Solutions for Energy Crisis in Pakistan

Volume II

Islamabad Policy Research Institute

Hanns Seidel Foundation (HSF)

Solutions for Energy Crisis in Pakistan
Volume II

The second volume is based on the findings and recommendations of the workshop held by IPRI & HSF On December 17, 2014.

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We are grateful to the contributors who presented their scholarly papers at the workshop and the chairpersons who presided over the lengthy proceedings and summed up the findings of each session with their valuable comments. We are also thankful to the representatives of public sector institutions who accepted our invitation to participate in the workshop as discussants.

All efforts were made to make the workshop as productive and result-oriented as possible. However, if there was any area left wanting in some respect the workshop management owns responsibility for that.

CONTENTS

ACRONYMS

ADB	Asian Development Bank
AFD	Agence Française de Dévelopement
Bcf	Billion cubic feet
BCMA	Billion Cubic Meters per Annum
BOO	Build, own and operate
BPD	Barrels Per Day
CASA	Central Asia South Asia
CCI	Council of Common Interests
CHASCENT	CHASNUPP Centre of Nuclear Training (Pakistan)
CNG	Compressed Natural Gas
CNNC	China National Nuclear Corporation
DRO	Debt Retirement Organisation
E&P	Exploration and Production
EIA	Energy Information Administration
ENERCON	National Energy Conservation Centre
ENI	Ente Nazionale Idrocarburi
ETS	Emissions Trading Scheme
EU	European Union
FDI	Foreign Direct Investment
FPCCI	Federation of Pakistan Chambers of Commerce & Industry
GDP	Gross Domestic Product
GENCO	Power Generation Company
GHCL	Genco Holding Company Limited
GIDC	Gas Infrastructure Development Cess

GNP	Gross National Product
GoP	Government of Pakistan
GUSA	Gulf-South Asia
HEC	Higher Education Commission
IAE	International Energy Agency
IAEA	International Atomic Energy Agency
IDB	Islamic Development Bank
IMF	International Monetary Fund
IP	Iran-Pakistan gas pipeline
IPC	Iran-Pakistan-China
IPI	Iran Pakistan India
IPPs	Independent Power Producers
JEXIM	Japan Export Import
JICA	Japan International Cooperation Agency
KANUPP	Karachi Nuclear Power Plant
KfW	Kreditanstalt für Wiederaufbau
KINPOE	Karachi Institute of Power Engineering
KKH	Karakoram Highway
KOMIPO	Korea Midland Power Company
KPT	Karachi Port Trust
LCDC	Lakhra Coal Development Company
LEED	Leadership in Energy and Environmental Design
LNG	Liquefied Natural Gas
LPG	Liquefied Petroleum Gas
MBTU	Million British Thermal Units
MIT	Massachusetts Institute of Technology
Mcf/d	Million cubic feet per day
MMCMD	Million metric cubic meters per day

MMTOE/MMOE	Million metric tons of oil equivalent
MoU	Memorandum of Understanding
MTPS	Muzaffargarh Thermal Power Station
MW	Mega Watt
NBT	Nordisk Bageriteknik
NCNDT	National Centre for Non-Destructive Techniques
NDFC	National Development Finance Corporation
NEP	National Energy Policy
NEPRA	National Electric Power Regulatory Authority
NPPs	Nuclear Power Plants
NREL	National Renewable Energy Laboratory
NSG	Nuclear Suppliers Group
NTDA	National Transmission Dispatch Authority
NTDC	National Transmission & Despatch Company
NUST	National University of Science and Technology
OECD	Organization for Economic Cooperation and Development
OGRA	Oil & Gas Regulatory Authority
PAEC	Pakistan Atomic Energy Commission
PBC	Pakistan Business Council
PEC	Pakistan Engineering Council
PEPCO	Pakistan Electric Power Company
PIEAS	Pakistan Institute of Engineering and Science
PMD	Pakistan Metrological Department
PNRA	Pakistan Nuclear Regulatory Agency
POL	Petroleum, Oil, & Lubricants
PPIB	Private Power & Infrastructure Board
PPL	Pakistan Petroleum Limited

PPP	Public Private Partnership
PQA	Port Bin Qasim
PSEDF	Private Sector Energy Fund
PWI	Pakistan Welding Institute
PWR	Pressurized Water Reactor
RPPs	Rental Power Plants
SECMC	Sindh Engro Coal Mining Company
SHS	Solar Home Systems
SNRS	School for Nuclear and Radiation Safety
SNS	School for Nuclear Security
SROs	Statutory Regulatory Orders
T&D	Transmission and Distribution
TAPI	Turkmenistan-Afghanistan-Pakistan-India
TPES	Total Primary Energy Supplies
UNOCAL	Union Oil of California
USAID	US Agency for International Development
WAPDA	Water and Power Development Authority
WB	World Bank
WHS	Wind Home Systems

Introduction

Ambassador (R) Sohail Amin
Air Cdre (R) Khalid Iqbal and Aftab Hussain

Islamabad Policy Research Institute (IPRI) in collaboration with Hanns Seidel Foundation (HSF), Islamabad office, organised a National Conference on "Solutions for Energy Crisis in Pakistan" on May 15-16, 2013. Soon after the IPRI-HSF National Conference, a new elected government took over which announced a National Energy Policy (NEP) in July, 2013. The NEP is reflective of a number of recommendations put forward by the IPRI-HSF National Conference. As a continuation of the effort, and to analyse the progress in energy sector after the National Conference, a one day workshop on "Solutions for Energy Crisis of Pakistan" was organised by IPRI and HSF on December 17, 2014 at Marriott Hotel, Islamabad. This book covers the proceedings of the conference and the workshop.

The workshop was divided into two parts. In the first part, four eminent experts and scholars made presentations on topics ranging from "Review of Energy Sector" to "Challenges and Options for Implementation of National Energy Policy" and from "Fund Raising for Energy Projects" to "Resource Mobilization in terms of Fuels and Finances". In the second part, ten discussants offered their comments on the energy policy of Pakistan.

Ms. Advocate Ameena Sohail, independent energy analyst and practising lawyer, spoke on **"Review of Energy Sector with Focus on Electricity Tariff Determination"** and discussed the legal and regulatory institutional arrangements. She highlighted the constitutional provisions on power and authority of each institution and discussed their functions. She reviewed the current energy crisis and highlighted the huge gap in demand and supply. She noted that after the 18th amendment, low investment had been observed in oil and gas sectors. She discussed high tariff thermal power generation which prevented initiation of new projects with low tariffs on short term basis due to non-availability of funds. She emphasised the need for an effective control mechanism to check frequent breakdowns, shortage of supply and theft. What Pakistan needed was a national vision

for sustainability and affordability of power based on indigenous resources, she said.

Mr. Ashfaq Mahmood, former Federal Secretary Water and Power and former member Planning Commission of Pakistan, in his presentation on **"Implementation of National Energy Policy: Challenges and Options"** said that Pakistan did not have an integrated national energy policy. He said that Pakistan needed a low cost and sustainable power sector to meet its energy requirements. He mentioned various indigenous and external options along with challenges that hindered the progress of projects. He discussed Pakistan's commercial energy supply mix in detail and emphasised the need for adopting energy conservation methods especially in oil and gas sectors.

Dr. Vaqar Ahmed, Deputy Executive Director, Sustainable Development Policy Institute (SDPI) talked about **"Fund Raising for Energy Projects in Pakistan"**. He discussed government's investment policy to raise investment for energy projects which due to lack of reforms, low revenue collection, circular debt, failure to exploit cleaner coal based generation methods and slow progress on import of energy supplies from neighbouring countries was not effective in attracting needed investment. He said the energy sector was marred by fragmented governance. The lengthy procedure, slow implementation and government's control over import/export prices and domestic supply quotas had created difficulties for the investors. The existence of preferential treatment and distortions through Statutory Regulatory Orders (SROs) was also impeding investment.

Dr. Vaqar further noted the different rates of tax on foreign and local investors — 20 per cent corporate tax for foreign investors and 33 per cent for the local. This policy had discouraged local investors. While comparing the government and private sector, he said that certain government policies tended to discourage the private sector e.g. the customs duty in the federal budget (2014-15) slapped on the import of solar cells which undermined the growth of a modern technology in solving the energy problem.

Mr. Shaukat Hameed Khan, former Vice Chancellor, GIK Institute of Engineering Sciences and Technology, spoke on **"Autarky in Energy and Power"**. He criticised various energy policies and said these were inadequate to address the current energy crisis. He stressed that these energy policies were almost the same as those aimed at increasing the generation capacity while the problem lay somewhere else. He placed the current generation capacity of the system at 23500 MW which due to circular debt of the order of Rs 872 billion in 2013, prevented generation of

electricity according to its capacity causing severe electricity load shedding in the previous two years. Moreover, climate change had not been discussed in Pakistan's energy policies.

The discussants included Mr. Umar Rasool, Additional Secretary, Ministry of Water & Power; Mr. Saeed Ahmad Khan, Chairman Oil & Gas Regulatory Authority (OGRA); Mr. Arshad Maqsood Malik, Chief Energy, Planning Commission of Pakistan; Syed Akhtar Ali, Member Energy, Planning Commission of Pakistan; Mr. Yusuf Raza Zaidi, Member Power, Pakistan Atomic Energy Commission (PAEC); Mr. Ghulam Rasool Athar, Director Applied Systems Analysis Division (ASAD), (PAEC); Dr. Gulfaraz Ahmad, former Secretary, Ministry of Water & Power; Dr. Shaheen Akhtar, Assistant Professor, National Defence University; Dr. Nazir Hussain, Associate Professor, Quaid-i-Azam University; and Muhammad Mustansar Billah Hussain, Lecturer, Gujrat University. Dr. Ashfaq Ahmed Sheikh, Assistant Registrar, Pakistan Engineering Council (PEC), and Barrister Aemen Maluka could not join the discussion due to their eleventh hour commitments; however they have contributed their papers.

The discussants provided meaningful input towards the workshop agenda and outlined that Pakistan faced energy crisis due to poor generation capacity, rising demand for power and gas, system losses, untargeted subsidies and lack of an overarching integrated energy policy. The malfunctioning power sector had resulted in a 4 per cent loss in GDP annually. Efforts should be made to improve energy efficiency/ conservation. To maintain balance between supply and demand, an appropriate energy mix that was cost-effective and could address the short-term and long-term energy needs of the country was needed. Pakistan had a power policy but a comprehensive energy policy was lacking. The discussants pointed out that in Pakistan, energy security had not been a priority. Pakistan needed a national energy vision with legislation and a strong implementation mechanism.

The controversial topic of building dams was also discussed. It was said that water shortage had badly hampered industrial growth, yet governments lacked the vision to build dams. The need for building Kala Bagh and Bhasha dams was highlighted. These two water reservoirs would generate 9000 megawatts of electricity. To counter the shortage of energy (estimated 7,748 megawatts) in the coming years and reduce the dependence on costly thermal fuels, the focus should be more on renewable

energy resources such as solar, wind and water. Biomass, coal and nuclear power generation were also the other untapped cheaper options.

It was emphasised that climate change necessitated the development of an integrated energy system. The northern areas of the country were rich in hydel resources, and the southern areas were rich in wind, solar and hydrocarbon. Pakistan had a hydro potential of 60,000 megawatt, which could be tapped to meet the current and future energy requirements. Once materialised, it would be the cheapest sustainable energy source. During the flood season a large area of agricultural land was devastated and a number of lives were also lost. To counter water scarcity and to secure Pakistan's survival, its rivers' water could also be stored and made available for power generation. Electricity generation through nuclear plants was supported as Chashma I and II produced electricity at half the traditional rate.

The energy supply projects that could provide relief like Iran-Pakistan (IP) gas pipeline, Turkmenistan-Afghanistan-Pakistan-India (TAPI) gas pipeline, Liquefied Natural Gas (LNG) and Liquefied Petroleum Gas (LPG) should be pursued as well. As access to affordable and uninterrupted supply of energy was the key to economic growth of the country, the issue of energy security also needed to be emphasised in the national narrative. Unless there was a consensus about the proper utilisation of available hydel, coal and gas resources in the larger national interest, Pakistan would not be able to overcome the energy shortage. In this national energy conservation campaign, the government, the private sector and the society should join hands.

To encourage the private sector, the lengthy and complex ministerial procedures currently in practice should be simplified. Furthermore, government's trade and taxation policies should reflect its seriousness for partnering with the private sector and create a conducive environment.

Energy conservation was identified as a remedy since 25 per cent of energy could be saved through conservation. Line losses needed to be controlled. Grid stations and equipment needed to be upgraded. Further reduction in power losses could be achieved by eradicating the illegal use of power. The universities as well as the think tanks could play a pivotal role in creating awareness among the masses. In collaboration with the policy makers of energy sector, conferences, seminars and workshops could be organised and the public could be made aware of energy conservation.■

Welcome Address

Ambassador (R) Sohail Amin
President, Islamabad Policy Research Institute (IPRI)

Ladies and Gentleman
Good morning and As-Salam-o-Alaikum!

I very warmly welcome the representatives of government departments, the session chair, speakers and distinguished scholars who will be presenting their views in the workshop today. I also thank the Hanns Seidel Foundation for making this event possible.

Ladies and Gentlemen,
Last year in May, we had organised a national conference on 'Solutions for Energy Crisis in Pakistan' — the same subject that we will be dealing with today. Its proceedings were compiled in the form of a book which is so much in demand that we had to print its additional copies which are also near exhaustion. Encouraged by the response of the stakeholders to the conference proceedings, we are holding this workshop today in collaboration with the Hanns Seidel Foundation to carry forward the process that began last year.

Ladies and Gentlemen,
Today's Chair, Mirza Hamid Hasan, in his paper last year had said that energy was the lifeline of all modern societies. Access to reliable, affordable and uninterrupted supply of energy was the key to economic growth and welfare of any society. Another distinguished speaker of the conference, Dr Shaukat Hameed Khan, had said that electricity in Pakistan was neither affordable nor available. He recommended massive investments in power generation and associated infrastructure. Most of the speakers agreed last year, that there were no easy and quick solutions to the power shortage problem being faced by the country.

Energy demand in Pakistan is expected to increase eight-fold by 2030, and by a factor of 20 in 2050. Electricity demand in Pakistan is now growing at over 9 per cent per annum, with a requirement of nearly 160,000 MW by 2030. This would include a minimum standby capacity of

about 10,000-12,000 MW, to cater for maintenance, breakdowns, or natural disasters. Our conference in 2013 had determined that Pakistan would need US$ 210 billion in the next 20 to 25 years to meet the growing energy needs.

Ladies and Gentlemen,
There have been some important developments since our last event on this subject. Soon after that conference, a new government was elected into office which announced a National Energy Policy (NEP) in July 2013. The NEP is reflective of a number of recommendations put forward by the conference.
The National Energy Policy seems to be a balanced document that demonstrates grasp over major challenges of the energy sector. It articulates a comprehensive way forward. Its assumptions are realistic as it is aware that no major issue can be solved in the short term. It also does not politicise the subject to raise public expectations. Today's workshop aims at identifying gaps between the national policy and its implementation and recommending course corrections where necessary. The workshop will also focus on the strategy and resources to achieve the vision evolved during the energy conference.

Ladies and Gentlemen,
Proceedings of this workshop will be published in the form of a book and circulated among professionals of energy sector and national policy making echelons.

I thank you all.■

Opening Remarks

Kristof W. Duwaerts
Resident Representative,
Hanns Seidel Foundation (HSF), Islamabad

Ladies and Gentlemen,

In May 2013, the Islamabad Policy Research Institute and the Hanns Seidel Foundation had jointly organised a national conference by the title of "Solutions for Energy Crisis in Pakistan". Due to the overwhelming response the subsequent publication generated, both the institutions jointly decided to publish a second edition of the book along with lessons learnt during the one and a half years since the publication of the first edition.

Energy security, the daily availability of energy in Pakistan that is, remains to be at the forefront of the issues most pertinent to the people, the businesses and the policy makers of Pakistan. Despite recent reliefs, even urban centres of Pakistan continue to suffer from daily blackouts; factories have suffered major losses; and policy makers have seen major demonstrations which were partly spurred by the non-availability of electricity in everyday life. Minister Khawaja Asif has been reiterating that one of the main issues for Pakistan's economic development and welfare of people is the acute shortage of energy.

And in many ways, he is right. Whereas horrible events such as the heinous massacre at the Peshawar Army Public School on December 16, 2014 have touched the very core of the Pakistani society and shaken it deeply, the non-availability of energy is a nagging nuisance in everyday life for every single individual. This non-availability does not come as a major shock, but it is dragging down the country and its economy bit by bit. People are directly affected by it, they do feel the consequences, and this feeling contributes to an overall sense of dissatisfaction, which ultimately might help subversive elements in the country. Energy and terrorism, or rather the paucity of energy, and the growth of terrorism, might well be interconnected.

Pakistan has been and continues to be among the most important importers of generators in the world. Rural areas continue to be among the

most “load-shedding” affected areas in the world, despite – at least technically – being connected to an energy grid. Rich people can afford to remedy this, poor people cannot. This in turn contributes to an overall sense of unfairness.

I do sincerely hope that the results of this workshop will contribute to a better understanding of the situation, and ultimately lead to a more productive approach in tackling it. I am grateful to the officials from concerned authorities for joining us in this endeavour. This shows, that despite negative propaganda by the media, the ministries are doing their work and have seen the need of the hour. IPRI’s role has been commendable for persistently identifying issues pertinent to the Pakistani society and organizing activities in order to tackle them on the basis of sound scholarly knowledge, gained from comparative perspectives of experts from a wide range of fields. In the end, let me reiterate what has been taught to me ever since my earliest childhood: energy security starts at home. If every individual were to turn off the lights, or even more importantly, his/her air-conditioning system when leaving the room, Pakistan might well have the electricity its people need; and load-shedding - with all the other problems in the energy sector still being present - would largely become an alien concept.■

Concluding Remarks

Ambassador (R) Sohail Amin
President, Islamabad Policy Research Institute (IPRI)

Ladies and Gentlemen,
Good Afternoon and As-Salam-o-Alaikum!

As we now conclude the workshop, I wish to state that holding this workshop was a source of great joy and pride for the Islamabad Policy Research Institute.

I take this opportunity to extend our most sincere thanks to the session's chair, speakers, and representatives of the government departments for their contribution.

I also wish to thank all discussants/participants for their valuable contribution and gracious presence. I thank the Hanns Seidel Foundation for making the workshop possible.

As a result of the contributions of the speakers and participants, we have been inspired and lifted to a higher pedestal in as far as our understanding of energy crisis in Pakistan is concerned. We have managed to formulate several concrete recommendations. Before concluding, I wish to inform that proceedings of this workshop will be compiled and published in the form of a book by the Islamabad Policy Research Institute in collaboration with the Hanns Seidel Foundation.

I thank you all.■

CHAPTER-1

Solutions for Energy Crisis in Pakistan

Air Cdre (R) Khalid Iqbal and Aftab Hussain

Introduction

Pakistan is in the middle of a major socio-economic crisis because of the non-availability of electricity on a sustained and affordable basis. The crisis is basically caused by major supply side constraints. Inefficiency in generation, transmission and distribution system is exacerbated by thefts, leading to higher prices for those who pay their bills.[1] The clear example of this state of affairs is reflected in the so called circular debt peaking at Rs 872 billion in 2012. Tariff differential subsidies, and mismanagement and confusion caused by unbundling of the earlier monolith, WAPDA, have all contributed to the present crisis.[2] Therefore, there is a need to identify the challenges faced by the national energy policy (NEP) at the implementation level and recommend appropriate course corrections.

To achieve energy autarky in Pakistan, the country needs massive investment in power generation and associated infrastructure; the implementation plans must be aligned with the global energy dynamics which determine supplies and costs. Second, Pakistan does not only need to be an efficient producer of energy, it also needs to be an efficient user/consumer. Third, there is a need to understand the importance of technological innovation, which serves to increase the global energy production and hence affects energy prices. Fourth, new renewables sources of energy production such as solar and wind are not expected to provide major relief, and need to be viewed only as supplements, since these are not sufficiently available; and are expensive anyway. Lastly, while regional energy grids can be attractive, Pakistan has failed to leverage this option in an effective manner because of political constraints while planning for

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[1] Dr. Shaukat Hameed Khan, "Pakistan's Energy Vision 2030," in *Solutions for Energy Crisis in Pakistan*, ed. Mushir Anwar (Islamabad: Islamabad Policy Research Institute, 2013), 217.

[2] Khan, "Pakistan's Energy," 217.

importing electricity from Central Asia or India have also been based on the wrong assumption that spare electricity is economically available and assured from these countries.[3]

Pakistan has ignored the energy factor in its economic growth. There are no easy and quick solutions to the power shortage problem being faced by the country as there was grave dichotomy at the policy level. There are homegrown solutions available, but policy planners have been neglecting these for over three decades now. Unless the new government harmonized the fragmented governance in this respect, it would be hard to end power outages anywhere in the near future. The country would need US$ 210 billion in the next 20 to 25 years to meet the growing energy needs[4].

Though the Western countries are moving away from nuclear power generation, Asian countries are projecting its phenomenal growth rate over the coming decades. China and South Korea are producing nuclear power at one-third to one-fifth the cost compared with Western countries. Unless indigenous supply of cheap gas is assured, nuclear power generation presents the next cheap and long term solution, beside hydel power. Nuclear fuel is cheap and does not throw up volatile pollutants like oil. Moreover, the cost of nuclear fuel is a small fraction of the overall cost. Though setting up of nuclear plants needs initial heavy capital investment and it takes about 48 months to come on line, these plants have long operational life spanning from 80-100 years. Once the initial cost is properly sunk in, which is a long process, nuclear power plants virtually become cash machines. Pakistan should gradually reconfigure its energy mix to reduce dependence on costly thermal fuels like furnace oil, and move toward greater reliance on water, coal and nuclear fuel.

The global energy demand is expected to double by 2050 as compared with 2000 levels, and 90 per cent of growth in energy demand is driven by emerging economies as more people are moving out of poverty, and demanding more energy.[5] Energy demand in Pakistan has increased four-fold in the last 25 years; it is expected to increase eight-fold by 2030, and by a factor of 20 in the year 2050.[6] Electricity demand in Pakistan is now growing at over 9 per cent per annum, with a requirement of nearly 160,000 MW by 2030. This would include a minimum spare power of

[3] Khan, “Pakistan’s Energy,” 217.
[4] Khan, “Pakistan’s Energy,” 229.
[5] Khan, “Pakistan’s Energy,” 218.
[6] Khan, “Pakistan’s Energy,” 218.

around 10,000-12,000 MW, to cater for maintenance, breakdowns, or natural disasters.[7] Because of past negligence, the energy and electricity scenario in Pakistan is likely to remain fragile for the next several years.

Analysis of National Energy Policy 2013

The vision statement of NEP outlines that: "Pakistan will develop the most efficient and consumer-centric power generation, transmission, and distribution system that meets the needs of its population and boosts its economy in a sustainable and affordable manner."[8]

Ostensibly, NEP is a balanced document that demonstrates grasp over major challenges of energy sector; it also articulates a comprehensive way forward. NEP is based on realistic assumptions; it does not claim to solve any major issue before 4-5 years; it also has not politicised the subject to heighten public expectations. Therefore, in this context, any professional evaluation of the policy, after only eighteen months of its formulation would not be fair. However, many eyebrows were raised because already at the implementation stage, government is facing serious problems and appears to be facing dead-end situations in some of the areas. For example, efforts to improve electricity governance before putting in-place compatible structural reforms have back-fired and the matter is being politicised; India and Afghanistan are holding back on grant of No Objection Certificates (NOCs) in respect of Diamer-Bhasha and Kunar power projects respectively; circular debt continues to be a major obstacle in the way of utilising the available generation capacity; even after onetime retirement of circular debt on June 30, 2013, the menace has resurfaced with the same ferocity;[9] resource mobilization is behind schedule; withdrawal of subsidies without controlling electricity theft amounts to punishing those who honestly pay their bills; foot dragging on Iran-Pakistan (IP) gas pipeline project and difficulties in the way of implementing Turkmenistan–

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[7] Khan, "Pakistan's Energy," 218.

[8] "National Energy Policy 2013," *Government of Pakistan*, http://www.mowp.gov.pk/gop/index.php?q=aHR0cDovLzE5Mi4xNjguNzAuMTM2L21vd3AvLi91c2VyZmlsZXMxL2ZpbGUvcG9saWNpZXMvMjAxMzA3MjkgV2F0ZXIgYW5kIFBvd2VyIFBvbGljeSBEb2N1bWVudCBGaW5hbCB2MS5wZGY%3D (aaccessed July 19, 2014).

[9] Zafar Bhutta, "Power crisis: Khawaja Asif looks heavenward," *Express Tribune*, July 15, 2014, . http://tribune.com.pk/story/735805/power-crisis-khawaja-asif-looks-heavenward/ (accessed July 16, 2014).

Afghanistan–Pakistan–India (TAPI) pipeline and Central Asia-South Asia (CASA) projects are likely to cause inordinate delays in the envisioned operational timelines of these ventures; the import of electricity from India has a political cost, and is linked with so many other issues that its expeditious implementation may not be forthcoming. Exploitation of indigenous resources remains a challenge. Hardly anything substantial is happening in the oil and gas exploration domain. Despite tall claims about potentials of domestic resources and several feasibility studies supporting such notions prepared by public and private institutions, only few steps have been taken towards fast-tracking alternative and renewable energy development.

Analysts are of the view that most of these impediments were well known; but were not realistically factored into the NEP framework and timelines; moreover, sufficient work has not gone into developing a comprehensive plan of action and implementation strategy. Detractors are of the view that NEP hangs in a vacuum with no professional and financial moorings; and that it is more of a wishful and less of a doable document. However, the reality may be somewhere in between these two positions.

Demand-Supply Dynamics

The demand for energy in Pakistan is growing day by day, outpacing government's efforts to bridge the demand-supply gap. Therefore, the window that utilisation of excess generation capacity for controlling the quantum of circular debt offers is fast narrowing. No serious campaign is afoot for energy conservation. Though some of the energy generation projects have been completed and a number of others are at various stages of execution in the short term, none of these is a mega project. While shortfall is of macro level, most of the additions during the short term are likely to remain of minor consequence. With government's focus on development of economy, ratings of our important financial institutions have improved, this is likely to increase inflow of Foreign Direct Investment (FDI); consequently, initiation of new development projects would put further pressure on energy supply-demand dynamics. Apparently, for quite some time, the energy production sub-sector is poised to lose in its race against time.

In this context, an important point from the planning perspective is that salvation lies in simultaneous implementation of a number of mega projects, whereas in the hydel sector, the apparent trend is to undertake

these projects in semi-serial manner. Parallel implementation certainly has resource mobilization challenges, warranting development of innovative incentive packages. Hence, there is a need to ponder over harnessing ways and means for adopting a macro implementation strategy by initiating as many mega projects in parallel as possible. This approach is likely to help in preventing perpetual widening of gap between demand and supply. For this, there has to be extensive exploration for securing foreign partnerships on the basis of liquidity and dividend sharing.

Performance Review by the Prime Minister

Feeling the heat of widespread disappointment amongst the masses during the summer months of 2014, the Prime Minister's office issued a sort of annual progress report about undertakings of energy sector. The report titled "Pakistan Power Sector—Achievements of Present Government (ONE YEAR)"; reveals that the government has launched seven new energy generation projects which will produce 1907 MW electricity. To enhance power generation through hydel resources, the construction of 8 small/medium dams in Khyber Pakhtunkhwa has been planned.[10] Design for Hingol Dam, and feasibility Study for Water Resources Development with "Construction of Small Dams in Balochistan" has also been done.[11] This government is continuing more than 26 power projects including construction of dams initiated by the previous PPP government which includes Neelum Jhelum Hydro Power Project (969 MW), Tarbela Fourth Extension Hydro Power Project (1410 MW), and Dasu Hydro Power Project (4320 MW).[12] The missing item in this report is correlation of these

[10] "PML-N government initiates eight power sector projects," *Business Recorder*, March 13, 2014, http://www.brecorder.com/fuel-a-energy/193:pakistan/1162140:pml-n-government-initiates-eight-power-sector-projects?date=2014-03-13 (accessed June 26, 2014)

[11] "PML-N government initiates eight power sector projects," *Business Recorder*, March 13, 2014,. http://www.brecorder.com/fuel-a-energy/193:pakistan/1162140:pml-n-government-initiates-eight-power-sector-projects?date=2014-03-13 (accessed June 26, 2014)

[12] "PML-N government initiates eight power sector projects," *Business Recorder*, March 13, 2014, http://www.brecorder.com/fuel-a-energy/193:pakistan/1162140:pml-n-government-initiates-eight-power-sector-projects?date=2014-03-13 (accessed June 26, 2014).

efforts with completion timelines and informing the public at large as to when their agony would begin to lessen.

In a recent briefing to the Prime Minister, Mr Ahsan Iqbal, Federal Minister for Planning, Development and Reforms, said that all out efforts will be made to complete the development projects in the span of 3 years that includes Port Qasim Power Plants of 660 MW, Coal fired Power Plant of 1260 MW in Punjab, Wind Power Projects of 250 MW in Gharo and 660 MW coal fired project in Thar.[13] However, grid infrastructure inadequacies, and shortage of railway carriages for transporting coal to Punjab-based coal projects present some of the challenges. Though government is taking measures to resolve such issues, jig-saw pieces are not comfortably falling in place to construct the broader picture of energy sector.

Progress on International Projects

Regarding cooperation at international level, there has been some forward movement. Pakistan and Tajikistan have agreed on the tariff of CASA-1000. A major challenge still stands in the way of this project as power transmission lines have to pass through Afghanistan. The World Bank has approved CASA-1000 project, offering $120 million, out of a total loan of $552 million, for laying transmission lines in Pakistan. The total cost of the project is estimated at $1.16 billion and the remaining funds will be provided by the Islamic Development Bank (IDB) and other donors. Under the project, the Kyrgyz Republic and Tajikistan will export 1,300 megawatts of electricity to Pakistan and Afghanistan.[14] The question is when would Afghanistan be calm enough to support the project accomplishment?

According to Asian Development Bank (ADB) officials, the TAPI gas pipeline project is making steady progress.[15] On completion, this pipeline would transport as much as 33 billion of natural gas per year from

[13] PM BRIEFED ON PAK CHINA CORRIDOR, July 11, 2014, http://www.pmo.gov.pk/press_release_detailes.php?pr_id=572 (aaccessed July 19, 2014).

[14] Zafar Bhutta, "CASA-1000 project: Pakistan, Tajikistan agrees on electricity tariff," *Express Tribune*, June 24, 2014, http://tribune.com.pk/story/726016/casa-1000-project-pakistan-tajikistan-agree-on-electricity-tariff/ (accessed June 27, 2014).

[15] Nick Snow, "ADB: TAPI gas pipeline making steady progress," June 5, 2014,. http://www.ogj.com/articles/2014/06/adb-tapi-gas-pipeline-making-steady-progress.html (accessed June 20, 2014).

Turkmenistan across Afghanistan to Pakistan and India. However, once again, due to instability in Afghanistan, no definite timelines can be worked out.

Iran and Pakistan are striving to find ways and means to expedite the construction of pipeline for the IP projects. However, owing to the UN and the US sanctions on Iran, there are insurmountable difficulties in the way of implementing this project. For the time being, it would be appropriate to count this project off, especially in the context of short to medium term. One has to wait for lifting of sanctions, then the project may revive even in its original Iran-Pakistan-India (IPI) format.

Pakistan is seeking assistance from China to deal with the energy crisis. Government to government cooperation with China on about 20,093 MW energy projects is on track.[16]

Domestic Resource Review

According to independent sources, the net power generation ability of the country currently stands at 14,700 MW against installed electricity generation capacity of 22,797MW.[17] Peak summer demand during 2014 hovered around 18,000 MW, resulting in a shortfall of 4,760.[18] The private power houses are presently contributing 7,150 MW to the national grid, against their generation capacity of 11019 MW.[19] According to Pakistan Electric Power Company (PEPCO), the reason behind IPPs capacity-generation gap is shortage of oil and gas supply.[20] Other thermal sources are

[16] "Prof. Ahsan Iqbal, Federal Minister for Planning, Development, and Reform signing agreement of early harvest projects", Ministry of Planning, Development & Reform,. http://www.pc.gov.pk/?cat=12&paged=6 (accessed on August 22, 2014).

[17] Zahir Kazmi, "Pakistan's energy security," *Express Tribune*, January 7, 2014, http://tribune.com.pk/story/655573/pakistans-energy-security/ (accessed August 2, 2014).

[18] "Electricity shortfall reaches 4,760 megawatt," *Associated Press of Pakistan*, June 18, 2014, http://app.com.pk/en_/index.php?option=com_content&task=view&id=142592&Itemid=2 (accessed July 3, 2014).

[19] "Countrywide power shortfall climbs to 3,000MW," *The News International*, July 6, 2014, http://www.nation.com.pk/business/06-Jul-2014/countrywide-power-shortfall-climbs-to-3-000mw (accessed June 23, 2013).

[20] "Electricity shortfall reaches 4,760 megawatt," *Associated Press of Pakistan*, June 18, 2014. (accessed July 3, 2014).

producing 1920 MW against their capacity of 13,000 MW;[21] input from hydel sources is 5,630 MW of power.[22] The overall gap between total capacity and net generation-ability is 9319 MW. Some ageing thermal units operate at sub-optimal fuel efficiency, even as low as 40 per cent, thus resulting in high per unit cost.

Cost of Power Deficit

In a 2010 study, the annual cost of load shedding was estimated at Rs 500 billion (almost equivalent to annual circular debt level). It resulted in loss of a million jobs and at least $2.8 billion reduction in exports[23]; another recent study quantifies the economic impact of energy shortfall to around 4 per cent of the GDP.

Thar Desert contains 175,506 million tons of coal;[24] it is the world's seventh largest coal reserve,[25] with an estimated potential of generating more than 100,000 MW of electricity over a period of 300 years.[26] However, it requires 5-7 years for infrastructure development. Oil and gas are two key components of the energy mix contributing around 80 per cent

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http://app.com.pk/en_/index.php?option=com_content&task=view&id=142592&Itemid=2.

[21] Aziz, Sartaj, "Who is responsible?" *Pakistan Today*, April, 2013, http://www.pakistantoday.com.pk/2013/04/23/comment/who-is-responsible-4/. (accessed August 6, 2014).

[22] "Countrywide power shortfall climbs to 3,000MW," *The News International*, July 06, 2014, http://www.nation.com.pk/business/06-Jul-2014/countrywide-power-shortfall-climbs-to-3-000mw. (accessed June 23, 2013).

[23] "PML-N government initiates eight power sector projects," *Business Recorder*, March 13, 2014.,. http://www.brecorder.com/fuel-a-energy/193:pakistan/1162140:pml-n-government-initiates-eight-power-sector-projects?date=2014-03-13. (accessed June 26, 2014).

[24] "Pakistan Coal Power Generation Potential," *Private Power & Infrastructure Board*, June 2004,. http://www.nepra.org.pk/Policies/Coal%20Potential%20in%20Pakistan.pdf (accessed July 2, 2014).

[25] "Pakistan world's 7th largest in coal reserves," *Daily Times*, November 14, 2013,. http://www.dailytimes.com.pk/business/14-Nov-2013/pakistan-world-s-7th-largest-in-coal-reserves (accessed June 25, 2014).

[26] "Thar Coal project to usher in new era of energy security: PM," *Associated Press of Pakistan*, June 29, 2014, http://www.app.com.pk/en_/index.php?option=com_content&task=view&id=263110&Itemid=2 (accessed July 3, 2014).

share to the 64 million tons of oil equivalent (TOE) of energy requirement in the country.[27] Pakistan also has proven oil reserves of 300 million barrels. Massive shale gas reserves in Pakistan have been estimated by the US Energy Information Administration (EIA). Pakistan has estimated shale gas reserves of 51 trillion cubic feet (TCF) in Balochistan alone. Currently, no Shale gas is being produced in Pakistan and significant work is required to kick start this high potential energy sub-source.[28] Also, if appropriately marshaled, our rivers have an additional potential of at least 40,000 MW. Financial constraints and political baggage are major challenges in the way of converting this domestic potential into production capability.

Conclusion

Domestic resource review suggests that Pakistan has the capability to overcome the energy crisis. However, proper investment and planning is needed to construct power projects. The policy makers should focus on the affordability of the energy produced by the new power plants for domestic and industrial consumers.■

[27] Muhammad Elahi and Hassan Ali, "Pakistan's oil and gas industry growing," *Daily Times*, June 18, 2014, http://www.dailytimes.com.pk/business/18-Jun-2014/pakistan-s-oil-and-gas-industry-growing (accessed June 29, 2014).

[28] "Pakistan shale gas reserves estimated at 51 trillion cubic feet," *Associated Press of Pakistan*, June 6, 2014, http://www.app.com.pk/en_/index.php?option=com_content&task=view&id=237226&Itemid=2 (accessed July 20, 2014).

CHAPTER 2

Review of Energy Sector with Focus on Electricity Tariff Determination

Advocate Ameena Sohail

NEPRA Tariff Regime

NEPRA determines tariffs for the three sectors of generation, transmission and distribution. The tariff for generation companies is determined on the rate of return (cost plus basis) in most cases, under long term (25-30 years) PPAs for greenfield generation projects. The tariff of transmission companies is determined on annual cost plus basis (where, in addition to the costs, certain return on equity or assets is allowed). Distribution companies are mostly given tariffs on cost plus basis, whereas multiyear tariffs have also been determined by NEPRA for KESC.

Tariff Methodology

- The company/licensee files a petition for determination of its tariff according to NEPRA Tariff Standard Procedure Rules -1998.
- The authority on the basis of information decides whether *prima facie* case exists for admission of the tariff petition.
- In case authority admits the petition for consideration it gives notice to all the stakeholders through advertisement in the national newspapers inviting them for intervention to participate in the tariff proceedings through personal participation or through written comments.
- After public hearing, based on the evidence provided by the petitioner and the stakeholders, the authority after due diligence determines the tariff and recommends to the federal government for notification in the official gazette;
- Generation and transmission tariff are determined on cost plus basis.

Criteria for Tariff Determination

Tariffs are determined, modified or revised, inter alia, on the basis of procedures prescribed under Rule 17(3) of the NEPRA Tariff Standards & Procedure Rules, 1998:

- Tariffs should allow licensees the recovery of any and all costs prudently incurred to meet the demonstrated needs of their customers.
- Tariffs should reflect marginal cost principles to the extent feasible, keeping in view the financial stability of the sector.
- The tariff regime should clearly identify inter-class and inter-region subsidies.
- Tariffs should, to the extent feasible, reflect the full cost of service to consumer groups with similar service requirements.
- Tariffs should take into account government subsidies or the need for adjustment to finance rural electrification in accordance with the policies of the government.

The tariff so determined is forwarded to the federal government pursuant to the Section 31(4) of the NEPRA Act for notification in the Official Gazette. Federal Government in pursuant to Section 31(4) of NEPRA Act read with Rule 16(12) of Tariff Rules – 1998 may file reconsideration request with reference to determination/decision of the Authority. The authority within 15 days shall decide upon the matter and intimate the federal government for notification in the official gazette.

Analysis of Electricity Tariff: Where do the Consumers Stand?

Electricity Generation Cost

Sources	Cost (Rs / KWh)
Hydel old (new)	**1.11 (7+)**
Gas	**5.00-7.00**
Coal	**5.50-9.00**
Thermal (HSD)	**24.00-26.00**
RFO	**18.00-22.00**
Nuclear	**5.50**
Wind	**14.00**
Solar	**22 .00**

The cost of hydel (old) is about Rs. 1.11 and for new hydro power plants, which would be built with huge cost in private sector or for WAPDA with a huge functional contribution towards irrigation, the generation cost would be around Rs 7 to 10. The cost of thermal is different on HSD and RFO. The cost on HSD is 24-26 and on RFO, it is 18-22 and the efficiency level of both is different. Among the renewables, solar has the highest price.

Fuel Mix and Tariffs: Peer Comparison

A comparison of the fuel mix and tariffs with India, Bangladesh, US and UK is quite important. The overall production in India is 20 times more than that of Pakistan, but its oil based electricity generation is just 1 per cent. Similarly, it is 13 per cent in Bangladesh.

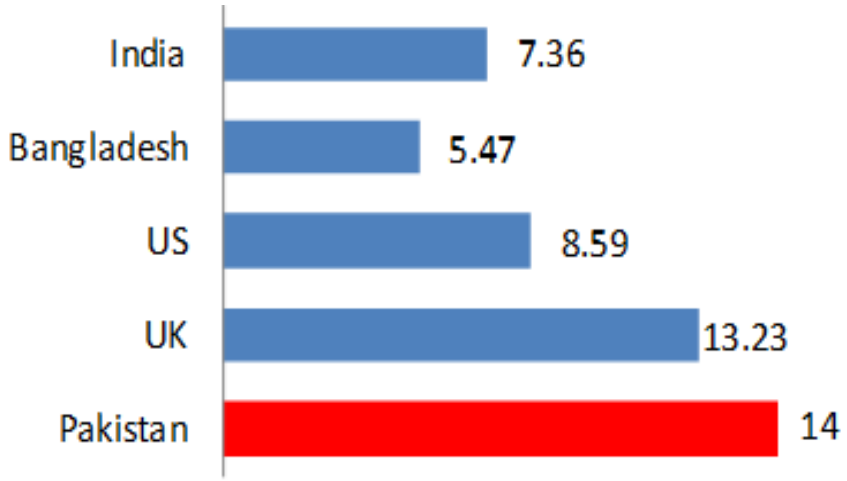
Fuel Mix: PEER COMPARISON

	Gas	Oil	Coal	HNO**
India	12%	1%	69%	18%
Bangladesh	82%	13%	2%	3%
US*	19%	1%	49%	31%
UK	44%	0%	29%	27%
Pakistan	27%	35%	0.1%	38%

In the gas sector, Pakistan attains bigger portion of 27 per cent other than UK and Bangladesh. Oil based generation has gone very high with 35 per cent. Coal has very little portion in power generation, while in India it is 20 times more than that of Pakistan. Due to flawed policies, Pakistan has been unable to generate or develop power houses of coal which is the cheaper source of energy. In the US, the portion of coal is 49 per cent but there is a lot of contamination attached with it.

