a lingering question? It is argued that large integrated projects have risks as has happened with PSM. It is argued that small disintegrated plants could be a better choice, as has happened actually, for the growth of the steel industry in the private sector.

4.9: Methanol from Thar Coal

Fertilizer production out of Thar coal and the gasification thereof has been under debate for a long time in Pakistan. There has been considerable suspicion regarding the suitability of lignite for gasification. It has been successfully proved in China and the U.S. that Lignite (Thar coal type) can be gasified and subsequently converted to various products such as fertilizer, gasoline and diesel and other chemical products. However, the issue is that Syngas is produced out of gasification. Syngas is not a final product. It has to be converted to final product like Methanol, Urea, Gasoline or Diesel. In case of Urea, fertilizer plants are located far away from Thar coal; the closest are 400 kms away on Sindh and Punjab borders. Either Syngas has to be transported there, which is not easy or Fertilizer plants may have to be de-installed from their present locations and reinstalled at Thar. Or coal may have to be transported to Fertilizer plants in their existing locations in Sindh. The latter may be a costly operation adding 20 USD/ton to coal costs which are already high under current production scheme at Thar. However, new urea fertilizer plants can be installed without such problems.

There are negotiations going on for producing Diesel from Thar coal. China is producing Diesel from coal since 2008. According to a Chinese publication, Coal to Diesel is feasible at 50 USD per barrel of crude oil prices. Current Brent crude prices are 64 USD/bbl and diesel is spotting at 579 USD/t. It requires 3.5 tons of coal (sub-bituminous probably) to produce one ton of Diesel. Thar coal CV is on the average half that of normal coal. Pakistan annual diesel demand is 7.2 million tons. It would appear that there should be good chances for developing a feasible project producing 1-2 million tons per year of Diesel, meeting 20% of annual requirement. By comparison, a 200,000 barrels per day of oil refinery produces 5 MTPA of Diesel.

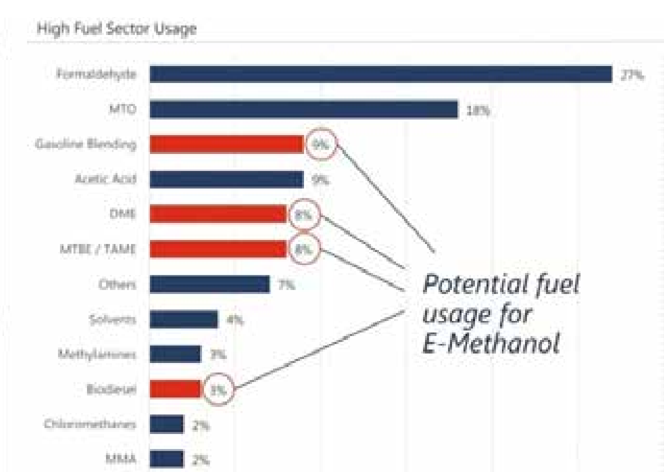
Chart 4.9.1: Methanol Solution for Transportation

FCA Emission Test Results

Average Emissions - FIAT			
Type	95 RON	M15	Improvment %
HC mg/km	37	24.5	33.78
CO mg/km	241.5	228.5	5.38
CO2 g/km	134	132	1.49
Nox mg/km	19	18.5	2.63
NMHC mg/km	10	6	40.00
PM mg/km	1.36	1.1	19.12

Methanol can also be the initial product at Thar site having physical and technical feasibility; economic feasibility calculations waited. China is the largest consumer of Methanol globally consuming 7 million tons annually. China is a net importer despite considerable local production. Thus, there is a scope for designing an export based Methanol project on Thar coal. Other products such as Urea, Gasoline and Diesel may be added as well later. Methanol can be converted to Gasoline as well under an Exxon Mobil MTG process.

Chart 4.9.2: Usage of Methanol by End-Use



Simply speaking, Methanol (CH3OH) is a colorless liquid form of Methane (Natural Gas). It is the simplest form of industrial alcohol being used both as fuel and chemical input. Methanol has many applications. Methanol is safer than LPG gasoline and diesel. Its risk rating (Beleve) is 15 vs. 36 for LPG. Its (M15) emissions are also lower than RON-95 Gasoline. Methanol is non-pressurized unlike LPG.

It can be mixed in LPG as 20% and make LPG cheaper. It can replace LPG altogether, or to the extent LPG is imported. More than 500,000 tons of LPG is imported annually. Methanol can be mixed with Gasoline as an Octane Enhancer in place of injurious metallic compounds based on Manganese. Methanol can be added to gasoline in 12% proportion to be marketed as M15-Gasoline.Methanol can replace Diesel in modified truck engines. Another application is in Marine transportation, where Methanol can replace dirty furnace oil. In China, all such applications are being utilized. India and Egypt have launched projects for M15 Gasoline and LPG mixing.

Table 4.9.1: Properties of different marine fuels

Properties	Methanol	Methane	LNG	Diesel fuel
Molecular formula	CH_3OH	CH_4	C_nH_m; 90 - 99% CH_4	$C_nH_{1.8n}$; C_8-C_{20}
Carbon contents (wt %)	37.49	74.84	≈75	86.88
Density at 16°C (kg/m^3)	794.6	422.5[a]	431 to 464[a]	833 to 881
Boiling point at 101.3 kPa (°C)[b]	64.5	-161.5	-160 (-161)	163 to 399
Net heating value (MJ/kg)	20	50	49	42.5
Net heating value (GJ/m^3)	16		22	35
Auto-ignition temperature (°C)	464	537	580	257
Flashpoint (°C)[c]	11		-136	52 to 96
Cetane rating	5		0	>40
Flammability limits (vol % in air)	6.72 to 36.5	1.4 to 7.6	4.2 to 16.0	1.0 to 5.0
Water solubility	Complete	No		No
Sulfur content (%)	0	0	<0.06	Varies, <0.5 or < 0.1

a for methane/LNG at boiling point
b to convert kPa to psi, multiply by 0.145
c the lowest temperature at which it can vaporize to form ignitable mixture in air
Sources: Jackson and Moyer, 2000; for LNG: Woodward and Pitblado, 2010; Hansson, 2015.

Methanol is cheaper than LPG and Gasoline. Current spot price of Methanol are 1.03 USD/gallon vs 1.65 USD /gallon Gasoline at Nymex, and diesel at 586 USD /ton vs Methanol at USD 342 per ton. However, it has to be noted that 1 liter of Methanol is thermally equivalent to 0.65 Liter of Gasoline. It can be manufactured from a wide variety of raw materials like biomass, natural gas, oil, coal and various wastes. In our case, it would save foreign exchange, if nothing else; if local methanol production is even equal to gasoline or diesel equivalent prices. Comparative cost calculations are to be done.

SNG –Synthetic Natural Gas-appears to be possible options due to the location and transportation issues discussed earlier.SNG is as the name implies is natural gas but is produced synthetically as opposed to being dug out from gas fields. It is Methane (CH4) as opposed to Syngas (mixture of CO, H2, CH and others). Chinese are facing similar problems with their coal and lignite resources buried in Mongolia desert. A number of SNG projects have been implemented and more are in process. Following production possibilities may be considered; Methanol 1.4 MTPA; SNG 600 MMCFD; Urea 1 MTPA; Diesel 1-2 MTPA. Individually, these quantities may not be very high, but combined;

this may become quite a large volume. Integrated power and petroleum/chemical products production may offer many opportunities of cost reduction, especially, through utilization of waste heat and improving yield and thermal efficiency. However, CAPEX requirements would be high. Individual coal projects of 10 MW have had a capex of 2.0 billion USD each.

We need energy but at affordable, competitive and fair costs. Local raw material projects cannot be given unreasonably liberal support and prices, on account of purported foreign exchange savings as the latter are very limited. The local raw material based projects have a considerably high foreign exchange input in the form of foreign debt servicing and profits and imported ancillary inputs. Fortunately, for traded goods like Methanol, Gasoline and Diesel there are known international prices around which agreements are possible. Even gas has become tradable in the form of LNG. Our weighted average import prices of LNG are, on the average, estimated at 7.5 USD and local gas prices are around 6 USD/MMBtu.

These are capital and technology intensive projects having longer gestation periods. Many companies may not be interested. Such projects may only be financed through Chinese cooperation under CPEC or otherwise. There is no free lunch. Investors expect good return. It has to make economic sense for the recipient as well. It is hoped that a competitive, air and mutually beneficial project schemes will be worked out eventually.

Concluding, there is a need for integrating various strands and interests that are circulating in the market and develop some kind of policy. However, it is good to see interest and activity. Let this not wane away.

4.10: Petrochemical Industry: Coal, Oil & Bio-route

Development of Petrochemical industry through installing a Naphtha cracker has been on agenda for a long time. Naphtha is an end product of old-type of refineries, of which there are many. New type of refineries recycles Naphtha into Gasoline. Naphtha cracker has not been installed yet; one of the possible reasons may be the ultimate non-availability of Naphtha whenever upgrading of oil refineries takes place.

Coal has emerged as a competitor to Naphtha) and Gas, not only in power production but as a base material for producing petrochemicals. Coal is more abundant in the world than Oil and Gas, especially in the U.S., China, and Russia and in India as well. Our Thar coal resources are more in energy terms than the combined Oil and Gas resources of Iran and Saudi Arabia. However, coal is a lower grade of Hydrocarbons containing less hydrogen and more waste material. It also produces more pollution. Ultimately, Renewable resources like Water, Air, Biomass and Sunshine will be the main raw materials replacing hydrocarbons or producing renewable hydrocarbons.

Ours and similar developing countries face two challenges, one of which is classical and one is new. The world is passing through a transition from fossil to Renewables; what to do in the mean time. Investments in energy industries and the associated infrastructure have a long gestation time and as well as life cycle. We are capital short and the risk is that our investments may get stranded or underutilized in a matter of 20 years or so; the risk of doing and not-doing? What happens, if we develop shortages of the required materials and inputs? 4. The other risk or controversy of industrial planning is; do we start at finished product end or at raw material end? Presence of the raw material or its abundance may be a favored argument for initiating raw material based industry. However, starting at Raw material end may create problems instead of promoting in developing down-stream industry. Scale economy or resource conditions may lead to higher prices of inputs for down-stream industry.

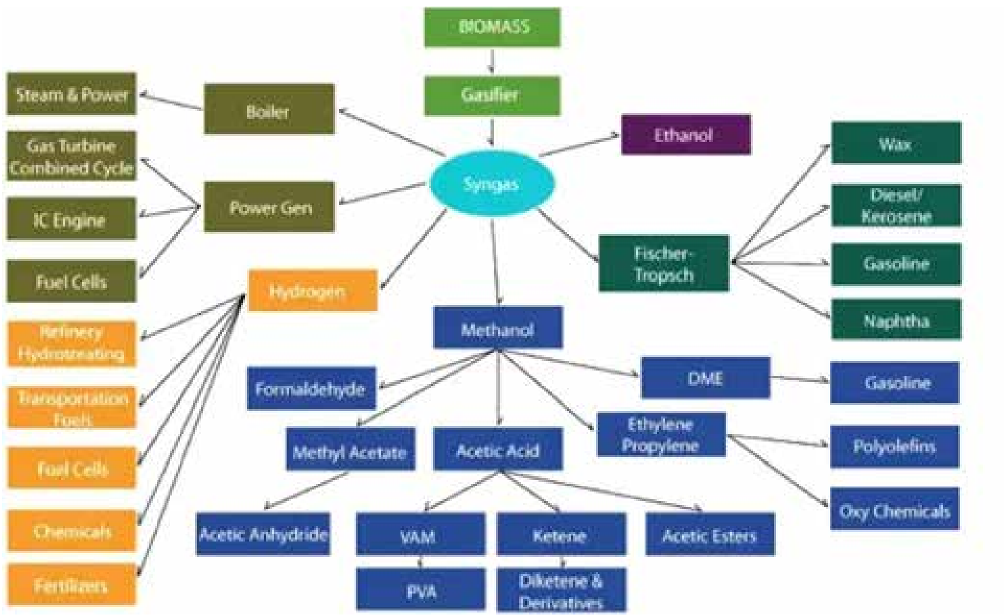
There are now a wide variety of raw materials that can be used as initial materials for producing petrochemicals. Traditionally, Oil and Gas have been used and continues to be so. However, Chinese have started using coal. New technologies have been developed to even use Municipal Solid Waste (MSW) and Biomass as initial materials. Germans are developing Hydrogen cycle through producing Hydrogen by electrolysis of water for which electricity is to come from Wind and solar power. In 1990s, Noble Prize winner, George A. Olah introduced and advocated Methanol economy. Chinese and more recently India have adopted Methanol Economy, as an intermediate step till Hydrogen Cycle is established. Thanks to the availability of abundant coal in the two countries, the Methanol cycle appears to be feasible. It may have some relevance for Pakistan as well.

Why Methanol? It is a versatile material; it is easier to transport; it can be produced at or around remotely located coal mines. Methanol can be used as basic material to produce downstream petrochemicals (Olefins such as Ethylene and Propylene) which in turn are used in making building materials, foams, resins, plastics, paints, polyester and a variety of health and pharmaceutical products. It can be used directly as fuel or can be converted into energy products. It can be mixed up to 15% with Gasoline in normal automotives without any alteration or adjustments in the latter. It can be used 100% in flex-fuel vehicles. It can be converted both into Gasoline and as well as Diesel. It can be mixed with LPG. It can be used in Kerosene cooking stoves replacing Kerosene. China is already the largest producer, consumer and imported of Methanol in the world.

Methanol and Syngas are two fundamental entities; syngas is an intermediate product while Methanol is both an intermediate ad as well as final product. Long chain hydrocarbons are broken into lighter components, (by the applications of high temperature and pressure), such as H2, CO, CO2 (a mixture of which being called Syngas) which are later combined in different fashions to produce different products.

Petrochemicals imports in Pakistan are of 1.5 billion USD (2 million tons) annually. There is a large export market as well. Olefins production can initiate a whole industry of intermediate products leading to wider industrialization.

Chart 4.10.1: Gasification-Options for Bio-based Products



Petrochemical industry is highly capital intensive requiring deep pockets. Only foreign investors like China, Saudi Arabia and multinationals can mobilize that kind of capital and deal with associated market and other risks. In the perspective of utilizing Thar coal, China seems to be the only party that is introduced in Pakistan market and has all the technology and capability.

Thar coal or Naphtha is an important question that has emerged lately. Earlier, all discussion was for installing a Naphtha cracker. It is argued that Naphtha availability is one time and transitional as in the medium term it would be recycled within the new or upgraded oil refineries; it is a cash item that can be sold easily, while one would be monetizing a remotely located Thar coal resource which may remain buried otherwise beyond its use in power production.

We should also keep in mind the evolution of Hydrogen economy. Hydrogen may emerge as a competitive and viable renewable fuel and raw material base. Hydrogen can be mixed up to 15% in current as pipelines. It is coincidental that new pipelines are being made out of plastic pipes which can easily transport Hydrogen or its mixtures with other gases. Our planners must make sure that only plastic pipes are used in laying transmission and distribution pipelines. Pipelines are for 70-80 years and Hydrogen would come much earlier. In this context, transmission of Syngas to Urea plants in upper Sindh and Southern Punjab boundary areas may be considered.

Syngas is produced at high temperatures and has to be cooled down for further processing. This heat can be utilized in power generation. Provided capital is available, power production cum Petrochemicals are produced jointly in what is called poly-generation which is already being practiced in China.

Thar coal has problems as well alongside advantages of huge resource availability. Water scarcity and pollution are two major disadvantages. Thar coal may have to be transported to nearby water abundant regions, though there is general water scarcity in Pakistan. Pollution and environment would be more of an international political problem than a domestic one as Thar is remotely located.

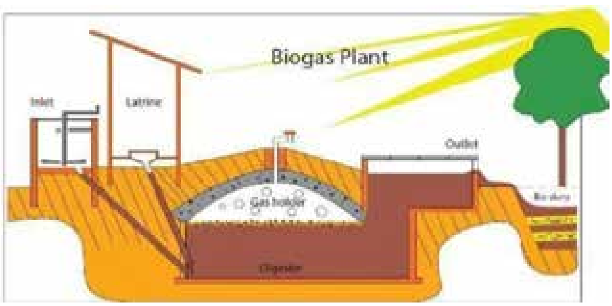
Economics of the two, among others, would determine the choice between Coal or oil route to Petro-chemical industry. Subsidies and protection, under whatever reasoning, should not be provided, while deciding on such matters. Neither should there be any guarantees, sovereign or otherwise. The project should be able to stand and survive on its own. Ideally, it should be an export-cum-local project. It is quite probable that Chinese companies may find the proposition attractive enough, as it currently imports a large amount of Methanol. Chinese companies can import Methanol from their owned factories in Pakistan and market internationally as well.

5: Bio – Fuels

5.1: Biogas: the way forward

The biogas initiative was launched in Pakistan as early as the 1980s. In the meantime, almost nothing of significance has happened; a few thousand family sized biogas units have been installed, thanks to the RSPN and others' action or lack of it. By comparison, India has installed 4 million units and China six million household units. This translates to one biogas unit per every 10 households and one out of every 10 households in India. We need biogas, especially, in our rural areas. Pipeline gas provides gas only to 20 percent of the population, while 80 percent remain and will remain unserved. Our rural areas will remain without gas, despite great potential, if a reasonable initiative is not launched.

Figure 5.1.1: Biogas Plant



Although biogas was initially conceived for households, nowadays it is a significant industrial solution. Today, large plants costing $20 million are being installed. Germany has 5000 of such units injecting gas into gas networks and producing electricity. In Norway, Sweden and Denmark, Bio-CNG has been fueling buses for more than a decade now. To give the readers an idea of biogas potential, only Karachi has equivalent of two gas fields of 30 mmcfd each – one in the Landhi cattle colony and one in solid waste dump. Landhi has 400,000 cattle; the area pollutes both land and sea and spreads disease as well. Municipal Solid Waste (MSW) has been a liability as well – 16,000 tons per day of MSW, containing 50 percent wet food waste. Converting it to biogas may be able to finance the MSW project costs, if not in full then significantly. A Landhi cattle colony biogas-to-electricity project has been talked about for about two decades now. The project has now been changed to fueling green buses by converting biogas to bio-CNG. Will it happen this time?

Figure 5.1.2: An anaerobic digester (AD) for rice straw in the Philippines

There is also talk of generating electricity out of senselessly burning solid waste to produce electricity in Karachi. The threat and risk is air pollution caused by burning solid waste. Poor countries like Pakistan have more wet waste than dry waste culminating into low heat content. An alternative solution could have been to produce biogas and inject it into the grid (after cleaning and upgrading) or/and fuel public transport buses and even private transport. Incineration is old fashioned and risky. Besides, MSW burnt electricity is expensive 10 USc per kWh as opposed to solar of 4 USc per unit. Interestingly, cow dung has traditionally been considered as the only traditional source of biogas. No more; today, biogas can be produced from all kinds of waste: crop waste, animal slaughter, poultry, food and vegetable waste and agro-industrial waste etc. Rice stubble is a menace which is burnt in the winter, on both sides of the border, practically shutting down Lahore, Haryana and Delhi. India has gone ahead with a project producing biogas out of rice stubble; the biogas produced will be injected into the nearby gas grid and supply gas to the adjoining areas. There is no move yet in this respect in Pakistan, although SMEs have to close their businesses in the winter. That's an easy task if not a complete solution. Can SNGPL rise to the occasion?

Biogas is somewhat more expensive; it costs anywhere between locally produced natural gas and the more expensive LNG. Many CNG stations are being given gas on LNG rates. In India, bio-CNG is cheaper than normal CNG. Both dung and crop wastes are free, costing collection cost only .Biogas costs in the two countries may not cost very differently. A bio-CNG plant in India costs $1 million or so in CAPEX but practically very little fuel or operating cost. In India, bio-CNG rates are IRs35 vs IRs42 per kg for conventional CNG. They plan to install 5000 bio-CNG plants in the near future. They have already started doing that and many such CNG pumps are already in operation.

Pakistan has a large sugar industry producing expensive sugar. Being water intensive, whether it should have been there at all is a controversial question. There are some 94 sugar plants, spread throughout Pakistan in Punjab, Sindh and Khyber Pakhtunkhwa. The sugar industry is a great pollutant, producing raw and dirty effluent and press mud-a solid waste. Despite EPA laws to the contrary, they divert their effluents into the water channel or divert it to agricultural land, purportedly providing fertilizer like material to the lands. Only if environmental laws are applied, and effluents from sugar plants can be passed in digesters (anaerobic), a lot of biogas can be produced. In fact, effluent and press-mud mixed have very high biogas generation potential – three times higher than gobar. Untreated biogas can be supplied to the adjoining areas at reasonable costs or/and bio-CNG plants can be installed at or nearby sugar plants. One sugar plant can feed at least 10 CNG pumps. Ninety-four sugar plants can provide biogas to 10 nearby NG pumps. Make money and solve the problem as well?

Put together, there is a potential of 1100 mmcfd of biogas, compared to the 4000 mmcfd of local fossil gas production. And this is renewable; as long as there is life and bio-activity on earth, this level of biogas and even more would be there. Fossil gas will go away; already our gas resources are dwindling and are projected to be exhausted in almost ten years, causing shortages in the meantime, as is the case already. It is not a fairytale; it is already happening in the region and has happened in Europe and the US.

We have some 50 million cows and buffalos in Pakistan. There are 2 million households that have 4-5 cattle each. Practically, all of them should be able to install biogas plants; one million should be targeted for the next five years. There are more than 20,000 households which have 50 or more cattle. Community scale biogas plants can be installed without the need for biogas cleaning or upgrading. Local isolated gas distribution networks can be installed, using 2-3 inch plastic pipe. People and communities can do it themselves, if the legal framework and bank financing is available. A good-sized community biogas plant with network may not cost more than Rs5 million. It is peanuts compared to the cost of LPG Air Mix Plants.

There is one problem, however, in biogas. It contains 65-70 percent methane only, well enough for firing hearths at home or industry. It remains a stranded resource, unless it is cleaned up, removing CO2 and sulfur; then it can be injected into the gas grid or used as CNG or for producing electricity. Significant investment is required to do this; 1 mmcfd plants may cost as much as $20 million. Biogas-based electricity is facing competition from the much cheaper solar, which is much more widely and conveniently used (however, only in the day). As a gas, it may cost anywhere between normal gas and LNG.

What is the way forward; both gas companies. SNGPL and the SSGC may be tasked to install a few biogas-bio-CNG pilot plants. They may eventually find it so good that they may like to block the entry of others. Local communities and governments may be involved for smaller isolated gas grids. Bank and government credit and finance may be arranged by the federal and provincial governments.

Biogas has the potential to initiate a cycle of economic activity without foreign investments. It will mobilize local investors and communities and create employment along with cleaning the environment. One does not see an equivalent competitor to this concept. Biogas should not be rejected or neglected among the list of national priorities.

5.2 Biogas and Bio-CNG

Rural life, especially for the poor, is very difficult in terms of fuel and energy. Cheap and clean fuel is a major and urgent requirement for rural and semi-urban areas. Moreover, local gas resources are going down necessitating imports of LNG resulting in foreign exchange drain in an environment of heavy current account deficit. Biogas, a local resource, can be an important source of fuel.

As a populous agricultural country with a population of more than 200 million, a vast amount of biomass is generated. Biogas potential from livestock manure alone has been estimated at a median value of 350 bcf as against 1400 bcf total gas consumption – 25 percent of the total gas consumption. Only rice stubble, currently a calamity, can yield 30 mmcfd of biogas or (224 million kg of bio-CNG).

Figure 5.2.1: Bio CNG Plant in India

Biogas has been on the agenda since the 1970s. In Pakistan, it was brought in the 1980s. Currently, the NRSP (National Rural Support Programme) and others are engaged in a support programme to popularize biogas. However, only 5000 biogas units have been installed as opposed to 5,000,000 units in India. Clearly, biogas has been neglected. There is no policy and no plan on it.

Biogas is mainly produced out of human excreta and cattle dung, although all kinds of biomass like crop residue, solid waste and sewerage can be utilized. Pakistan is one of the largest milk producers. A number of dairy farms have installed large biogas plants to fuel the requirements of associate industrial units. In Europe and elsewhere, large biogas plants have been installed using all kinds of biomass. Recently, Oman has installed a biogas plant as part of a large dairy farm there. Large-scale biogas has a marketing problem.

Biogas has limitations. Unprocessed, it can be burnt in stoves only, as it contains only 60 percent methane, the rest being CO2 and other gases. Secondly, it can be produced at or near the site of the biomass availability due to transportation issues. Manure has more limitations than crop residue which can be transported to longer distances. Briquette also offers some solution in this respect. Third, it has to be consumed at or near the production point. Normal biogas cannot be transported in pipelines due to its low energy content and extraneous materials. It has to be cleaned and processed to pipeline gas specifications.

Fourth, biogas units are expensive to install for a rural household. Household biogas unit has been costing more than Rs 50,000 per unit and is a substantial construction project of sorts by rural standards, although cheaper plastic made versions are now available. The NRSP and other NGOs have been subsidizing the installation of Biogas reactors in rural areas and training masons and workers.

In Europe, they are cleaning and processing biogas and supplying to the gas pipeline network. At one time, there was a target of supplying 20 percent of gas demand through biogas. A useful form of commercial biogas is bio-CNG. In India, biogas is being used as bio-CNG. Bio-CNG is nothing but biogas cleaned and processed to pipeline gas quality and calorific value. Bio-CNG is also being used in Sweden, where buses are running on it. Bio-CNG has been a recent phenomenon only. India has installed 17 units already. It is in the process of installing another 400 units. They have plans to install 5000 units in the next five years.

A typical bio-CNG unit, producing 8000 kgs of bio-CNG, costs INR4.5 Crores. Bio-CNG is competitive with normal CNG and is being marketed at a lower price (INR35 per kg) than normal fossil CNG (INR45/kg) in India. CNG price in Pakistan, by comparison, is Rs25-138 per kg. Bio-CNG, if produced and marketed in Pakistan, should cost around Rs70 per kg.

On a larger scale, the Landhi cattle colony in Karachi is waiting for the installation of a large biogas plant despite IMF interest in financing it. K-Electric was supposed to buy the electricity generated out of the biogas and the fertilizer byproduct was to be sold to agricultural customers. Reportedly, mafias didn't let them achieve an amicable formula of utilizing the dung. In the meantime, LNG and renewable energy like solar and wind have emerged as a competitive fuel. However, bio-CNG appears to be still feasible. The Ministry of Climate Change (MoCC) has shown interest in supplying bio-CNG to the Green Bus project in Karachi. There are six other cattle clusters in Karachi alone. Similar projects can be implemented in other major urban centers in the country. This can save foreign exchange and support hygiene.

Major urban centers can also install biogas and bio-CNG units at the sites of MSW (Municipal Solid Waste) centers and at sewerage processing plants. Both MSW and sewerage plants will improve their economics as well due to Biogas. At the current state of affairs, bio-CNG may be the only option to produce and market biogas, as pipeline transmission may be too far-fetched. Bio-CNG can be transported over short-to-medium distances though cascade trailers. Already, gas companies are considering replacing LNG-Air-Mix plants by the CNG trailer system at some feasible places.

It appears, however, that the time for biogas for rural family households is gone due to higher upwards capital investment that cannot be afforded by individual households. Massive subsidy and credit may be required, which is partly the reason that biogas could not be expanded to rural areas, except in China and India. There is a new technology of Gasifier stoves, which may be more affordable than biogas. Biomass is burnt directly in these stoves. Gasifier stoves burn cleanly and consume 50 percent biomass than the ordinary biomass stoves. To say the least, a formidable competitor of biogas has emerged; more on this later. Commercial biogas may be more attractive. Processed and clean biogas is commercially competitive at a cost comparable with fossil natural gas ($6 /MMBtu). We have noted earlier that bio-CNG in India is cheaper than normal CNG.

Unfortunately, there is no owner of biogas in the government system. Consequently, there is no policy, no target and no plans or projects. Agricultural departments, local governments, oil and gas companies etc are all stakeholders. However, there has to be one lead agency. The petroleum division appears to be the most active and resourceful institution in the country. They may be entrusted or they may themselves move forward in this respect; after all, biogas is gas, which is their major business. Certainly, they can take a lead in bio-CNG.

For rural biogas development, local governments and agricultural departments may appear to be the relevant organizations to undertake it. The Punjab government should be interested. Punjab lacks gas resources of its own. However, it has the largest livestock population and other vegetable and waste biomass resources. The Ministry of Climate Change and provincial environment departments should be interested as most of biogas is currently released into the atmosphere impacting climate change.

However, the government of Pakistan at the very top may be required to develop an integrated policy framework, possibly tying in subsidies and credit in the process. In addition to increasing fuel supply and decreasing LNG imports, biogas will help control deforestation.

5.3 Towards a Biogas Policy

Biogas is made by fermentation of bio-materials like food waste, agricultural residue, waste water, solid waste and excreta of human and animals among others. Several biogas initiatives have been launched in the past, but they did not achieve the desirable impact and targets for a variety of reasons. Several initiatives continue to date with various levels of achievements. Perhaps there is a need to have a biogas policy to integrate all the relevant sides, identifying gaps and promoting solutions and possibly announce some incentives.

Biogas has emerged from the 'small is beautiful' syndrome and is playing a significant role in renewable energy in Europe, where it is being utilized in electricity generation mostly in co-generation mode producing heat and power, and bio-methane production. There are more than 12,000 large biogas plants operating in Europe, most of which are in Germany, Italy, Sweden, Austria, the Netherlands and the UK. In Italy and Sweden, bulk of the bio-methane goes to compressed natural gas (CNG) while in Germany, the Netherlands and Austria, bulk of the bio-methane goes to the normal gas grid. Raw biogas is converted into bio-methane after cleaning and enrichment.

In Pakistan, 62% of the population uses some kind of biomass for its energy needs. This includes 50% of urban population and 90% of rural population. It is mostly agricultural residue, trees and dung cake.

Pakistan is an agricultural country generating 43 million tons of agricultural waste annually, of which around 11 million remains unutilized. There are 32 million cows and buffalos generating 480 million tons of cow dung.

It is estimated that 50% of it can be collected and utilized better in the form of biogas. It has been estimated that 60% of the rural energy needs can be met through biogas. There are three major modes of producing biogas; a) micro-plants for two or three families utilizing the dung of three animals; b) small plants utilizing dung of 3 to 50 animals and c) from 50 to 1,000 animals and more. In large plants, other agricultural material can also be utilized.

It has been estimated that some 5,000 family-sized biogas plants have been installed, most of which are under operation. Most of these plants have been installed under some subsidy programme due to low purchasing power of rural families. Small biogas plants have been installed by farmers to produce electricity and run tube wells. It appears that there is a greater possibility of success through larger plants installed in commercial modes. Several dairies have installed and are operating large biogas plants to produce electricity for internal use. Some niche entrepreneurs have started even selling biogas through their biogas plants where gas distribution possibilities are there.

Substituting LPG

There are three major areas where biogas can play a major role which include rural gas generation and distribution in off-grid areas, bio-CNG plants in off-gas grid areas and electricity generation projects up to one-megawatt in rural areas, possibly in tandem with solar projects. Biogas has a great potential in substituting or replacing liquefied petroleum gas (LPG) which is many times more expensive. The Ministry of Energy (fuel division) has launched a scheme for providing natural gas in far-off areas through laying isolated distribution networks and filling it with LPG. Heavy subsidies would be required to distribute expensive LPG costing Rs2,500 per million British thermal units (MMBtu) which would be sold at Rs600 per unit. Biogas can easily replace LPG in these projects as the LPG-air mix plants are installed in far-off locations where biomass may be available in abundance. Initially, one may try mixing expensive LPG with cheaper biogas to the extent of availability.

Bio-CNG plants

Similarly, bio-CNG plants can be installed in rural areas to cater to transportation needs and for agricultural tractors. In bio-CNG, the biogas production plant is set up at a suitable site where bio-material or dung is available. Biogas so produced is cleaned and enriched – raw biogas contains only 50-70% methane and contains H2S – and is transported to the roadside filling station through a specially laid pipeline of, may be, one or two km.

Raw biogas produced in small systems is consumed in raw form and is thus cheap and least capital-intensive. Clean biogas of right specifications can cost almost twice as much as the raw biogas. Clean biogas-based CNG can compete with re-gasified liquefied natural gas (RLNG) and LPG.

The Mahindra group has installed a similar project in India. There is a plan to install 1,000 bio-CNG plants in India for which cooperation from 1,000 farmsteads have been enlisted. It has been estimated that one bio-CNG plant will cost INR 50-70 million.

In Sweden also, bio-CNG plants have been installed. Large companies like Pakistan State Oil (PSO), Sui Southern Gas Company (SSGC) and Sui Northern Gas Pipelines (SNGPL) may be asked by Pakistan government to install a few demonstration plants. Private sector is likely to opt for the bio-CNG business in a wholesale manner. There should be an immediate market of several hundred bio-CNG stations in Pakistan.

Thirdly, in isolated areas where electricity is not available and abundant supplies of agricultural and plant material is there, small electricity plants can be installed. Biogas has always suffered from the distribution problem. However, creativity has no limits. Biogas is being distributed by biogas entrepreneurs in Kenya and India in used truck tubes. However, in organized sector as well, beginnings have been made in India to distribute biogas in FRP cylinder.

Project could not be executed

In Karachi, however, a biogas project at the Landhi cattle colony, with planned electricity production of 30MW, could not be implemented, even though financing from the International Finance Corporation was available. Biogas cannot compete with cheap local gas, but it may compete with RLNG. Karachi Metropolitan Corporation's (KMC) self-generation or biogas-electricity swap arrangement with K-Electric could also be examined. An alternative CNG project could be examined. Landhi cattle colony's 200,000 cattle can give 200,000 kg of CNG per day.

Many CNG pumps can be installed near the cattle colony. A less ambitious project can probably fuel KMC's truck fuel demand. Alternatively, cleaned and enriched biogas can be pumped into the SSGC gas grid. It is KMC's resource. KMC will have to take charge of the project; otherwise, it would remain a football among various vested interests. Until recently, dung had been almost exclusively used in biogas production. Recently, processes have been developed to digest crop residue as well. In many jurisdictions, crop residues are co-digested with cow dung and/or municipal waste water. Crop residues thus have acquired a market for their waste which hitherto had no market price. Thus, biogas would increase the earnings of farmers as well as animal owners.

Table 5.3.1: Biogas- Potential Pakistan: Poultry Sector

Chicken Bird Population(Mn)	729
Litter/bird/day(Ounce)	0.7
Litter Production per day-tons	231954.5455
Biogas Production Rate	80
Biogas production /day-M3	18556363.64
Biogas production-MMCFD	649.4727273

Source: Author's Estimates

Table 5.3.2: Biogas Potential from MSW: Karachi & Lahore MSW and Cattle

	Karachi	**Lahore**	**Landhi Cattle Colon**
Daily MSW-tons	10000	6000	6000
o/w Food Waste-%	50	50	
Daily Food Waste-tons	5000	3000	
Biogas Yield-M3/ton	450	450	150
Daily Biogas output-M3	2250000	1350000	900000
Daily Biogas output-MMCFD	78.75	47.25	31.5
Methane Content-%	70	70	70
Daily Methane output-MMCFD	**55.125**	**33.075**	**22.05**
Cattle Population			400000
Manure per cow-kg			15
Daily Manure Production-tons			6000
Methane per Hour-M3	65625	39375	26250
Typical output AD-Digester-M3	1000-2000	1000-2000	1000-2000
Per Plant CAPEX-MnUSD	15	15	15
Number of Plants	30	20	13
Total CAPEX-MnUSD	450	300	195
Unit Gas Value-USD/000 cft	8	8	8
Daily Gas Sales-Mn.USD	441000	264600	176400
Annual Sales-Mn.USD	154,350,000	92,610,000	61,740,000
GP-Margin %	15	15	15
Annual Gross Profit-Mn.USD	23,152,500	13,891,500	9,261,000
Pay-back yrs	19.44	21.60	21.06
Tipping Fee-USD/t	20	20	20
Tipping Revenue	73,000,000	43,800,000	43,800,000
Total Revenue Tipping+Gas	96,152,500	57,691,500	53,061,000
Pay Back-yrs	4.68	5.20	3.68

Source: Author's Estimates

Table 5.3.3: Sugar Plants Biogas Potential-Vinasse+ Press

	Rate				All Plants
Capacity-TPD sugar cane		3000	6000	10000	178082
Sugar-TPD-Recovery %	10	300	600	1000	17808.2
Vinasse					
Ethanol-L/t	90	270000	540000	900000	16027380
Ethanol-t	790	342	684	1139	20288
Vinasse-L/L of Ethanol	10	2700000	5400000	9000000	1.6E+08
Methane-L/L of Vinasse-L	7	18900000	37800000	63000000	1.12E+09
Methane -M3		18900	37800	63000	1121917
Methane- CFD		661500	1323000	2205000	39267081
Methane-MMCFD		0.6615	1.323	2.205	39.26708
Press-Mud					
Press mud-TPD(%of SC)	5	150	300	500	8904
Methane-(M3/t)-M3	119.6	17940	35880	59800	1064930
Methane-CFD	35	627900	1255800	2093000	37272563
METHANE-MMCFD		0.6279	1.2558	2.093	37.27256
Methane-Vinasse+Pressmud	Mmcfd	1.2894	2.5788	4.298	76.53964
No of CNG Stations serviced		21	42	70	1248
CNG Consumption-mmcfd		184			
CNG Stations-Total-no		3000			
CNG Consumption per station	Mmcfd	0.061333333			
% of CNG demand out of Sugar		41.60			

Source: Author’s Estimates

Fertilizer production

Additional benefit of biogas is the production of fertilizer as a byproduct. Last but not the least, biomass are CO2 neutral. Research is going on to convert CO2 into methane by reacting it with hydrogen, which means more methane would be produced in every user cycle. Pakistan is suffering from gas shortages which have been reduced by imported LNG. Local gas resources are depleting. In addition to developing local gas resources, biogas resources should also be utilized, particularly in far-flung areas where both conventional gas and electricity, or one of these, cannot be provided economically. Biogas can have multi-dimensional impact in rural and agricultural development, hygiene and foreign exchange savings.

5.4 Towards A Biofuel Policy

Pakistan's current account deficit has created many problems for the economy. The country's major imports are from the oil sector. There is a misplaced notion that nothing can be done about reducing these imports. Bio-fuels based on local agro-waste are a viable option and a competitive route. Not only can bio-fuels replace imports or lead to equivalent exports, they can also generate employment, increase farm incomes and revitalize rural life. Utilizing agro-waste would not compete with food supply, a risk that has often been put forth. Also, electrical vehicles can have a significant impact on the demand side. A strong case has been made in the following to create a market share of 20-30 percent bio-refining to make an impact of $4-5 billion towards improving the trade balance.

Pakistan has a population of more than 200 million and a large agricultural base. There is a great demand of all sorts of energy including transport fuels. An estimated $12-18 million of oil imports are there. Furnace oil imports have gone but have been replaced by LNG. On the other hand, there is a large variety of raw materials, agro-waste and municipal solid waste, which can be commercially utilized to replace these imports – at least partly. Pakistan is the 10th largest sugar producer and occasional exporter and importer. The sugar industry yields many materials which can be converted to fuel and energy. Already, ethanol is being produced, which can be increased by 50 percent by entering into a Cellulosic processing field, without any need for further land or sugarcane.

In Pakistan, agro-waste (wheat, maize, cotton, rice husk, straw and stalks) alone is to the tune of 135 MTPA; assuming 50 percent collection and 20 percent conversion efficiency, 13 MTPA of bio-fuels can be produced. As against this, the annual demand of transport sector is 13 MTPA as well. One can consume it or export it and import an equal amount of transport fuel of gasoline and diesel. MSW is an extra 48 MTPA, which can also generate an equal amount. Advanced 2G bio-fuels can be produced out of it.

Although ethanol is an energy product, it is not being used in the country, but is being exported. In about 40 countries or more, 5-10 percent ethanol is added to gasoline to replace fossil content and also as an oxygenate to enhance RON levels (anti-knocking property enhancer) from RON82-87 to RON 92-95. These products are called E5 and E10, the numbers representing the ethanol content. E5 is almost a standard fuel in most developed and progressive developing countries.

1G vs 2G Ethanol

There are two types of ethanol; one produced from sucrose obtained from sugar molasses and maize starch; this is called 1G-Bio-Ethanol.There is also 2G-Bio-Ethanol which is produced from cellulosic materials obtained from agro-waste and even MSW. 2G Ethanol production in a sugar refinery has the following advantages: 1) use of sugarcane and its byproducts; 2) use of raw materials already present in the production units offering a logistical advantage and cost saving; 3) increased ethanol production by 50 percent without additional land requirement of sugarcane cultivation; 4) production of bio-fuel during the off-season; and 5) reduction of carbon emissions.

In 2014, Brazilian company Raizen (JV of Shell Petroleum) installed a 2G Ethanol plant with a capacity of 42 million liters per year with a CAPEX of R$250 (US$62 million). Enzymes have been sourced from a famous Danish company Novozymes. Raizen plans to install seven more such plants by 2024, taking production to one billion liters per year.

Resource Base

The sugar industry is quite controversial. It has been largely established under government licensing and capital credit facilitation to the elite and the powerful. The CCP (Competition Commission of Pakistan) has recommended reducing the land availability for sugarcane cultivation since it consumes water that we don't have. There is competition for land for other more competitive and value-added crops like cotton.

The powerful sugar plant owners do not pay the right prices and at the right time; agricultural productivity of land under sugarcane production is low and the sucrose content is low also. Land owners and sugar plant owners are held responsible for not providing farmers, services and advice; and there is price collusion and hoarding.

However, there is a positive side as well; there is a foreign exchange saving to the tune of $2.5 billion, which otherwise would have increased our import bill as is happening in the case of other food items such as cooking oil and tea. The sugar industry can improve its image by investing in high technology and efficiency, decreasing the cost of production and improving resource efficiency; 2G Ethanol is one such route. The Capex requirement, as per data provided earlier, is not so high. There is already ethanol production of 600,000 MTPA out of 16 distilleries. It would be saving more foreign exchange if it is utilized locally. It could be increased by 50 percent without any increase in land use. Increased energy availability in the offseason will be quite a welcome addition.

There are other materials and wastes that are being recycled into bio-ethanol. Agricultural and even municipal solid waste is being converted to bio-ethanol. In Edmonton Alberta, a MSW to bio-ethanol facility has been set up by ERKEM in 2014. The facility processes 100,000 tons per year of MSW into 38 Million liters of bio-ethanol. It is a two-stage process; the first stage produces SynGas and in the second stage the SynGas is converted to bio-ethanol. Alternatively, one could truncate the process partly or wholly and only produce SynGas and convert it to SNG and pump it to the gas grid.

In India, a pilot plant and later larger demonstration plant (capacity of 10 tonnes per day of raw material) has been built which processes agricultural waste like rice or wheat straw, cotton stalk, bamboo and wooden chips. There are plans to upgrade it to a commercial scale facility. Pakistan is among the top ten sugar-producing countries of the world. There is a need for the sugar industry and the government to promote and facilitate investment in these areas. The government should develop G-to-G cooperation with the Brazilian government so that private-sector cooperation is facilitated. Similarly, self-financing projects could be promoted to process agro waste and MSW, cleaning the urban and rural areas and producing bio-ethanol or biogas. Pakistan has a large pool of scientists in the bio-technology area and a number of research institutions that can play a major role in this respect. They should be encouraged and tasked to work in this area.

Biofuels are agro-based fuels as opposed to fossil fuels, which include both liquid and gaseous forms. Current ethanol production is crop based, called 1G Ethanol, made out of fermentation of corn, sugar and others. Recently, 2G Ethanol (also called advanced liquid biofuel) has been introduced, which is based on cellulosic material such as bio-waste material including crop waste, municipal solid waste, sewage, etc.

Biofuels have been mandated for all petroleum products including gasoline, diesel and furnace oil. Biogas and bio-CNG are gaseous inclusions. Our discussion will focus largely on biofuel blending with gasoline. Biofuels have been a preferred fuel for a variety of reasons. These include energy security as most of the petroleum-importing countries have a large agricultural base producing ethanol; price stability which is a balancing insurance against mercurial oil price variations and shocks; emissions from burning bio-fuels in motor engines are considerably less than fossil-based gasoline and diesel; and ethanol is a good and benign octane booster.

Pakistan greatly needs all these four features. Biofuels, however, would not be able to completely replace fossil fuels as neither there would be adequate supplies to replace fossil fuels nor can bio-fuels be burnt alone as a single fuel. Biofuels have to be mixed in a ratio of 5-15% into the existing automotive engines without requiring any modifications. However, with modifications higher percentages of bio-fuels can be used. Ethanol is a great octane booster with octane rating of RON 113 as against RON 87 for an ordinary ex-refinery non-blended gasoline.

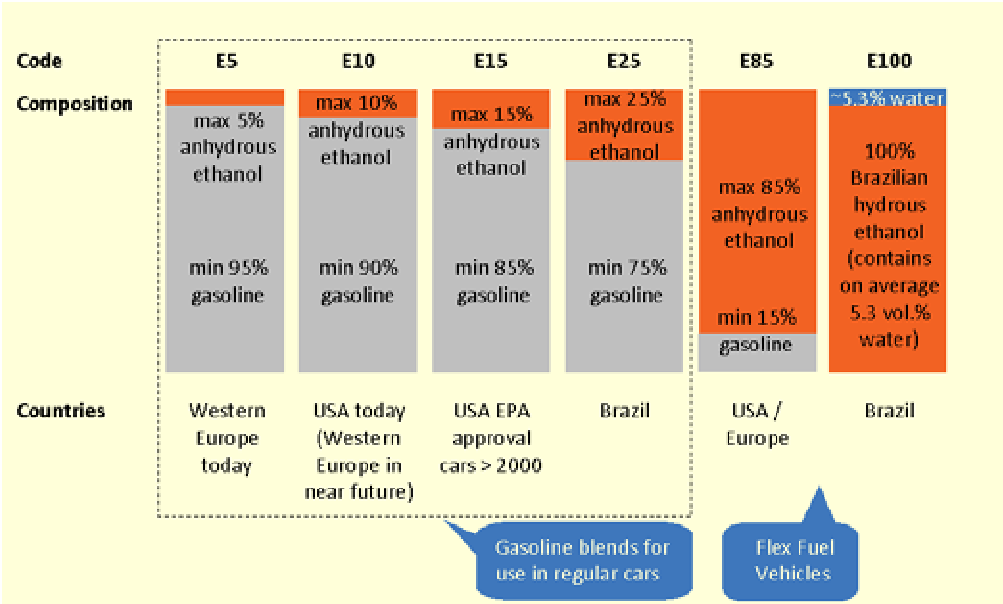
Bio-Fuel Targets around the World

Quite ambitious targets for biofuel mixing in fossil-based gasoline and diesel have been set by most industrialized countries of Europe, North America and Asia-Pacific. About 65 countries in the world have set such targets including 30 developing countries. Only the Middle Eastern region appears to have ignored bio-fuels possibly due to oil abundance and less agriculture. In Europe, E5 gasoline with RON 95 quality is most popular, although its universal availability is scarce. Many European countries have set targets to have E10 by 2020 but have reduced these to 5-7.5% lately. In the US, they are now talking of even E15 (15% ethanol).

In China, the target is 15% ethanol blending by 2020. Nine Chinese provinces have adopted E10 with various levels of success. Most developing countries out of the list of 65 have gone for E5.India mandated E5 in 2003 in 13 states initially and by

2006 extended it to all over India. By 2013, E10 was introduced. However, the actual target achievement in India has been 7.2% by averaging the various ethanol usage levels and non-usage.

Chart 5.4.1: Common ethanol fuel mixtures



Thailand deserves a special mention. Five grades of gasoline are marketed at Thai petrol pumps. Thailand plans to replace E10 by E20.On the diesel side, there are two products B7 (7% palm oil) and B10 (10% palm oil). It is mind boggling as to how such a variety of petroleum products are being provided at Thai pumps, while variety is a common feature in Europe. All Thai cars imported from Japan are said to be E20 compatible.

Ethanol exports

Pakistan exported ethanol to the tune of $425 million in 2018. In volume terms, it was 653,443 tons and average export price was estimated at $650 per ton. If blended with gasoline at a ratio of 5%, it can be mixed with 1.2 billion liters of gasoline. Pakistan's total annual consumption of gasoline is 7.5 million tons. If all of the exported ethanol is made available for blending with gasoline in the country, average ethanol content in gasoline would be around 10%.It means that all of the ethanol requirement for making E10 gasoline can be met by local production. However, it may be too optimistic to prescribe E10 in one go, it may be advisable that a more realistic E5 target is applied.

Pakistan has not adopted any such target in this respect. No apparent explanation is available for this. Pakistan is a major ethanol producer and reduction in ethanol exports could be a possible reason. Ethanol is cheaper than gasoline. It means that by exporting ethanol, we tend to lose net foreign exchange as an equal amount of expensive gasoline is imported. Thus, there is a net foreign exchange loss of 10-20% of ethanol exports per year. About 10 years ago, PSO did introduce ethanol blending and marketed it as a separate product. The initiative was suspended for unknown reasons. Lack of market acceptance and perceived risks to automotive engines were cited as reasons.

Ethanol as RON additive

Pakistan's oil sector has been using manganese-based additives in excess quantities to enhance RON levels, prompting complaints from auto manufacturers. A good alternative could have been ethanol as an octane booster. Reportedly, motorcycles would have some problems using E5. Admittedly, even RON 92 is overkill for motorcycles. A low RON 87 gasoline may be adequate for them. This may cause a price reduction of at least Rs5 per liter, which is significant for the low-income class. The share of motorcycles in gasoline consumption is about 50%. It was probably a mistake to discontinue RON 87 while it was correct to introduce RON 92.

Consideration may be given to reintroducing the regular RON 87 gasoline. In the US and Canada, the regular RON 87 gasoline is still widely available. Special petrol pumps may be installed for motorcycles as well. There may be some old vehicles which may be sensitive to ethanol. Thus, it may not be feasible to introduce mandatory ethanol blending in all gasoline. However, an additional product may have to be introduced. This may require additional infrastructure. Gasoline is being transported by trucks, so no issue in transport facilities. However, regional storages and pump storage tanks may have to be modified or added. Consultation with stakeholders would have to be done to sort out these issues.

Biodiesel

Biodiesel includes traditional biodiesel fatty acid materials and hydro-treated vegetable oil, also referred to as renewable diesel. The EU is the world's largest biodiesel producer. Biodiesel represents about 75% of the total transport biofuel market. Rapeseed oil, used cooking oil and palm oil have market shares of 39%, 22% and 19% respectively among the feedstock materials. Pakistan is short of cooking oil. A large amount of foreign exchange is spent on import of palm oil from Indonesia and Malaysia. Used cooking oil and animal fat may provide some raw material base for biodiesel. It appears that the raw material base not being there, one may postpone it from the agenda for the time being.

Present government appears to be more sensitive and responsive to environmental issues. The Ministry of Climate Change has been made more active and effective. Prime Minister Imran Khan has reportedly taken personal interest in issuing a policy statement on low Sulfur fuel. It is likely that steps may be taken in this respect as well. There may be some overloading due to the simultaneous implementation of low sulfur regime and introduction of Biofuels. A roadmap and a policy harmonizing various requirements and constraints are required.

6: Electricity

6.1: The complexities of Electrical planning

We have emerged from an energy crisis recently, but only to create new problems and issues or accentuating the existing ones. Lack of adequate planning and consensus, thereof, has been at the root of energy deficits and surpluses. Energy generates economic growth and economic growth requires energy. It is a two-way relationship. Energy supplies are capital intensive and have a long gestation time. Long-term demand forecasting is required to bring about supplies. In Pakistan, energy forecasting and supplies development have a chequered history. Shortages and black-outs have occurred several times in the country's history. Regional shortages are permanent, as we see that electricity supply coverage is 80 percent and gas supply merely 20 percent.

Currently, we are facing electricity/energy surplus. After suffering a decade of energy deficit, probably overinvestment has been made which is partly responsible for the rising and uncontrolled circular debt. Lack of reliable forecasting and consensus on expected demand levels led to excessive investment. Both imported coal and LNG power projects were launched at the same time. Currently, an interesting and vicious problem exists; if RLNG power plants are run, coal power plants are underutilized and vice-versa. Take or Pay conditions in LNG and electricity have made the problem more severe. Investments should be demand based rather than supply based. Unfortunately, the latter has happened.

Ironically, demand forecasting and energy planning skills have been in short supply and reliance has been made largely on foreign consultants. Multiple consultants and studies have been launched, often simultaneously, creating confusion and giving rise to arbitrary decision making. However, most effort has been focused on electricity planning and demand analysis, being under government tutelage. In case of oil and gas, not much planning effort has been done. The electricity sector also received a lot of restructuring effort which was transformed from a monolith Wapda monopoly to a highly variegated and structured system. While the oil sector is adequately structured except for privatization, the gas sector faces multitude organizational and structural problems.

To be fair, it is not easy to make accurate and reliable energy demand forecasts. Developed countries, being rich, have excess supplies, which poor countries cannot afford. The late Mahboob-ul-Haque, an eminent and influential economist of Pakistan, once argued that one hour of non-supply may be better than one hour of peak supply. As mentioned earlier, energy demand and consumption is related to economic growth. However, reliable quantitative estimates of economic growth rates (GDP) have not been there, mostly due to political instability.

In the last economic vision report prepared and launched by the previous government projected long-term GDP growth rates varying between 7 and 10 percent. And growth rate now and its projections tell us a different story. All energy demand estimates based on earlier GDP projections would not hold at all. Resultantly, energy planners in this country have been doing scenario forecasting – often taking three assumptions: low, medium and high economic growth. There is obviously, no way of knowing, as to which scenario would transform into reality.

Although qualitatively, there is a firm relationship between economic growth and energy consumption, it has never been easy to determine an exact relationship that could be used to determine energy demand. The relationship is called energy-GDP elasticity by economists. There are all kinds of estimates of GDP elasticity in papers published in economic journals. Estimates for Pakistan vary from 1.5 to 0.6. The variations are due to data, methodology and other factors.

The confusion is not there only in Pakistan. In India, the corresponding estimates have also a similar kind of variations. However, one thing is sure that energy efficiency is improving almost everywhere due to technology changes and the GDP elasticity numbers are going down. For example in Europe, energy-GDP elasticity has gone down to 0.25 from earlier figures of 1.0 or little less. The structure of the economy also influences the quantitative linkage between energy consumption and economic growth rates. Primary and raw material producing economies tend to have a higher demand of energy for producing one unit of GDP than secondary or tertiary economies producing finished goods or dealing heavily in services.

Intra-energy substitution also makes the job of an energy planner even more difficult. Electricity can be made in many ways. Oil and gas can substitute each other. Waste can be left as it is or can be utilized in many ways. Oil may produce less electricity than gas, for the same amount of energy content. Therefore, an Integrated Energy Plan may be a better choice than undertaking a subsectoral analysis of electricity, oil and gas demand separately. However, the usual practice is the latter, partial equilibrium analysis, making assumptions which may not always be tenable.

In Pakistan, an effort was made by the Planning Commission in the past but failed, although for reasons other than technical ones. It is not easy to integrate diverse groups and interests and make them work together harmoniously. There is yet another factor that affects energy demand in a significant way and that is price. Obviously, if the prices are high, demand would go down; if the price increases and vice versa. Thus, there is a negative relationship. It is even more difficult to forecast inflation and energy prices.

Technology change is another driver of variations in energy demand. For example, electrical vehicles (EV) have emerged as a formidable contender. If the claims of EV enthusiasts are accepted, in two decades, the demand of oil would go down challenging the viability of the oil business. The emergence of Renewables like solar and wind, and further emergence of storage would be another blow to fossil fuel.

Practitioners often tend to adopt or are forced to adopt a simple growth rates approach – demand growing or expected to grow at a certain rate. Past trends may be repeated or may be adjusted upwards or downwards according to the evolving circumstances. Others, scholarly inclined, have started adopting time series methods like auto-regressive analysis and have succeeded in getting reliable and credible results.

It is, therefore, not easy to reject some demand forecast or argue strongly in favour of another. Economists are often found making incorrect or erroneous forecasts and later explaining why their forecasts went wrong. It may take some more time to develop more advanced skills in electrical planning, and external advice and input may be needed. In case of demand forecasting, there is a wide spread and strong capability in econometric modeling in our universities.

This resource has not been tapped yet fully. There have been limited industry-academia contacts. Academia is generally shy and used to relaxed schedules, while industry demands tight schedules. There is a lack of common lingua issue as well. Both have to learn the technology of each other to be able to be of use to each other.

Also, it is no more feasible or fashionable in indulging 20 years or longer forecasting and planning effort. It can serve at best as a loose perspective. A ten-year rolling plan with five years updating is being adopted more and more by the planning and investment community. It is in this context that we should evaluate the Indicative Generation Capacity Expansion Plan (IGCEP) submitted by the NTDC.

Table 6.1.1: Energy Consumption Growth Rates % per annum(2012-13 to 2017-18)

	Energy	Electricity	Petroleum	Gas	Others
Domestic	2.9	8.4	-7.6	-0.5	
Commercial	4.1	7.5		-4.6	
Industrial	7.6	4.2	5.3	-0.1	
Agriculture	4.9	5.6	-14.5	4.1	
Street Light		0.7			
Bulk Supplies		5.9			
Other Government	9.5	63.1	4.1		
Power			-3.8	8.5	
Transport	8		10.3	-6.8	
Total	6.5	6.8	4.9	2.8	
Gasoline					17.2
Diesel					5.8
Furnace Oil					-2.6

Source: EYB 2017-18

6.2: IGCEP-A Power Plan for the Future

The NTDC has submitted to Nepra a long-term plan of expansion of electrical power generation covering the period till 2047.It is an indicative plan and is a statutory requirement under the Nepra grid code. Earlier, a similar plan was submitted for a period up to 2040.It is a fast changing world in terms of technology and economics. Even ten year ahead is quite a long term. It is wondered why 2047.It is said that it would be 100th year of Pakistan's birth. A perspective plan might have been all right. There was no need of mixing it with IGCEP. A good thing about this plan is that it has been made by locals using a new software PLEXOs which enables handling of RE and has many new features. Earlier such plans used to be made by foreign consultants. NTDC deserves kudos on it.

Three plans have been prepared in addition to additional simulations; Low demand Generation Capacity is 133000 MW; Base Case 164000 MW; High demand 222000 MW for the year 2047.W have provided Table 1, which summarizes the main results providing supply demand data of the three cases.

The energy consumption /demand has grown at a rate of 6.51% during the period 1990 and 2001 and at 4.37 % during 2001-2018.Over all long term energy growth has been at 5.22%.If historical demand is projected at a rate of 4%, FY 2030 demand/ generation comes out to be 49639 MW. This compares with the low demand scenario projections of a peak demand of 39111 MW by FY 2030, requiring 67964 MW. Capacity growth rate of 7% is there (as opposed to demand growth of 3.4%) which should not be so high in low demand case. There is a case for toning down the low demand case to be requiring 49639 MW or slightly more.

Base Case Demand as per IGCEP is 43820 MW for FY 2030 for which a capacity of 76391 MW has been provided. This gives a RoG of 4.2585 % in demand and in 8.581% in supply in the period FY 2020-30.For FY 2047, the demand has been projected at 103065 MW for which a capacity of 168425 MW has been provided. The RoG for 2020-47 comes out to be 4.825 %.

We will contain our discussion to low demand scenario up to FY-2030, as in this dynamic period, it is rather impossible to forecast technology and economics that far into 2047. The demand has been stagnant around 120,000 GWh for the last two years. In FY 2019-20, energy demand is expected to be at the same level of 120,000 GWh, instead of 155000 GWh predicted by IGCEP-47 base case. In this low scenario, IGCEP projects expansion of generation capacity at a rate of 7.32% .In the environment that is prevailing and is expected to continue, a slower expansion may be realistic. My suggestion is that 4% RoG be taken in this lean period. This would mean a capacity of 49639 MW installed by 2030.Existing Installed capacity is 33534 MW. A total of 16105 MW would be required to be added.4200 MW would be retied and 7200 MW is under construction. It means that only 13105 MW would have to be actually added. All of this should come out of RE, Hydro and Thar Coal. For the next two or three years, excess capacity is to be consumed. In the remaining 7 years of FY-2021-30, 13105 MW would have to be implemented; an average of 2000 MW per year. If there is some shortfall, it can be quickly added by additional 2-3000 MW of solar projects. No more expensive Nuclear in this decade at 4.5 Million USD/MW.A detailed plan on the afore-mentioned specifying locations and capacities should be prepared. It would be solicited projects or auctioning under CTBCM, hence detailed planning would be required by agencies and rather than the investors.

On fuel prices, Thar coal has been taken at USD 1.5/MJ while the actual TCEB determination is of 3.4 USD/GJ. Similarly, RLNG price has been taken at USD 9 per GJ. Perhaps Qatar Gas price has been taken which is up for revision in 2025, a few years ahead. It may be more appropriate to take a conservative Long Term Spot Prices of LNG at 6.00 USD/MMBtu.

Energy/Electricity-GDP Elasticity

The Report authors have not revealed the elasticity data which would have enabled to make some judgment or evaluation of demand model. There are all kinds of estimates of GDP elasticity in papers published in economic journals. Estimates for Pakistan vary from 1.5 to 0.6.The variations are due to data, methodology and other factors. The confusion is not there only in Pakistan. In India, the corresponding estimates have also a similar kind of variations. However, one thing is sure that energy efficiency is improving almost everywhere due to technology changes and the GDP elasticity numbers are going down. For example in Europe, Energy-GDP elasticity has gone down to 0.25 from earlier figures of 1.0 or little less. In some cases, it is even negative. And for India, it is 0.5.Involvement of Academia would have been mutually rewarding

Conclusion & Recommendations

Low demand scenario may be considered for the period FY2020-30 and Base case for 2030-2047.Number crunching and modeling seldom gives accurate plans. These are to be digested and normalized by the experts and decision makers. A strategy meeting of the related agency should be called to finalize a Plan based on the afore-mentioned and the modifications thereof.

7) It would be advisable to develop DISCO –centered plans as well based on broader precincts of IGCEP-47 or even independently. The Bottom-up and Top-down approaches may be reconciled.

8) For Balochistan, special planning is required for its specific need. It is an ideal case for distributed generation. There are 136 Tehsils. Solar-Wind-Battery Storage projects of 1-5 MW may be considered for Balochistan. Irrigation Pumps may be energized out of these projects.

9) Distributed generation should have been more visible than is the case in the IGCEP. It appears to be Grid-centered. At least one Solar project per district should be considered connected at 11 kV. Solar should be given preference as it is available everywhere, as opposed to Wind Power which is not available at all locations.

10) Hydro COGE of around 5 USc in most cases and higher capacity factor of 50-55% have been used. Recent hydro projects have been awarded at considerably higher prices exceeding 7 USc. On realistic prices including Hydro Royalty, possibly, higher share of RE (Solar & Wind) could have been there.

11. There are some data issues as well. Solar CAPEX has been assumed at 500 USD/kW as opposed to 1000 USD/kW as per recent NEPRA determinations. Similarly, Thar coal has been assumed to have a cost/price of 1.5 YSD/GJ as opposed to TCEB determination of 3.5 USD/GJ. Both data discrepancy would overstate the attractiveness of the two plant types.

12. In solicited projects or auctioning/bidding, more responsibilities of upfront project definition would lie on PPIB and System Operator. They should be asked to undertake preliminary studies defining location, technology and capacity. As per CTBCM, responsibility of IGCEP should be shifted to the System Operator. NTDC –IGCEP cell should be transferred to its new place.

Table 6.2.1: GDP Growth vs Projected Energy Demand

		Low-RoG-%	Base-RoG-%
High-RoG-%			
GDP-RoG Assumptions	4.5	5.5	6.5
Energy-GWh)2020-47	3.67	4.825	5.976
Energy(GWh)-2020-2030	3.1876	4.2585	5.267
Energy(GWh)-2030-47	3.96	5.16	6.36

Source: NTDC-IGCEP-2047(RoG Author's Estimates)

Table 6.2.2: Comparative demand vs Capacity: Low, Base & High

Demand

	Low Demand-MW		Base Case-MW		High Demand-MW	
	Demand	Capacity	Demand	Capacity	Demand	Capacity
Year 2020-MW	26844	33534	27128	33534	27391	33534
Total-upto 2030-MW	39111	67964	43820	76391	48718	84707
Addition-2021-30-MW	12267	34430	16692	42857	21327	51173
Addition-2031-47-MW	36633	65077	59245	91855	91038	138557
Addition-2021-47-MW	48900	99507	75937	134712	112365	189730
Total-2047-MW	75744	133041	103065	168246	139756	223264
RoG Capacity Addition 2021-30-%	3.84	7.32	4.91	8.581	5.92	9.71
RoG Capacity Addition 2031-47-%	3.96	4.758	5.16	4.75	6.39	5.87
RoG Capacity Addition 2020-47-%	3.91	5.24	5.07	6.16	6.22	7.27

Source: NTDC IGCEP-2047;Author's Calc

Table 6.2.3: Summary-Capacity Addition over Plan Period 2020-47-MW

Base Case

	L.Coal	Hydro	RLNG	Nuclear	I.Coal	R.E.	N.Gas	F.O.	Imported	yearly Total	Cum Total
Total-up to 2020	602	9945	6677	1230	3736	1846	3010	6488	0	33534	33534
Addition-2021-30	5453	10792	4205	3187	1561	22188	-1506	-4013	0	42857	42857
Total-upto 2030	6055	20737	10882	4417	5297	24034	1504	2475	0	76391	76391
Addition-2031-47	26893	35099	19695	-10	0	14127	-1484	-2475	1000	91855	92035
Total-2047	32948	55836	30577	4407	5297	38161	20	0	1000	168246	168426

Source: NTDC-IGCEP-2047

Table 6.2.4: Summary: Capacity Addition 2020-47-MW-Low Demand

	L.Coal	Hydro	RLNG	Nuclear	I.Coal	R.E.	N.Gas	F.O.	Imported	yearly Tot	Cum. Total
Total -up to 2020	602	9945	6677	1230	3736	1846	3010	6488	0	33534	33534
Total-up to 2030	3934	20622	7238	4407	5297	21507	2840	2475	1000	67964	67964
Addition-2021-30	3332	10677	561	3177	1561	19661	-170	-4013	1000	34430	34430
addition-2031-47	15241	35214	13170	0	0	5410	-2840	-2475	0	65077	65077
Total-2047	19175	55836	20408	4407	5297	26917	0	0	1000	133041	133041

Source :NTDC IGCEP 2047

Table 6.2.5: Capacity Addition 2020-47-High Demand-MW

	L.Coal	Hydro	RLNG	Nuclear	I.Coal	R.E.	N.Gas	F.O.	Imported	yearly Total	Cum. Total
Total-up to 2020	602	9945	6677	1230	3736	1846	3010	6488	0	33534	33534
Total-up to 2030	6743	11602	7933	3177	1561	24686	-1516	-4013	1000	84707	84707
Addition-2020-30	6141	1657	1256	1947	-2175	22840	-4526	-10501	1000	51173	51173
addition-2031-47	56255	55197	55591	4407	5297	42230	698	653		138557	138557
addition-2020-47	56914	45891	49281	3177	1561	43384	-2990	-6488	1000	189730	189730
Total-2047	57516	55836	55958	4407	5297	45230	20	0	1000	223264	223264

Source: NTDC IGCEP-2047;Author’s Calc

Table 6.2.6: Energy Security Plan-2010-2030-MW

	Nuclear	Hydel	Coal	Renew-able	Oil	Gas	Total	Cumula-tive	Actual
Existing -2005	400	6460	160	180	6400	5940	19540	19540	
Addition									
2010		1260	900	700	160	4860	7880	27420	
2015	900	7570	3000	800	300	7550	20120	47540	25000
2020	1500	4700	4200	1470	300	12560	24730	72270	35000
2025	2000	5600	5400	2700	300	22490	38490	110760	
2030	400	7070	6250	3850	300	30360	48230	162590	60,000
Total	8500	32660	19910	9700	7760	83760	162290		

Source: Planning Commission, Economic Survey-2008

13. Excess of 50-75 % capacity over demand has been provided which appears to be expensive. It should be checked and evaluated to minimize cost and investment. Possibly lower plant factor of RE is responsible for it. Higher load factor should be aimed at through Tariff optimization.

14. In order to evaluate the optimality of a Plan, one would like to know the capacity Utilization (System Load Factor) and the unit Cost. Both are missing. The functionality would be there in the software. All data input seems to be there. May be it has already been calculated but has not been included in the Report. I would suggest and request to include the same.

15. There is a rich presence of Econometricians in Academia in Pakistan. Academia should be involved in demand modeling for a mutually beneficial cooperation

6.3: Power Sector: From Deficit Crisis to Surplus Crisis

WE are an interesting people and country. Only a few years back, there was a power deficit and now we have so much surplus that we cannot cope with it; and more is in the pipeline. Partly, the surplus has been exacerbated due to low demand in the wake of current account deficit crisis, devaluation and now Corona. Even before these events, a surplus was being projected. Actually, we are a small economy with little space for making mistakes. GoP is ever in deficit with no money to subsidize and people are poor except for a tiny minority. Late, DR.Mahboobul-Haq wondered if a 1% surplus was better or 1% deficit: he chose deficit. His argument was that supply comes in lumps (Step function, mathematically speaking) while demand grows in geometrical terms. Thus, there would be periods of deficit and surplus around a demand slope. The policy question is whether to be inside the demand curve or above it or be in between.

Chart 6.3.1: Historical Annual Energy Generation (TWh) as of FY 2013-19

Chart 3-4: Historical Annual Energy Generation (GWh) from FY 2013-14 to FY 2018-19

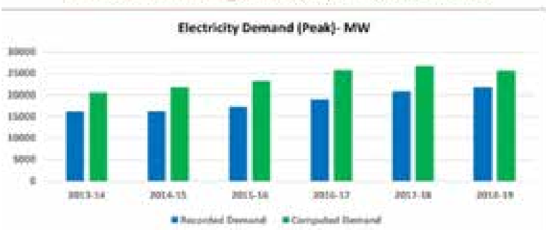


Chart 3-5: Historical Peak Electricity Demand (MW) from FY 2013-14 to FY 2018-19

Secondly, it is not easy to predict demand, even long term demand. It is linked with economic growth and one can only speculate as to what rates of GDP growth would be in different periods ahead. Thirdly, reasonable demand elasticity factors with respect to influencing factors have not yet been established. Amateurs, especiallised, in power planning have been running data on popular software without a deep insight and exposure into the art of econometric modeling. Abundant know-how is available in the academia in this respect which should be utilized, instead of going alone on the part of our power planners. The combined result is the following discussion on the nature and scope of the problem and wondering as to how to deal with it.

Power Demand Projections:

Four major studies have been done including NTDC-IGCEP-2047 with respect to Demand estimations and Power Planning. IGCEP figuratively proves 1: 1 relationship between peak demand and GDP growth. JICA and ESP have assumed very high GDP growth rates resulting on very high demand projections; ESP projected 106517 MW for 2030; JICA projected 69874 MW for the same year. NTDC –IGCEP has made three projections based on low (4.5%), Normal (5.5%) and High (6.5%) growth rate in GDP. IGCEP peak demand figures for 2030 are 43820-48718 MW. Keeping in view the devaluation-corona issues, it may be appropriate to assume low growth rates option for the decade 2020-2030.According to this low growth assumption, peak demand in 2030 would be 39111 MW.

Generation Plan:

Table 6.3.1: Maximum Demand & Load Factor (PEPCO)

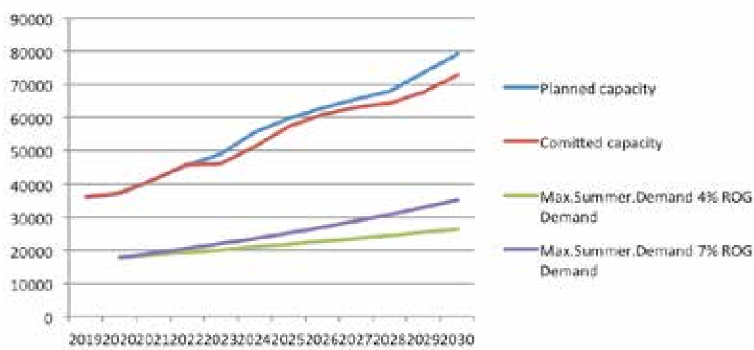
Fiscal Year	Maximum Demand (MW)				Energy Purchased by CPPA-G (GWh)	Load Factor (%)
	Recorded	Computed Peak with Export to K Electric				
	Including export to K Electric	Total	PEPCO	K Electric		
1997	8,305	8,772	8,552	220	49,584	66.33
1998	8,303	9,209	8,877	332	54,792	65.96
1999	8,379	9,351	9,191	160	52,752	66.35
2000	9,356	9,609	9,289	320	54,677	65.31
2001	10,023	10,138	9,828	310	57,262	65.16
2002	10,358	10,459	10,099	360	56,546	65.67
2003	11,069	11,044	10,484	560	62,894	65.06
2004	11,527	11,598	11,078	520	67,837	67.04
2005	12,305	12,595	12,035	560	71,670	68.09
2006	13,066	13,847	13,212	635	86,424	70.25
2007	13,645	15,838	15,138	700	86,967	71.94
2008	14,151	17,398	16,838	560	94,584	68.25
2009	14,055	17,852	17,325	527	82,702	67.57
2010	14,309	18,467	17,847	620	81,116	60.93
2011	14,468	18,521	17,901	620	86,775	70.80
2012	15,062	18,940	18,280	660	86,987	67.44
2013	14,756	18,827	18,227	600	87,060	61.37
2014	16,170	20,576	19,966	610	90,777	66.23
2015	16,233	21,701	21,031	670	96,463	67.88
2016	17,261	23,199	22,559	640	105,671	66.71
2017	19,035	25,717	25,117	600	106,766	64.15
2018	20,795	26,741	26,031	710	120,862	65.91
2019	21,736	26,267	25,427	840	122,300	64.28

Source: NTDC

WE would restrict ourselves o the period 2020-2030 as technological change rate is very high and economic conditions may also vary .A classical example is the results of ESP(Energy Security Plan), which proposed 83,760 MW of Gas (NGCC) power plant capacity, almost 50% of the total proposed capacity of 162,950 MW. Perhaps, Shale was assumed to be the gas resource which did not come up as a viable technology except for the U.S. LNG came but could not have possibly supplied proportional to the projections or anywhere closer.

Hence, it may be appropriate to restrict to a shorter time horizon of up to 2030. Adding 11000 MW of plant retirement in this period and subtracting existing capacity of 36000 MW, net capacity to be installed would be 14111 MW .IGCEP has two sets of power plants; committed power plants (36895 MW) and candidate or uncommitted power plants (43356 MW).This does not include Bhasha Dam(4500 MW).Thus, it appears that there would be no need of introducing candidate power plants. Not only that ,some more pruning may be required.

Chart 6.3.2: Generation Plan



IGCEP-47 did not include Bhasha dam in the light of political issues and that it has been on board now for a very long time and no progress was here. However, EPC contracts have been signed for Bhasha and the dam portion is to be completed in 5 years. In the next 5 years, 4500 MW of hydro turbines would be installed. In this perspective, Bhasha would push out other projects; which one is a difficult question.

A solar capacity of 12773 MW has been proposed,90% of which is non-committed, meaning that no investors have yet prepared any proposals for this capacity or part of it. Similarly, 10279 MW for wind power has been allocated which almost 90% falls into candidate category. Together, Solar and Wind power add up to 23000 MW. An important attraction of Solar and Wind power is its cheap generation cost of 2-4 USc which may further go down. Significant base-load capacity is there and more is proposed to be added. Solar and Wind can play a good role in bringing down the average tariff. It is renewable and does not require any fuel, imported or local.

Even before emergence of Bhasha as a real project, there was skepticism regarding demand and paying capacity both of the government and the people. Power demand is dismally low; it is 18000 MW now in the month of June which is peak summer. In winter, peak demand was just 8000 MW. The installed capacity is 36000 MW. It appears, in the coming few years, if the demand is assumed to grow at a rate of 7%, the demand would not reach a level beyond 36000 MW by 2040. It should be noted that as per NEPRA SOI report released recently, the load factor(capacity utilization in ordinary language) was 0nly 40.1% as opposed to a minimum requirement of 60-70% .A power deficit crisis, it appears, will be converted to excess power crisis. Capacity payments are to be paid irrespective of whether power plants are used or not. This is like renting or leasing a car. One has to pay the agreed rent or lease. Worst has yet to come, as 7000 MW of new capacity would be added in the next few years, all of which may remain under-utilized.

Despite decrease in fuel prices, demand is not increasing.LNG is cheaper now. Due o lower capacity utilization of LNG terminals, terminal tariff have doubled, although LNG itself is cheaper.Net effect is still cheaper LNG.

Why has it happened?

There are many centers of powers which push their favorite projects; WAPDA,PAEC, CPEC and private sector. Power planners such as PPIB, NTDC, NEPRA and CPPA have great difficulty in reconciling with the demands of all these sectors. The tariff is so good and high that despite economic problems in Pakistan and difficulties in payments, there is a long line of investors. Nobody wants to go away. In normal circumstance, companies risk departments may not allow such investments. But Risk vs Profits equation is highly in favour of investments. Generation tariff reforms would not only bring down electricity cost, it would displace crowding.

Table 6.3.2: Comparative Power Demand Projections of various Studies-MW

	Peak Power Demand- MW			**GDP Growth%**
Year	2020	2030	2040	
JICA-Base Case-2016	33913	57413	94980	8
JICA-High Case-2016	36314	69874	128377	9
NTDC IGCEP-47Low GDP-2020		39111	64538	4.5
NTDC -IGCEP47-Normal GDP		43820	83155	5.5
NTDC-IGCEP47- High GDP growth		48718	106517	6.5
Energy Security Plan-2008	72210	162590		10
SNC LAVALIN-2011-Low	42612	82457		
SNC LAVALIN-Normal	49824	107477		
SNC LVALIN-High	54998	128039		

Source: NTDC

Table 6.3.3: Forecast Year-wise Demand-IGCEP-2047:Theoretical high base vs Actual low Base

	IGCEP-2047 High Base			IGCEP-2047-Low Base Actual		
	Low	**Normal**	**High**	**Low**	**Normal**	**High**
2018-19	25627	25627	25627	25627	25627	25627
2019-20	26844	27128	27391	20000	20000	20000
2029-30	39111	43280	48718	29747	32889	36327
GDP-ROG%	4.5	5.5	6.5	4.5	5.5	6.5
Peak Demand-RoG-%	3.8-4.3	4.9-5.3	6-6.3	3.8-4.3	4.9-5.3	6-6.3
GWh-RoG-%	2.8-3.9	4-5	5-6	2.8-3.9	4-5	5-6

Source:IGCEP-2047 NTDC, Author’s Estimates

Table 6.3.4: Actual Demand vs Capacity Scenario

	Planned Capacity MW	Comitted Capacity -MW	Max.Summer Demand-MW		Max Demand MW Corona Case (4-7%)	Generation -GWh		Load Factor		capacity Factor*-	
			Low Demand	**Normal Base Case**		**Low Case**	**Base Case**	**Low Case**	**Base Case**	**Low Case**	**Base Case**
2019	36000	36000	25627	25627	25627	149556	149556	0.666	0.666	0.474	0.474
2020	37265	37265	26844	27128	20000	155203	156840	0.660	0.660	0.475	0.480
2021	41198	41198	28143	28755	20800	159016	162472	0.645	0.645	0.441	0.450
2022	45788	45788	29431	30454	21632	165003	170738	0.640	0.640	0.411	0.426
2023	49086	46086	30286	31755	22497	172664	176918	0.651	0.636	0.428	0.438
2024	55562	51156	31189	32975	23397	177021	182560	0.648	0.632	0.395	0.407
2025	59730	57308	32076	34209	24333	155203	188792	0.552	0.630	0.309	0.376
2026	62981	60805	33099	35636	26036	182086	196044	0.628	0.628	0.342	0.368
2027	65501	63020	34192	37182	27859	187499	203899	0.626	0.626	0.340	0.369
2028	68007	64146	35747	39260	29809	195404	214603	0.624	0.624	0.348	0.382
2029	73535	67657	37429	41537	31896	203939	226322	0.622	0.622	0.344	0.382
2030	79356	72895	39111	43280	34128	212418	237996	0.620	0.628	0.333	0.373
Additional capacity 43356			**36895**								

Source: NTDC data, * based on Committed Author’s Estimates Capacity

Moving Time-lines Ahead or Privatization

Corona may take a long time to end and the business and economy dislocation effect may be lasting even more. It is not easy to rebuilt bankrupt small businesses which are a backbone of our economy. A Corona scenario should also be worked out by NTDC as NEPRA has demanded so many options already. Such sensitivity analyses are desirable. There are two types of power projects; one, those which are under construction at various stages and nothing can be done about them, whether they lie idle or not. It is 7672 MW; there are 2 nuclear reactors of 2200 MW, one RLNG (Trimmu) of 200 MW, several coal power plants of more than 2000 MW and 3 Hydros of 1600 MW. There are other power plants which may be committed and close to signing PPAs but have not yet started construction. Negotiations should be done with the promoters to move their timelines ahead .i.e. delay start of the construction.

Table 6.3.5: Total Installed Capacity under IGCEP by 2030

	Hydro	Thar	Import-ed coal	Thermal/ Gas/ RLNG	Nucle-ar	Solar	Wind	Total
Existing capacity-2019	8713	330	3960		1467	430	1048	36000
Comm. Capacity addition-2030	5154	3270	1620	1263	3300	373	899	20300
Candidate Capacity-2030	2630	2174		4868		12000	8332	30685
Subtotal Capacity addition	7784	5774	1620	6139		12773	10279	45891
Retirement								7629
Bhasha	4500							
Total	20997	5774	5580	24567	4767	12773	10279	78762

Source: NTDC, NEPRA, Author's Estimates

Table 6.3.6: Indicative Generation Capacity Additions (Committed + Candidates Projects) as of April 2020

Source: NTDC

6.3.7: Committed Projects-Private and Public Sector

Private Sector Committed Projects			
	Capacity-MW	**Year of Completion**	**Fuel**
Thal Nova	330	2021	Local Coal
Siddiq Sons	330	2021	Local Coal
Thar TEL	330	2021	Local coal
Sino-SSRL	1320	2021,22	Local Coal
Suki Kinari	884	2023	Hydro
Azad Pattan	700	2027	Hydro
Kohala	1124	2027	Hydro
Small Renewables	5139		Solar,Wind,Bagasse
Total	10157		
Public Sector Committed Projects			
KHI Nuclear K-2	1100	2021	Nuclear
KHI Nuclear K-3	1100	2022	Nuclear
Jamshoro CFPP-1	660	2022	imported coal
Tarbela-5th Extension	1410	2024	Hydro
Mohmand HPP	800	2025	Hydro
DASU-1 HPP	2160	2025	Hydro
Chashma Nuclear C-5	1100	2026	Nuclear
small hydros	163	2026	Hydro
Total	10153		
Bhasha		2030	
Grand Total	20310	2030	

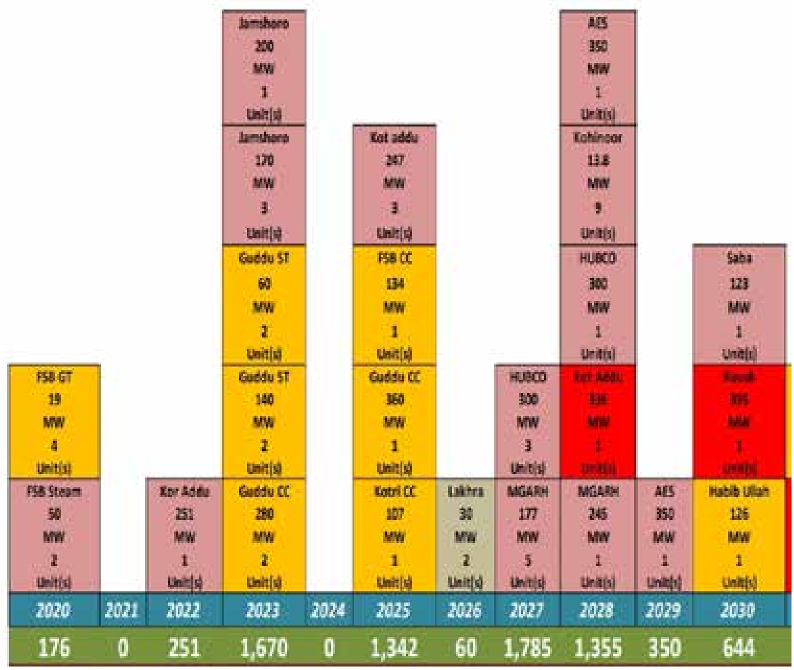
Source: NTDC-IGCEP47

Privatization may not be a solution in such a situation. Who will buy when there is no demand, even though capacity payments may be assured? GoP has already defaulted in paying dues of the IPPs. Assuming that demand picks up, one could try promoting wheeling and freeing the market. There are many risks in that as well. It is a catch-22 situation. Delaying the project time lines, may be the only option?

Table 6.3.8: Monthly Power & Energy Demand & Generation 2019-20

Month	Recorded Peak Demand MW	Computed Peak Demand MW	Computed Energy Demand GWh	Recorded Generation GWh	Shed GWh GWh
Jul-19	22,598	26,118	16,535	14,198	2,337
Aug-19	21,744	25,771	16,471	14,222	2,248
Sep-19	22,696	26,252	15,809	13,660	2,150
Oct-19	16,160	19,328	11,612	9,528	2,084
Nov-19	13,530	16,704	9,396	7,390	2,006
Dec-19	13,282	15,973	9,624	7,529	2,095
Jan-20	13,256	15,959	9,769	7,587	2,182
Feb-20	12,432	15,489	8,985	6,982	2,003
Mar-20	11,972	14,746	8,891	6,949	1,942
Apr-20	17,153	18,587	10,006	8,378	1,629
May-20	19,598	21,732	13,677	11,987	1,691
Jun-20	-	-	-	-	-

Table 6.3.9: IGCEP Retirement Schedule



Source: NTDC

6.4: Electricity Prices in the U.S., Europe and Asia

It would be of interest to readers to know of the electricity prices, elsewhere, in Europe, the U.S. and Asia. In this chapter, we have taken data from national and international sources. Most data is from U.S. EIA and European Union. For Asia, an ADB publication has been utilized which is rater dated of 2015.Most other data is fairly recent of 2017-18-19.The purpose is to show the comparative difference. Cross table comparison may not be valid as varying assumptions might have been used in different cases.

Electricity Prices in the USA:

End User Retail Prices

Average Residential Tariff in the U.S.is 12.85 USc. Averages can be misleading and hide real variations. Residential electricity tariff In Massachusetts (21.97 USc/kWh) and California (21.7 USc), are the highest, almost comparable with Germany and others in Europe. Similarly, average industrial tariff in the U.S. is quite low at 6.42 USc. Lowest industrial tariff 5-5.47 USc are in Kentucky, Texas, Arizona and other states possibly due to cheaper coal resources. But industrial tariff in Massachusetts (14.06 USc) and California (11.96 USc) are twice the country average. Overall electricity price for the whole U.S. and including all sectors is relatively modest at 10.45 USc. And Massachusetts and California are exceptions in this respect as well. It may be noted that there are other states, which are not included in the above short list, which have high electricity prices. Hawaii for example beats all in high electricity prices.

Whole Sale Prices

The adjoining table provides wholesale electricity prices in 12 Reliability regions. Most prices are between 30-40 USc, while ERCOT, CAISO, ISO NE, ISO NY and PJM exceed 40-47 USc. Forecast for lower prices have been made for the following years of 2019 and 2020.Thes exchange prices may be taken as a proxy of average generation costs, as a small amount has been added in these prices for UOS charges. It appears that retail prices are on the average 2-3 times higher than end-user/retail prices.

Table 6.4.1: USA :Average Price of Electricity by End Users-Feb 2020

	Residential	Commercial	Industrial	All Sectors
New England	21.97	16.39	12.87	18.22
Massachusetts	23.05	16.71	14.06	18.79
Middle Atlantic	15.45	11.63	6.39	11.96
New York	17.42	13.21	5.32	13.68
East North Central	13.03	9.88	6.56	9.9
Michigan	15.92	11.47	7.2	11.8
West North Central	10.89	9.09	6.92	9.13
North Dakota	9.28	8.45	8.42	8.66
South Atlantic	11.82	9.3	6.06	10.01
Florida	11.76	9.54	7.38	10.67
East South Central	11.09	10.69	5.48	9.23
Kentucky	10.44	10.19	5.2	8.46
West South Central	11.05	7.98	5.1	8.11
Texas	11.97	7.9	5.4	8.57
Mountain	11.4	9.02	5.79	8.86
Arizona	11.88	9.46	5.37	9.61
Pacific Contiguous	15.88	13.57	8.9	13.42
California	21.7	15.91	11.96	25.32
USA-Total	12.85	10.36	6.42	10.45

Source :US.EIA, Electric Power Monthly, April 24 2020

Tabel 6.4.2: Whole sale Electricity Prices: Reliability Regions- USA-2018

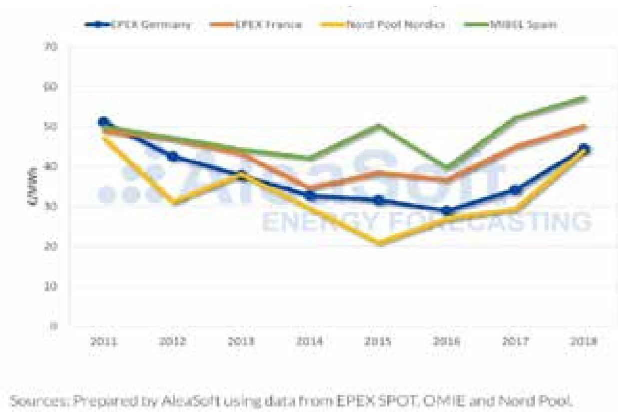
	2018	2019	2020
ERCOT-north hub	41.43	*29.92*	*32.74*
CAISO SP15 Zone	47.33	*36.91*	*39.29*
ISO NE internal hub	49.96	*37.46*	*40.9*
NYISO Hudson Valley Zone	42.39	*34.21*	*35.01*
PJM western hub	41.66	*32.13*	*32.78*
Mid Continent ISO Illinois hub	35.66	*31.14*	*32.76*
SPP ISO South Hub	30.36	*30.31*	*32.14*
SERC Index into Southern	30.78	*30.65*	*30.83*
FRCC Index, Florida Reliability	30.82	*30.51*	*31.09*
North West Index-Mid Columbia	37.77	*36.37*	*37.86*
South west index, Palo Verde	40.66	*33.57*	*37.8*

Italics numbers fore casted, normal actual

Source: US EIA Annual Energy Outlook-2019

European Whole sale Prices

Chart 6.4.1: Wholesale electricity Market Price



In the adjoining figure, we have provided the power exchange prices in Europe. It may e note that the lowest prices have prevailed and continue to do so in Nord Pool. In 2011, electricity prices at Nord Pool were close to 50 Euro/MWh, dipped for a short period around 2015 to the lowest of 20 Euro/MWh and reached earlier level near 45 Euro/MWh by 2018.The second lowest prices have been of EPEX Germany. The third one has been EPEX France. And the most expensive exchange is of Spain, Mibel Spain. NordPool prices have been the lowest possibly due to hydro and cheaper gas. In general, whole sale prices are higher in Europe than in the U.S. In the U.S., cheap Shale gas has played a role in putting down the electricity price. Coal is also cheaper in the U.S. (where it is locally mined) than it is in Europe, where it is imported.

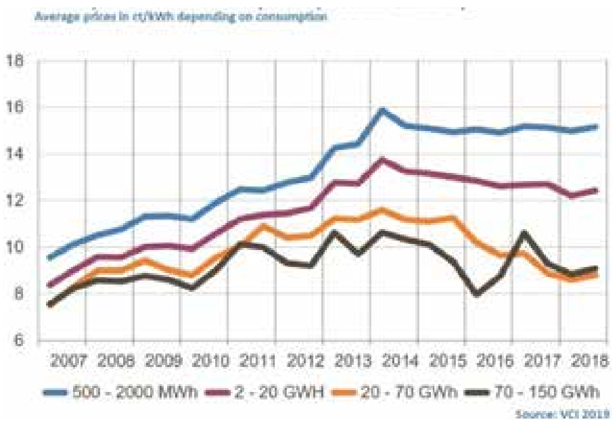
Retail Tariff in Europe

Energy/electricity taxation is quite high in Europe. We have discussed the case of heavy taxation on Petroleum in Europe, elsewhere in this book. In the case of electricity also, there is heavy taxation in quite a few European countries. Mostly, Residential sector is loaded with taxes, as industrial tariff has to be kept low for the purpose of industrial competitiveness.

In the case of Germany and Denmark, taxation is 50% of the residential electricity prices of 30-31 Euro-Cents/kWh. In most other countries, taxation is 25% including VAT.

We have provided the details on Germany's electrical tariff which is loaded by subsidies for Renewable Energy and Energy Efficiency. Out of a price of 31 EuCts, only 6.88 EuCts (23% of the final tariff price) belong to the energy charge. Another 24% belongs to grid charge. The rest is taxation and subsidies. Of significance is the Renewable Surcharge which is 6.79 EuCts.

Chart 6.4.2: Development of industrial power prices in Germany



Industrial electricity tariff of small users has gone up in Germany over the last 10 years. It has gone to 12-15 EuCts by 2018 from a rather modest level of 10 cents. For large users, electricity prices have not been allowed to increase much. These prices are roughly around 8-9 cents only slightly higher than 2008 level.

Whole Sale Prices in India

In India, most of the power is under publicly owned power plants. There are two electricity exchanges in which 1-2 % of electricity is traded. There is short term trade among state-owned electricity boards as well trading quotas in case there is gap between quota and demand. Average Power Purchase Price PPP in India was 3.85 IRs/kWh. There are many states in India each having its independent power system, T&D companies and regulators. PPPs are also different but do not vary a great deal. In the year 2017-18, power exchange price was IRs 3.59/kWh. There appears to be a convergence in the two prices.