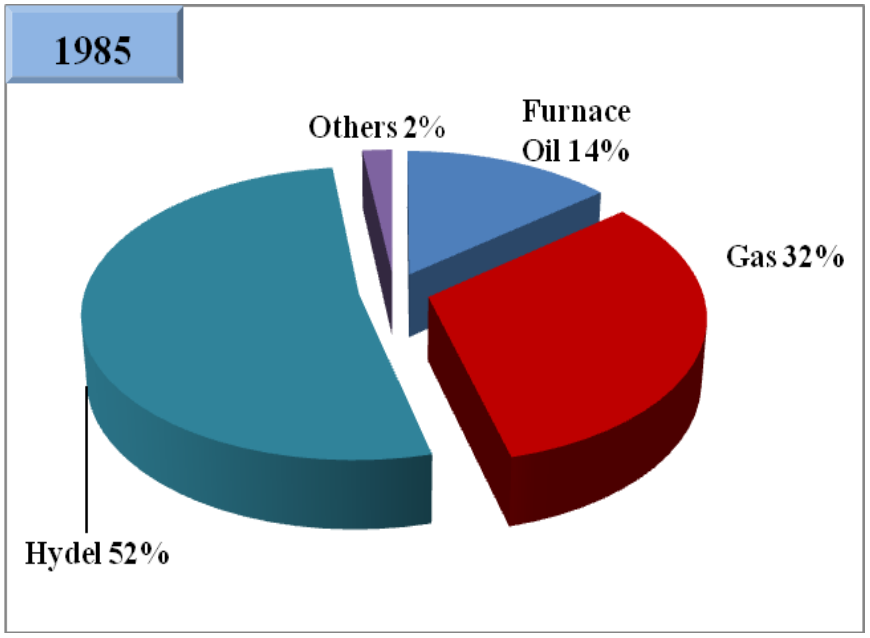
Consumer Tariff (PKR/kwh)

In peer comparison in the figure given below, the consumer tariff is highest in Pakistan and second highest in the United Kingdom. The overall picture is mixed. In UK, it is the second highest but in UK per capita income is very high compared to Pakistan. The existing power tariff in Pakistan is Rs.14 and with the addition of 17 per cent GST and 3.5 per cent excise duty, it comes to Rs. 16.95.

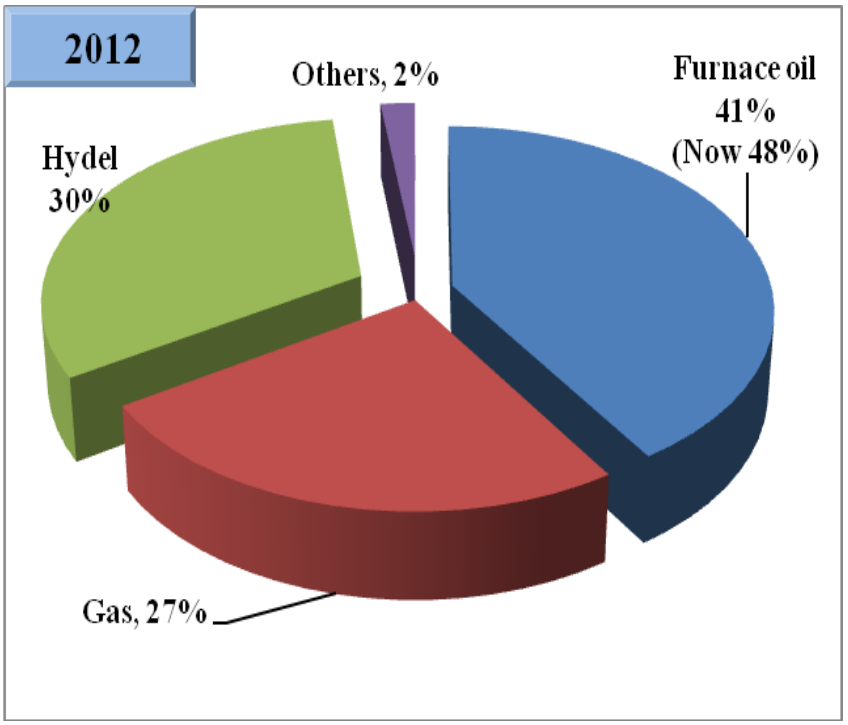


Power Generation by Source

There is an imbalance in power generation by source, which is at the root of the problem. Till 1980s, the share of furnace oil was quite low and the hydel attained a larger share than all other sources.



The imprudent policies led the share of furnace oil in power generation to increase to 48 per cent and due to least attention paid to hydel power generation, its share decreased significantly. There was no progress in the field of alternate and renewable resources.



Analysis of 5 year plans (1955-2010)

If we analyse the five years plans, the answer would seem to lie there. In the first plan (1955-1960) there was planning for 379 MW for the next five years, two times more than the installed capacity of 168 MW. It meant 80 per cent increase every year.

Achievement of Plan Targets in Installed Capacity 1955-2010

	Installed Capacity at Start of Plan	Planned Addition	% of Target Achieved
First Five Year Plan (1955-1960)	168	379	101%
Second Five Year Plan (1960-1965)	550	324	82%
Third Five Year Plan (1965-70)	815	1,198	78%
Fourth Five Year Plan (1970-1975)	1,743.4	3,001	51% (est.)
Fifth Five Year Plan (1978-1983)	3,280	2,090	73%
Sixth Five Year Plan (1983-1988)	4,809	3,795	50%
Seventh Five Year Plan (1988-1993)	6,716	6,558	46%
Eight Five Year Plan (1993-1998)	9,786	6,562	86%
Ninth Five Year Plan (1998-2003	15,421		
Medium Term Development Framework (2005-2010)	20,289	7,880	6%
Tenth Five Year Plan (2010-2015)[22]	20,782	8,370	

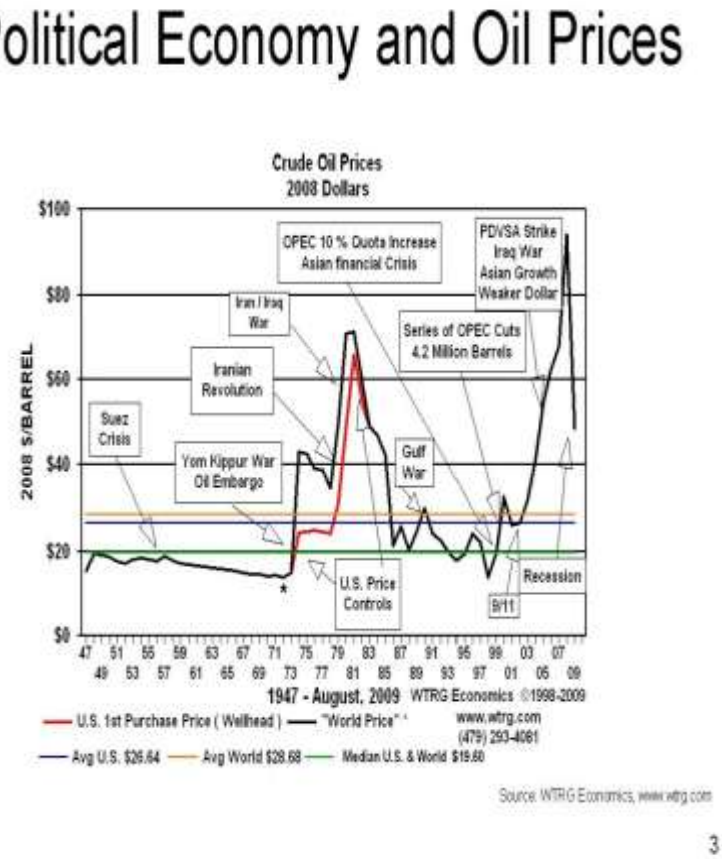
Source: Planning Commission 5 year plans[23]

In the second plan (1960-1965) 324 MW against 550 MW, in the third plan (1965-1970) 1195 MW against 815 MW were targeted to achieve. In the third plan, 150 per cent more electricity was to be generated in the next five years, with 30 per cent annual increase. The government supported the power sector. Although there were loans, no money was free money for WAPDA consumers. They were giving loans, therefore having huge growth 100 per cent (first plan), 78 per cent (second plan), 82 per cent (third plan), 51 per cent (fourth plan), 73 per cent (1978-1983). In sixth plan (1983-1988) 3,795 MW against 4809 MW was targeted, a plan of equal amount of action in next five years and there was 50 per cent progress because the allocated money flow was there. Again, in the 7th plan (1988-

1993), 40 per cent of the target was achieved. There was considerable progress, 86 per cent, in the 8th five year plan and the huge target of 6,562 megawatts was set at that time. In later years, 6 per cent of the goal set was achieved. The 10th five year plan (2010-2015) had 8,360 MW targeted but that plan was not even issued.

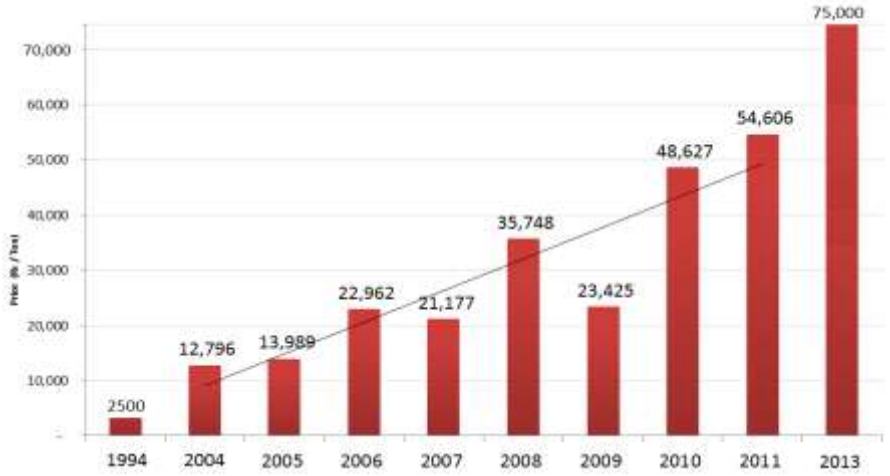
Political Economy and Oil Prices

The prices of crude oil are increasing internationally due to different international events and it has gone from less than $20 to $107 as of now, which increases the cost of furnace oil and all other oil products.



Price of Imported Oil

The price of imported oil rose from Rs 2,500 per tonne in 1994 to Rs. 75,000 that is 30 times more than the earlier price because of private power policy (based on oil). The expected escalation and its projection were not done properly which caused huge problems.



Historic Demand Supply Position

Fiscal Year	Computed Peak Demand	Corresponding Supply	Surplus/ Shortfall
2001-02	10459	10894	435
2005-06	13847	12600	-1247
2010-11	19230	13163	-5581
2013	20016	16100	**3916**

In demand and supply, huge deficits have been seen during these years and the economy of the country has suffered severely.

Historic Values of Average Tariff

In 1960, tariff was Rs. 0.10 per kilowatt hour, between 1960- 1973 there were high rates on initial units and lower on subsequent because initial units were capturing the capacity price. Then in 1973 it was reversed, initially the rates were cheaper and subsequently higher so the ratio changed. In that tariff there was no capture of the capacity cost in a proper manner. It was an upside down tariff rate.

The tariff in 1985 was Rs. 0.5 KWH, 2.24 in 1995-96 and its cost was Rs. 1.76 KWH. WAPDA was earning about 50 paisa year and that 50 paisa was going to the expansion of new power stations. From 1960-1996 WAPDA was always earning profit out of electricity sale and putting that money into the expansion and development, but the budget was not clear to the government, media and analysts. That profit never went as bonus, it never appeared as a profit to the people but it was being spent on expansion. Then the IPP's came and from 2001 to 2007, the price was constant at Rs. 4.04 for five years. In 2012, it was Rs. 9.5+ 3.5 per cent GST (11.4) and then in 2013, it rose to around Rs. 14 + 3.5 per cent GST (16. 95). The maximum tariff for domestic consumers is Rs. 18 including taxes. It increases to Rs. 21.8, the highest domestic tariffs being charged from those who pay.

Policies Related to Electric Power System Development

WAPDA was formed as a consolidated body and the development of hydropower was its assigned task. WAPDA was making policies for the development of hydro power. A tri-partite agreement was concluded among GOP, WAPDA and World Bank in 1985, after which the government stopped funding the projects leaving that to the World Bank and other financial institutions. But since then loans have been coming at the rate of 2 to 3 per cent while the government is charging 18 per cent interest on those loans. This has increased the tariff. NEPRA never objected to it, never considered it and never advised the government what it ought to do. For instance, the price was reduced for KESC by 77 per cent.

A power sector reconstruction plan was approved in 1992, then there was the 1994 Private Power Policy; 1995 Private Hydro Power Policy; Enactment of NEPRA Act1997; 2002 Power Policy; R.P.P's of 2006/7, 2009-10; the 18th Amendment and the policy for power generation development. The latest in line is the 2013 policy in which average price

given is Rs. 14.61 – slightly reduced or increased by NEPRA and adjusted on government's directives.

WAPDA's Development and Issues

WAPDA started with 118 MW installed capacity, 700 GWH generation, Rs. 70 million revenue and 270,000 consumers. The power sector became self-financed. WAPDA's generation increased to about 5700 MW out of its own profit and GOP loans by the mid 80's despite 17-18 per cent compound interest charged by GOP. The GOP loans were then stopped for WAPDA projects as a result of the 1985 (Tri-Partite Agreement). Load growth during 1960-1985 was tremendous as it was up to 18 per cent annually. World Bank undertook to finance 60 per cent of the entire power projects' development on condition of 40 per cent self-financing by WAPDA out of the profits.

Introduction of IPPs

The first tender for private power generation was opened in 1985. For this enterprise, the first MOU had been signed in 1988 in favour of HUBCO out of tonnes of offers based on furnace oil and many others on gas. Hubco with 1292 MW was too large on furnace oil. There were many offers based on gas and coal but the government ignored all of them despite their cheaper prices. The price increased several times in between 1989 and 1994. Then the BOOT mode changed to 'build on operate' (BOO) mode without tariff reduction impact. BOOT meant that the price of the plant would be taken back as interest in the tariff. While changing BOOT to BOO, at least 80 per cent of the cost on the plant had been taken in the tariff. The Power Purchase Agreement (PPA) was one sided in favour of HUBCO which entailed high capacity cost. Pakistan was the first country in the Third World to have Private Power. Blunders were made in PPA conditions. The fixed charges were $ 20/KW/month with US CPI. Seventy-five per cent of the capital cost was to be paid back with 14 per cent interest in dollars in the first ten years. KAPCO was privatised in 1996 by paying 75 per cent with tariff 2.6 times higher. Both started being paid in July 1996 at this rate.

WAPDA started running into deficit finding it difficult to operate satisfactorily. The 1994 IPP policy based on HUBCO's style was working a little better. NEPRA, enacted in 1997, was empowered to regulate and to

approve tariff, with some positive effect, but that was not fully adequate. The 2002 IPP Policy was somewhat better for CPP but it was mostly approved on furnace oil which increased the cost and tariff tremendously. In 1994, the cost was Rs. 0.6 which increased to Rs. 15 in 2013. It might go up to Rs.100 in 2025 which is the final year of HUBCO or the 1994 projects. The RPPs were resorted to with exorbitant rental values. The RPP's on gas were contracted without gas availability. There were numerous scandals and court cases. The Supreme Court got all RPPs rescinded. The ADB's audit report was an important reference. The development of power stations got delayed. Consequently, the demand supply gap widened. The government did give subsidies in 2010 but those also proved insufficient. The supply of fuel remained insufficient which hampered energy security; as a result. Hydropower development was also delayed e.g. although Kalabagh Dam/Power Station (3700 MW) was conceived in 1953, there was no progress to start the construction due to political constraints.

Flaws in Tariff Determination Pattern

The model of BOOT tariff was applied to the BOO regime – payment of 80 per cent cost of plant in first 10-15 years. The 15-18 per cent returns on equity with return in dollars despite substantial cost incurred in Pakistani rupees causing huge capacity cost. Higher outages were allowed; NEPRA is still allowing 500 hrs per annum to all the power plants instead of 250 hrs in Bangladesh. DISCOs were allowed to buy power through CCP which is not fully authorized and technically equipped to handle such matters. Higher capital costs are allowed making CPP higher. Plants were approved on furnace oil instead of coal and hydropower. Hydropower had not been supported by Pakistan government (unlike India and others) since last ten years. Nuclear development has been slower than required. The development on renewables had also not been encouraged. For all this, NEPRA may be held responsible along with others.

The furnace oil cost has increased by 25 times in rupee terms and eight times in dollar terms; such an increase wasn't anticipated by all related departments. It increased from Rs. 0.6 to Rs.15, a 25 times increase in 19 years; it might go up to Rs. 75 in 2024 (only the fuel cost) and Rs. 375 per KWH by 2034 following the same trajectory. NEPRA is unable to appreciate this fact and still assumes constant cost of fuel (Rs. 10.14 per KWH for next 30 years) while determining the tariff on thermal plants. Levelised tariff of different technologies is being compared against one and

other without different escalation cost. The escalation cost is not being considered by NEPRA or others. While comparing hydro power with thermals, the latter do have different escalation percentages which are neither projected nor considered; coal, gas and furnace oil also have different ratio of escalation. This needs to be projected by NEPRA and put along with the tariff. The levelised tariff is the same tariff of 8 rupees which is given on the thermal plants under the policies of 2002. If they had projected the escalation and given different tariffs then the hydro power would have been Rs.10 and the thermal Rs. 60. That is what India is focusing upon i.e. making more hydro power projects, allegedly by diverting water from Pakistani rivers.

Hydro power development has been delayed enormously which could have given respite in reducing tariff. Thirty years' average tariff on furnace oil based plants to start now may go up to Rs. 400 per 900/KWH. Levelised tariff on the same plants on discounting factor of 10 per cent may escalate to Rs. 60/KWH. On the other hand, 40 years' hydropower tariff may rise only to Rs. 20 on an average and Rs. 5-10, on levelised basis. The decision makers get a figure of levelised tariff of Rs. 15/KWH for furnace oil based plants and Rs. 10/KWH for hydropower. They are also told that hydropower plants may take 7 -10 years which is beyond the government mandate, so should be ignored. Decision making elite then favours thermals power projects, ignoring hydropower and dams — for instance, Kishenganga court case. Consider the RPP's selection for assumed quick commissioning – 6 months, because they want quick results.

The present tariff is very high and unaffordable for common Pakistanis. There is a huge demand-supply gap of 3000-6000 MW. Industries are without power and development of industries is coming to a standstill. There are huge job losses; unemployment and underemployment both are increasing. The Gross Domestic Product is not growing; according to a latest study by Dr. Hafeeez Pasha, one KWH not supplied to the industry causes a loss of Rs. 53/unit. As a result, there is unrest, demonstrations, inter-political parties' debate and power riots.

There is a dire need to set the things right. There is a lesson to be learnt from our faults. The reasons behind soaring electricity prices should be analysed. In Pakistan, the labour cost is cheap, the construction of basic material is cheap than that of UK, US and India. But electricity in Pakistan is expensive because of wrong choices, wrong actions, wrong people and wrong decisions.■

CHAPTER-3

Implementation of National Energy Policy: Challenges and Options

Ashfaq Mahmood[1]

Abstract

This paper brings out that at present Pakistan does not have any integrated energy policy. Generally, and quite mistakenly, power policy is being taken as the substitute for energy policy. Policies for some subsectors of energy have been formulated in the past with mild success but major issues and challenges have emerged which are not receiving the due attention. The development and the use of indigenous energy resources is not being pursued proactively and aggressively. There are mismatches in the power generation initiatives and the logistic infrastructure i.e. transmission lines, coal transportation, import facilities and storage etc. Demand Side Management (DSM) is not given due priority. In many areas, there are deviations from the existing policies, particularly in the case of the Power Policy announced in July/August 2013. Slogans do not match with actions and the ground realities. The institutions are in disharmony and organisational culture is more of dictation than professional. On the whole, the sector is not driven professionally or with proper planning and is thus unsustainable.

Introduction

Pakistan is a developing country in South Asia with population of about 180 million. The economic growth of the country in the past five years has average 3.1 per cent against a potential of over 6.5 per cent. The GDP of the country comprises of 20.9 per cent from industries, 21.4 per cent from agriculture, 18.2 per cent for wholesale and retail services sector and the rest from other sectors. The country's growth

[1] The paper is based on a talk delivered at a conference in the Institute of Policy Studies in June 2014.

potential is even higher but, due to various reasons – including but not limited to electricity shortages – the growth has been constrained. Pakistan's per capita income is around $ 1368.

Energy Situation

Total energy consumption in Pakistan comprises of nearly 66 per cent from commercial energy resources and 34 per cent from non-commercial resources. The commercial energy resources comprise of oil, natural gas, coal and hydroelectricity. Their percentage shares in supply of energy in 2012 were: oil, 30.8; natural gas, 49.5; LPG, 0.5; coal, 6.5; hydro, 10.5. (See figure 1).

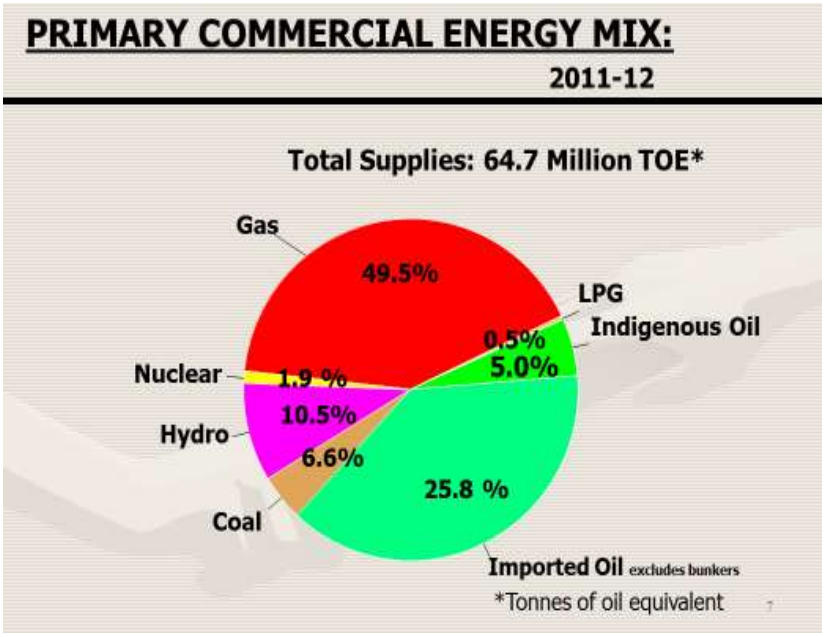


Figure 1

Pakistan is short of energy supplies and thus is experiencing severe power and gas load shedding. It is being projected that at the present trend natural gas shortages will further increase.

Natural Gas Demand and Supply Outlook (Business as Usual)						
	Short Term			**Medium Term**		**Long Term**
MMcfd	**2009-2010**	**2010-11**	**2011-12**	**2013-14**	**2014-15**	**2019-20**
Gross Demand	5,572	6,149	6,266	6,555	6,588	7,509
Domestic Prod	4,121	4,820	4,984	4,125	4,063	2,424
Gap if no action	1,451	1,329	1,282	2,430	2,525	5,085

Figure 2

The total primary commercial energy supply in Pakistan was 64.7 MTOE (million tons of oil equivalent) in 2011-12. Of the total commercial energy supply, over 30 per cent was imported in the form of oil, coal, and small amount of electricity. This import dependence is, however, increasing due to increased oil-based power generation. At present, oil is the fuel of last resort and energy shortages are met by increases in oil imports. The net oil bill for 2010-11 was about US$ 11.7 billion. Future projections show (Figure 3) that it can soar to US$ 24 billion in 2020-21 (assessed at US$90/barrel).[2]

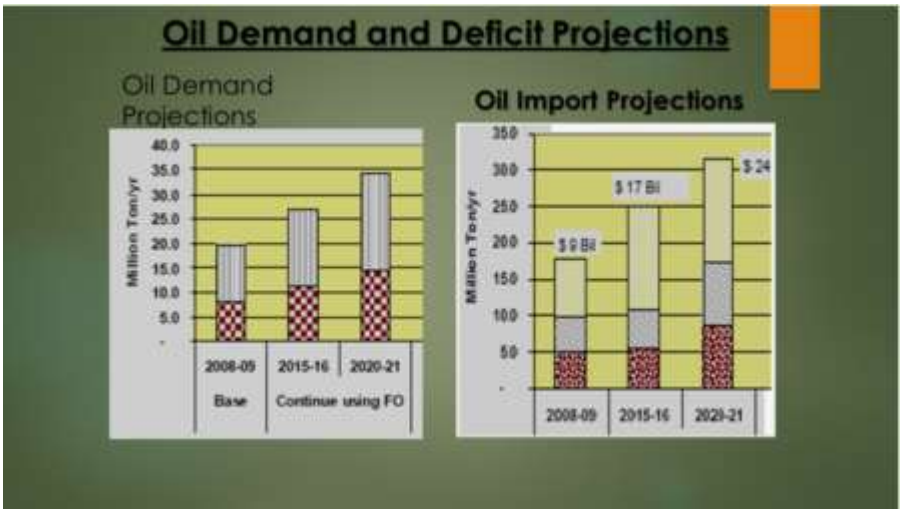


Figure 3

This situation is, un-sustainable as the country's economy may not be able to afford the required foreign exchange and increased exposure to the volatility of oil prices. Pakistan has large untapped energy resources in the form of hydro potential of over 50,000 MW; lignite coal, 186 billion tons; Solar energy, 1.2 million MW; and Wind Energy, 50,000—340,000 MW besides other smaller resources.

[2] FODP ESTF Report

Power Situation

Per capita electricity consumption in Pakistan was about 600 GWh (2012 Year) and over 23.5 million customers. The total installed capacity for power generation is 23500 MW against the annual maximum demand of about 19000 MW. The true capability of power generation is, however, much less than the capacity because many of the public sector plants are of very old vintage, hydropower is reduced to less than 20 per cent of its generation capacity in GWh (about 40 of Power Capacity) in low water months (Figure 4 gives typical situation), high forced outage rates, withdrawal of thermal plants for maintenance, shortages of primary fuels for thermal power generation either due to supply constraints or inability to pay for the fuels due to poor cash flows. Consequently, the availability of power generation capacity has been less than the demand and the country has been chronically suffering from load shedding of varying severity. The shortage of investment, pricing electricity below the cost of service, and poor governance have been the key causes for this dismal state of affairs.

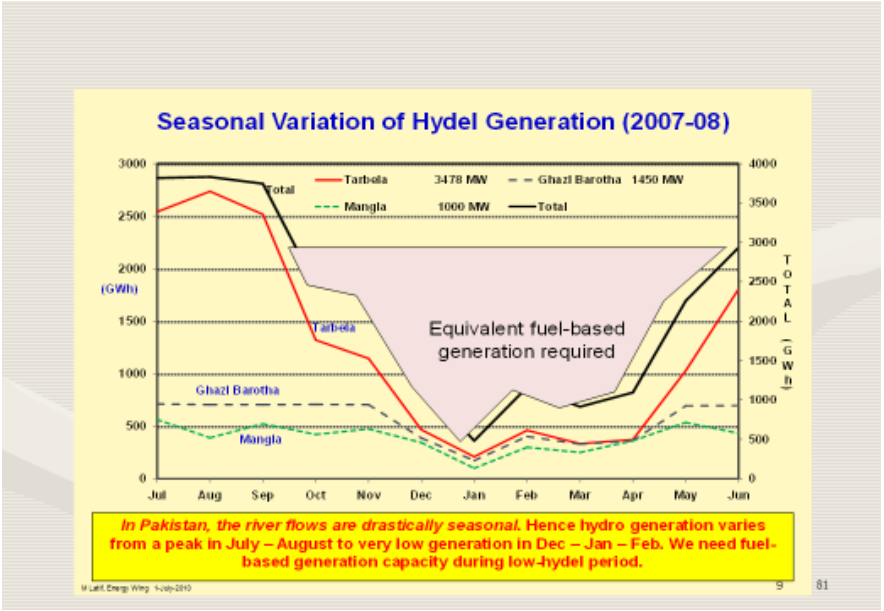


Figure 4

Energy Resources of Pakistan

Figure 5 shows the overall picture of the energy resources of Pakistan.

COMMERCIAL ENERGY RESOURCE PICTURE:

	Potential Resources	PROVEN RECOVERABLE RESERVES (As of 30th June 2013)	PRESENT LEVEL OF PRODUCTION (2012-13)	PRESENT LEVEL OF CONSUMPTION (2012-13)	PROVEN RESOURCE TO PRODUCTION RATIO (YRs)	RESERVE TO CONSUMP-TION RATIO (YRS)
OIL	3.5 BTOES	49.78 MTOEs	3.73 MTOEs	19.8 MTOEs	13.5	2.5
GAS	4 TMTOE	445.83 MTOEs	31.15 MTOEs	31.15 MTOEs	14.3	14.3
HYDRO ELECTRIC ITY	60,000 + MW	60,000+ MW	6773 MW (Installed capacity)	6.25 MTOEs	-	-
COAL	186 Billion Tons	3450 Million Tons	3.18+3.71 (imp) million 3.86 MTOES	6.89 Mil. Tons 3.86 (includes steel) MTOEs		

Figure 5

The figure shows that the oil and gas are dwindling while the hydropower and coal resources, besides the renewable energy resources are not being fully exploited. Only 12.5 per cent hydro power potential is being tapped while exploitation of the Thar coal resources – one of the world's largest lignite coal – is practically dormant.

Energy Policy

At present, there is no integrated energy policy. Usually it is confused with power policy overlooking the fact that electricity is only a secondary form of energy. Policies for various subsectors prepared at different times exist which are listed below:

- Power Policy August 2013
- Vision 2025
- Petroleum Policy 2012
- LNG Policy
- Tight Gas Policy 2011
- Renewable
- Policy

- Energy Conservation Policy (a Bill is pending with the Parliament)
- LPG Policy
- Coal Policy/ National Mineral Policy 1995/ 2012
- Co-generation policy
- Tariff policy 2006
- Power Policy (IPP Policy) 2002

Except for the Power Policy 2013, all the above policies deal with upstream supply side matters. A bill laying down the law for energy conservation is pending with the Parliament for several years. Demand Side Management (DSM) is only marginally addressed.

The Era of Lignite Coal: Power Policy 2013 Onwards

The present government announced the National Power Policy in July/August 2013. This policy was prepared in the backdrop of 4500-5000 MW of load shedding, circular debt of about Rs. 480 billion i.e. US$ 4.8 billion, average power transmission and distribution losses of over 23 per cent. Moreover, some individual DISCOs had losses in the range of 30% to over 35 %; due to all factors discussed above, the average electricity price increased to about Rs. 12 (US Cents 12) per KWh and average overall revenue collection remained 87 per cent of the amount billed; while DISCOs rate rose from 55% to 99%. The vision of the policy was, *"Pakistan will develop the most efficient and consumer centric power generation, transmission, and distribution system that meets the needs of its population and boosts its economy in a sustainable and affordable manner."* The aspirations and major goals/targets envisaged in the policy are summarised in figure 6 below:

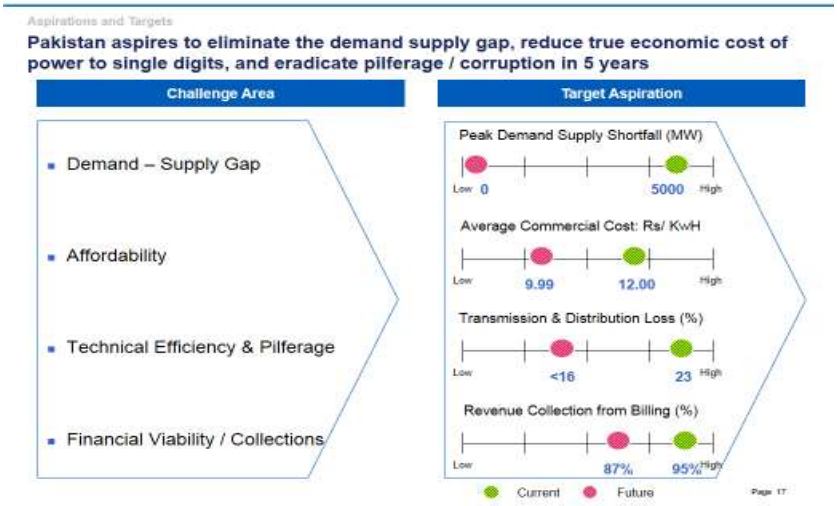


Figure - 6 Aspirations and Targets of the Government Announced in August 2014

The government launched a major initiative of pursuing a coal-led power policy. It envisaged that the existing oil fired plants will be converted to coal and that future plants will be based on imported and indigenous coal. The coal thrust was on the grounds that coal is much cheaper than imported oil. So much was the obsession that within about 12 months, memorandums of understanding were signed for about 27 imported coal fired plants (600-660 MW) mainly from China. As investment from IPPs is less, the regulator has already revised its determination for upfront purchase price of electricity increasing the return on equity from 15 to 27 per cent thereby defeating the very basic argument of coal based electricity being cheaper. In this drive, many rules have been bypassed: environmental studies have not been carried out; coal movement logistics have not been given due attention; infrastructure plans for evacuation of power from power stations have not been synergized. Above all, the indigenous coal deposits at Thar, which are stated to be amongst the world's highest reserves, have been practically ignored. The potential for hydro, solar, wind and other renewable based generation has receded in the background except for one large hydro project being financed by the World Bank.

Government has started reducing electricity subsidies, fuel prices are increasing and there is not much improvement in collection of revenues, efficiency improvement and loss reduction. Consequently, the menace of

load shedding, rise of electricity bills by up to 80 per cent and circular debt are haunting the sector. Customers are up in arms in public protests and burning off electricity bills in public agitations and rallies.

Strategic Thrusts, Aspirations and Goals of the August 2013 Power Policy

The vision of the policy was, *"Pakistan will develop the most efficient and consumer centric power generation, transmission, and distribution system that meets the needs of its population and boosts its economy in a sustainable and affordable manner."* It observed, *"Pakistan is poised to build a low cost and sustainable power sector that would meet its energy needs."* Major goals and targets envisaged in the policy (reference figure 5) are summarised below:

Diminish Supply-Demand Gap

The policy envisaged that the yawning gap of 4500—5000 MW between demand and supply causing 12-16 hours of load shedding across the country will be reduced to zero by 2017.[3] It resolved to build a power generation capacity that could meet Pakistan's energy needs in the long-term in a sustainable manner.

Create Affordable Electricity

Reduce the average price of electricity from 12 cents per unit to 10 cents per unit by the year 2017, while ensuring the generation of inexpensive and affordable electricity from indigenous sources such as coal (Thar coal) and water. Dependence on oil based expensive fuels is to be reduced. Nuclear power would be developed in close collaboration with friendly countries. Development of coastal energy corridors based on imported coal (mixed later with local coal), rapid proliferation of coal mining all across the country – especially at Thar, and conversion of expensive RFO based plants to coal were the central tenets of the coal policy. The proposed strategy would change the energy mix of Pakistan in favour of low cost sources and significantly reduce the energy cost on the common consumer.

[3] The target was repeatedly changed in various statements ranging from 6 months to one year and even 5 years.

Build Operational Efficiency

To deal with inefficient generation, transmission, and distribution system, the goal is to minimise pilferage of electricity and adulteration in fuel supply, promote world class efficiency in power generation, create a cutting edge transmission network and minimise inefficiencies in the distribution system. A target of reducing the transmission and distribution losses from 23-25 per cent to 16 per cent by 2017 was set.

Financial Viability and Collections

Increase collection from present level of 85 per cent to 95 per cent of the amount billed by 2017. The collection in individual DISCOs ranges from 5 to 100 per cent.

Governance

Align the ministries involved in the energy sector and improve the governance of all related federal and provincial departments as well as regulators by decreasing decision making processing time.

The then prevailing economic model (of the previous government) was regarded as unsustainable that discouraged investment and created circular debt. The policy envisioned a target that would pave the way for a profitable and bankable power economy that invites investment and protects public interest. This was expected to be possible through realisation of the goals mentioned above.

Analysis of the Progress

Supply Side

To eliminate the demand supply gap, government has announced a number of supply side initiatives which are discussed below.

Imported Coal Based Power Generation

One major initiative introduced was that of generating electricity through imported coal using super critical technology. The idea was that in view of shortage of gas as fuel for power generation, insufficient hydropower

generation and the fact that the cost of imported coal per million BTU[4] was much cheaper than furnace oil, the next best choice was imported coal based power generation. Until now,[5] 27 plants of 660 MW each have been announced by the Federal and Provincial governments of Punjab. These include 10 plants to be constructed in Gadani, 2 at Port Qasim, 12 in Punjab, 2 in Jamshoro, etc. KESC has also announced that it will construct several imported coal based projects. Of these 14 projects will be located at various elevated country locations.

Here the analysis focuses on the question: Are the actions in line with the strategic vision? How many of these projects are based on firm agreements and how many of them are based on MOUs[6] or diplomatic niceties. How many of these would be realised or can be realised by 2017? Do these projects fit in the macroeconomic framework? As regards the consistency with the vision, the policy had envisioned, "ensuring the generation of inexpensive and affordable electricity by using indigenous resources such as coal (Thar coal) and hydel". It also envisaged the "Development of coastal energy corridors based upon imported coal (mixed later with local coal), rapid proliferation of coal mining all across the country – especially at Thar, and conversion of expensive RFO based plants to coal are the central tenets of coal policy". The policy did not envisage new imported coal fired plants up country. However, at least 14 plants are now proposed to be located up country.

The policy statements on hydrogenation and Thar coal projects are not matched with actions and governmental backing. For the coal based projects, there is no clue how many of these announced projects are based on implementation agreements. Basically these are in the form of MoUs. Except for the two plants at Jamshoro for which Asian Development Bank has extended loan, others are just announcements. Even proper requests for proposals (RFPS) have not been advertised. Most of the 27 imported coal projects have been announced without any environment assessment study making a mockery of the environmental regulations and institutions of Pakistan. Credible feasibility studies and even basic project pro forma have not yet been prepared. Clear implementation plan with milestones, financing plans, availability of finances, Implementation Agreements, Power Purchase Agreements, Coal supply Agreements, Transportation

[4] British Thermal Unit.
[5] June 2014
[6] Memorandum of Understanding

Agreements etc. all needed before the commencement of the project, are not in place. These activities alone take two to three years besides the construction and installation of plants which usually take about five years. Announcements of completion of the imported coal fired projects by 2017 are thus tantamount to closing eyes to realities.

Logistics for coal import, transport and storage, which include port, trains, handling etc., have been generally ignored. The transportation of coal for 14 up country plants would require proper logistics and railway infrastructure. For a 1320 MW project, supply of around 13000-14000 tons of coal is required per day. While each wagon contains 50 tons of coal, it will require seven or eight trains to supply coal for Jamshoro. According to some studies, to supply coal to all 14 up country plants, around 90 trains have to take off from Railway Marshalling yards in Karachi and at least one train must leave the yard every 15 minutes. All of those trains have to travel on the present infrastructure of the railway as there are no new plans for implementation by 2017. The deteriorating state of the existing railway infrastructure does not lend any confidence that the fuel requirements of the up country plants will be serviced. Apart from railways, additional port facilities may also be needed at Karachi Port and Bin Qasim Port to receive the huge amount of imported coal for the 14 up country plants. In addition, the Power Park at Gadani would also require its own port but not much is known about actions to meet this requirement. Such a big programme should have been linked with transfer of technology which has not been done yet.

Regarding the consistency of macroeconomic framework, one wonders whether the government has even made any such framework for future. A number of parameters have to be checked. To illustrate, the impact of Foreign Exchange Component is not worked out. Looking at the large number of plants announced, the immediate impression being communicated is that the foreign exchange component of power generation would be less due to the cheaper price of coal as against oil. A deeper analysis will, however, reveal that the cost of the capital, mostly in foreign exchange, is very high compared with the cost of the furnace oil plant. In terms of rupee, the price of electricity may be less but in terms of foreign exchange outflow, which includes debt service and fuel cost, it is possible that the burden on foreign exchange may be unbearable.

This drive for new plants might be good for generating electricity through cheaper sources but all of these are ambitious plans and very few of these are likely to be materialised by 2017. At this time, there is too much

talk about bigger plans with little focus on implementation feasibility. Lack of transparency or over-selling would create problems.

Another important factor is the price of electricity. NEPRA had announced up front tariff for imported coal plants based on 16 per cent rate of return but all of a sudden, a few months ago, it was increased to 27 per cent. There is no clear, transparent, analytic rationale for offering such a high rate of return except the perception that NEPRA has yielded to outside pressures. This does not augur well for the credibility of the Regulator in Pakistan bearing in mind the long term implications. Besides, the high electricity price flies in the face of the policy for making electricity affordable and ensuring transparency in all facets of the economy. The macroeconomic impact of the high price of electricity has not been analysed.

Conversion of Existing Oil Fired Plants to Imported Coal

The conversion of existing plants to imported coal was also among the goals. Some of the public sector plants are making progress but IPPs are reluctant due to the tariff issue and plant shut down losses. The plants have to be shut down for the period of time needed to convert it into coal-based plant. Thus there are financial losses which may have to be compensated by increased tariff which should be commensurate with those financial and economic losses. The objective of conversion to coal, though attractive on paper, is not being supported by actions on the ground. It appears that the announcement was made without proper study.