Table 6.4.3: India Electrical Market Prices-Irs/kWh

	Bilateral Trading	Power Exchanges	DSM
2009-10	5.26	4.96	4.62
2010-11	4.79	3.47	3.91
2011-12	4.18	3.57	4.09
2012-13	4.33	3.67	3.86
2013-14	4.29	2.9	2.05
2014-15	4.28	3.5	2.26
2015-16	4.11	2.72	1.93
2016-17	3.53	2.5	1.76
2017-18	3.59	3.45	2.03
Average Annual PPP India	3.85		

Source: IEX India Annual Report-2018

Table 6.4.4: Electricity Prices in selected Areas in Asia-USc/kWh

	Pakistan -1	Pakistan -2	Bangla desh	Tamil Nadu	Maha rashtra	China	Mala ysia	Philip pines	Singa pore	Korea	Thailand	Vietnam
Household												
Small		**2.38**	4.81	**2.04**	6.95	7.69	**5.07**	**10.63**	**15.5**	6.51	0.76	6.6
Medium		5.51	5.42	**2.46**	7.29	7.69	**5.07**	**16.1**	**15.55**	5.71	9.13	6.7
Large		6.5	6.21	**3.87**	9.49	7.69	**5.07**	**19.85**	**15.55**	8.29	10.07	7.26
very large		9.19	8.24	8.6	14.48	9.47	**8.4**	**22.64**	**15.55**	27.89	11.43	9.8
Commercial												
Small		14.11	12.76	12.74	16.96	11.93	11.49	**19.64**	**15.55**	9.25	11.8	10.64
Medium		13.25	9.97	12.74	23.45	11.93	11.31	**18.4**	**15.55**	10.37	11.37	10.36
Large		8.31	9.83	14.37	20.24	12.01	11.31	**18.36**	**14.17**	10.88	11.01	9.59
Industry												
Small		11.25	10.07	9.92	8.52	10.59	10.21	**17.96**	**11.68**	8.03	12.2	**7.13**
Medium		10.71	9.97	11.85	12.68	10.86	10.59	**17.66**	**14.17**	9.08	11.37	**6.83**
Large		10.71	9.83	11.85	14.3	11.06	9.06	**17.81**	**14.05**	8.91	11.01	**6.61**
Very Large		10.56	9.83	11.85	15.92	10.83	8.52	**15.19**	**13.36**	10.81	10.67	**6.45**

Source: ADB Study on Electricity Prices in Asia, 2015

Table 6.4.5: India States End user Tariff 201718-Usc/kWh

	Domestic			Com-mercial	Agri-culture	Small Indus-try	Large Industry	Heavy Industry
	100 kWh	400 kWh	1000 kWh	30 kW	10 HP		11kV/1000 kW	33kV, 20000kW
Andhra Pradesh	3.26	7.68	10.62	16.58	1.12	11.36	12.29	11.53
Chhattisgarh	4.19	8.51	11.78	15.25	8.13	9.77	12.62	11.87
Gujarat-Min	**3.94**	**7.91**	**8.85**	**10.04**	**3.16**	**9.05**	**8.60**	**9.84**
Maharashtra	5.66	15.26	20.05	23.73	4.92	10.59	14.72	13.45
TamilNadu	0.85	7.34	9.13	13.92	0.00	10.71	11.87	11.87
Himachal Pradesh	4.00	6.25	6.25	7.81	4.84	6.72	6.02	5.47
Mumbai/Reliance	**5.26**	**13.57**	**17.49**	**21.91**	**7.78**	**15.14**	**17.94**	**18.10**
Mumbai/Tata-Max	**4.60**	**12.15**	**18.44**	**18.79**	**0.00**	**16.44**	**16.38**	**16.38**
Haryana-Min	**3.70**	**8.54**	**10.70**	**12.14**	**0.16**	**10.08**	**9.70**	**9.41**
Ahmadabad/Torrent P	4.23	7.94	8.67	11.72	5.16	8.77	9.04	0.00
U.P.	6.20	10.58	11.54	18.53	10.25	15.43	14.27	13.63
Bihar	6.52	12.05	13.17	13.53	8.27	11.28	11.53	11.36
Punjab	5.66	11.28	12.44	13.52	8.93	10.68	12.88	12.88
Avg Rate	4.47	9.93	12.24	15.19	4.82	11.23	12.14	11.22
Pakistan Tariff Ist Jan 20	3.74	6.58	13.35	12.26	7.24	9.86	9.54	10.00
USD INR Rate	64							
USD-Pk.Rs.	155							

Source: CEA Annual Report India 2017-18,NEPRA

Table 6.4.6: India States End user Tariff 201718-PKR/kWh

	Domestic			Com-mer-cial	Agriculture	Small Indus-try	Large Industry	Heavy Industry
	100 kWh	400 kWh	1000 kWh	30 kW	10 HP		11kV/1000 kW	33kV, 20000kW
Andhra Pradesh	2.09	4.92	6.80	10.61	0.72	7.27	7.86	7.38
Chhattisgarh	2.68	5.45	7.54	9.76	5.20	6.25	8.08	7.60
Gujarat-Min	**2.52**	**5.06**	**5.66**	**6.42**	**2.03**	**5.79**	**5.51**	**6.30**
Maharashtra	3.62	9.76	12.83	15.19	3.15	6.78	9.42	8.61
TamilNadu	0.54	4.70	5.84	8.91	0.00	6.85	7.60	7.60
Himachal Pradesh	2.56	4.00	4.00	5.00	3.10	4.30	3.85	3.50
Mumbai/Reliance	**3.36**	**8.69**	**11.19**	**14.02**	**4.98**	**9.69**	**11.48**	**11.58**
Mumbai/Tata-Max	**2.95**	**7.78**	**11.80**	**12.02**	**0.00**	**10.52**	**10.49**	**10.49**
Haryana-Min	**2.37**	**5.46**	**6.85**	**7.77**	**0.10**	**6.45**	**6.21**	**6.02**
Ahmadabad/Torrent P	2.70	5.08	5.55	7.50	3.30	5.61	5.79	0.00
U.P.	3.96	6.77	7.39	11.86	6.56	9.87	9.13	8.72
Bihar	4.17	7.71	8.43	8.66	5.29	7.22	7.38	7.27
Punjab	3.62	7.22	7.96	8.65	5.72	6.83	8.25	8.25
Pakistan Tariff Ist Jan20	5.80	10.20	20.70	19.00	11.22	15.28	14.78	15.50
USD INR Rate	64							
USD-Pk.Rs.	155							

Source: CEA Annual Report-2017-18

Table 6.4.7: Comparative Power Tariff: LESCO vs UGVL Power Tariff-April 2018

	UGVL		LESCO	Bangladesh	
	Irs/kWh	Pk.Rs/ kWh	Pk.Rs./kWh	TK/kWh	Pk.Rs/kWh
BPL	1.5	2.8354	4	3.3	6.0176
RGP-Rural-250 units +	4.9	9.2622	14		
LESCO;1-100	3.5	6.6159	10.87	5.14	9.3729
LESCO;100-200	3.5	6.6159	14	5.15	9.3912
LESCO;201-300	4.25	8.0335	15.58	5.36	9.7741
LESCO;301-700	4.25	8.0335	16.85	8.7	15.8647
LESCO-700+	4.25	8.0335	18.95	9.98	18.1988
Commercial\l-I	4.6	8.6951	17	3.82	6.9659
Commercial-II	4.6	8.6951	14		
Charity Schools	3.9	7.3720			
Non-GRP	4.65	8.7896			

Non-RGP-Night	2.6	4.9146			
LTP-Irrigation	1.8	3.4024			
WWSP-Water Pump, sewerage	4.3	8.1280		7.17	13.0747
TOU discount-evening	0.4	0.7561			
TOU discount-night	0.85	1.6067			
SG-Irrigation	0.6	1.1341	OP,13.9,P17.90		
Street Lights	4.05	7.6555	15.95		
Temporary	4.65	8.7896	18.2		
Electrical Vehicles	4.1	7.7500			
High Tension Power HTP-1/B2	4.2	7.9390	F13.50,P17,OP17.9	7.57	13.8041
HTP-2-B3	4.65	8.7896	P17.9,OP,10.10	7.35	13.4029
HTP-III-temporary	6	11.3415	17.5		
HTP-IV-night only	2.25	4.2530			
HTP-V Agriculture	1.8	3.4024			
Railway Traction	4.25	8.0335			
EV-HT	4	7.5610			
1 USD=155 Pk.Rs=72 IRs					

Source; LESCO, GUVL, Bangladesh

Retail Tariff in Asia

1. Among the fast economies of Asia, Malaysia has the lowest Residential tariff around 5 USc.
2. Vietnam has the lowest Industrial tariff in Asia around 7.0 USc.
3. Philippines has the highest Tariff in Asia, after Hong Kong; all sectors have an almost tariff around 16-18 USc. It almost compares with many European countries .Only small residential slab is a bit lower at 10.63 USc. Singapore has a tariff almost the same or similar than Philippines, however, Singapore has lower industrial tariff.
4. Tamil Nadu, India, has the lowest Residential tariff, even lower than Pakistan and Bangladesh.
5. All Asian countries have similarly comparable industrial tariff around 11-12 USc, except Vietnam (lowest-7 USc), Philippines (highest -18 USc).
6. In India, all states have different tariffs. We have chosen Maharashtra and TamilNadu which are some of the most advanced.

6.5: Electricity Prices in Pakistan

Prime Minister Imran Khan has stressed the need of bringing energy prices down and has asked for out-of-box solutions. Bureaucratic processes deride creativity and innovation. At the risk of appearing naïve, let me posit the following obvious proposals;

Reduction and adjustments in taxes: Energy sector is a major tax payer. According to some estimates, the tax revenue from energy sector amounted to Rs.700 billion in 2016-17. Due to lack of propensity to pay fair taxes by our elites and commercial people, GoP relies mainly on indirect taxes. And now under IMF tranches, any income reduction is unacceptable. In fact they have encouraged indirect taxation seeing lack of success in increase in direct tax collection. Some adjustments are, however, possible.

Electrical tariff is much more lopsided than the petroleum sector.VAT on electricity in India is under provincial domain at a rate of 6% or even lower. The same may be done here. Although, high tariff award of recent power projects is a factor, Currency depreciation and increase in interest rates have done a major jolt to electrical tariff. Energy sector is highly dollarized based on DFI and foreign date. Interest on working capital has also increased due to rise in interest rates. Most renowned economists are crying hoarse that interest rates should be brought down. An early action in this respect will relieve power tariff stress to some extent as well. Some reforms are at the disposal of NEPRA which have been discussed in this space earlier. High O& M cases can be corrected immediately. NEPRA is not moving in the direction of competition and has unnecessarily involved itself in the rigmarole proposals of CPPAG. It has to do some independent thinking. Inviting competitive bidding does not require a big policy reversal.

There is low capacity utilization; huge difference between winter and summer demand. Fixed charges are increasing due to increasing capacity vs slower growth in demand. MoE has issued some demand increasing incentives decreasing winter tariff. It has to do more. There is perpetual under-utilization of capacity throughout, whether summer or winter. There is reduced night time tariff for night-only industries in India. There is a night time tariff of IRs. 2.60 for night-only industries vs IRs 4.25 general industrial tariff. Some steps can be taken in this direction along with slowing down the induction of new capacity.

There is a case for reducing GST in reciprocating with India's action. In India VAT on electricity is 6% or even less in some states. It would not be aping the competitor. One has to announce counteracting measures to remain in competitive. Such a concession may at-least be given to industries.

Slowing down activism on circular debt; GoP has shown more than due activism on reducing circular debt. However, along with devaluation and high interest rates shock, clearing the balance sheet and bringing all kinds of suspended payables and receivable into consumer tariff has increased the electricity bills disproportionately. There should be a mid-of-the-road tempo.IMF will be happy but people will be unhappy. It is a cash-flow issue and not of cost.

Let us compare the electrical tariff in India with Pakistan. As we will see, that Pakistan prices are 50-100 % higher and in some cases even more. India benefits from cheap local coal. Pakistani Thar coal unfortunately is as expensive as imported coal and twice as expensive if compared to similar lignite elsewhere including in India. However, Indian power sector is beset with almost same problems as these are in Pakistan; high T&D losses including theft at 20%; accumulated debts and liabilities and poor liquidity; old inefficient Gencos and stranded assets. Poverty, the common denominator.

Lower Electrical Tariff in India

Most of the tariff slab in India vary between Irs.4-5 per kWh which translates to Pk.Rs.8-9 per kWh.LESCO tariff correspondingly varies between Pk.Rs. 16-18 per kWh. We can roughly conclude that overall,LESCO(Pakistan) electricity tariff is around 1.5 to 2 times or insome cases even more than twice the ,India(Gujarat –GUVL) tariff.Power tariff vary widely across India, where every State/province has an independent power system, from regulator to financial ownership and liability. We will give some example here in later.Comparison with Gujarat is relevant from many angles;it is geographically contiguous;it has a textile focus;and it is quite progressive and successful province.

Let us take the survey of 6 states residential tariff; Jamshedpur, Ranchi, Nagpur, Pune, Mumbai and Delhi. In Jamshedpur and Ranchi, residential tariff is the same across small and large consumers(400-1600 units) and it is around IRs.4-4.5 per kWh. However, in Ranchi,Nagpur and Pune, there is a wide variation in prices across the consumptin slabs of 400,900 and 1400 units;for 400 units,the average tariff in these states is IRs.8.0 per unit;for 900 units slab 10-11 IRs;and for 1400 units-11-12 IRs. Per unit.Delhi is a special case where the rates are the lowest; 1.25 IRs per kWh for 100 units slab and 4.22 IRs for 900 units slab.

There is subsidised eletricity in Gujarat and in all India, a poor mans tariff.In Pakistan,it is called Life-line consumer and in India it is called BPL-below poverty line.However,one could not ascertain the percentage of consumers in this categoy. In LESCO,it is Pk.Rs.4per unit being 1.4 times the corresponding rate in Gujarat.The highest tariff slab in residential sector in GUVL starts from 250 units with the price tag of IRs. 4.25(Pk.Rs.8.05 /kWh) ,while in Pakistan,the highest slab is of 700 units+ with a price tag of 18.95 Pk.Rs.per unit,while in India. Similarly,in the case of Industrial tariff,LESCO B2 slab is priced at Pk.Rs.13.50 per kWh as opposed to GUVL tariff of Pk.RS.7.9390 /kWh; a timer of 1.637.

There are some peculiar slabs in India,which we don't have here in Pakistan.They have introduced 2 slabs for EV;one at low tension priced at IRs.4.00. and the other at HT of IRs.4.10.There is a special tariff for Railway Traction as well.The most striking feature of GUVL,which perhaps is inmost parts of India as well,is the night time special tariff meant for only those ompanies which operate during the night.The tariff is Pk.Rs. 4.25-4.90 per unit.This comes out to be one-third of the B2 equivalent tariff of Pk.Rs.13.5, flat rate.Are these export industries or some highlydesirable energy intensive industries.There must be more peculiarities and conditions to it.We in Pakistan,need a similar concessional tariff which encourages consumption in winters; and in winter or even summer nights.The night load both in summer and winter and overall winter load 24/7 is very low;8000 MW vs 35000 MW installed capacity.It may be worthwhile investigating the possibilities in this respect which appears to have potential for bringing down the average tariff.

General Tariff Comparison:

In domestic sector,European tariff is very high;the reason being high taxation and subsidies for Renewable energy.In Germany ,the residential tariff is USc 33.50 per kWh,50% of it is taxation and subsidies.Resultantly,Germany is able to have an industrial tariff of 16.89 USc per unit.Among the industrialised countries,France seems to have the lowest electrical tariff;USc 18.50 for households and 11.22 USc for industries and commercial.Spain has 26.07 USc in Household and USc 12.46 for industrial end users.Spain and Italy have identical household tariff at USc 25-26 USc. However,Italy's industrial tariff (USC 18.02) is 50 % higher than that of Spain.The power tariff in the U.S. is perhaps the lowest among industrialised countries.11-15 USc for household and 7USc for industries.Like India,there is a wide variation in power tariff among states in the U.S..The difference may be of the order of 100% or more. Varying resource endowments and environmental laws,among others, appear to be the reasons for variations.

Emerging Economies: Malaysia,seems to be having the lowest tariff at 6 USc for household and USc 10.00 per kWh for industries.Malaysia's energy resource endowment and export oriented economy seems to be the drivers in this respect.

Similarly,Turkey has a low tariff;9.19 USc for households and USc 7.66 per kWh to be the industrial tariff.China seems to have comparable tariff with South East Asian region where it is situated.Reportedly,there are wide variations in regional tariff there too.There are fuel imports and domestic resource endowment as well.

Tariff Slabs; Share and Impact

It should be noted that life-line consumers have a share of 2% in consumption which should not be a big load on either GoP or other consumers.However,concessional tariff as a whole(upto 300 units) has a share of 31% which is a considerable load.High end consumers(700 units plus) who pay the real cost of electricity or even more have a very small share of 5.35 %in total consumption.Agricultural sector with a share of 12.87 % also is under concessional tariff.Industrial sector with a share of 22.67% is required to pay the full cost .And parts of the industry like export sector also requires a concessional tariff of 6-7%.Internationally,residential sector tariff is low and most costs and taxes are loaded onto the residential sector with tariff of 20-25 USc per unit.The issue is poverty and low incomes in Pakistan,while consumption attitude and behaviour is approaching to international norms and practices.Resultantly,electricity theft is there and may increasae in future despite efforts to the contrary.Rising tariff induces theft.This is not in Pakistan alone but elsewhere also in all poor developing countries including India where electricity losses are higher than Pakistan.

Table 6.5.1: Comparative Electrical Tariff selected countries-USD/kWh

	Household	Industry etc
Germany	0.3350	0.1689
France	0.1850	0.1122
Spain	0.2607	0.1246
Italy	0.2497	0.1802
UK	0.2302	0.1646
USA	0.1500	0.1500
Turkey	0.0919	0.0766
India-Lifeline 3.61 YSC	0.0800	0.0000
Bangladesh-Lifeline-3.88 USc	0.0630	0.1010
Pakistan-life line ;2.58 USc	0.025-12	0.1500
Malaysia	0.0600	0.1000
Thailand	0.1200	0.1200
China	0.0800	0.1000
1 USD=85 Taka=72 IRs=155 Pk.Rs=0.92 Euro		

Source: EU Energy, Dacca Power, Bijli- Bachao India, Global petrol Prices

Table 6.5.2: LESCO Electricity Tariff and Subsidies thereof(Rs/kWh)

All DISCOs			
Slabs	**NEPRA Tariff**	**Notified Tariff**	**Subsidy**
up to 50 units	4	2	2
01-100 units	13.9	5.8	8.1
101-200 units	15.9	8.1	7.8
201-300 units	16.8	10.2	6.6
301--700 units	20	19	1
700 units +	22.4	22.1	0.3
ToU-Peak	20.8	22.1	-1.3
TOU-Off Peak	14.2	15.8	-1.6
Total			
Commercial	16.81	18.01	-1.2
Industrial	14.95	15.79	-0.84
Agricultural	14.56	14.56	0
Total-GWh			

Source: LESCO,NEPRA

Elite Capture in Cross Subsidies

In Pakistan we have an entrenched, cross subsidy system implemented through a cascaded tariff. It operates both in electricity and gas tariff. There are on average 5-6 slabs in residential tariff. Low consumption consumers get lower tariff and high consumers have to pay higher tariff. For example, In case of electricity, small consumer consuming 50-100 units pays around 5 Rupees per unit and large consumer may pay as much as 20 Rs. Similarly, small gas consumer may have to pay as low as Rs.500per month, while large consumers may have to pay 5-7 times higher rates.

Large houses residents benefit from cross subsidies

On the surface, the idea appears fine; small consumer is supposed to be poor or among lower economic classes and thus gets to pay less and large consumer supposed to be rich or well-to-do, pays more. However, it is not as simple as that. There may be and there are consumers who live in large houses but through various legitimate ways of conservation and energy efficiency have a smaller bill due to reduced level of consumption. Should they benefit from a tariff system which is primarily meant to benefit the low income classes?

Inequities of Net Metering

Now, there are other schemes which are accentuating this problem. Those who install solar facilities on their roof tops, they benefit in two ways. Apart from cheaper solar energy, their consumption is reduced and starts falling into lower rates category. Another, there is a Net-Metering system through which the solar owner sells electricity to the DISCO. He may be avoiding peak tariff and in exchange sell during the non-peak period. Both are at the same rate. Practically, his monthly bill may be reduced to zero and in some cases he may actually make more money from DISCO. In this category may come people who are living in large and expensive houses of one canal or more and may have invested 0.5-1.0 million Rupees in their solar roof top?

DISCOs do not bring it from its own pocket. They has no pocket other than the consumers, rich and poor. Average tariff increases and everybody pays. There was a time when solar energy was expensive and such promotional schemes might have been considered fair and opportune. No more; solar prices have come down and efficiency has increased. There is no need for providing solar incentives. Solar is viable on its own. It is cheaper than grid. Besides, it provides autonomy and saves the investor from untimely load shedding and break-downs.

No wonder, interest in India on Ne-metering is waning. As it is the market share of Net Metering did not exceed 5% despite active promotion in early stages. Recently, four important states have served notice to discontinue Net-metering. They have announced they would be interested in gross metering only. i.e. just buying at going whole sale rates currently at IRs.3.79 per kWh. In Europe, many countries have withdrawn net-metering schemes because Solar OV can now stand on its own economic feet. In Asia, there are other issues, as mentioned elsewhere, of resource transfer from poor to the well-to-do and rise in average cost and tariff.

There is a case for correcting the situation. First of all, Net-Metering should be discontinued except perhaps the existing contracts where in Solar may have been installed at higher costs.Net-metering may be replaced by Gross Metering whereby electricity is purchased from Solar roof tops at an appropriate going rate. The other is a Flat Tariff for large houses of more than one canal(500 Sq yds) or even 1o Marla(250 Sq.yds) at the rate of highest slab. This should be applicable for both gas and electricity sector.

IMF and World Bank have been demanding targeted subsidies, meaning thereby that lower income groups be paid cash transfers rather than lower tariff. And the tariff is saved from cross subsidies. Our proposal is an alternative and possibly more manageable than cash transfer subsidies. Concluding, there is a tendency in Pakistan looking for grand solutions and small improvements are ignored or looked down upon. There are no grand solutions. Small improvements add up to a large improvement .This proposal should be taken in this spirit.

6.6: Circular Debt – Removing Cost-Tariff Deficit

The circular debt has reached Rs1160 billion and is expected to grow further if nothing is done to control it. The debt has caused extreme liquidity crisis, forcing several IPPs to shut down their plants. In today's difficult economic circumstances, the government's capacity to inject cash into the sector is quite limited.

The consumer's ability to afford increase in electricity prices will also be limited due to the impending cycle of inflation and slow economic activity. The supply chain of the power sector has the following sequence – fuel producer and/or supplier like PSO and gas companies who sell fuel to the IPPs and Gencos who produce and sell electricity to distribution companies which sell it to consumers. The government acts both as a financier and the consumer also. If consumers do not pay or steal electricity or if Nepra does not calculate the full-cost tariff or delays its determination, etc, the distribution companies suffer a loss and have cash flow problems.

As a result, they cannot pay their own bills to the electricity suppliers and the IPPs, in turn, have cash flow shortages and do not pay to fuel suppliers or pay partly. Fuel suppliers being government companies keep supplying until their own suppliers refuse to sell to them or LCs are not honored. The buck stops here and the government comes in which is the ultimate buyer and manager of the system. The government itself is a defaulter also in many ways. It has to pay accumulated subsidies of Rs244 billion. It lowers tariff for certain users and promises to pay on their behalf in the form of subsidies, but never pays or pays only partly, which creates cash flow problems and debt.

It is often convenient for the government to funnel subsidies to other sectors such as agriculture through cheap gas or electricity, which otherwise would be impossible to give directly to farmers. Cheaper fertilizer is passed on through cheaper gas provided to fertilizer plants. These debts or shortages do not get resolved in a year or two but keep adding up over the years. Thus, there is an accumulated debt of Rs1, 196 billion, call it circular debt or serial. This amount will grow at a pace of Rs180 billion or more per year if not controlled.

Senate Report

The Senate released a very informative and useful report on the circular debt in the name of the author – Senator Shibli Faraz, who is the convener of the Senate Standing Committee on Circular Debt. This section is largely based on the data provided by the report. According to the report, the CPPA-G/ distribution companies' receivables stand at Rs824 billion, of which Rs500 billion is owed by defaulters. About 5.3 million consumers are running defaulters meaning they continue to consume electricity despite default and no payment and power connections of only 1.3 million defaulters have been cut off.

The government has to pay Rs244 billion in outstanding subsidies to the AJK, for tariff differential, agricultural tube wells, etc. Against the estimated circular debt of Rs1, 196 billion, the defaulters have to pay Rs500 billion, the bulk of which belongs to three companies – Qesco, Pesco and Sepco.

The second major cause of circular debt is unpaid subsidies. Under this head, Rs44.4 billion has to be paid to agricultural pumps. In fact, a major issue causing financial problems is agricultural consumers running tube wells. They have defaulted on payments amounting to Rs188.5 billion. Agricultural consumers operating tube wells require a major intervention. The report has made a major recommendation.

Transmission and distribution losses of Rs187 billion appear to be much lesser than the receivables of Rs500 billion from the defaulters. It appears that authorities may have to either write off more than three-year-old receivables or launch a major drive to recover the amount. It may be possible that leakages have been hidden under the receivables. A more dangerous indicator is that such receivables are on the rise. For example, for Sepco, the receivables have increased from Rs39.8 billion in 2013 to Rs84.6 billion in 2017, more than double in five years. One would be skeptic about the correctness of these numbers. A rigorous audit may be conducted.

Regulations

Regulatory issues also contribute to the accumulation of circular debt. In order to control costs, Nepra pulls a tight rope which, however, results in lower recoveries. The regulatory time lag is there due to a time-consuming cost-plus cycle. Also, it takes very long to notify the tariff. We may have to examine an alternative performance-based tariff system for the distribution companies' ala K-Electric in order to eliminate the need of frequent rate-setting which is time-consuming. The Senate report says the power sector lacks 3C – consensus, cohesiveness and continuity – for which the report recommends creation of an institution. Utopia of so-called independent and effective boards has been relied upon, which has not happened. Instead executive power has practically been exercised by the ministry.

The ministry, now Power Division, could not organize itself according to the challenge and vacuum created by the erstwhile Pepco. On the other hand, its counterpart the Petroleum Division managed to create a modicum of organizational infrastructure in the form of directorate generals. One would like to support the recommendation of the report of creating an institution. To give it a concrete picture, let us call it reviving Pepco in an improved form with a progressive organizational structure and design.

The report proposes the introduction of hydro royalty/net hydel profit ala Khyber-Pakhtunkhwa and doing away with the reduced tariff for the AJK. Most probably, the AJK would benefit in a number of ways. There is another recommendation of handling the receivables of tube well consumers, particularly in Balochistan. The proposal is to develop a solar PV scheme in this respect.

Bridging Cost-Revenue Gap

The real solution lies in reducing the gap between the cost of supplies and the electricity revenue. Following means may help achieve this – tariff reforms in the form of reducing excessive rate of return and other parameters, introducing competition, changing the fuel mix in favor of cheaper ones in the form of cheaper solar, wind and Thar coal; reduction of T&D losses and theft along with collection of bills regularly; improving law and order situation in major default areas of Pesco, Sepco and Qesco, in cooperation with provinces. On a lighter note, there is another point of view that debt is not that bad so long as you can service it and that financing business through retaining payables is a common business practice. However, excess of everything is bad.

One should not be too scared of Rs1, 160 billion in circular debt, but should be mindful of financing the payables to fuel suppliers like PSO and to the IPPs which stand around Rs523 billion. The government has to pay Rs248 billion in subsidies, thus a net of Rs275.9 billion may be passed on to consumers in installments so as not to have an impact of more than Rs0.5 per unit. Years of accumulated problem cannot be wiped out in one go. A gradual approach will be required which, in turn, will require external financing. A concessionary loan from Chinese banks or the ADB of Rs300 billion may be obtained, if feasible. At 2% interest rate, the servicing cost will be Rs6 billion.

The interest cost may be passed on to the consumer tariff, which would result in Rs0.6 per unit addition to the latter. Concluding, the ultimate solution lies in removing the deficit between the cost of supplies and the consumer tariff. Recent projects have been installed at a tariff 40% higher than normal rates.

Introduction of renewable energy which is the cheapest today can help. Reforms in the tariff system and a competitive regime can bring down the cost of local resource-based electricity such as Thar coal. Control on transmission and distribution losses as well as on receivables are to be undertaken with seriousness and in an organized manner.

Table 6.6.1: DISCOs Financial Impact of Losses and Under Recoveries-BnRs

DISCOs	T&D Losses	Under Recoveries	Total	Share %
QESCO	28.55	204.79	233.34	29.60
PESCO	55.33	71.55	126.88	16.09
SEPO	37.53	74.42	111.95	14.20
HESCO	30.02	60.93	90.95	11.54
IESCO	2.18	76.05	78.23	9.92
LESCO	39.5	27.01	66.51	8.44
MEPCO	18.28	14.51	32.79	4.16
TESCO	1.93	18.02	19.95	2.53
GEPCO	2.55	16.95	19.5	2.47
FESCO	5.75	2.51	8.26	1.05
Total-ALL DISCOs	221.62	566.74	788.36	100.00

Source: NEPRA, IPP Report-2019

Table 6.6.2: Cumulative Budgetary Support to Power Sector-Rs Billion

	FY2016	FY2017	FY2018	FY2019	Total
to WAPDA-PEPCO					
Inter DISCO Tariff Differential	128.59	91.08	48.75	130	2123.52
Others	29.49	11.58	9.13	16.86	263.65
Total	158.08	102.66	57.88	146.86	2387.17
To KE					
Tariff Differential	53.4	10.68	11.37	13.64	453.23
Others					
Total	53.4	10.68	11.37	13.64	453.23
Other Liquidity Injections					341
Grand Total	211.48	118	83.98	160.5	3201.74

Source: IPP Report

6.7: DISCO Performance

There are two major issues in the power sector; high generation cost and distribution losses; the latter being one of the major issues in improving profitability, sustainability and performance of DISCOs.

Table 6.7.1: Salient Data on DISCOs-2019

	Peak. DEMAND MW	Demand RoG %	Consumers no	Sanctioned-LOAD MW	Units Sold GWh	Loss %	Area SQ.Kms
PESCO	3110	1.67	3472445	7473	9073	36.56	77474
TESCO	609	3.5	442586		1603	10.44	27220
IESCO	2314	-4.24	2979990	8090	10789	8.86	23160
GEPCO	2413	-4.94	3528952	7809	10004	9.87	17207
LESCO	4765	-7.31	4889862	14267	21132	13.17	19064
FESCO	3053	-4.35	4171409	13259	13499	9.81	36122
MEPCO	3663	2.41	6485432	13921	16310	15.79	105505
HESCO	1234	-3.74	1115660	2860	3917	29.48	81087
SEPCO	1359	-2.95	762132	1621	2781	36.97	56300
QESCO	1770		624601	2189	4779	23.56	334616
KE	3270	0.09	2808069	10728	14318	22.63	6500
PEPCO	22875	-9.6	28473069	71491	93887	16.86	

Source: NEPRA

For improving anything, one has to know where he stands and where he wants to go and what ways and means have to be adopted and are available. In technical terms, it is called strategy and action plan. Thus, the government may do well by asking all the DISCOs to develop a strategy and action plan. Although targets will vary among companies, a 50% reduction and a five-year time frame should be a general target.

It is essential that loss reduction cells are formed, which should coordinate and manage all of this activity. Primarily, it has to be at the DISCO level and at the proposed Pepco level. Pepco is there, it has to be energized. An action plan without monitoring is of no use. An element of third-party involvement may have to be there due to the existing insider mafias. A wider anti-corruption drive is required to curtail these tendencies, which is well discussed and is being improved upon by the PTI government.

There are several technical steps that may have to be taken beyond the strategy and action plan without which all of it may remain a paper-full bureaucratic exercise. Several of which like amending the law and support system of law enforcement strategies, removal of illegal connections and unmetered electricity, proportional and higher load-shedding in high-loss areas have varying levels of success. This has to be improved, institutionalized and brought into a formal framework of the action plan and monitoring.

Table 6.7.2: Coal-shedding hrs per day

Name of DISCO	2013-14	2014-15	2015-16	2016-17	2017-18
IESCO	5	4	3.43	3.33	3.125
PESCO	4.8	2.5	2.3	3.2	3.25
GEPCO	3.2	4	4	3.25	11
FESCO	7.25	4.33	3.5	3.23	0.74
LESCO	3.5	2.33	1.67	2	1.7
MEPCO	10	4.25	3.2	3.35	1.30
QESCO	10.5	3.4	2.83	3.875	5.8
SEPCO	2	1	1	2.25	2.25
HESCO	3.75	4	3.33	4.5	3.75
K-Electric	2.3	1.1	1.33	2.5	1.26

Source: NEPRA

A formal and high-profile loss reduction activity backed by the strategy and action plan is a must to take the energy sector out of its sustainability issues. Both power and gas loss reduction involves identical planning and management systems, notwithstanding the technicalities of the systems. It is hoped that the leadership and managers of the Ministry of Energy (Power and Petroleum Divisions) would redouble their efforts in a more organized and persistent manner.

In the following, we will identify, a number of issues that impinge on the performance of DISCOs.

Geographical Re-organizations

Table 6.7.3: Disco Recoveries

Name of DISCO	2013-14	2014-15	2015-16	2016-17	2017-18
IESCO	120	99.8	99.3	100.37	99.1
PESCO	86.3	88.0	88.6	89.1	89.5
GEPCO	96	97	99.6	98	97.0
FESCO	100.05	100.06	100.06	97.21	97.93
LESCO	97.87	95.88	99.65	100.45	97.8
MEPCO	96.04	102.33	99.99	96.21	99.68
QESCO	42.2	32.6	71.6	43.5	46.1
SEPCO	58.60	57.81	55.2	110.8	60.1
HESCO	79.2	78.2	72.4	95.2	76.7
K-Electric	91.22	90.37	87.63	90.04	91.04

Source: NEPRA

It may be noted that most DISCOs are spread over large geographical areas-varying from 105505 kms for MEPCO, 81087 kms for HESCO and 77474 kms for PESCO, while QESCO has a special case of a maximum of 334616 kms. Other DISCOs are on the average spread over 25000 Sq.Kms. Control of manpower and physical assets and the vigilance is not possible by higher management sitting in head offices. Even regional management in regional offices often fail to control operations in their areas. Splitting of DISCO into smaller units has long been on agenda of reforms of DISCOs. Previous administration took practical steps towards splitting PESCO. The initiative could not be sustained probably due to political suspicions implying splitting of the province-a highly divisive and politically sensitive issue. There is a strong case for splitting MEPCO into 2 or 3 smaller companies. It may be argued that splitting of HESCO has not paid off. However, its lack of results may have to e searched elsewhere. QESCO will automatically get divided with developments in Gawadar.

Competition and Privatization

Privatization of DISCOs has been on agenda for a long time. It has not happened for a variety of reasons including unions' pressures and possible political opposition. Except for PPP, however, all other parties support privatization during their own times of rule but oppose it when other party wants to go for it. It is a classical opportunism. Lack of clear understanding and plan is also a reason for inaction. Privatization Commission is forming its own agenda without understanding the policy environment and the changes that are in pipeline. A classical case is the refusal of prequalified parties for privatization of the two RLNG power plants to submit their bids arguing that policy environment is not clear and that they would wait for the results of dialogue that is going on with the IPPs.

In the case of DISCOs, many policy issues are pending. The issue of retail market is there and the separation of wires/infrastructure and the supply business. The issue has to be finalized before bidding takes place; otherwise nobody is going to bid as has happened in the case of RLNG power plants. All DISCOs need not go into retail market. There may be phasing of one or two followed by privatization. Performance of KE and the heavy load-shedding in Karachi may create public opposition to privatization of DISCOs. However, KE bad performance has been in the area of generation as evinced by the show cause notice issue by NEPRA. Bulk of the show-cause deals with generation issues.KE performance has been better in the area of distribution management and reduction in losses. It is alleged that losses are lesser than what is declared by KE management?

Chart 6.7.1: Interruption Frequency Index (SAIFI-No.)

Name of DISCO	2013-14	2014-15	2015-16	2016-17	2017-18
IESCO	0.05	0.036	0.03	0.029	0.04
PESCO	316.5	315.40	261.65	160.60	170
GEPCO	10.52	10.41	35.44	3.26	30.97
FESCO	35.40	46.54	32.41	39.99	38.87
LESCO	78.04	52.49	45.79	37.44	32.92
MEPCO	201.5	177.61	203	235	316.22
QESCO	144.95	112.58	107	96.92	95.18
SEPCO	251.5	227.96	216.71	601.37	568.59
HESCO	229.9	202.3	184	188.40	180.74
K-Electric	24.71	22.21	20.52	19.6	17.55

The question is; can there be competition without privatization; yes and no. There is competition in China and Russia despite enterprises being in public sector. Competition can be brought in procurement of both power and projects. There was competitive procurement for Jamshoro coal power plant which enabled to get drastically reduced EPC costs as opposed to what was obtained through regulated CPEC projects. Total competitive market will not come in one go. However, DICSO privatization will make a lot of difference towards bringing market element in the electricity sector. Voluntary market exchange can, although not included in the proposed CTBCM model, can be another device for bringing in competition in DISCO power procurement and excess and stranded power supply.

Losses (theft) can only be reduced if corruption is controlled both within DISCOs and outside in the larger society. Private owners may be partly successful in reducing theft and losses through better management and care. There are many technology options which public sector could not implement despite the potential of success in reducing theft and losses.

Innovations in T&D Loss Reduction Technologies and Approaches

Smart Sensors

Interesting developments have taken place in the field of T&D loss (Theft, leakages and Billing frauds etc) reduction. A Canadian company has developed a smart and mobile sensor which can be installed (clipped with ease) on transmission or distribution wires and major electrical parameters can be measured. It has an inbuilt wireless communication module which instantaneously transmits data which inputs into an analytical software plat form .Anomalies in energy flow can be diagnosed with the help of database. The sensor at 100 USD a piece is not a bad deal. It is not required to be fixed at one place but is mobile. Hence, a few teams per district can have sets of these sensors to keep monitoring possible anomalies and theft.50 sensor sets per district can enable formation of a viable anti-theft squad. For 100 districts, it would be 5000 sensors. In 1.5 Million USD, a whole country-wide project can be launched.

However, there is a catch in it. It requires the support of a software platform which can be costing more than the hardware and the consultant's fee. The company offers a performance based payment. It brings its own software and hardware and takes a share in the savings from loss reduction.

Data Analytics

Remarkable progress has been made in the area of data mining and analytics and forensic software. Billing analysis can reveal cases of fraud and collusion in meter reading, bills compilation and payments received; there can be internal or external issues. It would be advisable that our DISCOs (both electrical and Gas) employ these software or employ specialized consulting services in this respect.

Table 6.7.4: DISCO Assets- 2019

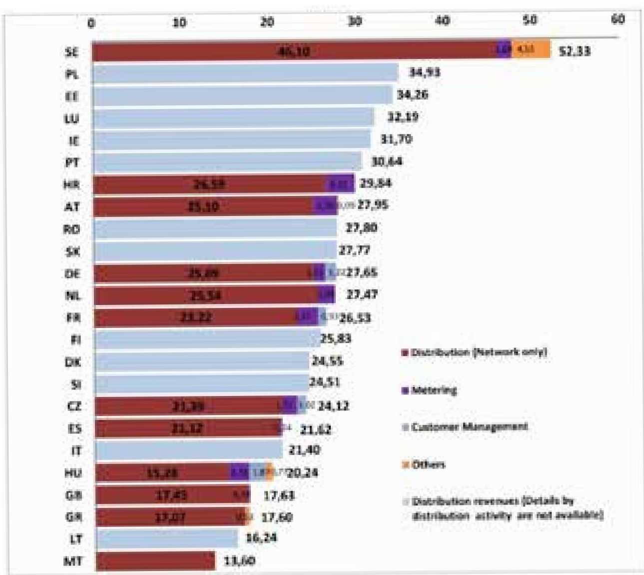
	Power Transformers		Total HT lines	11 kV feeders	D. Transformers	
	No	Capacity -MVA	km	no	No	kVA
PESCO	243	6327	40365	1056	76126	5999
TESCO	48	1210	10529	215	18730	
IESCO	257	6311	29004	1116	49109	4032
GEPCO	176	4951	26347	864	67587	4219
LESCO	391	11713	32598	1821	110092	8516
FESCO	235	5930	47472	1054	108652	7084
MEPCO	293	8188	80858	1392	169938	8383
HESCO	121	2694	31702	533	37305	1854
SEPCO	130	2794	28269	531	38196	2151
QESCO	180	3397	46179	642	60870	3133
KE	160	6077	10823	1807	28183	7702
PEPCO	2074	53176	373324	9224	736605	45370

Source: NEPRA

6.8: Distribution Cost and T&D Losses

Power system losses, according to the latest Hydrocarbon Development Institute of Pakistan (HDIP) Report 2017, have reached 19.8%.Electricity consumption should have crossed a level of 100,000 Gigawatt-hours (GWh) by now, which is a good news. This, however, pushes the absolute loss numbers up also. It has been estimated that total energy system losses amount to $2,168 million per year, of which electrical system losses are $1,400 million and gas system losses are $768 million. These losses can be reduced by almost half, saving about $1,186 million.

Chart 6.8.1: Electricity Distribution revenues per energy delivered across EU Member states in 2013



Source: Own elaboration on data provided by National Regulators.
Total Distributions revenues include: Distributions revenues (Network only), Metering and Customer Management. Cost of distribution losses is not included.

Energy losses have been high in many developing countries including in our region, where India and Bangladesh also suffer from the same syndrome. However, these countries and their utilities are on a path of loss reduction. A lot of literature documenting successes and the strategies and methodologies has come to the fore in this respect. It may be of interest to have a review of similar losses prevailing in other parts of the world and make a judgment on the improvement level that may be possible in Pakistan.

World average transmission and distribution (T&D) losses are at 8% while in the developed world, the average is 6% – 2% for transmission and 4% for distribution and almost all of it is technical loss and very little commercial or theft, etc. In Africa, East Asia and the Middle East, the average figure is 12%, in Latin America it is 17% and in South Asia the average is the highest at 20%. Pakistan lies at this average .T&D losses have been decreasing over time due to advancement in electrical technology, for example, in 1926 in the US, these losses were almost the same as those in Pakistan today and came down to 6% by 2008.

Table 6.8.1: Distribution (T&D) Losses (%)

Name of DISCO	2013-14	2014-15	2015-16	2016-17	2017-18
IESCO	9.46	9.41	9.10	9.02	9.13
PESCO	33.5	34.8	33.8	32.6	38.1
GEPCO	10.97	10.72	10.58	10.24	10.01
FESCO	11.3	11	10.2	10.6	10.5
LESCO	13.4	14.1	13.9	13.8	13.8
MEPCO	17.5	16.7	16.4	16.9	16.6
QESCO	28.3	24.4	23.8	23.1	22.4
SEPCO	38.56	38.29	37.72	37.8	36.7
HESCO	26.46	27.1	26.5	30.8	29.8
K-Electric	25.30	23.69	22.24	21.71	20.4

Source: NEPRA

It can be conjectured that currently technical losses are 10% and commercial losses are 10% in Pakistan. We can assume a target level of improvement to 8% for technical losses and 2% for commercial losses, totaling 10%. It is vital that improvements are made in order to make the power sector sustainable and viable. However, what is not certain is that it can be achieved in the next five years, seven years or 10 years or cannot be achieved at all.

It is good to know that the prime minister is giving targets to his ministers and it is hoped that an adequate target will be given by him in this respect. Although apparently there has been realization and sensitivity among successive governments in Pakistan to reduce these losses, at best there is stagnancy in the electrical sector and in the gas sector there is degeneration from bad to worse.

Energy losses, especially theft, are a complicated affair. All types and kinds of people consume more than they can afford or would like to pay for and indulge in stealing energy; rich and the poor, weak and strong, industry, commercial, domestic, etc. The issue becomes more complicated by the technical losses creeping into theft and vice versa and the collusion of insiders with outsiders and the associated mafias.

Difficult to monitor, control

A common theme in the utility sector is its hugeness and geographical expanse, which makes it quite obtuse and abstract, difficult to monitor and control. A possible but partial solution may be to fragment the larger distribution companies (DISCOs) into smaller ones. Privatization does not help in a cost-plus regulated environment in the absence of a competitive market, which may reward efficiency.

There is, however, light at the end of the tunnel as evident from the success of many countries and utilities in this respect. A DISCO (called DISCOM in India) APSPDC in the state of Andhra Pradesh has managed to reduce its T&D losses from 12.98% to 10.68% in four years and subsequently to 6%.In Gujarat, MGVCL has managed to reduce its T&D losses from 14.51% to 12.41%, a reduction of 2.10% in the same period. In Delhi, TPDL/BSES reduced its losses from 20% to 16.06% and then to 10.63% under a franchise system operated by Tata. In Maharashtra, MSEDCL managed to achieve the highest reduction of 6.6% in four years, from 20.6% to 14%.

Table 6.8.2: Distribution Losses Countries-%

Malaysia	5.79
China	5.47
Japan	4.31
Germany	3.88
Brazil	15.77
Turkey	14.82
Argentina	14.66
Pakistan	17
India	19.33
India –Bihar	30.3
Rajasthan	29.7
Uttarpradesh	23.6
Haryana	33.7

Source: Economic Times India, Index-Mundi

Table 6.8.3: WAPDA EX-DISCO Distribution Cost-2017-18

	Units Sold Mn. kWh	Losses %	distribution Margin Rs/kWh	Unit Sales Price Rs/kWh	Unit PPP Rs/kWh	UDM+ Losses
IESCO	11754	8.65	1.4777	14.9310	10.3137	4.6173
LESCO	23785	11.76	1.2454	16.1184	11.0484	5.0700
FESCO	14211	10.24	1.5019	17.3533	11.5019	5.8515
GEPCO	11134	10.03	1.2950	14.6595	11.3413	3.3182
MEPCO	17920	15	1.1450	17.7994	11.9779	5.8215
PESCO	9730	31.95	1.9708	21.6532	14.4073	7.2459
HESCO	4612	22.59	2.3068	23.8361	18.9790	4.8571
QESCO	5484	17.5	1.8722	17.2489	12.2872	4.9617
SEPCO	3406	29.75	2.2866	20.8638	13.8385	7.0252
TESCO	1736	12.47	1.5294	14.5167	12.3767	2.1400
Total	103773	15.53	1.4820	17.3565	11.8634	5.4931

Source: NEPRA Annual DISCO Determination Annual-2017-18Revenue Requirement

Distribution Margin and Losses

It may be noted that the unit Distribution Margin of DISCOs is very low, Rs 1.25-2.31 per unit. In the adjoining we have provided distribution cost data, which is referred as Network Cost, in Europe. Median figure there is 20-30 Euro/MWh which is equivalent 2.2-3.3 USc (3.3-4.95 Rs) per kWh, almost twice the Pakistan figure. Higher service level and high labour cost appears to be the reason for the difference. Distribution is more labour intensive than generation. However, when losses are added, Distribution cost in Pakistan goes to as high as 7.2 Rs per kWh in case of PESCO and IESCO and LESOC at 4.6-5 Rs. PESCO losses are the highest 31.95 %.IESCO losses are the least at 8.65%.Amazingly, Smart Meter project intended to reduce theft have been designed for IESCO and LESCO which are lowest and low loss DISCOs.