Thar Coal Based Power Projects

For decades, governments had been trumpeting the potentials of the Thar coal reserves and how these can liberate us from energy import dependence. The present government had also verified the calculations that the reserves are more than Saudi Oil resources in terms of energy content. Their policy had also envisioned that indigenous coal based plants, especially Thar will be given priority. Accordingly, it was hoped that a large initiative (perhaps bigger than imported coal) would be taken by the government for Thar coal based plants. However, except for Sindh Engro Coal Mining Company and Sindh government which have made some tangible progress for a mining project, there are no other signs of progress. The pace of work is very

sluggish and the imbalance between imported and indigenous resource utilisation is quite obvious.

Hydropower

The policy laid emphasis on harnessing hydropower. Except for World Bank's Agreement to provide loan for the Dasu project for which efforts were initiated many years ago, new hydro power project seems to be languishing. There are many projects in private sector which need government support for fruition as well as in the public sector. Even Dasu project is a far cry as it will take much longer than 2017 to complete. Hydropower provides cheaper electricity, even cheaper than coal. While focusing on imported coal for cheap electricity generation, due consideration should have been given to Hydro. Countries that give priority to hydro (like India) do not wait for donors for funding in case of any hurdle in fund raising. They provide funds from local resources. Just as the government could make bullet payment of Rs. 480 billion for clearing circular debt in haste, without even audit or negotiating gradual payment, it could also support some hydro projects from its own resources. The Diamer-Bhasha project was and is ready for construction. The government could have started the construction employing its own resources; however, it was not done. The estimated cost of US $ 10 billion is an affordable amount which could be made available if it was spread over 6-7 years, considering that the government had the ability to dish out US$ 5 billion for circular debt in a bullet payment. It is a major anomaly that on the one hand we claim to reduce the price of electricity and increase our self-reliance through hydro energy but on the other new hydro projects have largely been ignored or slow paced. Initially in the year 2013, there was no talk of Diamer-Bhasha Dam but when people started pointing at it then local funding for land acquisition was allocated. There is no aggressive force behind hydro projects to push them to fruition. Moreover, the Kala Bagh project, which is the most economic and important project for water resources of Pakistan, is being put on the back burner on the plea of lack of consensus. No efforts are under way to develop consensus. There is a lot of talk on the adverse hydro thermal mix and exploitation of indigenous energy resources; however, the situation is deteriorating day by day. We may remain dependent on imports and our energy prospects, insecure.

Solar Park 1000MW

In the area of solar energy, the project of Solar Park 1000MW has been initiated in Cholistan and work on a100 MW project has been started. When the first project is completed, a lot of information and knowledge will be attained. It would have been better that a smaller project should have been initiated. But if a project of 100 MW is being developed, its lessons should be documented properly including all data, information, details of capital and operational costs, efficiency and price of electricity which should be made available to public and private sectors for transparent implementation.

Power Transmission

Timely availability of power transmission lines for power from existing plants has been neglected. A project PC-1 has been approved by the government for the transmission of power from Gadani. According to media reports, it is all about plans, studies and MoUs. There are no answers to questions as to what has been decided about the voltage levels; DC vs Ac transmission; final routes of the lines; which lines are found feasible for implementation; when engineering and bidding documents will be ready; and how the power would be transmitted in a safe and reliable manner. No information is available about transmission lines for the projects announced by the Punjab government. There is disharmony and disconnect between the transmission and generation plans.

Implementation of Petroleum Policy

Demand Side

Demand Side Management (DSM) offers the "low hanging fruits" of reducing power shortages in a short time. The actions which could have been taken on demand side include conservation, loss reduction, controlling power theft to reduce load shedding and metering. Performance in this regards is discussed below.

Load Shedding and Demand Management.

Load shedding was targeted to be reduced from 5000 to Zero. First it was targeted to reduce load shedding in one year but later, the target time was increased to two and then three years. When the circular debt was cleared; there was a temporary reduction in load shedding. Now the circular debt has

reemerged and is in the range of Rest. 300-400 billion. Power shortfall is between 3000 to 4000 MW with 6-8 hours load shedding in urban areas and up to 16 hours in rural areas. So there was a blip of success followed by business as usual. It is feared that in the next few years, the load shedding would be back to 5000+ MW. The reason is that the mega projects would be completed in around next eight to ten years while nothing has been done on the demand management and conservation side. UPS might be domesticating electricity but it is an inefficient use of electricity. The country has become even more inefficient in the use of electricity. We need to analyse best possible ways to invest in order to get the best possible return. Except for a few flyers, sporadic advertisement there is no active leadership on Demand Management. There had been talk about closure of shops after sunset or at least no public electricity to commercial sector, but no sustained and proactive moves have been made so far. The "time of day" tariffs announced by NEPRA are not making much impact as there are many areas which lack digital meters, the off peak tariff does not provide appreciable benefit as compared to flat tariff applicable to non-digital meter customers and it has not been widely and effectively disseminated.

Conservation and Efficiency Improvement

Conservation reduces the consumption and is a very low cost measure to meet energy deficit but it has not been among the priorities of the government. Conservation law has been drafted and is pending promulgation for years. Continuing on the same track, last one year has not been much different as no progress in this regard has been made. There is no big campaign for efficiency labelling, manufacture of efficient appliances and accessories. A Compressed Florescence Lamp project pending for a long time was taken up during the last year. No updates are available on the progress of the plan.

Loss Reduction Including Thefts

It was targeted to reduce losses from 23-25 to 16 per cent by 2017. Many claims have been heard about loss reductions in Islamabad as well as KPK but no concrete progress has been observed. Recently during a Television programme reduction of merely 0.3 per cent losses was claimed. DISCO-wise progress, particularly of the ones making huge losses in Quetta, Peshawar, Multan, Sukkur and Hyderabad is not known. On the whole, the progress is not commensurate with what was actually targeted to be

accomplished. The government also recruited services of FIA to deal with power theft; whether right or not, we don't know about its impact. There was an announcement about a separate law for curbing power theft; however it remained an announcement. The overall reduction of 0.3 per cent is no news.

Metering

There has been much talk about smart meters and digital meters. Without knowing much about smart meters, power sector strategists considered it the panacea for all the ills but it is not. It may be good for some large electricity customers but for smaller customers we need digital or cheaper meters. In Pakistan, there are more than twenty-two million customers and one smart meter is about ten times more expensive than the digital meter. Introduction of smart meters is desirable but the impact of cost is not affordable. We need a well thought-out strategy and plan.

Revenue and Finance

Circular Debt

Circular debt of Rest.480 billion was retired and 1700 MW were added back to the grid. The resurfaced circular debt of Rs. 300-400 billion is still outstanding. So whatever was achieved, was a one-off arrangement and not a sustainable solution.

Revenue Collection

Overall collection of revenue was supposed to increase to an average 95 per cent from 87 per cent. The latest report about it is not available. One of the major contributors to collection short fall is lack of revenue collection from private sector. According to a news source, there is not much improvement in this regard. If DISCOs could recover Rs. 200 billion from the private sector, the circular debt would be controlled to a large extent.

Prices/Tariffs

Electricity prices are to be reduced to single digit by 2017. The general impression is that the tariff is being increased instead of being reduced with no chance of achieving the affordability target. The target is not difficult to achieve, though it is not based on thorough analytical work. The planning

target of bringing losses from 25-16 per cent by 2017 is not a utopian target; it is possible, given proper investment. In the same way, reduction of electricity prices is a good target if hydropower was pursued instead of thermal. Similarly, Demand Side Management and conservation should have been vigorously pursued. All of these could help in making tariff affordable.

Attracting investment

In terms of investment, greater focus had been on signing MoUs. It is not clear how many of these have been firmed up, how much investment would be actually coming and to what extent the impediments of investment have been addressed. Even the Chinese counterparts, who really want to contribute, are repeatedly raising issues.

Planning and Analysis

There is not much emphasis on planning and analysis in the policy announced by the government. Future planning and analysis seems relegated to low priority. There is no credible estimate of planned investment, how much will be required for the announced projects and ancillary facilities, how all this investment can be realised, what will be the macroeconomic impact, reality check of targets, priorities etc. The financial side has totally been neglected. If we take the example of 27 plants along with transmission lines, investment of US$ 70-80 billion would be needed. If we plan to do it in five years, we will be needing 16bn $ per year. On the other hand, the budget of public development sector for all sectors for the year 2014-15 is $ 11billion including power sector allocation of US $ 2.4 billion. So it implies that all the rest of investment, about US$ 12 billion, will come from private sector, even for transmission lines. If we add to it the cost of other power projects such as major hydropower and gas turbine projects, investment in DISCOs, infrastructure for fuel then the additional annual investment required will be of the order of US$ 18-20 billion per annum. It needs to be worked out that even if it is materialised in the private sector what it would mean in terms of foreign exchange outflow in later years. Debt servicing of such a large investment may not be affordable. A macro-economic study is required to analyse whether such investment is sustainable and affordable. If not, how to make it sustainable and affordable.

The Planning Commission, on the other hand, is mostly functioning as a clearing house with no forward thinking and leadership and nobody seems to be willing to listen to solicit their advice. The projects are being prepared in haste sometimes over a few days, even violating the guidelines laid down by the Planning Commission about feasibility studies and environmental assessments. The Planning Commission is not coming up with planning and policy advice. Resources are being spread thinly.

Politics, Governance and Professionalism

Institutional Efficacy

Many projects start even before approval and proper studies. This had been the course in the past too. Whenever the projects are pushed through by powerful sponsors or government functionaries, it is very hard for the experts to offer objective comments or oppose nonviable projects for the fear of reprimand. Those who dare, become "*persona non grata"* and are side lined. The culture is that if someone wants to survive, one should say yes or become a part of the rubber stamping culture. Lip service, "pass the buck" is the name of the game. Professionals, competent bureaucrats are looking for safe havens and institutions are deteriorating; it's not a good omen for sustainable development.

Strengthening, Restructuring and Reforming

In terms of strengthening, restructuring and reforming institutions, policy statements had been made: CEOs would be appointed on merit; independent boards of competent persons would be established; ministry of water and power would be strengthened; there would be task force in the ministry; power sector companies will be made autonomous; power markets will be opened and the regulation of the sector will be improved etc. But the situation on the ground is different.

One example is that NEPRA can be pushed into giving 27 per cent return for upfront tariff for coal projects. This speaks volumes for itself about the loud claims to improve institutions. Questions arise as to what is the professional competence of NEPRA? What is the strength of the regulator? Where is the independence of regulator? What the regulator is supposed to do and what the regulator is doing? The Board of Directors, CEOs have not yet been appointed in many cases. Similarly, boards of

directors of companies are not empowered and in many cases, competence is lacking.

Basically the reliance is on slogans and MOUs. Most of the slogans project achievements on previously ongoing projects. Neelum-Jhelum Hydropower is the project of the past as well as Nandipur Combined Cycle project, which are being expedited. However, the inauguration of the latter , even though it is only partially complete with 95 MW turbine out of 450 MW and that also to operate largely on oil due to gas shortage, prompted the government to go for the press release. Similarly, plants at Uch (Phase II) and Guddu (747MW), started in tenures of previous governments, are producing electricity partially but tall claims appeared in the press. Regarding theft of electricity, FIA was asked to assist with far-fetched claims, but the accomplishment is not appreciable. Complaint centers are being set but this is not what people are looking for. They need electricity. Regarding import of electricity, slogans of import from Tajikistan under CASA1000 project, import from Iran and import from India are heard while realisation of such projects may take many years. Same is the case with MOUs. Slogans can please people for some period but if the policies are not robust, meaningful and concrete and not implemented in time, then mere slogans cannot be the measures of progress.

Lack of Harmony

There has to be some mutual harmony between the Federal government and the provinces. KPK and Federal governments continue fighting over PESCO. Same is the case with Federal and Sindh government over power issues. People are suffering and instead of sitting together to resolve the problem, the governments are more interested in extracting political mileages. The governance and institutional movement is not moving in the direction of making the sector sustainable, professional and more analytical. The Federal government should get all the provinces together. Capacity building is very important and Federal government has to provide leadership. Large projects whether it be Thar coal or Hydro, have to be under the leadership of Federal government.

Energy Options and Issues

In the light of the above discussion, major energy options and challenges are given in the table below.

Table 1

Energy Options and Issues (Indigenous)		
Resource	**Status**	**Remarks**
Hydro Power	Large Potential Exists	Need Consensus, funds, Resolve, delays in Bhasha , Dasu
Oil Gas	Untapped Potential exists Pakistan is under explored despite high success ratio	Review well head price Review policy package Support shale gas production and in fill drilling Improve Law and Order
Coal	Very large potential exists, though low quality	Attractive investment promotion package including reasonable price, funding support, coal blocks with bankable reserves, and balance of plant facilities and infrastructure may be provided
Solar Wind Other Renewables, small hydel	Very large potential , though expensive	Facilitate service providers for solar for domestic uses. Subsidies to support entrepreneurs Feed in Tariff Policy concessions Electricity Wheeling.

Indigenous production of oil and gas has not picked up despite repeated revisions of petroleum policies. As shown in the figure, the average of the last 5 years is that approximately 25 exploratory wells are drilled per annum. There is need to immediately review the petroleum policy to address this performance particularly in view of the fall of oil prices in the international market.

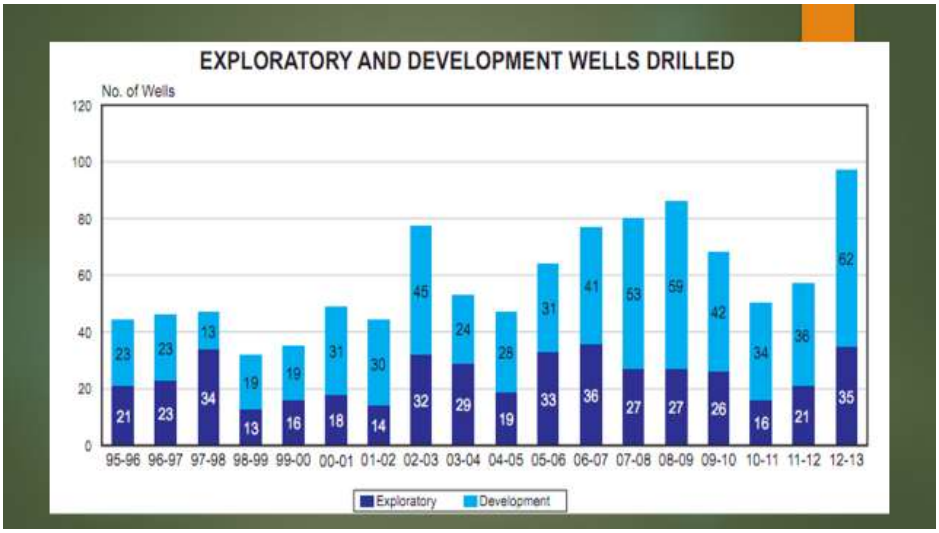


Figure 7

According to the report prepared by the Friends of Pakistan, there is great potential for energy conservation (Figure 7) in Pakistan but not much attention is being made in this regard. Energy conservation is a low hanging fruit which Pakistan must pluck.

Figure 8

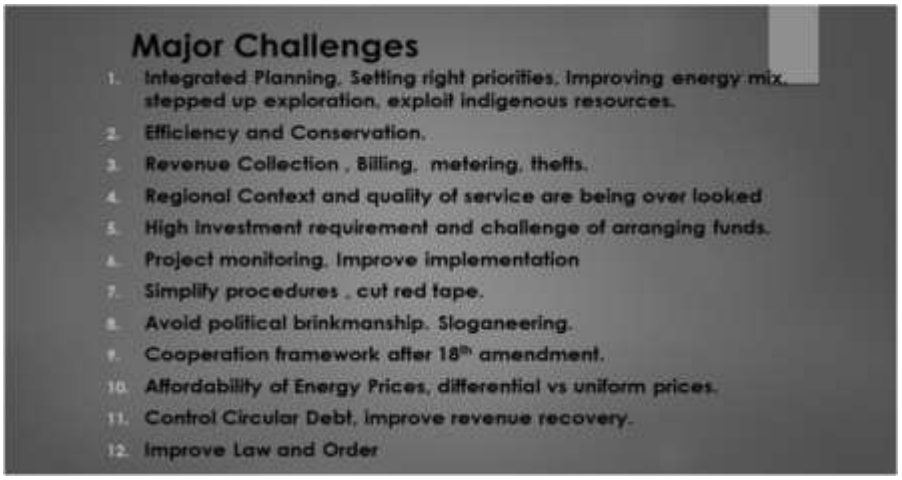
Institutional Issues are summarised below.

Table 2

Institutional/ Governance Challenge	
Major Action Areas	**Comments**
Institutional Efficacy	**Projects start before approvals and studies Lip Service, Pass the buck –the name of the game . Professionals, competent bureaucrats look for safe heavens.**
Strengthening , restructuring reforming institutions	**NEPRA?? BODs? CEOs? All actions attributable to the ministers CMs or PM! Strengthening Ministry of Water and Power? Power Market Development**
Living by slogans	**Tall claims---not supported by professional analysis**
Mutual Harmony	**Boxing / Fighting with KPK on PESCO, Sindh issues, Dissipating Energies Wastefully**

Conclusion

Pakistan needs an integrated energy policy immediately. There is need for proper planning, prioritization of resources, good governance, and pragmatic professional approach. The bullying culture should be shunned in dealing with professionals and making slogans without homework. In summary following are the major challenges:



Way Forward

All the above challenges can be addressed through strong and capable institutions. The government must pay highest attention to strengthening and building energy institutions on professional lines. Institutions are the backbone of a country. If institutions are in place and their professional work is respected there will be an in-built capacity in the system to address energy issues as they arise. No single recipe can be prescribed for all times to come. It is the institutions which continually address the issue.■

CHAPTER-4

Fund Raising for Energy Projects in Pakistan

Huma Dad Khan and Vaqar Ahmed

Background

Pakistan faces a lingering energy crisis due to poor generation capacity, rising demand for power and gas, system losses, untargeted subsidies, and lack of an overarching integrated energy policy. It has been estimated that the malfunctioning power sector is resulting in a 4 per cent loss in GDP annually.[1] In order to alleviate these woes the PML-N government after coming to power in 2013 announced energy projects under the new power policy 2013. However, the financing of many such projects still remains a substantial challenge. The power sector's total investment declined by 9.1 per cent in 2013. The share of this sector in GDP also declined from 2.4 per cent in 2011-12 to 1.9 per cent in both consecutive years 2012-13 and 2013-14.[2]

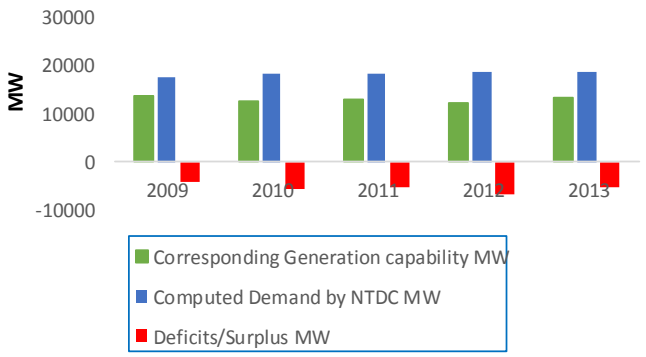
Currently, the country is not able to produce the required energy demand. With 22,158 MW installed capacity averaging almost 18,000MW, the shortfall stands at 5000-7000 MW per day.[3] It is noteworthy to mention that 30 per cent of Pakistan's population has no access to the formally supplied power.[4] If this segment of the population has to be catered, the officially estimated demand will actually be a number greater than 7000MW.

While the newly initiated projects could lend about 5094MW by the end of 2017-18, however this additional supply will again be passing through an inefficient power transmission and distribution (T&D) network. Around a quarter of generated power is lost to T&D losses and this includes power theft. The National Transmission Dispatch Authority (NTDA) released a load forecast report that by the year 2017-18, the electricity demand will rise to 35,000MW. Pakistan will be facing a shortage of about

[1] Sattar (2013)
[2] Economic survey of Pakistan 2013-14, Ministry of Finance.
[3] Nepra (2013)
[4] Mills (2012)

7,748MW, even if the government succeeds in adding 5095MW along with operating at fully installed capacity of 22,158MW.

Figure1: Persistent Demand and Supply Gap



Source: NEPRA (2013)[5]

The pricing and tariff structure in the energy sector needs to be revisited. The power sector received PKR 22-24 billion in subsidies per month till June 2014, which had been increased to PKR 35 billion in the month of Ramazan during 2014.[6]About PKR 1.7 trillion is the total amount of subsidy given to the power sector over the last one decade i.e. from year 2003-2013.[7] Subsidising the power sector is an ineffective and fragile policy that benefited the select power generation entities and larger energy sector entities of the country. Much less amount out of the total subsidy was actually targeted for the poorest of the poor whose consumption is under 100 units. Even key exporting industries having a large concentration of small and medium enterprises which were deprived of power at subsidised rates. The hidden and cross subsidies are also resulting in a loss to the exchequer.

Pakistan is now under a stand-by balance of payments support programme which demands the government to remove untargeted, hidden and cross subsidies. Under this programme, Pakistan has committed with

[5] NEPRA (2013)
[6] Kiani (2014)
[7] Pakistan Economic Survey 2013-14

the IMF, a reduction in subsidy outlay. Already a reduction of PKR 60 billion had taken place by August 2014. Moreover, an equalization surcharge[8] has also been levied on industrial and commercial consumers.[9] The amount collected after imposing the additional surcharge on the commercial and industrial consumers will be used to pay the circular debt of the power sector i.e. PKR 239 billion and its markup.

In the absence of structural reforms in energy sector, the circular debt reappeared after the government had cleared the previous stock of PKR 500 billion in July 2013. One of the key reasons why circular debt increased was due to the diversion of 18.5 per cent of the natural gas to the fertiliser sector. This led to a reduction of natural gas supply to the power sector by 8 per cent contributing PKR 239 billion to the circular debt.[10]

In 2012, Pakistan's indigenous energy availability was 65,639 thousand tons of oil (ToE) equivalent with 64,588 TOE as primary energy supplies, implying a 2 per cent loss of energy during conversion procedures. In 1995, Pakistan's total energy supply was 28 million TOEs with main sources as oil (41.6%) and gas (36.8%). While energy supply has increased, the pattern of primary energy sources has also changed. The share of gas has increased to 48.2 per cent and of oil has decreased to 32.5 per cent. This shift in energy source from oil to gas is due to a general rise in oil prices globally. Gas being a domestic source was found easy to subsidise.

Electricity is a secondary source of energy, obtained by converting primary sources like gas, oil, coal, nuclear and other natural resources. The share of electricity in energy supply during 2013 was 12.9 per cent. The total installed capacity of Pakistan Electric Power Company (PEPCPO) was 22,812MWs in June 2013 with major contribution of 6,773MW hydroelectric power followed by thermal with 15,289MW and nuclear power of 750MW.

During fiscal year 2012-13 total energy of 98,894 GWh was generated in the country, with high share of thermal electricity generation (64%), hydel (30%), followed by nuclear (4.2%). The alternate modes of energy generation are still accounting for low contribution. For example the

[8] Price equalization surcharge is an additional duty levied for equalization of prices of certain goods imported at different prices under different conditions and from different countries under section III of 1967 Act, also called "The Import of goods Act 1967"

[9] Government reduces power sector subsidy by Rs.60 billion, Pak tribune, 13 August, 2014

[10] Pakistan Economy Survey, IPR Analysis June 2014: Institute for Policy Reforms.

share of wind power was 0.03 per cent. The increased use of thermal energy generation has depressed the country's scarce financial resources. Around 65 per cent thermal electricity generation is based on high speed diesel (HSD) and furnace oil (FO). The efficient and relatively cheap source of hydel resource seems out of sight. The share of public sector in total electricity generation shows a decreasing trend, while private sector is increasing. Electricity generation by-type and sector during 2009-10 and 2012-13 is given in the following table 1 and figure 2.

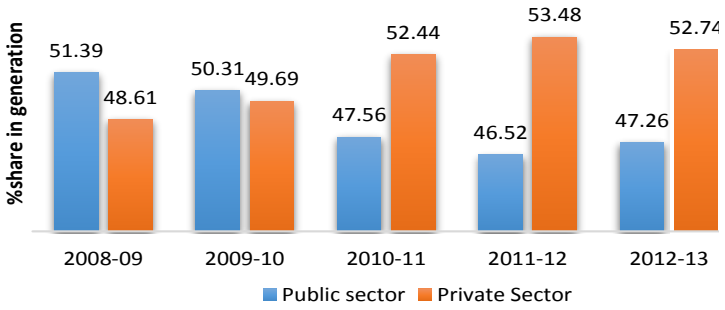
Table 1
Energy Generation by Source (GWh)

Source of generation	2008-09	2009-10	2010-11	2011-12	2012-13
Thermal	64978	68606	65462	65298	64681
a. Public	19520	19594	13018	12893	13235
b. Private*	45458	49012	52444	52405	51446
Hydel	28183	28492	31990	28652	30032
a. Public	27636	27927	31685	28207	29326
b. Private	547	565	305	445	706
Nuclear					
a. Public	1486	2668	3130	4872	4181
Total	94647	99766	100582	98822	98894

* Includes Import from Iran and K-electric. Source: PSS/NTDC[11]

[11] www.ntdc.com.pk

Figure 2: Total Electricity Generation by Sector



Source: NEPRA (2013)

In this paper we will look at the investment demands of the energy sector and how best to raise such funds from domestic and external sources. The objectives of this paper are as follows:

- What are the current modes of investment being pursued by the Government of Pakistan to raise public investment for energy projects?
- How has the Government planned to attract private investment in the energy sector?
- What are the challenges and future opportunities in raising investment for energy sector development in Pakistan?

Literature Review

A number of studies in Pakistan have tried to study the relationship between energy consumption and economic growth in Pakistan. Similarly some studies have also examined causality between GDP and energy use in Pakistan.[12] However one finds fewer studies on how changing patterns of public and private investment in energy generation, transmission and

[12] Ahmed and Zeshan (2013), Ahmed (2013), Aqeel and Butt (2001), Hye and Riaz (2008), Kahkar and Khilji (2011), Chaudhry, Safdar and Farooq (2012)

distribution have impacted the GDP growth. It is important to recognize that the modes of financing used for energy generation have a bearing on the overall structure of GDP over the medium to longer term. This is also a concern for the multilateral funding bodies and international financial institutions that support the development of energy sector in developing countries.

Current literature also informs us regarding the fair rationale to invest in the power sector of Pakistan as the demand for electricity is outstripping the supply. The Independent Power Producers (IPPs) have a certain long term tariff structure for 25 years with power purchaser public authorities heavily dependent on private production. Any rise in fuel cost or change in taxation pattern will be passed on to the power purchaser authorities by the IPPs (IGI securities report 2008). The same report explains that the power sector's annual average sales growth is 35 per cent, which is above the regional sales growth of 14.8 per cent.[13]

Around 13 per cent of Pakistan's river water flows could be stored and made available for power generation. This again will require fund mobilization in the water sector which has its own regulatory and political issues (OSEC 2011). The PPP government had considered a strategy in 2008 whereby construction of several small dams could be completed within a decade. However the same government in the end went for a move to import 19 rental power plants (RPPs) for meeting the domestic energy demand. The investment outlay planned to make available 2,734MW of rental power, however only one plant (Kaya Bey- Turkish power) with 62MW against the guarantee to provide 231.8 MW with a diesel based system for 5 years was made available.

The same study also highlighted that the restructuring in power sector (deregulation, privatisation, management reforms at WAPDA and PEPCO), running of Private Power & Infrastructure Board (PPIB), implementing National Power Regulatory Authority (NEPRA) decisions and various initiatives under the national power policy will require substantial financial resources through domestic and foreign sources.

The investors however are shying away due to lack of energy governance reforms, losses and theft during T&D, low revenue collection by distribution companies, persistent circular debt, and higher capital cost of alternative resources like hydro, failure to exploit cleaner coal based generation methods, and slow progress on import of energy supplies from

[13] Bloomberg (2008)

neighbouring countries.[14] The role of state in the energy sector has also been termed ambiguous. The government is controlling import, export, prices and domestic supply quotas. Such heavy regulation only serves as a barrier to the entry of new investors. There have also been controversies surrounding the privatisation of distribution companies, for example K-electric.[15]

KPMG (2013) has reviewed investment in power sector of Pakistan along with the possible opportunities it provides to the investors. The report stated that government has taken some positive initiatives to produce additional power supply of around 16,800MW by the end of 2015-16. One of the initiatives is that an agreement has been signed between Balochistan government and a Korea based solar investment firm to produce a 300MW solar power project in Quetta. A joint venture of constructing a 1500MW hydropower project on Kunar River between Pakistan and Afghanistan was also planned.

The same study demonstrated that 135,000 ToE imported costing US$ 100million can be saved with the New Bong Escape Hydro Power Project built by EPC contractors of Sambu Construction Company of South Korea. The private hydel power project in Azad Kashmir is expected to generate 84MW of electricity. Pakistan is still struggling to attract similar or higher levels of investment in wind energy for power generation. This report shows that the Gharo-Keti Bander wind corridor at Thatta with a potential of 50,000 MW has close vicinity to the national grid and major load cities, which can be made attractive for investors through policy and regulatory measures.

The public-private partnerships in energy sector have also been explored in the literature. Munir and Khalid (2012) explained that the private sector can deliver its best if power policy fosters a facilitating environment instead of an intrusive attitude by the state. Furthermore, government's trade and taxation policies should also reflect its seriousness for partnering with the private sector. A key example of discouraging private sector through trade policy was seen in the federal budget of 2014-15 when customs duty was slapped on the import of solar cells and inputs that go into producing such cells.

Investment patterns in the energy sector also impact the mix of factors of production and therefore employment patterns. Ammad and

[14] Ahmed (2014)
[15] Abbasi (2012)

Ahmed (2012) show that in some sectors employment has increased due to public investment in energy while in the other sectors capital has substituted labour due to high level of capital intensity required for complex operations. As the energy sector achieves greater sophistication, improved quality of human resources will be required to manage production and distribution. This implies that public and private investment should also step in to provide higher levels of skills to the labour force involved in this sector. There is also evidence that public sector's borrowing from the banking sector in the country has resulted in crowding out of private investment in general (GoP 2011).

We also see some quantitative modeling to forecast investment needs of the energy sector in Pakistan. IRG (2011) using an integrated energy model for Pakistan, explained that for achieving an annual average economic growth rate of 6 per cent until 2030, electricity generation capacity will have to increase four-folds, implying that around 82000 MW will have to be added to the current capacity. A three-fold increase in consumption of petroleum products from 6.2 to 18M ToE by 2030 will also take place. The natural gas reserves under the Business As Usual (scenario) were projected to deplete by 2030. Apart from the investment requirements, the report explained significant annual savings with best policies and practices of energy conservation. PKR 41 billion were the estimated net savings by improving the end-user energy efficiency. Around 20 per cent more gas could be delivered by investing in successful exploration and this could save Rs. 37 billion in 2011 prices. Investment in renewable alternatives like wind, solar, bio-energy and municipal solid waste (MSW) management could improve energy security and reduce 38 per cent of total energy imports.

Investment Support by Multilateral Development Partners

The details of key multilateral development partners currently engaged in the financing of energy projects in Pakistan are provided below. It is important to mention that most new projects deal with enhancing Pakistan's generation capacity; however, this may not be very helpful in improving the lingering governance and management issues in this sector. This is where the significant role of the state departments involved in this sector still remains. It is only with governance reforms in this sector that the efficiency of new investments can be ensured.

Table 2 and Table 3 provide the investments carried out through loan facilities provided by the Asian Development Bank and the World Bank group. Most of these are long term financing projects with secure cash flows once completed.

Table 2
Asian Development Bank (ADB) Energy Projects

Project Name	$ Thousand	Approval Date
1. Power Transmission Enhancement Investment Program II	$ 1500	16 Dec 2014
2.Strengthening the Central Power Purchasing Agency	$1500	3 Dec 2014
3. Trimum and Panjnad Barrages Improvement Project	$150,000	22 Sep 2014
4. Sustainable Energy Sector Reform Program - Subprogram	1$ 400,00	24 Apr 2014
5. Power Distribution Enhancement Investment Program Tranche 4	$167,200	13 Dec 2013
6. Jamshoro Power Generation Project	$900,000	9 Dec 2013
7. Power Distribution Enhancement Investment Program Tranche 3	$245,000	14 Dec 2012
8. Capacity Building for Enhanced Safeguards Management	$550	10Dec 2012
9. Power Transmission Enhancement Investment Program Tranche 3	$243,240	22 Dec 2011
10. Power Distribution Enhancement Investment Program Tranche 2	$2727	14 Dec 2010
11. Renewable Energy Development Sector Investment Program Tranche 2	$200,000	13 Dec 2010

Source: www.adb.org

Table 3
World Bank (WB) Energy Projects in Pakistan

Project Name	$ (Million)	Approval Date
1. Dasu Hydropower Stage I Project	$588	10 June 2014
2. IDA Partial Credit Guarantee for Dasu Hydropower Phase I Project	$460	10 June 2014
3. Power Sector Reform: Development Policy Credit	$600	1 May 2014
4. Natural Gas Efficiency Project	$200	26 April 2012
5. Tarbela Fourth Extension Hydropower Project	$840	20 March 2012

Source: www.worldbank.org

Investment Support by Bilateral Development Partners

This section will discuss Pakistan's bilateral partnerships in the energy sector including possible arrangements in energy trade with neighbouring countries and other countries of the region which facilitate energy projects in Pakistan. China leads this category with recent approval of 14 power projects and a potential to generate 10,400 MW. Ongoing projects include Karot, Taunsa, Kohala and Bunji hydro-power projects. The newly approved projects include Port Qasim (coal) that would generate 1,320 MW, Suki Kinari (hydropower) 870 MW, Sahiwal (coal) 1,320 MW, Engro Thar (coal) 660 MW, Muzaffargarh (coal) 1,320 MW, Gwadar (coal) 300 MW, Quaid-i-Azam Solar Park 1,000 MW, United Energy (wind) 100 MW, Dawood (wind) 50 MW, Sachal (wind) 50 MW, Sunnec (wind) 50 MW, Rahim Yar Khan (coal) 1,320 MW, SSRL Thar (coal) 1,320 MW and Karot (hydropower) 720 MW. In the second round of investment, China plans to engage in generation of another 6445 MW with Pakistan. Some analysts have been critical about China's engagement in coal-based power generation due to environmental implications for Pakistan.

The United Arab Emirates has agreed to provide an existing power plant with the capacity of 320 MW. An agreement already is established between the Pakistan Electric Power Company (PEPCO) and the Abu Dhabi Water and Electricity Authority.[16] This will involve 13 gas turbines that will be transported and reinstalled in Pakistan. To increase its power generation capacity, PEPCO had planned to transform this into a combined cycle power plant, by installing two steam turbines of a total capacity of 120 MW and the project has been approved by the Executive Committee of the National Economic Council in December 2010 but the project is still pending with no further progress in its status.[17]

An MoU was also signed between Ministry of Water and Power, Pakistan, Private Power and Infrastructure Board (PPIB), and Al-Nakhra Company (ANC) holding LLC in March 2014. According to this agreement, two coal based projects with a capacity of 660 MW each at Pakistan Power Park at Gadani will be installed to add 1320 MW to the national grid. Total investment of USD 2.5 billion will be made and the project will be completed in three years.[18]

From the European Union, the French government has been receptive to Pakistan's request in supporting energy demands. The French companies *Total* and *Sun Power Corporation* will support up to a 100 MW solar power capacity in Quaid-e-Azam Solar Park at Bahawalpur. The French firm GDF SUEZ has also constructed 404 MW UCH-II independent power plant in Dera Murad Jamali, Balochistan. Similarly, Jaggran II hydropower project in Azad Kashmir at River Neelum is under construction with a soft loan of Euro 68 million for 48 MW capacity and the project is expected to be completed by 2016-17 which will cater to the electricity needs of 1.2 million people in Muzaffarabad.

The Government of France has agreed to provide another PKR 8.5bn (USD 86.61m) funding for establishing two hydro power projects, namely Mohmand/Munda hydro power project and Harpo hydro power project 775MW capacity. In the Mohmand Agency of Khyber Pakhtunkhwa province, Agence Française de Development (AFD) will provide loan for funding Phase-I of the 740MW Mohmand/Munda project.

[16] Since 2009.
[17] The News International (2009) and Dawn paper Magazine (2013)
[18] www.ppib.gov.pk

From the European Union, German government and Kreditanstalt für Wiederaufbau[19] (Kfw) have agreed to provide Euro 20 million for 35 MW Harpo project in Gilgit-Baltistan. In case of alternate energy, AZUR Energy Group of Germany plans to setup a 50 MW solar project for Multan and Bahawalpur, for which the feasibility report has been conducted.

The Italian oil and gas company, ENI (*Ente Nazionale Idrocarburi)*, discovered a gas field in Badhra near Karachi with estimated reserve between 300-400 billion cubic feet. ENI is also the largest foreign producer in the Pakistan exploration and production (E&P) sector since 2000 with a yearly average net production of 54,800 barrels of oil equivalent per day in 2011.

Russia has been a recent entry in the list of countries supporting Pakistan in the energy sector. Techno Pro Mexport Russia and Genco Holding Company Limited (GHCL) signed an MoU in May 2014 for rehabilitation and conversion of 660 MW at Muzaffargarh Thermal Power Station to coal. The government has decided to privatise the Muzaffargarh Thermal Power Station (MTPS) and its conversion to solid fuel (imported coal) will also be taken up at a later stage.

From the neighbourhood, Iran will build a powerhouse in its Zahedan province bordering Pakistan to generate electricity for export. Iran has also expressed its willingness to provide a loan of USD 800 million for the project. Under this project 1000 MW power will be imported and the power transmission will take four years. A 700-kilometre transmission line of 500 kilovolts (0.5MW) will also be laid from the Pakistan-Iran border up to Quetta. Iran has shown its willingness to provide USD 900 million for the project.

The government has already approved USD 1.5 billion in January 2013 for constructing the 785 kilometers Pakistan segment of the pipeline with Iran to deliver 750 MMCFD (million cubic feet gas per day). About USD 1 billion will be financed through Chinese loan facility and Pakistan will raise USD 500 billion through Gas Infrastructure Development Cess (GIDC). The project was expected to be completed by December 2014 but international sanctions on Iran led to the postponing of the (IP) project. Despite sanctions Pakistan is already importing 74 MW of electricity at Gwadar.

Another possibility being considered by the Ministry of Water and Power is the import of 500 MW initially on an urgent basis and 1,200 MW

[19] Reconstruction Credit Institute

at a later stage from India. The World Bank (WB) has offered to finance the feasibility study and transmission line through Wagah-Attari border. The counterpart ministries have met on three different occasions and terms have been decided. However, trade relations between both countries are being harmed due to security threats and mistrust. This has partially been the reason for slow progress on Turkmenistan-Afghanistan-Pakistan-India (TAPI) gas pipeline since 1995. This 1,680 km pipeline is envisaged to have a capacity of 3.2 billion cubic feet of natural gas per annum (Bcfd) from Turkmenistan through Afghanistan and Pakistan up to Pakistan-India border with estimated capital cost revised in 2008 at USD 7.6 billion. Turkmenistan would be the only supplier of gas to Afghanistan. The latter will buy 500 MMcfd and Pakistan will purchase 1,325 MMcfd with India also purchasing 1,325 MMcfd. The first gas flow was planned to start from 2017.

Pakistan has also engaged Tajikistan, Afghanistan and Kyrgyz Republic for Central Asia South Asia (CASA) power project through which Tajikistan would export up to 1000 MW of electricity to Pakistan. The total project cost estimated is USD 997 million and World Bank being the major contributor will grant a loan of USD 526 million. A transit fee of 1.25 cent per kilo watt hour has been finalized for supplying electricity to Pakistan from Afghan territory.

The Ciner Group of Turkey has also agreed to establish a 660 MW power plant at Gadani in February 2014 and offered to start work immediately in Gadani Power Park. This park was announced by the government in August 2013. Another Turkish company, Limak Group, has completed the pre-requisites for investing in wind energy and a coal-fired power plant in Gadani Power Park in 2014.

An MoU was signed in August 2013 with Qatar for investing in power projects that will generate 6,600 MW at Gadani. China National Power and QInvest Qatar will make investment of around USD 5 billion for these initiatives. Pakistan will also start importing 500 million cubic feet per day of LNG from Qatar at a cost of 19 dollars per MMBTU. The imported LNG will be provided to the power sector for generating 2,500 MW of electricity. The LNG terminal at Karachi port will become operational from January 2015. In the first year, government will use 200 MMcfd of the capacity to import LNG and then it plans expanding the import volume.[20]

[20] The Express Tribune (2014)

Saudi Arabia provided a loan of USD 100 million for Neelum-Jhelum hydropower project in addition to USD 81 million loan for the same project earlier. An agreement of USD 40 million has also been signed with Kuwait for this project.

An MoU between Pakistan and United Kingdom was signed in June 2013 for Kandhkot Gas-to-Power Project to be implemented by Pakistan Petroleum Limited (PPL) and Orion Energy plc, an oil and gas exploration company based in UK. The power project will be installed near the Kandhkot field with an initial size between 25-50 MW. An additional 40-45 MMscfd gas may be allocated to the project by the government in which case the power plant's capacity could be enhanced up to 250 MW. The Oracle Coalfields of UK will invest USD 610 million to produce 5 million tonnes of coal and 300 MW power plant planned for K-electric. The lease for the mine has been agreed for 30 years. It is extendable if required.

Rame Energy from UK has lined up an arrangement with Pakistan-based engineering company Vital Tech Engineering and Services. In August 2014, Rame's subsidiary, Beco, has signed an MoU with Vital Tech (VTE) to provide off-grid, renewable energy based power supply systems for a variety of applications, which VTE will then install and maintain.

A Norwegian company NBT (Nordisk Bageriteknik) is set to invest in a 500MW wind power project at Thatta with USD 1 billion investment that will cater power demand for the locals in the district. The preliminary studies regarding wind data, environmental protection report and technical studies have been done by the NBT. NEPRA is in the process of finalizing the tariff structure and modalities for this license.

With South Korea, the government has signed three MoUs in energy sector investments in April 2014. Under one of these MoUs, Korea will invest in 100 MW Gulpur hydel power project. Similarly two Korean firms, Korea Midland Power Company (KOMIPO) and K-Water and Daewoo consortium will invest USD 2 billion for 1,161 MW electricity generation in lower Spat Gah hydropower project and Lower Pallas Valley hydropower projects located in Kohistan district of Khyber Pakhtunkhwa.

United States and Pakistan signed a USD 72 million project agreement to refurbish and upgrade Mangla Dam located in the Mirpur district of Azad Kashmir in March 2014.[21] The rehabilitation will improve the operating capacity of the hydroelectric plant at Mangla Dam by 90

[21] Pakistan, US sign $72 million deal to upgrade Mangla dam published in "The Economic Times" Mar 7, 2014.

megawatts (MW), enough electricity for about 119,000 Pakistani households. A total amount of USD 150 million loan will be granted by USAID for the project, with $72 million allotted for this initial phase. The detail of investments by USAID and Japan is provided in Table 3 and Table 4.

Table 4
USAID Energy Projects in Pakistan

Project Name	Start Date	Funding ($ thousands)
1. Energy Policy Project	Feb 2012	33,337
2. Gomal Zam Dam Project	Jan 2011	40,000
3. Satpara Dam Project	Jan 2011	26,000
4. Guddu Project	May 2010	18,068
6. Jamshoro Project	May 2010	18,360
7. Muzaffargarh Project	May 2010	15,193
8. Power Distribution Project	Sep 2010	124,000
9. Tarbela Dam Project	April 2010	16,500

Source: www.usaid.org.pk

Table 5
Japan International Cooperation Agency (JICA)
Energy Projects in Pakistan

Project Name	Start Date	Million YEN
1.Energy Sector Reform Program	June 2014	5000
2. Project for Improvement of Training Capacity on Grid System Operation and Maintenance	May 2011	474
3. National Transmission Lines and Grid Stations Strengthening Project	March 2010	23,300
4. Introduction of Clean Energy by Solar Electricity Generation System	2010	480
5. Dadu Khuzdar Transmission System Project	December 2006	3702
6. Punjab Transmission Lines and Grid Stations Project	May 2008	11,943
7. Load Dispatch System Upgrade Project	August 2005	3839

Source: JICA 2014

Fiscal Provisions for Energy Sector Investments

The private sector independent power producers (IPPs) are generating more than half of the power demand i.e. around 57 per cent of the total power production at an average of 6168 MW. There are 37 IPPs in thermal electricity generation (27 connected to PEPCO and 10 to K-electric) with 5 of these IPPs in hydel generation and 1 IPP in wind electricity generation.

The energy sector is marred with fragmented energy governance.[22] Around six ministries and substantial number of ancillary organisations are involved in the country's power policy management and regulatory processes. The entry for the private investors is difficult in this sector given the collusive behaviour of the existing players. Even with certain profits for the existing private power sector entities, it is difficult to expand and raise investment owing to slow progress of power policy implementation and

[22] Ahmed (2013)

existence of preferential treatment and distortions through statutory regulatory orders (SROs).

Table 6 indicates the loss to national exchequer by the government's concession and exemptions granted in the taxation structure through SROs issued within a time period of one year (2013-14).[23] The custom duty exemptions incur a loss of PKR 249 billion annually to the economy. These exemptions are granted to imports from China, Indonesia, Sri Lanka, Malaysia, Mauritius, Pakistan-Iran and more recently to Pakistan-Afghanistan transit trade along with vendors and OEMs of automotive sector in the country. The exemptions once allowed are rarely revisited.

Table 6
Economic Loss to National Exchequer

Type of Tax	2013-14 PKR Billion	2012-13 PKR Billion
Income Tax Exemptions	96.6	82.3
Sales Tax Exemptions	249	37.4
Custom Tax Exemption	131.5	119.7
Federal Excise Tax Exemptions	20	-
Total	497	239.4

Source: Computed from SROs at http://www.fbr.gov.pk/SROs.aspx

Some key factors responsible for the reluctance of private sector to invest in Pakistan's energy sector are discussed below.

Biased slabs of Corporate Tax Rate

It is indicated in the Finance Act 2014 that 20 per cent corporate taxation rate will be charged to foreign investors for a time period of 5 years in setting up new plants. This is in sharp contrast to the local investor who is

[23] Not all of these SROs relate to energy sector, however they do have knock-on effects on all sectors of the economy. A detailed study is still required to assess the impact of energy-specific SROs.

being charged a rate of 33 per cent. Some businessmen are of the view that such concessions can cripple the local industry and reduce incentives for long term investment by local investors. The situation is exactly opposite in India where corporate tax rate is 40 per cent for foreign investors and 30 per cent for local businessmen. Table 7 highlights the prevalent corporate tax rates in different countries:

Table 7
Corporate Tax Rate Comparison with Different Regions

Country	Tax Rate	Country	Tax Rate	Country	Tax Rate
India	30%	Australia	30%	Switzerland	8.5%
Bangladesh	27.5%	Germany	15%	Norway	27%
Uzbekistan	8%	China	25%	Canada	15%
Kazakhstan	20%	Singapore	17%	France	33.3%
Azerbaijan	20%	Russia	20%	United Kingdom	21%
Bhutan	30%	Malaysia	25%	Denmark	24.5%
Afghanistan	20%	Indonesia	25%	Kuwait	15%
Pakistan	33%	Thailand	25%	Oman	12%
Kyrgyzstan	10%	Japan	25.5 %	Saudi Arabia	20%
Sri Lanka	28%	Singapore	17%	Brazil	34%

Source: www.kpmg.com,

Discouraging Alternate Modes of Energy

Under the shelter of the original SRO 575(I)/2006, government had exempted the custom duty on imports of solar panels and related equipment like PV modules, solar lanterns, batteries and inverters to meet the energy demand specially in summer when the country's energy demand jumps to around 18GW of electricity. The government tried to encourage the local manufacturers to invest in solar energy.

The Finance Act 2014 announced not only 5-10 per cent duty on solar imports, a 32 per cent import duty was also imposed on PV cells, 10 per

cent duty on batteries and 15 per cent on solar lamps. This has sent a discouraging signal to the private sector wishing to invest in green technology and alternate energy generation in Pakistan. Such interventions discourage the raw material import of alternate modes of energy.

Gas Infrastructure Development Cess (GIDC)

Government has raised the GIDC by issuing SRO 1091(I)/2013. Initially, GIDC was introduced by "Gas Infrastructure Development Cess Act 2011'' in 2011 to finance the infrastructure development for import of natural gas.

It was estimated that government will be able to collect PKR 34 billion under this surcharge.

As per SRO 1091(I) /2013 the GIDC surcharge on fertiliser sector has been raised to Rs.300 per Million British Thermal Unit (MMBTU) from Rs.197/MMBTU and for power and industrial sector, it is doubled from Rs.50/MMBTU to Rs.100/MMBTU which was later increased to Rs.150/MMBTU through Finance Act 2014. Similarly, the GIDC for IPPs has been increased to Rs.200/MMBTU.

It is estimated that under this surcharge of GIDC, PKR 140billion will be generated from the gas consumers which can be used to finance the ongoing gas infrastructure projects including TAPI pipeline, Iran-Pakistan (IP) pipeline project and in the development of Liquefied Natural Gas LNG project. This increase in GIDC has put the investors in a liquidity crunch as they are already suffering from the supply shortage of gas.

Discretionary Powers of Inland Revenue Authorities

The granting of discretionary powers to Intelligence and Investigation authorities under Inland Revenue with the help of SRO 351(I)/2014 will become a major threat in keeping private sector from investment in mega projects. This would also allow constant intervention of public authorities and rent-seeking activities. It is important that before arbitrary issuance of such SROs, the private sector associations such as the Federation of Chambers of Commerce and Industries (FPCCI) and Pakistan Business Council (PBC) are taken into confidence. It is possible that with their intervention, the revenue collection could be further broadened and new sectors could be brought under the tax net.

Monopolisation of Energy Supply Chain

After restructuring WAPDA, NTDC is still under state control and is the sole buyer of electricity in the country.[24] The National Electric Power Regulatory Authority (NEPRA), a regulatory authority that came into being in order to promote efficiency and equally promote the interest of investors, operators and consumers and is responsible for tariff structure and pricing mechanism in the power sector. The current practice indicates that NEPRA has become a toothless body with no effective powers to check or punish the wrong interventions by the state. The private sector in energy generation has no open access to distribution and transmission network in the country; nor are they allowed to sell electricity directly to the consumers.

Box 1 provides a case study from India which has created competition within the private sector but with effective regulation. This has implied certain access of the consumers to both residential and industrial power supply.

[24] Water and Power Development Authority (WAPDA) and KESC are the two main electric utilities in the country, though after unbundling, WAPDA was split into 9 distribution companies DISCOs and 4 thermal generation companies GENCOs and 1 National Transmission and Distribution company (NTDC). All have their own institutional and organizational weaknesses which are well documented across literature.

Indian Electricity Act 2003:

This Act marks the third phase of India Power Policy 1995. The Government of India has decided to increase the private sector investment in 1,000 MW power generation projects. The electricity Act 2003 replaced all the existing laws and created well-restructured framework of Indian power sector where special incentives were given to private producers. The three key components of the Electricity Act 2003 include:

Generation	***Transmission***	***Distribution***
Objectives i. De-licensing of generation ii. Captive power policy liberalisation	i. Access to transmission and distribution lines	i. Access in phase manner ii. Transparency in subsidy management iii. Penalties for power theft
Impact i. Attraction of more private investors ii. Captive generation Increases	i. Free choice to choose efficient way of power transfer/customer of own choice	i. Reduction in losses ii. All equally benefited iii. Open choice for buyer to choose supplier

Liquidity Crunch

In 2013-14, 37 private power producers were involved in thermal energy generation either by consuming petroleum products or natural gas. Under 2002 energy policy, IPPs have to buy fuel on their own for running the thermal plants while in the case of IPPs of 1992 policy, the state will provide fuel to them through Pakistan State Oil or natural gas distribution companies.[25]

The IPPs working under 2002 power policy are not able to sustain their operations if they do not make payments to the fuel suppliers (otherwise they have to stop their production). However under 1992 power policy, IPPs do not need to pay to national oil refineries until they get payment from government.

[25] The News International (2014) Jamal Nasir: IPPs plan cut in generation amid rising circular debt, Dawn 2014 Ali Fahd & Fatima Beg (2007)

These cash flow problems of the private sector are not allowing them to achieve full capacity level. Almost 65 per cent of the petroleum products used by the private sector are imported for thermal power plants, which also require foreign exchange reserves to meet the current demand.

Conclusion and Recommendations

This paper identifies challenges and opportunities of fund raising for energy projects in Pakistan. Our qualitative assessment reveals that law and order – although an important issue – was not ranked as the most important barrier to investment in energy sector. Those with larger capacity to invest, work under the regime of favourable sovereign guarantees and several layers of insurances and hence damage compensation.

Investors were however found to shy away from the energy sector due to the following reasons: (a) fragmented energy governance in Pakistan, (b) low revenue collection by existing energy generation and distribution companies, (c) persistent transmission and distribution losses and theft of both power and gas, (d) distorted fiscal incentives through SROs regime and (e) lack of favourable regulatory and operational environment for alternative energy projects.

The business community also pointed out the ambiguous role of the "state" in the energy market. The state apparatus in Pakistan persistently controls prices, supply quotas and also the import of energy inputs through which power is generated. Such a heavily regulated environment is acting as a barrier to entry for new firms which intend to invest in the energy sector. Foreign investors have also pointed towards controversies surrounding the privatisation of DISCOs, for example K-Electric, where the federal government continued to subsidise the operations of this entity after several months of its privatisation.

The role of fiscal policy in promoting investors for energy security in Pakistan needs to be quickly revisited. Key reforms should be as follows: (a) FBR may be asked to look into the biased slabs of corporate taxation in case of foreign versus domestic investor, (b) finance act 2014 discourages the renewable/alternative means of energy generation and this anomaly should be removed, (c) business community should be taken into confidence vis-à-vis utilisation of GIDC proceeds, (d) processes and procedures involved in the import of petroleum products particularly for raw material should be rationalized and (e) the issue of untargeted, hidden and cross subsidies in energy sector should be resolved.

The multilateral and bilateral development partners have shown their keenness to expand their assistance in energy sector. However, they lamented the lack of capacity in the public sector to develop innovative project proposals. A large part of investments by friendly countries are government to government contracts, though for investment promotion, business to business joint ventures involving foreign direct investment may be encouraged. In this regard, Board of Investment (BOI) should allow "automatic route" investment for all the countries. The rules related to foreign currencies' movement, particularly repatriation of profits and invested capital may be relaxed for the energy sector. This will also help in raising funds for future energy trade opportunities such as CASA-1000 and TAPI. ■

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CHAPTER-5

Autarky in Energy and Power

Dr. Shaukat Hameed Khan[1]

Introduction

Pakistan is facing a major socio-economic crisis in the energy and power sector, which is entirely self-made. Energy and power is neither secure nor useable/affordable. There are plenty of policies, but their implementation is uneven, and even incoherent. Pakistan now faces a major risk of de-industrialisation if energy and power is not available at appropriate price. Various studies have estimated the annual losses at about 2 per cent of GDP and industrial decline of 12-37 per cent due to power outages.[2]

The present generation capacity is around 23,000 MW against 47,000 MW planned for 2015 in the Energy Security Plan of 2005, which had also proposed a power generation capacity of 160,000 MW by 2030 (adding on average of 7,000 MW every year). This may appear high at first, but if this target is realised, the per capita electricity in 2030 would still be the same as that of Malaysia in 2012. Demand is suppressed by unreasonable pricing and inefficiencies in the entire supply chain, which leads to massive black outs and 'load shedding' across the entire country. The circular debt of Rs. 872 billion in 2013-14 has already crossed Rs 550 billion in six months of the current financial year. The matter is further complicated by subsidies and confusion about pricing and contract enforcements in private sector power production coupled with considerable T&D (transmission and distribution) losses, which is basically theft. Those who pay their bills are burdened for this 'loss' by higher prices.

The saving grace in the entire scenario is that Pakistan is the cleanest energy producer and consumer in South Asia, as natural gas is used for home use, transportation, and power production. The gas transmission system is over 11,045 Km long, with a distribution network of 129,000 Km.

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[2] I. Cheema, Pakistan Defence, Jan 24, 2015.

Demand Data

All scenarios in Pakistan point to a rising gap between supply and demand in the foreseeable future. The demand has increased four- fold[3] in the last 30 years, and is projected to increase eight times by 2030, and by a factor of 20 in 2050, brought about by a rising middle class. The ratio of growth in primary energy production against GDP growth is currently hovering above 1.15 because of slippages and backlog of the past several years.

Pakistan has singularly failed to manage energy pricing, mix or diversification of resource in the power sector. Base load (availability 24/7) is only possible through fossil fuels or nuclear, while hydro power in Pakistan is seasonal, since the dams are meant primarily for agricultural use as a replacement for water lost to India in the Indus Basin Treaty of 1962. Similarly, renewable energy (RE) will not be able to provide the base-load; it can only supplement fossil and nuclear based systems. Moreover, RE was never competitive without special subsidies and incentives, and has been further hit by falling oil and gas price. Any attempt at achieving energy autarky has therefore to be addressed within the following context:

a. Electrification of global economies and societies in the last 20 years, which has seen primary supply growing by 2.5, while electricity demand has increased by 3.5 during the period.
b. Looming drawdown of fossil fuel resources globally.
c. A supply glut caused and dropped in oil and gas prices by OPEC preserving its market share and higher oil and gas production in USA and Iraq, coupled with falling demand.
d. Retreat from nuclear in some countries but new investments in others.
e. Increasing policy focus on energy efficiency.
f. Growth in RE (wind and solar), based upon incentives in some countries, even as many RE companies face crippling debts and even bankruptcies.

The Pakistani Factor

Several aspects of Pakistan's energy scenario stand out prominently. Apart from a badly managed supply chain for primary fuels, the system is plagued by gross inefficiencies in electricity generation and bad contracts for

[3] Pakistan Economic Surveys, 1970 -2013.

primary supplies and power from private producers. This is further compounded by inadequate local exploration and prospecting, as well as storage and shipping capacity.

Natural Gas

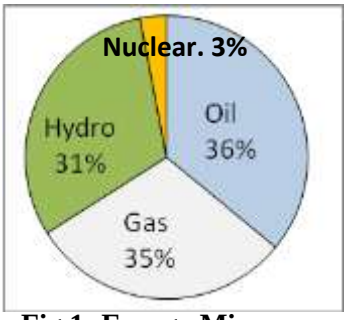


Fig 1: Energy Mix

The current energy mix (Table 1) is dominated by oil and gas followed by hydro. Coal is negligible at under 0.2 per cent while the share of nuclear is just 3 per cent. Pakistan is running out of local natural gas, with a shortfall of 3.2 bcfd[4] (48%) in 2014 against a demand of 6.7 bcfd. This is expected to reach 5.7 bcfd (71%) in 2017[5] as against a demand of 8 bcfd. The reserves had dwindled to only 13 tcf (trillion cubic feet) in 2013, just enough for 12-15 years at current production rates. While it makes sense to import gas from Central Asia and Iran through pipelines or LNG from the Persian Gulf to feed the large T&D infrastructure, built over the last 50 years, the prices negotiated so far are high and the amounts to be imported are totally insufficient to have any meaningful impact.

If IP (Iran-Pakistan) and TAPI (Turkmenistan–Afghanistan-Pakistan-India) pipelines and the Engro LNG terminal had been commissioned, we would have received a total of 1.05 bcfd in 2015. Only the LNG terminal is likely to become operational during 2015, which means that only 0.3 bcfd may be added this year (**Table 1**).

Flow, billion cubic feet/ day (bcfd)	**2015**	**2017**	**Cost, US$/ MMBTU**
IP	0.25 **(0)**	0.75 **(0.25)**	11-12
TAPI	0.5 **(0)**	1.3 **(0)**	11-12
LNG (Qatar)	0.3 **(0.3)**	0.6 **(0.6)**	18-21
TOTAL	**1.05 (0.3)**	**2.65 (0.85)**	**Avg : 13.8**

Table 1: Amount of Gas Import and its Negotiated Price.
(The actual supply is shown in brackets)

[4] bcfd: billion cubic feet per day
[5] ISGS, 2013.

The effective additional supply in 2017 would therefore be only 1.05 bcfd against the projected shortfall of 5.7 bcfd. In addition, IP and TAPI will supply gas into our system at around US$ 11 compared with a typical price of US$ 6/mmBtu charged by Turkmenistan for export to China.

India and Spain contracted for LNG imports from the USA (end of 2013) at US$ 9.5 and US$$ 10.4 per mmBtu respectively, and are expected to fall by another 30 per cent during 2015[6] because of over-supply and weak demand. These prices are set to fall further with the lowest growth of Chinese LNG imports since 2006 while the Henry Hub spot price also fell to $2.73/mmBtu in the first week of February 2105.[7] LNG spot prices are currently hovering around US$8 in the Asian market.

Pakistan has reasonably assured reserves of shale oil and gas of 9.1 billion barrels and 265 tcf (recoverable 105 tcf) respectively.[8] The bad news is that Pakistan had only about 100 conventional wells drilled last year, although this is an improvement[9] on previous years when the average number of wells drilled annually stayed at around fifty-eight. This needs to be scaled up significantly and shale reserves exploited at the earliest.

Oil

Pakistan imports some 80 per cent of its oil requirement. The current assured reserves of 310 million barrels will last about 11 years at the current production rate of 100,000 barrels/day. The drastic fall in oil prices in the past six months offers opportunities for lower prices in power generation. Furnace oil has been used for decades in Pakistan to produce electricity, and was competitive in terms of heating value until 2004, when oil prices climbed upwards. The recent fall in oil prices means that this can now continue to be used in power plants for the foreseeable future. This

Spot Prices, Dec. 2014	**Price US$**	**$/mmBtu**
Oil/barrel	45	7.5
Coal/Ton	53	2.35
Gas/mmBtu (Henry Hub)		2.73

Table 2: Price in Dec 2104 vs Heat Value

[6] *Reuters*, Dec 11, 2014.
[7] EIA Natural Gas Weekly Update, Feb. 4, 2015.
[8] EIA/ARI, 2013.
[9] www.indexmundi.com/energy.aspx?country=pk

also offers an opportunity to plan for increase in storage facilities from the current 18 days to 90 days, as envisaged in Vision 2030.[10]

Coal

While lignite coal in Thar has been discussed for decades, no worthwhile mining has taken place. The reserves are estimated at about 185 billion tons, but the reasonably assured minable (RAR) reserves are only 3 billion tons. If 20,000 MW is produced from this coal, the RAR would last only 20 years (at a minimum of 7 million tons /1000 MW). It may be noted that gas (synthesis gas) from conversion of lignite coal has a heating value which is one-tenth of natural gas. Table 2 shows the heating value of fossil fuels based on heat value and current market prices. Coal is now cheaper than oil or gas because of glut in inventories, weak fundamentals, and weak demand from major European and Chinese importers.[11]

In the absence of large scale mining of Thar lignite coal, an interim solution lies in importing coal from South Africa, for instance, to feed new coal fired plants. While there are concerns of environmental impact, Pakistan can and should invest in such plants as our GHG footprint is extremely low, because no coal fired plants exist in the country. Further, such plants should be based on super-critical and ultra-super-critical systems which operate at higher pressures and temperatures, and have efficiencies of around 58 per cent. This also helps to reduce emissions because of better heat conversion.

Pricing of LNG Import

An alternative pricing mechanism, such as a linkage to Henry Hub or NBP (UK National Balancing Point), in long-term LNG contracts[12] is both desirable and possible. This involves moving away from the JCC benchmark, and re-negotiating prices based on heating values and Henry Hub calorific values.

The Asian LNG markets have been historically linked for their long-term contracts to oil prices. However, increasing discontent among Asian buyers is likely to lead to the development of an Asian hub, and some Japanese utilities are already re-negotiating contracts with Henry Hub

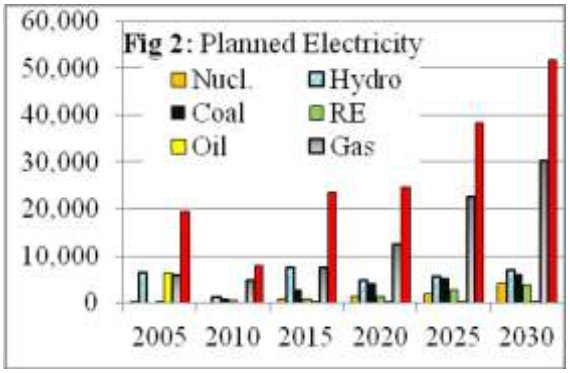
[10] Vision 2010; Planning Commission, 2007.
[11] Gareth Carpenter**,** Platts, Jan 23, 2015
[12] Miyazaki et al;

benchmark instead of JCC. Pakistan should play an active role in the facilitation of an Asian pricing hub based upon plentiful supply projected in the next 5-6 years.

Pakistan also suffers from low storage capacity, which would prevent it from benefitting from lower prices and demand at the global level. Storage capacity needs to be set up which would include on-shore and off-shore tanker capacity. Oil storage capacity is also low.

Pakistan's Power Sector: Efficiency Matters

Fig.2 illustrates the slippage between planned and actual additional electricity generation. If the 2005 Plan had been implemented, 47,000 MW should have been available in 2015, while actual capacity is around 23,000 MW. Electricity production did increase from 59 GWh to 93 GWh during 2000-2008, but it has remained more or less flat since then.



The average plant factor has hovered at around 45 per cent, and one GENCO (Faisalabad) is operating at as low as 6 per cent, while the overall[13] efficiency of GENCOs i.e. the generation companies is 24 per cent (NEPRA, 2013). This can be attributed to failure at all levels, from regulation to generation, transmission, distribution, and maintenance, in addition to poor management. The result is that average national electricity tariffs are

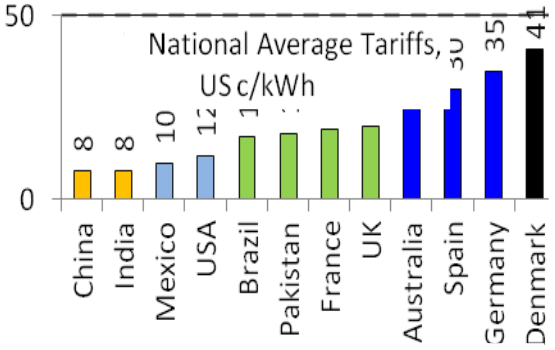


Fig 3

[13] NEPRA, 2013

around 18c/kWh, the same as France,[14] and higher than China or India (8c/kWh) or the USA (12c/kWh), which make Pakistani industry quite noncompetitive, leading to gradual de-industrialisation.

Improving the energy chain efficiency, coupled with stoppage of thefts, reduced T&D losses and the use of flexible smart grids is imperative if Pakistan wants to produce electricity at competitive rates. In addition there is a need to establish 220 Kv rings around major urban demand centers. *Training of operators* in operation and maintenance of generation and T&D systems needs to be implemented on priority basis. By comparison, nuclear power plants in Pakistan operate at 86 – 90 per cent availability factor.

Nuclear Power

Nuclear power is an attractive alternative. It is least sensitive[15] to price as compared with coal (by 40%) or gas (by 90%), and is cheaper for electricity generation even after the recent drop in oil prices. Typical cost of generation (including O&M and fuel and capital cost is estimated at Rs 7/kWh for the new NPPs (nuclear power plants).

However, the CAPEX is much higher, and this factor has to be borne in mind in the context of the recent announcement of the PAEC that 40,000 MW will be generated by 2050. This may not be feasible, as it would require a growth rate higher than South Korea's. Further, at the rates contracted with China for additional nuclear power plants, the overall capital cost for 40,000 MW of nuclear power will be nearly US$ 140 billion. Coal fired plants of over 130,000 MW capacity can be installed for the same investment.

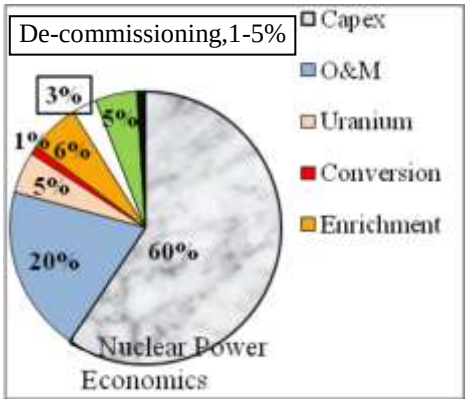


Fig 4

[14] OECD/NEA, 2013
[15] *Ref:* Economics of Nuclear Power, WNO, 2009.

There are also concerns for long term disposal of radioactive waste. A recent study[16] in the USA highlighted the fact that no country was ready for long term safe disposal of hi-level waste, and proposed multilateral programmes to tackle the issue. With 165 reactors over 30 years old and another 138 between 22 and 30 years in age, the global decommissioning costs were estimated at US$ 250b in 2014.[17] One snag will be the Nuclear Suppliers Group which discriminates against Pakistan vis-à-vis nuclear fuel, even though other countries such as India which have nuclear weapons face no such embargoes.

Renewable Energy Climate Change and Energy Efficiency

The year 2015 will be important for tackling global warming. The world is set for warming well beyond the 2 degrees Celsius goal without a new internationally agreed framework to deeply cut emissions. Fortunately, the international community will meet in Paris (COP 21) in December to agree on a comprehensive climate deal which will, for the first time in the world's history, cover both developed and developing countries under a single agreement. This follows a bottom-up approach whereby countries make pledges which reflect their national circumstances. This is very different to the top-down approach adopted in the Kyoto Protocol which had a global mitigation target and country targets allocated were based on the developed/developing country division.

"Mother nature gave us a certain amount of emissions to release in the atmosphere. **If we go above that we should just say goodbye to our today's lifestyles**..... **nuclear power** can play a role in energy security and carbon abatement, yet financing and public concern are key problems that must be addressed".[18]

The increasing emphasis on **energy efficiency** is good news, and has resulted in higher standards and lower energy demands as is the case in China whose growth will become less energy intensive. However, cost concerns[19] in RE are paramount (Fig 5).

[16] Blue Ribbon Commission, USA, 2012.
[17] The Economics of NPPs. OECD, 2012.
[18] Fathi Birol, Chief Economist, The Climate Group, 05 Feb 2015.
[19] OECD/NEA (USA): Grid-Level Systems Cost, 2013.

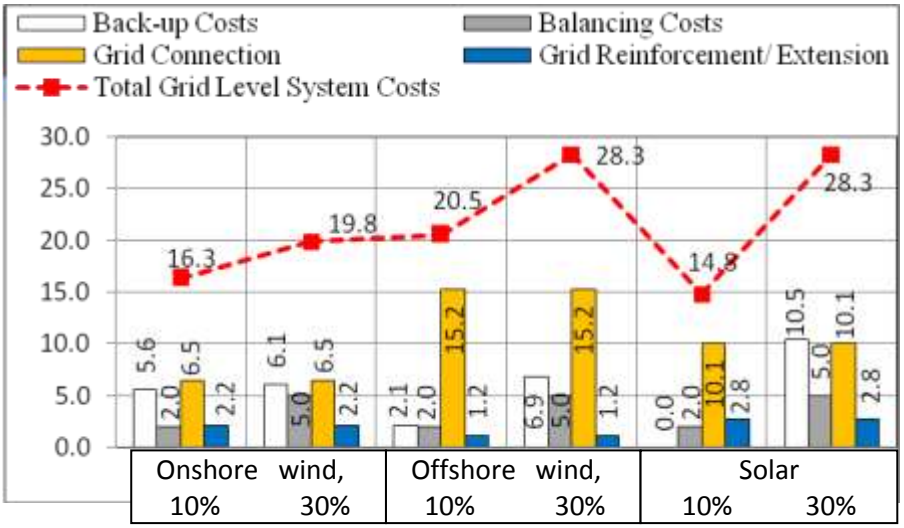


Fig 5: Grid Level System Costs for Wind and Solar, US$/MWh

The main challenge faced by RE is its intermittent nature and unpredictability, especially with wind.

Both require shifts in time and hence storage systems which are expensive, in addition to special incentives ('feed-in-tariffs'- FITs). RE prices have fallen recently, but this is due to over-capacity rather than actual production costs. Chinese PV solar modules are the cheapest at present, but the top 10 producers were facing debts of US$16.3bn in 2014, and are surviving on state credits of US$ 47.5 bn. In Germany and Spain, solar power has witnessed a massive fall in sales after FITs were withdrawn. The Indian wind energy company, Suzlon, has triggered India's biggest corporate default, after losing US$ 338 million in 2012-13. It has been forced to sell off its holdings, including its HQ.

Germany is regarded as a 'green' energy producer with a nameplate wind capacity of 30 GW.[20] However, there are many periods with virtually no wind energy production across the country, and the variation can be between 7 –530 GWh, i.e. by a factor of 75.

The RE storage depends on application, whether it is bulk or distributed. A typical standard might be 2-5 MWh, but it is costly at this scale. However, the demand for storage of electrical energy is already having an impact on the development of grid infrastructure.

[20] Fraunhofer Institute For Solar Energy Systems ISE, Freiburg, 2013.

Biogas Plants

An interesting development in Pakistan has been the growing use of biogas

Farm	Cattle Heads	Digester Size	kWh+ M^3 Thermal	Cost PKR (m)	IRR (%)	Pay Back Period (yr)
Hamidpur Multan	144	175	96+ 18	1.35	42	2.37
Nestle Sukheki	129	200	73+ 6	1.75	37	2.68
Simly Islamabad	143	250	88+ 2	2.18	31	3.2
Sial Farm Jhang	144	100	28+ 5.5	0.78	31	3.2

Fig 6: Examples of Biogas plants in Pakistan, 2012

plants based upon manure from cattle which offers large energy potential. There were 165,000 households in the rural area with 20+ cattle, while 40,000 farms had more than 50 cattle heads. [21] The plants provide gas from fermentation in the digester as well as electric power. The slurry is excellent fertiliser while the rates of return and pay-back period are attractive; such plants can provide gas and electricity at affordable rates in the rural areas in normal times and even better if carbon credits are utilised.

Carbon Credits

Pakistan has not made use of available carbon credits, which are attractive even with falling carbon prices. This applies to the so called 'energy saver lamps' as well as new coal fired plants based on highly efficient heat convertors employing super-critical and ultra super-critical boilers.

Conclusion

There has been talk about importing electricity from Central Asia (CASA 1000 MW Project) or from India. The Indian offer makes little sense, because of India's own chronic power shortages (24%) and losses. The

[21] Pakistan Livestock Census, 2006. Kamruddin, et al , Energy Conference, GIKI, March 2012.

Indian State Electricity Boards (SEBs) are in debt[22] to the tune of US$ 100b. Eight of the 24 SEBs have made losses as high as 40-50 per cent, and another has suffered losses of 30-40 per cent, the numbers being worse than in Pakistan.

As regards the CASA project, electricity will be available in summer and not in winter, in addition to issues related to the Roghan Dam and lesser projected supplies in the future as the Central Asian region's own demand will increase. It also makes no sense to set up the transmission infrastructure over the mountainous earthquake prone area, while coal plants in Pakistan can provide 24/7 electricity at far lesser costs.

Hybrid plants (fossil fuels + solar) can reduce cost of generation in Pakistan, as up to 30 per cent fuel can be saved by pre-heating the steam through solar heating, before sending it back into the system's steam cycle.

At the policy level, Pakistan needs to facilitate the market for energy. This will include preparing business models in generation, transmission, and infrastructure to enable proper pricing of energy within Pakistan and for cross-border trading. Risk assessments, insurance, and dispute resolution mechanisms have to be in place while regulatory frameworks need to be re-defined. When this is coupled with incentives for attracting domestic and foreign funds, the energy crisis can be controlled.

Finally, Pakistan needs to invest over US$ 230 billion in the next 15 years to meet its power needs. This offers an excellent opportunity for industry for manufacturing power plant equipment through strategic alliances with foreign partners.■

[22] Charan (Tata), 2013.

CHAPTER-6

Issues in Energy Policy

Syed Akhtar Ali

Introduction

The nature and scope of the energy problem Pakistan is going through, has become more of a cliché. The crisis, however, is of such a magnitude that it cannot be allowed to continue the way other crises have become part of our national life. It has to be ameliorated as early as possible. The problem is that demand keeps increasing continuously with the increase in population and almost doubles itself in ten years and quadruples in twenty years. The lack of inaction may not be felt immediately, as has happened in the reign of the last military rule. Supplies take longer times to build. Also unfortunately, the institutional and socio-political system has not and may not correspondingly make progress and grow in capability to provide for the bulging demand. In the current decade, as much new electrical capacity (15-20,000 MW) may have to be installed as it has been done in the last 60 years. And it is not the electrical energy alone; there are demands of primary energies as well for house-hold, transportation and industrial and commercial sectors. This is certainly a challenge which will continue unabated. Supplies have to be provided at an affordable cost, preferably lower or competitive with other countries. Pakistan has indigenous energy resources that can make it possible.

Let me say this at the very outset that the current problem of excessive load shedding is not due to shortage of generating capacity of electricity. For the demand that has stagnated over the last 4-5 years, there is sufficient installed capacity of 23000MW plus. A few thousand MW can be considered unstable and unreliable. Even then the demand of 18000 MW could be met, possibly without and may be marginal load-shedding. The problem is of liquidity that does not enable the power producers to purchase oil in required quantities. Liquidity problems are there due to the circular debt caused by non-payment of the promised subsidy while subsidy is required because the cost of generating electricity is more than the retail tariff. There are T&D losses and theft and the non-payment of bills by the

rich and the powerful and even the government agencies, especially of the provinces. To resolve the issue, the government has been able to raise the tariff successively to bring the deficit down to the current level of Rs.1.25 per unit from a level of more than twice this figure. The subsidy requirement would still remain at Rs.125 billion per year. The government has recently declared that it is in the process of arranging the required money to pay off the circular debt, it is hoped that it succeeds and puts its priorities right. It has been estimated that the energy shortages have caused the economy at the rate of 2 per cent GDP per year. It is hoped that government is able to implement, what it has announced.

The issue of gas shortages to the tune of a crisis is, however, genuine and that of capacity. As we shall see, that there is no dearth of resources either, be it coal, hydro power, or wind. Even with natural gas, better management at OGDC could have brought to stream the already discovered resources of 800 MMcfd .It is mired in legal and management issues of various sorts. OGDC has the resources and potential to go into the exploration and development of new gas resources, which are there. FDI and foreign oil companies could also be encouraged in this respect.

The challenge can be met. Institutional and policy environment must be streamlined and fine-tuned to remove bottlenecks, attract domestic and foreign investment, and bring into play the market forces replacing fiat, command and political power. The purpose of this study is to examine in detail the underlying issues at overall and at more practical sub-sector level. We will undertake a perusal of some of the major issues and problems here in this chapter in the following before reverting to the discussion on energy policy.

The last oil price hike was among one of the major factors of devastating Pakistan's economy. Another hike in oil prices in future would put country’s economy at a greater risk. Our dependence on oil is increasing despite such impending and known risk. Pakistan is importing oil worth 10-11 billion US dollars in a year, which amounts to be one-third of its total imports, causing trade gap resulting in IMF loans and assistance that alone bring draconian demands which tend to destroy social peace. Almost all power plants that have come on stream recently run on oil; more are to come. Domestic oil production is not increasing, despite some potential. Gas production is going down and is in the process of being used up. New exploration and discoveries are hampered due to political and law and order problems in Balochistan and elsewhere. Despite the Balochistan package

and other palliatives and offers, the political situation in Balochistan has only deteriorated.

There is no serious breakthrough on Thar coal despite its great potential. Some new initiative is required to cause a breakthrough. On the other hand the federal bureaucracy, barring some settlement on "joint development", seems to be searching for options except Thar coal. The Chinese have been approached to supply more nuclear reactors, which are three times more expensive in capital costs and associated with many other hurdles and political difficulties. However, only the Chinese can possibly develop Thar coal in the remote and scorching heat of Thar Desert. No other country or company can handle the risks involved in such a large project. One can sign countless MOUs, nothing would happen. As a token World Bank has withdrawn support among criticism of financing dirty coal. It is hoped that we manage to put our act together before it is too late and financing coal is stopped altogether in the nearing prospects of solar power. The solution may lie in awarding a 5000 MW project to the Chinese to include all the infrastructure development costs. The Chinese may agree to it on suitable terms.

Some provincial leaders continue opposing construction of new hydel power dams, despite catastrophic floods in their provinces, almost every year. What more rationale and justification can be given of excess water to be stored in dams than these horrific floods in which 45 MAF (million acre feet) of water has over-flown in a few days as opposed to a normal flow of 100 MAF over the entire year? The combined storage of all the dams proposed to be built is smaller than this flow. It is hoped that people in Sindh in general are not going to block dams any further. Dams have long been used throughout to store water and prevent floods. Americans, Chinese, Brazilians, Indians and others have done it successfully. There is no colonialism about it. Let us hope that sense prevails ultimately.

And as for the pricing, government has been subsidising electricity amounting to Rs. 150 billion per year. It has not been able to pay it however, along with the non-payment of electricity bills by the provincial governments. This has given rise to circular debt of Rs. 200 billion. It does not get paid off, as more amounts are added to it successively. And IMF is also demanding to do away with these subsidies. If these subsidies are withdrawn, along with the uniform subsidised tariff, electricity rates in Pakistan would increase. Without electricity subsidy borne out by the government, every province and user would pay for its losses. Thus, Punjab

having lesser losses would end up in lower tariff and the opposite will happen to the users elsewhere.

As it is, electricity is expensive and kind of unaffordable for most of the people and even businesses, Pandora's box will open up. The issue may not end up in terms of the aforementioned cool and cold logic. The issue is far more complicated. KPK will contend that you take away their cheap hydroelectricity at one rupee a unit and sell it back to them at 6-7 rupees. In Balochistan, the cost of gas-fired electricity is Rs. 4 per unit and similarly Sindh produces a lot of gas for electricity production. What is the way out? Balochistan's consumption is quite low and could be jangled in a variety of ways. In Sindh, problems would be further compounded due to KESC against rest of Sindh. More thinking is required on this.

However, the KP issue can be at least partly fixed by resolving the Hydel Profit/Royalty of Tarbela Dam produced electricity. No permanent solution has been implemented. Our suggestion is simple: 12 per cent of Tarbela generated electricity to KP free as royalty or alternatively pay 12 per cent royalty at CPPA's wholesale price. Both are more or less equivalent, transparent and simple to understand and not mired by the complicated calculations of AGN Kazi. It is being done in India. Elsewhere the royalties are lesser. This maximum should be acceptable to the government of KP and even the other distracters. An early decision should be made in this respect in consultation with the stakeholders. These royalties should go towards adjustments of tariff increases. I would tend to support 12 per cent free electricity which has a larger public appeal and would be politically attractive.

Finally energy conservation and efficiency issues should receive government support and attention. A unit saved is a unit produced and even worth more due to environmental reasons. In order to remain out of technical complexity, let me propose here a simple solution that may go a long way in reducing the demand of air-conditioning to a more acceptable level. Two or even three-piece suits have become unduly popular in Pakistan government and business circles, requiring chilling while the outside temperature may be 45 degree C or more. This is awfully expensive. Instead bush shirts should be promoted, as one Japanese PM reportedly proposed for his country in the context of rising cost of energy.

The government has already taken steps towards Demand Management that have worked with varying levels of impact and effectiveness. More could be done, like banning air-conditioning use during

peak hours. This should not sound too horrifying. An efficient country like Malaysia has similar rules in this respect.