6.9: Doing Away with Inefficient Power Plants

There are many questions and issues faced by policymakers in the energy sector in Pakistan – what to do with rising energy prices, especially, after devaluation; what to do with furnace oil; furnace oil export possibilities; should more of RLNG be inducted; what to do with thermal power plants producing expensive electricity – can these be shut down? Other questions are what to do with the retiring power plants which have adequate efficiency and are still good to run; how to add a reasonable amount of renewable energy despite a purported surplus in the near term and in the face of financial crunch?

Let us first examine the status of power generation. Following conclusions emerge from examining the data of November and December 2018, compiled by Nepra/ CPPA-G. The capacity of hydroelectric power production has increased to 9,000 megawatts with the inclusion of Neelum-Jhelum and Tarbela-IV projects, which added 2,300MW.In December, however, the hydroelectric power production went down to 1,334 million kilowatt-hours (kWh) from 2,564 million kWh in November, a decrease of 48%, which is understood for seasonal reasons. The reduction has been met partly by utilizing furnace oil plants, which provided literally no electricity in November and in December it came back to 12% of the total. Furnace oil has been probably inducted in December on the insistence of oil refineries, which faced a shutdown.

Coal-based electricity share in total generation increased from 13% in November to 20.2% in December. Their total capacity, at 80% capacity factor, is supposed to be 1,800 million kWh, which, however, produced only 1,563 million kWh in December and only 1,042 million kWh in November. Coal power is supposed to be the cheapest. It should produce more.

In November, re-gasified liquefied natural gas (RLNG) generated 1,300 million kWh, while in December; it came down to only 933 million kWh. Balloki plant did hardly produce any significant volumes. RLNG plants are based on 'take or pay' contract for LNG supply. It is hoped that RLNG is diverted to other sectors and is not wasted

Unstable Oil Prices

Brent crude oil prices are unstable at best. Year 2018 started with Brent prices at \$69 a barrel, which increased to \$80. Brent is now trading at around \$60. It would be good news, if oil prices remain at this level, although in 2014, oil prices went as low as \$40.If Brent remains at \$60, the prices of fuels like coal, furnace oil (RFO), local gas and RLNG would go down by 20-25%. As one can see, coal is the cheapest source at \$4.54 per million British thermal units (MMBtu) but its advantage is slightly reduced because of low-efficiency (42%) plants as compared to RLNG plants having 60% efficiency.

RLNG prices are \$11.3 per MMBtu as opposed to \$14 for RFO. There is a price advantage of 20% in RLNG in comparison to RFO. This advantage is increased by high-efficiency (60%) combined-cycle power plants with fuel cost per kWh of 6.43 US cents for RLNG vs 11.37 US cents for RFO.RFO price is slightly less than double. Local gas prices are almost half that of RLNG. The price effect gets even more pronounced with local gas wherein fuel cost per kWh in high-efficiency plants becomes 3.41 US cents vs 11.37 cents for RFO, a difference of three times. However, cheap local gas prices are a double-edged weapon – they help keep energy mix prices low but simultaneously lead to less optimum allocation of resources.

Generation companies' (Gencos) lowest thermal efficiency plants are quite early in the merit order and are running due to the cheap local gas. If priced at RLNG levels, these plants would never be able to operate and will be at the end of the merit order. There is a strong case for shutting down these plants with a few exceptions.

Inefficient Plants

There is 6,000MW of thermal power plants under the public sector Gencos, which have a fuel cost of 16 to 20 cents per unit. Only two power plants, namely Guddu combined-cycle (747MW) and Nandipur (567MW), have somewhat acceptable thermal efficiency of 40% or above. Except these two, all other plants in this category may be shut down. Another 5,000-6,000MW of thermal independent power plants (IPPs) is to retire in the coming decade ending 2030. Important ones among these are 1,600MW Kapco – retiring in 2021 – and 1,262MW Hubco – retiring in 2027.

Out of the 10 plants in this category, four have thermal efficiency, of less than 40% and should be retired as their agreements expire. There are other plants such as Kapco, Rousch, etc, which have higher efficiencies of 43.7% and 47% respectively.

Higher efficiency plants such as these may be considered for extension on a take-and-pay basis. These may also be ideal candidates for putting them under the proposed energy exchange. A policy should be devised in this respect. The power plants may need balancing, modernization and replacement (BMR) for which they would require time to plan, arrange financing and implement. There is a CPP cost of 4.5 cents for new power plants but they would have higher thermal efficiency of 50-60%.

One has to calculate the cut-off point where it may be of interest for both the operators and the buyer. Power planners should provide for a retiring capacity of 8,000-10,000MW from generation companies and the IPPs. Small IPPs running on internal combustion engines aggregate to about 2,000MW and run on RFO. These are mostly efficient power plants with some combined-cycle capabilities. To be able to run local refineries, one has to run RFO power plants of some 2,000-2,500MW. In winters, there is no or very little hydel production, creating a space for these RFO plants and use of RFO. However, another 2,000MW of cheap coal power is coming up soon. Are we in a capacity trap? If the textile sector picks up following devaluation and energy price incentives, demand may pick up as well. However, in the wake of forecasts of lower growth rates of economy, the demand may not grow much.

Towards a virtual WACOG

RLNG prices are more than twice the local gas prices. WACOG (Weighted Average Cost of Gas) has been proposed to solve a number of problems that have been developed due to this price duality. We have discussed the issue in detail elsewhere. WACOG would be in between. Once it has been calculated at 7 USD, somewhat in between the two prices. The specific issue with respect to inefficient plants and merit order is that an inefficient plant run on local gas is treated as efficient as due to lower price, its fuel cost comes to be lower and vice versa. An efficient plant is treated as inefficient if run on RLNG as due to higher LNG prices, its position in the merit order may fall above the inefficient plan running on cheaper local gas. What to do? WACOG can be calculated, even if consensus is not reached with the provinces on the subject. And until it is not there, WACOG is implemented in making the merit order. Merit order in that case would help eliminating the inefficient plants from the merit order or put it in its right place high in the merit order to be used sparingly when demand is high.

Concluding, power generation costs and tariffs are rising. The problem has become even more severe and complicated due to the recent heavy currency depreciation. Reduction of T&D losses, doing away with inefficient plants and removing other leakages and inefficiencies will go a long way towards healing the ailing sector laden with circular debt.

6.10: Smart Meters -Towards an Alternative Project Design?

After a lapse of a number of years, the smart meters' project has emerged again without any required adjustment of the stakeholders. The motivation behind installing the smart meters is primarily to control and prevent theft and receivables. Smart meters enable a utility to monitor online consumer meters, penalize defaulters, cut-off connection or release it. Meters are read automatically without meter readers, which in advanced countries is a major motivation for installing smart meters. Smart meters are expensive and more so as things are generally, as we see in most of the power and energy projects. Our resources are limited and there are other priorities in the power sector such as expanding the transmission and distribution system. There is a need to redesign the smart meter project to increase its cost effectiveness and implementability.

Table 6.10.1: Number of Overloaded Distribution Transformers

DISCO	Total No. of Distribution Transformers		Total No. of Over-Loaded Distribution Transformers (Above 80%)		Percentage of Total Over-Loaded Distribution Transformers (Above 80%)	
	2016-17	2017-18	2016-17	2017-18	2016-17	2017-18
PESCO	72,078	74,104	21,033	6,183	29.18	8.34
TESCO	18,198	18,475	--	--	--	--
IESCO	46,359	47,830	2,868	3,770	6.19	7.88
GEPCO	61,661	64,344	1,475	1,741	2.39	2.71
LESCO	100,718	105,185	30,350	2,950	30.13	2.80
FESCO	100,276	104,058	1,843	392	1.84	0.38
MEPCO	156,460	161,197	8,128	5,844	5.19	3.63
HESCO	35,996	36,670	3,340	532	9.28	1.45
SEPCO	35,875	37,562	7,424	3,736	20.69	9.95
QESCO	55,770	59,336	8,873	7,094	15.91	11.96
Total	**683,391**	**708,761**	**85,334**	**32,242**	**12.49**	**4.55**

Source: NEPRA

Stakeholders, therefore, demanded a more cost-effective approach in the project design. It was because of that reason the project suffered from delays in approval. The lending agency did not show much sensitivity to concerns of the stakeholders and did not rectify the project. Resultantly, the sponsoring ministry also went slow on it and decided to close the project. With the change in government, the lending agency has managed to revive interest in the project. We would like to make some suggestions here to improve the project, make it cost-effective and enlarge its impact to the entire country instead of being limited to the areas covered by just two companies.

Figure 6.10.1: TGI Raptor 3

The project, being funded by the ADB, costs $800 million and covers the best companies of LESCO and IESCO, but the coverage is not complete. There are three major issues – selection and prioritization of companies and consumers, costs and technology. The major problem is the project design. It is aimed at covering all consumers indiscriminately, irrespective of the size or potential to achieve the objectives and selects wrong companies. Instead of selecting high loss-making companies; IESCO and Lesco have been selected where losses are much lesser than those in problem companies like MEPCO, PESCO, HESCO and SEPCO.

Wider Outreach

Similarly, all consumers are selected for the installation of smart meters, even the lifeline consumers with consumption of 50 or 100 units, which makes it very expensive. Even in Germany, the smart meters' policy selects consumers with consumption of 500 units and similar is the case in India. With a selective approach, one could have a higher outreach and coverage with the same amount of money and resources and would be able to achieve targets in lesser time of say three years than the current design which appears to have no target or thinking about the outreach, effectiveness and time.

For example, in the case of Lesco, more than 65% of domestic sales in terms of units are made to the small consumer category of up to 300 units. Only 30% of the domestic consumers may thus be selected for the installation of smart meters, which can be a big saving. All categories of industrial customers and tube wells are to be covered 100% due to their size and consumption. It is more profitable and convenient to contractors than to the consumers and utilities, it is widely believed. Under the current project design, it may require in excess of $5 billion and a period of 10 years to have countrywide coverage. Also, the unit cost is too expensive at $150 – $50 for a meter and $100 for installation.

Under an ADB-funded project in India, as per website of the bank itself, the installed cost is $70 – $35 for the meter and $35 for the installation and the overhead. EESL India is charging utilities 70 Indian rupees per month for installation and maintaining the system for seven years. It is true that final prices would depend on the bidding – the reference prices affect the bidding outcome and should not be too outlandish. In India, the theft and loss problem is even more severe. It has 250 million consumers and losses are more than 21% amounting to $44 billion.

Cost effectiveness is a must, especially, that smart meters may not be able to eliminate all theft such as illegal connections (kundas) and due to law and order issues. Another approach for cost-effectiveness could be limiting the installation to distributed transformers, which may enable the companies to close on the defaulting areas. This may reduce the project cost and may provide coverage to the entire country in a matter of two to three years.

Technology

There are communications technology issues as well which would have to be reviewed. The main issue is mobile/cellular technologies vs others. Mobile technologies make it much simpler and shift the responsibility of operations and maintenance to the mobile companies which are much more organized and efficient. However, it adds up to the operations cost. Other technologies require capital expenditure and make utilities responsible for their maintenance. Decision-makers should not totally depend on the advice of lending agencies and should use their own mind as well, keeping in view the peculiar circumstances in the country. We are suffering from a circular debt of Rs1.85 trillion and utilities are in weak financial conditions.

Cost-effectiveness and target achievement should receive utmost consideration. About 5,000 megawatts of generation capacity is reportedly unutilized due to lack of concomitant transmission and distribution and capacity payments are being made. Such is the magnitude of the issues. A review and revision of the project design is in order.

Towards a Project Redesign?

It has been estimated that in order to have 90% coverage of the project consisting of 35 million consumers, at least 6 billion USD of CAPEX and 6-10 years would be required. Without coverage of 90-95%, the objectives of identifying and preventing of electricity theft would not be achieved. The question is that do we have that much time and money? The smart meter project was designed under a governance regime which like borrowing aimlessly with the result that we are all seeing today.

Certainly, a project redesign is required involving a phased and time and cost-efficient approach. The alternative solution is installing smart meters (preferably along with a smart DTMU-Distribution Transformer Monitoring Unit) on Distribution transformers. This would enable identifying and measuring electricity losses in areas covered by individual Transformers (DT).As opposed to 35 Million meters(consumers), there are only 708,701 DTs installed throughout the country(2017-18 NEPRA SOI). We have provided DISCO wise installation figures in the adjoining table.

It has been estimated that all DTs would be covered under such a programme in the CAPEX of the current programme of 500 Million USD and should be completed in 2-3 years. This would enable identification of DTS where there are considerable losses. Once high losses (theft) DTs are identified, follow up detailed monitoring and house-to-house search and meter inspection can be initiated. Hopefully and reasonably, 20% of DTs may be identified under first phase identification programme. In subsequent phases, threshold may be reduced to include more DTs. Smart meters can then be installed on individual consumers who are suspected of theft.

An additional advantage of the proposed design is that over all distribution management system would be improved. DTs burning and depreciations would be reduced through its condition monitoring. Power quality parameters would be monitored as well; killing two birds with one stone.

Secondly, high loss DISCOs should have been prioritized; PESCO, MEPCO, QESCO and HESCO and SEPCO.LESCO and IESCO have been selected which are not high loss/theft companies. Under a USAID programme, smart meters had been installed in PESCO and MEPCO as pilot projects. These pilot projects should have been upgraded, rather than initiating projects in totally different DISCOs ab-initio. Apparently, no benefit is being taken out of these pilot projects. Partly, it may be ascribed to inter-agency rivalries. It is the job of GoP, the borrower, to make sure that right choices are made. Lender-vendor combines should not be allowed to hold sway. Planning Commission has been making the afore-mentioned recommendations since the very inception of the project. The project promoters keep silent for a while and then restart on their beaten path again. Reportedly, LESCO has invited bids for a reevaluation of the project. It is the Power Division which should involve a third party consultant not associated with the lenders to reexamine the project and the recommendations of the Planning Commission.

Beginning of a smart grid

The alternative project design would be a beginning towards a smart grid, in addition to assist in solving the theft issue. Smart Meters can measure power quality parameters also, although in may require additional communication protocols and software to be able to analyze the power quality data sent by the smart meter installed on the DT. Additional sensors may be installed at other points as well. This would enable to even reduce technical losses caused by power congestion and cables overheating as well.

Viva KE

While the afore-mentioned proposal has been around since 2016, LESCO and IESCO did not bother to consider it, KE has adopted .KE has been installing Smart Meters on its DTs and has been able to identify high loss DTs and is zeroing on the areas covered by such DTs. They are now prioritizing DTs and focusing on defaulters and stealers.KE will be installing in Phase two consumer smart meters selectively on the basis of the results obtained .It would not be a blind exercise of installing smart meters but a considered and well planned one. This would enable KE to start getting results earlier with staggering investments easing cash flow as well.

Power division would be advised to examine the smart-meter-DT system as installed by the KE and try to convince the lending agency to shun its intransigence and let the KE system replicated, rather than continuing with the existing project design. Earlier it was an idea, now it is a reality and can be more convincing.

Innovations in T&D Loss Reduction Technologies and Approaches

Smart Sensors

Interesting developments have taken place in the field of T&D loss (Theft, leakages and Billing frauds etc) reduction. A Canadian company has developed a smart and mobile sensor which can be installed (clipped with ease) on transmission or distribution wires and major electrical parameters can be measured. It has an inbuilt wireless communication module which instantaneously transmits data which inputs into an analytical software plat form .Anomalies in energy flow can be diagnosed with the help of database. The sensor at 100 USD a piece is not a bad deal. It is not required to be fixed at one place but is mobile. Hence, a few teams per district can have sets of these sensors to keep monitoring possible anomalies and theft.50 sensor sets per district can enable formation of a viable anti-theft squad. For 100 districts, it would be 5000 sensors. In 1.5 Million USD, a whole country-wide project can be launched.

However, there is a catch in it. It requires the support of a software platform which can be costing more than the hardware and the consultant's fee. The company offers a performance based payment. It brings its own software and hardware and takes a share in the savings from loss reduction.

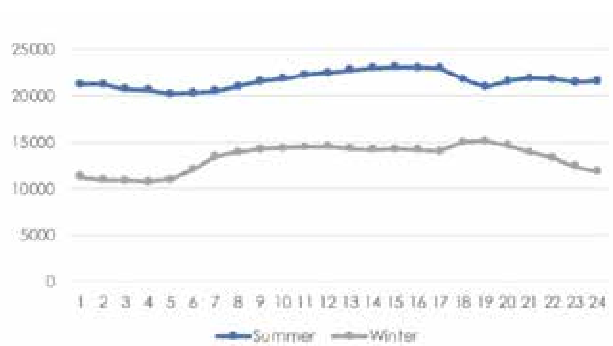
Data Analytics

Remarkable progress has been made in the area of data mining and analytics and forensic software. Billing analysis can reveal cases of fraud and collusion in meter reading, bills compilation and payments received; there can be internal or external issues. It would be advisable that our DISCOs (both electrical and Gas) employ these software or employ specialized consulting services in this respect.

6.11: Increasing Capacity Utilization through Tariff

Energy costs and tariffs have been increasing and may go up further. There is a need to explore ways and means for reducing these, wherever a reasonable opportunity exists. There is some scope in increasing various kinds of efficiencies and reducing various kinds of leakages and losses. Electricity cost and tariff can be brought down by increasing capacity utilization and thus being able to offer a reduced seasonal tariff.

Chart 6.11.1: Seasonal Load Profiles (MW)



Source: NEPRA

The electricity cost and tariff are projected to increase further due to two major reasons – rupee depreciation from Rs105 (the exchange rate to which most of the power projects are pegged) to Rs150, the rate assumed by the Central Power Purchasing Agency-Guarantee (CPPA-G) in doing its projections.

There is also an increase in the London Interbank Offered Rate (Libor). The current Libor, as assumed by the CPPA-G, is 3.64% as opposed to 0.5% at which most of the independent power producers' (IPPs) tariffs have been based. This means that at Libor plus 4.5%, the interest rate and thus debt servicing cost of the IPPs will increase from 5% to 8.14%.Energy projects are at varying stages of their debt cycle. To give the reader an example, the current generation tariff for a wind power project is Rs28 per kilowatt-hour (kWh) as opposed to Rs4 per unit for new wind power projects. The averages power purchase price (PPP) for 2019-20 has been projected at Rs12.10 per kWh as opposed to below Rs10 per kWh earlier. Once expensive nuclear power comes in, the increase will be even more. Thanks to the depreciated power plants and cheaper local gas, the increase may still be controllable.

When we examine the latest cost and energy forecast data for 2019-20 released by the CPPA-G recently, some interesting phenomenon is readily discernable. Although such figures were available earlier also, the monthly cost data this time invites much attention. Electricity demand (megawatts) and consumption (gigawatt-hours) in winter are much lesser than in summer, reducing capacity utilization and increasing capacity charges (CPP) and thus the total generation cost (PPP).For example, the January cost is Rs14.47 per kWh while July cost is Rs9.94. In January, demand is only 16,762MW and in July, the demand is 25,030MW.

There is a temptation to wish and think that if consumption in winter is somehow increased, the electricity cost can come down. We have tried to do this exercise. If we increase energy utilization by 21.88%, the total energy cost (PPP) comes down 12.46%. If energy consumption is further increased, the potential for cost reduction further rises. However, the reverse may not be true, i.e., if the price is reduced, demand may not go up in consonance with the cost formulae. It will depend on the consumer propensity to save and many other factors such as market structure, consumer habits, labor conditions, work habits, technology, etc.

Secondly, the winter generation capacity may not be as much as dictated by the market. An obvious factor is the lower hydel generation. The idea is worth exploring. Prima facie, there appears to be a potential for the application of this possibility. The industry may shift to higher production levels in winter due to lower energy tariff or winter industries may acquire more competitiveness. Domestic consumers may shift to electrical heating (resistance or inverter ACs) instead of using liquefied petroleum gas (LPG) or natural gas. The gas tariff is increasing?

Competitive Energy Market

In advanced countries, there is a retail competition regime whereby many suppliers compete to sell electricity or even gas to consumers. At the wholesale level also, there is a share market-type energy exchange where prices are offered and accepted on the basis of supply and demand and thus considerable variations occur in wholesale prices. However, at the retail level, the consumer tariff (especially the residential one) is kept relatively stable based on the average. There are dozens of tariff plans that are being offered by energy suppliers in the retail competition regime. However, one can divide those into two types – a fixed tariff for one or two years and variable tariff, which may change monthly.

So, there will be nothing abnormal in having a seasonal tariff that changes twice or four times a year. In Pakistan, there is already a provision of variable tariff wherein fuel price adjustments are made monthly. Accordingly, the fixed price adjustment can also be made monthly or quarterly. The government also plans to have a competitive energy market wherein investment and pricing decisions are made by market forces and controversies in IPP prices and investments are done away with. This will reduce the role and liabilities of the government and is also expected to promote efficiency and reduce energy prices. Easier said than done; existing contracts are a major impediment in the way of bringing new competition rules. There is always a possibility of anti-competitive behavior.

Night Time Tariff

There is another opportunity for improving the load factor; introducing nigh time Tariff. If one examines the adjoining daily load curve, two trends are easily observable;1.difference of 5000 MW between winter and summer demand which we have already discussed;2.another important factor is low utilization/load in night hour between 11 pm to 5 am. A special industrial tariff can be introduced for specialized energy industries. It would serve two ends; increase load and promote industrial out put. Of-course, there are always risks and uncertainties. Intended customers may not shift and unintended customers may shift, hurting economics of the utilities. End-user studies are to be conducted before introducing such innovative tariff.

6.12: Restructuring KE

Karachi is passing through one of the worst power crisis in its history. People and eminent businessmen have demanded either revoking or amending KE contract in order to be able to correct the situation. KE has a long history of profit maximization at the expense of consumers. NEPRA had difficulty with it in making it utilize its Furnace Oil power plants which it has used only reluctantly causing hardship to consumers. NEPRA has fined it on this issue earlier.KE has managed to create Furnace Oil issue again which Minister Omar Ayub solved it through his active intervention. There are plans to privatize other DISCOs in the country. KE privatization must succeed in order that other similar privatization is not discouraged. In addition to relieving the government from the financial burden of DISCOs, the expectation is higher efficiency and service level and consumer satisfaction and not the otherwise; unfortunately, KE performance does not present a good example. What are the other options to bring about a workable solution of the KE problem other than discontinuing with its contract as has been demanded by general public. Let us examine what can be done in this respect.

Load-shedding in such hot and humid weather is highly painful in addition to causing economic losses of industry shutdowns. It is not a result of any accident to be condoned or ignored. It is either dereliction of duty on the part of managers of KE, lack of required management skills, result of uncertainties in KE or an act of blackmail to force government to accept whatever concessions may be in the process of negotiations. It may be all of this. In most countries, utilities are fined heavily and consumers are monetarily compensated. In our case, NEPRA does it sparingly and pockets the income itself (although for understandable reasons).

Unlike the other DISCOs in the country, KE is a vertically integrated company meaning thereby that it has all the three functions combined, generation, Transmission and Distribution? And it is independent and almost isolated from the country's larger

NTDC system. This problem of KE has to be resolved before any improvement is possible. Accepting and keeping the current status of KE is negating what the GoP has been doing with the power sector for the last more than two decades. The monolith of WAPDA has been fragmented into separate organizations, separating generation, transmission and distribution functions. Separation of these functions has been accepted as the cornerstone of energy reforms in most countries of the world. It may be wasteful to try to prove in this short space the benefits and rationale of separation of the three functions.

KE was privatized hastily in special circumstances when its distribution losses reached an imaginable level of 40%.Its MD was assassinated. Government of the time thought it appropriate to privatize it immediately without first restructuring it .Special circumstances have occurred again. Abraaj and its founder chairman who legally control and manage KE are under bankruptcy and facing legal charges which would lead into their liquidation. It may have consequences for KE and a risk that KE may go into unknown hands. However, there is an offer from Shanghai electric of purchasing majority shares of KE and control and manage it.

The fatal mistake of not restructuring KE may be repeated again. It must not be done. The contender for KE take-over has a strong backing .It would be difficult to handle them due to political risks and consequences. The take-over deal could not go through due to receivables and other financial issues that could not be sorted out yet; otherwise, it would have been implemented long time back. Now legal issues of liquidation proceedings may delay it further. This gives time for GoP to think through the problem and sort out its issues before handing over to its new owners. Karachi has a complicated political profile with racial and religious factionalism. Distribution companies come in close contact with these pressure groups and factions and may create a very difficult situation, should it go into the hands of foreign companies. It is hoped that GoP and other institutions have adequately considered and weighed the options. *In any case, why would we need foreign investment in DISCOs (and restructured KE), anyway? Profits are taken away and we are faced with current account deficit. Local investors should be capable to handle these companies including KE.*

While the whole country has power surplus, Karachi is in deficit. At some point in time, people of Karachi and the politicians may bring up a political issue. Do they have rights in the resources and development of the country, legal issues of KE responsibilities being apart? Political mantra can be created among common people who do not know and understand the problems and the legalities. All they know is that they are suffering under load-shedding while the country is flush with electricity.

However, the fact is that GoP has done all that was possible. It has allocated electricity for KE but it cannot take it due to the lack of transmission facilities that KE had to establish.KE has a vested interest in keeping itself isolated from the national grid in order to be able to install its own generation. There are formal and informal gains in installing new projects. KE has, therefore, all kinds of generation proposals involving Coal and LNG.

How is the proposed separation of generation, transmission and distribution are to be separated? There are complications of KE's investment in generation, whatever, little it may be. And there is a special tariff formula which combines the three functions. Fortunately, the arrangement is ending in 2022 and by 2023 a new system may have to be negotiated. Thus, this is the right time to restructure KE.

Restructuring does not mean confiscation of any sort. The proposed formula is that KE separates its generation facilities into a separate company and starts acting as an independent IPP with all the benefits and consequences that an IPP have. It loses monopoly in generation but may continue to get preference in installing generation facilities. Transmission system may be bought out by NTDC or STDC under arrangement of KE receivables. Separation of the three functions is feasible and must be initiated without losing further time.

There are other proposals and options, some radical and some not so radical, pertaining to eliminating KE monopoly as consumers in Karachi are fed up; geographical splitting to consumer choice, wheeling and retail competition. Geographical splitting of DISCOs is among policy proposals at Pakistan level, although KE has not been considered for the same. Consumer choice and retail competition is part of the proposed CTBCM (Competitive Trading Bilateral Contracts Markets) There are some unresolved issues in it and it may take some time, however, for its finalization and implementation.

If nothing else, a cooperative may also be considered giving people of Karachi in participating KE management and share profits. There are many cooperative models working efficiently in the U.S.5% of the electricity in the U.S. is generated by Coops and have 13% market share in electricity sales.42% of electric distribution lines are owned by cooperatives; there are 831 distribution cooperatives and 62 generation and transmission cooperatives. Electric Cooperatives' contributions to the U.S. GDP are 88 billion USD and contribute 22 billion USD in taxes. In a no-owner and liquidating situation, Cooperative option deserves serious consideration.

It would be important here to remind the policy makers that these issues should be sorted out before handover of KE to a foreign party which may oppose later day changes in the electricity regime and legal complications may emerge causing political repercussions with important friends of Pakistan**.** The buyer should also be informed of the possible and potential changes that may occur in electricity regime.

NEPRA Show Cause Notice to KE

1.In the background of severe load-shedding in Karachi recently which is continuing, NEPRA has moved finally to take some action under tremendous political and public pressure. Cynics or Skeptics believe that nothing is going to happen except some fine and any meaningful step may not be taken. The fact of the matter is that KE has delayed many actions and projects which cannot be rectified quickly .There is a problem of under-capacity and under-utilization of existing capacities. KE has been on profit maximization strategy for a long time now, ignoring its contractual and legal obligations, which tantamount to killing the goose that lay golden eggs.

NEPRA has issued a show cause notice with the following list of charges, which except for a few issues, are correct and legitimate. Following is the list;

1. The Licensee (KE) has failed to ensure availability of stock of 120,000 M. tons at BPQS-I despite having storage capacity
2. Hourly generation data examined at BQPS-I revealed that BQPS-I was underutilized as it could only generate 916 MW as against a dependable capacity of 1107 MW.
3. lack of proper maintenance of machines despite routine maintenance expenses allowed by the Authority to the tune of Rs.25.07 billion in multiyear tariff; with proper maintenance it could have generated approximately 250 MW additional power from its own generation facilities.
4. a new power plant of 900 MW BPQS-III which was to come online by December 2019 ; NEPRA allowed US$ 730.51 million or Rs.84, 408.6 million as total cost for BPQS-III and allied projects in multiyear tariff determination dated 09-10-20 17 of the Licensee. Despite the fact that cost of the said project has been allowed in 2017 and passed on to the consumers, KE has failed to complete the said project to fulfill its obligation to make adequate investment in generation segment to meet load demand ;
5. KE has not executed Gas Supply Agreement (GSA) with Sui Southern Gas Company Limited (SSGCL) to ensure reliable supply of gas for its generating facilities despite clear direction of the Authority.
6. Fuel Supply Agreement (FSA) between the Licensee and Pakistan State Oil Company Limited (PSO) requires the Licensee(KE) to place month wise order for estimated quantity of furnace oil on 1st May 2019 for FY 2019-20 i.e. 60 days in advance; this created short supply of RFO which contributed to load-shedding.

7. KE has not executed Energy Purchase Agreement (EPA) with the independent power producers i.e. Tapal Energy and Gul Ahmed Energy which has been duly approved by NEPRA.
8. KCCPP and BQPS-II have the provision of dual fuels as per its generation license; however, KE has not yet commissioned both power plants on alternate fuel (HSD).
9. power drawl from 500/220kV NKI grid station can be enhanced from current 450 MW - 500 MW to 700 MW - 800 MW so as to have 200 MW -300 MW additional power available from existing NKI 500/220kV grid station; despite NEPRA approval of investment in transmission segment to the tune of Rs. 115.7 billion, KE has not put serious efforts to upgrade transmission system. Consequently, KE could not utilize the excess power available in the NTDC system.
10. The other 3 points are regarding overloading of Transformers, repair issues of feeders and load-shedding policy based on AT&C losses. Frankly, these three issues are common in all DISCOs .Higher load-shedding in high loss (theft) areas is a GoP policy throughout Pakistan and is being implemented cruelly and generously. Thus, we have to ignore these points which have been presumably added to make a longer list of KE's default.
11. Show cause notices and advices have been regularly issued by NEPRA covering the following points; i. excessive load shedding; ii. failure to adequately increase generation capacity to meet demand; iii. Underutilization of generation facilities; iv. failure to restore power supply within the permissible time limits; v. failure to upgrade transmission and distribution system; and vi. failure to provide secured, safe, reliable and efficient supply of power.

KE has been under financial and management stress for a long time. They wanted to make a killing by selling it to Shangahi Electric without paying up the liabilities and leaving these under a confused legal and contractual state which was naturally not acceptable to the lenders and suppliers. The main issue has been gas purchase payments to SSGC.

3. There is a consensus now among knowledgeable people that KE was privatized (off-loaded in indecent haste) without adequate forethought and sound policy principles under the "veritable' guidance of IFIs. The administration of that time thought that their guidance should be good-enough. In the industrialized countries, a take-over of even a motor garage (workshop) is allowed only to eligible buyers; otherwise the license of the workshop is cancelled. Selling such important companies to stock brokers is, to say the least, a highly immature and irresponsible act.

NEPRA has threatened to levy fine on every single violation which can add up to a significant amount. If fines are adequate and proportional to the damages done and calculated to nullify the purported and intended benefits, it can, indeed, discourage future violations. In many European countries, utility is required to compensate the loss and disturbance of consumer. If calculated diligently and according to this norm, KE's current year's profit can be confiscated in lieu of fine. Frankly, that may be the only action people are thinking that may be implemented.

Threat of cancellation of license without any elaboration appears to be phony or at best a theoretical legal construct. Cancellation of license can be a highly complicated issue. Who can take over-government's bureaucracy? How good job is being done in other government controlled DISCOs. We have, time and again in this space, argued for a permanent solution i.e. to bring KE at par with other DISCOs (Original privatization agreement provides for such a possible arrangement), taking the generation and transmission functions from it. No case of confiscation is being made here.KE may be allowed to own and operate its generation assets by registering as independent IPP. Transmission assets can be acquired by NTDC under a commercial arrangement. This way, Karachi would come at par with other areas of Pakistan and would be able to benefit from the country-wide creation of generation capacity of 75000 MW by 2030. It would be lot more easier to meet demand and supply deficits of Karachi of 5-8000 MW from this larger pool. This would do away with a feeling of discrimination against Karachi among a section of people. After all, it is said, if something is good for other parts of the country, why shouldn't it be bad for Karachi, except for bygone circumstances. Sooner or later, this may become a festering political problem that may be exploited by politicians, although federal government has already allocated generously from the new power plants.

There are other radical proposals like allowing more companies(geographical distribution)or wire-only with open retail market .In case of KE, these may create more complications, although, wire-only model may be a good alternative to privatization of other government controlled DISCOs.

The current tariff arrangement is to expire and replaced by a new one sometime in 2021.This is the ideal time and opportunity to implement our proposal. Courts appear to be ready to allow reasonable executive action. New arrangements have to be made before handing over the KE to a powerful party wherein strategic issues may get mixed up. Structural problems have to be resolved. KE has not shown interest in generation and transmission except in projects wherein there are prospects of making quick bucks and under-hand deals as is an unfortunate common practice in Pakistan in power sector. It can make good money by concentrating on distribution, reducing losses, increasing efficiency and optimize its resources on distribution. It can continue with its generation assets as IPP. Both the parties, GoP and KE, should seriously start working on a new arrangement including our proposal.

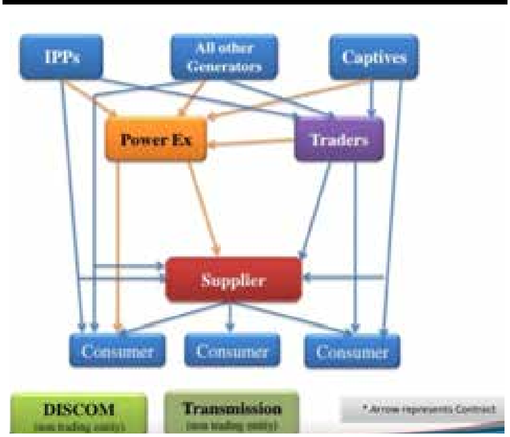
6.13: The Case for Alternative Electricity Market Exchange in Pakistan

The Competitive Trading Bilateral Contract Model (CTBCM) is a highly intimidating, if not misleading, title. A new electricity governance regime is being introduced. The name is so intimidating that most people tend to stay away from it. All that CTBCM is offering is facilitation and institutionalizing large consumer choice, wheeling and competitive tariff-based bidding for new investments. One would like to do more to be able to have a functioning and truly competitive market based on tools and systems as applied in many regions and countries.

The system, proposed by the Central Power Purchasing Agency-Guarantee (CPPA-G) and approved by Nepra, does not seem to offer even a beginning in that respect. We would make a case for an alternative market exchange system as per standard practice in international markets.

Proposed CTBCM

Chart 6.13.1 : Arrow represent Contract

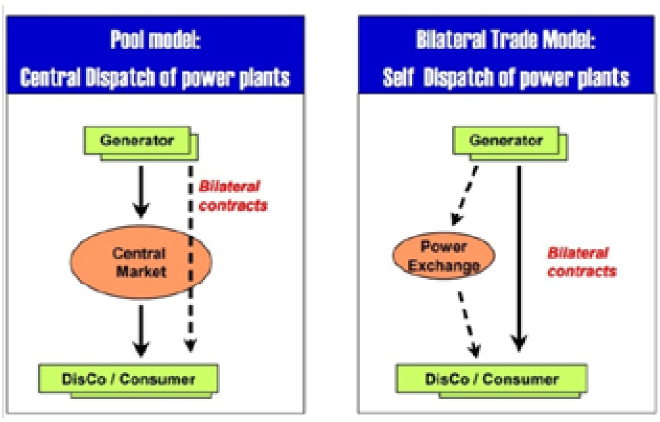


The CTBCM system has essentially the following roles or functions. Simply speaking, existing power purchase agreements (PPAs) are transferred from a single buyer – CPPA-G – to several buyers, essentially distribution companies (DISCOs) and possibly large buyers. Capacity auction for new investments would be introduced based on competitive tariff bidding instead of regulatory pricing for new electricity investments. Roles of organizations would remain almost the same in the intervening period, which may be quite long as the life of existing PPAs is quite long. Only recently more than 10,000 megawatts have been added. The Private Power and Infrastructure Board (PPIB) will continue to promote and facilitate investments but as an auctioneer.

CPPA-G will continue to do what it is doing now. It will have a new section. It will be facilitating the conversion of current PPAs into bilateral mode. NEPRA will stop issuing tariffs and will oversee tariff-based competitive bidding undertaken by the PPIB. NTDC will continue to be a transmission company with possibilities of competition in transmission. National Power Control Centre (NPCC) would be an independent system operator with more independence. New market players would be introduced like wholesale traders? Wheeling would be promoted. Direct buying by large consumers would be promoted.

Taking Government Out of Market

Chart 6.13.2 : Pool Model and Bilateral Trade model



The purported objective is to do away with "take or pay" liabilities, sovereign guarantees and government role in the electricity sector. However, the proposed mechanism may not be able to lead to this destination in the foreseeable future. If nothing else, competitive bidding would be introduced, but in the meantime Nepra is issuing tariffs at a rather fast pace. From single buyers to multi-buyers need not be such a compelling regime. It is working in India where electricity boards are buying and provisions for trading among large buyers and sellers are already there under wheeling arrangements in both the countries. If there are government-controlled DISCOs, what difference does it make, whether it is CPPA-G or a distribution company. Establishment of market exchanges has a much greater potential than CTBCM.

End of Uniform Pricing?

The most important aspect or consequence of CTBCM will be differentiated tariffs of DISCOs as opposed to the uniform pricing to which Pakistan's economic system is largely wedded. In federations or even otherwise, electricity prices do vary across states, provinces and regions. The question being; are we ready for such transformation and are we preparing for it. I am not sure if people understand the implications of IPP-DISCO bilateral contracting as proposed in CTBCM. The issue should have been discussed by high-level policymakers than simply limited to the electricity or energy sector.

Towards a Spot Market Exchange?

In a country having a history of corruption and collusion, bilateral contracts without market exchange would be a recipe for catastrophe. CTBCM can be amended to have a hybrid configuration. It is said that a major obstacle to having a market exchange is the longer-term PPAs. The solution may be a virtual market exchange with the following mechanism: PPA prices are taken as hedged prices and market players, as proposed in CTBCM, remain as these are. The difference is, however, that market players buy and sell in a day-ahead market. Daily market clearing prices are obtained and billed to buyers. Money is credited into the IPPs and wholesalers' account. Reconciliation is done monthly between PPA dues and market clearing prices. CPPA-G either receives or pays the residual.

Table 6.13.1: Overview of existing wholesale power markets in developing countries

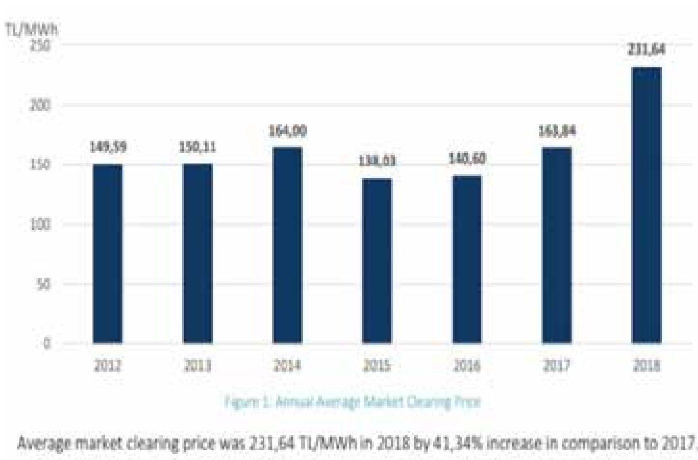
Country	Year of market establishment	Type of market design established	Market size at establishment (yearly energy demand in TWh)
Nicaragua	1998	Cost-based	2.0
Bolivia	1992	Cost-based	2.3
Guatemala	1998	Cost based	4.3
Ecuador	1996	Cost based	9.1
Dominican Republic	2001	Cost based	9.7
Chile	1982	Cost-based	11.9
Peru	1993	Cost-based	14.5
Colombia	1994	Centralized bid-based	40.8
Philippines	2001	Centralized bid-based	45.2
Romania	2000	Centralized bid-based	49.6
Argentina	1992	Cost-based	53.4
Czech Republic	2001	Centralized bid-based	69.9
Poland	1999	Cost based	130.0
Turkey	2013	Centralized bid-based	228.3
Brazil	1998	Bid-based power pool centralized	317.0
India	2003	Partially centralized bid based	614.4
Russian Federation	2011	Bid-based	996.8

Source: OECD

There may be 25 DISCO buyer units and about 70 generators and 10 wholesalers. Derivative products such as forward prices and capacity auctions can also be introduced to guide new investments and capacity. IPPs may be encouraged under an accounting settlement mechanism to convert to market exchange. A secondary market may be introduced for the underutilized capacity. It is a transition instrument, converts PPAs into market exchange and inducts new investments through market products like capacity or forward prices. Alternatively, a small market exchange may be established wherein underutilized capacity and energy may be traded, like India's IEX. Roughly, the same may be done for the gas market.

Dealing with Existing PPAs and Other Issues

Chart 6.13.3: Annual Average Market Clearing Price (MCP)



There are some 56 power plants of 35,000MW, some PPAs are to expire shortly, some have entered into PPA in the last few years, some have and some have not retired their debt. It may be possible to develop and negotiate mechanism and financial arrangements for transferring PPAs into market domain. A policy would be required. It should be possible to acquire some liquidity for the market exchange over a period of two years or so. Following can be done in concrete terms;

1. Privatize GENCOs on selling assets basis and based on take and pay terms and being members of the exchange whenever it materializes.
2. Privatize RLNGCC plants on the same basis and possibly some hydro-power plants as well eventually.
3. Allow IPPs completing their 25-30 years PPAs to compete in the exchange
4. Convert IPPs to market exchange, those IPPs to market exchange which have paid their debt. Continue paying the agreed amounts under PPAs under a price settlement agreement; the difference between market price and PPA price to be settled. If market price is higher, CPPAG/GoP gets the difference; if market price is lower, IPP is paid by CPPAG.
5. In the final round, deal with other IPPs which have yet to retire their debts completely. Same mechanism would apply for price settlement as in point 4 above.

6. All new PPAs to be under take or pay and market exchange rates basis. PPIB auctions or solicited acquisition through a Capacity market basis ala practice in the U.K.
7. As a complementary operation, convert DISCOs to wire-only. This can be done before or after privatization. The current CTBCM proposal of converting existing contracts to bilateral s with DISCOs becomes redundant. IPPs and other market players would then sell electricity directly to all consumers, irrespective of size. Alternatively, DISCOs continue to operate under existing arrangements but procure their need through the exchange.
8. NPCC (National Power Control Center) continues to work as a system operator planning and managing dispatches. The responsibility of making IGCEP is to be shifted from NTDC to NPCC.
9. NTDC to perform its core functions with open and equal access mandate and a fixed tariff system.
10. For a considerable period of time, a hybrid and transition regime is to prevail. In his period NEPRA's role become even more significant. Eventually, NEPRA may have an oversight function to see to t that markets are working transparently.
11. PPIB-AEDB to continue performing facilitating role and transitional management, especially, with respect to sovereign guarantees and the associated negotiations.
12. A competitive fuel market is to be organized to assure a frictionless market regime in electricity sector-to-G fuel contracts are to be avoided and existing arrangement to be converted, if feasible. Qatar LNG may be sold at spot market prices and the deficit recouped as equalization charge from all user sectors. Preferably, a new local well-head gas formula may be introduced linking local gas price to spot LNG or some kind of average of several and relevant gas market hub prices.

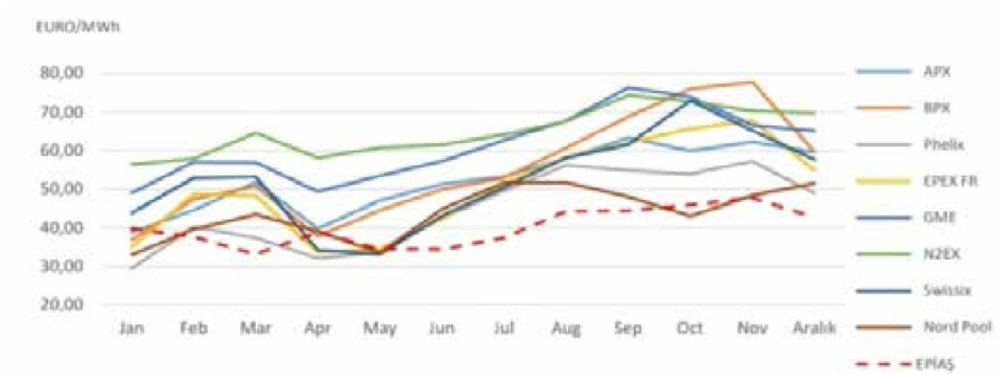
Central Electricity Regulatory Commission (CERC) in India has announced similar proposals to bring all the electricity generated under one pooled market. There is an intimidating misnomer that the market has to be very big in order to have market exchanges. Most large and small countries in Europe are members of one exchange or the other. There is an EU directive that most countries should have their own hubs and exchanges.

Will Market Deliver?

Will the market be able to function transparently? Will it be able to attract investment? Will it be captured by the elite or mafia? Will it be able to facilitate poorer segments' access to energy? The alternative is government and bureaucracy. Demo models can be run and there may be a phased approach, starting with a market of 10,000MW.

Expertise can be hired. There are exchange-operating companies in Europe, which have the software, knowhow and experience to run energy exchanges. They would be happy to have a business opportunity. Training activities can be initiated remotely even now on their software. Concluding, market exchange is too important an institution to be ignored outright. Pakistan's market is not small as the capacity of 35,000MW will double in less than two decades.

Chart 6.13.4: European Energy Exchanges and Exist DAM Price



Bilateral DISCO contracting is a move in reverse direction when the world has long moved into pooled markets. Bilateral DISCO-IPP contracts would be shifting sector management from a larger stronger system to weaker DISCO organizations involving many risks. Competitive pooled markets are the order of the day. One is not sure if Nepra has given sufficient thought to its determinations in his respect. Adequate consultation has not been made on all the available options and a prescription is being implemented as a fait accompli without considering and evaluating options. Higher national bodies such as the Senate Standing Committee on Power and others should be consulted on the larger social and economic impacts. The issue is too big to be left to technicians alone.

Philippines: From Vertically Integrated Regulated System to Spot Market Exchange

The NPC's (WAPDA of Philippines) financial performance seriously worsened during the late 1990s. It was adversely affected by high debt payment and power purchase obligations. The deterioration was the result of several factors: *the Impact of the Asian*

Financial Crisis of 1997–1998, the subsequent depreciation of the Peso, the high cost of take-or-pay power purchases from IPPs, and government reluctance to increase retail power prices. The government response was embodied in the EPIRA and called for radical reorganization and reform in the power supply industry. The plan involved (i) disaggregation of the industry into generation, transmission, distribution, and supply segments; (ii) introduction of competition in the generation and supply subsectors; (iii) introduction of a WESM; (iv) creation of the PSALM to manage the privatization of generation assets and transmission operations (but not of the ownership of the transmission facilities); (v) introduction of open access to distribution networks, and (vi) independent regulation

The MMS, financed and implemented with project support, formed the core of the WESM. Establishing the WESM was meant to enable distribution utilities and electricity suppliers to purchase bulk electricity directly from the generating entities or to buy it on the spot market. The WESM would make it possible for generated power to be dispatched on the basis of prices bid into the market, with the lowest priced electricity dispatched first. A well-functioning WESM with nodal pricing would provide the economic signals needed to encourage efficient investment in new generation capacity.