Energy has been wasted traditionally due to being cheaper in earlier days. There are upper limits to enhancing residential tariffs due to generally low consumer incomes. In the meantime, tariffs have been on the rise inducing consumers to control usage. Energy saver bulbs and other devices have replaced the earlier types of bulbs. The cost of energy saver bulbs is still too high for the poor. The government has rightly taken steps to provide free or low cost energy saver bulbs to the poor. Energy saving can be promoted also by inducing manufacturers to produce energy efficient devices. Washing machines, air-conditioners, refrigerators, fans, water pumps and motors etc can all be made more energy efficient. Energy labeling programmes, certifying and grading electrical devices and equipment have been introduced in advanced countries. In addition to introducing such programmes, capacity building programmes for producer SMEs may also be launched.

Incentives or coercion may be needed in the industrial sector as well. Price does not work always, if awareness and sensitivities are not there. All saving effort may be diverted towards reducing labour cost and the government dues. Most energy efficiency programmes require infusion of capital and payoff beyond the current years. Tax and cheaper credit incentives for making energy efficiency investments have proved useful elsewhere and the same may be tried here as well.

As has been mentioned earlier, Pakistan faces two crises, among others, that is of electricity and gas. Electricity crisis can be resolved by reducing and eliminating the circular debt and is thus a cash problem and not a capacity problem. It can be resolved, if money comes from somewhere and the debt is paid off. However, it would accumulate again due to the tariff being lower than the cost of production. In a few years, it would become a capacity problem as well — in fact, of both capacity and cash. The gas crisis is essentially of capacity and resource. We have run out of gas, as many other nations have. Allegedly and perhaps correctly, it is said that had enough attention been paid to exploring and developing new gas resources, the situation would not have been as bad as it is today. It has been estimated that there is six times more unexplored gas in Pakistan, than the present known gas reserves.

And then there is the rising price of oil, which often remains at USD 100 per barrel and more. Our domestic gas price is priced at US$ 5 per million Btu is about four times lower than oil. People and industry want gas

or alternative fuel at the usual price. Today, there is a gap of 33 per cent in gas supplies (6 billion CFD demand vs. 4 Billion CFD supplies). All imported gas resources (LNG and Iran Pipeline) are nearly as expensive as oil and will take time to implement the projects. Although some good news has come in, for it has been agreed that TAPI (Turkmenistan gas) would be priced at 55 per cent of oil. It may enable Pakistan to renegotiate prices with Iran on an ongoing basis, without delaying the project, as the terms of agreement reportedly provide for. The logical conclusion is that we have to have cheaper and sustainable energy resources which are only possible through developing the abundantly available indigenous resources, namely coal, hydel and wind.

The Thar Coal Resource

Hydro and wind both are seasonal resources, peaking in summer and receding in winter and thus would need a supporting base load thermal power, which can only come from coal, keeping in view the supply constraints and high prices in oil and gas. Despite all the hue and cry against coal, the latter remains one of the major sources of energy in the US and elsewhere. Unfortunately, the World Bank has reportedly terminated its technical assistance programme for Thar coal due to the opposition of environmental lobbies. We should, nevertheless, continue and develop our Thar coal resources on a fast track basis. There is merit of coal that I would like to draw the attention of the readers to, which is the potential of coal to be converted into diesel and fertiliser at low and competitive cost.

The technical case of coal conversion into oil and fertilisers and other chemicals had already been proved decades earlier. The economics of such conversions had been shaky under an abundant oil and gas price regime respectively under US$ 50 per barrel and US$ 4 per million Btu. The current oil and gas prices at 100 US$ plus and 18 US$ per million Btu, and supply constraints, price instability and political crises have made coal attractive. It was attractive for power production and now it is attractive for conversion to oil and gas. There are studies that indicate a price equivalent to US$ 40 per barrel and gas (from coal) at 4 US$ per million Btu. Although in the US, coal gasification plants are operating by now for many decades, the abundant supplies of natural gas have always militated against coal converted oil and gas. However, countries like Australia, China, New Zealand, South Africa and Germany are taking interest in these propositions. South Africa has already been producing diesel from low rank

coals for several decades now. Its company Sasol has acquired great technical prowess in coal conversion to diesel and has been given contracts in China recently to do the same. China is already quite ahead in converting coal to ammonia and fertilisers. More than two-third of its urea output comes from coal conversion plants. And now Australia has launched several projects in the same domain to convert its low rank coals. Both above-ground and underground coal gasification are being adopted.

UCG has several attractive features such as lower cost and cleaner coal options. However, pollution of ground water table is a major environmental issue and not much is known about it. Perhaps, in Thar, this should not be a major issue, because it already has scarce water resources; practically no water to be polluted, and the population density very low. Water brought from outside is going to sustain the local population and the coal developmental activities.

All routes to coal conversion pass though coal gasification. Coal is burnt under low oxygen (sub-stoichiometric) conditions, to yield SYNGAS which is a mixture of CO, H2, C02 and others with a calorific value of 200-300 Btu, as compared to a CV of 800-1000 Btu per thousand cubic ft for ordinary natural gas. The skeptics may argue that our coal being lignite may not be amenable to gasification. However, it is more appropriate due to its low rank and density. Most projects in Australia, China and Germany are focusing on lignite. Thus UCG (ala Dr. Samar Mubarakmand) or above ground gasification and Lignite or otherwise, there is perhaps no technical hurdle. There is no need of controversy and blame games. All routes are feasible including conventional coal mining and coal gasification. As these are all capital intensive projects; priority, choice and phasing is to be done based on the availability of foreign firms and financing.

Dr. Samar Mubarakmand has done a tremendous job in demonstrating the technology. His exercise should have released tremendous data. It may also result in some power production as well. However, his project and endeavours should not become a liability. It should not stall other projects and initiatives. It is one thing to make a demo project and quite another to install reliable power generating capacities of 1000 Megawatts. There have to be demonstrated credentials to be able to undertake such projects. For no fault of Dr. Samar, Pakistani companies lack the technical and organisational capacity to undertake such tasks. While local R&D may continue, it should be utilised to attract eligible foreign companies to implement power projects based on UCG or otherwise.

More than 200 billion Cft (4 Million Tons of Oil equivalent) is consumed by fertiliser industry for its feedstock and energy input which is about 15 per cent of the total gas consumption. More gas would be required to meet the increasing demand of fertilisers. Existing fertiliser plants, especially those located in the South, are a ready candidate for conversion from Gas to Coal (Syngas). Due to the gas crisis, fertiliser production and availability have been affected which would affect agricultural output. It would be cheaper to produce fertiliser from coal. However, the conversion of one plant is a 300 million US$ plus proposition and may take 2-3 years to complete. But once done, such an initiative will usher into a large and competitive fertiliser. Then, fertiliser industry in Pakistan, would not only meet domestic needs but also potentially result into a viable export commodity. The demand for food and fertilisers is to grow continuously into the future. Through this route, both food and energy security of Pakistan would be enhanced.

For marketing reasons at least, we may have to structure our Thar coal project on Cleaner Coal concepts as coal gasification fits neatly into the theoretical framework of cleaner coal. By designing a programme adding facilities phase-wise, one may be able to diffuse the objections of the environmental lobbies which may oppose the financing of Thar project.

Energy Pricing

Energy pricing issues have become very complicated and loaded against consumers. Our energy sector, in almost all phases and aspects remains totally regulated, and for understandable reasons, hence the possibility of distortions and many malpractices remains there. All costs including theft and graft are passed on to the consumer. Costs are over-stated due to the inefficiencies of the system, and not just the regulatory bodies concerned with energy. There are possibilities of inducting some competition in at least generation activities by auctioning projects on either capital cost basis or on upfront tariff. The irony is that even EPC contracts are not adequately advertised and proper bidding practices adopted.

The regulatory agencies, especially NEPRA, accept the capital cost claims of the project promoters, without credible scrutiny by competent third parties. There is an overbooking of more than 25 per cent in capital costs, as generally believed among the knowledgeable circles. This undeserved surplus is obviously shared among the powerful circles. The Seth alone cannot gulp it down alone very conveniently. Elsewhere anti-

fraud and taxation authorities would also play a role in curbing these practices. In Pakistan, authorities have handled this issue softly for the fear that it may drive away the investors. There is a tendency of seeking more equity share in projects, as practically there is no equity. The regulatory agencies are bending backwards to enhance rates of return on equity, which in their perception, would attract investments.

This practice was relatively less injurious in conventional energy regime wherein the capital cost used to be less than 30 per cent of the total cost of electricity generation. This practice would, however, play havoc with alternative energy projects, as has already started to happen in the case of wind power. Wind power costs have come down throughout the world. In the US, good sites are even offering a rate of 5 cents per unit. The average in world market is around 8 cents. In India, it is about the same or is lower. In Turkey and Brazil, recent bids have given a tariff in that order. In Pakistan, with a very good wind source near sea shore and a capacity factor of above 30 per cent, the upfront wind tariff is 15 cents. Some investors have filed petitions even for more. One can accept the financial cost argument due to higher risk ratings for Pakistan, but the major issue is the capital costs that have been claimed at 2700 US$ per KW and more instead of an average of 1300 US$ per KW, a margin of more than 100 per cent.

There are two fallacies or aberrations that are responsible for such a grave situation. First, classically regulatory agencies have used oil prices as a reference which was perhaps acceptable in low price regime till 50 US$ per oil barrel. This is no more affordable as a viable reference. For, if one has to pay dearly for oil, what would be the situation when it comes to alternate energy source, which public believes is a free source. Affluent countries may be able to adopt that logic for environmental reasons, but even they are not doing it.

Wind power cost in these countries is at its lowest, competing even with coal and gas. Should we think that we are doomed, we would not be able to benefit from the alternative energy sources, because these would be twice more expensive than elsewhere. The prospects for solar energy are bleak, if this kind of pricing behaviour jointly enforced by investors and regulatory agencies continues. Surely, something would have to be done to eliminate these practices. The hope of those responsible is that the average cost may not go very high. The current mix of cheap hydro and gas is not going to go very far. Even new hydro projects are costing more, more than Rs. 5 per unit instead of Rs1.50 for the existing projects. Public is resisting

increase in tariff despite government subsidies and its lack of ability to sustain the latter. It is uncertain that such high pricing approaches would promote expansion of wind power and the power purchasers may stop buying after a few hundred MW. Expansion in wind power is to come though at low prices. Through bad practices and inept policies, every possible opportunity and advantage can be converted into a mere liability.

There is a potential for 5000 MW of wind power in the next 5-7 years at reasonable costs hovering around 8-10 cents, which may be possible through inducting large projects, promoting local manufacture and inducting regional cooperation in South Asia, including India and China. Our Energy Policy should bring about changes that should make the afore-mentioned possible.

The Kalabagh dam issue is mired in controversy and may cost more in terms of national cohesion more than its benefits and better be put on a cold burner. The Bhasha and other large dams may be implemented in public sector, as government is currently doing. The power generation, however, can be implemented under IPP regime to reduce burden on public resources, whether equity or borrowing. Small dams and hydro schemes can make a reasonable contribution, developing local manufacturing and entrepreneurship. As said earlier, hydro is not going to be Rs. 1.50 per unit but would be several times higher. The constitutional issues pertaining to provincial royalties and share in electricity are to be settled without the loss of any more time.

Electricity cost of generation in the US (2011) averaged around 5 cents or under, whereas the average tariff across regions and sectors hovered at 10 cents per KWh. These averages hide a great deal of variations across sectors and regions, but do provide a sense of prices in that country. Natural gas traded at 2.941 US$ per MMBtu on January 10 2012, which was 1.458 US$ lower than the corresponding period in 2011.This is due to the advent of shale gas. While in Europe, around the same period, European Electricity Index (gross weighted average price of the member countries) stood at 6.57 US cents per kWh and Gas Index at 8.16 USD per MMBtu. Natural gas being more than 200 per cent more expensive than it is in Europe; and electricity 30 per cent more expensive in Europe at wholesale prices. It may be of interest to bring in oil prices as a reference. At Brent Crude prices of US$ 110 per barrel, crude oil cost comes to be 19 US$ per MMBtu. In Europe, traditionally, natural gas prices have been at 75 per cent of the oil price. Due to high oil prices, this ratio has come to slightly less than 50 per cent, which used to be the classical gas to-oil price ratio in the

US. Except for LNG, there is generally no linkage between oil and gas prices. Coal, hydro, gas and nuclear are major energy sources in Europe with significantly more imported content than in the US. In the US, mostly cheaper and abundant coal followed by equally cheap and 'abundant gas have kept electrical cost at the lowest in the OECD group.

An important question is whether energy prices can be and should be kept lower than in industrialised countries? From the affordability and social point of view, perhaps we should. How can a consumer pay at the same rate, if he earns at one-tenth the rate? Partly, he can by consuming less, as is generally the case. From the cost point of view, there may not be a very strong argument for lower cost and prices. Most energy has a large imported content; in case of oil fired plants, almost all the inputs are foreign. Including the importation cost and other inefficiencies, the oil based electricity and petroleum costs are going to be at a margin than international prices. In case of natural gas, which remains virtually non-traded except for the small traded component of LNG, we have noted the wide differences between Europe and the US. Similarly, powder basin coal traded at mine-mouth is priced less than 10 US$ per tonne, while the imported coal may cost upward of 70-80 US$ per tonne C&F, although coal is a widely traded commodity. The moral of the story is that international trade price may or may not be an appropriate benchmark while negotiating prices with the developers of local resource. Sufficient safeguards should be built in pricing formula to diffuse and delay the peaks by introducing upper and lower slabs. The same may or may not be possible under long term supply contracts. In TAPI, it has been possible to have this included, while Iranians did not accept this kind of upper or lower slab.

There can be differences in energy prices, especially where local resource is involved and this advantage may not be lost in negotiating DFI contracts for local resource development. Secondly, distribution being labour intensive, these costs for electricity may amount to as high as 40 per cent of the retail price, while in Pakistan this is only 10 per cent. The reason for such a great difference between the two costs, apart from difference in labour cost, level of service requirements in the West and Japan requires distribution companies to keep considerable infrastructure and resources in inventory. Ironically and most regrettably, this cost advantage is lost due to very high T&D losses (more than 30% as compared to 5% in industrialised countries) that include a large amount of outright theft. Otherwise, assuming identical generation cost, electricity can be provided at an average cost that is 25 per cent lower than elsewhere. If Thar coal is developed

carefully on fast track, reasonably low prices of electricity and gas would perhaps be feasible.

It is incumbent upon the Thar Coal authorities to come up with the reasons in public as to justify and explain the rationale for delay. The Eighteenth amendment has brought powers to the provincial authorities. In fact, even before the passage of the 18th amendment, Sindh government had wrested control over Thar coal. However, the complicating issue is that coal is only one aspect; electricity is a federal subject in all provinces. It has been alleged that Sindh bureaucracy has tried to indulge in goal making, while the issue requires a team playing with a large number of federal and provincial players. Provincial bureaucracies have obviously limitations in terms of horizons, capabilities and powers. Unless the federal leadership at the highest political level, having the same party ruling at the centre and the Sindh province, plays a leadership role, perhaps exploiting Thar coal reserves may remain a dream. However, under the PPP government, these political prerequisites were available. There was nothing genuine, profound or real to stall the progress.

If Thar coal somehow does not see the light of the day – which would be a great national tragedy – then the second best choice is the development of natural gas resources. More appropriately put, the next to Thar coal is gas, even if Thar coal sees some progress. It can be the cheapest, cleanest and ready thermal resource. There is a considerable potential for much more gas, six times the known resources. Another opportunity is in Shale and tight gas. Shale gas has brought down gas prices in the US by 25 per cent.1t requires technology and investments mostly from the US companies as the latter have the technology in this respect.

New Gas Resources

The US government has expressed its willingness to share this technology with other nations and has taken certain practical steps in this direction. Global Shale Gas Initiative (GSGI) has been launched, and many nations including India and China have been taken as members of this initiative. Unfortunately, Pakistan despite being dubbed as most allied ally or lackey or care-taker of US interests is found nowhere in the list. Partly or mostly, the fault probably lies with us, of not showing enough interest and lobbying in this respect. Part of the problem lies in the under-development of our oil sector, and partly the law and order situation in our gas prone areas, which discourages involvement of external parties, agencies and companies.

We have to do something about these issues and work towards a political break-through and settlement with the disgruntled forces, and pave the way for initiating much needed efforts both to exploit conventional and new resources in the oil and gas sector. On the diplomatic front, instead of sole focus on acquiring arms or cash from the US, technology such as for Shale gas development should be sought.

For the development of local energy resources, achieving development capabilities is essential. An input suppliers and service provider's network must be there to attract DFI. It is often said that due to rudimentary market conditions, a foreign company has to bring in many resources from abroad which is pretty difficult. In better markets, oil/gas development companies may be awarding contract packages to local service providers and only do the project management and coordination, besides bringing in money. In other areas, the contrary may be true. In case of hardware, most foreign companies are skeptical about local suppliers, except where volume and price difference may be high in their favour.

Chinese suppliers, reportedly discourage even small fabrications to fill up their own factories with orders; and in China, every possible thing is cheaper. However, in the long run, local capabilities and skills, not only of individuals but more so of the companies and organisations will be required. It reduces cost and risk and encourages international companies to undertake projects and invest. Iran, Malaysia and Turkey have made tremendous progress through building local capabilities and incorporating local content policies in the procurement and importation policies. Easier said than done, as international lending agencies and performance guarantee requirements of (turn-key) suppliers often militate against local contents, both positive and negative instruments may have to be used. A good candidate in this respect is wind turbine and its gradual local manufacture for which considerable local capabilities do exist.

The Dilemma of Energy Policy

The dilemma of energy policy and management today is that all cheap local resources are exhausted or their capacity cannot be extended in the short run, no short term supplies are there except expensive solutions like LNG and the consumer is not willing to pay any increase in cost. The CNG consumers pushed the government to the wall and extracted the 50 per cent withdrawal in CNG tariff after a crippling transport strike and street protest. As much as this study’s predilection is towards the development of local

low cost resources which cannot be done in the short term, one may have to go along with GOP's decision for LNG imports. However, one would advise the government to take other short term measures like encouragement of solar heaters and curtailment of CNG consumption by the rich car owners. Also the industrial use of coal briquettes from Thar and elsewhere in the country could fill in the gas supply gap. It is the gas crisis which is real. Power crisis is actually a financial one which can be handled through budgetary means or borrowing mechanism in the short run and by tariff setting in the medium term.

It must also be noted that the time of solar PV is nearer to reality than many people thought earlier. Solar PV may be economical and competitive with grid power by 2020 which is not very far into the future. We should not be repeating what we are doing with wind power, making the latter artificially expensive simply to please and attract unethical profiteers' capital. We should rather be building an enabling environment for the future building skill pools and institutional and organisational capabilities. Somewhere down the line, private investment in solar panels manufacturing and service providing network may have to be facilitated and encouraged. In fact, local manufacturing of solar heaters may be viable even today. Government policies can generate demand for solar heaters thus building this industry and saving considerable amount of natural gas consumption that goes in winter's space heating in most of central and northern Pakistan.

Energy policy can be a thankless job, as it may try to reconcile producer and consumer interests; the producer wanting to have more profits and returns for share-holders which may maximize investments and supply, and consumers with their limited means and general poverty in this country would want to have it extremely cheap. Expensive energy may otherwise lead to widespread theft bordering on loot, as is the case with electricity in most parts of the country except Punjab. Ironically in Punjab, natural gas theft is the highest than in any other province, perpetrated, not by the poor house-holds but by the industrial sector. Then there are supply chain dependency and linkages. If the policy satisfies the primary energy sector, it may leave little margin for the electricity producer. All problems are for a sensitive and conscientious policy maker and government functionary. For those who don't care, there is no issue. People don't expect much from them, lose hope and look forward or pray for their exit or ouster.

Curing the Ailing Energy Sector: Some Humble Submissions

Pakistan is facing the worst energy crisis of its history. Perhaps no other crisis or difficulty has caused as much damage to Pakistan's social and economic conditions as this issue has. It has caused trade and foreign exchange deficit, currency devaluation, decline in economic output and exports and has caused massive unemployment. The energy issue merits highest attention of the government in developing and implementing short term and long term measures. Here are some of the suggestions in this respect.

Development of Local Energy Resources

Pakistan has imported 10-11 billion US$ worth of oil per year over the past few years. High and volatile oil prices have damaged Pakistan's economy. The continuing reliance on oil for producing electricity is a highly dangerous trend. Most projects that have come on stream in the last few years and the ones in pipeline are IC engines running on RFO. The danger stems from three directions: one is increasing cost of generation of electricity (COGE) and the other raising the foreign exchange import bill. The oil price hike of 2007-8 virtually destroyed the economy and damaged electricity /energy sector. Thirdly, oil-based IC engines are less efficient than other options.

Thar coal is larger than the oil resources of our rich brothers of the Middle East. Total Middle East oil and gas resources add up to equivalent of 385 billion tons of brown coal, out of which Iran and Saudi Arabia own 110 billion tonnes of coal equivalent each. Pakistan's Thar coal is 185 billion tons. There is an urgent need to develop Thar coal, without which Pakistan's energy problem cannot be solved. Federal government and its institutions must support Thar coal development. Similarly, hydro and wind resources offer near-term solutions.

Financing Thar Coal

The residual issue as it stands today is not financing of the mining and power parts of the project, however difficult it may itself be, it is the financing of infrastructure which is a stumbling block. Various estimates put these requirements to between 1 to 2 billion US dollars. More money is required for infrastructure, than the first coal mine and power plant itself. The Government of Sindh, obviously would not have such resources, nor

could the Federal government. And in these days of emphasis on provincial autonomy, the demand for common projects has abated. There are also issues related to the technical and management capability of the provincial bureaucracy, as the project continues to be run from the narrow confines of the Sindh secretariat. Apparently, there is no shaft of light at the end of this tunnel, although it is not the only one.

There are two options. One is to tender for a large project of 5000 MW or so, which may be able to assume the infrastructural development costs as the cake becomes big enough to absorb all kinds of interests. This is not new. In India, the coal projects of these sizes are being planned already. The feasibility of this proposal in Pakistan's context can only be tested once it is actually tendered. The second option would be to float tenders for establishing a mining development company that undertakes to develop and finance the infrastructure and manages the Thar coal operations on behalf of the Sindh government, within the framework of the relevant rules and regulations. The company recoups its investments by granting mining leases and charging a fee on coal production by individual companies. Obviously such a company would be a multinational which may have a joint venture with local private sector and government of Sindh's share in it. Such a company would offer many advantages: first, it would bring in finances, which appear to be well-nigh impossible for Sindh government; second, the operations would be more commercial and fast track.

Importing Coal

Uncertainties over Thar Coal implementation have compelled investors to think about imported coal. Several projects have been proposed in the past based on imported coal. Imported coal, although cheaper than oil, it is no less volatile than oil in terms of price variability. In the oil price hike of 2007-8, coal prices also rose proportionally and came down proportionally. It is not coal per se, but the local resource development and controllable prices offered by local coal that is to be a preferred option. However, the option of importing the coal could be utilised for an interim period till better technology to use Thar coal economically was available.

Conversion to Coal

Power Plants

Many oil-fired (Steam Turbine) power plants were converted to coal in the wake of the oil crisis of 1973, and the trend continues till to date despite heightened environmental opposition. The dilemma however that is to be faced is whether it is local coal or imported one. Coal is already being imported for non-utility industrial purposes and hard coal is being mined locally as well, although under low productivity and inefficient environment. Hard coal production, although with smaller deposits, could be fast tracked by installing modern mining equipment and management practices. Utilities use of this coal would spur such conversion. In Punjab, 50 MW coal based power plants have already been proposed under provincial domain. Conversion to imported coal should also be subject to the same provisos as have been proposed in the earlier paragraph.

Urea Fertilisers and SNG

Similarly all urea plants should be converted to coal which would save 200 Billion Cft of natural gas per annum. Similarly, consideration may be given to produce SNG (Synthetic Natural Gas) from coal. The core of these conversions is coal gasification. Both underground and aboveground approaches are feasible and should be followed up depending upon the investor's choice and interest.

Towards a Sustainable Gas Policy

1. Implement Iran -Pakistan Gas Pipeline project counseling Iran on more agreeable pricing and the US to refrain from opposing it. South Asia is an eventual and natural market for vast Iranian gas reserves. Also pursue TAPI to create competition and alternate supplies.
2. Shun LNG, except for emergency period of next 5 years.
3. Pay attention to E&P for new gas finds; Re-energize OGDC; encourage Shale and tight gas resources.
4. Let cooking needs of homes be the first priority. Also facilitate LPG for this sector.
5. All thermal power be moved away from natural gas and be

substituted by coal (from Thar). Existing NGCC combined cycle plants be allowed to complete their economic life on gas. All steam turbine power plants be converted to coal as early as possible; all new thermal power be run on coal.

6. All fertiliser plants (Urea) be converted to local coal including all cement plants, though a number of these have already successfully been converted to coal.
7. Industry located in dense urban areas should be allowed to run on gas for pollution reasons. Industries outside be encouraged to run on coal briquettes and possibly bio-mass.
8. Encourage solar heating, replacing gas heaters. Introduce District Heating and Cooling (CHP & CCHP)
9. CNG to eventually be restricted to urban area public transport for environmental reasons and the needs of an affordable commuter transport. Private vehic1es (more than 800cc and less than 5 years old) be disallowed CNG use.
10. Encourage LPG markets through land routes on Iran and Afghanistan border. Encourage LPG in transport, if found feasible, under varying market conditions.
11. Promote conservation; reduce T &D losses and theft
12. Utilise small dormant/stranded gas fields for well-head power or CNG

Controlling High Cost of Generation of Electricity

All efforts must be made towards controlling the electricity cost and tariff. The full brunt of high cost projects has not yet been felt, due to the availability of one -third electricity from old hydro projects like Tarbela at Rs. 1.30 per unit. There are three aspects that need special attention.

1. Capital costs esp. of power generation projects.
2. Thermal efficiency
3. Reduction of technical and non-technical losses.

Capital Costs

There is a general consensus among experts in Pakistan that the capital cost of generation projects is high. In the adjoining table, we provide data on comparative capital cost, which is self-explanatory. There may be both technical and commercial reasons for this. Regulatory effort and capability in this respect need a lot of improvement. In developed electricity companies, electricity generation prices are market driven. In India there is a big market and a local industry and sufficient domestic market data is available. CERC India is able to announce bench mark rates for capital cost with much less difficulty. In Pakistan NEPRA does not have recourse to such inputs, neither does it seem to have made adequate efforts to enhance its capability in this respect. It relies on simple brow beating the proponent into some downward adjustment based on some input from inadequately informed interveners, and EPC quotes.
In this respect, we make the following recommendations:

1. **NEPRA** should announce benchmark capital cost for three years (indexed) based on external/foreign-consultant recommendations.
2. **EPC** for turnkey projects is replaced by a package approach, whereby a project is tendered in 5-6 packages.
3. **PPRA** procurement rules must be made mandatory for all regulated projects, including energy and electricity.
4. **NEPRA** invests in acquiring and subscribing to 3rd party data source on capital costs, instead of constructing buildings for its offices.

A case in point is the remarkable difference in capital costs and COGE of wind power, among India and Pakistan. In India the capital cost of wind projects is half that of Pakistan, 1200 US$ per kW in comparison to 2500-2700 US$ per kW in Pakistan.

Introduction of competition in a cost-plus regime is possible through auctioning projects based on capital costs or an upfront tariff. Also PPRA rules may be made mandatory for the EPC bidding of the project.

Opening up of Electricity Market

Consideration may be given to introduce an element of open market and liberalisation in the electricity sector. Some of the feasible steps may be the following:

1. Promoting consumers choice for large customers (l MW+).
2. Opening up electricity transmission by allowing 3rd party access on pre-determined wheeling tariff.
3. Doing away with generation licensing requirements for up to 3-5 MW. Mandatory filing may be continued for 1M and upwards.
4. Promotion and permission of open market operations among producers and large consumers on mutually negotiated tariff utilising open transmission regime.
5. Promotion of independent electricity marketing companies.

Royalties

Hydro Royalties

A permanent solution to hydropower royalty issue should be finalized. Ideal and most practical solution may be giving 12 per cent free electricity (a la-India) to the producing province with provisions for sharing with local governments. An alternative is to compute royalty dues at the rate of 12 per cent of CPA price; both options are almost equivalent.

Wind Power Royalty

It is unfair and even unconstitutional to derive benefit from provincial lands without adequate compensation or royalties. No royalty is being included in the NEPRA tariff calculations yet. A policy must be announced in this respect. Wind power royalty is to go to the land owner/lessor. If a government is the owner, federal, provincial or local that government may get the royalty. If it is a private land, private owner gets it. A rate of 2 per cent of sales has been popular in many western countries. This is also compatible with royalty formulae in the mineral sector. At this moment only Sindh province would benefit from it.

Wind potential is there in other provinces as well, especially in KPK, Balochistan and FATA which would benefit from it eventually. It may be worth noting that wind turbines use only 3-5 per cent of the wind farm area, which can continue to be utilised for agricultural purposes. Based on 150 million kWh per year of electricity sales per year of a 50 MW wind power plant, a royalty of 2 per cent would mean a royalty income of 1.5 million

US$ per year that could be shared among local and provincial governments depending on the ownership status of the land. Fortunately, wind power costs are coming down due to emergence of solar option, and unsold inventories are building up. The additional 2 per cent incidence of royalty would be tolerable now than ever before. NEPRA would be well advised to revise its determinations on wind power in the light of recent downward trend in wind power equipment prices world-wide.

Reorganisation of the Energy Sector

Recent Energy Summit deliberations have indicated the need to take a total and integrated view of the energy sector, be it short term emergent needs or long term planning and management. Following steps are recommended in this respect:

Merger of the Ministry of Water and Power and Ministry of Petroleum into one Ministry of Energy ; after the 18th amendment, there is not going to be much federal involvement in mineral sector anyway. Except for India, many federal countries have adopted this approach. Merger of NEPRA and OGRA, which would enable the two organisations to learn from each other and facilitate coordinated energy regulation. In most countries, this practice has been adopted including the USA (FERC), Singapore and elsewhere.

Reorganisation and Liberalisation of the Gas Sector

The current domination of the sector by two distribution companies (SNGPL & SSGC) must go and the sector and the two companies fragmented on the lines of electricity sector, namely replaced by one or two transmission companies and several distribution companies like LESCO, GEPCO, and FESCO etc.

Open transmission access regime to third-party suppliers and gas producers along with consumer choice for large customers should be instituted.

The gas market and a parallel unregulated gas sector, in addition to the existing regulated one, should be instituted to promote investment, production and greater supplies in the sector. This should also cover and include the so called tight or non-conventional gas exploration and production.

Draft rules for tight gas, in the absence of the proposed de-regulation,

seem to be adequate and forward looking. Consideration may be given to pegging the tight gas price to 75 per cent of the oil price subject to 80 US$ per barrel of upper slab, as has been the case of imported gas from Iran.

Demand Management

The recent energy summit has prescribed short term demand measure. Longer term rules are required to be put in place. Two most important ones are suggested in the following:

1. Restriction of air-conditioning load during peak hours for consumers having demand exceeding 100-200 KW, and obliging them either to install gas based air-conditioning of absorption chillers or buy-in chilled water from distributed cooling systems. A sufficient notice of two years should be given to such users. Malaysia has introduced this provision for quite some time now. Distributed cooling through chilled water distribution has become quite well known in several middle Eastern and South East Asian countries.
2. Distributed and district cooling projects be promoted and mandated in co-generation and tri-generation mode which has a potential of a thermal efficiency of 75 per cent as opposed to present average of 40 per cent in good cases.

Revamping Existing Generation Capacity

1. Against an installed capacity of some 22000 MW, existing peak generation does not go beyond 14000 MW. Although circular debt and consequent financial problems of energy companies have had a role in lack of adequate electricity generation, it is widely recognized that some 3-5000 MW of existing capacity needs a varying degree and level of revamping / BMR. Prior and immediate attention may be given to those projects including privatisation of such units along with their gas allocations. Government and MoWP are reportedly seized of this matter, along with USAID support in this respect.
2. Single cycle gas turbines (mostly out-dated) should be put much later in the economic dispatch order, than the current which should not have a capacity factor/utilisation of more than 20-30 per cent.

3. NEPRA monitoring code of generation capacity should be implemented with strictness and monthly website publishing be made mandatory. Electricity generation data by generation facility must be published daily by CPPA/NTDC.

The Nexus of T &D Losses and the Circular Debt

T&D losses in the electricity sector amount to 25 per cent, a large portion of it is downright theft and unrecovered receivables. This amounts to some 30 billion kWh, valued at 2-300 billion Rupees. This is almost the range of our circular debt, arising out of unpaid subsidies. If these losses are reduced, electricity costs would come down obviating the need of any subsidy; easier said than done, but it is feasible. In fact this may be the only option to eliminate the problem of subsidies and the circular debt. Enhancing the tariff may appear easy but politically explosive and that is the reason government has avoided taking any drastic move in that direction. Enhancing tariff enhances the incentives and compulsions to steal electricity.

1. Ironically T&D losses in electricity sector in Punjab are minimal (12%), while elsewhere these exceed 25-30 per cent. In industrialised countries, T&D losses to the exclusion of non-existing theft are a mere 5 per cent. However, in the same very Punjab, gas T&D losses, which mostly are shear theft, are phenomenally high, much higher than in Southern sector (SSGC network). This indicates that company culture and history, its organisation, work-force and management has a lot to do with theft than the possible sociological factors. Regulatory authorities ought to delve deeper into this phenomenon.
2. USAID assistance a la DRUM project India must be procured where such programmes are showing good results.

Renewable Energy

Towards a Sustainable Wind Power

The good news is that several wind projects are in the pipeline and the bad news is that the projects are unaffordably expensive i.e. 15 cents per kWh (Ievellised/average) and 2.8-3.1 million US$ per MW installed cost. Both these figures are incomparably higher than most places on earth. Pakistan's wind resource is among one of the best in the world, in terms of the

capacity factor; at around 33 per cent. It is higher than many other countries e.g. India where capacity factor is spread around 20-25 per cent. Electricity production costs (wind power) are directly proportional to the capacity factor. On this count, Pakistan's wind power tariff/cost should be 25 per cent lower than India. However, in India wind power costs are fewer than 8 US cents per kWh, almost half that of the recently approved upfront wind tariff approved by NEPRA. In the US, current wind power prices are even lower at 5 cents per kWh.

The current high price-low volume strategy is not to work in the long run. After a few projects, power purchasers would run out of their breath in paying for abnormally high wind tariff. We have outlined an alternative route to the promotion and induction of wind power. This is a low price-high volume regime based on involving local content. These kinds of policies, if continued, will hamper the growth and induction of all other alternative energy resources.

Solar Energy

It appears that the earlier US target of achieving grid-parity in 2015, meaning that solar power becomes competitive with fossil power on the e1ectric grid, would be achieved. The indicators are several; last month, the quoted capital cost rates in the US markets came down to 3.5 US$ per KW, it used to be more than twice this figure only some years back. Solar cells of high thermal efficiency (mono-crystalline Si- 17.5% efficiency) are costing less than 2.5 US$ per KW, and thin-film lesser efficiency ones are being sold at 1.0 US$ per kW or less. In China, several government contracts have been made at the rate of 1.5 US$ per kW for domestic power, although Chinese rates, especially in the domestic market do not quite reflect true costs and prices. Still, it gives some trend.

However, even if grid parity in solar power is achieved as early as 2015, it would not mean overnight conversion in the US, Europe and Japan. It would take a long time to develop production and supplies infrastructure. Solar and other renewable market share in the developed world may not exceed 10-15 per cent by 2030, although new fossil plants construction rates may come down very significantly by that time (2030).

Towards a Solar Policy

Solar future may be far off for us, if we do not equip ourselves with the right technology at the right time. Easier said than done, but it can be done. This should not, however, mean recruiting non-productive scientists. Bureaucracy in our R&D institutions and elsewhere, is marveling at show case projects; throwing money at it does not bring in technology, neither doing nothing and waiting to be supplied packaged technology, in the rich oil producing Arab countries' style, suits us. Private sector would have to be integrated, which is a separate discussion. It would remain a difficult question as to when to enter into this and how. Although a few things can be done immediately, like introducing solar energy in schools' and universities' curricula, and augmented by R&D activities in PhD programmes should receive immediate priority. A trained work-force brings down technology induction costs and speeds up process, would not be lost to anyone.

When should we jump in? We are already in it in limited ways, largely on the basis of foreign funded projects, which are also serving demonstration models for manufacturers as well, and hence the rationale for foreign aid, apart from its philanthropy and Solar PV costs are coming down very fast. Sometimes, in the next five years, solar power may be competitive in off-grid markets, of small and far off villages. For special applications such as power supply to communications tower, monitoring stations, pipelines instrumentations, health and education facilities in far off villages, it is already competitive and in demand. In Bangladesh, reportedly, PV-LED combination has become very popular and successful in villages, where a 20 watts PV-LED power is lighting rural homes. The rent/tariff, it is said, has been kept as low as their kerosene budget for lighting. Not a bad deal, if that can be replicated here in this country.

Institutional Issues

Even if the real days of solar power may be ahead in time, there is to be some homework and an enabling policy in place, to guide investors, businessmen, R&D institutions, vendors etc. For example, in which areas and villages government is to prioritise solar power. What kind of institutional arrangements are required and may be permitted and supported. In this case, company model may not work as well as it does for grid power. Cooperative bodies may have to be promoted and the role and functions of

such co-operatives may have to be defined. Electricity co-operatives have worked successfully in the US in the initial days, and have survived till this day. Electricity cooperatives are going to be in fashion again throughout the world and more so in the developing countries. May be for development purposes a few one-MW solar power plants may be permitted every year, which may require auctioning such opportunities. Local content may have to be mandated.

Following Steps are Recommended

1) A limited number of small commercial-demonstration projects may be approved and installed as IPPs, such as in the following;

one or two solar PV projects of 5 MW each.

10 - 20 MW Solar Thermal (Parabolic trough) as ISCC with an existing Steam Turbine or Gas Turbine Combined Cycle Plants in Kot Addu/Muzaffargarh.

One or two solar dish 1 MW projects.

These projects may be auctioned to get lowest offers as solicited projects. The preferential feed-in-tariff would not pose a heavy burden on consumer tariff.

Full Disclosure and Transparency

Electrical Sector

1. Freedom of information act 2003 must be implemented in letter and spirit in the regulated sector of electricity and industry. Visiting websites of Indian utility and government energy agencies may be useful in learning as to how this aspect can be improved in energy sector in Pakistan.
2. Implementation of the following two NEPRA notifications must be expected;

Instead of annual reporting, monthly publishing on the websites of individual entities/companies may be instrumental in resolving many problems. A case in point is the NEPRA determination on KESC's fuel adjustment charge (FAC) wherein two of four members have distanced themselves from siding with and signing NEPRA determination and have written "notes of dissent". There is a petition in Sindh High court in this respect as well. Had requisite data, mandated in the two of NEPRA gazette

notifications (on generation and distribution performance) been implemented and requisite data made available on monthly basis, the scope of confrontation and confusion could have been lessened if not eliminated altogether.

NEPRA has done well by publishing details of "fuel (adjustment) charges (FAC)", for the first time in May 2010. Earlier it used to simply announce a figure in a few lines' statement. We would encourage NEPRA to continue with this practice and even broaden the scope of such detailed publications in this respect. NEPRA should also publish data or/and require agencies such as PEPCO/CPPA to publish data on "Annual Fixed Cost payments". Although "reference data" is already published by NEPRA in its determinations, there is a significant discretion and detail in this respect. The scope of such disclosure is required to be broadened and extended to include IPPs.

Oil and Gas Sector

Oil and gas sector is worth more than 20 billion US dollar in terms of sales and output. Except for Gas T&D tariff and mere posting of petroleum retail prices and gas wellhead prices, there isn't much to show by OGRA. The sector is almost totally regulated, theoretically, except LPG where there is confusion as to the regulatory domain. Admittedly OGRA works within the framework of the role assigned to it by Ministry of Petroleum (MPNR) and the GOP. It cannot arrogate powers to itself, although it can build pressure towards higher domain and role for itself. The due process is lacking in the following areas. Surely, there are and must be rules in the following areas which are not enough. The actual application and adjudication of those rules is to be the subject of due public process, where price is not determined by the market forces. .

International transparency moves and initiatives these days even go beyond public tariff and pricing determinations. They are demanding *Publish what you pay* (PWYP) policies and regime, for it has been found that the actual payments vis-à-vis publically determined tariff may be deviating for legitimate and not so legitimate reasons. The following areas should come under some process of public input and scrutiny through the regulatory process of OGRA and the latter should not restrict to posting of results but invoke the whole regulatory input and process into these.

1) Well-head prices of oil and gas.
2) Ex-refinery prices of petroleum products such as gasoline and diesel, including crude oil imports
3) Oil pipeline tariff
4) PSO imports of petroleum products (50% of the total demand is met through imports valued at around 8 billion dollars)
5) Furnace oil pricing despite claims of being in the open sector; and most importantly
6) High Speed Diesel (HSD) pricing.

On the other hand, what little powers have been granted to OGRA, successive leadership of that organisation, has not chosen to make use of those. For example who stops OGRA in holding public hearing for discussions on the other constituents of petroleum prices, if the ex-refinery (wholesale or producer price) is made an untouchable tree for it?

Energy Development Fund

Pakistan is suffering from an energy crisis, causing social, political and economic difficulties. The region is a victim of terrorism furthering and pronouncing the aforementioned problems. Lack of timely investments in the immediate past in the sector has been diagnosed as one of the key issues. It is more than a simple government failure. There are structural problems. Current electrical power installed capacity is around 23000 MW. The demand is expected to double itself every ten years, which means an additional capacity requirement of 75000 MW in the forthcoming two decades. Besides generation capacity, this would entail investments in transmission, and distribution, also investments in primary energy production and transportation utilities.

This may require an investment of 200 billion US$. This can be both a problem as well as an opportunity. This is one area where Pakistan would need support from friendly countries in terms of foreign equity and project loan investments. A commercially viable capacity building project is being proposed to facilitate domestic and foreign investment in the energy sector. An Energy Development Fund is proposed, which would not be a recipe of free lunch. The basic idea, as explained in the forthcoming, is that the proposed fund acts as an intermediating and facilitating instrument and institution.

There are wide variations of risks including country political risk,

project location etc. The proposed fund may offer various mechanisms to mitigate risk or offer to share or fully take up risk premium as a subordinate loan or outright grant etc. The fund may also market credit lines, concessionary or otherwise, dedicated to green projects such as alternate energy, energy conservation, energy efficiency, related BMR, CDM etc. EDF can also source market, manage or intermediate ordinary debt and equity instruments. To shorten lead times, project identification studies, preliminary and feasibility studies and other investigations may be financed on grant or concessionary loan-basis.

Energy Technology Indigenisation

Indigenisation often suffers from chicken egg syndrome; indigenisation does not occur due to lack of an adequate market, while market does not develop due to lack of indigenous resources. A lot of energy and power equipment is labor intensive, bulky and transport cost sensitive, paving way for local cost efficiency. Except for turbine-generator, the rest of power plant (about 50% of the total) can be locally manufactured with lower costs and higher efficiencies. There is abundant evidence from India and China, where coal power plant and wind power plant are produced at 50 per cent of the price level presenting in OECD countries. Western companies do not even compete when Chinese/Indian suppliers are expected to bid. In automotive sector, vendor industry has been developed largely under tariff protection, which cannot be done in the case of energy sector, where near zero tariffs regime exists due to the need of keeping energy prices competitive, if not low enough. In the case of power (equipment) industry, the Energy Fund may go a long way towards development of local indigenous industry creating jobs, self-reliance, saving foreign exchange and reducing costs. Apart from cost reasons, local availability is expected to facilitate speedy project completion and lesser cost escalation risks.

Towards Zero Energy Taxation

Petroleum taxation is a major cause of inflation in Pakistan, especially in sensitive prices index. All daily consumption items have to be transported from long distances to retail outlets and daily workers travel to suburbs which are at the city limits requiring major transportation expense. Petroleum taxation and in general all indirect taxation has been guided more by practical reasons of collectability at source or purchase and rather than

much economic rationale. A marginal petroleum tax may still be maintained to cover the user charge and financing needs of the transportation sector.

Zero-energy taxation regime is integrating the energy sector and its taxation; pooling the taxes and subsidies to balance and cancel each other. This would allow withdrawal of electrical subsidies and reduction in petroleum taxation resulting in falling petroleum prices with the rise in electrical tariff. This may be acceptable and affordable to all parties; lower prices to consumer, no budgetary loss. Above all, it would be sellable to lenders and donors who pose a major constraint in independent economic policy making.

Conservation and Energy Efficiency Issues

As energy demand and consumption increase, there is a great need for promoting and encouraging conservation and efficiency. The price argument is not enough, although important. Keeping the prices at their real economic value does dissuade the consumer from profligacy. However, in an economy, where major sectors operate on cost-plus, and the strong elite groups being able to pass down the costs to the lower strata, policy measures are required to promote and even enforce conservation and efficiency. Competitive forces can be setup by announcing standards, labels and awards, setting examples in government and forcing the government dependent vendor purchase organisations in the private sector. The building sector in Pakistan and generally in South Asia is very inefficient.

Building codes are focused only on structural issues. Insulation practices are unknown. It is usual to find outside temperatures being much cooler than inside, especially in Karachi, due to inadequate architectural design practices, aping designs of cold countries. Passive cooling and zero-energy buildings is not even discussed and talked about, not to talk of implementation. *It is heartening to note that ENERCON has taken some initiative in this respect and an Energy Code for buildings has been brought in the statutes. Much more effort and support, however, may be required at implementation level.*

Similarly electric fans, water pumps and motors, washing machines, air-conditioners etc offer a tremendous potential for energy saving if these are used more efficiently. Modest technical assistance programmes aimed at traditional manufacturing clusters like Gujranwala and Lawrence Road could pay much dividends. Also there is a need to control import of inefficient electrical appliances, which although is easier said than done due

to a highly competitive price sensitive market. Perhaps custom duties could make some difference. **Energy Equipment Labeling programmes,** whereby energy consumption data of appliances is required to be printed on the labels that are fixed on the household appliances, have proved very effective in Europe, North America, and Asia. Equipment ratings like A, B, C create remarkable incentives on the part of manufacturers to produce energy efficient equipment. It similarly assists consumers to take right decisions in buying energy efficient equipment. These have been introduced even in India. PSI or ENERCON may be mandated to introduce and implement such a programme.

Conservation and efficiency issues are not limited to end user sectors only. The utilities and power sector itself can contribute a lot towards conservation of objectives. First of all, there is transmission and distribution losses issue of 24 per cent of total energy generated. District cooling and CHP has come of age. Micro turbines and small absorption chillers have been perfected, with tri-generation efficiencies as of 80 per cent as opposed to traditional electricity's efficiency of 30 per cent, utilities themselves are not a model of conservation and efficiency. Their thermal efficiencies are low and heat rates high; an improvement of 10-15 per cent would be easily possible. Similarly average load factors are low, typically under 70 per cent and poor O&M practices. Things can improve, both with carrot and stick. India has announced a Utility Benchmarking programme to improve the operating efficiency of utilities and rewards have been announced. Indians have been doing it, rather routinely for the last 10-15 years, with remarkable improvement in the efficiency of their utility sector. To summarise, the following areas need attention with respect to the conservation and energy efficiency.

1. House-hold appliances, electrical efficiency as water pumps and motors, washing machines, electric iron, bulbs and lamps
2. Fuel efficiency of vehicles
3. Thermal efficiency of buildings.
4. CHP sectors' introduction in hospitals, commercial buildings, institutions, government etc.
5. Electrical efficiency in industry
6. Thermal efficiency like steam generation, and its usage, avoiding wastage and gas

Review of Energy Trends

The new government is in office, it has announced its budget. The good news from the Budget 2013-14 is that the circular debt would be cleared in 60 days. Exact modalities have yet to be announced. We have been arguing at this forum that beg, borrow or steal, but circular debt has to be cleared, even if some of it may recur again with lesser intensity. Structural tariff issues would take time to be handled without which complete solution would not be possible.

Energy consumption in Pakistan has virtually stagnated over the last five years, growing at a dismally low rate of 1.3 per cent p.a., lower than the population growth rate, with obvious implications for per capita availability of energy. One need not lament the reasons, for these are too obvious. Energy consumption cannot increase in the milieu of energy crises and shortages and consequent economic malaise.

Electric power supplies have stagnated as a whole and no rise in electricity consumption has been noted in any sector: domestic, industrial or others. Total generation stood at 98.664 million kWh in 2012, only one million units or so higher than in 2007. The share of thermal power remained as it was around 65.7 per cent, Hydro at 29 per cent and nuclear 4.94 per cent.

Gas consumption has also stagnated at a constant level of around 1.22 TCF per year. Household sector increased its share from 15.9 per cent in 2007 to 20.34 per cent in 2012. Industries' share remained as it is at 22.2 per cent and constant in absolute terms as well, and similarly fertiliser sector. CNG consumption more than doubled itself, from a share of 4.46 per cent in 2007 to 9.24 per cent in 2012, registering a phenomenal growth rate of 16.1 per cent p.a. This has been achieved at the expense of the power sector, whose share reduced from 35.42 per cent in 2007 to only 27.8 per cent in 2012. A hefty 74 billion Cft per year has been diverted which almost all of it went to the CNG sector. In the current year 2012-13, CNG share should have further increased in the wake of Supreme Court intervention and reduction in CNG prices with further deleterious consequences for the power sector. In just one year, oil consumption in power sector went up from 43.84 per cent to 55.12 per cent in 2012, while gas consumption in power sector decreased from 55.9 per cent share to 44.78 per cent in 2012.

Oil consumption has increased from 18 million tonnes p.a. in 2007 to 20 million tonnes in 2012, giving an average growth rate of 1.9 per cent

p.a. Although the increase appears to be nominal, due to oil price increase, there is a huge impact on balance of payments. The oil import bill has gone up from 7.5 billion US$ in 2007 to 14.5 billion US$ in 2012 – almost double. Furnace oil price increased from Rs. 21,000/- per tonne in 2007-8 to Rs.73,000/- in 2012 with obvious implications for power tariff and circular debt. Gasoline retail price increased from Rs.53 per liter to around Rs. 100 or so. Diesel price increased even more, from Rs. 38/- to Rs. 108-10, almost three times the 2007 level. No wonder, HSD consumption remained static in that period. There was an en-masse shift of public transport to CNG. However, gasoline consumption has doubled itself from a market share of 7.1 per cent to 15.48 per cent in 2012. The reason is understandable as there has been steep increase in two and four wheeler population.

Remarkable differences in fuel consumption and fuel costs have come up; the Uch Power Combined Cycle power plants have a fuel cost of Rs. 1-2 per kWh due to its higher thermal efficiency, while other plants have 4 times as much fuel cost, the reason – differences in thermal efficiency as we shall see and discuss later. Typical fuel cost in gas power plants is Rs. 4.00 per kWh which is almost the same as that of coal, if we go by the recently approved upfront tariff of coal power plants. The RFO run power plants in private sector cost Rs.13-14 per kWh, while HSD plants have fuel cost of Rs.17-18 per kWh. Their counterparts in public sector have fuel costs ranging from Rs. 24.7 per unit to even Rs. 50 per unit. A lot of theft of expensive oil is camouflaged under low thermal efficiency. Former Minister of Water and Power Ahmad Mukhtar admitted in a TV interview that there is oil theft in GENCOs, be it at transport stage or otherwise. NEPRA could take measures to curb it, despite the constraints and limitations of cost-plus regime.

The good news is that there has been a reduction in T&D losses of electric power, if figures have to be believed. The bad news is falling thermal efficiencies in generation, which we will discuss a little later. The claim is that in the PEPCO system T&D losses have come down from 23 per cent in 2007 to only 18 per cent in 2012.1n Punjab DISCOs, the T&D losses are comparatively low around 12 per cent, the only bad boy is widely dispersed MEPCO with losses of 18 per cent. However, this is small if compared to HESCO at 28.58 per cent losses and PESCO at 37.25 per cent losses. But then why are DISCOs bankrupt? Is it because of showing performance in reducing losses and losing money in NEPRA determinations? It is quite plausible in the public sector system. Even KESC

has suffered distribution losses of 29.71 per cent in 2012 down from a staggering 34.12 per cent in 2007, although KESC's improvement at least partly appears to be coming from over-billing and slapping extra charges on helpless consumers. And NEPRA looks the other way, when all of this happens.

Ironically, unit gas consumption in gas fired power plants, as estimated by NEPRA has gone up from 12.43 Cft per kWh in 2007 to 13.7 in 2012, while it should have been the other way round in times of gas shortage. Gas is consumed in Combined Cycle power plants, single cycle gas turbines and IC engines and in a mix mode in steam turbine power plants. Average efficiency is low around 25 per cent, in some cases it is only 12 per cent. In 2012, about 5700 MW electricity (28 .99 GWh at 5000 hrs of operations) was produced with 358.381 Bcft of gas. With new and efficient combined cycle power plants, this figure can be doubled. If 5700 MW extra power may appear to be too ambitious, one could aim at around 3000 MW easily. Fortunately, new CC plants are in pipeline e.g., Chicho-Ki-Malian (525 MW), Nandipur (425 MW) and Guddu BMR (747 MW). There is a scope for a few more which could be added while undertaking BMR and Revamping of existing GENCOs. This could perhaps be the fastest approach. However, the move can be compromised by privatisation talks. It is not easy to privatise in Pakistan, as we have seen in the past.

There is another avenue for increasing power production. If by some magic, CNG consumption can be brought down to its 2007 level, 68 Bcft of gas would be released. And if fertiliser sector's 100 Bcft is taken away, as they have been provided with a dedicated field with 100 Bcft of gas output per year, a total of 168 Bcft can be diverted to the power sector. This would mean 2584 MW of extra power at the prevailing low thermal efficiency levels. One can add another 40 per cent through higher efficiencies.

Utilising gas efficiently will become unavoidable, once LNG or IP projects are implemented which are 3-4 times more expensive in terms of gas price. If gas is wasted in the fashion it is being done now, it would cost as much as Rs.20 per kWh, almost the oil based electricity. It is therefore essential that new more efficient thermal plants are installed, while these expensive imported gas projects are implemented.

CNG would be ultimately eliminated, if and when expensive imported gas and LNG is imported. If the cost is passed on to users instead of producing and managing organisations, CNG would become expensive. However, would it be politically feasible? The problem is that a lot of public transport is on CNG now. Public transport in Karachi becomes thin

on days when there is CNG problem. Caretakers took the right step of banning use of CNG in large private cars.

As per budget documents (2013-14) of PML (N) government, circular debt stands at Rs. 580 billion. This means, a power subsidy of about Rs. 5.8 per unit, assuming generation of 100 billion units. NEPRA SOI report 2012 puts the subsidy estimate at Rs. 3.1 per unit, up from Rs. 2.1 in 2011. It appears that the circular debt is more than one year old. If this is not the case, the situation is really dismal and out of proportion. Somehow, the new government intends to clear it in 60 days. The new one would start piling up. For a popularly elected government depending on the goodwill and votes of people, it is not so easy to enhance tariff immediately after coming into power. Remember, circular debt issue started during General Musharraf's regime who did not need votes. There is now another dimension to the circular debt in addition to expensive oil. At reduced level of generation, the fixed cost per unit should also have gone high, although I do not have data to support it.

Thus a costless and immediate solution (marginal and partial) appears to be to enhance supplies of low cost sources like gas fired units. The near term solutions are conversion of oil fired steam turbine plants to coal, up-gradation of Guddu and extension of Tarbela by 1000 MW. These would take three years to complete and have been provided for in the budget.

Wind power can be the fastest solution. Excluding, preparatory operations, a wind power plant of 100 MW can be executed in six months and 100 MWS can be added every three months. A wind power auction of 500- l000 MW can induct power into the grid in 24 months, under 8 cents, if top political support is applied and rent-seeking (a euphemistic term used by economists for corruption) by all is avoided. For this all existing cost-plus approvals of 16 cents would have to be cancelled. Ironically, more or less the same parties and their coalitions (although with marginal share in equities) would be able to combine with large international IPPs to cause this revolutionary change. What my local investor brothers should understand is that a smaller pie of a big and expanding market ultimately brings in more profit than a one-time windfall.

The good news is that, as reported in SOI 2012 of NEPRA, there are 5000 MW of hydro projects at various stages of implementation and are destined to be completed by 2018. This is other than Bhasha or Bunji, the large projects which are always subject to uncertainties of various sorts. The new government would be doing well in facilitating and following up these projects for their earliest completions. Most of these projects are costing

around 5 Rs. per unit, much lesser than any other source other than the dwindling local gas. The days of One-rupee Tarbela hydro are gone. If KPK and its bureaucracy have their way, they would charge several rupees per unit in hydro royalties alone. Their claims variously put at 87 or 124 billion are still in the books. PM Gilani's government in its naivete and initial enthusiasm wanted to payoff this liability but could not pay beyond a few billions.

The Energy Crisis: in Search of an Energy Policy

Elections are in process and the new government should be in saddle sometimes in May. One of the major challenges the new government would have to face is the energy crisis. It is key to economic recovery; here is a consensus on it. The imperatives and outlines of a new energy policy are presented below. The task for the new government would be huge and difficult but is essentially still manageable, if efforts are applied with zeal and sincerity selflessly. The hopefuls should read this piece carefully, so that they do not grope for policy endlessly and waste precious lead time while in saddle. I will first identify the basic issues and then present some key recommendations. Let us have some background information first;

1. There is a shortfall of 5000 MW: in summer when the demand is 18000 MW, the supply is 13-14000 MW and in winter when the demand is 13000 MW, the supply goes down to 8000 MW. The total installed capacity is close to 25000 MW, of which 5000 MW is dilapidated and unreliable capacity. In summers, the shortfall is due to lack of fuel supply, as government cannot subsidise enough to get the required oil. In winters, Hydro power production falls down from 6000 MW to 1000 MW.
2. There is a 30 per cent incidence of distribution losses, most of which is theft and lack of payments by the powerful including the government agencies. Successive governments have tried to reduce the losses, but in vain. This seems to be a long term systemic problem related to social, political and economic conditions. In India, the theft problem is of comparable proportion. Any realistic plan has to accept this.
3. Cost of production is lower than the selling price by a margin of 2-3 Rs. per kWh, which government has to provide as subsidy. However, government promises but never manages to pay in full,

giving rise to a phenomenal circular debt issue which restrains electricity generation and supply.

Finally, the financial burden is transferred to the fuel supply companies like PSO, SSGC and SNGPL, which are under great financial strain.

4. An obvious answer appears to be reducing the cost of production for reducing the tariff rates. It is politically and otherwise very difficult to significantly enhance tariff, and as we have argued earlier, cannot be eliminated in short term. Thus the only option available is to develop new sources of cheap energy. It can be done, but requires a cycle of 5-7 years.
5. Unfortunately, all the new projects that are being planned are at high rates and in some cases highly unjustified. For instance, Wind Power, which under right policies could bring in 2000 MW in 5-10 years, at an affordable tariff of 8-10 cents. Our generous policy has awarded tariffs of 16 cents, which few investors believe would be paid actually. Also, the Ministry of Finance is reluctant to give approval to power purchase agreements and extend guarantees .Wind power is competing with natural gas in the US where the gas is at cheapest in the world. Brazil and Uruguay have closed deals at 6 cents recently in open tendering. Here we have a choice.
6. In other cases we do not have much choice. Recent LNG tenders have returned with offered prices around 17-18 US$ per million Btu (MBtu). IP-Iran gas project offers the same prices as well. At cu 110 US$ per barrel oil price, the Iranian formula of 76 per cent of the price of oil plus transmission project costs would come out at 18 US$. By comparison, oil prices are at around 20 US$ per MBtu. Currently, our local prices to utilities are at around US$ per MBtu, resulting in electricity generation price of Rs. 4-5 With Iran gas or LNG, the cost of electricity would be Rs. 14.00 per kWh. But we do not have options in the short term, although in medium term, we have some choices. Both the projects are in doldrums. LNG project due to upfront financial commitment of 25 Billion US$ suffers from rivalries and legal difficulties.
7. It appears that the international gas market is in a state of transition. It is difficult to accept a price of 18 US$ per MBtu for South Asia, while in Europe LNG prices (landed) are around 8-10 US$. There is such a glut of gas in the US, that gas prices are the lowest in American history. Americans currently are vacillating between

thoughts of keeping the bounty unto themselves or exporting to Europe boosting the latter's energy security and giving tough time to Russian gas of which there is a kind of monopoly. There have been proposals of arbitrage including by this scribe, a chapter which is not to be closed yet. If the US is opposing IP-lran pipeline project, at the expense of appearing naive, I would urge that the US must do something for the regional LNG market making it more reasonable. This was a little diversion, while we were focusing on what to do in terms of our energy planning.

8. Our current gas production capacity is around 4 billion cft per day (BCFPD), which is projected to go down by the year and would be halved in the next ten years. They want to add another 4 BCFPD through LNG, IP and TAPI projects. In the end, the net capacity would stagnate at 6 BCFPD due to decrease in local production by 2 BCFPD. The demand has been projected at 8 BCFPD for the year 2008. Thus the gap and crisis would persist despite LNG and IP. Iran's gas resources are going to be there for a long time, if the US keeps restraining their gas exports. So for gas, both price and supplies are difficult issues at best.
9. The problem is that nobody is willing to pay the higher gas price, to industry, CNG sector or the household. Everybody is hiding behind the magic of average price, caring little where would the average go when half of the gas comes at such exorbitant prices. CNG consumers maintain that the differential be maintained at 50-65 per cent between the price of petrol and CNG. The Fertiliser sector gets the gas virtually free to keep wheat prices under control and there are limits to charging the real price. The prospects of more of local cheaper gas – which in fact is probably the only possible solution – are dwindling by the day, in part due to the law and order situation in Balochistan. Despite the potential, experts are not very optimistic. Let us pray for God's bounty but planning has to be based on more secure footing.
10. Before offering recommendations and proposals, it would be useful to narrate a sordid story in our planning history. In 2005, in a large meeting of energy bureaucracy at the Planning Commission, a presentation was made by the then chairman of Planning Commission. The chief audience was General Musharraf, the then President and PM Aziz. The presentation is still available on the internet. There is no time and space to critique the whole

> presentation. I will only discuss the gas issue, as it is most relevant and instructive. The presentation provided for the installation of 30,000 MW of gas powered plants by 2020 and another additional 50,000 MW of the same 2020-30, so that by the year 2030, it would be 80,000 MW. Of coal which we have enough, the proposal was only for a capacity of 20 MW. Ironically, we do not have gas, local or imported, to fire such a goal. Nobody stood up. Nobody objected. Musharraf government kept approving oil fired capacity, precipitating the crisis of circular debt.

Let me now put my basic recommendations which are: l)turn away from oil and gas and go for coal, hydro and alternate energy, turning away from centralization to distributed generation, in as far as it is feasible; 2)Keep a 10 cents ceiling on all new projects, and a ceiling of 10 US$ per MBtu on gas prices, imported or local; 3) Introduce competition and bidding in energy procurement; 4) a power generation investment plan has been proposed and presented in the adjoining table. Let us examine these in detail.

Currently, the capacity problem is not there due to the sagging economy and fuel shortage. In the medium to long run, this would be a major issue and problem. I present a power generation plan based on the aforementioned thesis. In this plan, as you would note, there is no addition of further oil or gas based capacity. The existing oil and gas capacity retires by 2030. The backbone is hydro balanced by coal. We recommend that 5000 MW of Thar coal capacity be created in the next seven years, a difficult target though, but can be achieved. If handled politically well, one transaction of 5000 MW is possible. China, the coal leader in the world holds the key, and then are Russians. Americans would keep opposing coal and their companies would waste time in risk analyses of all kinds. Let us bring back Chinese to Thar coal again. They are the coal experts and can implement coal projects the fastest, may be three years only as opposed to 5-7 years for the others. Had President Zardari been more attentive to business than domestic politics, he would have been successful in bringing in Chinese again. The next PM would be measured by his efforts and success in this respect.

Another 15000 MW of Thar coal is to follow in the period 2020-2030.The outgoing PPP government put all its eggs in one basket (company) which could not deliver. Probably they should have bit as much as they could swallow. 1000 MW was too much for a new comer private

company. The company's top management has been relieved of its duties. They are now in for greener pastures in politics vowing to solve Pakistan's energy problem in no time. The point is that energy sector is too capital intensive. Local parties are more of a liability, serving more or less as rent seeking intermediaries. They should restrict themselves to 100 MW or so which has been the case by now. All major thermal projects in the IPP sector have been from FDI.

Nothing would be more damaging to Pakistan's economy than to impose unreasonably high generation tariff of Thar coal. This would tantamount to converting our strength into weakness and opportunity into threat. Those who have vested interests in Thar coal have started lobbying for coal tariff higher than 11 cents. The Chinese (Senhua) offered under 6 cents during the reign of General Musharraf. The offer, however, was rejected by him. Make all kind of escalations; estimated tariff would not go beyond 8 cents. There is something wrong with the Thar project design. It is typical of cost-plus cost heaping systems. Something seems to be wrong in the coal bureaucracy and Sindh government. They practically teamed up with one partner which could not deliver. They allowed inordinate delay in the project and in turn made PPP earn the discredit. Would the new government reward or punish them? They may deserve both for varying reasons.

In addition to coal (Thar) power, coal gasification has to be pursued, whether above-ground or underground. However, the project must be retrieved from a personalized approach and strategy and should be structured and organised in a befitting manner. Similarly, all fertiliser production would have to switch to coal (Thar). It would take 5-7 years to do that, earlier the better. It is not an empty thought. It is technically and economically feasible. All alternatives are feasible compared to the scary price of 18 US$ for imported gas.

Biogas is yet another alternative, although more relevant to distributed generation. All waste is an energy commodity be it dung, municipal solid waste, food and vegetable waste or agricultural residue. Both local power and gas can be generated and distributed through small local networks. It should no more be restricted to small digester schemes for the household.

Large dairy farms may be encouraged to take up MW level projects. A cogeneration scheme of sugar industry is pending for a long time due to controversies on project design and pricing. Biogas and Solar power have a potential to make our agriculture independent of varying fortunes and

misfortunes of the energy sector. For, no alternative is feasible against the prevailing cheap local gas prices and all alternatives are feasible against expensive oil and gas imports.

In Hydro, the equal and same emphasis should be given as proposed on Thar coal; the capacity of hydro production up to 5-7000 MW should be achieved by the end of 2020 and another 15000 MW should be attained in the period 2020-30. Given the linear organisational growth and societal growth, the targets for 2020-30 appear to be difficult. Some slips may occur. A major slippage, however, would be catastrophic. This may require policy and environment change, which is expected to come by then. Market and competition may have to be brought in replacing bureaucracy and regulation; more on this elsewhere.

Table 1
Power Plant Capacity Development Scenario (in MW)

Plant Type	2013	2013-2020	2021-	Retire	Cum-2030
Oil	6000	0	0	6000	0
Gas	6000	0	0	6000	0
Hydro	6000	5000	15000 -	0	26000
Coal	100	5000	15000	0	20100
Wind	100	1000	2000	0	3100
Solar			5000	0	5000
Total	25000	11000	37000	12000	61000
Cumulative	25000	36000	73000		
Net Cumulative			61000		
Distributed	500	2000	5000	500	7000

Source: Author's Estimates

The good news is that solar power has come of age. The prices are coming down fast. These were halved in the last two years and would go down further. By 2020 or even earlier, Solar PV Cells would come to 1 US$ per Watt. It is already 1.6 US$ per Watt, all included, while PV cells cost as low as 0.5 US$ per Watt. Of course, these are prices for bulk project sales. This means, solar electricity prices would be under 10 cents by the year 2020. Although, these figures are for India, US and China, Pakistan is

equally enriched with solar energy; it can attain the same figures as the countries mentioned above would in next five years. Thus along with hydro and coal, solar and wind resources should also be utilised. Solar is much superior because it is available everywhere, close to the user and demand, and comes in all capacities and sizes, from 10 Watt to 10 KW and 10-100 MW. Wind is localized mostly in Sindh, although there are other places as well; away from demand and users and usually comes in MW capacities. The real solar age is to begin after 2020 and for that reason, we propose 5000 MW or even more from Solar PV. All of it need not be in the centralized sector. Already, Solar PV is competing with diesel based electricity of Rs. 25 per unit. Diesel-run tube wells are being bought by those who can manage to finance the initial investment. A financing scheme in this respect is recommended.

Let us return to the issue of pricing. Cheap gas (at 4 Rs per unit) and Hydro projects (at Rs 1.50 per unit) have been the backbone of a reasonable and affordable pricing system, albeit with subsidies. The low cost of hydro has been possible due to older investments. New hydro projects are to cost around Rs 5 per unit, still quite cheaper than others. The prospects of availing cheap gas are dwindling by the day. The system cannot afford any lavish pricing policy as we have witnessed in the case of wind Power and some other cases. Here is a simple and general pricing formula. There is to be an upper limit of 10 cents or less on generation tariff, whatever be the energy source; 10 cents ought to be the guiding slogan to garner coherence and direction. It is a reasonable upper limit.

On the gas front, let the slogan (real commitment) be 10 BCFPD for 10 US$ per MBtu. Local gas exploration would get a boost under this policy, after all you are prepared to give 18 US$ per MMBtu to the imported gas. US$10 is the right price of gas, be it imported or local. It would be 50 per cent of the oil price. This is what prevails in gas-starved Europe. Ultimately, we should be able to bring our Iranian brothers to this price level. Islam promotes fairness and forbids exploitation of the weak. Islamic Iran must follow this precept.

Cost-plus schemes are required in virgin areas and technology on which there may not be any prior experience. Cost-plus schemes are meant to save time which is lost otherwise in a competitive process or in avoiding risk and thus higher costs. In our case, neither time was saved nor cost, unfortunately. Under cost-plus schemes, there appears to be what we call in Urdu slang '*Khulla Khata'*, something which has no check and balance. All kinds of unreasonable padding in capital costs is proposed by the investors

and NEPRA only does a perfunctory marginal pruning instead of doing a reasonable job of scrutiny. One wrong decision is a benchmark for the other. It is imperative to bring in a competitive system based on bidding. Many developing countries have introduced it and are benefitting tremendously. India, Brazil, South Africa, Turkey are just a few examples. In developed countries, it is the norm; be it spot market or long term contracts. Utilities routinely invite RFPs from IPPs in a transparent bidding process. However, to be effective, the bidding process must be serious and all preparatory work should be done as required. A mere advertisement in the local or even foreign press is not enough. Be ready with Power Purchase Agreements (PPAs), to be signed within one month of the announcement of results. PPAs and guarantee instruments are what the bidders and investors want to have. They know the price.

Our problem is that neither the minister-politician has the background knowledge of the sector he is given the responsibility of, nor the bureaucracy has the required background. Generalists prevail everywhere. Then who should know and who will know and do the work. One does not need to hold a PhD degree in the subject, but should have done some homework. In parliamentary democracies, there are shadow ministers and members of the parliamentary committees. Besides, political parties routinely adopt positions through their expositions and induct experts and knowledgeable people in their cadre. As a result, it is always a foreign consultant from ADB or World Bank who prepares policy papers. Ironically, our dictatorships also did not induct the right people despite having considerably more leverage and freedom of action. Finally, let us pray and look forward to the new government and hope that they would provide the leadership, enthusiasm and sincerity of purpose to take us out of the mess that we find ourselves in.

The Ten-point Agenda

1) Bring in competition, transparency and openness into the energy sector; generate financial resources to be able to lubricate the engine of growth and implement policies; increase revenue and levy income tax on agriculture; reduce non-development expenditure including Military expenditure; improve relations with India in order to be able to achieve economic objectives of regional trade which has a definite bearing on energy issues as well. This may appear political and non-typical for an energy policy, but without this, no meaningful economic policy

including energy policy can be implemented adequately.

2) Integrate energy decision-making avoiding the pitfalls and predicaments of similar initiatives like one-window operations of the past; ministry (of Energy) consolidation may be too disruptive in the beginning for the government when so much has to be done; Chief Energy Advisor's Office may instead be created with multi-ministry jurisdiction under the Cabinet division; merger of NEPRA and OGRA is highly desirable; reorganise and transform all major energy institutions into out-put based organisations.
3) Reduce cost of production and at-least arrest the rising cost escalation; introduce competition; make regulation and control an exception in market and competition a norm; except for transmission and distribution, both in gas and electricity, introduce auctions and tendering in place of cost-plus projects; introduce coal and hydro to bring down prices. Keep a 10 cents ceiling in all new power projects, and a ceiling of 10 US$ per M Btu on gas prices, imported or local.
4) Encourage large consumer choice, self-generation and market aggregation (wholesale power marketing companies); introduce and strengthen wheeling charge approach in both electricity and gas sector; include IPPs and captive generation in subsidies as well.
5) Divide gas and electricity distribution into smaller units and organisations, possibly division based or around 8-10 companies each; if politics permit then provincialise distribution companies; launch an extensive programme for T&D loss reduction both in gas and electricity; establish separate organisations to undertake this.
6) Reform OGDC and Oil and Gas concession units; launch a major political-cum-commercial package to boost local exploration and production of gas; consider upward adjustments in whole-sale/producer gas prices in view of very high imported gas prices in LNG and Iran Gas. Balance American versus Iranian interests and get a favorable LNG supply from the US or better prices of Iran-pipeline gas.
7) Discourage CNG; close the price differential to 75 per cent in terms of Btu prices; encourage public transport on CNG; immediately ban CNG use for private vehicles of more than 800 cc; encourage and introduce Bio-CNG; put other gas wasters to notice such as captive generators who are illegally running single cycle facilities violating their terms of license.
8) Fast Track Thar Coal and launch a transaction for 5000 MW of Thar Coal immediately; Fast track conversion of GENCOs to Coal, local or

foreign or both; convert Diesel Engine IPPs to Biogas where feasible; give notice to fertiliser plants to convert to coal (Thar); organise Coal Gasification project in a more structured way, inviting foreign companies which can utilise the data already generated.

9) Promote competitive renewable energy that can be afforded and improve supplies; Launch 300-500 MW Wind Power Auctions every six months; encourage Local component; facilitate and mandate local WT tower and rotor blade production which is 40 per cent of the WT cost; launch solar power schemes for diesel replacing applications e.g. tube-wells; organise an IPP for this purpose; negotiate green credits for renewable energy from multilateral and bilateral sources mortgaging CDM incomes; encourage Bioenergy such as Biogas, Bio-CNG; all waste is energy, extract energy from solid and liquid waste.
10) Resolve political issues pertaining to energy sector; a) Hydro and Coal royalties; b) provincial role in energy sector; possibly provincialising distribution; energy quotas, priorities and allocations; subsidy allocations; apportionment of sovereign guarantees for energy projects implemented by provinces.

Managing the Natural Gas Crisis

Introduction

The interim government has banned CNG use in large private cars (exceeding 1000 CC). This is a step in the right direction. This is one of the series of decisions, some of which may be unpopular, that may have to be taken to solve the energy crisis. The interim government has not stolen the show from the upcoming PML (N) government by fast-tracking this decision, but may have saved the latter from the wrath and displeasure of the affected parties. The dual menace of power and gas shortage is a serious issue that has caused much damage to the national economy and is likely to damage more, if the right decisions and actions are not taken speedily. In this brief, we would like to explore the gas crisis and offer some suggestions in this respect.

The gas crisis has the following dimensions which we would take one by one:

1. Falling local production and lack of reasonable efforts in exploring new resources, compounded by poor law and order situation in Balochistan.

2. Gas import projects of LNG and IP, and the problems thereof: high prices of imported gas
3. Gas pricing and Tariff issues
4. Gas uses and the required diversification into other sources such as Coal Gasification, Biogas etc.
5. Conservation and efficiency issues
6. Priorities setting under gas shortages; the case of CNG and fertiliser plants
7. Performance of Gas companies and their reorganisation or privatisation; market forces and competition in the sector

The Case of CNG

Let us first deal with the case of CNG. There is one strong argument in favour of CNG and that is of its environmental friendliness as compared to petrol and specially diesel, the latter two being more polluting. Indian High Court has ordered the Delhi city authorities to run buses on CNG, as pollution had become intolerable due to diesel buses. Many European cities are planning to switch the commercial vehicles to CNG, even to Bio-CNG, the reason being environment. European car drivers though still skeptic of carrying a high pressure (200 bar) CNG cylinder in their vehicle loathe to switch over despite environmental and monetary advantage.

CNG consumption has been increasing at a phenomenal rate under highly attractive CNG prices. People and even knowledgeable circles like CNG and industry associations want not only gas but cheap gas also. They are not willing to pay the real opportunity cost. CNG association wants to maintain a sizeable difference in the prices of CNG and Petrol and Diesel. Today CNG sells at 65 Rs. per kg and Petrol/Diesel at around 101 Rs. per liter. One Kg of gas is equivalent to 1.3 litre of Diesel. Common people take 1 litre of diesel or petrol to be the same as 1 kg of gas, which obviously is not correct. This means that even if there is no difference in apparent prices of gas and diesel/petrol, there is a 30 per cent price advantage. A 25 per cent margin of difference translates into a real margin of 55 per cent. The long lines of CNG indicate that there is too much of a price differential. There used to be an unofficial fee for OGRA license of Rs. 1-2 crore. There are still pending license cases, despite a negative horizon for CNG, at least apparently. There is a strong case for pruning it down.

As suggested by some, LPG may not be able to compete in the

market in the automotive sector. In real terms, there is no price advantage in LPG vis-a-vis petrol. LPG competes with petrol in markets where taxation on petrol is high such as in Europe and even in India. In Pakistan, petrol taxation is milder than in many jurisdictions where LPG has prospered under reduced taxation. Thus LPG is expected to be limited to domestic and commercial sector's requirements, especially in Northern Areas where there is no gas network.

The CNG sector has a huge footprint in Pakistan's transport sector, if not the whole economy; there are addicted and needy consumers, public transport owners and employees, and CNG pump owners and their employees. This together makes a sizeable stakeholder which any government cannot wipe off summarily. Its discouragement would have to be phased and gradual. Among the knowledgeable, there is almost a consensus that to say the least CNG future is not bright. CNG stakeholders should start withdrawing from their commitment and investment in a planned manner. I had CNG in my last car. In my new car I did not install CNG, believing that its life was limited. It has survived more than I initially believed it would. Unless something drastic happens in the gas supply scenario which is highly unlikely, CNG would face rationing to a disproportionate level, increased gas tariff, reducing margins and ultimate phase out or limited to a drastically reduced role. This would be my recommendation as well.

Table 2
Economics of Transport Fuels

Prices US$ per MJ				
	Unit	**Pakistan**	**India**	**Eu(Germany)**
Gaso	US$IMJ	0.0282	0.0371	0.0610
HSD	US$IMJ	0.0275	0.0274	0.0495
LPG	US$IMJ	0.0217	0.0336	0.0407
CNG	US$IMJ	0.0126	0.0113	
Prices in National currencies				
	unit	Price Pakistan (Rs)	Price India (IRS)	Price EU(Euro)
Gasoline	Litre(L)	100	71	1.624
HSD	Litre(L)	106	57	1.428
LPG	Kg	100	46	0.774
CNG	kg	70	34	

Source: PSO, OGRA, IOCL India, EU Energy Portal
1 US$=100 Pk.Rs=54 IRP=0.75 Euro; LPG is in litres in India and EU.

Natural Gas-Supply and Demand

There is a shortfall of gas to the extent of 2 BCFPD. Our current gas production capacity is around 4 billion Cft per day (BCFPD), which is projected to go down by the year and would be halved in the next ten years. They want to add another 4 BCFD through LNG,IP and TAPI projects .In the end, the net capacity would stagnate at 6 BCFPD due to decrease in local production by 2 BCPD: The demand has been projected to be 8 BCFPD for the year 2020. Thus the gap and crisis would persist despite LNG and IP, although, one can expect more of the same from the same sources. Iran's gas resources are going to be there for a long time, if the US keeps restraining their gas exports. So for gas, both price and supplies are difficult issues at best.

Exploration and Production of Natural Gas

I grew up as a child hearing that our Sui gas resources (there was no gas source other than Sui and late Akbar Bugti, then Young Bugti, used to drive

flashy sports cars in Quetta, as per the account narrated in late General Shujaat's book) would last for a century. Then only a few years earlier, our Planning Commission was planning for a whole 80,000 MW of electrical power coming from Gas. After that kind of planning, Raja Parvez Ashraf and the PEPCO WAPDA bosses attempted to go for the infamous Rental Power, to run on fuel oil. Today, 1000 MW of existing IPPs running on oil are reportedly unutilised because of lack of cash and circular debt issue. PPP spent a lot of money in election campaign castigating PML (N) in their media advertisements that Shaheed Benazir Bhutto wanted to install 24000 MW, but Nawaz Sharif and the famous unknown forces opposed it: The common theme in all this is that there has been little realisation that there is a shortage of primary energy sources and whatever is there has not been developed. Hydro resources kept suffering under Kalabagh controversy, only lately has there been a consensus of sorts to go ahead with other hydro projects.

Serious efforts in local exploration of more gas, if not for oil, have been lacking most of the time. The kind of scandals and inefficiency, OGDC has been allowed to suffer indicates the poor realisation, that there has been a shortage of primary resources .There is a potential of 282 TCF of gas resources (as per Planning Commission's presentation), six times the gas resource that were discovered originally. True, that the law and order situation has been bad in Balochistan. Outside OECD countries, most source regions of raw materials suffer from law and order situation. Hopefully, if the Government of PML(N) is able to bring about a political solution in Balochistan, this excuse would go away. In addition to conventional gas, there are tight gas, Shale and CBM (in Thar). The last PPP government did bring out some policy on tight gas, but nothing seems to have happened. The promise of cheap and abundant gas is too much to be taken lightly or forgotten or soft-pedaled. Both local and as well as foreign companies are to be inducted and facilitated for gas exploration activity in all potential areas. Our proposal of direct marketing by gas producers to large consumers may provide incentive enough to gas companies to risk their investments in our gas fields.

The Expensive Imported Gas-LNG and IP

Recent LNG tenders have returned with offered prices around 17-18 US$ per million Btu (MBtu). IP-Iran gas project offers the same prices as well. At current 110 US$ per barrel oil prices, the Iranian formula of 76 per cent

of the price of oil plus transmission project costs would come out at 18 US$ as well. By comparison, oil prices are at around 20 US$ per MBtu. Currently, our local prices of utilities are at around 4-5 US$ per MBtu, resulting in electricity generation price of 4-5 Rs. With Iran gas or LNG, the unit cost of electricity would be Rs 14.00 per kWh. But we do not have option in the short term, although in medium term, we have other choices. Both the projects are in doldrums. The LNG project due to the upfront financial commitment of 25 billion US$ suffers from rivalries and legal difficulties. The Iran project is opposed by Americans. The PPP government could muster the courage of symbolic inauguration only in its last days, knowing well that the music will be faced by the new government.

It appears that the international gas market is in a state of transition. It is difficult for me and many others to accept a price of 18 US$ per MBtu for South Asia, while in Europe LNG prices(landed) are around 8-10 USD$. There is such a glut of gas in the US, that gas prices are the lowest in American history. Americans currently are vacillating between thoughts of keeping the bounty unto themselves or exporting to Europe boosting the latter's energy security and giving tough time to Russian gas of which there is a kind do monopoly. There have been proposals of arbitrage- including by this scribe, a chapter which is not to be closed yet. If the US is opposing IP-Iran pipeline .project, at the expense of appearing naive, I would urge that the US must do something for the regional LNG market making it more reasonable. The private sector should show its efficiency in this respect. The now-redundant LNG regasification plants may be shifted to Pakistan in a JV arrangement along with its LNG supply arrangements from North Africa.