The evaluation found that the MMS has been highly effective. It has fulfilled its primary function of automatically enabling competitive market forces to help determine the amount, mix, and cost characteristics of generating plants to meet demand. Increased competition has led to the dispatch of power from the most efficient, and cost-effective power plants first, with the highest cost and least efficient plants being dispatched and providing energy to the market last. The MMS was scheduled to operate until 2012 but is still in service and not expected to be replaced until 2017.

Source: Extract from ADB Evaluation Report

Title	Involved Countries	Products
APX Power NL	the Netherlands	Day-Ahead-Auctions, Continuous Intraday
APX Power UK	UK	Day-Ahead-Auctions,UK Half Hour
ASX	Australia, New Zealand	Day-Ahead 15:30 Auction, Spot Market, Prompt Market, Third Party, Notification and View Only Services Derivatives (Futures)

Belpex	Belgium	Day-Ahead-Auctions, Continuous Intraday, Strategic Reserve
BSP Southpool	Austria, Italy, Slovenia	Day-Ahead-Auctions, Continuous Intraday & Intraday-Auctions
CROPEX	Croatia	Day-Ahead-Auctions, Derivatives (Futures)
EEX	Germany	
EMC	Singapore	
EPEX Spot	Austria, Belgium, France, Germany, Luxembourg, United Kindgom, the Netherlands Switzerland	Day-Ahead-Auctions, Continuous Intraday & Intraday-Auctions
EPIAŞ	Turkey	Day-Ahead-Auctions, Continuous Intraday
ERCOT	USA	Real-Time Energy Market, Day-Ahead
EXAA	Austria, Germany	Day-Ahead-Auctions
EXIST	Turkey	Day-Ahead-Auctions, Intraday-Auctions, Balancing Market
GME	Austria, France, Greece, Italy, Malta, Slovenia, Switzerland	Day-Ahead-Auctions, Intraday-Auctions
HEnEX	Greece	Day-Ahead-Auctions
HUPX	Hungary	Day-Ahead-Auctions, Intraday, Physical Futures
IBEX	Bulgaria	Day-Ahead-Auctions
ICE	Europe, Singapore, USA	Derivatives (Futures)
IEX	India	Day-Ahead-Auctions, Term-Ahead Derivatives (Futures)
KPX	Southkorea	
JEPX	Japan	Day-Ahead-Auction, Intraday-Auction
MOSENEX	Russia	Derivatives (Futures)

Nasdaq OMX	Denkmark, Estland, Finland, Germany, Iceland, Latvia, Lithuania, Sweden, USA	Derivatives (Future)
Nordpool Spot	Denmark, Estonia, Finland, Germany, Latvia, Lithuania, Norway, Sweden, United Kingdom	Day-Ahead-Auctions, Continuous Intraday
Nodal Exchange	USA	Derivatives
OTE	Czech Republic	(Futures)
OMIP	Portugal, Spain, UK, USA, Germany, Switzerland, Netherlands, Malta, Belgium, Cayman Islands, Denmark, Luxembourg	Day-Ahead-Auctions Derivatives (Futures)
OMIE	Spain, Portugal	Day-Ahead-Auctions, Intraday
OPCOM	Romania Slovak	Day-Ahead-Auctions, Intraday
OKTE	Republic	Day-Ahead-Auctions Real-Time
PJM	USA	Energy Market, Day-Ahead
Power next	France	Day-Ahead-Auctions, Futures
PXE	Czech Republic, Hungary, Poland, Romania, Slovakia	Derivatives (Futures) Day-Ahead-Auctions,
PXIL	India	Term-Ahead-Market, Intraday, Any-Day, Derivatives
TGE	Poland	(Futures), Day-Ahead-Auctions, Intraday
WESM	Philippines	Spot Market

Excerpts SUMMARY ANNUAL REPORT Philippines' Wholesale Electricity Spot Market (WESM)

This Annual Market Assessment Report (AMAR) provides an assessment of results of the integrated Luzon and Visayas operations of the Wholesale Electricity Spot Market (WESM) for the period 26 December 2017 to 25 December 2018. At the close of the billing year, the total WESM registered capacity only climbed to 18,902 MW, narrowly higher than last year's 18,764 MW. Capacity offered by scheduled generators comprised about 66 percent of the total registered capacity or 12,394

MW while around 2 percent or 390 MW was nominated by must-dispatch, priority dispatch and non-scheduled generators. The other 3 percent were on account of capacity related to the conduct of testing and commissioning of plants which have yet to start commercial operations (258 MW) and capacity of Malaya TPP as Must Run Unit (418 MW).

Meanwhile, average system demand plus reserve climbed beyond the 10,000 MW mark as it finished at 10,497 MW amid increase in the economic growth both in Luzon and Visayas. Average effective supply level posted a slim increase this year at 12,625 MW from previous year's 11,652 MW, influenced by the slight improvement in the average outage capacity level in 2018 as earlier mentioned. As a result, the supply margin recovered by 22 percent this year at 2,065 MW from a benign 1,693 MW supply margin recorded the previous year. Sufficient margin between supply and demand generally prevailed during the twelve-month period. Notwithstanding, narrow supply margin was still observed during periods of tight demand and supply conditions, with 10 trading intervals recording supply margin levels below 100 MW.

Over the five-year period, average market price was observed to slump beginning the year 2014 sliding to its lowest level in the year 2016 at PhP 2,947(57.931 USD)/ MWh. This however slowly 26 December 2017 to 25 December 2018 Annual Market Assessment Report iv (MAG-AMAR-2018) recovered by 8 percent bringing the market price by the end of 2018 at PhP 3,618(71.122 USD)/MWh. During the billing year, market prices in Luzon were higher than in Visayas except during the billing months of May, August, September and November. Particularly, during the August billing month, average market price in Luzon was lower by 10.8 percent than in Visayas.

50.87 PhP=1 USD (21.03.2020)

TURKEY-EPIAS PROFILE

- **Total Installed Capacity:88526 MW**
- **Annual Generation:306.7 TWh**
- **Day-Ahead Cleared Volume:149.39 TWh**
- **No. of Market Participants:1066**
- **o/w Generators:828**
- **Wholesale:152**
- **Transmission:1**
- **Max. Transmission Loss: 2.13%**
- **Retail:63**
- **Distribution-DISCOs:21**

6.14: The complexities of Electricity Markets

Sugar, Cement and Flour scandals have shaken the confidence of people in markets. Regulations and government controls have not delivered either. In Karachi, people are suffering under the poor performance of KE- an example of privatization. There are no formal and organized markets as we see Whatsapp sugar price manipulation groups instead of spot markets. Thus neither markets nor privatization nor regulation has delivered. Yet markets and privatization has helped other regions in bringing about well supplied markets. Market works and should work on its own without bureaucratic or autocratic controls or intervention. Broad oversights and institutions should be enough. We will discuss here the issues involved in bringing about an Electricity market instead of a regulated control regime.

Three Major Issues: Circular debt, IGCEP and CTBCM

There are three major issues faced by the power sector today on which major actions and decisions have to be taken by the government and the regulator. These are: Circular Debt; Power Plan (IGCEP-Indicative Generation Capacity Expansion Plan) and Market (CTBCM-Competitive Trading Bilateral Contracts Markets). IPP report has identified issues with respect to Circular debt and negotiations are being held with IPPs to neutralize the excessive payment and higher tariff issue. The problem is that worst has yet to land in this respect when very expensive tariff projects will be commissioned between now and the year 2025.The tragedy is that new projects and PPAs are being signed under the old framework against which there is complaint and negotiations are currently taking place. What would be the result, we do not know. Other aspects of Circular debt are DISCO restructuring and reforms and full cost recovery from consumers. Technical people want cost recovery and higher tariff while politically sensitive leadership is opposing rise in tariff, in fact they want the opposite of it. DISCO reforms have yet to be initiated in a major way which is stalled due to other related policy issues.

Table 6.14.1: Comparative Electricity Tariff in India

Category	BEST		Tata		Adani		MSEDCL	
0-100	3.22	3.18	4.53	3.77	5.06	4.47	4.94	4.91
101-300	5.92	5.81	7.66	6.22	8.42	6.42	9.31	8.88
301-500	8.89	8.69	12.16	9.57	9.65	8.22	12.55	11.77
500 & above	10.47	10.26	14.75	10.37	11.60	9.37	14.31	13.16
HT industry	7.92	6.11	8.84	6.33	9.48	6.60	7.99	7.02
HT commercial	7.94	6.67	9.36	6.78	9.74	6.93	13.5	11.47

Source: Economic Times India

We will focus in this space on Electricity market issues, while taking a brief overview of the power plan-IGCEP-Power Plan which is a related issue. Current installed generation capacity is 36000 MW, while demand is only 25000 MW or even less, while it was 26000 MW in 2017-18 and should have been 30,000 MW by now. There is clearly a demand slow down and the future is risky and unknown in the context of corona. Power Plan envisages a generation capacity of 75000 MW by 2030 by the addition of 50,000 MW of new capacity and retirement **of 10,000** MW of old plants. Out of 50,000 MW, there are committed projects of 25,000 MW? And the remaining 25000 MW gap may be filled by yet undefined solar and wind power capacity.

Main Bottlenecks in Electricity Market

Two classical episodes would reveal the problems and issues in energy sector planning in Pakistan; ESP (Energy Security Plan-2008) provides for 80,000 MW of electricity generation capacity in 2030 indicating a shear ignorance of the resource endowment of the country or a romantic attitude in planning. The second is a more recent one pertaining to current planning. IGCEP ignored Bhasha dam altogether in its plan, almost at the same time when WAPDA was negotiating a major contract on Bhasha and on 13th May ,2020, signed a major contract !!! What does it indicate? A bureaucratic culture thriving on secrecy syndrome and non- communication. All kind of (lame) defense can be offered but the fact is that there is a structural flaw. There is a need for bringing about governance reforms.

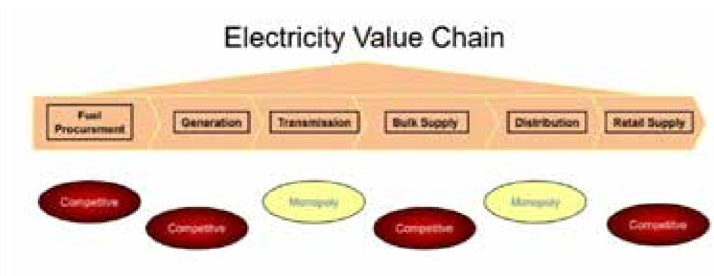
The main issue or bottleneck in bringing about electricity market is the existing or inline power projects for which PPAs have been signed or are already in operation or are at an advanced stage of construction. These are under Take or Pay arrangements which are an anathema to competitive market. If there is some commitment for competition why are new liabilities being created under old arrangement which has to be changed? Currently, there is 50,000 MW capacity that is under Take or Pay.

There has been provision all along for solicited projects in various power policies under which competitive bidding could have taken place? However, easier said than done. Any competition in CPEC project would have been a farce. Yet, other projects were there in which competitive bidding could have been organized. There have been talks of organizing some sort of competitive bidding, reverse auction or otherwise, which has not happened.

Do we really need Electricity Market?

Do we really need market to have competitive prices and competition; yes and no. There is provision in existing policies for competitive bidding for selecting the least cost offers be it capex or tariff based. Power policies provide for competitive bidding in what is called Solicited Projects. However, almost all of the power capacities have been approved under unsolicited projects in which regulated prices have been applied without competition. Solicited projects can provide competitive costs/prices for Generation and Transmission projects. Distribution costs are not covered and cannot possibly be covered under the provisions of Solicited projects. In India, though, they have developed a scheme for auctioning Gas Distribution Licenses thru tariff based bidding. More than 80 Gas DISCOMs have been licensed under such schemes in India.

Chart 6.14.2: Electricity Value Chain



Under the new competitive market system, Distribution tariff is determined for wire business DISCOs by the regulators. Marketing companies are allowed to charge any price (often under price ceiling) and customers buy from the lowest price supplier. Supplier has incentive to sell at a lowest viable price in order to earn through higher market share.

There are three types of projects and PPAs; one which is in early stage of operations and their debt has not been paid off; second which are in the mid or later stage of debt pay-off; and the third, where debt has been paid off. It is in this last category of power projects, where new market design and terms may be feasible. This is a capacity of **7500** MW. And there is 25,000 MW of yet not sure solar and wind power capacity that may be brought under new market regime. In other richer countries, where this market transformation took place, reportedly paid off the investors and started the same projects on the new slate of competitive market. In our financial situation and circular debt situation, this kind of financial undertaking is not feasible and s rather thinkable. There may be other solutions such as bond or conversion to forward markets which is beyond the scope of a newspaper article. It appears that regulated and market based projects may run side by side.

The Indian Experience

It may be worth-while examining the Electricity Law promulgated in 2003 which laid legal foundation of electricity market in that country. There were the following key elements of that legislation:

- De-licensing of Power Generation
- Open Access to Transmission System
- Open Access to Distribution System
- Key Provisions of Renewable and Cogeneration
- Trading in Electricity Permitted
- Liberal Provisions for Captive Power
- Multiple Distribution Licensees Permitted
- Rural Generation and Distribution freed from Licensing and other controls

Chart 6.14.1: Electricity Act 2003-Salient Features

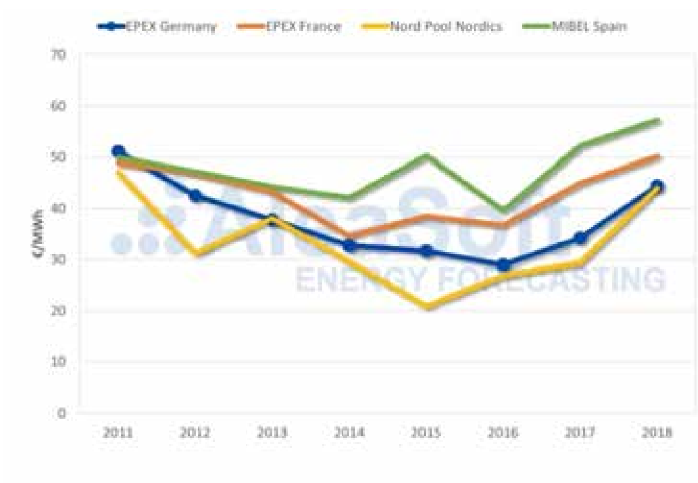
- De-licensing of power generation
- Open Access to Transmission System
- Open Access to Distribution System
- Key provisions for renewable and cogeneration
- Trading in electricity permitted
- Liberal provisions for captive power generation
- Multiple Distribution Licensees permitted
- Rural generation and distribution freed from licen
- Direct and transparent payment of subsidies
- Expanded role for the Regulatory Commissions

However, practically speaking, there is no electricity market in India in a significant way. There are two electricity exchanges with a small market share (5% or less) and open access and multiple distribution licenses are working in Mumbai (Maharashtra).There has been success in the induction of Solar and Wind power due to competitive bidding. 40,000 MW of solar capacity has been auctioned and installed at very low prices and more is coming to reach the target of 100,000 MW. Tariff in open access areas (Mumbai) does not appear to be low. In Gujarat and elsewhere dominated by public sector facilities have lower tariff. Distribution losses and theft is almost at the same level as it is in Pakistan. The main issue, as here in Pakistan is the large capacity under Take or Pay PPAs. In Pakistan, innovative approaches are needed keeping in view the failures in India.

Competitive processes have brought Renewables' prices down. While, in Pakistan some old Wind power plants are charging more than Rs. 25.00 per kWh, the same vintage plants are charging less than 50% of that. From 2012,Wind power price in India remained stable at IRs.3.75 per kWh and came down to Irs. 2.43 by 2017 and are falling since then. Solar is even cheaper and has been on price falling track for the last 5 years. Competition in Coal power plants brought coal electricity prices to IRs.2-3 per kWh.

The European and American Market Experience

Chart 6.14.2: Wholesale electricity market price



Sources: Prepared by AleaSoft using data from EPEX SPOT, OMIE and Nord Pool.

We have provided tables of spot electricity prices in Europe and the U.S.A. There are 8-10 electricity market regions in the U.S. In none of them spot market average has exceeded USc 4.00 and in most of the markets the median figure is of USC 3.2 per kWh. Average retail price in the U.S. has remained around USC 10-11 per kWh; however, this average hides large variations above and below the average from state to state.

In Germany, Spot electricity prices kept falling down from Euro 5.00 per kWh in the year 2011 and after reaching a dip at Euro 3.00 acquired earlier Euro 5.0 level by 2028. In Germany, residential tariff is high but that is due to heavy taxation. Taxation share is larger than the basic electricity price itself. Industrial tariff, however, has been kept competitive at 7 Euro.

The CTBCM

There are two types of market model; one is cost based and the other bid-based. CTBCM has adopted the cost-based model, probably due to the bottlenecks created by existing PPAs. The like of Cost-based model is already there in a rough form under the existing merit-order system wherein NEPRA determines the costs and may continue to do so. For competitive market enthusiasts it is an anathema; to them price should be decided through bids by sellers and the buyers. They reject a system where all the trappings of a regulated system manage to survive.

Electricity market has essentially two components; wholesale market and retail markets. Retail markets often depend on wholesale market. Retail markets require open access to transmission and distribution, while wholesale markets require unrestricted investment activity and competitive generation tariff. A million dollar question is; is it possible to have retail competition without wholesale market. Theoretically, no but practically something can possibly done to bring about a functioning retail market without a wholesale market; how?

Open Access and Retail Markets

By retail competition, one means, that there are electricity suppliers who could be independent traders or IPPs or a combination of both which sell electricity to the retail customers in the place of a DISCO. Currently, DISCOs sell electricity and is a monopoly. In the open access retail market, electricity suppliers use the infrastructure of DISCOs to distribute electricity to their customers. Suppliers pay a wheeling charge to the DISCOs who invest in physical infrastructure and maintain it. DISCOs have no connection with the consumers; suppliers market, sell and collect bills. Thus, there may be many suppliers creating a competitive situation whereby consumes have a choice of selecting their supplier company based on quality of service and price. Thus retail customers, in fact, throw up, the suppliers. Suppliers are thus forced to procure cheaper or competitive electricity. He may buy from a competitive wholesale market and in the absence of which may make bilateral arrangements with IPPs under prices which are essentially dictated by the retail market. This indicates that, indeed, retail market may function without a formal structure of a competitive wholesale markets working under an exchange system or the like.

A practical example is Mumbai where there are three suppliers and retail customers are free to select the supplier. Earlier, there was demarcation of customers which with the passage of time has gone away under court decision in the framework of 2003

Electricity Law of the market in India. There is no formal wholesale market in India. There are two small market exchanges which market share does not exceed more than a few percentage points.

In Pakistan also, we can also have voluntary electric market exchanges wherein excess electricity may be traded; it may come from captive power plants, normal IPPs under arrangement with CPPAG wherein a certain portion of PPA electricity may be traded under certain circumstances; new solar and wind projects and independent merchant IPPs may sell their output through such exchanges. A lot of work would, however, would be required; establishing wheeling charges and Annual Revenue Requirement- ARR- of DISCOs. Upper ceiling of consumer tariff may also be enforced in order to prevent market manipulation and undue price increases.

Towards an untutored Privatization ?

Unfortunately, Privatization Commission is moving ahead with privatization in a solo flight without getting itself informed of the proposed CTBCM-Electric Retail Market provisions. It would create many legal complications post privatization. Wires-only model and existing DISCO models are two very different models having serious and severe business implications. PC would be well advised to get informed on the subject accordingly. Privatization is on agenda of successive governments but does not happen for one reason or the other, mostly due to Unions' and other insiders' opposition. Retail market-Wires only model is a part privatization reducing the existing DISCO load and involvement to be significantly reduced reducing the rationale of privatization itself or reducing the consequences of not privatizing.

Electricity Cooperatives?

Another relevant model is of Electricity Cooperatives wherein users are the owners themselves. There are many cooperative models working efficiently in the U.S.5% of the electricity in the U.S. is generated by Coops and have 13% market share in electricity sales.42% of electric distribution lines are owned by cooperatives; there are 831 distribution cooperatives and 62 generation and transmission cooperatives. Electric Cooperatives' contributions to the U.S. GDP are 88 billion USD and contribute 22 billion USD in taxes. In a no-owner and liquidating situation, Cooperative option deserves serious consideration.

Electric market should address issues of rural and unserved or underserved areas. In order to promote micro-grids ,cooperatives and self-initiatives, licensing requirements and other restrictions for generation and distribution businesses should not be there and should be eliminated that would promote informal markets.

Table 6.14.3: Power Projects which Debt Servicing Completed or about to

	Capacity-MW	Fuel	COD
Pre-1994-HUBCO	1292	RFO	1997
Post-1994 Policy	3105	RFO, Gas, Diesel	2000
Privatized-Kot –Addu	1638	RFO, Gas, Diesel	1996
2002 Policy	1700	RFO, Gas, Diesel	2009
Total	7735	RFO, Gas, Diesel	

Source: NEPRA,PPIB

Table 6.14.4: Complete List of Power Projects

Sr. No.	Project Name	Location	Gross/Installed Capacity (MW)	Fuel/ Technology	COD	Term (Years)	Expiry
Prior to 1994 Power Policy							
1	Hub Power Project (HUBCO)	Baloch-istan	1292	RFO	1997	30	2027
Total (Prior to 1994 Power Policy)			**1292**				
Under 1994 Power Policy							
2	Lalpir Power Project	Mehmood Kot,	362	RFO	1997	30	2027
3	Pak Gen Power Project	Mehmood Kot,	365	RFO	98	30	2028
4	Altern Power Project	Attock	31	Gas	2008	30	2038
5	Fauji Kabirwala Power Project	Khanewal	157	Gas	1999	30	2029
6	Gul Ahmed Energy Project	Karachi	136	RFO	1997	22	2019
7	Habibullah Coastal Power Project	Quetta	140	Gas	1999	30	2029
8	Japan Power Genera-tion Project	Lahore	120	RFO	2000	30	2030
9	Kohinoor Energy Project	Near Lahore	131	RFO	1997	22	2019
10	TNB Liberty Power Project	Ghotki, Sindh	235	Gas	2001	25	26
11	Rousch (Pakistan) Power Project	Khanewal	450	Gas	99	30	2029
12	Saba Power Project	Sheikhu-pura,	134	RFO	1999	30	2029

13	Southern Electric Power Project	Lahore,	117	RFO	1999		1999
14	Tapal Energy Project	Karachi	126	RFO	1997	22	2019
15	Uch Power Project	Balochista	586	Gas	2000	30	2030
16	Davis Energen Private Limited	Jhang, Punjab	10.5	Gas	2013	30	2043
Total (1994 Power Policy)			**3100.5**				
Projects Privatized from Public Sector							
17	Kot Addu Power Project (KAPCO)	Kot Addu	1638	HSFO, Gas and HSD	1996	25	2021
			1638				
Under 1995 Power Policy							
18	New Bong Escape Hydropower Project	AJ&K	84	Hydro	2013	25	38
Total (1995 Power Policy)			**84**				
Under 2002 Power Policy							
19	Attock Gen Power Project	Rawalpindi	165	LSFO	2009	25	2034
20	Atlas Power Project	Sheikhu-pura,	225	RFO	2009	25	2034
21	Engro Power Project	Qadirpur	227	Gas	2010	25	35
22	Saif Power Project	Sahiwal	229	Gas+HSD	2010	30	40
23	Orient Power Project	Balloki	229	Gas,HSD	2010	30	40
24	Nishat Power Project	Near Lahore,	200	Gas,HSD	2010	25	35
25	Nishat Chunian Power Project	Near Lahore,	200	Gas,HSD	2010	25	2035
26	Sapphire Power Project	Muridke,	225	Gas,HSD	2010	30	2040
27	Liberty Power Tech Project	Faisalabad,	200	RFO	2011	25	2036
28	HUBCO-Narowal Project	Narowal, Punjab	220	RFO	2011	25	2036
29	Fauji Dahraki Power Project	Daharki, Sindh	185	Gas	2011	25	2036
30	Halmore Power Project	Bhikki, Punjab	225	Dual (Gas+HSD)	2011	30	2041
31	Uch-II Power Project	D.Murad-Jamali	404	Low Btu Gas	2014	25	2039
32	Patrind Hydropower Project	Kunhar River, KP/ AJ&K	147	Hydropower	2017	30	2047

33	Gulpur Hydropower Project	District Kotli, AJ&K	102	Hydropower	2020	30	50
Total (2002 Power Policies)			**3183**				
Under 2015 Power Policy							
34	Sahiwal Coal Power Project	Sahiwal	1320	Imported Coal	2017	30	2047
35	Port Qasim Coal Power Project	Port Qasim, Karachi	1320	Imported Coal	2018	30	48
36	Haveli Bahadur Shah Power Project	Jhang	1230	RLNG	2018	30	2048
37	Bhikki Power Project	Bhikki, Sheikhu-pura	1180	RLNG	20-May-18	30	2048
38	Balloki Power Project	Balloki, Punjab	1223	RLNG	29-Jul-18	30	2048
39	Engro Powergen Limited	Thar Block-II, Sindh	660	Coal	2019	30	2049
40	China Power Hub Generation Company –HUBCO	Hub, Ba-lochistan	1320	Imported Coal	2019	30	2049
Total (2015 Power Policy)			**8253**				
Grand Total (1994+1995+2002+2015 Power Policies)			**17550.5**				

Source: NTDC

6.15: IPP Enquiry Report

Pakistan is passing through an interesting time among Corona troubles.IPP enquiry report has surfaced after equally contentious Wheat and Sugar report. It is a good omen that questions are being asked and the system is not afraid of the powerful. Irrespective of the outcome, the transparency and fearlessness of GoP and its agencies is to be appreciated.

The IPP Report has been received under a lot of controversy and has been dubbed to be unfair, one-sided singling out IPPs alone for power sector's problems. A cursory reading indicates that the report has focused on most of the problems and issues including private sector IPPs and government projects and organizations including DISCOs and CPEC. Excessive interest and Capital costs and Fuel and O&M costs have long been under discussion. The Report brings these issues in a formal framework for the purpose of discussion and resolution. It has enabled beginning of a consultation process with IPPs and something is expected to come out of it.

The IPP Report depicts a very serious situation of the power sector with a Circular Debt of about Rs. 2 trillion and annual financial cost of Rs.200- 250 Billion. It recommends conversion of Circular Debt to public debt i.e. transferring Power sector liabilities to federal government. GoP subsidies to power sector have reached a cumulative total level of Rs. 3.2 Trillion between 2007 to 2019, an average ofrs.250 billion per year in that period. The subsidies peaked in FY 2013 at Rs 686 billion and gradually came down to a minimum of Rs 83.98 Billion in 2018 but almost doubled next year in 2019 to Rs 160 billion in 2019 probably due to currency depreciation effect.

It points out several reasons for such a precarious situation;

Over payments to private sector IPPs in various forms; high O& M expenses; irregularities in fuel expenses and payments, over reported capex, iniquitous escalation and indexation and mismatch between NEPRA tariff and the payments made by CPPA to IPPs. The IPP Report recommends a recovery of Rs. 104.43 Billion from the IPPs; out of which a major share (Rs. 64.22 billion) pertains to excess Fuel and O&M issues.

The Report highlights 7 private sector IPP companies of making excessive RoE varying between 31 to % to as much as 87%.One has to search for the rationale of such high RoE. It has been alleged elsewhere that a number of factors including but not limited to excessive Fuel charges and O&M expenses are involved. It does sound scandalous, though. Similar are three times expensive HVDC CAPEX discussed elsewhere.

It does not spare government sector projects including CPEC and RLNG power plants. It points out undeserved IDC (Interest during Construction), high CAPEX in coal power plants and HVDC transmission line. It also points out high interest rates in the form of LIBOR and KIBOR spreads. The Report suggests corrections and rescheduling of loans of government sector projects in order to reduce the cash-flow load posed by these projects. The Report points out excess capacity and recommends moratorium on new capacity and investments. It also suggest integration of NTDC and KE allowing free movement of electricity and avoiding an ugly situation of KE making investments in new capacity of LNG and Coal Power plants while in the country there is excess capacity.

The Report also suggests Gas Pricing Reforms recommending introduction of weighted average cost of Gas (WACOG).Currently, LNG is treated and accounted separately resulting in waste in gas consumption in inefficient GENCO plants and creates other complications. It also recommends doing away with the provision of mandatory capacity utilization of 66%.It recommends shutting down all inefficient GENCOs and IPPs which have completed their contractual period.

The Report brings DISCOs lack of performance into sharp relief putting its cumulative losses and receivables at more than Rs. 1 Trillion out of which 55% are private sector bills defaulters; 18.2%are to be paid by Federal and provincial governments;10.7 % are unpaid subsidies while IPPs and KE have to pay another 8.4%.Total DISCO losses during the period 2014-2019 have reached a cumulative total of Rs 788 billion out of which Rs 567 billion are under recoveries and T&D losses are Rs 222 Billion. As a result most DISCOs are in negative equity; PESCO topping the list at Rs. – 227 billion followed by HESCO at Rs. – 126 billion. A modest reduction of less than 2% in &D losses has been reported over the past 5 years, from 19% to 17.7 %. Under recoveries of bills stand at a constant yearly level of 7%.

It recommends action in improving their performance, possibly, by breaking DISCOs into smaller companies. It also recommends separating Distribution from supply business and introducing electricity traders. It also recommends separation and independence of System Operator (NPCC) and transmission (NTDC). These recommendations have been on the table for almost a decade being pressed by IFIs and their foreign consultants. The report also recommends a mechanism of sharing subsidies (losses) with the provincial governments (to alleviate financial burden of Federal government and make provincial governments more cooperative in loss reduction activities of DISCOs)

The Report recommends bringing in competition by introducing CTBCM which is already under process and suggests bringing CTBCM under NEPRA regulations whole reverse may be more appropriate. The Report does not display much understanding of the competitive electricity market issues and its implication but, nevertheless, supports it.

Without criticizing the Power Division, the Report recommends reorganizing and restructuring of the Power division and even puts in an organogram in order to increase technical capabilities and skills in the division.

The Report estimates the supply cost of electricity without subsidy to be Rs.22.5 per kWh for FY 2020 out of which CPP is 9.9 Rs per kWh. Only highest tariff of 700 units plus of Rs 22.5 equals the cost, all other domestic tariff are lower than the supply cost.

The Report criticizes NHP(Net Hydro Profit) considers it a heavy load on power sector and recommends bringing it in line with international practice. It points out that the dangers that KPK enthusiasts demand Rs.400 billion for NHP under AKN Qazi Formula which may completely render electricity economics off the balance.

There are some issues that are quite difficult. The Report recommends switching to Take and Pay as opposed to Take or Pay as is the case in IPPs. Frankly, Take or Pay is not feasible under the single buyer market system that prevails in Pakistan. It is feasible in a multi-buyer competitive market. Even if somehow, Take or Pay is accepted, in that case investor would demand higher tariff for lower capacity utilization and may ask higher tariff in case of peak times and seasons, negating any purportive advantage. And then, Take or Pay is contractual stipulation. Secondly, here is a recommendation of converting to local currency payment and producer tariff, which again is a contractual requirement and may not be negotiable. Implementation anomalies only can be negotiated. Then, NEPRA has determined upfront tariff which is an independent regulator supposed to have made a fair determination without fear or favour. It is a separate matter that IPPs may be able to offer some concession in the peculiar circumstances voluntarily such as debt rescheduling.

Concluding, a circular debt of Rs 2 trillion in addition to subsidies of Rs 3.2 trillion given in the past is certainly not sustainable neither for the government and a supply cost/tariff of Rs. 22.50 is not payable by consumers. All of this compounded by the incoming recession does indicate need of accommodation on both the sides.

IPP Enquiry Committee's Report's Recommendations

IPP Report has 37 Recommendations in 3 parts;13 on Private sector IPPs,17 on Circular Debt and Distribution Inefficiencies and 7 on Competitive Markets.

A. Review of Private Power Producers

1) Shift from USD to PKR based Tariff for All IPPs
2) End Take or Pay arrangements
3) Establishment of Commission for Forensic Evaluation
4) Review set-up costs of IPPs and Lahore Matiari HVDC
5) Review Risks highlighted in the Report
6) Recover Excess Profit made from fuel, O&M, Excess set up cost
7) Rectify IRR and Debt payment frequency mismatch
8) Review IDC and other set up costs of coal IPPs to recalculate RoE
9) Review plant capacity benchmarks in renewable IPPs for a more prudent sharing method and recover excess payments made
10) Introduce reasonable claw-back mechanism in all tariffs when required
11) Verify fuel inventories of thermal IPPs and adjust outstanding payments against actual levels
12) Recover excess profits made by generation beyond capacity benchmarks from Renewable IPPs
13) Consider retirement o GENCOs as well as IPPs established under 1994 and 2002 Policies

B. Circular Debt and Distribution Inefficiencies

1) Circular Debt stock reduction/elimination and reduction of finance cost in line with Committees recommendations (conversion to public debt)
2) Debt reprofiling of public sector power plants (WAPDA, PAEC, GENCOs, 4x1200 MW RLNG based plants, renewable, CPEC and coal based projects
3) Moratorium on new plants, delay and reconsideration of upcoming plants and nonrenewal of plants reaching expiry
4) Novation of PPAs to KE instead of KE setting up new 900 MW RLNG and 700 MW coal based projects

5) KE to submit retiring/mothballing of old 900 MW bin -Qasim Thermal plant
6) Integration of KE & NTDC systems
7) Roll out of a comprehensive plan for electrification of domestic energy consumption (cooking, space heating, water heating and EVs)
8) RLNG contract renegotiation and inclusion in WACOG
9) Rationalize Natural gas tariff for captive power plants to incentivize their shift to the public grid and GENCOs to be appropriately utilized in merit order
10) Strengthen Management of DISCOs, PEPCO, NTDC and PHPL
11) Restructure Balance Sheet of DISCOs
12) Public Private Partnership, separation of wire and commercial business and possible break-up of DISCOs into smaller service territories
13) Payment of Outstanding subsidies and devising a mechanism of sharing future subsidies with provinces with at-source deduction from NFC transfers
14) Subcontracting recovery of receivables to private sector
15) Reform QESCO thru distributed generation and Microgrids
16) Solutions for QESCO for water supply for irrigation and household consumption
17) Rationalizing of existing NHP

C. Competitive Power Market

1. Establish an inter-provincial committee to finalize draft policy for approval of CCI and draft policy for approval of CCI and 5-year plan for approval of federal government
2. Review CTBM Model to ensure it is in line with NEPRA Act
3. Develop Rules for giving effect to new provisions of NEPRA Act regarding Power Market

3.1. Separate system operator and Grid

3.2. Separated Distribution and Supply

3.3. Establish Electricity Traders

4. Develop Regulations to give effect to new provisions of NEPRA Act and bring old rules in line with amended NEPRA Act.

6.16: IPP Imbroglio: The Way Forward

The recent IPP Enquiry Report (IER) has caused much uproar and anxiety. It has revealed that there has been a subsidy of Rs 3.3 Trillion over the last 12 years and the circular debt has reached a level of Rs1.95 Trillion. Together a drain or outlay of more than Rs5 Trillion over a period of 10-12 years means a yearly drain of Rs450-515 billion, half of which goes into servicing the circular debt alone. IER has suggested recovery of Rs100 billion from 12 IPPs which have been overpaid on various counts. We have provided the details of the report in our last piece. Even if Rs 100 billion is recovered, would it solve our problems of a dimension of Rs450 Billion? One has to go to the root cause. We would present here our cause-and-effect analysis of main issues and venture to suggest some remedies.

The Role of Regulator

Regulatory framework has a focal role in allowing sustainable and fair tariff acceptable to all parties and to later see to it that things go along its determinations and rules. Nothing can happen without its approval or connivance. IPPs have done what has been allowed by NEPRA. We will present here the role of the Regulator-NEPRA- in what we are facing today. This scribe and others have been pointing out the possible and potential consequences of various laxities NEPRA was indulging in. It is not intended to defame any organization but to offer corrective measures, as no time is more appropriate than now to speak out the truth.

In the regulatory issues, there are six issues; 1.High Generation Tariff; 2. Excess Capacity; 3.T&D Losses and under-recoveries; 4. Inefficient GENCOs; 5.Consumer Tariff Issues; 6.Institutional Issues. Within High Generation Tariff are the following issues; CAPEX and Financial Cost, Fuel and O&M Cost. We shall quote here some examples of high CAPEX.A ready example is the 40% difference in the EPC cost of Jamshoro Coal Power Plant (for which bidding took place under the auspices of ADB) and the three other coal power plants. The report points out very high CAPEX differences in HVDC Matiari-Lahore project as compared to similar projects installed in India. One of the Wind power plants and several others of its genre have a current tariff is Rs 23.00 per unit. Perhaps, nowhere in the world, a working wind power plant would have this atrocious

Table 6.16.1: Electricity Tariff Rates in India

States	Tariff rates per kWh	Annual tariff escalation	Percentage Renewable Portfolio Standard for wind
Andhra Pradesh	Rs. 3.50	Constant for 10 years for the PPAs to be signed during 01-05-09 to 31-03-2014	5% for all RE (2011/12)
Gujarat**	Rs. 3.56	No escalation for 25 years of project life	5% (2011/12) 5.5% (2012/13)
Harayana	Rs. 4.08	With 1.5% per year till 5th year	10% (2010/11) for all RE
Karnataka*	Rs. 3.70	No escalation for 10 years	7-10% (2010/11) for all RE
Kerala	Rs. 3.64	No escalation for 20 years of project life	3% (2011/12 & 2012/13) for all RE
Madhya Pradesh**	Rs. 4.35	No escalation for 25 years of project life	6% (2011/12)
Maharashtra	Wind Zone I–Rs. 5.07 Wind Zone II–Rs. 4.41 Wind Zone III–Rs. 3.75 Wind Zone IV–Rs. 3.38	No escalation for 13 years	7% (2011/12) 8% (2012/13) for all RE
Orissa	Rs. 5.31	No escalation for 13 years	5% for all RE (2011/12)
Punjab	Rs. 3.49	With base year 2006/07 & with 5 annual escalations @5% up to 2011/12	4% for all RE (2011/12)
Rajasthan**	Rs. 3.87 & Rs. 4.08	No escalation for 25 years of project life Rs. 3.87/kWh for Jaisalmer, Jodhpur & Barmer districts while Rs. 4.08/kWh for other districts	7.5% (2011/12)
Tamil Nadu	Rs. 3.39	No escalation for 20 years of project life	14% for all RE (2010/11)
Uttarakhand	Wind Zone I–Rs. 5.15* Wind Zone II–Rs. 4.35* Wind Zone III–Rs. 3.65* Wind Zone IV–Rs. 3.20*	Rs. 5.65 for 1st 10 year & Rs. 3.45 for 11th year onward Rs. 4.75 for 1st 10 year & Rs. 3.00 for 11th year onward Rs. 3.95 for 1st 10 year & Rs. 2.55 for 11th year onward Rs. 3.45 for 1st 10 year & Rs.2.30 for 11th year onward	4.53% for all RE (2011/12)
West Bengal*	Rs. 4.87	No escalation for 10 years	3% for all RE (2011/12)

* *RPS for Bangalore Electricity Supply Company Ltd. (BESCOM), Mangalore Electricity Supply Company Ltd.(MESCOM), and Calcutta Electricity Supply Company Ltd. (CESC) is 10% while for Gulabarga Electricity Supply Company Ltd. (GESCOM), Hubli Electricity Supply Company Ltd. (HESCOM) and Hukeri it is 7%.*
** *RPS percentage specified only for wind*

Conversion Rate: $1.00–Rs. 45.00

Source: CERC India

tariff. Coal power plant tariff is 8.45 USc as opposed to 5-6 USc almost everywhere in the world. Why is this so? It is partly because of NEPRA tariff framework and the associated practices.

CAPEX Anomalies

There is laxity in NEPRA on assessing CAPEX correctly .Whatever little options are there to monitor and control EPC costs are not utilized by NEPRA. In case of Hydro projects, especially, almost phony EPC bidding takes place , and NEPRA looks the other way. There are issues of capacity building and neither does NEPRA seek expert external advice to get the right assessments. They try to save consultants' fee of 20-30000 USD and in process lose hundreds of millions of USD. Penny wise, Pound foolish. They tinker with the investors provided data and award the Tariff. Some collusion or pressure from powerful circuits has also been alleged. It is difficult to trace who influenced in such cases as we are seeing in the recent case of sugar and wheat cases. The upfront tariffs are so high that it is a common knowledge in the power sector that no equity is required to finance power projects. When there is so much cream, it is natural that the powerful and the functionaries would demand some share in it. Public hearing is a charade where participation of third parties is highly limited. Appellate Tribunal has been provided in the legislation but has not been implemented. Advisory Committees consisting of experts and representatives of think tanks and trade associations are usually there to assist regulators in many countries. It has become obvious that some third party oversight over NEPRA ought to be there.

High Financial Cost

High Rate of Return of ROE-IRR of 15-20% in foreign currency and indexed with inflation and currency depreciation takes it to a figure of 30-40%.High interest rates awarding 4.5% margin over LIBOR is a major cause. It used to be 3% earlier and is a usual norm in other countries. And this margin doesn't vary with the level of risk or weak or strong parties. A small local party investing in a 25-50 MW gets the same margin and an international company with a strong balance sheet and experience also gets the same margin. A Gov-to Gov project like CPEC or Saudi investment often enjoying higher protections and safeguards would also get the same margins. A differentiated approach with the three types may be called for.

There was complacency on the issue earlier, as when most of the tariffs were awarded LIBOR was under 0.5%; it went as high as 3% and has only recently come down to 2% .Interest cost ,therefore, increased by 30%. And then, there is currency issue. NEPRA tariff are dollarized. Due to Rupee depreciation, tariff has automatically increased by another 30%.Many countries calculate tariff in national currencies and the same ought to be here as well. There are some other important issues as well of loan tenure. On large projects, costing more than 500 Million USD, loan tenure ought to be 20-25 years. NEPRA generation tariff is cash-flow based and not on cost based exacerbating the projects cash flow problem and front loads the tariff in early years. Some reform is urgently required in this respect and NEPRA would be urged to initiate studies and considerations in this direction.

Fuel Cost Issues

Fuel theft has been alleged in government owned GENCOs and illegal fuel booking is blamed on private sector IPPs. NEPRA has failed to follow standards and has maintained lackadaisical attitude towards fuel costs and the controls thereof. Thar coal costs more than twice what it costs in India and elsewhere. There is controversy on imported coal prices that are charged by the coal IPPs .The difference in fuel cost of the Sahiwal and Port Qasim coal power plants is Rs. 2.7738 per kWh which is 49.5 % higher for Sahiwal over PQCEPP. If the difference is genuine, it should be the inland coal transportation component. This is the cost of installing coal power plants in Punjab. The former Chief Minister Punjab wanted to install 4 coal power plants in Punjab. He was persuaded with difficulty to be content with one coal power plant at Sahiwal. In the mean time, he got another bandwagon of LNG and he got 4 RLNG combined Cycle. As a result, there is excess capacity. There is already excess capacity and another 7000 MW will be commissioned in the next two years. One 1000 MW plant costs at least 50 Billion rupees in fixed costs (capacity payment).A moratorium on new projects and stopping early stage projects is called for earnestly. Also, inefficient and old GENCOs should be retired at their earliest.

There are other issues such as related to high Qatar LNG prices and the merit order allowing inefficient power plants to come ahead than these deserve wasting otherwise valuable gas. WACOG (Weighted Average Cost of Gas) has been suggested by the report and has been on the table of negotiations with the provinces. Gas producing provinces producing cheaper gas do not agree to co-mingled gas with higher prices. Until, the issue is resolved, one would suggest using virtual WACOG for preparing the merit order.

O&M Expenses

There has been laxity in awarding O&M expenses. Reportedly, NAB has also been after it. Certain IPPs got more than 4 times the usual O&M tariff components. With indexing some power plants are enjoying more than Rs. 3.00 per kWh. Most of the IPPs which are alleged to be earning 40-80% RoE seem to have got this largesse through excessive O&M earnings.

The Alternative System

There is another way, all these controversies can be avoided; that is by introducing competitive tariff based bidding. It is provided currently under the rules of solicited projects. Also, in the proposed CTBM framework, PPIB has been provided with a role of capacity auctioneering Competition and market is the solution of all ills. NEPRA itself was quite enthusiastic about competitive bidding, but continues to neglect it. Electricity market Exchange/CTBCM is under process but may take a long time to implement. Let us first start with tariff based bidding.

However, competition cannot be organized under G-to-G contracts which should carry a concessional financial rate, say, of 2%, as its CAPEX is usually inflated. Also, one can possibly develop a formula based on international electricity prices. In India domestic gas prices are linked to a weighted average of five gas market prices? It can be tried in case of G-to-G contracts where competitive bidding is not possible?

One keeps wondering as to why oil and gas sector is working on international prices and how they are able to get investment at affordable rates so as to become competitive. They get a small subsidy of 5-10%.Electricity generation tariff in Pakistan, on the other hand, is 40-100% higher.

T&D losses

Distribution losses in government controlled DISCOs are extensive at 20% and 7-10% bills remain unrecovered. There is 700 Billion Rs worth of receivables accumulated over the last five years resulting in annual losses of Rs 140 Billion Rs. These losses enhance the distribution cost to Rs 6-7 per Unit; changing the cost structure of Capacity charge, Energy Charge and Distribution costs to be one-third each of the cost of supply of Rs.21.00 per kWh. It wouldn't be easy to reduce these losses but is not impossible. There is a strong case or reviving PEPCO with giving a mandate to reduce losses. Currently, bureaucracies' role and interference in running DISCOs has increased and there is ineffective control on DISCOs. The experience and expectations of Board of Directors have not come true. There is dispersion and cracking of the power sector. Some accumulating organization is badly needed to develop and store know-how. Instead of adding technical component in the Power division, an independent organization should be formed with a fresh upgraded mandate.

Innovative Tariff

Some innovation in consumer tariff is required. There is huge lack of capacity utilization in winters .Also, after 1100 hrs to 0500 hrs, there is lesser utilization. A night time tariff and a special seasonal tariff may be introduced for night time and seasonal industries. This may promote some special industries and may help part of the fixed costs which otherwise go wasted. Also poor and rich both benefit from the concessional tariff slabs which subsidize Rs 6-8 per unit. There are many ways, in which this anomaly can be reduced. Thus, there is quite some scope in enhancing revenue by adequate tariff optimization. GoP has to also consider reducing GST on electricity bills from 17.5%

to 5% in the prevailing circumstances and balance it possibly through taxation on oil prices, but only partly.

Institutional Issues

It would be unfair to single out IPPs for all the problems of the sector. Heavy handed approaches would not be advised. Regulator, and other government agencies and the reigning governments are all responsible for the mess that we are in. Something has to be done. IPPs have the option of bringing out their counter report rebutting or responding to the IPP Inquiry Report point by point. The proposal of hiring an international consultant is also a good one. The new commission that has been formed may like to do this. Politics and Ideology should be separated from energy economics. Ministers should avoid heading the boards of decision-making bodies like PPIB. Instead of Top-to- Bottom ordering, especially by CCOE, there should be bottom-up approach. All over capacity has been there due to CCOE orders in the last regime.