One has to ponder over as to what would happen when imported expensive gas, LNG or Iran Gas, makes its way into our pipelines at prices between three to four times of the existing rates. Gas would be at the price of oil. Today, you shut down your power plants because Oil is expensive, tomorrow you will be shutting power plants and almost everything else because gas would be expensive. There could be a case for expensive imported gas, however, if it is put to. high efficiency use, where 50 per cent or more of its energy content is extracted and usefully utilised, e.g. cogeneration, tri-generation and combined cycle power plants. Giving it away to fertiliser plants at near zero prices or to inefficient boilers and furnaces wasting energy and demanding lower gas tariffs should not be permitted. As to the CNG, in that kind of price environment, CNG would

die its own death. One did not have to make an extra effort to close down or discourage CNG. LNG projects would have done it ultimately.

Price Framework

Energy planning both by the government and the private sector should be done on the assumption of short term price of 120 USD per barrel of oil and 150 USD in the long run. Indexing of any energy commodity with oil is going to be a losing game for the buyers. Presently both LNG sellers and pipeline gas sellers insist on indexation with oil and that at 80-90%.This is unsustainable. Precious years have been lost trying to get hold of imported gas, be it LNG or otherwise. Affordable gas and electricity can come out of hydro and Thar only; and if Allah is kind and conditions improve in Balochistan, cheaper local gas resources can be developed. Only then CNG can continue although at a lower price differential.

Table 3
Pakistan Natural Gas Data

Natural Gas Potential	=282 TCF
Original Gas Reserves	=52.9TCF
Consumed to-date	=30TCF
Net Remaining	=22 TCF
Current Production Rate	=4 BCFPD
Remaining life of Gas Reserves	=10-15 yrs
Existing Demand	=6.0 BCFPD
Current Short Fall	=2.0 BCFPD
IP Gas Imports Planned	=0.75-1.5 BCFPD
LNG Import Projects	=1.75 BCFPD
T API Capacity	=1.35 BCFPD
Projected Demand 2020	=8-9 BCFPD
Shortfall despite above projects	=2 BCFPD (25%)
Current Avg Well-head Gas Price	=5 USD per MMBTU
IP Gas Price	=1.8 USD per MMBtu (76% of Oil Price)
LNG Price Pakistan	=17-18 USD per MMBtu (recent tenders)
LNG Price Europe	=8-10 USD per MMBtu
Avg Gas Price Europe(network)	=8-10 USD per MMBtu
Avg Gas Price USA(wholesale)	=3-4 USD per MMBtu

Source: OGRA, Interstate Gas, HDIP

Let the target be 10 BCFPD for 10 USD per MBtu. Local gas exploration would get a boost under this policy, after all you are prepared to give 18 USD per Mbtu to the imported gas. 10 USD is the right price of gas, be it imported or local. It would be 50% of the Oil price. This is what prevails in gas scarce Europe. Ultimately, we should be able to bring our Iranian brothers to this price level. Islam promotes fairness and not exploiting could somebody in need, a lesson Iranian government needs to be given by some preacher.

Exploring Natural Gas Alternatives

Astonishingly, both industrialists and the CNG sector are noted investigating for other alternatives. All they are looking forward is purchase of expensive energy by government, its dilution in the total mix and the in eventual subsidy and an unfair tariff in their own sector's favor. Media support is garnered through expensive advertisements through this end. This is naive and short-sighted being continued for long and no more sustainable. The hour of truth has arrived. Energy professionals and managers dealing in energy efficiency and conservation projects often complain that industry does not take interest in saving energy and continues wasting in inefficient devices and machinery. Heat losses are not prevented and put to good use. Hardly any interest is shown in cogeneration, when the world is talking of tri-generation trying to extract 80-90% out of any thermal resource. We currently are at Ire level of 30-35 % generally except for combined cycle power plants where this number goes to 40-45 %.Gas companies imposed a condition of using cogeneration in awarding permission to install gas generators. Compliance remains only on paper while the gas inspectors are entertained suitably. So everybody wants cheap gas and energy and ends up wasting it. IMF and World Bank are abused when they argue for increase in' tariff, terming them enemies of Islam and Muslims, Exploiting cheap labor and energy seems to be the motto all around. What happened in the Baldia garment factory (where several hundred people perished in a fire that was potentially controllable) is not unrelated. It is a continuation of the same theme and attitude. Yet the change has to come from within. The nation is looking for leadership which has yet to emerge. May be it does in the upcoming electoral process.

Bio-gas and Bio-CNG

There are alternatives that need to be investigated by government and its ministries, gas distribution companies like SSGC and SNGPL, CNG and industrial users. We have in this space discussed Biogas alternatives in detail. In order to achieve diversity and energy security, Europe is trying to have 20% of gas supplies coming from bio sources, although the US is lukewarm in this respect as it has a gas glut these days which may continue for quite a while. We have both price and energy security imperatives. The Biogas issue should be examined beyond the small biogas schemes being currently pursued at a very low tempo. While the scale of effort, resources and targets ought to be increased many times, there is a need to consider large biogas seriously for distributed generation, Bio-CNG and even for injection to gas grid.

Our estimates show that the Biogas potential in Pakistan is as much as the current annual production. Because it is widely distributed, its potential may be best developed at the point of tri-generation. However, there are many point sources where large scale biogas can be generated at one location. The most ready example is of Landhi's Cattle colony, where a 20 MW power project of Biogas has been formulated. Lately, KESC and IMF involvement has given the project more credibility. Biogas would be produced from gober slurry, blood and offal and bio- waste of all sorts. There could be several large projects of this size elsewhere in the country. There is waste from food industry, dairy farms, vegetable and fruit waste at markets, solid waste, agro waste etc. Biogas need not be a monopoly of electric power producers. Gas companies can and should also enter in this arena of biogas. In fact they ought to be the primary players. Biogas can be upgraded to pipeline quality gas. I am not dreaming or talking theory. It is already being done in Europe and there are big targets about it for 2020 and beyond. European targets should not be taken as lightly as we take ours. They take it seriously. Similarly, there are Bio- CNG projects. Electricity sector may have other cheaper options like hydro and Thar. Gas sector's alternatives are LNG and Iran gas which have not only been problematic but are too expensive to afford. A biogas alternative, cheaper and securer, to LNG and even Iran gas is certainly there. Although I would neither oppose LNG nor Iran gas as short term alternatives which can be brought on line 'the fastest, all eggs should not be put in the basket of these projects, as there are uncertainties in both the cases. I would encourage the LNG promoters to also start developing these projects as extra business. Also

novel methods may be investigated for gas distribution like promoting micro gas grids for local purposes and Plastic sacks for holding low pressure biogas for rural areas. Syngas from Thar coal is a serious option for mega resource which ought to be pursued rigorously.

Thar Coal Gasification

Also Coal gasification has to be pursued, whether above-ground or underground .However, the project must be retrieved from a personalized approach and strategy and should be structured and organised in a befitting manner .Similarly all fertiliser production would have to switch to coal (Thar).It would take 5-7 years to do that, earlier the better. It is not an empty thought .It is technically and economically feasible. All alternatives are feasible compared to the scary price of 18 USD for imported gas.

Thar Coal Briquettes as Industrial Fuel

In almost all countries where Lignite is mined, Brown Coal Briquettes are used as industrial fuel, especially, in furnaces. Briquettes are much cleaner burning fuel than ordinary coal. Briquettes are easily manageable and handled and do not leave dust and debt is. Throughout Central Europe, Briquettes have also been used as domestic fuel mostly for heating. The same can be done in Pakistan. In winters, there is a pervasive problem of finding enough gas for heating. Gas is not available in Punjab, even for cooking. Large houses can install hearths to burn coal briquettes. There are briquettes burning heaters that are also available in many parts of the world. Now Biomass briquettes are replacing coal briquettes in theses jurisdictions. Germany is still a top ranking coal briquette user, followed by Thailand, Ukraine and others. In Pakistan, much more dangerous material, especially in Punjab, is being used as industrial fuel. Thar Coal briquettes can be a reasonable alternative to such obnoxious fuels. Reportedly, Thar Coal Board has done studies in this respect. Once power projects get going on Thar coal and Mining is initiated, Coal briquetting plants may be installed in SME sector which would not only boost employment and income generation in the area, but can make a significant contribution to filling the gap in industrial gas demand. Biomass briquettes can also be included in the programme where feasible.

In fact one does not need to wait for Thar Coal. There are low grade coal deposits in all the provinces, whose output is being currently utilised

by Bhattas, which can be utilised for immediate action. Fortunately, there is already a nucleus available at FRC (Fuel Research Centre) of PCSIR who are engaged in relevant R&D on the subject. There is a project in FATA where FRC, FDA and SMEDA are working on. These nuclei can be energized to facilitate the induction of coal briquettes at a fast pace that is required in the current circumstance.

Reforms in Gas Sector

Reform is due in gas tariff system. It would be unfair to blame OGRA in this respect. OGRA is not a supra government agency, it works under the policies of government and has to implement the latter. OGRA at best is only slightly more than a calculator. So much so that the formula can he computerized and prices calculated automatically and posted on websites. And because, fuel is a multi-sector and multi-ministerial issue, it is rightly being handled at ECC level. There is a general mantra, which has been pursued by IMF and World Bank experts, of having a uniform gas and electricity tariff irrespective of the sector or user category. There is only I partial merit to this. In a theoretical setting, price dictates resource allocation and thus has to be left independent to optimize resource allocation. Practically no government has accepted it anywhere.

There are separate tariff rates for industrial and household customers; differentiation is made between small and large consumers. Industrial and large customers are charged lower tariff and households are charged higher tariff. However, Gas fertiliser sector is charged so low that it is close to nil. It's almost free to them. The argument is to contain the agricultural and food prices, fertiliser being an important input. There are other ways to achieve this in the form of higher support prices. The current practice robs the gas sector of its legitimate revenue and creates many distortions. It also promotes undesirable practices in the fertiliser producing sector as well.

The Gas Market and the Need for Competition

Some element of market, competition and consumer choice has to be brought in the gas sector as well. The existing one or two buyers' model has to be modified and price control lifted for large consumers. A gas producer should be able to directly sell to large consumers at mutually negotiated prices, outside OGRA tariff frame-work. The Transmission and Distribution companies are to be paid their service charges, called wheeling

charge. Under this scheme of things, the pressure of upward revision of gas prices may be relieved from the government. A local gas producer or a gas importer may be able to arrive at a short or long term deal if OGRA controlled price constraints are removed or minimised. The bureaucratic processes may be eliminated from the business and gas exploration and production may also be facilitated and encouraged. A policy should be made in this respect.

Reorganisation Versus Privatisation

Instead of considering protracted and controversial privatisation, consideration may be given to dividing and reorganising the gas companies' and establishing smaller distribution companies at divisional level; about eight to ten gas distribution companies may be brought about. For all the companies providing public goods and services, a two-board system ala-Europe should be introduced.

Put together, these measures of marketising, wheeling charge and smaller companies and the supervisory board system may bring about the or better level of service and efficiency as may be expected out of privatisation. Eventually, it may be easier to privatise smaller companies in a dual and orderly manner. Talk of privatisation creates unnecessary certainty and paralyses decision making. Fast track privatisation becomes controversial and brings forth ineligible and unsound parties.

But what to do immediately is to let housewives cook their family meal. The people in Karachi do not have a realisation as to how grave the situation is in Punjab where there is a double menace of electricity and gas load shedding. Ironically, highest CNG concentration is also in Punjab. In the following, we summarise our conclusions and recommendations for the gas sector:

- Increase CNG price to around Rs. 80/- per kg and accordingly increase the CNG pumps tariff.
- Immediate ban on CNG use for private cars of more than 800 cc, which is easiest to implement. Ban has already been imposed, but has to be broadened to include vehicles larger than 800 cc.
- Ban on CPP generators who are violating cogeneration requirements and issuance of notices for conversion to cogeneration; independent audit of their energy use be instituted.
- Award CNG the lowest priority in gas management plan and first priority to household.

- Combined Cycle Power plants to get the second highest priority. Single Cycle gas turbines to be permanently shut off, if this has not been done already. Speed up the coal conversion projects.
- Second last priority to fertiliser sector, as fertiliser imports are possible to substitute local production; a notice of five years should be given to fertiliser sector to switch to coal.
- Examine the feasibility of gas storage in depleted gas fields. This may assist in load management and don't make billion dollar projects out of it.
- Re-negotiate IP gas prices to a reasonable level of 65% of oil prices or 10 USD per MMBtu which is the usual price in Europe.
- Lure cheaper American LNG (shifting the redundant regasification plants with its LNG arrangements -in arbitrage) in as bargain, if IP gas pipeline is opposed.
- Issue notices to fertiliser plants to switch to Thar coal in a maxim of five years. Fertiliser industries diversification to Low Btu gas is step in the right direction.
- Coal briquettes may be introduced for meeting the industrial requirements, where end-user conditions permit. Initially imported briquettes may be introduced to be followed by Thar Coal briquettes as and when the elusive Thar coal project gets going.
- Reorganise Gas companies and open up the gas sector, creating market outside the regulated framework for large consumers.

Gas Salvage Plan

Apparently the predicament appears to be very grim. There is already a shortage of 2 BCFPD. The production level of existing gas resources is going to dwindle every year and would be reduced to only 2 BCFPD(50% of the current level) in 2020, which is only less than seven years away. If serious attempt is not undertaken to control/shift the demand trend, there would be chaos causing tremendous economic and social calamity. In the salvage plan (see Table 3) that we have proposed in the light of aforementioned discussion, we have proposed both demand control and as well as supply augmentation measures.

A demand shift of 1.349 BCFPD has been proposed. A provision of 35 % increase in demand in the 2013-2020 period has been accommodated. This would actually mean that the (constrained) demand would remain at

the same level as of today. This would be achieved through following measures:

- 50% reduction in CNG demand though administrative and pricing measures, to be achieved in one year
- 50% reduction in industrial gas demand by shifting industry to alternatives such as imported coal briquettes initially to be followed by supplies from Thar coal eventually in 3 years.
- 85% reduction in gas consumption of fertiliser sector by converting to Thar Coal
- Reduction of UFG losses by 50% in 2-3 yrs

No demand control measures are suggested or expected in the Power and Domestic sectors to be treated as the, highest priority end-users. The supply measures propose the creation of some 4.5 BCFPD of new gas or equivalent resources, with the following details:

- Development of Bio-gas and Bio-CNG to the tone of 0.5 BCFPD in next 5 years, a reasonable goal indeed in the light of potential that is there. There is no uncertainty of source material as may be there in case of Fossil gas.
- Exploration and development of 2 BCFPD equivalent of Natural Gas Resources in Balochistan, Sindh and KPK. This includes Tight, Shale and CBM gas. This is to be achieved in 5-7 yrs.
- Development of Coal Gasification from Thar, whether under-ground or over-ground, to the tune of 2.0 BCFPD, to be achieved in 5-7 years. Smaller production levels 0.5 BCFPD may start even earlier i.e. 3 years. This is separate from Conversion of Fertiliser factories to coal, which is covered under demand shift measures.
- There is allowance of slippage in the proposed salvage plan. For example, a production resource of additional 4.5 BCFPD is proposed to be added to the 2 BCFPD of the NG resource that is going to be there in 2020, which adds to around 6.5 BCFPD, while we propose to contain demand at 4 BCFPD. The proposed measures would cater to the unsupplied demand of 2.0 BCGPD.
- It is expected that the proposed development can occur at a cost rate of 10 USD per MMBtu, which is twice the current price level and almost half the price of imported gas, IP or LNG. These prices would justify the risky investments in exploring new gas resources and capital intensive coal to gas projects.

- The skeptics may dub our proposed self-reliance or salvage plan as too optimistic, while we consider the proposals of imported gas to be unrealistic and even counter-productive. A whole term of PPP government was wasted in trying to implement the gas import projects. Additionally, the import prices are almost approximating the oil prices, if all hidden and additional costs are to be included. In fact, if serious efforts had been applied to the development of local resources, some of the results might have already started coming in. However, one would like to see atleast one gas import project to materialise, preferably the IP gas project from Iran, hoping that Iranis would eventually agree to a fair and affordable price. In fact by the logic of Iranis, who argue that the gas price should be equal to the buyer's next best resource, development of cheaper alternatives would impel them to bring down the price to around European level. It is unfortunate that the extractive capitalist pricing principles have been adopted by a revolutionary government of Iran which originally rose for Mustazafeen (the week and the down-trodden).

Table 4
Gas Salvage Plan

Demand Control							
	Current Consumption			**Demand Reduction**		**Net Demand**	**Gr. Demand**
			%of		BCF		
Power CNG	BCFPD		Total	%	PO	BCFPD	BCFPD
	1		25	0	0	1	1.35
	0.31		8	50	0.155	0.155	0.20925
Domestic	0.64		16	0	0	0.64	0.864
Industrial	1		25	50	0.5	0.5	0.675
Fertilisers	0.64		16	85	0.544	0.096	0.1296
	0.3		10	50	0.15	0.15	0.2025
	4		100	33.715	1.349	2.651	3.57885
Supply Augmentation Measures				Supply Increase		Net Supply	
Production Natural Gas (2020)	2			100	2	4	
Bio Gas	0				0.5	0.5	
Coal Gas					0.75	0.75	
					3.25	5.25	

Table 5
Reality Check

Estimation of Coal requirements					
	Units	**Qty**	**Mbtu/yr**	**Coal T/yr**	**Coal T/day**
Coal to Gas eqv IP gas	MMCFt/day	750	273,750,000	14,607,791	40,021
Power	MW	5000	350,400,000	18,697,972	51,227
Fertiliser	MMcft.lyr	200,000	200,000,000	10,672,359	29,239
Industries briquettes	MMcft.lyr	150,000	150,000,000	8,004,269	21,930
Total			974,150,000	51,982,391	142,418
Heat Rate	Btu/kWh	10000			
Thar Coal CV	Mbtu/ton	18.74			
N.Gas CV	Mbtu/MMCft	1000			

Reality Check

In this section, we would like to check the feasibility of the targets we have proposed. For this we have worked out the coal requirements, for these targets, to be able to see the magnitude of effort that may have to be applied. We have taken the following targets:

- Coal Gasification with an output equal to the supply capacity of IP Pipeline=0.75 BCFPD
- Electric Power Production =500 MW
- Fertiliser Plants conversion to coal, with a capacity=200,000 Million per year
  Coal Briquettes to replace 50% of Industrial Gas demand =150,000 Million Cft per year
- Coal gasification to replace IP pipeline may have to be dropped to reduce the load on coal mining requirements.
- Fertiliser plants' switching to coal may have to be extended in two phases of 5 years each; alternatively, one model conversion may be aimed initially or fuel requirements (rather than feed-stock conversion) of fertiliser plants may be addressed in the period 2013-18.
- Industrial coal briquettes production may have to be halved to limit coal demand for briquettes to 4 million tonnes per year.

The Challenges and Achievements of the Present PML (N) Government

We have ushered into a new year 2014 and more than six months have passed after the installation of the new government of PML (N). Although a lot should not be expected "in this short period, yet it is long enough a period to look at the direction, the new administration is going in. Instead of enumerating the list first, I would venture to jumpstart the discussion with the very first few steps of the present government.

Paying off the Circular Debt

The most important step was the clearing of the circular debt. It was a courageous and timely step in the right direction. However, the cause of the problem could not be addressed which is the difference between cost and

selling price of electricity. Admittedly, the problem cannot be solved in short run as it has links with distribution losses, dependence on expensive oil and the inability and inadvisability of passing on the entire deserved and undeserved burden on the consumer. Politicians would always advise going slow in this respect, unlike economists. Government will have to gradually and inexorably go towards addressing tariff anomalies and reduce the gap between selling price and the cost of electricity. As a result of these payments, electricity supplies have increased and load-shedding reduced, although not as much as it was being predicted.

Shift to Coal

On the supply side, strong statements have been issued for converting oil based Steam Turbines Power Plants to coal. Previous government was also in hurry to do that. It is a good solution. However, there are issues of logistics, technology and funding. There does not appear to be much progress on the issue yet. However, ADB has approved a Coal Power project at the site of Jamshoro, Sindh, 150 kms East of Karachi. The plant (2x600 MW=1200 MW) would be based on imported coal with a provision for utilisation of Thar Coal. It would take five years to complete this project. This is a major breakthrough financing coal power in Pakistan.

The PPP government had put all its eggs in the basket of Engro for Thar coal Engro's Chief was rushed out of the office in haste by the board of that company reportedly on the charges of pushing the company into impossible projects. Engro Fertiliser's expansion of one Billion USD without an assured gas supply prospect and developing a behemoth Thar coal project of 2000 MW; trying to bite more than what one can chew. The CEO of Engro switched to better pastures in politics and Engro Corporation backed out, putting the PPP government at the centre and the province into an embarrassing situation. Reportedly, the project is being revived with more modest aim of a 600 MW power plant in Thar. It is a million dollar question whether Engro would be able to go ahead. There are other MOUs on Thar Coal which have remained MOUs only so far and no progress seems to be there on those.

One does not hear much about the underground coal gasification project either. Has it been quietly abandoned? As for myself, I never believed that it would be a success without a participation of a credible foreign company. It has been a solo flight of an individual all along. Precious time and money has been spent on it. It should be retained as an

R&D project on a low flame till some credible partner picks it up to develop it. The chief of this project is now reportedly busy with Gadani coal project.

Keeping the failures in view and the persistent opposition of the Sindh government against involvement of Federal Government under the provisions of 18th amendment, the Government of Pakistan announced a mega project of 5-6000 MW at Gadani. AES (a major American Power Company which had installed a power plant at Kot Addu and later sold the plant to Mian Mansha) had earlier prepared a feasibility study for a 1000 MW Power Plant based on imported coal. They got a NEPRA tariff approval in 2009 as well. It was a wise step to pluck the lowest hanging fruit; otherwise 18-24 months are required to conduct a feasibility study, especially for government which has to keep up with transparency and PPRA rules. Land is being acquired. The Pakistan Power Park Management Company has been formed as a Special Purpose Vehicle. Seargent and Lundy have been appointed consultants to prepare a feasibility study in the perspective of the larger project. The Government of Pakistan will provide services and support facilities like jetty, switch-yard, ash disposal, cooling water, transmission facilities and housing complexes. There will be sovereign guarantees extended to all investments. This seems to be the right model. This could have been possible only by the direct involvement of the Federal government. Sindh Government leaders should reevaluate their attitude and policies towards doing it alone, trying to achieve everything through private investments in which problems arise in extending sovereign guarantees. Perhaps it is too late in the day.

Chinese have promised support and have expressed strong interest in installing one or two 1000 MW power plants. I do hope, however, that the Chinese would be able to deliver on all their promises from nuclear power (6 Billion USD), Hydro (10 Billion USD), Khunjerab Highway, double-tracking the Railways, Gadani Coal and what not and all being rather urgent. It is not yester-years' Communist China. Bankers in China also should be doing their risk analysis. Unrealistic promises and hopes often meet bad fate in the face of realities. Chinese kept quiet both in 1965 and 1971 wars despite some understandings and assurances reportedly given to Z.A. Bhutto. Let us look forward to some progress in this respect. One wonders if the same kind of efforts and energies that have been applied for Gadani, were applied for Thar coal, better long lasting results could have been obtained. National interest is always defined in convenient terms and is almost the last one in political priorities. Thar Coal is one project where

collaboration among the two mainstream political parties and their governments could have done much benefit to this country. We do hope that sense would prevail. If miraculous progress is not achieved eventually in Gadani, it would not be a bad idea to lend support to the provincial government of Sindh for fast-tracking Thar coal project. It is too early, however to make a judgment on the prospects of success of Gadani.

Every kWh of electricity produced on imported coal would result in a drain of 5 cents. This would mean a forex drain of 350,000 USD per MW per year. For 5000 MW of Gadani Park, the forex drain would amount to 1.75 billion USD per year. It is so difficult to generate an export volume of that amount. It would have been all right had there been no alternative.

Nuclear Power

The biggest cracker in investment market is the announcement that China would supply two nuclear power reactors (2x1000 MW=2000MW).The project would cost 9-10 billion USD with a Chinese low interest loan of USD 6.5 Billion. Where would Pakistan bring the required equity of 3-3.5 Billion USD from is an open question. Admittedly, nuclear power plants are expensive: 4000 USD/kw in comparison to 1600-20001KW for other plants. Interest during construction is usually very high due to the long time it takes (5-7 years) to put up a nuclear power plant. However, nuclear fuel is cheap, costing 0.5 cents per kWh as opposed to 16 cents for oil or 4 cents for gas. Also, due to a high capacity factor of over 90%, it gives more electricity per MW than other power plants e.g. twice that of hydel power plants and 30% more than other conventional plants. If Chinese are financing – and no one else would do it for sure – there is a scope and justification for these power plants. Without such assistance, no nuclear power plants can be brought in. We have examined the issues in nuclear power in a separate chapter.

Natural Gas: LNG and IP Pipeline

On LNG, there is some progress towards the construction of an LNG Terminal. Rightly and finally, the issue of LNG supplies has been separated from the construction of the terminal. Reportedly, it has been decided to sell the LNG to large end-users instead of mixing it in the general pool giving rise to a general gas price hike. The high prices of LNG (14 USD per MMBtu vs 4.5 USD/MMBtu of the current average tariff) can only be

justified for uses in high thermal efficiency power generation like NGCC combined power plants where efficiencies of 45% are currently there. Although, new GE turbines offer as much as 60% of thermal efficiency, which is twice the thermal efficiency of presently installed oil -fired power plants i.e. low efficiency plants running on expensive oil. Nevertheless, the tariff burden would be passed on to electricity sector, wherein Gas Power would be costing more than 10 Rs. per unit in place of the current 4 Rs. We may not have much choice in the short term, although in the long run, there are many options and choices.

Fortunately, the era of expensive LNG seems to be over. The shale gas production in the US has deluged the market. The quantities are so high that the US is entering into export markets. Despite distance, LNG imports from the US would be a lot cheaper than hitherto available from our so-called brotherly Muslim countries of Iran and Qatar. There are new large Gas discoveries in East Africa, all putting a downward pressure on gas prices which were kept high by monopolies artificially. In such a transitional stage, it was inadvisable to enter into long term agreements on gas supplies at high prices. Iran and Qatar will have difficulty in selling their gas at impossible prices. CNG price forecast is 10 USD per MMBtu for the US exports landed at Karachi ports.

Recently, there were short-lived hopes for the revival and implementation of IP Gas Pipeline project in the wake of the recent break-through in US-Iran nuclear negotiations. As it comes out, the loosening of embargoes on Iran may not affect the international legal status of Iran's gas sales to Pakistan. The project is again in jeopardy and there are no signs yet that the pipeline would be implemented in one or two years' period. The negotiators of the two countries are busy setting new targets and deadlines and possibly the well-advised reduction in gas prices.

Our gas resources are dwindling. Production has been going down year by year. Gas resource would finish in the next ten years, if new discoveries are not made in time. Some breakthrough has occurred in the area of tight gas resource development. Large resources have been indicated of Shale gas many times more than the original gas reserves of 57 TCF. Owing to the current investment climate which is being marred by terrorism, foreign companies have either not shown interest or have demanded excessive prices. However, sooner or later, GOP has to make a decision towards enhancing the well-head tariffs to competitive rates plus a margin. This would be around 8-10 USD per MMBtu, which would be still lower than LNG or IP gas prices. If one is prepared to pay a price to the

imports, why not the same or a little lower to the local producer even if of foreign origin.

Theft of Gas and Electricity

The new government has started acting tough on the electricity and gas theft. Gas theft problem is much severe than anywhere in Pakistan and in Electricity sector, theft is much less in Punjab than anywhere else in the country. The PML (N) has provincial government in Punjab. It is quite likely that in Punjab, meaningful progress would be made towards the reduction in power and gas theft and receivables. Elsewhere, the problems are much more severe.

Electricity thieves are almost among all sections of the society; they are abundant among the super-rich and the poor alike. In Sindh, big landlords having political clout, control or nuisance value, steal electricity without any compunction and do not pay their bills. Even provincial government departments are involved in this directly. In Balochistan and KPK, poverty and unaffordability is a major factor.

PML (N) government is very anxious to pass on the loss giving power distribution companies to the provinces. Provinces should not accept this. An actual offer was made to KPK government which demanded the cheaper Tarbela electricity to be included in the deal. The proposal went nowhere. The issue of losses in power sector would not go away simply with passing on the bucks from federation to provinces, although it is the provincial government which can use its coercive administrative powers and machinery to discourage electricity theft.

Irrespective of where the negotiations reach in respect of the transfer of the power sector to KPK, there is an urgent need to resolve the royalty/net profit issue of the KPK. In "India, they have solved their problem by giving 12% free electricity out of hydro sources and allocating a quota of 25 % in the supplies on a payment basis at accepted tariff rates determined by the regulatory agencies. It is a simple formula, does not involve any complications of computing the real or imputed profits etc. Our political and socio-economic conditions are the same; common inheritance of the Raj, poverty, federal constitutional structure, insensitive elite etc. There should be no harm in borrowing good examples even from India.

Privatisation: A Panacea?

There has been a long standing proposal for privatising electricity distribution. Are the losses of these companies there because these are in public sector? Certainly not. The losses and subsidies are there because of the differences between the selling price and cost of production. These losses would mostly go away once selling price matches with the cost plus margin. KESC continues to require subsidy in the same proportion as elsewhere. There is hardly any reduction in losses, although there might have been improvements in peripheral areas. There is already a strong private sector presence in IPP sector which should continue. Distribution is a natural monopoly where public sector performs well. The thermal generation assets should receive priority rather than the distribution companies.

Alternative Energy Sources

There are more than a dozen approved wind power projects. However, none could be implemented except the two projects: Zorlu and Fauji. The reason, an unreasonably high tariff granted by NEPRA to these projects i.e. 14-16 cents per unit as opposed to 8-10 cents in most parts of the world, is shear avarice of the project sponsors and inefficiency of NEPRA. Who can buy electricity generated through wind energy projects at such exorbitant rates? GOP has already footed the bill of Rs. 450 billion. How much more can it afford to pay? The solution is to invite competition and hold a price auction among the prepared projects for 250 MW initially, for instance. Many would be ready to revise their calculations without shame. It has happened elsewhere, in Turkey, South Africa, Brazil etc. Competition always results in lower prices than the cost-plus where profits are guaranteed even to the most inefficient.

Wind resource is almost exclusively located in Sindh, some 35000 MW or so, although there are wind resources in far off locations of Balochistan and KPK as well where demand is scanty and infrastructure non-existent. Solar Energy, however, is everywhere. Recently, Solar PV investment costs have come down to as low as 100 USD per KW, leading to a generation cost of 15- 16 Rs. per unit which is still expensive, although prices may fall low enough in a few more years to be competitive and affordable. Already, Solar PV is competitive with Diesel applications where daytime use of electricity is required. As a result, Solar PV is

attracting a lot of investment in private sector irrigation replacing diesel tube wells. There are public sector schemes as well which ought to be put on fast track; credit lines and concessionary loans to farmers may facilitate growth in this sector. Recently, Punjab government has floated a tender for 100 MW of Solar PV Power Plant in Southern Punjab. A lot of interest has been shown by private sector. There may be interesting price outcomes.

Hydro Power

There is a common misperception in Pakistan even among policy makers that Hydro Power costs as low as 1-1.5 Rs per unit. It is true that current generation tariff is that much which is due to the older investments. All new hydro projects are going to cost anywhere from 5 to 8 cents.

Reportedly, Hydro projects are moving ahead. Questions arose on Bhasha Dam when ADB asked Pakistan to get NOC from India as the project lies in the disputed territory. The issue seems to have been resolved amicably. More large hydro projects like Bunji (5000 MW) have been initiated. Unfortunately, it takes a decade to initiate and complete a hydro project.

Neelum-Jhelum Hydro project (950 MW) is nearing completion. Neelum-Jhelum had its share of snags that have been overcome. In the wake of the recent earthquake in AJK, the project was considered designed inadequately. Seismic safety factors were upgraded and design altered. There were issues of a tunnel boring machines. All issues would be hopefully resolved in the current year i.e. 2014. Present government has expedited this project, which is a wise step on their part. Perhaps this along with Chicho-ki-Malian Thermal Power project of 650 MW (which is also under fast track implementation) offer some hope of meaningful enhancement of the power production capacity in the near future.

In addition to the Mega projects, meaningful progress can be achieved in small to medium capacity dams – i.e. of 100 MW – which can also attract smaller investors. KPK government could do well for the province and the country and for PTI by lobbying such projects. Hydro projects construction can create jobs in the far-flung area. Imran Khan's charisma and general support in the West should be of some value in putting life into this sector.

Conclusion

No immediate relief appears to be in sight, although there would be improvements in the next two years by the injection of 2000 MW+ of electricity and bringing in some LNG, the latter would be a double edged sword, augmenting supplies and aggravating costs and tariff. There are two major factors impeding a rapid solution. Almost all energy projects take a long time to complete. Oil, gas, hydro and coal are the only mature and commercially viable technologies. Oil is unaffordably expensive; gas is no more; hydro will take a decade and Thar coal is marred and barred by politics. Terrorism has compounded the difficulties. Habit of teamwork has yet to be developed among the political parties, namely PML (N), PPP and PTI. Provinces tend to behave as countries in terms of long-winding and stand-offish negotiations and decision-making.

Nuclear Power

Are Chinese Nuclear Reactors Safe?

PAEC has launched a nuclear power expansion programme under which two Nuclear Power Plants (NPPs) are to be installed in or near Karachi. Foundation stone laying ceremony was held in November 20 13.The two NPPs are to be located near the existing KANNUP site at Paradise Point (Hawkesbay). A lot of concern has been raised over the project which can be summarised as follows:

1) The NPPs would be supplied by Chinese who are not as competent as the traditional suppliers from the US, France and Russia. The technology is new and not tried and tested. China has acquired this technology from the US recently and now it seeks to try newly-acquired plants in Pakistan which can be risky from safety point of view.
2) The NPPs are expensive and the nuclear power coming out of this project would be costly and unaffordable.
3) It is highly unsafe to site the plants in the vicinity of KANNUP, as any reactor accident – for instance, Three-Mile Island accident or more recently Fukushima nuclear disaster etc. – may cause irreparable damage to life and property of a major city of the country.

While I do not agree with the first points, and may only partly agree with the second but agree strongly with the third. Let us take the issues one by one. Before I do that, I may clarify that I am a supporter of both civilian and military technology. I believe that nuclear weapons have made tremendous contribution in our national security by bringing about a detente and counter capability. For a smaller country facing a much larger adversary, nuclear weapons have been a good deal. Thus what I am submitting may not be dubbed away as coming out of traditional opponents of nuclearisation and nuclear energy.

ACP-1000 reactor that is being supplied by China is of Westinghouse origin (adapted from APl000). It is a third-generation reactor based on tried and tested PWR design. Some people have confusion about it who term it altogether a new design requiring extensive testing. This is the safest design ever developed in the world. Westinghouse PWR designs have been implemented in more than 50% of the current nuclear power installation of the whole world. Nuclear Regulatory Commission (NRC) of the US has given its type approval after many years of the approval process. Several such reactors are being installed in the US itself. China is in the process of installing several such reactors. China plans to install 30 such reactors by 2030.1t has bought Westinghouse technology and designs, which in fact is being soft-pedaled to avoid criticism from NPT lobby.

AP-l000, among other innovations, has passive safety features like shutdown during critical faults and emergencies under a natural forces regime of gravity and air pressure without necessarily requiring communication and power which may itself be out of order due to the fault. For example, Water Tanks on the top of reactor buildings have been provided to supply water during emergency shutdowns. It would flow with as much ease as we use in overhead storage tanks in our houses in Pakistan. There is double containment vessel to block radiation leaks. Outer containment vessel is crash proof against aeroplanes intentionally or unintentionally ramming into it. Seismic designs have been rationalized at 0.3g seismic scale. This kind of safety feature was being longed for a long time. And now it has come to the market. A design is not to be rejected because it is new. The choice is between adopting the latest technology which is much safer or the earlier technologies of 1970s vintage which are decidedly much less safe. To the extent, Chinese are willing to supply and finance, nuclear power can be installed and sustained. NPT issues would keep all the Western Countries out of this business with Pakistan.

Courtesy: WNO (showing containment structure)

The Siting Controversy

The PAEC, which is the project proponent, has launched its own public campaign and recently held a seminar in a local hotel in Karachi in which responsible PAEC and PNRA (Pakistan Nuclear regulatory Authority charged with the task of regulating nuclear energy) including chairman participated. A brief was circulated defending their position on siting two 1100 MW nuclear power plants called K2 and K3 at or around the existing KANNUP site at Paradise Point.

The PAEC maintains that the site chosen is the best among the available options and puts forth the following arguments and reasons justifying their claim:

1. Sites at greater distances along the coast are vulnerable to a higher seismic risk because of their proximity to seismic fault lines; or they do not have an appropriate height above Mean Sea Level; or there are greater flood risks. The rock type under the surface and the absence of groundwater are also important considerations for selection of the present site. A plant built at any place along the coast other than at this site would have been prone to risk from earthquakes and tsunamis, and plant vulnerability would also have been higher because of poor soil conditions. Also an adequate seismic design factor of safety has been taken (g=0.3).
2. KANUPP already has a well-defined emergency plan drawn up according to regulatory requirements, duly approved by PNRA and adopted by the local authorities. This plan caters to the evacuation zone of up to 5 km which is the requirement for KANUPP, and exercises are regularly carried out to test and improve the implementation of these plans. Similar plans will also be a part of the documentation for the new reactors; even the current US regulations do not require the plant emergency programs to plan any evacuation beyond 10 miles.

Whoever has read the PAEC brief is not convinced as to the siting decision. Karachi is a city of more than 25 Million. Siting a nuclear power plant so close to it at Paradise Point, is definitely going to cause fear and controversy. As we will demonstrate in this space from the evidence in many countries, that in almost all the countries effort is made to locate nuclear power plants quite away from the population centres, and in particular the large cities. Even PNRA's gazette siting guidelines require

additional considerations for large cities. It is not sufficient to argue that KANNUP has operated for the last 40 years without any catastrophe thus more of the same can be done without any compunction or reservation.

One would take this reasoning with a pinch of salt. There is no safe and suitable site for installing nuclear power plant other than the proposed one. This is a counter-productive argument strengthening the thesis that Pakistan being an earth-quake and Tsunami prone country, nuclear power plants are too dangerous to be located here. Mere statements on unsigned plain papers may not be enough to prove their point of view and getting it accepted. There is a structured EIA process wherein site choices are examined; site ranking is done and mitigation plans are developed under public scrutiny and oversight. What national security is endangered in such a site ranking which is made public.

However, the proponent has chosen to get SEPA's approval in a secret manner bypassing the standard process scrutiny. The national committee of IUCN, a credible environmental body operating in the country has demanded a full-scope and open ETA. The project, in my view, would have got more credibility and acceptance, had you chosen to make public certain safety related details, proactively. Belated explanations are of no use as some individuals have publicly aired their point of view. IAEA's siting guidelines provide for the due process and public participation. It is a part of our civilian nuclear programme, where National Strategic considerations and secrets are not involved. It is highly advisable that the two programmes are kept separate. TAEA safeguards would ensure that such is the case. In this background, pursuit of secretive processes and bypassing standard procedures is not understandable. All democratic societies involve open and inclusive approaches involving public participation in nuclear siting decisions. Even in India, full-scope EIA is done with public participation. The Atomic Energy Regulatory Board of India (AERB) has also started sharing safety data, studies and determinations with public.

There are, among other economic and operational criteria, the following three major considerations in siting a nuclear power plant:

1. During normal reactor operations, nearby populations should be safe from radiological and other emissions and effluents
2) Minimum risk of damage to human life and health in case of a nuclear accident or emergency whether designed for or beyond design.

3) Minimum risk to economic and social life of the area

On all these considerations, the proposed site fails to earn a good rating despite claims made to the contrary by the relevant quarters. We will advance our argument and bring evidence to support our differences. However, some nitty-gritty of detail is important at this stage.

To implement these broad principles, in addition to the relevant studies and evaluations, following two siting parameters have been provided for by the international and national nuclear regulatory authorities;

1. An emergency evacuation zone of 16 kms around the nuclear power reactors has been defined which mandates compulsory evacuation in that zone, should there be some nuclear accident involving leakage of radioactivity at an unacceptable scale. Many people argue that this range is not enough. We have seen that evacuation in case of Fukushima was in much larger zone. The US government advised its nationals to evacuate out to a 50 Miles distance.
2. A contamination zone of 50 Miles has been defined where there may be risk to food and water contamination. Extensive monitoring of food and water sources is mandated in this zone in case of a nuclear accident involving radioactivity leakage and release.

Unfortunately, PAEC is focusing its considerations on this narrowly defined 16 kms region and is seemingly oblivious of food and water contamination possibilities and the risk of disorder in a city like Karachi which is normally unmanageable and suffers from routine anarchy besides terrorism. And even in that narrow consideration, it is underestimating the magnitude of the problem in evacuation of risky populations.

In the case of Paradise Point (KK-2), it may be noted that it is situated in the densest part of Karachi called Karachi West; the adjoining communities of Orangi, Lyari, Baldia, SITE area etc. have a combined population of 8.55 million people living within 20 kms. Also Clifton and Defence and PECRS are also within more or less 20 kms. It must also be noted that in these advanced and affluent countries, it is a lot easier task to evacuate. Most people have cars and money to eat and survive for days if not weeks on their own. The disaster management data from Japan, for example, tells us that only a few persons have to be assisted in most emergencies. People leave on their own – unassisted. In our case, neither

the people nor the government have money and resources and nor are we organised adequately. I have personal experience of evacuation during the Oil-Spill tragedy of Karachi and know how difficult and excruciating it can be. Moreover, the food and water gets contaminated in a radius of 50 Miles which means, all Karachi including Port Qasim Area would have potential for food and water contamination, in case of a nuclear accident or emergency.

As to the KANNUP's regional spatial control in the area, residents of Karachi know that all kinds of activities have been allowed in the vicinity of KANNUP. Moreover, allotments have been made in Hawkesbay Scheme-42 and within a few years, lacs of people are going to be populated there.