Possible Approaches for a negotiated Solution

It may be advisable to look for a negotiated solution. Arrears of Rs. 100 billion may have to be proved further and may be time consuming. A negotiated solution may be tried on the following lines.

1. There is a shortfall of Rs 5.00 per unit. Rs. 2.1 goes to subsidy and Rs. 2.9 goes towards interest payment of circular debt.IER has suggested absorption of Circular debt into public debt. It may still cost around 4% in interest payments. It is wondered if IMF or World Bank may lend some concessional money to this end.
2. IPP may be requested to offer concession to share the deficit/subsidy of Rs 2.1.Let us assume if 50% burden is shared by the IPPs, they may be required to offer a reduction of Rs. 1.05 per unit. They can possibly offer a RoE of 10-12% (in any case, equity is zero usually, exceptions may be there).However, can it match the requirement of RS 1.05 per unit of CPP reduction. IPPs may try refinancing of their debt; interest rates reduction and extension of loan term. Refinance is not uncommon. It has become more legitimate in the context of IMF and G-20 announcement.
3. Interest rates have come down again after reaching a peak in the intervening period. LIBOR Rates were very low (0.5%) between 2010 and 2015.Most of the reference tariff were awarded in the period 2015-18.LIBOR rates kept increasing since 2015 and peaked at 2.5% around 2019 and then continued to go down gradually throughout the 2019 to reach 1.8%.In 2020, it has come down to o.6% and may further go down in the context of Corona. CPPA in its forecast budget of 2019-20 has assumed LIBOR to be 3.2%.By the way, LIBOR system s going away

and will be replaced by some other equivalent system. Some irregularities had been detected in LIBOR rate setting which led to its proposed closure. I wonder what may not be happening in KIBOR.I don't know much about it.

4. Interest rates for late payments may be reduced to a more reasonable level. This should be possible now with the decrease in LIBOR and KIBOR.
5. However, the bomb shell that will come down is 7000 MW capacity to be commissioned in the next two years. It may all remain unutilized. Two are nuclear reactors which have been pushed in without due process. We have mentioned elsewhere that 1000 MW may cause a fixed cost burden of 50 billion Rupees.7000 MW would mean another 350 billion Rupees or more of annual burden. Major concessions may have to be tried to be obtained from CPEC authorities. Moratorium on debt servicing till the corona is over and recession is ended.

Concluding, the above-mentioned regime may be applied for new and as well as existing projects. There are many government projects where it may be easy and directly under its control. With private parties, some tariff concessions may be negotiated as well. There is Corona causing recession creating force majeure conditions. IPPs may be more inclined to negotiate under such circumstances.

Table 6.16.1: Supply Cost, Revenue Gaps

	Amount	**Unit Cost-Generation**	**Unit Cost-Billed**	**Unit Cost-Collection**	**Total-GAP Mn.Rs**
	Billion Rs	**Rs/kWh**	**Rs/kWh**	**Rs/kWh**	
Capacity Purchase Price	914	7.2	9	9.9	
Energy Purchase Price	696	5.5	6.8	7.5	
Power Purchase Price-PPP	1610	12.7	15.8	17.4	
UOS Charges	50	0.4	0.5	0.5	
Distribution Margin	150	1.2	1.5	1.6	
Cost of Circular Debt	270	2.1	2.6	2.9	298833
Supply Cost	2080	16.4	20.4	22.5	
Subsidy	-191	-1.5	-1.9	-2.1	216397
Supply Price	1889	14.9	18.5	20.5	
Supply Cost-USc/kWh		10.6	13.1	14.5	
Supply Price-USc/kWh		9.6	11.9	13.2	515230
Total Subsidy+ Interest CD				5	
Total Units Billed	103046				
Exchange Rate-Rs/USD	155				

Source: CPPA,IPP Report 2020

6.17: The IPP Agreement

IPP issue has been dangling for a long time now. Negotiations were going on for the last few months after the famous IPP Report which laid bare facts and background for the need to correct the high electricity tariff issue. A few days back, a MOU has been signed between government committee and a section of IPP representatives. There may be those who support and those who oppose the MoU, but the agreement has been hailed by a large section of the people rekindling hopes for an amicable settlement leading to a reduction in electricity tariff. The agreed MoU will pass through a ratification process by the respective set of stakeholders of the two sides. It is hoped that sense would prevail and every effort would be made to conclude the agreement.

1. Two separate MoUs have been signed; one with Wind Power Plants and the other with Oil/Gas power plants. First let us examine the major clauses of the agreement with Wind IPPs.1.debt tenor to be extended by 5 years and reduce the LIBOR spread by 50-75 points and KIBOR spread by 100-125 points;2.reduce O&M expenses by 20-25%;3.reduce insurance premium in the operational years;4. Delayed payment interest rate to be reduced from KIBOR +4.5% to KIBOR + 2% for the first two months and remains LIBOR+4.5% for further delays;5.RoEDC(Return on Equity during Construction) to be reduced to 13%;6.there is some confusion about reduced RoE on total investment to 12% on foreign equity and 17% local equity;7. For Oil and Gas plants, verification of thermal efficiency/Heat rate is to be done and any saving would be shared according to a formula.
2. One of the main areas of contention has been in the area of financing i.e. RoE and interest rates. All costs are translated into these two financial parameters. RoE of 12 % for foreign investments and 17% for local currency component/projects has been negotiated. It is not clear if this would apply prospectively to existing WPPs or it would be a general policy. Existing RoE policy rate is 17% for Renewables and 15% for all others. There is no distinction of local or foreign currency. All get

indexation in USD. Local currency projects/component has lost indexation with USD which was really unreasonable but get a higher RoE, which compensates for Rupee depreciation. Government has offered two main concessions;1. measures to settle IPP receivables; 2.lifting of more energy from WPPs which is otherwise wasted by NTDC transmission congestion issues.

3. Let us give you a breakdown of a typical wind power tariff on existing plants; April-June 2020, total tariff is Rs 26.39/kWh; out of which O&M is Rs 3.0875, RoE is Rs. 8.5049, debt repayment and interest is Rs 14.00. One would be surprised to learn that the wind power tariff is around 25-26 Rs per unit for the already installed WPPs under the 2013 tariff as against 6 Rs for new power plants under the new tariff. Admittedly, Wind power cost and tariff was high internationally and have come down only recently and the new and old tariff is not comparable. On the other hand, the Wind tariff under 2013 prices was unreasonably high; 60-100 % higher than international prices then. Knowledgeable circles including this scribe kept protesting against such an excessive tariff but no bell rang in the ears of NEPRA and other relevant authorities. NEPRA awarded wind power levelised tariff in 2013 was 13.52 USc as against 7.3 USc in Turkey, 7.78 in the USA, 8 USc India,6.235 USc in South American countries. Similarly NEPRA CAPEX based on which the tariff was calculated was unreasonably high;2.4 Mn USD per mw as against 1 Million USD per MW elsewhere including India and the U.S. while in Europe it was slightly higher i.e. 1 million Euro per MW. In China, it was even under 1 million USD per MW (for further details, the reader is referred to my book Issues in Energy Policy, 2014).

4. Whose fault is there in such excessive tariff; obviously NEPRA is the regulator who did it despite the advice to the contrary. NEPRA even did not bother to engage third-party consultants or simply browse the internet and get the data from regional countries, Europe and the U.S.

5. Some oversight is due on regulatory agencies against exercise of arbitrary powers or incorrect decisions hurting public interest as is evidenced by high tariff that it has been awarding .Appellate Tribunal is provided in the Electricity Legislation, which has not been implemented yet and should be implemented without further loss of time. Now that, there is a combined Ministry of Energy, Appellate Tribunal may be extended to Oil and Gas sector. We have seen how KE has been playing with the legal system and obtaining stay orders against NEPRA decisions. Courts take almost infinite time to hear and adjudicate the cases.

6. A lot of regulatory reforms are required to be implemented; 1.Public hearings have to be made more representative and meaningful. Normally, investors are well

represented and consumer interest is not adequately represented. Fortunately, internet meetings have been held by NEPRA which managed to gather points of view from a diverse section of population. This should continue beyond the prevalence of COVID.

7. Fortunately, the volume of Wind power purchase is small 1000 MW or so. Had it been a large volume, the level of destruction could have been much higher. Imagine Rs 26.34 per unit plus losses plus transmission and distribution cost, while average tariff is Rs.16.00 .Thus the scope of causing destruction and damage in an unrestricted authority of the regulator is very high and thus the overriding rationale for a reasonable oversight. New leadership at NEPRA had no role in the past policies and actions and should think about the needed reforms with an open and positive mindset.

8. While NEPRA has been at the fore-front, in the shadow, PPIB has been guiding(or even misguiding) NEPRA. Major reforms are also due in this organization. It has often been headed by the Minister and literally no debate or discussion has been taking place in its board. Behind the door collusive decisions have often been rubber-stamped by the PPIB board under the presiding Minister. Instead of Minister, an independent professional of repute should be made chairman of the PPIB board. This should be the part of the present government’s reform agenda.

9. Concluding, a competitive market is the solution for all future energy investments, which is easier said than done. A voluntary electricity exchange (ala India, where two such exchanges are operating which are planned to be extended in market share) could gradually bring the electricity sector under competition. The proposed CTBCM does not, however, offer a good competitive foot print. The issue should be deliberated upon by the policy makers carefully. Competition can be introduced in many forms for new projects. Rules are already in the books for solicited projects which means price competition in awarding generation projects. Reverse Auction is being talked about by NEPRA and AEDB for a long time now, but NEPRA is continuing with its routine process. Somehow, there has been dislike or fear for competition. Also, some preliminary hard work has to be done for defining project parameters.

10. It would not be easy to convert existing projects to competitive market. For projects, which have paid off their debt, their prevailing tariff would be lower than the expected market prices and the power purchaser would stand to lose, as the latter would have paid a big share of project cost already. The Committee should think through this issue before agreeing to any concrete terms on this issue.

11. Although,the IPP agreement will cover only about 5 % of power capacity, this template can be used for negotiations with other projects, especially, CPEC ones. No doubt, the present government s committed to reduce the energy tariff wherever it is feasible. It would be in the interest of IPPs to accept the agreed terms and follow it through with their side of the stake-holders. Otherwise, there are a lot of illegalities that have been committed by IPPs and a frustrated government would be predisposed to take a harsher approach that may not be in their own interest. The terms are mild and reasonable. Let all the parties get it through**.**

Impact of IPP Report

Prime Minister Imran Khan has already been given detailed presentation on the pacts signed with the IPPs and future line of action. As the CCoE clears the IPPs report, it will be submitted to the federal cabinet for final nod next week. According to sources, the financial impact of agreements with IPPs, government owned IPPs and closure of old power plants would be around Rs 1000 billion over a period of seven to 10 years.The savings under power policy 1994 would be Rs 225 billion, followed by Rs 200 billion under generation policy 2002 and over Rs 250 billion under power generation policy 2006 during the life of these projects.

However, the agreements between the government and IPPs will materialize once the former clears IPPs receivables which are around Rs 400 billion. IPPs signed MoUs are applicable for six months with the government subject to acceptable payment instrument of IPPs receivables."A lot of discussion has already been held on payment mechanism of IPPs receivables. One possibility is issuance of zero coupon bonds as commercial banks are agreed to this scheme," said one of the representatives of IPPs. The government is expected to constitute another extended committee, which will include some existing members as well as a few new members from Finance Ministry etc. Power Division and Nepra have also been taken on board on the MoUs. The committee will take the MoUs forward and convert them into agreements and ensure payments to the IPPs. In case of private IPPs, concessions to be given to government would be an integral part of payment of receivables. IPPs are of the view that they are placing billions of rupees on the table as concession to the government for future but these concessions will be applicable only when the government will clear hundreds of billions of dues.

However, revision in agreements of power plants established under China Pakistan Economic Corridor (CPEC) will be made during the forthcoming visit of Chinese President as both countries have reportedly agreed on revision of agreements on the pattern of IPPs. The outgoing Chinese ambassador to Pakistan has played key role in evolving consensus between the two governments.

The Cabinet Committee on Energy (CCoE) has also decided to settle payables of government owned power plants amounting to Rs 357 billion as of June 2020 at par with settlement with Independent Power Producers (IPPs).The government has also decided that return on equity of the Quaid-e-Azam Solar Park should be included for a reduction to 17 per cent IRR (rupee based) recalculated using USD rate of Rs 148/ USD - or given a similar treatment to other government IPPs. The CCoE has directed Power Division to consider reduction in Rate of Equity in government IPPs up to 10 per cent and fix it in rupee terms rather than in dollars.

The CCoE also took the following decisions : (i) return on equity of the Quaid-e-Azam Solar Park should also be included for reduction to 17 per cent IRR(rupee based) recalculated using USD rate of Rs 148/ USD as similar treatment to other government IPPs;(ii) the financial settlement of payables to government owned power plants shall also be considered at par for any future settlement with IPPs pursuant to the ongoing negotiations by the IPPs committee; (iii) the financial benefit to Wapda, if any, due to reduction in RoE shall be arranged through PSDP funding for implementation of mega development power projects i.e. Diamer Basha, Mohmand and Dasu;(iv) the financial deficit to Gencos, if any, due to reduction in RoE shall be funded by Finance Division to support loss making Gencos and ;(v) Power Division to submit information regarding payables to government owned power plants to the CCoE for information.

The sources said, Power Division has been directed that necessary process/ approvals for submission of tariff revision petition to Nepra should be completed immediately. The government has also decided that financial settlement of payables to government owned power plants (Rs 357 billion as of June 2020) shall also be considered at par for any future settlement with IPPs.

The government has also decided to close defunct plants (Gencos) of 1519 MW which will result in saving of Rs 5.674 billion per annum CPP. There are 2,015 working employees and 2,077 pensioners attached to these plants whose annual salaries and pension impact is Rs 1.326 billion and Rs 2.9121 billion respectively. The accumulated liability on account of pension benefits amounts to Rs 24.614 billion as on June 30, 2020.

The plants / units to be retired are as follows: (i) TPS Jamshoro(unit 2&3) 340 MW (strategic asset);(ii) GTPS Kotri(unit 3&7) 130 MW(delicenced by Nepra);(iii) Block

3&4, 450 MW(delicenced by Nepra);(iv) TPS Quetta, 22 MW(delicenced by Nepra) ;(v) TPS Muzaffargarh (5&6), 355 MW;(vi) SPS Faisalabad units 1&2) 92 MW(delicenced by Nepra);(vii) GTS Faisalabad (units 1&4) ,75 MW(delicenced by Nepra);(viii) NGPS Piranghaib, Multan (units 1, 3 & 4) 192 MW(delicenced by Nepra);(ix) GTPS Shahdara (units 1 to 6) 85 MW and ;(x) FBC Lakhra (units 1&2) 70 MW.

Retained plants will result in saving of Rs 8.608 billion per annum and permanent reduction in capacity by 2475 MW. There are 2,987 working employees and 2,215 pensioners attached with these plants whose annual salaries and pensions impact is estimated at Rs 2.318 billion and Rs 4.416 billion respectively. The accumulated liability on account of pension benefits amounts to Rs 37.560 billion as on June 30, 2020.

TPS Jamshoro 400 MW (units 1& 4) will be retained during low wind; GE Block(units 5 to 10) 415 MW to be retained on merit order; Siemens Block(units 11 to 13) 413 MW to retained if unit 13 is restored; 747 KW Block (units 14 to 16) 747 to retained; TPS Muzaffargarh(units 1 to 14) 920 MW to b retained in the system as contingency reserve with gas fuel; GTPS Faisalabad (units 5 to 9) 140 MW will be retained till commissioning of Trimmu power house and also reactive compensation in Faisalabad area till installation of SVC and 525 MW CCPP Nandipure 525 MW to be retained on merit order.

Talking about impact of plants on active list for privatization, the sources said, privatisation model will be decided by Privatization Commission. However, there are 634 working employees and 498 pensioners attached with the plants whose annual salaries and pensions impact is Rs 305 million and Rs 666 million respectively. The accumulated liability on account of pension benefits amounts to Rs 10.293 billion as on June 30, 2020.Source:Mushtaq Ghumman, Business Recorder

6.18 : A Resume' of Power Sector Reforms

Government has taken two major steps with remarkable degree of success; IPP report and the follow-up agreement which will reduce Generation costs by a whopping 1 Trillion Rupees over the next 10-20 years, provided all generation companies including government and CPEC ones are included. If implemented finally, it would be a major achievement. Secondly, GoP has finally going for revival of PEPCO in the form of managing agent, although holding company could have been a better choice, which would separate policy making role of the Power division and keep it away from day-to-day involvement in the running of the companies. PEPCO was made dysfunctional hoping that the DISCO boards would be more effective than PEPCO. This has not happened. Appointments in the boards could not be merit-based and two-hour' board meeting of non-qualified and disinterested directors could not have achieved much. It is hoped that GoP would be able to man the reorganized PEPCO with competent people, some through transfers from DISCOs and some from the open market. We have elaborated on it in an earlier article. The readers are advised to read that, if they are interested in details on the subject. WE will briefly touch upon the other steps GoP should take in order to bring about the required change and impact in the power sector.

Surplus capacity and rising capacity charges is contributing to circular debt. More capacity is coming in, while demand is not increasing.25,000 MW of new capacity is under various stages of implementation. Thinking people are nervous as to how the capacity payment would be made. Circular debt is being projected to go as much as to 4 Trillion Rs. One solution is to slow down the capacity build-up as much as one can. All interested parties are trying to push their projects lest their projects are dropped.

Tariff Reforms are badly needed. The other approach for reducing the rise of circular debt is to increase the demand; easier said than done. But, it is possible. There is a known and accepted negative relationship between price and demand. Demand can increase with lower prices and tariff. When fixed costs are high, increased demand under lower prices can contribute to increase in contribution to overheads if not profit. However, there are several provisos to it; 1. The price decrease has to be in paying sectors and not in the subsidized sector which is already a loss sector.2. Industrial sector can definitely expand if electricity prices go down. New products and industries can come up. Products which, hitherto, are not viable can be introduced. Industries can be encouraged to add third shifts.3. IT industry can expand and become competitive, if tariffs are low. Exports can increase.4. There is much less electricity demand in the night, and a special night time industrial tariff could be introduced. Winters may have a reduced tariff encouraging people to switch to gas where a shortage is being forest for the next two years. Some steps have been taken in this respect but were based on mediocre calculations. A scientific study would be required in this respect.6. There are other areas which should be looked into. Currently, even well to do are benefiting from the consumption-based tariff.

Market and Competition should be another focus of reforms in the power sector. Immediate possibilities are in the area of Wheeling and competitive bidding in new projects. Unfortunately, NEPRA and PPIB are continuing with the traditional system despite their avowed commitment to competitively based tariff at-least in the area of renewable energy like Solar and Wind. We have seen, how, competition brings down prices in the case of ADB funded Coal power plant vs other projects. .A new framework is under process, called CTBCM. It has to be revised to make it more purposeful. Currently, it is focused on bilateralisation of GENCOS and DISCOs, which will create electricity pricing disparity, something GoP is combating in gas in the form of WACOG.CTBCM in many ways is almost the same as current merit-order. It does propose wire-only-DISCOs and retail electricity competitive regime, which is perhaps its only positive side.

The issue is where the free electricity will come from for competition. All capacity and even the new capacity would be bound under long term take or pay contracts. The market can be brought about gradually. Initially, both competitive and regulated sectors would co-exist. A voluntary market exchange should be organized wherein captive power plants and the to-be-retired power plants can trade and compete. Some portions of Take-or-pay contracts may be allowed also to be traded. Some new plants may be encouraged to get into the market on under Take and Pay. Theoretically, it is possible to pay off the present value of the take or pay contracts to the developers and issue bonds adjusted through income under new market. But, it is highly complicated. A beginning has to be made as they say a thousand miles journey starts with the first step.

DISCO reforms are essential. Privatisation has been on agenda but does not happen for one reason or the other. Wire-only has offered a new opportunity for reducing DISCO risks in public sector. In second stage, DISCOs could be privatized under leasing-model. Immediate step towards improving DISCO efficiency would be to divide large DISCOs into smaller ones, especially, the ones spread over large geographical areas such as PESCO, HESCO and MEPCO. Merit based Board of Directors and PEPCO (holding company management approach as discussed earlier

On Theft and technical loss reduction, the discussion may become lengthy; we would emphasize redesign and revival of Smart Meter programme, which has a potential of reducing theft. The current programme is purposeless and not-feasible. If implemented, throughout Pakistan, it would cost more than 7 years and almost ten years. A redesigned programme focused on Distribution Transformers would be cost effective and can be fast tracked to two years. Priority should b given to high loss DISCOS like PESCO, MEPCO and HESCO etc. where initial grounding already exists through earlier US-Aided pilot projects.

Finally, NEPRA reforms should be at the top of the agenda.IPP Report and subsequent agreement has made it known that NEPRA has been a partner, by design or default or due o shear ignorance and lack of capability.IPP agreement terms should be adopted by NEPRA by toning down the financial parameters based on which it has been awarding high tariff; high capex, escalations, high RoE, interest rates and cash flow based tariff spread over shorter debt period. Cash flow based tariff increases the initial tariff of first 5 years by 25% making it even worse. A formal external review of NEPRA is highly desirable. Its members should be appointed on merit rather than on the current provincial representation promoting nepotism. If OGRA can have merit based system, why shouldn't NEPRA have the same? It is a separate matter that some provincial enthusiasts want to bring NEPRA system to OGRA.A supervisory board level, however, could be introduced in both the regulatory bodies to take care of provincial interests. Appellate Tribunal which has long been opposed by NEPRA and has tried to subsume it has now become a reality under Supreme Court order. It should be organized as early as possible. Later on, Oil and Gas sector should also be included in the tribunal as well.

7: Renewable Energy

7.1: Towards a Solar Strategy

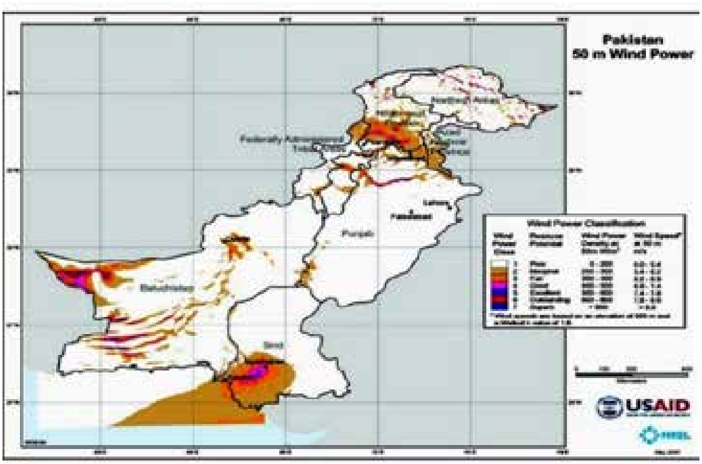
As most people know that Solar energy(PV) has become very popular n all forms and applications such as roof top, irrigation pumps and Solar Parks etc; reason being low cost and wider availability. If there is any limitation, it may be of space in some cases. Today, solar (PV) energy is half or cheaper than fossil fuels. Unfortunately, we have stagnated in this area. Most nations have done much more than us. We will examine the issue and propose a strategy for expansion of solar energy investments and usage in Pakistan.

To be fair, it is to be acknowledged that Solar has become cheaper and competitive only recently. It is now under 2 USc in many jurisdictions. Even in Pakistan, notorious for cost padding, the new projects are being approved at a tariff of around 4 USc. Fossil based power is costing 8-10 USc life cycle cost terms and 24-30% higher in earlier project years when project debt has to be repaid.

Unfortunately, we have moved from a power deficit crisis to surplus crisis which may discourage and delay investment in solar sector. There is a circular debt of 2 trillion Rs, and capacity utilization has fallen and may continue to do so in the coming 5 years. The demand today is only 22,000 MW, while it was 26,000 MW in the year 2017-18 .According to earlier estimates, the demand should have been around 30,000 MW. While the existing installed capacity is 36000 MW, another 10,000 MW of capacity would be commissioned by 2025 and another 10,000 MW to come on line between 2025-30.Most of the 20,000 MW is expensive electricity. There is an urgent need for reviewing these projects and extend the timelines of these projects wherever feasible. Unfortunately, our relevant institutions are working overtime to process these projects on fast track, possibly, under lobbying and pressure from the project promoters.

Admittedly, IGCEP (Indicative Generation capacity expansion plan), does provide for Solar and Wind power among the 50,000 MW additional capacity investments it has proposed; there is a provision of 13000 MW for Solar and 8332 MW for wind. Some cross adjustments may also have to be done in these capacities in favour of solar with its widely spread potential for distributed generation. Due to demand factors created by Corona, power demand may remain limited and 50,000 MW investment capacities may not be realized. And thus the turn of Solar and Wind power investments may not come at all within this decade. IGCEP, amazingly, does not include Bhasha dam (4500 MW) for which initial contracts for ancillary works have been signed recently. If Bhasha comes in, and as it appears it will within this decade, there would be further pressures to push out some planned capacity.

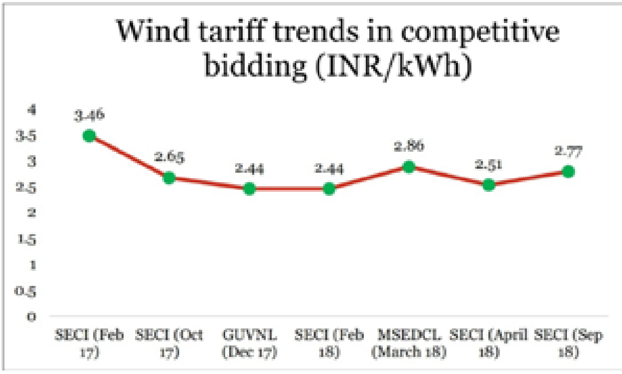
Chart 7.1.1: Wired Power Potential



This is a bleak scenario for Solar and Wind power as well. Wind power would remain less attractive as it is regionally constrained. Something `should be done to rearrange the projects and create some place for solar power capacity and the beginning should be made early enough. We delayed Thar coal utilization and hoped that a lot of energy would come out of it. For a variety of reasons, Thar coal dream may not come true in the evolving circumstances. Thar coal capacity may not go beyond 5000 MW as is also evident from the proposed IGCEP. Unfortunately, there are no candidate projects for Solar and Wind power and only broad allocations could have been made.

To fill the gap, let us make a Solar Plan. India has had a target of 100,000 MW out of which 40,000 MW has already been implemented. Our achievement I this respect is only 346 MW.A Solar Plan of 10,000 MW should be prepared in two phases of 5000 MW each; a pace of 1000 MW per year . A project package for5000 MW may be launched for a period of 5-7 years which should tie in local manufacturing of Solar panels and allied equipment such as inverters etc. There is severe competition in solar trade internationally. It may be possible to attract good offers for such a capacity as low as 2 USc which would be one-fifth of the going fossil cost thus may cause cost reduction I overall project mix.

Chart 7.1.2: Wind tariff trend in competitive bidding India (INR/kWh)



There should be distributed generation obviating the need of expensive long transmission networks. Pakistan is a big country having a population of more than 200 millions living in 104 districts. On the average,50 MW of solar facility per district may be a good start. This is an average figure; some may get 25MW and some 100 MW. One has to test the waters; if there is resistance or controversy to a large project, as is the case usually, one could go piecemeal. In that case the local manufacturing component and indigenization would suffer. A Solar Plan is the need of the hour.

Solar-Wind Hybrid Plants

Solar-wind hybrid means integration of solar and wind energy production by installing both solar and wind power plants at one piece of land or at nearby plots utilizing common transmission facilities. India has released a policy in this respect recently and a captive hybrid project has been commissioned there. In Pakistan also, several investors are examining the feasibility of this useful mode of power generation.

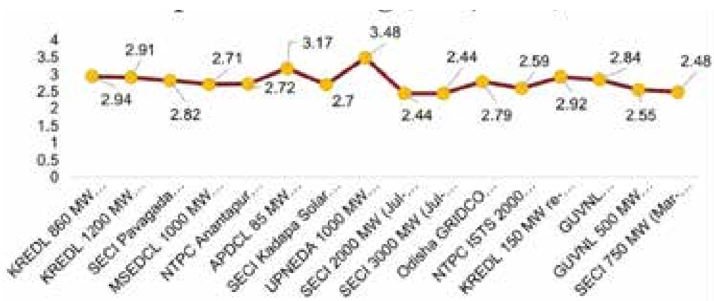
Solar and wind power suffer from intermittency and variability. In simple words, Sun shines in the day and wind starts blowing in the afternoon and continues till past midnight, but mostly in summers. In western countries, it is the opposite where wind blows hard in winter coinciding with their peak energy demand. Thus, solar covers one part of the daily peak demand and wind covers the second peak at night hours. In summers, it is handy for us. It is said that some 25% of the costs goes into land and transmission which is saved in the hybrid concept. Transmission facilities are under-utilized in case of individual solar and wind plants proportional to their capacity factors – solar 17% of the time and wind about 35% of the time. Hybrid accumulates it to the sum of the two minus some overlapping portions. Thus, it is not uncommon to get a capacity factor (utilization) of 45% to 55% which is a much improvement.

Investment per megawatt remains low with weighted average of the individual investments minus land cost plus some additional investment in batteries. It has often been wondered as to why this very useful concept has not been adopted in advanced countries by now. The answer is perhaps the requirement of battery storage, which has been expensive and its cost has come down to somewhat affordable levels only lately along with availability of right technology.

Wind, Solar Sites

In Pakistani wind sites and new technologies, the capacity factor of 45% is becoming possible, giving even better opportunities. Hybrid power plants should have a lower capital expenditure per megawatt as well as lower production cost. Unfortunately, Punjab lacks wind power resources. Hybridization will be possible in Sindh (Jhimpir and Gharo) and in Balochistan. Western Balochistan has many sites where hybridization is possible due to availability of both wind and solar resources of high quality. In the context of Gawadar, this hybridization possibility may be of special importance. Gawadar today suffers from both lack of water and energy. At present, a coal power plant of 300MW is proposed to be installed.

Chart 7.1.3: Lowest discovered solar tariffs in competitive bidding India (INR/kWh)



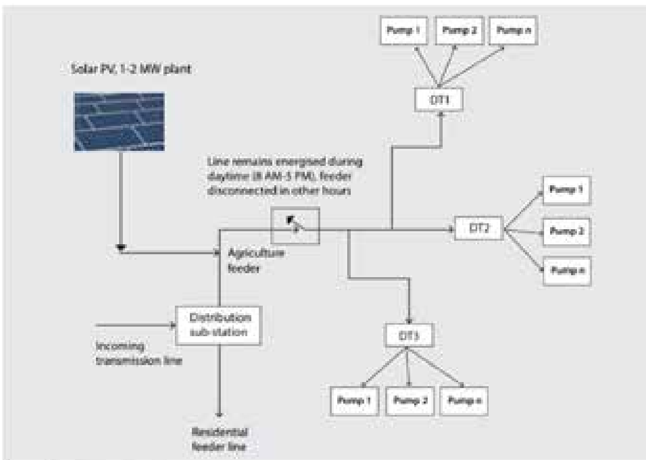
An alternative concept could have been a hybrid solar-wind power plant with some addition of oil-fired power plant. However, one cannot continue proposing and contesting new concepts. Some enthusiasts tend to suggest that all wind sites should be hybrid as a matter of policy which one would find rather too ambitious. Despite the potential, the world wind power industry has not caught on the bandwagon of hybrid. Furthermore, such stipulation may create monopoly for the existing wind power plant owners on new solar capacity.

Hybrid may also be promoted at kilowatt level in schools, hospitals and other institutional buildings in wind power corridors like Hyderabad and around in Sindh and western Balochistan like Turbat etc.

Ten-to-twenty-kilowatt facilities can be installed at such locations in combination with roof and ground space and its main advantage is almost round-the-clock availability in half part of the year, as mentioned earlier. This is high time that a policy is announced by the Alternative Energy Development Board (AEDB) in consultation with the National Electric Power Regulatory Authority (Nepra) and other stakeholders. Policy need not be heavy or verbose. There are a few points that should be elucidated. However, the normal wind and solar power is suffering due to policy confusions and the CPPA-G's reported incapacity to honor ensuing capacity payments. Also under deliberation is the reverse auction of the projects that has been instrumental in bringing down solar and wind tariff in India and elsewhere.

Indian Hybrid Policy and Experience

Chart 7.1.4: Solar-powered agricultural feeder system



Source: Prayas (Energy Group).

In India recent cost data indicates that not much tariff advantage has been obtained in solar-wind hybridization. If one adds savings in Transmission, some cost advantage may accrue. Land utilization and cost saving thereof is another clear advantage. India is a land scarce country .Ultimately, they may have to mandate hybridization which currently voluntary. In the adjoining table, we have provided tariff data on solar and Wind alone and of hybrid projects. It is possible that hybrid tariff may go down with time as more experience builds-up.

In India, a captive hybrid power plant (HERO) has been installed and commissioned recently. The plant has wind power capacity of 50MW and solar capacity of 28.8MW. With a wind power capacity factor of 28% and solar power capacity factor of 18.7%, the combined capacity factor of the hybrid reaches 41.8%.

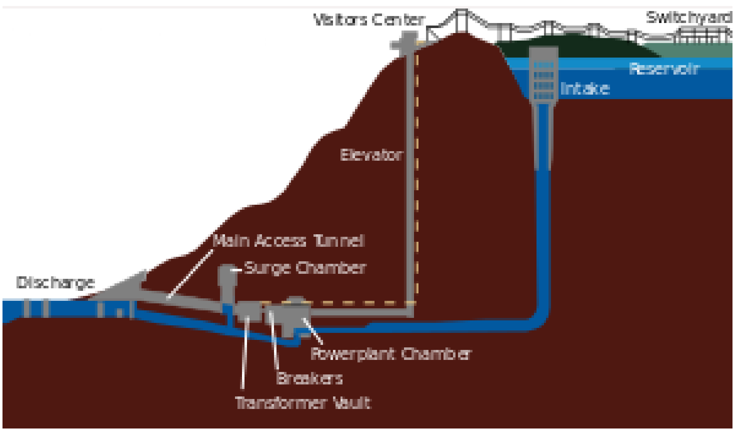
There are hybrid policy variations among Indian states. One common feature is requirement of at least 25% capacity of one resource; Solar or Wind. Most states provide a minimum of Capacity Factor of 45%.In Pakistan, more CF may be possible due to higher wind power capacity factor.

7.2: Electrical Utility Storage Systems

Electricity storage system is not new. However, with the advent of intermittent solar and wind power systems, electrical storage has acquired a new context and need. Pumped Hydro has been a classical system. Battery storage is a new addition. In this space, we will explain the use of two systems and their economics and policy issues.

Pumped Storage Hydro

Figure 7.2.1: Pumped-Storage Plant



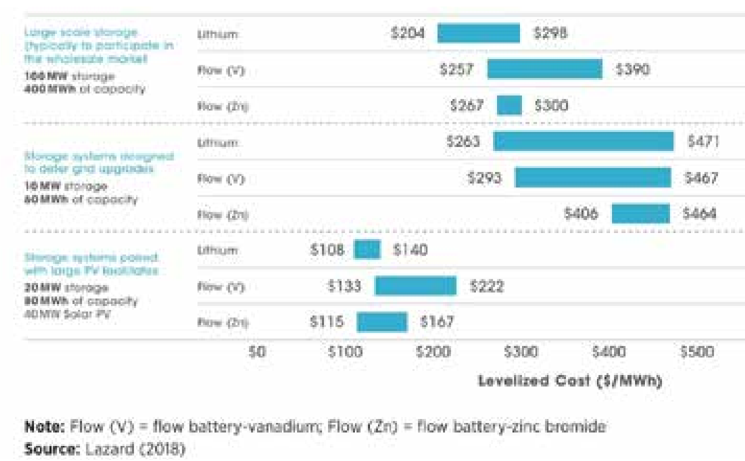
Energy Storage has been in use for a long time, particularly, Pumped Storage-Hydro (PSH). PSH has been used largely for load balancing. Sometimes, supply increases or decrease in hydro due to water supply variations, seasonally and daily. And Load varies regularly as well in the same way; thus the need for storage for load balancing. Water is pumped up either through reversible turbines or independent water pumps to a higher site reservoir or a dam. When needed, stored water is allowed to flow through the hydro turbine to produce electricity. PSH is not a new energy producer. It rather consumes energy with an efficiency of 80-87%; 13-20% loss of energy. However, it provides energy when needed, especially, during peak hours when energy is priced higher balancing the energy loss. There is a renewed interest in PSH due to the advent of intermittent and variable Solar and Wind energy. Although, there are other competing technologies like Battery Storages. The disadvantage of PSH is that it can only be installed in usually remote hilly or mountainous areas, while Battery Storage can be installed anywhere and in all capacities in modular and containerized form. We will discuss BS later.

PSH accounts for over 95% of all storage installations worldwide, with a total installed nameplate capacity of over 184 GW, of which about 25 GW are in the United States.

High PSH users are only few countries; in Austria (18.7%), Switzerland (32.6%), Portugal (17.8%) and Japan (8.8%) of Hydro capacity are installed and utilized. In other countries, PSH installations are 2-5 % of installed hydro capacity.

Battery Storage

Chart 7.2.1: Comparison of levelised cost of storage (USD/MWh)



One is familiar with lead acid batteries used in automotives for starting purposes. These are, however, of less than 1 kWh 12-24 volt batteries. EV batteries have come up which replace fuel and thus are of 100-300 kWh capacities. Utility batteries, however, are in MW range storing MWh range of electrical energies. Batteries are lead acid and now Li-Ion. New technologies are creeping in fast. Costs are high but fast reducing; from 1000 USD/kWh in 2010 to 230 USD in 2016 and expected to drop to 100 USD shortly. Half of the price of EVs today constitutes battery costs. EV batteries have a requirement of low weight and volume which is not there in grid storage.

Utility Grid Storage Battery

Li-Ion batteries have been used and are in current use as well, typically, in smaller capacity applications. I -Ion and Redox Batteries are competitors. Unit costs may ultimately decide the fate of competition ultimately. Costs of both are coming down fast with no surety as to who would win ultimately. Li-Ion would remain a winner in EVs and Redox may win in grid scale applications.

However, Flow Batteries are increasingly becoming more popular for a variety of reasons including cost and characteristics. I-Ion degrade in frequent charge and discharge situations and are less cost efficient in 4hrs plus storage times.

Redox Flow Batteries, like all batteries, work on the principle of electrolysis. Catholytes and Anolytes liquids are stored in separated liquid tanks and are pumped into stacks which have electrodes separated by thin membrane. There are 10-12 types of Redox Flow batteries. DC current is produced which is converted into AC through the use of inverters. Typically vanadium is used in electrolyte solutions like Sulfuric Acids. These are infinitely scalable as one has to increase liquid storage and pumping capacity which can be done limitlessly. A target of less than 5 USc per kWh is being projected.

Use Cases for Battery Storage Systems(BSS)

Main drivers of Storage systems is the emergence of solar and wind power as a mainstream power source. The projections being 50-100% market share of Renewable Energy. Most recent storages have been installed near solar or wind power plants to handle intermittency. Most popular capacity has been 100 MW-400 MWh. Elon Musk delivered a 100 MW Li-Ion project in 100 days indicating the speed at which such projects can be built and delivered. Extension of the hours of solar projects late into the evening is one of the major drivers. Also to store electricity, which may have otherwise gone wasted the so called curtailment.

Grid support in the form of frequency regulation, voltage support, provision of reserves and smoother integration of variable generation. Open Cycle gas turbines and Diesel Engines, being expensive and inefficient peakers are being replaced by Battery storage systems. Fast ramp rate of Battery storage is in mili-seconds as against minutes in case of fossil plants. Black start (starting grid after a black-out) functions may also be performed more economically and reliably by BSS.

Peak electricity rates can be twice as high as normal rates. Both utility and consumer can benefit from BSS peakers function. Utility earns higher rates of peaking and consumer saves on high peaking rates by installing captive storage at his premise. Utilities are installing modular BSS at substations as well in order to deal with congestions. Utilities are also planning to marshal the storages installed at the consumer premises for its own grid control and stability purposes.

Recent Storage Projects in India

SECI India has recently awarded a 1200 MW Storage project; 900 MW Pumped Hydro and 300 MW Battery storage System (BSS).PV Magazine reports the following details on the project:

“The procurement exercise was held to contract 1.2 GW of capacity in the form of assured supply of 600 MW of clean power for six hours daily during peak demand hours – 5.30-9.30am and 5.30pm-12.30am – on a day-ahead, on-demand basis. The successful bids comprised at least 3 GWh of energy storage capacity – pumped hydro or battery storage – plus associated clean energy generation assets .The tender was staged to secure reliable, fixed-price energy supply for state electricity distribution companies otherwise hidebound to the vagaries of spot markets.”

In the adjoining table, we provide the tender results. Average Tariff for Pumped Storage(PSH) has been 5.6111 USc/kWh and for Battery System (5.97 USc/kWh). Peak rates came to be 8.5 USc for PSH and 9.5139 USc for Battery(BSS).We have also provided a general cost data table for Battery systems(BSS).

Towards a Storage Policy and Plan –Pakistan

Indicative Generation Capacity Expansion Plan (IGCEP-2047) has been submitted by NTDC to NEPRA recently. It is a pretty long term plan extending up to 2047(27 years). Yet, it provides for open cycle gas powered plants for peaking and load balancing purposes. Perhaps, there is no policy? The question is which comes first; plan or Policy. More than 20,000 MW of Renewable capacities are being projected. It would definitely require Battery storage if not pumped hydro storage. Policy is also required for Hybrid Solar and Wind which has relevance with storage. Balochistan is in great need of distributed energy system which may require storage as well. It has both Solar and Wind resources widely dispersed throughout Western Balochistan. There is already wind power curtailing in Sindh .With increase in Solar and Wind capacity, grid stability issues would emerge. It would be appropriate if NEPRA, CPPA, PPIB and AEDB put their act together and do planning for adequate storage systems and capacity.

Early signals in this respect may help indigenization in his respect. It would be quite feasible to locally develop and manufacture Redox Vanadium Storage batteries which are nothing more than an electro-chemical plant. There are indications of the availability of local Vanadium mineral resources as well. There can be JVs as well. Electronic controls system package may be initially imported. It can be done. Forward planning s essential both for production and installations.

Table 7.2.1: Renew Power Haryana Storage based Bidding Results-India

Fixed price 25 yrs

	Hydro Pumped Storage	Battery Storage
Capacity-MW	900	300
Average Tariff-Irs/kWh	4.04(5.6111USc)	4.3(5.9722 USc)
Peak-Tariff-Irs/kWh	6.12(8.5 USc)	6.85(9.5139 USc)
Off-Peak-Irs/kWh		2.88(4 USc)

Source: PV Magazine, Uma Gupta, Jan 31,2020

7.3: Problems and Prospects of Hydroelectric Power

Pakistan has installed capacity of 6,902 megawatts of hydroelectric power, which meets one-third of the country's electricity needs. However, there is a potential of more than 50,000MW. Hydroelectric power development has suffered due to prolonged Kalabagh Dam controversy on which national consensus could not be developed. Sindh feared that Punjab would divert water depriving it of its share and that it required extra water to flow down Kotri to push the encroachment of sea into their land. Khyber-Pakhtunkhwa (K-P) feared that Nowshera would be inundated. Dams are not a zero-sum game. Dams increase water supplies and are an insurance against drought. Every country that has a river, builds a dam.

Table 7.3.1: Hydropower Project Under Implementation or Construction

Project Name	Capacity(MW)	Start year	Completion
Neelum Jhelum	968	2011	2017-18
Tarbela IV	1,410	2014	2017
Tarbela V	1,300	2017	2019
Dasu	4,400	2016	2022
Bhasha	4,500	2016	?
Munda	800	2017	2022
Sukhi Kinari	900	2016	2020
Golen Gol	108	2012	2018
Karot	720	2017	2022
Total	15,106		

Source: WAPDA & PPIB

Total river flows are to the tune of 179 km3 in Pakistan against consumption of 126 km3, leaving an excess of 38 km3 that goes into the sea. It has been established now that only 11 km3 is required for excess flow into the sea to prevent sea intrusion. It means excess water to the tune of 27 km3 is available to build dams. The capacity of Kalabagh Dam is only 7.5 km3. So practically, four such dams can be built while having enough water to satisfy Sindh's criteria and objections. Fortunately, there is no controversy over Bhasha Dam and Kalabagh Dam has to be postponed until there is water and food crisis? It is the cheapest dam to build as it is close to plains and would have cost less than half of Bhasha Dam. It would have irrigated a million acres in Punjab and a million acres barren land in Sindh. A lot of time has been wasted in controversy with no final output. Mangla Dam's height has been raised to increase its storage capacity. Now Mangla is the largest storage dam of Pakistan in place of Tarbela whose storage capacity has gone down due to siltation.

Projects Being Implemented

Only lately some interest has been revived and many projects have been prepared for implementation. The World Bank has agreed to finance Dasu Dam – a 4,400MW project to be built in two stages of 2,200MW each. Bids are expected to be invited by 2018.Tarbela Dam's power generation capacity is being upgraded through two projects – Tarbela IV and Tarbela V with capacity of 1,410MW and 1,300MW respectively. Tarbela IV is at advanced stage of construction and may be completed and commissioned in 2018. Tarbela V financing has been approved and is at initial stages. Extension projects do not require much time to complete as compared to the traditional hydroelectric power projects.

Finally, Sukhi-Kinari with installed capacity of 900MW has entered into the implementation phase due to being taken under CPEC. It is perhaps the first or second private sector hydroelectric power project. Bhasha Dam of 4,500MW capacity is the most important project. It is a multi-purpose dam that will produce electricity as well as store water. There is no controversy surrounding it as there would be no canals and thus no water diversion. Neither is there any issue of a city being inundated. Being free of internal issues, it is mired in external issues as it is situated in what India calls a disputed territory. International financial institutions have asked Pakistan to get NOC from India which is obviously quite unacceptable to Pakistan.

USAID has shown interest, but to the extent of scrutinizing the design, which should not have been opposed, but a hue and cry was created by some circles and demands were made not to hand over the documents to USAID. Any technical input should be welcome, while we are free to do what we can, if we have the money. The government has, however, continued with the preparatory operations such as land acquisition. More than Rs100 billion has been spent in the process making many locals quite rich. The project is ready for construction. Wapda has prepared a proposal for self and local financing arrangement according to which the project would have two stages. Storage components would be built under public sector financing involving Wapda's own income stream, PSDP funding and local bank borrowing. In the second stage, the power component would be implemented under the IPP regime. The proposal is quite reasonable and if nothing happens, we may have to go along these lines.

Role of CPEC

There is a parallel stream of negotiations with the Chinese who have reportedly presented a very grand and ambitious plan of owning and operating the whole Indus cascade. It is a difficult issue and may involve a bitter debate in the political arena and thus may be time consuming. It may be desirable to separate Bhasha Dam from the grand scheme for the time being and start its implementation with Chinese cooperation. They would be the most probable builders and EPC contractors in any case. The grand scheme can be discussed and negotiated and if consensus reached, Bhasha can be retrospectively included. Pakistan should not delay Bhasha and should start on its own, as is the case of Ethiopia which has built a similar project in similar circumstances from its own meager financial resources.

Problems and Difficulties

First of all, all hydroelectric power plants do not have a water storage component. Except for a few, like Tarbela, Mangla, Bhasha and Kalabagh, no other projects would provide any significant water storage at all. Apart from seasonal variations in water/electricity supply, there are long-term variations as well. Brazil depends on hydroelectric power to the extent of 64-80% and it has severe problems of power supply due to drought conditions recently. Brazil is now taking steps towards access to more non-hydro sources. Due to climate change reasons, it has been projected that in Pakistan there would be large variations in precipitation and water supply, resulting either in extraordinary floods or drought conditions.

Having a large component of power supplies coming from hydro would compound our difficulties – no water and no power. Thus, there is an upper limit on the ratio of hydroelectric power in the total energy mix. A large construction period, environmental issues and displacement of people have been the other reasons discouraging the increase in hydroelectric power. The advent of solar and wind power at 4-5 cents has created an altogether new situation in power markets. Large capacity projects requiring expensive transmission facilities would increasingly face tough competition from solar power. One or two of the major fallacies based on which popular support for hydroelectric power has been built is that it is cheap and brings water also.

It is true that until recently, hydroelectric power tariff was Rs1 per unit. Now, it is Rs3.50 per unit, partly as a result of increase in royalty payments to K-P. It is still an attractive price compared to Rs5-10 per unit of fossil-based power tariff; however, no more. All recent projects are to produce expensive hydroelectric power. K-P government is developing expensive projects costing in excess of $2.5 million per megawatt, resulting in a tariff of around Rs10 per unit, approaching oil-based electricity. Neelum-Jhelum has the same situation, although it has unique problems. There are issues of high re-lending charges which will result in a tariff of Rs14 per unit. In any case, the tariff cannot fall below Rs10 per unit, whatever financial restructuring is done.

In China and Canada, hydroelectric power is priced at 4 cents, which is its average price internationally. In India, capital expenditure on hydroelectric power is not so high. On the average, it is $1.5 million per megawatt, resulting in a tariff of about 5 cents per kWh, which appears to be quite reasonable. There is something terribly wrong or deficient in our hydroelectric power sector – $2.5 million per megawatt vs $1.5 million elsewhere and a tariff of 8-10 cents plus vs 5-6 cents elsewhere. There is a difference of more than twice. May be there are design and engineering issues, or the monopoly of contractors coming from only one country, perhaps due to law and order situation.

As there is a long gestation period, there might be issues of escalation formulae which are normally understood with difficulty and the multi-currency issues as well. There could be contract management issues as well. As billions are involved, it may be worthwhile spending some money to investigate the issue through credible international advice and a third-party input.

7.4: Hydro Royalty

Hydro royalty or net hydel profit (NHP) as it is called in constitutional (1973) terms has been a major dividing and polarizing issue. Some provincial leaders of Khyber-Pakhtunkhwa (K-P) have issued strong statements on the subject, demanding early resolution of their grievances. The Council of Common Interests (CCI) has reached a consensus on the issue, which has been passed on to relevant authorities. The Water and Power Development Authority (Wapda) has applied for its tariff to Nepra, containing approved figures and a public hearing has been scheduled for its consideration.

Table 7.4.1: Comparative Royalty Rates in Hydro Sector in Various Countries

	USD/MWh	Rs/kWh(Pakistan)	
China	0.75-1.25	0.075-0.125	
Brazil	1.8	0.18	6.7% of sales price
Saskachewan (Canada)	5.1 Canadian $	0.3825	Canada Hydroelectricity price 40 C$/MWh
Quebec	3.82 C$	0.2865	
Ontario	3.80 C$	0.2865	
Manitoba	1.51-3.11 C$	0.013-2.33	
USA	2.01	0.21	
India	4.8	0.48	12% free electricity; electricity price 4 cents
Nepal			2% during first 10-12 years and 15% thereafter
Pakistan		1.1	100Rs=1 USD

SOURCE: 1) HYDRO POWER ROYALTIES: A COMPARATIVE ANALYSIS OF MAJOR PRODUCING COUNTRIES BY PIERRE-OLIVIER PINEU ET AL, MDPI, APRIL 20, 2017; 2) CERC INDIA

Nepra has issued some questions as the issues to be considered as a matter of standard practice.CCI has reached consensus on Rs1.10 per kWh as NHP, settling many issues of payables and receivables. Wapda has been earlier paying Rs0.58

per unit as NHP or royalty. Actually, the real and internationally recognized term is royalty, which is dealt with in the case of resources such as minerals, oil and gas, etc. The term NHP has created difficulties. It is difficult to define and exactly determine NHP. There could be many interpretations. One of the interpretations was done by late AGN Kazi, a towering personality of his time in government bureaucracy. His formula defined NHP as the difference between average cost of electricity production (average wholesale price) and the production cost of hydroelectricity.

Some people argued that instead of average cost of generation (COGE), it should have been the next best rate from which the difference should have been calculated as NHP. AGN Kazi formula created some controversy as it yielded a NHP of Rs1.80 per unit at a time the hydro tariff was Rs0.50 or even less. Another reason for controversy has been the unduly low COGE of Tarbela due to the depreciated assets having very little or no book value.

A tribunal was constituted which gave its ruling in favor of AGN Kazi formula. One of the tribunal members while signing the tribunal decision also said that let us not kill the goose that lays eggs. The goose (Wapda) has since been protesting and asked the government to foot the bill as it did not have the resources to pay such a high royalty/NHP.

K-P people and politicians should feel happy and satisfied. They have the highest possible award of NHP/royalty if compared with other countries. It is more than twice than that of India and several times higher than in other countries known for internal fairness and equity policies.

Re-Examination

There is a need to re-examine the issue on a permanent basis. The current CCI decision, although a welcome one, does not lay down a formula. It is a figure that may be contested later due to inflation and other factors. Interestingly enough, NHP, as defined by AGN Kazi, renders hydropower as expensive as any other resource for if there is a difference, it would be charged as NHP. Thus, no more slogans of cheap hydropower should have been raised. Hydropower is getting expensive each day.

All new projects are yielding a COGE of Rs8 per unit or even more. Solar and other renewable energy prices are coming down to Rs4-6 per unit. Local gas-based electricity is already available at a COGE of Rs5-6 per unit. Low oil prices have caused reduction in average tariff. When furnace oil is eliminated from the energy mix and more economic resources come in, the situation may drastically change. There would be no NHP.

But K-P would need revenue and it should continue to get revenue. This indicates a need for reconsideration of the NHP issue to settle it on a more sustainable basis. It does not mean as should be evident from the aforementioned, one would not mean to oppose the current NHP determination at Rs1.10 per unit. It is a consensus creating decision and it should be welcomed. Royalty is generally considered a reward to the people and governments of a region or country for their resources are consumed and regional and local environment is usually compromised causing land-use changes, pollution and general disturbance, unpredicted changes in life and power structure, etc.

Many royalty provisions, therefore, require distribution of a share to local people and government. In my opinion, hydro royalty should have been spent on people in social sector and improvements in the areas which have been affected by resource development activities. When Tarbela was developed, compensation rules were not fair, although, today more than Rs100 billion has been spent on land purchases and acquisitions-P government has instead opted to develop hydro sources from a Hydro Development Fund that has been created to channel royalty income. K-P has grinding poverty and much-needed social sector assistance is required there. K-P has no obligation to generate or provide electricity. It should not divert its much-needed resources to something for which the federal government is responsible.

Water User Charges

While NHP is payable by public sector projects to the provincial governments where the project is located, IPPs are required to pay user charges. Hydro-royalty, whether termed NHP or water user charge, ought to be payable irrespective of the ownership being in public or private sector. It is a compensation or user charge whatever term may be adopted. Currently, IPPs are liable to pay a water user charge which is Rs0.45 per kWh. Up till now, it did not matter as there was no hydropower project in the private sector. However, in future, many hydropower projects are expected, a number of those are in the pipeline already. It is only fair that the IPPs be required to pay as much as public sector pays.

Royalty Payments to AJK

Currently, no royalty is paid for Mangla Dam, which is situated in AJK. There are, supposedly, some political or constitutional implications or impediments to applying NHP provisions to AJK. There can be issues of extraction or levying charges. This is an anomaly that should be removed. Some Kashmiri nationalists raise it as a negative point against the government of Pakistan. It should be, however, noted that AJK gets payments on many accounts and also there is an almost free electricity regime in AJK.

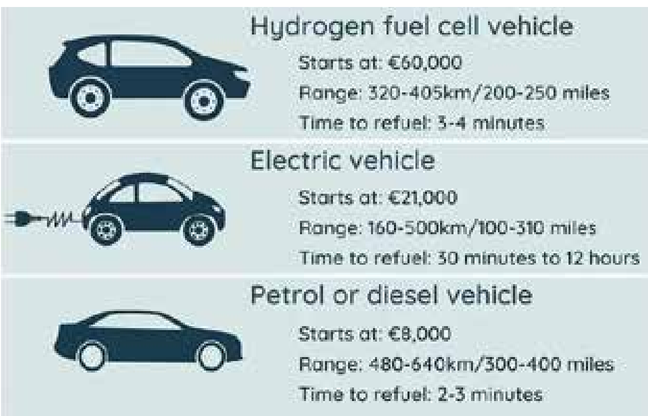
Royalty for Punjab

Up to now, successive Punjab governments did not want to charge royalty. Perhaps, there was a political stigma to it being an unnecessary extraction. No royalty has been paid on Ghazi Barotha. The Punjab government has demanded royalty on the lines of K-P and CCI has ascended to their demand. Even back payments are being made. Therefore, Wapda has included Punjab royalty payments in their tariff application. So now that Punjab is getting hydro royalty, AJK should also get it. However, there may not be a case for small hydro projects of Punjab to get NHP, as its cost of generation is very high and there is no NHP or profit to be charged on the power producer in that case, although it is a small amount. Concluding, although consensus has been reached on numbers, it is temporary. There is a need for building a lasting and sustainable solution based on definite definition and methodology on which there should be consensus among the stakeholders.

7.5: The Electric Vehicles

Electric vehicles (EVs) are getting increasingly popular by the day. Clean air requirements and GHG mandates have made EVs a reality. EVs have a high purchase cost, but are energy efficient. Due to cheaper electricity than petrol and diesel and higher efficiency, the operating costs of EVs are much less. Thus, the life cycle cost of EVs is lower than conventional fuel vehicles. However, the upfront costs are still high, and thus the need of a policy. In Pakistan, the capacity trap is another good reason to introduce EVs to improve capacity utilization. Night charging of EVs may particularly be useful in this respect.

Chart 7.5.1: Hydrogen fuel cell vehicles are expensive to buy and expensive to fuel in 2020



EVs have a fuel-cost advantage over conventional vehicles by a factor of 2, depending upon the comparative prices of petrol vs electricity. However, the high upfront cost is a major impediment in EV sales, especially in poor developing countries. It is being projected that by 2025 or slightly later, the price difference will go away. There are varying driving factors in individual countries. In Northern Europe, where there is heavy fuel taxation, EVs may be more attractive than in the US where fuel costs are probably the lowest among advanced countries.

Global market shares of EVs stood at 4.6 percent in 2018. By 2025, the market share may go as high as 12.5-25 percent. In China, EV market share of 50 percent is expected by the year 2025 and in Norway, it is already 50 percent. The market share of EV buses in China is already 90 percent. The largest electric bus manufacturer in the world is BYD of China (The CPEC framework could be utilized for launching the system under which technical and financial assistance could be obtained). In Europe, there is a target of 100 percent urban electric buses by 2030 and a market share of EV buses of 75 percent by that year. EVs may become the market leader between 2025 and 2030 in the developed world.

India plans to have a 30 percent market share of EVs by 2030.This year, India has announced a $1.4 billion subsidy programme for EVs. The programme is, however, focused on two and three-wheelers and buses and only marginally on cars. After China, India has made great plans for introducing electric buses; the main driving factor being urban pollution. Several EV production plants have already been built. Of special interest to us may be the Maruti-Suzuki and Mahindra-Mahindra initiative activity in EV production in India. Another important company is the BYD (Chinese) joint venture with a local Indian company manufacturing electric buses.

In India, Mahindra has launched its E2O electric car at a price of PKR1.0 million and an e-Rickshaw at a price of PKR2-3 lakhs (for 3 and 5 seater respectively). Maruti-Suzuki is to launch its new electrical version of the Wagon-R by the year 2020 at a price of $10,000 with subsidy and 30 percent higher without subsidy. The petrol version today is priced at $7000. Suzuki has a strong presence in Pakistan, and its Indian experience may be replicated here conveniently.

In Pakistan, to contain pollution, EV buses may be an ideal solution for metros and the satellite feeding buses that are required for connecting the metro with different areas. The annual bus demand is of 800 vehicles, catered to by three assemblers. It is unlikely that local production would be justified at this volume. On the other hand, one can foresee some activity towards conversion of existing conventional buses into electric buses. There are 250,000 buses and an equal number of trucks (250,000) operating which may create a much larger demand of conversion. Conversion of diesel buses into electrical bus has become a mainstream activity. Earlier, it was a DIY activity or on a smaller scale. Now big companies have come into this sector and are offering conversion kits. All it requires is to replace the existing diesel engine by an electric motor and fit the battery under chassis. In Pakistan, there is great potential to introduce the conversion business. The EV policy should consider conversion aspects as well.

There are three major companies in cars (Suzuki, Toyota and Honda) and three (Hino, Isuzu, Master) in the buses and trucks market, which may have a major stake and influence on the EV policy. Toyota and Honda do not have a clear vision or market plan yet for the EV sector, even globally or in the region. They have an interest in hybrids which are not really EVs in the real sense. They do have one or two symbolic EV models but have not developed a full range of products. Their limited current offerings in EV do not match with their main products, here in Pakistan and elsewhere. As mentioned earlier, Suzuki has one EV product that has chances of good market share in the absence of Toyota and Corolla in the EV market.

Many small local investors backed by Chinese principals are interested in local assembly of EV cars and have reportedly submitted their proposals in this respect. Reportedly, not much interest has been indicated in electric buses, perhaps due to the smaller market size. Whether it is EV or a conventional car, it is still largely conventional technology and the processes of painting, welding and metal work. Only 30 percent of the cost may be EV specific. There has been a yearning in the country to produce rather than assemble cars. A number of attempts have failed earlier in this respect, and it requires deep pockets, technology and market power.

There are three policy choices; one, to allow free import of EVs at none or reduced custom duties which can flood the market at the expense of the existing local car industry. The second is to promote local manufacturing under custom duty concessions; this will introduce a small and separate EV industry away from the mainstream automotive industry. The risk is that the market may be fragmented by the induction of smaller uncertified and established companies, something that should be avoided.

The third is to induce the existing automotive industry under a deletion programme; to introduce EV; the existing players may be able to introduce limited models not catering to the market spectrum. They may require a longer time framework. New players, such as from China, may be introduced under this. The government may be able to attract big Chinese companies under its SEZ programme of CPEC via this approach. There is another potential market of motorcycles which can also go electric. The motorcycles market is of a respectable size.

The establishment of electrical charging infrastructure is a major policy question. Public transport should receive priority. Conversion of buses (five years or less old) to EV should receive attention. Pick-ups and 4x4s may have better chances to succeed. EVs offer a good opportunity to bring in more and genuine competition in the automotive sector. All this requires an EV policy which should pull together the various strands of the issue through stakeholder consultations. Oil is already gone from the power sector; if it also goes away or is significantly reduced from transport sector, one may have to reconsider or dilute the heavy investments programme in the oil sector that is being considered by the government.

Localization

It is impossible to expect localization in a few years as is being proposed by some enthusiasts or new entrants. It takes time and effort to do so. A five-year programme modeled on the deletion programmes already being implemented would be feasible. There is always a risk that later day relaxations are sought and customs duty advantages find ways into the pocket of companies and not into the intended purposes.

Lessons learnt should be incorporated into the new policy. This would require active involvement of those who have been handling it along with new blood and thoughts thereof. China has got an opportunity worldwide to enter into the EV sector. Automotive is a difficult sector to enter against competition from well-established market players. However, there has been some kind of laissez faire in China in this sector. There are more than 400 EV companies in China and the Chinese government has a hard time dealing with the situation.

It has consequences for product quality and country image that the government there has been trying to build for years. There is a spillover of this into developing markets. All kinds of products and parties have become interested in the sector, creating the risks and circumstances mentioned earlier.

Petrol demand has been increasing at a rate of around 20%, which would put a lot of strain on foreign exchange reserves in coming years and is doing even now. Thus, EVs along with renewable electricity can go a long way towards solving these problems.

Motor Bikes

Motorcycles should not be ignored in EV considerations. Motorcycles consume 50% of the total petrol requirement. Pakistan is the fifth largest market of motorcycles in the world after China, India, Indonesia and Vietnam. There is a scope of competition among two or more electric motorcycle manufacturers. In fact, existing companies may be encouraged to enter into this sub-sector. Similarly, there is a good market for conversion of newer buses into EVs. Conversion industry has come of age in Europe and the US.

The objectives of development of local industry often militate against the introduction of that product itself. Local manufacturing invariably demands monopolistic policies and protection, which results in an increase in prices and lowering of efficiency, at least in the short to medium term. In the longer run, however, costs are recouped. The same has happened in the case of automotive industry in India. Solar PV manufacturing in India is expensive than international levels, despite a large emerging solar demand. Who pays or should pay for the protection – consumer or government – is a policy question. In the current circumstances, the government cannot afford it. Also, the IMF has least sympathy with development of the local industry. It prefers trade. The least, the government can do is not to allow market fragmentation.

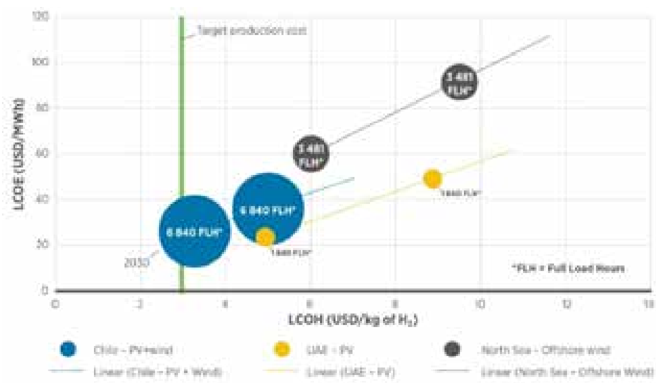
An ideal solution may be to introduce and manufacture EVs under a CPEC programme. For the first time, one would see a good possibility of protecting the EV market from fragmentation. China has helped Pakistan earlier in technology ventures such as HMC and others. A third component under SEZ is being deliberated. This would provide a robust opportunity to enter into this sector. There is a scope of mutually compatible commercial interest on the two sides. The Ministry of Commerce and Planning Commission should put their acts together to formulate an appropriate project proposal in this respect.

Concluding, it is the market fragmentation that would prove to be the biggest stumbling block in the development of EV industry which should be avoided at all cost.

7.6: Hydrogen Economy

Popular even governmental discussions have been limited to Solar and Wind energy and Electrical Vehicles. Hydrogen, the next and probably the ultimate in Renewables has not yet received much attention. Hydrogen is much more versatile and larger energy source and Store than Battery technology-the latter is limited to electrical uses. Hydrogen, however, replaces gas and fossils in much versatile and smoother transition. For example, Hydrogen can be transmitted through existing pipeline networks up to a mixture of 25% with Natural gas. Before the advent of Natural gas, Town gas used to be there in gas network. Town gas was 50-60% Hydrogen.

Chart 7.6.1: Cost of hydrogen as a function and cost of electricity and utilisation rate of PEM electrolyser

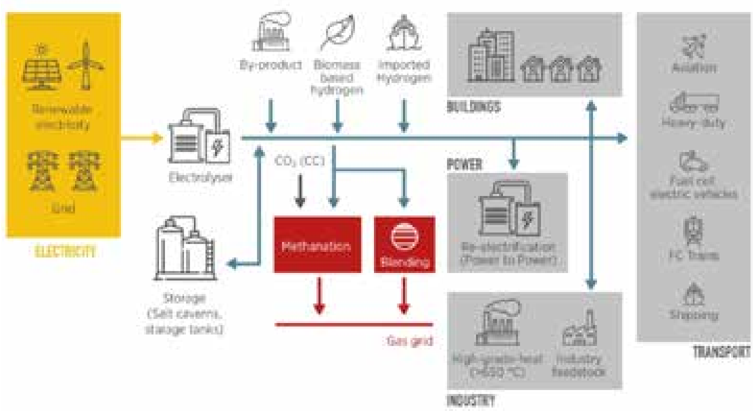


How close is Hydrogen technology regime? In several places in Europe, Hydrogen is already being mixed with Natural gas and distributed to end users. By next year, European Union has required all gas turbines that will be shipped by 2021 to be ready for combusting a Hydrogen-Natural gas mixture. By 2030, 100% Hydrogen based turbines would be al law except the existing ones. In Germany, steel makers are experimenting with Hydrogen to replace coal in blast furnaces and others.

On a more practical level, commercial interests are colliding among those who are planning and supporting Hydrogen/Fuel Cells vs those who have invested in competing Battery Technology. Both Hydrogen/Fuel-Cells and Battery Electrical vehicles run on electricity. Batteries are charged from external sources, irrespective of whether external electrical resources draw from fossil or renewable sources. Hydrogen is and will be produced through application of Renewable resources. Excess Solar and Wind energy will be used in electrolysis of water producing Hydrogen and Oxygen. Hydrogen will be stored in various media and used as and when desired just as batteries do. There are strong backers of Hydrogen /Fuel-Cell vehicles like Toyota who have committed to bring Hydrogen Car in near term.

Storage of electricity is becoming more and more important as share of renewable energy increases in grids, as Renewable energy, solar and Wind, are highly variable. In Germany, in some days, Renewables provide 75% of electricity load while some days, it is limited to only 15%. In Germany, they are fearing and projecting, what they call, Dunkelflauten (dark doldrums)-electricity drought lasting for one or two weeks in a row. Some argue 80% to be the upper limit while others are preparing Hydrogen to meet the challenge in providing 100% renewable grid through Hydrogen storage without electricity cost/price jumps.

Chart 7.6.2: Integration of VRE into end uses by means of hydrogen



Hydrogen is a starting material for many chemicals such as Fertilizers. Currently, Hydrogen is extracted from Natural gas through cracking. Earlier coal was used in place of Natural gas. We have still remnant of a fertilizer plant which used to work on coal as feed material. We are on a crossroad in this respect. Should we invest and utilize Thar coal or wait a little longer and utilize water to produce hydrogen which in turn is converted to Ammonia and fertilizer. Indeed, there are broader issues as to whether one should invest in Oil Refineries any more. What to do in the transition period? By 2050, it may be a different world, in at least so far as the energy sector is concerned. BP and Shell have long started into investing in solar business and development. The smartest way would be to have no residual investments in old technologies and should be smoothly transforming into the new energy regime. Clinging to the older regime and delaying entry into new one would be at our own cost and disadvantage, as the new regime is not only cleaner but is cheaper and more versatile and accessible.

New Hydrogen Technologies

Solar Cells are being developed with directly split atmospheric moisture into Hydrogen and Oxygen. Prototypes have been produced which are 15% efficient. Its rated power is 210 Watts.20 panels of these cells produce 250 liter of Hydrogen per day which meets the total energy needs of the house; light, cooking, heating and cooling. These use cheaper materials than Silicon and are projected to be cheaper finally in terms of finished cost.

Fuel Cells

Fuel Cells are reverse of a battery with some difference. FC produces electricity using Hydrogen and Atmospheric Oxygen, while battery stores and provides electricity when needed; both use electrolytes and Cathode and Anode. Fuel Cells were invented in 1838 and are being used already in many applications such as Fork Lift Trucks, Buses, and Bikes etc .FC have efficiency of 60 % and if waste heat is utilized combined efficiency can go up to 85%.

Green vs Blue Hydrogen

Green Hydrogen is produced totally out of renewable resources (Solar, Wind etc) and has low carbon foot print. Blue Hydrogen has low carbon foot print but may be produced out of Nuclear, Biogas etc. Grey Hydrogen is produced out of fossil fuels like natural gas or coal and has high Carbon foot print.

Hydrogen Cost:

Currently, there is a demand of on-site Hydrogen of 70 Million tonnes per year coming out of Natural gas reforming; almost half from fertilizer sector and half from Oil refining. Grey Hydrogen produced at site in gaseous form costs around 1-1.8 USD / kg varying on the price of Natural gas. Liquid Hydrogen costs around thrice as much at 2.20-3.08 USD/kg. Blue Hydrogen is costing 1.40-2.40 USD/kg. Green Hydrogen is costing upwards of 2.50 USD/kg.CV of Hydrogen is 7.37 kg/MMBtu. By 2030, Blue Hydrogen may be competitive in certain sectors and regions. It has to come down to 1-1.8 USD/kg to be competitive.

Comparison of FCEV vs BEV:

We have provided comparison of the FCEVs with BEVs in terms of the following criteria:

Range, fuel efficiency, fuelling network availability, fueling time, fuel Cost and CAPEX.

- Range: Range of EVs is lower, 125-150 kms, of FCEV is almost double than BEV. While Gasoline is practically unlimited due to fuelling infrastructure availability.
- Efficiency: highest fuel efficiency is of BEV at 70-80%; FCEV efficiency is 50% while another 50% is lost in Hydrogen production itself. In that sense, FCEV efficiency goes down to 25%.However, the fuel production efficiency losses are equal in thermal routes of electricity production and Hydrogen production.
- Fuelling Infrastructure: More charging stations are currently available than Hydrogen filling stations, almost everywhere. Things can change in future. Electricity networks are available everywhere. Hydrogen may have to be imported in many countries.
- Fuelling time: fuelling time of BEVs is high, about an hour at charging stations and 14 hours at home. Hydrogen charging is instant and as fast as Gasoline.
- Fuel cost: electricity charging cost would vary with tariff policy. An average tariff can be taken at 12 USc (18 Rs) plus charging station cost. Hydrogen cost at 8 USD/kg, would cost USc 0.13 per km. At 12 USc per kWh, and consumption at 20 kWh per 100 kms, BEV electricity cost would be 2.4 USc per km. Hydrogen would be cheaper but only conjectural by 2025-30.
- CAPEX: Currently, FCEV cars are twice as expensive as BEVs: 60,000 Euro for FCEV and 30,000 Euro for BEVs.

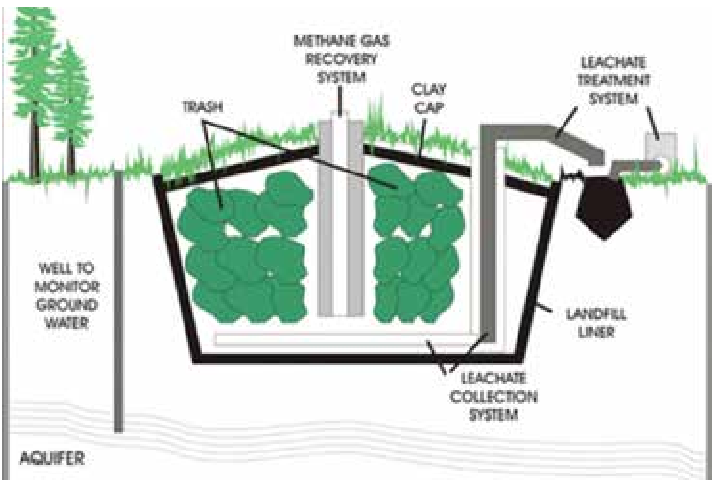
It can be concluded that the time of FCEVs may not have come yet, while BEVs are already there. On the other hand, the ultimate may be FCEV and BEVs may be a transition.

8: Environment and Recycling

8.1 : Managing Solid Waste

Solid and liquid, both wastes are becoming a serious issue, especially in large cities. In mega-metropolitan cities it is becoming a menace. Recently, waste-to-electricity production has received much publicity and attention. There are other options like biogas, compost and RDF (refuse-derived fuel) production that may be worth examining as well.

Chart 8.1.1: Modern Landfill



Waste collection and its disposal both are important and complimentary components of a waste management programme. While collection is relatively well known (dust-bins and collection vehicles), waste disposal has often created controversy and issues. Waste is often dumped in open areas in an unorganized fashion, creating all sorts of social and environmental problems. Land is expensive and populated areas are expanding near and around cities. Waste is generated daily and keeps accumulating, putting pressure on waste land resources. Thus waste cannot be left untreated and has to be properly disposed.

There are two major ways to handle waste disposal – direct incineration and generation of electricity in what is called Waste-to-Energy (WtE) plants; and indirect disposal which we will discuss a bit later. WtE plants are quite popular and common in Europe. Both power and heat are produced and utilized. Hot water is produced through waste heat generation and distributed in residential areas through pipelines. In northern and central Europe, this method is specially adopted. The main advantage of this method is less space requirement and waste reduction. Waste is reduced to ashes which are 10-15 percent of the original waste input. The main disadvantages are high capex and environmental emissions. Mercury and dioxin and other hazardous emissions are generated which have to be cleaned increasing capex.

Chart 8.1.2: Source Separated Materials

In cost terms, around \$3.5 million, more than twice the normal fossil power plants, is involved. The cost of electricity generated can be quite high, as much as 10-14 USc. In these days of cheap solar and wind of 4-5 USc per kWh, this is rather a high cost. There is also a possibility of bypassing pollution /emission control rules and pocketing the investment via collusion with the regulatory and other authorities. Capital padding is not uncommon in this and other similar countries. Emission control is a problem even in the US, where WtE plants are discouraged. Europe has adopted this possibly because of the lesser space requirement. The way the environmental movement is going, it is quite possible that even Europe may start discouraging WtE plants.

In Pakistan, there has been a mistaken impression that WtE plants may solve our electric power scarcity problem. The fact is that a very small amount of electricity is produced. WtE plants are highly inefficient and produce low-grade waste heat, which in Europe is utilized in the form of hot water distribution, while in Pakistan such possibilities may be problematic.

The other indirect MSW route or method consists of a number of steps: a) segregation and recycling; b) landfill and bio-gas generation: and c) RDF making. This route is simpler, environmentally safer and less capital intensive. Waste segregation is preferably done at source. In many jurisdictions, there are two or three bag collection systems enforced by municipalities. This may be difficult to practice in chaotic developing countries. Waste segregation in that case is done on disposal sites through mechanical, aeration and magnetic separators. This can be capital extensive.

The other alternative is to utilize mechanical belt conveyors and employ labor for manual sorting and segregation. Recyclable material like paper, glass and metals is segregated for recycling and sold to various industries as a useful raw material. Organic material (vegetable and food waste etc) is put in a sanitary and organized landfill; a rubber-lined and drainage provided land excavation is made wherein organic waste is dumped in an organized manner. Biogas can be produced from this landfill as well. The remaining materials like plastic, rubber, textiles, rags etc are shredded, screened and palletized. This is called RDF.

RDF quality, composition and CV depends on the care employed in waste segregation and separation and also on how many recyclable items having calorific value are extracted prior to the RDF making. The RDF calorific value can be variable but generally is 56-60 percent of the CV of imported coal and saves 40 percent of fuel cost with reference to coal.

RDF is sold as a fuel comparable to and partially replacing coal. Extractive industries like cement, bricks, tiles and glass making are quite popular end-users in many countries. In Europe, there are targets and policies in many countries to replace normal fossil fuel like oil and coal by alternative fuels like RDF. In Germany, and Austria, in the cement industry, more than 60 percent of fuel used is RDF; in Czechoslovakia 54 percent, Poland 40 percent, and the EU-27 average is 30.52 percent. In Pakistan also, two progressive cement manufacturers (DG Khan and Fauji Cement) are doing good to their bottom line by utilizing RDF in their furnaces. Both the companies are buying raw MSW and convert it to RDF themselves.

There is a large cement sector in Pakistan producing 41 million MT per year of cement in 24 plants widely dispersed in all parts of Pakistan. The cement sector should be consuming around eight million tons of imported coal, resulting in foreign exchange drain of $600-800 million per year. Half of this can be substituted by RDF and half by local coal.

We are facing a current account deficit problem. The cement sector may be encouraged or even obliged to convert to local Thar coal and RDF; 30-40 percent RDF and the remaining coal. RDF can be burnt in coal power plants as well. Textile and other industries can use it as well. RDF can be used by the poor for their cooking needs. At Rs5 per kg, it is much cheaper than charcoal, kerosene and LPG. Thus, two birds are killed with one stone – getting rid of solid waste and getting cheap fuel, and getting bio-gas and fertilizer from landfill.

Solid waste management, from cradle to grave (collection to disposal) can be very simple but requires an organized approach. Waste has economic value in the form of energy it contains. It is now amenable to private sector participation, replacing municipalities' direct involvement in waste collection and management. Both in Lahore and Karachi, waste collection companies have been employed.

RDF appears to be a better, environmentally acceptable and cheaper option. It provides many associated products like bio-gas and compost. Other approaches may also be applied like regional or zonal waste processing, say, in and around food centers and vegetable markets where direct composting and biogas production may be feasible. Sewerage can be mixed in solid waste for more biogas production.

The issue is not technical or economic but is social and political. So how to and how not to streamline such interests and issues to a common purpose? Karachi is a ready example.

8.2: Waste to Energy?

Solid waste and smog has been on the agenda of public debate lately. On Solid Waste Management (SWM), good news has started coming in. Recently there was a public hearing at Nepra, on a tariff petition for a Khyber Pakhtunkhwa Waste to Energy (WtE) project. Earlier, Nepra had awarded tariff to a similar project in Lahore.

Figure 8.2.1: MSW and Components

Most recently, reports have been published of KE signing a MoU for a similar project. While this is all good news, we would like to caution against some risks in planning and implementing such projects from an environmental perspective, lest solving one problem may cause yet another one. Such warning or cautions, however, may not be construed as opposition to these initiatives but are really meant to improve upon them.

The Green movement and its stalwart international NGOs have been traditionally opposing burning solid waste and have been arguing in favor of Landfill sites. In the past, they even opposed the installation of a much smaller hospital waste incinerator project at a local hospital in Lahore. However, that was in the 1990s. Sentiments have changed since then. Landfills have not been managed effectively, especially in developing countries. They have been often seen to conduct open dumping rather than be organized and well managed landfills. GHG emissions in the landfills have been high. In the US, GHG emissions from landfills are the third largest source.

WtE and MSW incineration has been quite popular in Europe, probably due to land scarcity. In the US, landfills have been more popular. However, around 77 WtE plants have been installed in the US as well. Elsewhere in the world, enthusiasm and support for WtE projects has increased? More than 1000 WtE plants are in operation now in the world; 400 in Europe and 200 in China. China, although, has been a newcomer with only 15 WtE plants in 2005 has reached a level of 200 units. In the process, they have improved technology and have reduced costs and are quite competitive in the global market.

WtE plants essentially burn coals in CFB or grate type boilers to produce steam which drive turbines and generators to generate electricity. WtE power plants emit many injurious chemicals and metals, much more than any other type of power plant including coal, except that coal power plants are very large;1000 MW coal vs 100 MW WtE typically. WtE plants, however, install expensive pollution control equipment. More than half of the CAPEX of WtE plants go into the installation of such equipment. That is why WtE plants are expensive – costing $3.5 million per MW as compared to half or one-third that much for coal power plants.

Scrubbers and filters are installed; urea and ammonia is used to neutralize NOx; calcium for SOx, activated carbon for absorbing mercury, other metals, Dioxin and Furan and other chemicals. Both equipment and chemicals enhance CAPEX and OPEX and thus WtE electricity is expensive at 10 USc; in the US, a cost of USc 6 has been quoted by some sources. One may not mind it if one compares it with coal power at 8.5 USc.

The risk is that IPP investors may cut corners in installing all the required equipment, despite provision in the regulators tariff award; both equipment and chemicals use may be compromised. In Pakistan, this has happened frequently in many public-sector facilities. Budgetary provisions are not there and whatever budget is there is pilfered. Provincial EPAs normally collude with the polluters or appear to be too timid in monitoring large government supported projects.

One is not sure whether there are proper environmental regulations for the environmental performance of WtE plants. For the Lahore WtE project, only an IEE (Initial Environmental Examination) has been found to be adequate. Due to its size – 40 MW – perhaps, such lax treatment has been allowed. Although it is a smaller power plant, its potential to cause harm is much more due to the heterogeneity and uncontrollability of MSW which is its fuel.

Nepra considers an NOC from EPAs to be enough. Nepra's generation licensing activity also does not pay much attention to environmental aspects. Similarly, acceptance testing and monitoring during operations gets short shrift treatment with regard to this aspect. If for nothing else, Nepra should take more interest in it, so as to guard financial compliance which is its forte.

There are other risks as well which must be mitigated. WtE electricity cost and tariff would be dependent on the heat content (CV) and composition of solid waste which would be provided by the local governments. Will it be more effective if MSW collection is also contracted to the WtE IPP in order to have more direct leverage on availability and quality of MSW? Recyclers may scavenge high calorific value items which may never reach the WtE plant, causing lower CV in MSW fuel. More than half of the WtE plants in India were closed due to this issue. This has, however, not deterred India from installing more of it. WtE plants are new projects. Adequate effort should be applied in drafting PPAs and fuel supply agreements.

The Lahore project will produce 40 MW, disposing 2000 tons per day of MSW, as per data provided in the Nepra approved generation license. MSW is relatively low in CV, about one-third of the CV of coal. Lahore MSW generation is of the order of 8000 tons per day. This solves 25 percent of the problem. Luckily, Lahore's MSW project is resorting to other routes as well; composting and RDF (Resource Derived Fuel) as well which hopefully will take care of the rest of the MSW.

For KP, Peshawar and adjoining areas, 40 MW may be a good capacity. However, for Karachi, 40 MW may be too small for 16000 tons per day of MSW taking care of 12.5 percent of the problem. However, this may be a good start only; more capacity can be added later, in addition to adopting other technologies like composting.

WtE plants are a waste disposal tool and not a mainstream energy production route; they are at best a byproduct subsidizing waste disposal costs. Wind and Solar are much cheaper at 4 USc, although, such lower costs have yet to materialize in this country. Elsewhere, it is as low as 2 USc per unit. WtE plants may, however, be comparable with coal both in terms of CAPEX and CoGE (Cost of generation); 1.4 Mn USD per MW CAPEX for coal vs 3.5 Mn USD per MW for WtE; CoGE for coal 8.5 USc vs 10 USc for WtE. Neither will capital be available for wide-scale electricity generation on MSW nor there will be enough MSW. Potential is one thing and actual reality another. The total potential of WtE plants may not exceed 500 MW.

WtE plants are mass burning facilities, which have no time and space for such nice and soft things as pre-segregation, reuse, composting, biogas and recycling which may be compromised. Nevertheless, some composting must be done, using extra MSW, to create green places and change the adjoining bio-life. Recycling of paper, metals and glass is highly attractive and creates useful employment for poor scavengers. Recycling of paper and similar burnable materials may, however, cause reduction in the calorific value of the MSW fuel affecting operations and economics of WtE plants.

The overwhelming benefit of WtE plants is mass reduction, reducing the waste to 13 percent of the initial mass, saving often expensive space. People have been skeptical of such burning. Increasingly, municipalities have been flaunting these plants developing skiing facilities, hotels and other tourist facilities around it. We can use the released land for a low-cost housing scheme for the poor.

8.3: From Stubble Burning to Smog

Smog has arrives every year again and again especially in October November. Children do not go to school. Air flights and normal road traffic is disturbed. We had discussed in this space earlier the role of petroleum, automotive vehicles and road traffic in causing air pollution and smog in Punjab and elsewhere. In the following, we will deal with the role and impact of stubble burning and will explore ways and means of handling and mitigating the issue as well. The issue is full of controversies. On both sides of the border in our region, blame is being leveled that the stubble burning pollution is travelling from the other side. Both may be right as the area is contiguous and the wind direction keeps changing.

At least in India, farmers are downplaying the role of stubble burning in causing smog and are shifting the blame on other sectors. They are also contesting the role of machines in recycling stubble into the soil – terming it ineffective, expensive and unaffordable. High courts have been issuing edicts banning stubble burning but the ban has not been effective. A subsidy of IRS100 per quintal (100 kg) has also been ordered by the courts to help farmers meet the expenses of machinery in recycling the stubble.

There is no doubt that stubble burning is not the sole reason for smog. Traffic emissions, brick kilns, industrial pollution especially burning of dirty fuels and no pollution controls, dusty construction activities, all are contributors to the problem. However, in the autumn when rice is harvested on both sides of the border and the stubble has to be cleared within fifteen days in order to be able to sow a new crop – both the volume and the time enhance the intensity of the problem. So the cheapest and fastest way is to burn the stubble.

Expensive equipment and technology is around which can be used to clear the stubble without burning it. But only rich farmers can afford it. However, without a useful use of the stubble, nobody would have the incentive to invest in it. Indian Punjab alone produces 20 million tons of stubble, most of which is burnt in a month in October. A recent study in Pakistan estimates stubble burning at some two million tons appears to be an underestimation for a six-million-ton annual production of rice.

Overall, 60-80 million tons of agricultural waste and residue is generated in Pakistan annually. This can be a resource rather than a liability. It contains energy as is readily seen by the burning flames. Instead of wasting it, it can be usefully employed and can be used in producing electricity, and in the industrial and domestic sectors. Bio-fuels are a new product that is being increasingly produced from rice straw and other agricultural waste.

Raw stubble is, however, a liability and its burning is inconvenient and wasteful. For efficient and convenient use, it is converted into briquettes or pellets. The biomass is to be dried, crushed and pressed into pellets with or without the help of binding additives. Densification reduces volume, reducing transportation costs, and increases volumetric calorific value. It also slows down burning; raw biomass burns too fast making it uncontrollable and wasteful. Also storage becomes easier reducing volume requirements and increasing stackability. While biomass/stubble may be generated in a short time, it cannot be consumed instantaneously; it has to be stored for later sustained consumption.

Raw biomass is currently used by the rural poor in domestic cooking and even heating. In its raw form, it causes indoor pollution affecting women especially. In pellet form, it is less polluting and manageable. All rural areas are not equally endowed agriculturally. Pellets can make biomass transportable and tradable and converted into a saleable commodity. Currently, it has no value, except in some special cases such as Bagasse. If it has a value, it won't be as mercilessly burnt as stubble is burnt currently. Only 20 percent of the population in Pakistan has access to gas where a pipeline network is available. In other areas, charcoal, LPG and kerosene are used which are much more expensive. Gas is subsidized (cross subsidy) to small and medium consumers. Gas availability is going down and it is getting costlier, especially due to the advent of LNG.

Biomass pellets can be affordable. Biomass pellets have almost the same energy content as Lignite (Thar coal). Thar Lignite is being produced at a cost of $47 per ton. The government of Pakistan could encourage small, medium and large-scale utilization of biomass including stubble – paddy waste. Small pellet producing plants can be installed on farmlands. Model and demonstrating plants could be installed and easy credit terms provided.

Third parties like the cement industry can install medium to large sized plants. Some progressive cement producers are already lifting municipal solid waste to burn in their kilns. Brick kilns can be encouraged to use biomass briquettes in place of coal and other dirty coals. Thus biomass briquettes can be introduced as another fuel in the fuel market of the country which would improve the quality of life and contribute to rural economies. A curse can be converting into blessing.

Ethanol production from food crops (first generation technology) is not new. However, producing ethanol from Cellulosic materials like rice straw is a relatively new phenomenon. Rice straw can now be converted into biogas and bio liquid fuels. In Italy, Romania, the US and Brazil, rice straw is utilized in producing bio-ethanol. Ethanol is mixed with gasoline in without affecting engine performance or requiring modification.

Policies are in place in most advanced countries requiring 5-10 percent ethanol in gasoline. It is a separate matter that Pakistan produces ethanol but exports it. India is going ahead with several bio-refineries base on rice straw. It is time to examine the feasibility of a similar bio-refinery in Pakistan. It would produce much required petrol, save foreign exchange and would provide incentives to farmers not to burn rice straw. However, varying and low oil prices have put all such proposals into question. Bio-char (a fertilizer) can also be produced from rice straw and other agricultural waste. Gas and bio-CNG is another option and attractive enough in the context of falling local gas production. Agri-biomass including raw straw is often mixed with sewage to produce biogas. This partly solves sewerage issue as well.

Economics is the final constraint in technology choice. Economics varies regionally with location and resource endowment. If smog and pollution health effects are internalized in economic calculations, the aforementioned solutions may possibly become more attractive.

Finally, it is said that it is easier to build and finance a bio-refinery than to collect rice straw and biomass from the farmer, as he has his own constraints and economics. Capital investment in collection by third parties and conversion of rice straw into useful products as mentioned earlier offers a practical solution. If all of it is found too difficult to implement, de-zoning, prohibiting rice production near large cities may have to be introduced. There can be alternative crops. Health is more important than money.

8.4: International Waste Recycling Business Opportunities

Waste or scrap is both an asset and a liability. If one can retrieve good materials economically and responsibly (environmentally speaking), it can create economic opportunity, promote industrialization and generate employment. However, if a country cannot process waste properly and encourages waste imports based upon low-paid workers, that waste may be a liability. China has developed out of poverty by, among others, processing and recycling the waste imported from industrialized countries. It has stopped it because it does not need it any more. It has its own materials, if not waste, to utilize. And it wants to clean up.

The world plastic recycling trade alone has been a $200 billion per year business handling 270 million tonnes; half of that is taken up by China. China has made important changes in its waste imports policy. It has banned imports of post-consumer plastic waste. From the US alone, plastic scrap exports to China used to be around 250,000 tons, which has been brought down to zero. Overall, US exports of plastic scrap have been reduced from 750,000 tons to 375,000 tons annually.

Developed countries have a temporary problem of how to dispose waste that has been denied by China. Although other developing countries have started accepting plastic waste, their capacities are still far too less developed to substitute China. Resultantly, landfills have a problem in the US, although Europe has been classically relying more on incineration than land filling; the latter, therefore, is not much affected by Chinese waste imports ban.

Until quite some time into the future, waste processing will remain labor intensive, although automation is fast creeping in. Developing countries, even with improvement in safety and environmental standards, will remain competitive in this business. And eventually and hopefully, local waste generation will increase if and when waste imports and trade market dries up.

An important and emerging area in waste processing is e-waste in electronics and computer equipment. Cathode Ray Tubes (CRT) contain two kg of lead alone. Although CRTs, being heavy energy consumers, are no more manufactured, used units are still around and would be candidates for waste processing.

Roughly, 70 percent of global e-waste ends up in China. China's domestic contribution of e-waste is also substantial. In 2012, the country was the world's second largest producer of electronic waste, generating 229.66 million units, compared to the 32.99 million units generated in 2001. China is now the second largest e-waste producer in the world after the US, creating up to 6.1 million tons per year. This amount is expected to continue rising with China's economic development, technical innovation and urbanization as more electronics are created and consumed, and disposed.

China's Guangdong province is the largest electronic waste site on earth. Guiyu town has up to 5,000 workshops treating up to 70 percent of the world's e-waste, and employing around 100,000 people. The disposal sites recycle 15,000 tons of e-waste on a daily basis. Over 80 percent of the town's residents make a living off of manually disassembling and disposing e-waste full-time. In 2012, China adopted the extended producer responsibility (EPR) system from the EU, which held manufacturers responsible for the collection and recycling of electronics. Otherwise known as "Producer Take back," the EPR management system requires manufacturers to carry out environmentally safe management of their products even after they are discarded.

Many companies, like Nintendo, are aware of the problem of e-waste and are developing their own initiatives. China Mobile, Motorola, and Nokia collaborated in launching a recycling programme where they took back used cell phones and electronic accessories. This "take-back," or "Green Box" programme safely collected about 20 tons of e-waste by 2009.

Pakistan's e-waste issue is no less. TV sets, refrigerators and other kitchen appliances are consumed and discarded in millions. The worst example is of automotive batteries. Most of the used batteries end up in informal setups which remelt lead cells in an extremely primitive and dangerous manner affecting their own lives and those living in their poor neighborhoods. A formal recycling industry can possibly bring them into some kind of safe handling system as subcontractors. The advent of EVs and the batteries thereof will further exacerbate the battery disposal and recycling problems.

The Basel Convention forbids members of the OECD from exporting e-waste to non-OECD countries. However, this has not prevented e-waste landing into developing countries. American, Chinese and even European companies may be encouraged to install and transfer waste processing factories to Pakistan. It may be legally possible under a negotiated system being a part of the 'Producer Responsibility System'. The regenerated material can be sent or sold back to the original owner of the waste. A lot of left material can help promote electronic and metal industry.

After China's plastic ban, many Chinese companies have gone bankrupt and many have shifted to other South East Asian countries. Today, Malaysia is the biggest plastic waste processor; other beneficiaries are Thailand, Vietnam and Indonesia. Due to the sudden influx of plastic waste, there are problems in these countries. In time, they will be able to install the required waste water treatment and other facilities.

E-waste and plastic waste can be imported into Pakistan, if state-of-the-art electronic waste processing facilities are brought about. In this, China can be of great assistance. Chinese waste processing companies can be encouraged to relocate their factories. They have ready customers and are part of the international supply chain. In fact, an SEZ can be dedicated to waste processing. Gadani can be revived and an SEZ developed there. It would not be simple plastic waste disposing; there would be a whole downstream industry producing a wide variety of plastic and products starting from sheets, shoe-soles, construction materials, furnishings, doors and windows, sports goods, furniture etc. The list can be very long. Companies like IKEA may like to have a plant around or in such facilities. Similar would be the case with e-waste.

Every country has its own socio-economic situation and peculiar circumstances. If European, American or Japanese safety and environmental standards are enforced here, no car can come on the road, no factory can run and no electricity can be produced and no refinery can function. In fact, old environmentally unacceptable refineries in the exporting countries have been installed here happily and without any qualms. Similarly, one should not oppose the transfer and relocation of waste processing industries which have so much potential benefit. Poverty and unemployment are the worst enemies to fight.

Pakistan's CPEC authority and the Ministry of Commerce along with the Ministry of Industries should give due consideration to this proposal. One has to be quick in identifying and seizing upon opportunities and the gaps being left by China. Such windows of opportunities do not last long. There is always some competitor lurking.

8.5: Recycling Used Motor Oils

Lubricant oils are as important as Petrol and Diesel. It is a high margin lucrative business for all those involved in the supply chain. It is unregulated as well giving pricing freedom to the lubricants suppliers and manufacturers. Unfortunately, scant attention has been paid to the issues involved in this sector. It used to be under regulated sector requiring licensing; it is unregulated now, with positive and negative consequences. Used oil is an environmental liability having potential to pollute water resources. Used oil is being recycled by SME recyclers with rudimentary processing and is marketed as spurious product compromising engines performance and integrity of vehicles. Recycling is beneficial and is done in most developed countries; however it has to be under oversight and controls. OMC (Oil Marketing Companies) should recognize their role and responsibility in this respect.

There is an only one refinery NRL producing lubricant. However, Lubricants are imported as well. OMCs blend and market lubricant Oils through their distribution networks. There are thousands of petrol pumps and unaccounted workshops involved in oil sales and change business. Traders and importers also sell through shops and directly to large industrial and institutional buyers.

Total demand of lubricating oils in Pakistan is approximately 400 million liters (400,000 mt) per annum out of which about 50 percent is produced locally by registered blending plants with locally available Lube Base Oils (LBOs) from National Refinery Limited (NRL). 11 percent of the LBOs are imported in raw form which is further converted into finished products while 11 percent finished lubricants are being imported and smuggled to meet local demand.

Used Oil –an environmental liability

While Petrol and Diesel and other fuels are consumed, Lubricating oil is not. It remains there in the engine sumps and gear boxes etc. Oil has to be changed after a certain period varying from a month to several months. And thus, used oil comes into being. It is both an asset and as well as a liability; asset, because it can be recycled after some processing and thus has an economic and even commercial value. It is an environmental liability. If not adequately controlled, it can cause water pollution. Also used oil may find its way into spurious products damaging the automotives and other user equipment. There are many reasons to reuse and recycle used oil include:

- Recycling used oil keeps it away from polluting soil and water.
- Motor oil does not wear out—it just gets dirty—so recycling it saves a valuable resource.
- Less energy is required to produce re-refined base stock than a base stock from crude oil.
- Re-refined oil must meet the same stringent refining, compounding, and performance standards as virgin oil for use in automotive, heavy-duty diesel, and other internal combustion engines, and hydraulic fluids and gear oils. It is, therefore, a regulated activity requiring license and other quality and performance requirements.
- Re-refined oil is equivalent to virgin oil, passes all prescribed tests and, in some situations, even outperforms virgin oil.
- Used oil, in addition to being recycled, is also use as a fuel. After some minimal processing (filtering etc), it can be mixed with furnace oil and can be burnt in power plant, industrial boilers and furnaces. However, recycling as a lubricant offers a higher financial award.

Producer Responsibility Principle

In accordance with laws prevailing in almost all developed countries, the “Producer Responsibility Principle” is applied. This principle stipulates that “producers, importers, or any other party” responsible for placing products in the market may be obliged to take direct charge of the management of the waste generated by their products. In the case of used oil, this means that industrial oil manufacturers must guarantee and finance the management of an amount of used oils proportional to the amount of new oil placed on the market. Normally, lubricant manufacturers assign this job to a third company under contract, which collects, refines and resells the refined lubricant to the lubricant manufacturers.

Unfortunately, in Pakistan, there is neither any legislation nor any cooperative self-control industry mechanism fulfilling the requirements under, Producer Responsibility of Care. This is despite that respectable multinationals like Shell and others are involved in this business. Although, it is government’s responsibility to bring the required legislation, industry could have guided the government. Alternatively, nobody would have stopped them in bringing about the remediation system voluntarily, individually or under a cooperative self-help system.

Some measures have been taken at the petrol pump level .Adequate lubricants suction machines have been installed. Earlier, manual systems used to be there involving risks of spillage and other issues. However, the lubricant collected at the petrol pumps is not taken back by the lubricant manufacturers/suppliers. Petrol pumps owners sell it to recyclers in SME sector. The recyclers are under no controls and employ very rudimentary processes like heating and filtering and using fuller earths and possibly may be adding some additives. These SME recyclers sell their reclaimed product in the secondary market of unbranded and cheap lubricants.

Need for Policy and Controls

Even this rudimentary system is not applicable to all the lubricant sold in the market. A significant amount of lubricant oil might be spilled and may be finding its way into the sewerage and ground water and even surface water that is drunk by people. Also, all lubricants may not be sold through petrol pumps. And there are a variety of lubricant oils used in other than automobiles; transformer oil, industrial machinery, railways, defense etc. An all embracing and comprehensive collection system has to be there. Collection points are to be there as well. It is not difficult. Although, it is a waste, it is an expensive commodity. All agents in the collection, transport and refining sector are paid under the market system .Only legislation, management and controls are required. All parties involved in the system are to be registered. Violations must be punishable under law. There is no dearth of legislative codes, most of it available on institutional websites. The OMC's are operating in advanced countries as well and should be aware of the requirements and the details.

Due to poverty, unemployment and availability of low cost workers, waste recycling in all sectors has fared well in Pakistan. All kinds of wastes are collected and recycled, used oil included. Sometimes, this brings some disadvantages as well. Market and processes become uncontrollable and is penetrated by spurious elements, as has happened n the case of used oil. Fortunately, there are multinational OMCs as well who have access to knowledge, technology and capital.

Petroleum division appears to be the lead agency in this. Other stake holders would be the OMCs, Petrol Pump associations, provincial EPAs, OGRA. A technical committee is required to be set up to develop the framework .This committee may prepare the legislative code as well for the consideration of the parliament as well.

8.6: Circular Economy

Circular Economy is a broader concept of living, producing and consuming. Today's economy is linear wherein a material is discovered, produced and consumed and is dumped, safely or unsafely. A circular economy aims to design out waste. The word Waste does not exist in such a vocabulary. Zero Waste is an outcome of circular economy.

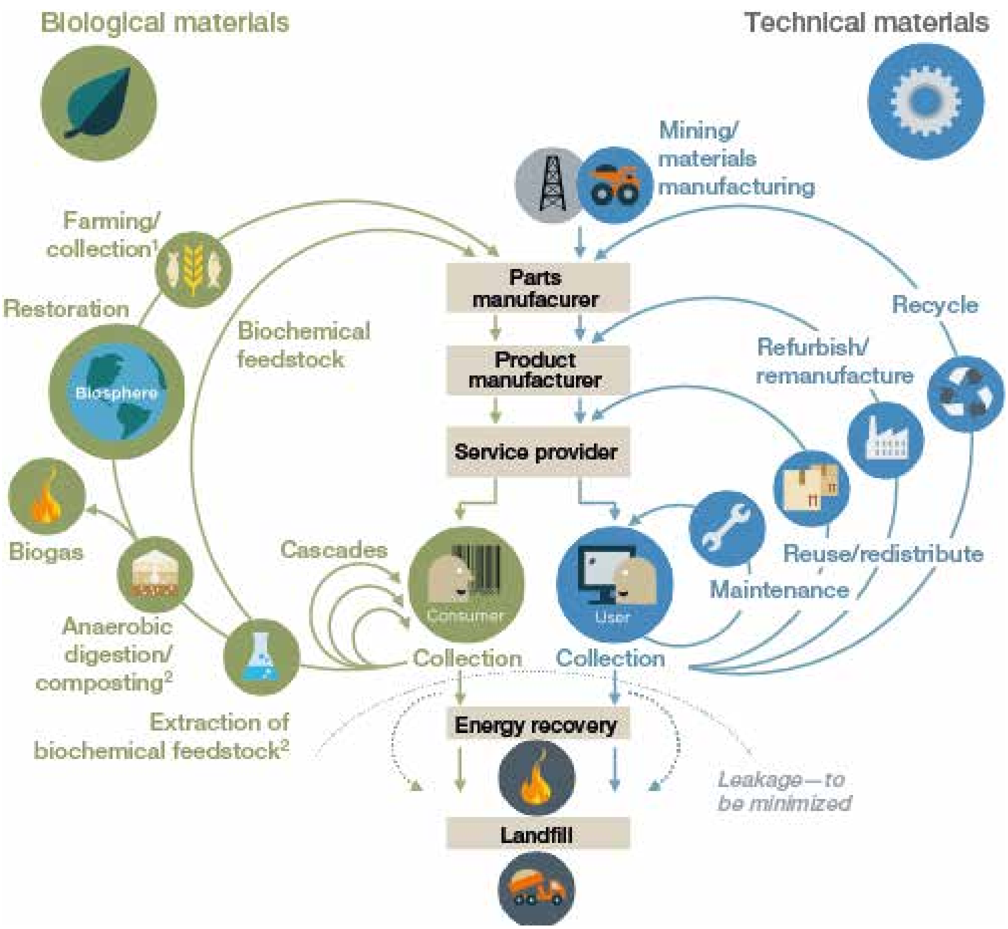
Instead of waste collection, management and its dumping or disposal (building landfills or incinerators) somewhere outside the cities, advanced nations are moving towards eliminating waste altogether or most (90%) of it. Concepts of Circular Economy and Zero-Waste and 3R (Reuse, Reduce and Recycle) have evolved and targets and plans have been made for its implementation. May be, all of it can be achieved by 2050; 90% of it will be.

According to Zero Waste regime, there should be no waste at all. There is nothing as a Waste. All materials are useful, even excreta. Waste is a resource. Waste from one production process or society or company should be the input for the other people, process or company. Materials no more required in one place or system can be put to use or reuse in another; if no reuse can be found, than Recycle.

Instead of viewing used materials as garbage in need of disposal, materials are recognized as valuable resources. Refuse Waste otherwise Reduce Waste. If nothing else, produce energy out of Waste. Nothing should be sent to landfills or incinerators. These are bad for health and worse for the poor communities where these are installed.

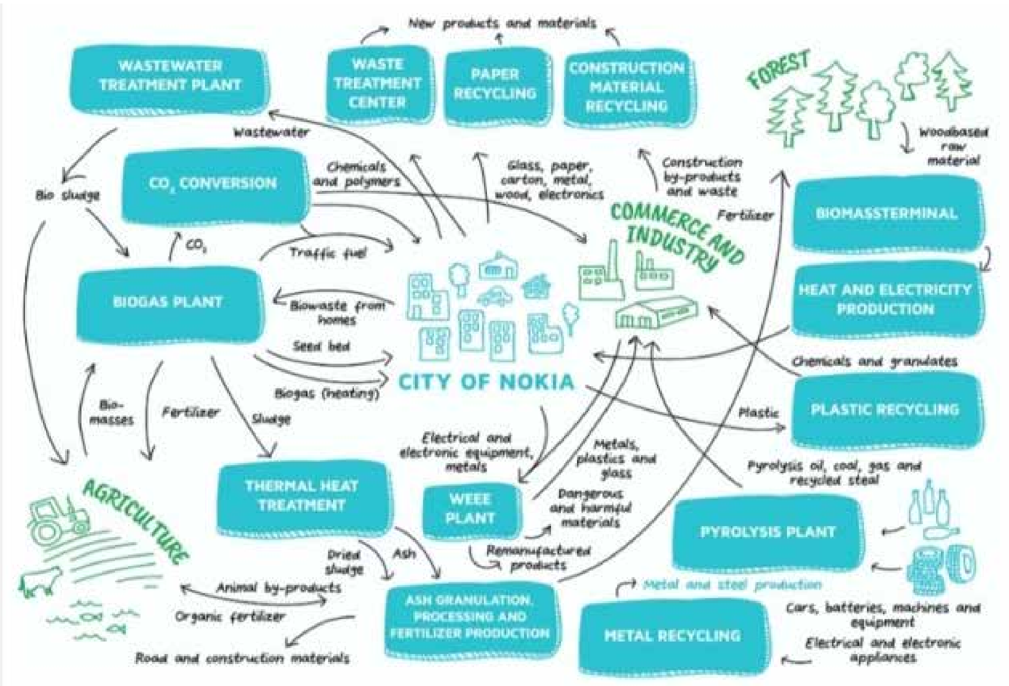
The waste that has gone into the landfills should be rediscovered and brought back to use through recycling. One by one, materials should be drawn away from Landfill and incinerators; start with food waste. Ultimately (by 2050), there should be no landfills or incinerators.

Chart 8.6.1: Biological materials, Technical materials



Landfill is being discouraged and reduced with a target of only 10% of MSW to go to landfills by 2030, implementing 3 R (Reduce, Reuse, and Recycle) diligently. EU has defined 70% recycling target for 2030 to promote circular economy. Among the stated goals: increased packaging recycling (60% by 2020, 70% by 2025, and 80% by 2030). Other stated targets include 90% recycling for paper and 60% for packaging made of plastic by 2025 as well as 80% for packaging made of wood by 2030. Also for 2030: 90% recycling of all packaging consisting of iron, aluminum or glass; recyclable waste would be banned from landfills by 2025 (plastics, metals, glass, and paper, cardboard and biodegradable waste). This ban is likely to also cover all recoverable municipal waste by 2030.Food waste will not be allowed to landfills either by 2030. Food waste would be digested producing renewable energy and fertilizer or composted. Source segregation will be enforced.

Chart 8.6.2: EC03's potential for innovative circular economy concepts



In Pakistan, we are trying to implement things what is being shunned by others. This is a general dilemma with us. What to do in the transition period leading to the utopia of clean energy, zero waste and circular economy? Investments in landfills and incineration are being planned and some are under implementation. In our socio-economic system, waste is still a liability and not a resource that could be utilized to regenerate new materials and energy. We are at a stage where commingled refuse is handed over to the waste collector. Even if segregated waste is given to the waste collectors, he mixes it in his vehicle. All kinds of waste are mixed creating a massive collection and disposal issue at one or two disposal sites.

Instead of handing over commingled waste and making investments for disposing a comingled MSW, perhaps the first thing that we may start to do is start separating the household waste in two bags; one for wet waste containing food waste (estimate ad 50-60% of the total waste) and the other for dry waste, containing plastics, paper and glass and even electronics. It is not so difficult. We all have excess of plastic bags. Industries and hospitals may be doing it already for specialized waste. Let the collecting vehicles have two compartments as well. Let us intercept the waste somewhere in the middle extracting resources and energy, where feasible. Wet waste may go to digesting or composting centers which may be co-located with the landfills or may even be diverted to closer locations(ahead of the central dumpsites) like undeveloped parks or unutilized land pieces available in places like Lyari-Naddi , Mewa-Shah and Korangi and Landhi and Mangopir etc, in case of Karachi. These places can generate as much biogas as a conventional gas field as much as 30 mmcfd each.

Thanks to poverty, there is a thriving market of kabadia in this country and a stock of poor private scavengers and waste collector. We may have to organize them and recognize the usefulness of their role. Dry waste collection points may be installed at mohollas and streets. Dry waste does not disintegrate and give smell. Why to take it all the way to the landfill or the dump site. The recyclers are located within the cities. Some storage land spaces may be provided to the kabadia and they may possibly allowed to build warehouses at waste transfer locations (but not dirty dump sites). Dry waste travels to other cities as well where the relevant industrial users of the waste are located. Paper mills or glass factories are not there in all urban centers. Waste transfer should get a new role and a new meaning. Small or medium waste Digesters (anaerobic) may be installed near the food centers and sabzi mandis or even juma bazaars. Bio-CNG pumps may be installed at such locations as well. There is a ready case of Landhi cattle colony where significant biogas can be produced. Waste water facilities and treatment plants and even golf courses can house joint waste water and waste digestion facilities.

There would still be need of a waste collection and disposal system and a dump site out-side city limits, but the volume of the waste would be reduced and would be manageable. In any case, local bodies would not have the resources to handle a commingled and centralized waste management system that does not believe in waste reduction and decentralization and segregation. It may be a folly to take all the wet waste all the way to dumpsites or landfills where it leaches and creates unhygienic conditions. Landfills are filled and have to be closed down after 10 -15 years and new ones have to be built. Where would be the space and the money? It is not too early for 3R-Reduce, Reuse and Recycle. It will lead to zero-waste and the circular economy eventually.

Let us have a disaggregated system that recycles most of the waste before it reaches dump site. At dumpsite, let us have composting, RDF-making facilities; recycle warehouses, anaerobic digesters producing biogas and fertilizers and a small landfill for the inert and useless material. It would no more be a dumping site; it would be a recycling centre. It might as well be an efficient SME industrial estate housing paper, packaging, plastic, glass and metal raw material industry and eventually finished products. Biogas can be supplied to industries around and Bio-CNG can fuel the collection vehicles and other users. This is circular economy boosting economy and generating employment. Thinking, planning and organizing is required. People and their local bodies and other stakeholders like scavengers and Kabadias etc have to be involved.

9: Institutional Issues

9.1: Federal vs Provincial Control of the Energy Sector

Provincial Issues

Every winter, there is gas shortage and the controversy erupts that Sindh produces more gas and it should get its due share. The issue is complicated and has many sides to it. We will present all sides of the issue, which may provide a basis for some kind of a settlement. The main contention is that the producer province – Sindh – should get priority for the gas produced in the province, as per the constitutional requirements. Constitution is supreme and must be respected. However, there are other legal and commercial aspects, which may also have direct and indirect constitutional provisions. We have a federal system. It may be useful to see how such issues are dealt with in other federations.

In federations, the energy sector as a whole is generally devolved to states or provinces. Minerals including oil and gas resources belong to the provinces generally. However, the political ownership of resources is diluted by the role of commercial companies. All commercial contracts are to be honored under the law. Supply contracts cannot be undone by the provincial or federal government except under extraordinary and emergency conditions. All major decisions regarding these resources are made by the provinces. However, companies operate the facilities which are generally independent. Political decisions are based on commercial contracts and requirements of the companies.

Regulators in most federations are also in the provincial domain. However, the regulator in the developed economies is restricted only to gas and electricity distribution. Transmission of gas and electricity is regulated and non-regulated as well. In many cases, there is retail competition without regulatory controls. In the developed countries, irrespective of the federal or unitary system, electricity generation and oil and gas production is priced competitively through energy exchanges and thus beyond the regulatory control or government influence.

Indian example would enable us to understand the issue. In India, there is a provision of joint determination. Pakistan used to have concurrent list before the 18th Constitution Amendment.

In India, provinces maintain the gas and power sector accounts, bear all deficits, provide subsidies and absorb losses, wherever required. Electricity regulators are in the provincial domain. However, oil and gas regulation is in the federal domain. GAIL India – a federally owned and controlled corporation that deals with gas transportation, mainly gas distribution – is in the private sector and its capacity charge is competitively determined through auctions. There are more than 100 gas distribution companies in India and more are coming.

There are provincial electrical boards similar to Pakistan's federal Central Power Purchasing Agency-Guarantee (CPPA-G). Most of the electrical distribution companies are provincially owned. There are hardly private distribution companies. There are IPPs but a large number of power generation companies are federally owned. Thus, except for losses of the generation companies, most of the energy sector's financial liabilities are on provincial shoulders. The situation is complicated in Pakistan as much of the energy sector is in the public sector, owned by the federation. The federal government has all the liabilities of the energy sector. There is a circular debt of billions of rupees, which is the liability of the federal government. Similarly, gas-sector deficits are there, although mostly cross-subsidies finance them. The issue is more complicated than it appears to be. Thus, reasonableness, accommodation and economic efficiency arguments must also be considered in addition to the constitutional requirements. Some of the issues are as follows: Resources are developed by the federation. It is the federal market and finance that creates financial feasibility of resource development. At the time of Sui gas exploration and development, there was no market in Baluchistan. There was no export possibility, pipeline or liquefied natural gas (LNG). The development of Thar coal is another example, which may not have been possible without federal support and input. Sindh government's equity input is the only example. Further development of Thar coal may also depend on the federal support.

The energy sector is integrated. Gas is also used in the power sector which supplies electricity to all provinces. Electricity and gas losses are the highest in Sindh, which have to be federally financed, resulting in circular debt, which is the federal liability. Commercial supply contracts, whether in federal or provincial domain, have to be honored with priority. The country is mostly governed under the uniform pricing system and federal development system. Industries have been located without provincial considerations.

There can be a provincial pricing system for which much preparation and development work is required; if at all a consensus is reached on it. Finally, there is a moral question as well. Should the poor of one province suffer and not be able to cook food, while in the producer province; people may have all kinds of consumption including CNG. However, a new problem has emerged lately with the emergence of LNG. Expensive Qatar LNG contract has made it even worse. LNG prices are almost twice those of locally produced gas.

Power Sector

Sindh Chief Minister warned Hesco, Sepco and Wapda to either pack up or stop the disconnection operation. The Sindh government could handle its electricity sector itself, he said. It is not for the first time that a chief minister of a province has expressed the desire for autonomy in the electricity and energy sector as a whole. Similar statements have been issued by K-P on issues related to tariff, hydel royalty, autonomy, etc. Excessive centralization and preponderant role of Punjab led to the passage of 18th Constitution Amendment. There are people who are not satisfied with implementation of the amendment and would like to expand its scope. There are others who have doubts whether the amendment has been successful in delivering the provinces what was expected from it.

It is true that there are capacity issues in the provinces. It is said that problems of democracy can be solved with more democracy. In the same way, the proponents of autonomy and decentralization argue that failures cannot be made an alibi to wind up or dilute the process of decentralization. Albert Einstein says: “Life is like riding a bicycle; in order to keep the balance, one must keep moving.” So let us see how we can move in this issue without falling down on either side.

Government Control

We are a federation like the US, Canada, Australia and Germany with a difference that the US has a presidential system while all others including India and Pakistan are parliamentary systems. In developed countries, the confusion and controversy over federalism and self-control are much less limited due to the role of the market. Electricity generation, for example, is out of government control – federal or provincial. Transmission and inter-state trade is normally under the federal control. Provinces can have provincial transmission under their control as well. Distribution is almost everywhere under provincial or even local government control.

However, federal or provincial control in market economies does not mean ownership and management also. Companies normally own and operate the facilities but the regulation is with government only. The problem becomes much more complicated in countries like ours as well as India, where most of the electricity sector is owned and operated by governments. When it is the government, there is this controversy of federal or provincial.

Cooperative Federalism

In Pakistan, we have a cooperative federalism. We do not leave the provinces on their own, but share the burden of each other. For example, there is one price of petrol or electricity from Karachi to Chitral. In other commodities, such as fertilizer and wheat, perhaps, there is a somewhat similar system. This has a lot of merit and has served us well, although the WTO might disagree. Pooling has its problems as well as being seen in the electricity sector which is beset with the problems of losses such as theft and receivables. In Punjab (except for Mepco whose losses are 20%), the losses are generally around 10%, while in all other provinces, the losses are in the bracket of 25-35%; in a way, Punjab subsidies the other provinces. However, things are more complicated than this. Hydroelectric power of K-P is cheaper and also gas-based electricity of Sindh and Balochistan.

K-P nationalists argue that hydroelectric power costing Rs3 (earlier Rs1) is taken from them, although not exactly as Tarbela and others are all federal investments, and resold at Rs10. However, if you ask them, as to what would they do in winters, when there is no hydel electricity, they would have no answer.

Power is a capital-intensive sector. A lot of external political issues influence this sector. It is highly unlikely that provinces alone would have the wherewithal including finance, management and other resources to go alone in this sector. Look at Thar, despite Sindh's successful struggle to gain full control, the coal and power project took so much time. Federal guarantees had to be given despite a 49% private equity and a higher tariff.

All other Thar projects would come under CPEC; otherwise, there would be no other possibility. Also the federal government would have to restrain Punjab from installing imported coal power plants. If not, where would the Thar electricity go? Where is the market and who would invest in Thar. So, there is merit in cooperative federalism of sharing strengths and weaknesses and opportunities and threats. Especially, when all of us are weak and poor, we need more cooperation.

The federal government in the past has offered to the Sindh government to take control of electricity distribution and even Pakistan Steel. Interestingly, the wise men of Sindh only want to have management control and do not want to bear the cost. Smaller provinces should stop acting as free riders and cooperate with the federal government in reducing losses and theft. All are involved – poor and rich, and private sector and government departments. These losses cannot be reduced by active cooperation of the provincial governments. In smaller provinces and to some extent in the large one as well, it is often difficult for the governments to take action against the powerful, both rich and poor.

However, in the long run, all provincial governments may consider alternative models, where there is larger provincial role in the electricity sector and do a cost-benefit analysis. We should try to improve on the current system by improving the operations of Council of Common Interests, while the federal government should take steps to reduce the influence of Punjab government on its determinations. Justice must be done and it should appear that justice is being done.

9.2: The Case for Energy Cooperatives

The cooperative movement was founded when people felt that they were not getting a fair deal in terms of products' or services' availability or pricing. Long before communism, in 1761, the Fenwick Weaver Society was formed to sell discounted oatmeal to local workers. The most visible examples today are fair price shops run by students and labour unions – both of which do not exist in Pakistan, though. There are consumers' and producers' cooperatives and credit unions. There are workers' cooperatives to manage and share businesses etc. There are building and housing societies which promote affordable housing. Sometimes, governments encourage the formation of cooperatives to be able to distribute and develop land for housing, the likes of which have been a success example in Pakistan. Keeping in view the extractive role of middlemen in agriculture, it appears that cooperatives in agriculture may improve the lives of farmers and boost the agriculture sector. However, our focus in this space is on the possible role of cooperatives in the utility/energy sector.

There are three million cooperatives in the world serving more than one billion members and employing 12.6 million persons. All cooperatives combined have a turnover of $2.9 trillion; assets of $19.5 trillion; half of the world cooperatives are in the Agri/grocery sector; and two-third cooperatives are located in Asia. The dominant sectors are banking, insurance, agriculture, grocery, education, health, housing, utilities and workers. There are 1714 cooperatives in the utility sector. Robobank of The Netherlands and Agricole France are two major cooperatives engaged in banking in Europe. Amul and IFFCO in India have a large presence in the milk and fertilizer sectors.

By 1936 in the US, 90 percent of urban areas had electricity and 90 percent of rural areas had no electricity. The Rural Electrification Act of 1936 allowed establishing electric cooperatives to provide electricity in rural areas which hitherto did not have electricity .Later on telephone and water services were added. The 1936 Act allowed groups of people to buy or generate and distribute electricity in their communities and areas. Long-term loans (35 years) at low interest rates were provided.

Cooperatives played a great role in improving rural life in the US. At present, there are 900 electric cooperatives, spread over 47 states and serving 40 million people. Electrical cooperatives in the US have a market share of 12 percent serving 19 million customers. The median number of customers per cooperative is 13000 vs 400,000 for normal utilities. The initial cooperative size was much smaller.

Table 9.2.1: The Case for Energy Cooperatives

Sector Totals	Cooperatives	Members/Clients	Employees	Offices/ Outlets	Assets	Annual Gross Revenue
Banking/Credit Unions	210,559	703,070,123	2,452,130	296,566	11,262,671,499,563	167,413,448,242
Insurance	3,644	248,804	961,409	1,361	7,500,074,558,634	1,219,472,098,520
Agriculture/Grocery	1,224,650	122,120,167	1,181,682	35,386	133,811,867,460	337,705,145,870
Utilities	1,714	19,858,921	94,882	1,015	141,544,317,085	41,944,022,702
Grocery/Consumer	81,437	97,869,940	875,181	100,396	243,888,763,326	154,573,071,133
Worker	84,799	4,369,600	1,218,751	0	1,393,874,620	124,821,200,417
Housing	15,247	16,383,048	102,823	173	52,405,481,487	20,709,518,041
Health	1,700	3,441,221	153,180	51	485,789,252	4,075,077,199
Education & Social	87,998	21,876,052	497,445	13,122	840,678,955	12,305,812,264
Purchasing or Marketing	41,865	26,256,054	3,402,008	320,599	239,000,352,255	736,631,647,399
Other or Undefined	760,985	56,296,177	1,671,257	3,319	31,310,913,789	143,245,072,152
WORLDWIDE TOTALS	**2,514,598**	**1,071,790,167**	**12,610,748**	**771,988**	**19,607,428,096,426**	**2,962,896,113,938**

Source:

We may require much smaller cooperatives. For identical reasons, some other countries in Europe and Asia have also adopted cooperatives in rural areas; Spain and the Philippines are noteworthy in this respect. In India, Microgrids are being organized for rural electrification, although not under cooperative framework. It does provide a technical model, however.

Rural areas in Pakistan stand at a comparable situation of 1936 of America. Overall access to electricity in Pakistan is 67 percent. Twenty percent of the urban population has access to gas, while the rural population has no piped gas. Many rural areas have the physical and organizational, if not financial, resources to generate their own electricity (solar, wind and small hydro) and biogas resources. Their scale, volume and distance do not allow the organized main utility sector to serve them. They can organize small and micro grids, install biogas plants and lay gas pipes to distribute biogas produced out of crop and animal waste. Some may already be doing it. Cooperatives are great organizational instruments to organize people on a self-help basis.

Why cooperatives? Off grid areas, both in gas and electricity, remain un-serviced and may remain so for quite a while. Eighty percent people are off network in case of gas. Neither utilities nor NGOs would be able to mobilize local resources. It would also be expensive. There are abundant opportunities to install solar-based systems. Not much activity is visible in that respect. Biogas resources are abundant. Pakistan is an agricultural country with a large cattle population and milk production. Enthusiasm, autonomy, participation and organization seem to be lacking; these may be provided by cooperatives. Cooperatives are more stable and sustainable than a private corporation.

Energy cooperatives ala USA may be of great help. First of all, the licensing and legal lacunae may be removed by awarding licensing exemptions (or dilutions) to cooperatives, and soft financial resources may be funneled through them. Cooperatives may be organized on the democratic principles of one-member, one-vote and may thus be saved from exploitation by the local powerful. Cooperatives may or may not be non-profit, depending on the local circumstances. Rates may be approved by local governments or administration in case of profit seeking cooperatives. Government funds may also be diverted through non-profit cooperatives.

Table 9.2.2: The Case for Energy Cooperatives

Region	Coops	Membership & Clients	% Pop. Coop Member	Employee	% of Pop. Employed in Coops	Offices of Coops	Total Assets in US Dollars	Annual Gross Revenue in US Dollars	Gross Rev % of GDP
Africa- Sub Sahara	85,260	18,509,605	2.73%	10,914	0.00%	5,844	10,847,166,275	851,640,000	0.08%
Asia	1,933,299	484,105,695	12.68%	4,306,521	0.11%	481,871	3,847,329,029,490	653,629,184,870	3.25%
Caribbean	1,049	3,583,511	12.94%	54,569	0.20%	462	5,934,856,987	182,714,007	0.13%
Europe	356,380	368,006,463	45.55%	5,248,852	0.65%	224,593	11,688,164,988,277	1,482,481,568,728	7.08%
Latin America	42,765	44,179,104	7.81%	816,122	0.14%	14,913	83,898,544,610	18,360,221,538	0.33%
MENA	162,779	4,537,084	1.57%	37,714	0.01%	1,095	31,681,636,000	3,619,358,000	0.27%
North America	31,078	134,725,891	38.63%	1,675,778	0.48%	41,750	3,825,837,112,751	744,228,134,380	4.12%
Oceania	1,988	14,142,814	37.80%	460,278	1.23%	1,460	113,746,762,037	59,543,292,416	3.46%

It is quite conceivable that these cooperatives may develop the technical and organizational capabilities to install solar panels, local grid, and water pump thru supplier's market channels. Otherwise district administrations or development organization bodies like the NRSP/RSPN may be able to assist. Similarly, gas supplies and crop and animal waste resources are widely and freely available in most areas. Individual biogas plants have been installed, even in very small numbers as compared to the regional numbers. Community biogas plants are not there, except for some politicized and expensive LPG-Air-Mix Plants which have been found highly unsustainable. Community biogas plants are much more affordable as these are built by the community based on local raw material resources.

A cooperative framework is required not only for financial reasons but also for operational and management purposes. While electricity networks may not require much of an O&M effort, biogas would require considerable O&M cooperation from waste collection to running the biogas plant. Biogas need and potential is very high. Only 20 percent of the population has access to gas under the existing utility based gas system. If 10 percent of the population gets biogas under the proposed scheme, it may not be a bad idea. And, it would be perpetual and sustainable, while conventional gas fields tend to expire within a decade.

Are cooperatives for the poor? That is a difficult question. Pakistan's energy sector, both electricity and gas, are subsidized by government and cross subsidies. The poor pay Rs5.0 per unit as against Rs25 by the rich, and similarly for gas. On the other hand, cooperatives would not be burdened by the high T&D losses, leakages and over-heads etc and may be able to offer electricity at an average price of Rs10 per unit or lower – based on solar and other Renewables. It may also have tax exemption. Similar is the case of gas.

Cooperatives may be able to mobilize cheaper biogas. However, it would be difficult to cater for the low price regime for the poor. Some kind of subsidy, in cash or kind, in addition to no-taxation would be required. Existing utilities may offer only high cost difficult areas out of their franchise areas. Small cooperatives (100-500 members) appear to be more feasible than the larger ones on the lines of the US. A pilot project scheme is recommended which may provide a firm basis to evolve the requisite policy.

9.3 : Reorganizing the Planning Commission

The Planning Commission has had a glorious past in the 1960s, 70s and 80s. Its plans of the early 50s left an impression internationally. Rightly or wrongly, the nation expects a lot from this institution However, with time, its image and standing seems to have eroded. Perhaps, it has not been able to update and synchronize itself with time, and restructure and renew itself through injection of new ideas and visions. In the following, we propose some measures that may help enhance the performance of the PC and meet expectations from it.

In 2014 India's Planning Commission was shut down and replaced with a new organization NITI AYOG (National Institution for Transformation of India).This probably prompted the two leading ministers of the then Nawaz Sharif government to propose in a public seminar that the Planning Commission in Pakistan should be closed down as well, terming it a stumbling block in progress, and outlining many other faults. This was done possibly due to the esteem Modi was being held in at the time due to his economic performance in Gujarat. The magic of Modi, however, appears to have been fading since then. Admittedly, NITI AYOG has done much good for India in a short while. We may borrow what is useful and relevant for us, instead of copying them as suggested by the former two ministers under a bout of misplaced enthusiasm.

Performance and potential issues notwithstanding, the Planning Commission does have some genuine third-party role in appraising and scrutinizing development projects and approve development funding. In a country where there are genuine allegations of corruption in government departments and in development projects, financed under the PSDP, this third-party project evaluation function are possibly a major protection against the claimed pilferage.

There may be issues of delays in approvals and release of funding where improvement may be possible. However, the function is important and indispensable. One is not aware as to who performs this function in India. There is discussion in India about reverting this function back to NITI AYOG. Secondly, the Planning Commission offers a multi-disciplinary examination of projects, which single subject line ministries and departments would not have the wherewithal to undertake. The issue is therefore more of improving performance than of redundancy.

There has been controversy regarding the need for many infrastructural projects, in terms of project design, need and utility, debt impact and cost-benefit ratios. There is no evidence that adequate scrutiny had been done by the Planning Commission and that projects were approved or approval was rubber stamped. The problem is not just the tendency of politicians to bulldoze investment proposals (for good and bad reasons); the problem is that the Planning Commission does not enjoy much credibility. It has to build capability and acquire credibility.

While planning came in disrepute in the wake of the downfall of planned economies, the new market mantra could not replace it. There has been market failure in bringing the right kind of investments in the right kind of quantities. Problems and failures in agriculture, energy and industrial sectors are the evidence.

Planning and five-year plans have to be rediscovered, revitalized and performed with rigor as opposed to the mere documentation type activity that currently happens. Provinces would have to be involved. After all, it is the provinces where the action is. National targets alone do not mean much. In the wake of the 18th Amendment, this has become even more essential. The Planning Commission may have to have provincial offices or may have to develop via the media to integrate or interact with the provincial planning departments. Broad-based indicative plans and strategies might be the answer.

It is an impossible idea to monitor hundreds of projects centrally, although some exceptional projects may require issue-based monitoring or investigations. The Planning Commission would be better off by closing its monitoring department. More rigor has to go in project evaluation in terms of need-assessment and cost-benefit analysis. Similarly, post implementation-project impact evaluation should receive more attention and resources to guide further investments or provide lessons for project design. Currently, this activity appears to have gone into oblivion. PC-IV which is meant to do this activity is hardly visible and is riddled with myriads of issues.

In terms of facilities, it lacks a good library, does not subscribe to international journals and magazines and online services providing data and information. Most library acquisitions are old, as current budgetary provisions hardly exceed a few lakhs of rupees. It has no planning and modeling software. It does not have GIS systems which are now an essential part of planning activities. Significant investment would be required to acquire these facilities. In the past, project-based inputs have been acquired under capacity building projects but were wound up as soon as the international funding went away. No arrangements, frameworks or policies are there for sustainability and continuity.

Line ministries are responsible for making plans and policies for their sectors. The Planning Commission has been totally disenfranchised from any role in this respect. It may have been done in the interest of work speed, expertise and decentralization. Problems frequently occur; there are various instances such as the LNG controversy, circular debt, over capacity in power generation and underinvestment in transmission and distribution, the current Electrical Vehicle policy conflict between two ministries etc.

The Planning Commission can provide an inter-ministries consultation structure, while the ECC finally approves them. However, it is a chicken-egg problem. The Planning Commission is not consulted because of lack of credibility – and credibility comes out of involvement. The argument is not to establish the supremacy of the Planning Commission but to create a research and consultation framework integrating the related ministries and departments.

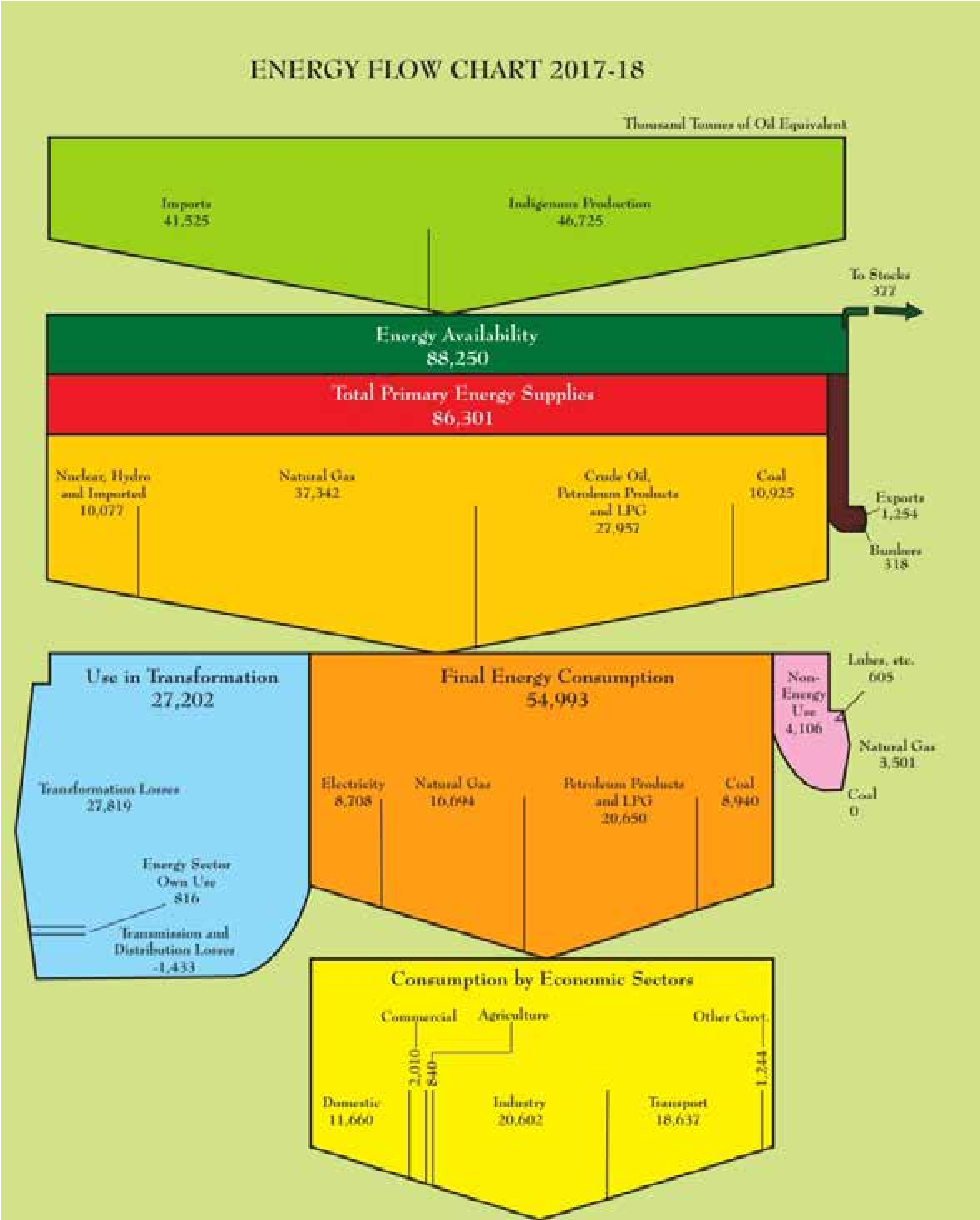
Finally and most importantly, the Planning Commission should incorporate a new Development Strategy Department in the form of a think tank. Associated with the government, it would have attention and some muscle and would be unlike NGO-type institutions. It would be able to have recourse to documents and would be able to call meetings involving public officials. This think-tank should be managed by short-term experts inducted as research fellows for a period of one to three years.

The experts may come from all walks of life – retired government servants, private sector retired or in service executives, secondment from the military services and academia, resident abroad Pakistanis and even foreign experts etc. There are hundreds of competent persons that would be potentially available in this framework. The experts may be recruited based on their qualifications, experience and quality of their research proposals. ToRs may also be developed institutionally; where required, multi-disciplinary teams may also be formed.

The output of these experts and the divisions should be the examination of long-term issues in all sectors; population, infrastructure, energy, agriculture, industry, education etc. Various academic and sectoral R&D institutions may remain in their geographical and institutional positions and be incorporated as institutions. To have a critical mass, around 20-25 experts should be inducted although through an organized and well-considered induction scheme.

A lot can be done; planning with thought and vision; consultative and consensus-seeking involving line ministries, provinces, public and civil society; assessing the future and developing strategies and options and not just number churning; a vibrant organization or a department with openness and open and flat structure renewing itself periodically and not jammed by incumbents. It is possible even in these difficult days.

Finally, Minister Asad Umar has assumed charge of the Planning Commission and the associated ministry. He has all the credentials to lead the Planning Commission towards rejuvenation and renewal. He may be already thinking on these lines. We wish him success.


ENERGY FLOW CHART 2017-18
Thousand Tonnes of Oil Equivalent
Imports 41,525
Indigenous Production 46,725
To Stocks 377
Energy Availability 88,250
Total Primary Energy Supplies 86,301
Nuclear, Hydro and Imported 10,077
Natural Gas 37,342
Crude Oil, Petroleum Products and LPG 27,957
Coal 10,925
Exports 1,254
Bunkers 318
Use in Transformation 27,202
Final Energy Consumption 54,993
Non-Energy Use 4,106
Lubes, etc. 605
Natural Gas 3,501
Coal 0
Transformation Losses 27,819
Energy Sector Own Use 816
Transmission and Distribution Losses -1,433
Electricity 8,708
Natural Gas 16,694
Petroleum Products and LPG 20,650
Coal 8,940
Consumption by Economic Sectors
Commercial
Agriculture
Other Govt.
2,010
840
1,244
Domestic 11,660
Industry 20,602
Transport 18,637

Source: HDIP

The Dynamics of Energy in Pakistan

Syed Akhtar Ali

Syed Akhtar Ali is an eminent energy expert and consultant, advising public and private sector clients on energy policy, investments and tariff issues and has authored a number of books on the subject. He has held top management appointments in Pakistan's public and private sector.

His also appointment was as Member Energy, Planning Commission. He was a visiting Professor of Energy at IoBM and has taught energy management to MBA students. He is an author of eight books on various subjects such as energy, governance, political economy and resources. He has done consulting assignments in Energy Sector in Europe, the Middle East ,Africa and South Asia .

His main area of interest is economics of energy and tariff issues on which he has advised regulatory agencies. He has been board member of many energy companies and member of Expert Working groups and various committees of federal and provincial governments. He has done many consulting assignments and has supervised projects in the area of sustainability, environment, conservation, energy efficiency and renewable energy.

About the Book

This book deals with Energy policy and economics issues of Pakistan. The book attempts to develop an integrated view of energy sector. It has nine sections; Energy, Oil, Gas, Bio-Fuels, Coal, Electricity, Renewable Energy, Environment and Institutional and Policy Issues. The book emphasizes sustainable energy production and prices along with a fair return to investors. It deals with the issues of Circular debt and distribution losses and high generation cost. It emphasizes indigenization and explores uses of new technologies like Thar coal gasification and its uses in producing Fertilizers, Steel, Chemicals and Petrochemicals etc..