PAEC's explanations are not presenting or defending its emergency evacuation plans but are decrying the need of doing so. They argue that emergency evacuations may cause more problems and deaths than otherwise. How can a population of 8 million people be evacuated within 72 hours (i.e. the emergency cooling duration capacity of the reactor) of an accident? The only exit points are Banaras Chowk, Kharadar, Gulbai which cannot even cope with normal traffic. It is obvious that they do not have viable evacuation plans. While IAEA guidelines mandate evacuation plans. If the feasibility of an evacuation plan for a site cannot be demonstrated, IAEA guidelines require that such sites may not be selected. We reproduce here the IAEA guidelines:

IAEA Guidelines

"Before final approval of a nuclear power plant site, the feasibility of an emergency plan should be demonstrated. There should be no adverse site conditions which could hinder the sheltering or evacuation of the population in the region or the ingress or egress of external services needed to deal with an emergency. Many site related factors should be taken into account demonstrating the feasibility of an emergency plan. The most important ones are: population density and distribution in the region; and distance of the site from population centres. The presence of large populations in the region or the proximity of a city to the nuclear power plant site may diminish the effectiveness and viability of an emergency plan. If, upon evaluating the aforementioned factors and their possible consequences, it is determined that no viable emergency plan can be established, then the proposed site should he considered unacceptable."

IAEA SAFETY STANDARDS SERIES, Dispersion of Radioactive Material in Air and Water and consideration of Population Distribution in Site Evaluation for Nuclear Power Plants SAFETY GUIDE No. NS-G-3.2

Universal Siting Norm

As a general Siting Rule, almost universally, Nuclear Reactor siting away-from-population centres is a norm and makes common sense. Let me reproduce, the excerpts from NRC (USA) Guidelines on the subject:

As stated in 10 CFR 100.21(h), "Reactor sites should be located away from very densely populated centers. Areas of low population density are, generally, preferred.... Locating reactors away from densely populated centers is part of the NRC's defense-in-depth philosophy and facilitates emergency planning and preparedness as well as reducing potential doses to large number of people and reducing property damage in the event of a severe accident. Numerical values in this guide are generally consistent with past NRC practice and reflect consideration of severe accidents, as well as the demographic and geographic conditions characteristic of the United States.

Preferably a reactor would be located so that at the time of initial site approval and within about 5 years thereafter. The population density, including weighted transient population, averaged over any radial distance out to 20 miles (cumulative population at a distance divided by the circular area at that distance), does not exceed 500 persons per square mile. A reactor should not be located at a site whose population density is well in excess of the above value.

Additionally, 10 CFR 50.47(a)(1) requires reasonable assurance that adequate protective measures can and will be taken in the event of a radiological emergency before all operating license for a nuclear power plant call be issued. Adequate plans must be developed for two areas or Emergency Planning Zones (EPZs). As stated in 10 CFR 50.47, the plume exposure pathway EPZ for nuclear power plants generally consists of an area about /6 km (10 mi) in radius, and the ingestion pathway EPZ generally consists of an area about 80 kin (50 mi) in radius.

For, Plume Exposure Pathway EPZ of 16 kms requires mandatory evacuation due to direct radiation inhalation possibilities; and in the Ingestion Pathway EPZ(80 kms), food and water is contaminated.

Source: Regulatory Guide 4.7 - General Site Suitability Criteria for Nuclear Power Stations,
(Draft issued as DG-4004), Revision 2, April 1998http://www.nrc.gov /reading-rmldoc-collections/reg-guides/cnvironmcntal-siting/rgl04-0071

There are 100 nuclear power reactors in the US with a total installed capacity of slightly more than 100,000MW. In the enclosed table we have provided population data for 13 most dangerously located reactors. Out of these, only 4 nuclear reactors, namely Indian Point (NY), TM Islands (Penn), Limerick (perm), and Mcquire (NC) have populations of 880,820- to 1187284 living within 20 miles of the nuclear reactors. In most other locations, this number is typically under 200,000. Even in this list of dangerous locations, one would find sparse populations in quite a number of situations. In the category of 10 miles (17 kms) distance, even Indian Point (NY) would fare better than our proposed KK-2; a population of 272.5 as opposed to more than a million living within 17 kms of KK-2.Typicall less than 50,000 people live within 17 kms of nuclear reactors in the US can be seen readily from the table. The figures match even with China where environment and safety issues may fare lesser on agenda, as is the common belief. We have provided numbers on China as well in a table. PAEC selected only the worst possible example to prove its case.

Following are the 13 most dangerous nuclear reactor locations in the US.

Reactor Name	**State**	**10 miles(1)**	**20 miles(2)**
Seabrook	New Hampshire	118747	463872
Vermont Yankee	Vermont	35284	147109
Pilgrim	Massachusetts	75835	307359
Millstone	Connecticut	123482	317466
Indian Point	New York	272539	1187284
Oyster Creek	Philadelphia	133609	485719
Limerick	Pennsylvania	252196	1168871
TM Island	Pennsylvania	211261	880821
Salem	New Jersey	52091	545820
Calvert Cliffs	Maryland	48798	181324Saint
Lucie	Florida	266595	420273
McGuire	North Carolina	199869	1013135

Source: NBC http://www.nbcnews.com

(l) Population living within 10 miles of nuclear reactor
(2) Population living within 20 miles

Population of nearby Communities to KK2			
Community	**Population**	**Road distance -km**	**St.line distance**
Orangi	1,540,200	25	18.75
Baldia	406,165	22	16.5
Lyari	2,700,000	24	18
Saddar	616,051	28	21
SITE	467,560	22	16.5
Kemari	383,788	22	16.5
Tota1(l998 census)	6,113,764		
Estimated current	8,559,270		

1) Current population should be at least 40% more than the 1998 Census
2) Straight line distances have been assumed to be 75% of the road distances.

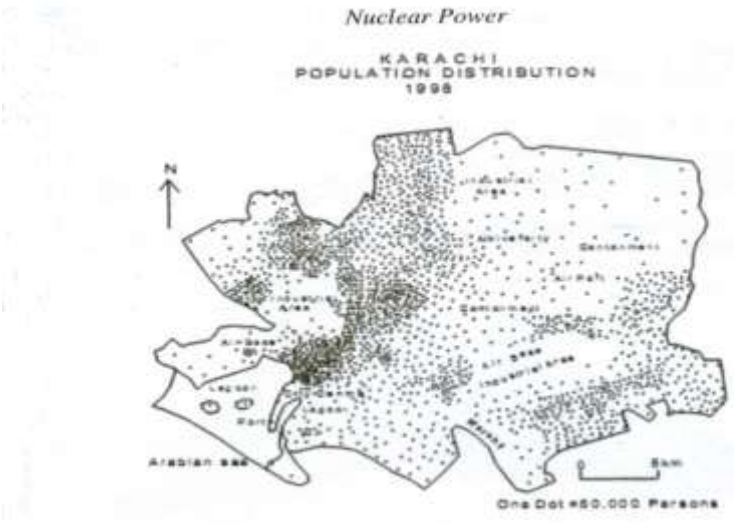
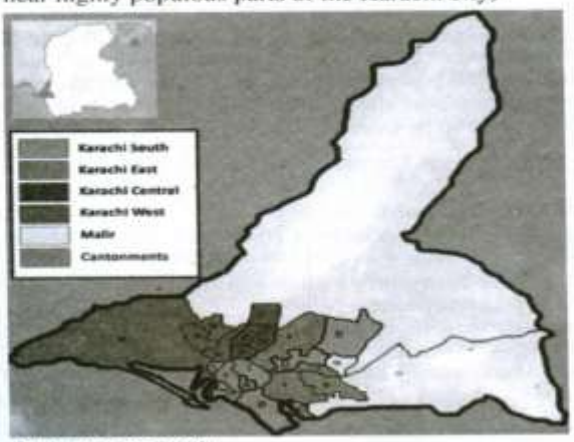


Fig 2: Population distribution in Karachi City

Source: Akhtar and Dhanani , *Population Distribution in Karachi City* **.Sindh Univ. Res. Jour. (Sci. Ser.) Vol.45 (1): 59-64 (2013);**(dots represent population density. It is evident that the proposed location is near highly populous parts of the Karachi city)



Source: Wikipedia

Issues in Energy Policy

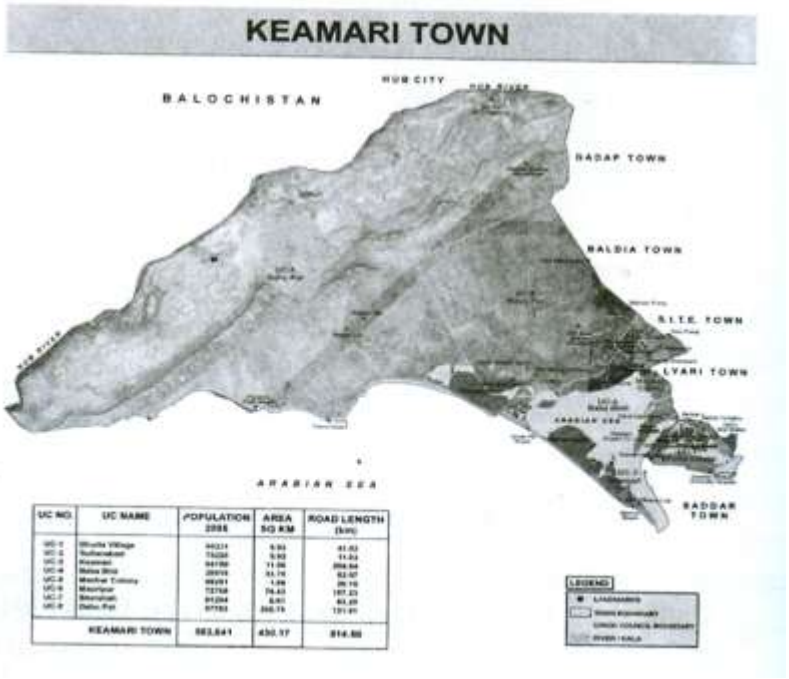
Karachi South

1. Lyari Town 2. Saddar Town

B Clifton & DHA

Karachi West

Kemari Town SITE Town Baldia Town Orangi Town



NPP Siting Framework in India; A full scope ETA with public participation is provided in Indian law. Apart from AERB(Atomic Energy Regulatory Board), there is jurisdiction of local and regional bodies and EPAs. EIA and AERB guidelines provide for the following distances and rejection criteria of potential sites. You may note that no population centres of more than 100,000 are to be there within 30kms of the NPP.

Rejection Criteria (1)

Population Considerations:

L) Population Centers of more than 10,000 should not be within 10 km of the site

2) Population density within a radius of 10 km of the plant should be less than 2/3 of the state average
3) No population centers of more than 100,000 within 30 km from the plant
4) Total population in the sterilized area should be small (20,000)
5) A distance of 5 kms from active or inactive fault lines.

Source: EIA Manual for Nuclear Power Plants, India. 2) AERB Guidelines

Chinese NPP Location Framework

We would reproduce Chinese NPP framework for location here from a highly credible Chinese source (reference provided in the end):

"Regulations for Environmental Radiation Protection from Nuclear Power Plants" ruled that a non-residential area and a planning restricted area should be set up around the nuclear power plant. The radius of the residential area should not be less than 500 meters; and the planning restricted area generally not less than 5 km. While planning limited areas, the mechanical increase of population must be limited and new and expansion projects should also be guided or limited to ensure that in emergent cases appropriate protective measures can be effectively taken. Nuclear power plants should be built in those areas where the population density is relatively low and the district average population density is relatively small. Nuclear power plants shall keep a proper distance from towns and cities with populations over 100,000 inhabitants. Table 2 shows the population distribution around some planned nuclear power plants."

Table 6
Population Distribution around some Nuclear Power Plants in China

Site		Hubei Xianning	Liaoning Taishan	Guangdong Tiashan	Fujian Ningde	Guangdong Ling'ao	Zhejiang Saanmen	Guangxi Fangchenggang
0-5Km	Number of Villages and Towns	3	1	1	2	2	2	1
	Population Size	12850	1654	1015	6945	864	16036	7684
	Population Density (People/Km 2	163.7	21.1	12.9	88.5	11	204.3	97.9
0-10Km	Number of Villages and Towns	7	3	3	7	3	8	6
	Population Size	51175	16233	13126	64481	12349	42358	
	Population Density (People/Km 2	163	51.7	41.8	205.4	39.3	134.9	135
	Population Density of the Province	325	295	482	288	482	460	191

The table shows the population density around each site is far lower than the average level of the province. In the 0-5 km range, only Zhejiang Sanrnen's population density is slightly higher than that of Fukushima's first nuclear power plant (174.6 people/km2), and the rest are far lower; In 0 - 10 km range, only Hubei Xianning's and Fujian Ningde's population density is slightly higher than that of Fukushima's first nuclear power plant (151.3 people/km2), the rest are far lower. From the total size of population, each site is in line with the provisions of the state - not over 1 million populations within l0 km. This shows that China properly considered the factor of population distribution when selecting nuclear power plant sites.

Source:http://www.dynabondpowertech.com/enlnuclear-power-news/scientitic-articles/5934-study-on-the-impact-of-the-fukushima-accident-on-nuclear-power-plan

Malaysian Framework

According to Malaysian framework of guidelines, a potential site will be rejected if the distance to a population centre of 25000 persons is less than or equal to 10 kms.

Nuclear Power Plant Siting Rejection Criteria (Malaysia)

Rejection criteria are requirements based on physical characteristics of a potential NPP site and potential sources of external events which could jeopardize its safety.

The brief rejection criteria established are:

1. Potential sites must not be within surface faulting and geologically unstable areas.
2. Potential sites must not be within flood prone areas.
3. Potential sites must not be located within Rank 1 Environment Sensitive Areas (ESA).
4. Potential sites must not be located within an area whereby man induced events such as installations with explosive, flammable, corrosive, toxic or radioactive materials, airports and the take-off and flight path zones, military installations and military target

practice areas etc. is within the NPP surrounding Emergency Planning Zone (EPZ).

5. *Within a Mukim [sub-district] with population density of more than 250 persons/km2 and/or, straight line distance to existing major population centre of more than 25,000 people is less than 10km.*

PNRA's Guidelines on NPP Siting

PNRA's gazette guidelines provide for special considerations for large cities. A part of para 6 is reproduced below:

> *A population center distance of at least one and one-third times the distance from the installation to the outer boundary of the low population zone. For this purpose, the boundary of the population center shall be determined upon consideration of population distribution. Political boundaries are not controlling in the application of this requirement. Where very large cities are involved, a greater distance may be necessary because of total integrated population dose consideration.*

There is no evidence that special consideration and assessments have been made as per legal requirements. If such is the case, it should be made public.

Fukushima and Chernobyl Lessons: There are various comments on Fukushima and the lessons learnt. Let me quote from a credible institution:

An earthquake of 9.6 on Richter Scale followed by Tsunami of not expected and designed for magnitude followed. The severe earthquake resulted in the disruption of the grid resulting into non-availability of offsite power. All the operating plants were automatically shut down on sensing the earthquake. The decay heat removal system started functioning normally as per design requirements. The Tsunami which hit the affected area about half an hour later, resulted into submergence of the emergency power supply systems at Fukushima Dai-ichi leading to total loss of on-site power supply, termed as station blackout condition. Spread of radioactivity necessitated evacuation of public in the nearby areas extending up to 20-30

kms to prevent exposure of the public. The event was initially rated as Level 5 on the International Nuclear Event Scale. The rating was subsequently revised to Level 7. However, the total radioactivity released during this incident was about 10% of that released during the Chernobyl accident in 1986. There was also degradation in the cooling provisions of spent fuel pool in Unit-4 resulting in spent fuel getting uncovered. It will take decades to dismantle it completely.

Fukushima officials revealed that areas extending more than 60km (36 miles) to the north-west of the plant and about 40km to the south-southwest have seen radiation levels exceed annual limits. There was a 20km mandatory evacuation zone and 20-30km voluntary zone. Tens of thousands were evacuated. Five communities beyond the existing evacuation zone have also been evacuated. As Greenpeace reveals on Fukushima that had the wind blowing in the other direction whole of Tokyo and other communities' up to 250 kms away may have to be evacuated.
http://www.econ.cam.ac.uk/research/repec/camJpdf/cwpe1344.pdf

On Chernobyl, following is taken from the Website of a US Government Institute

Much of what is known about cancer caused by radiation exposures from nuclear power plant accidents comes from research on the April 1986 nuclear power plant disaster at Chernobyl, in what is now Ukraine. The radioactive isotopes released during the Chernobyl accident included 1-131, Cs-137, and Sr-90.

Approximately 600 workers at the power plant during the emergency received very high doses of radiation and suffered from radiation sickness. All of those who received more than 6 grays (Gy) of radiation became very sick right away and subsequently died. Those who received less than 4 Gy –a measure of the amount of radiation absorbed by a person's body – had a better chance of survival.

Hundreds of thousands of people who worked as part of the cleanup crews in the years after the accident were exposed to lower external doses of ionizing radiation, ranging from approximately 0.14 Gy in 1986 to 0.04 Gy in 1989. In this group of people, there was an increased risk of leukemia.

Approximately 6.5 million residents of the contaminated areas surrounding Chernobyl received much lower amounts of radiation. From 1986 through 2005, these people received an accumulated average dose of

0.0092 Gy from external and internal sources of radiation. Children and adolescents exposed to 1-131 showed an increased risk of developing thyroid cancer.

A study led by National Cancer Institute (NCI) researchers followed more than 12,500 people who were younger than age 18 at the time they were exposed to high doses of 1-131 (0.65 Gy on average) from the Chernobyl accident. A total of 65 new cases of thyroid cancer were found in this population between 1998 and 2007. Roughly half of these new cases were attributed to 1-131 exposure. The researchers found that the higher a person's dose of 1-131, the more likely they were to get thyroid cancer (with each Gy of exposure associated with a doubling of risk). They also found that this risk remained high for at least 20 years.

Source: National Cancer Institute, USA http://www.cancer.gov/cancertopics/CactsheetIRisk/nuclear-power-uccidents

Karachi's Uncertain Seismicity

We are enclosing excerpts from a research paper on seismicity of Karachi due to lack of data and inadequate research. As can be seen from the paper, Karachi used to be included in High Seismic Hazard zones (highest hazard rating of 4) of the world, equal to Los Angeles California. It was later changed to zone 2 with moderate hazard rating. There are several active and inactive faults. However, no earthquake has occurred for the last two centuries. Requisite Research and data collection on the area is not up to the international standards. Whatever data collection and map-making has been done is under global initiatives of Hazard map-making. There is controversy whether, Karachi falls under zone 4 (High Hazard) or Zone 2 (moderate Hazard). For normal construction activity, such controversies and confusions could be taken lightly. However, for siting of multiple nuclear power reactors of 1000 MW, the risks and consequence of not applying the right code of construction is very high.

It may be useful to make a global comparison of the seismicity of regions. Iran is perhaps the riskiest country with almost all of the country falling in zone 4 of highest hazard. Except for the west coast, the whole of the US falls under low seismicity rating. The whole of Africa and Saudi Arabia falls under no seismic green zone. Except for Himalayan region which falls under zone 4, most of India is largely in low seismic green zone. Pakistan, however, falls under moderate to high seismic risk zone.

All of us remember the recent earthquake in Kashmir which devastated parts of KPK and all of our part of Kashmir. While northern parts of Pakistan are in zone 4, controversy notwithstanding, Karachi falls under moderate seismic risk and rating, under the most optimistic assumption. However, it is reassuring that the proposed Generation-III reactors' (K2 and K3) designs take a very high seismic factor (0.3 g) in their designs.

Worst Possible Scenario: Reactor Fuel Melt Down

Keeping in view the seismic factor and the terrorism, both in adjoining Balochistan and the wider menace of extremism, lack of exposure and expertise in operating such high (1000 MW) capacity power plants and week transmission grid, worst possible scenario becomes a relatively significant possibility. Project design cannot take care of all of these issues. Locating away from the populous areas is the only option. The proposed location, close to one of the densest parts of the country and even of the world, appears to be the riskiest option warranting a detailed review.

Other Location Possibilities but NIMBY

Going further into Balochistan coast merits some consideration, although one cannot go very far, due to power demand issues and increasing seismic risks as one approaches midway towards Iranian border. One approaches Gadani, if one moves 50 kms from Paradise point, where already a 5-6000 MW imported coal power project is being implemented. Why not around Gadani, as massive power transmission projects are being planned. One would also wonder, whether Gadani is real in comparison to Thar. One can go farther but then Ormara seems to be the limit. Some people point out the separatist threat and the long term consequences for continued access to facilities located in Balochistan. That, however, is a defeatist argument. Are we mentally withdrawing and conceding step by step? There are possibilities between Gharo and Keti-Bandar, closeness to India and Run of Kutch seismicity may be the constraints though. Pakistan lacks geographical depth. Such considerations vis-à-vis India would not let us do many things. In any case, it is highly unlikely that India would attack a nuclear reactor.

Vagaries of Nature

Nature has its own ways to be innovatively destructive some times. What happened at Chernobyl was not repeated in Fukushima and what may happen here may be completely different set of circumstances. You may always discover that you did not do something that should have been done or that your data and assumptions were lacking. As we have discussed elsewhere, Karachi's seismic data is controversial and uncertain. It is based on a two-hundred years of history only while in most cases 1000 years of earthquake history has been made use of in developing seismic ratings and codes.

On the other hand, we accept that nuclear power is safer than other technologies and that, more deaths and diseases are caused annually by conventional technologies such as of coal power. However, the consequence of highly unlikely event, if it occurs, can be extremely devastating. Why to risk our biggest city, even if the probability is extremely low. Impact and evacuation area of 16-kms much touted by PAEC and PNRA is a general planning figure. It may be highly inadequate in case of very large cities like that of Pakistan, where environmental data is lacking in quality and quantity. Fukushima was designed on high quality data, yet earthquake and Tsunami of unexpected magnitude occurred which it was not designed for. The PNRA guidelines require special considerations for very large cities. What PAEC is arguing for may be generalIy correct. However, their judgment, in case of the highly populated, chaotic and strife-stricken city, appears to be lacking sensitivity and even responsibility. And on top of it all, secretive approaches and bypassing due processes is even more painful for us, the residents of Karachi. PAEC and PNRA bureaucracy lives in and around Islamabad. It is but natural that they may have taken it differently, had they been living here. AII is well but not NIMBY.

Meaningless Secrecy

Our nuclear establishment should examine and reevaluate their workings and policies and adapt themselves to the newer times and a new Pakistan where multi-pronged and counter-acting sources of power have emerged; an informed public, strong media and independent judiciary. No longer, can one hide behind the so-called national security argument endlessly and unduly. At this moment, the debate is in rather knowledgeable circles.

Eventually, it wilI trickle down to public. Electronic media has not yet become alive to this. PAEC has to make its case, if there is one, and put forth the facts and make use of common sense. The argument and data has to be compelIing. Up to now, it has not been convincing. And it is doubtful if they can convince people that under a worst-possible scenario of a nuclear accident within or beyond design (and quite likely terrorism threats), there would be no threat to Karachites' safety, life and property.

After all what is so secret about nuclear power and nuclear reactors. There is an imported design, originally from the US and replicated and indigenised in China. And for environmental evaluations, one need not reveal a lot of reactor details. One has to develop a dispersion models and examine the contamination paths of air and water under various scenarios including Worst possible and most likely cases. The kind of data that we have presented indicates that the proposed site is risky and does not match with the generally prevalent practices and norms. Still, one would like to hear the case.

Additionally, in a country where three major military installations have been attacked with the kind of ease that everybody has noticed, it would be impossible to make a reasonably strong or acceptable case about impenetrable defense. It is impossible to predict and prevent such attacks, although one has the option of doing this dangerous business elsewhere where the impact of such happenings may be much limited. It would be in everyone's interest including the ambitious ones wanting fast track rewards and careers.

Conclusion

We are not taking an extremist view here of opposing nuclear power altogether. All we are asking is a little more careful attitude. The nuclear siting policies and data that we have provided strongly suggest the need for changing the proposed site to another location. FAEC is using 'the evacuation zone of 16 kms as a basis for locating nuclear power plants in a rather routine and callous way irrespective of population at risk. Contamination zone extends to 50 Miles as defined by NRC and the nuclear industry in the US and there have been talks of extending this zone. Indian Code requires a minimum of 30 kms distance from a population centre of more than 100,000. And even the most dangerously sited Indian Point reactor is at 25 Miles (40 kms) from the city limits. That was done in 1970s.lt would be unthinkable now. Common sense suggests that the safe

distance in case of Karachi nuclear plant L2 would be 50 Miles(75 kms).In fact this should also be a general yardstick for nuclear site planning in Pakistan.

Nuclear Power Economics

Up to now, a general impression has been that the nuclear power is a competitive energy source, if not the cheapest. It has been the case earlier and up to now, but may not continue to be the case, if the Generation-III (such as ACP-l000 and K3 plants being acquired from China) capital costs are taken into consideration. We will examine in this space, as to how to bring these costs down.

The proposed K2-K3 project would cost 9.50 billion USD with Chinese low interest loan of USD 6.5 billion. Admittedly, Nuclear Power Plants have become extremely expensive; 4000-5000 USD/kw versus 1600-2000/KW for conventional plants. Interest during construction in the case of nuclear power plants is usually very high due to the long time it takes to put up a nuclear power plant. Actual financial cost would depend on the interest rates charged by Chinese, of which much has not been revealed. Chinese finance companies have started behaving like any other western financing agency. They are requiring 4% or so of insurance charge on the lines of EXIM-Bank of the US.

Reportedly, on some projects (e.g. wind power projects) China has exempted Pakistan of this rather hefty charge. Usual net interest rates for such projects should be around 5%, especially as against a LIBOR of under 1%. Where would Pakistan bring the required equity of 3-3.5 Billion USD –which appears to be the owners' cost and interest during construction – from is an open question?

However, nuclear fuel is cheap, costing 1.0 cent or slightly more per kWh as opposed to 16 cents for oil or 4 cents for gas. Also, due to a high capacity factor of 80- 90%, it gives more electricity per MW than other power plants e.g., twice that of hydel power plants and 30% more than other conventional plants.

In the two adjoining tables, we provide CAPEX and COGE (Cost of Generating Electricity) data of nuclear power in a number of countries: a) Europe and the US; b) India and; c) Pakistan. The lowest COGE is in case of Indian-Russian design NPPS such as KudanKulam commissioned recently with a price tag of 6.5 USc only, as opposed to 19.4 USc of the new Western supplied NPPs based on APl000 technology of Westinghouse.

DAE India is quite concerned over such costs although they have entered into advance implementation agreements. Most common estimates of COGE of NPPs in many countries hover around 12-15 USc. This data, however, belies the general impression that nuclear power is cheap. Capital Cost (CPP) alone is costing USc 10 or even more per kWh. DAE, India is rather desperately trying to get arrangements under which nuclear electricity costs out of AP 1000 power plants comes out to be 10-11 cents.

The situation is even worse in the US California Energy Commission (CEC) predicts much higher COGE for Gen-III power plants. For 2018, following COGE forecast has been made:

- Merchant NPPs (IPP selling to open Markets=USc 34.24/kWh(2018 nominal prices)
- Investor Owned Utilities-IOU NPPs (IPPs selling under long term arrangements)= USc 27.311k Wh
- Public owned utilities-POU NPPs=USc 16.68/kWh

Admittedly, there are methodological differences in costing. Gen-Ill reactors are being designed for 60 years as opposed to 30 years earlier.

Table 1 **Comparative Nuclear Power Cost** **from Western vendors**					**Vendors**
Reactor Type	**Project**	**CAPEX**	**COGE**	**Country**	**Origin**
		USD/kW	UsclkWh		
AREVAEPR	Jaitpur	4850	14.55	India	France
Ap1000	Mithi Verdi	6460	19.4	India	USA
Rosatom-Russia	Akkuyu	4160	12.3	Turkey	Russia
EDF	Hinkley Point C		15	UK	France
Ap1000	Georgia Power	6360	10.4-11.5	USA	USA
API000	Sanmen	3000		China	
Source: Compiled by the author, various sources including WANO					

Table 2
Nuclear Power CAPEX and COGE (Domestic) in Russia, China and India

Country	**Technology**	**Capacity (MW)2**	**CAPEX (OCC)**	**Investment**	**CPP·**	**EPP**	**LCOE (tot)'**
			USD/k W	*·USD/kW*	*USc/kW* h	*USc/kW* h	USclkW h
China	CPR-1000	1000	1763	1946	1.30	1.643	2.999
	CPR-WOO	1000	1748	1931	1.345	1.637	2.982
	AP-1000	1250	2302	2542	1.77	1.861	3.631
Russia	VVER-1150	1070	2933	3238	2.275	2.074	4.349
India	VVER-1000	1150	2513		4.6	2.0	6.6
	PHWR	700	2430				

Source: Cost of generating Electricity: NEA/OECD: 1) CPP@5% discount rate; 2) Capacity Net; 3) In China, 2013 Tariff for Nuclear electricity has been fixed at 7 USc/kWh based on 5% cost of debt, l5% return on equity and a 70-30 debt equity capital structure.

Table l. gives NPP cost data from Western vendors that ranges around 5000 USD/ kW. Table 2. gives cost data from China, Russia and India where, CAPEX is nearly half that of Western countries. Quality differences, financing rates and higher manpower cost may be responsible for such differences. One may note from Table 3, that China is asking for Western prices of around 5000 USD/ kW from Pakistan. There appears to be a scope for friendly negotiations as both sides do not have much choice. The Pak-China deal could be around the same terms as Indo-Russian deal for roughly the comparable technology, Russians having more experience. Russians have also provided 80-85% finance at 4% as well. If deal were structured around this cost data, one would have expected nuclear electricity from K2 reactors to be around 7 cents per unit, quite an affordable figure. In present case as the deal has been reported, it may be 70% higher, indeed quite uncompetitive and rather unaffordable.

A common theme would be apparent in the data on India and Pakistan; CAPEX both in India and Pakistan doubled every 10-12 years or with change in generation i.e. from generation I to II and now III. Up to generation-II reactors, nuclear power was competitive both in India and Pakistan i.e. gradually escalated to around 10 cents level .With the Gen-III reactors unit CAPEX has again doubled to 5-6000 USD/kW level bringing CPP(Capital Cost component) of COGE to be over 10 cents. With 1.25 cents for fuel cost and another 1.25 cents for O&M, the total COGE hovers around 15 cents. In order to address this situation, many buying countries are resorting to negotiations seeking discounts and other measures. India managed to get a 30% discount from Russia, while Turkey negotiated based on a long term tariff of 12.5 cents/kwh in its recent deal with Russia for its Akkuyu Nuclear Power project. Unfortunately, our Chinese friends are charging the full US price which nobody else may be able to offer in the international market. Pakistan can get nuclear reactors and the associated finance from China only for a variety of reasons, while due to rather lower credibility, no other country would buy nuclear reactors from China. Hence, sympathetic negotiations are required. China has installed similar reactor in Sanmen at a cost of USD 3000/ *kW,* as we have indicated in the adjoining table. If prices of K2 and K3 are brought down to this level or slightly more, the nuclear power would become competitive. Otherwise the cost scenario would be inadequate. Pakistan has to bring down its cost of production to be able to solve its circular debt problem, as there is very little room to enhance power tariff anymore.

Chashma I had a tariff of Rs 5.00 per unit approved by NEPRA,

while Chashrna II is reportedly producing at close to Rs. 10.0 per unit. Hydro is the cheapest (5 cents), followed by Natural Gas (Rs.5.00 at currently prevailing low gas prices, the situation would change drastically with the induction of LNG), Coal (7-8 cents). Nuclear Power would lie between Oil and others. Hydro and Thar Coal appear to be the most optimum choices for Pakistan in this scenario. Nuclear would become uncompetitive.

Table 3
Nuclear Power Cost in Pakistan

NPP	CAPEX (USD/kW)	COGE (USc/kWh)	Status
Chashma I & II-Cl,C2	2866	7;0(PAEC)	Operating
Chashma III & IV -C3,C4	°3D0	9.59(PAEC)	Under construction
K2	5000(PAEC)	16.0*	Foundation ceremony

Source: Compiled by the author based on newspaper accounts, of Chairman PAEC statements. http://www.thenews.com.pk/Todays-N ews- 2 - 2"" 4000-Pakistan-can-operate-larger-N -power-plants-PAEC-ch ief J an 2.2014.

Conclusion

Pakistan has more than one reason to add nuclear power. There is a large nuclear establishment that has to be maintained and paid for. Lowest cost may not be the sole criterion to shape a country's energy options. Nuclear power would add diversity to its energy profile. It may be advisable to creatively explore ways and means of reducing the capital cost like Turkey-Russia deal. This can be achieved by permitting Chinese to own the nuclear plants and sell electricity at an affordable price. Easy financial terms like 4% interest and 20 years repayment period after commissioning may be explored, if there is no discount on EPC prices. The PAEC may be well advised to contain its programme to 8000 MW only by 2030, keeping this rather discouraging price scenario in mind and being more realistic.■

CHAPTER-7

Nuclear Power – an Essential Part of Solution for Energy Crisis in Pakistan

Syed Yusuf Raza and Ghulam Rasul Athar

Introduction

In Pakistan, over the last two decades, the demand for electricity has been increasing with the pace of economic growth. However, the development of electricity supply infrastructure could not keep pace with the demand. The electricity generation capacity mix of the country is not sustainable as bulk of the capacity is based on imported fuel oil and domestic gas which is not sufficient to meet the demand of power plants. High transmission and distribution losses, have further worsened the electricity supply-demand balance in the country. As a result, the country is facing severe shortage of electricity supply, which is affecting economic growth and depriving people of routine comforts.

Pakistan has to use all available resources for sustainable supply of electricity. Even with optimistic prospects of development of hydro, indigenous coal and wind resources, the recent power system expansion plans – the 2005 Energy Security Plan approved and the National Power System Expansion Plan of National Transmission and Despatch Company (formulated in 2011) have both given due weight to nuclear power as an essential component of the country's electric system expansion plans.

Nuclear power is a proven base-load electricity generation option to enhance the security of supply and diversity of the power system. The country has good nuclear power infrastructure and more than 40-years' experience of safe operation of nuclear power plants to develop its nuclear power programme. Currently, in Pakistan, nuclear energy is providing around 5 per cent of electric power to the national grid.

Current Status of Electricity Supply Sector

At present, the installed electricity generation capacity in the country is around 25,000 MW. The mix of the capacity comprises of 7,077 MW hydro; 16,920

MW of gas/oil; 755 MW nuclear; 165 MW coal and 106 MW wind (NEPRA: 2013, HDIP, 2013).

During 2012-13, the grid supplied electricity was 98,894 million kilowatt-hours (NEPRA, 2013). The power generation is dominated by hydro, oil and gas sources. Around two-third of the installed electricity generation capacity is based on gas and oil which cannot be fully utilised owing to insufficient natural gas supply to the power sector and unaffordable oil prices. The gap between electricity production and demand has remained around 5,000 MW during the past few years.

Demand of Electric Power

Electricity is a key input for socio-economic development . Pakistan is the 6th most populous country in the world with a growing population (2% per annum) of more than 180 million people. During 2013-14, the per capita income of the country was US $ 1,386 [GOP: 2014]. The economy of Pakistan was growing at an average rate of 6.8 per cent per annum during the period of 2002-2007 but the global financial crisis and the worst floods in the country brought down the growth rate to 2.4 per cent in 2010-11. The economy has now recovered to 4.1 per cent in 2013-14 and its sustained growth will require adequate supply of energy.

A study carried out by the National Transmission and Despatch Company for electricity demand projections concluded that even in the pessimistic economic growth scenario (4.8% annual economic growth during 2010-2035) the electricity demand will surpass 100,000 MW by 2035. In the medium economic growth scenario (5.9 % annual economic growth during 2010-2035) and high economic growth scenario (6.5% annual economic growth during 2010-2035), the electricity demand would reach to 134,800 MW and 169, 300 MW respectively (NTDC: 2011).

Electricity Supply Options

Electricity can be generated by various fuels and technologies. Each fuel and technology has its own pros and cons. No single fuel or technology can fulfill the electricity requirement of a big country like Pakistan. Pakistan has various options to meet the growing demand of electricity i.e., indigenous coal, hydro, nuclear and renewables.

In this paper, the status and prospects of nuclear power have been discussed.

Nuclear Power Development

Nuclear power is a proven electricity generation technology. At present, 438 nuclear power plants are operating in 31 countries providing 11 per cent of total electricity supply of the world. More than 50 countries have plans to introduce nuclear power into their power systems.

The construction of nuclear power plants in the US virtually stopped since 1996. But now, even in the dawn of shale revolution in USA, five new nuclear power plants are under construction; two in South Carolina, two in Georgia and one in Tennessee State. The United Kingdom has reached to an agreement with French utility, EDF, to construct two French designed EPR nuclear power plants at Hinckley Point in Somerset. EDF will be the major shareholder (45-50%) in the Pound 14-16 billion project while the Chinese are expected to take 30-40 per cent stake. Oil-rich United Arab Emirates is constructing four nuclear power plants while Saudi Arabia is also planning for nuclear power. Countries like Turkey, Bangladesh, Vietnam and Jordan having almost no nuclear infrastructure, are introducing nuclear power in their electricity systems.

Pakistan made an entry into the nuclear power club in 1972 when the first unit of electricity was sent to the Karachi grid from the 137 MW Karachi Nuclear Power Plant (KANUPP). When KANUPP was commissioned, Pakistan was only the 15th country in the entire world to have set up a nuclear power plant. The global politics of embargoes restricted Pakistan's further growth in nuclear power capacity for many years. But after China had developed an indigenous capability for constructing nuclear power plants in 1991, PAEC decided to set up a 325 MW Pressurized Water Reactor (PWR) with the help of China National Nuclear Corporation (CNNC) – providing the first example of South-South cooperation in the development of nuclear power.

At present, three nuclear power plants i.e., KANUPP Unit-1 (K-1), Chashma Unit-1 (C-1) and Unit-2 (C-2) are already operating in Karachi and Chashma (Mianwali), contributing 690 MW to the national grid. These plants are currently providing around 4 – 5 per cent of electric power to the national grid. The performance of the operating nuclear power plants over the years has been commendable. In 2013-14, capacity factors of C-1 and C-2 were 83.46 per cent and 83.82 per cent, respectively – well above the average of capacity factors of thermal power plants in the country.

Construction of two nuclear power plants at Chashma, Unit-3 and Unit-4 (C-3/C-4) of 680 MW is underway. The construction of C-3/C-4 is

almost 6 months ahead of schedule and the plants will be operational by 2016.

Nuclear power has proven itself to be a viable option of electricity generation in the country and a strong element of future energy mix to solve electricity crisis in the country and enhance the security of supply. Furthermore, nuclear power effectively replaces expensive imported oil to improve the balance of payment of the country.

Pakistan, having good nuclear infrastructure and more than 40 years' experience of safe operation of nuclear power plants, should expand its nuclear power programme for enhancement of energy security and mitigation of energy poverty in the country. Among all the indigenous electricity supply options, nuclear power has an additional advantage of availability of more than 80 per cent of financing from the supplier at very reasonable terms.

Trained and experienced manpower is a key factor for nuclear power development in the country. Pakistan has ensured continued inputs for its programmes through a large infrastructure for human resource development with several dedicated institutions for imparting training and education in all relevant disciplines and at all levels, from technical training programmes to academic programmes leading to M.S. and Ph.D. in most relevant areas. Furthermore, PAEC professionals share their operational experience with experts of other countries through international meetings, conferences and seminars organised by International Atomic Energy Agency, and other nuclear energy related organisations. PAEC, having its own institutes for training and re-training of nuclear power plants operators, can provide training to operators of other power plants in the country.

By virtue of experience, PAEC has developed a base in operating, maintaining and upgrading nuclear power plants. It has also developed an indigenous know-how in site selection, design, equipment manufacturing, in-service inspection and safety analysis of nuclear power plants. With this background, PAEC can develop a large nuclear power programme towards meeting the energy requirements of the country.

Nuclear Power Development Plans

PAEC is planning to meet the target of 8,800 MW nuclear capacity by 2030 as envisaged in the Energy Security Plan (GoP: 2005) approved by the government (Figure 1).

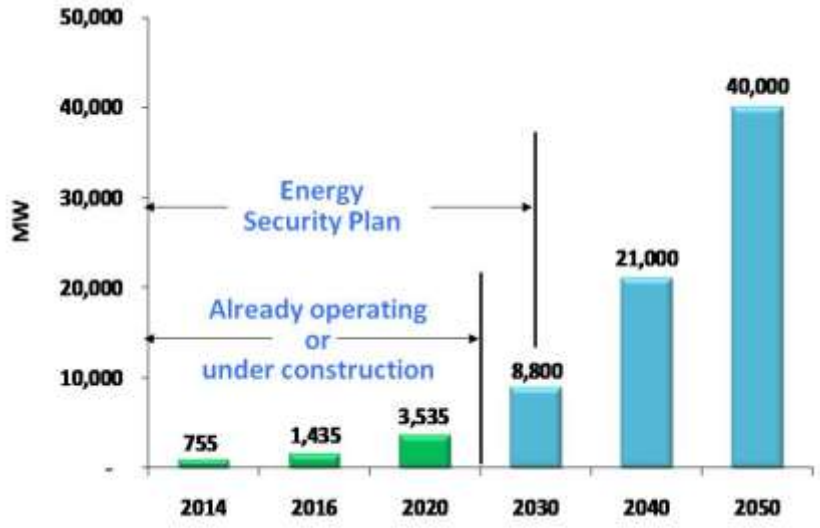


Figure 1: Nuclear Power Expansion Plan of Pakistan

The K-2/K-3, 2,200 MW, has the approval of the Executive Committee of the National Economic Council. Now the government has directed PAEC to go for 40,000 MW by 2050. The Prime Minister has already directed to establish sites for the future plants. PAEC is actively preparing itself for this challenge.

Concluding Remarks

For the envisaged economic development, Pakistan needs maximum exploitation of all least cost and plausible energy resources including nuclear power for filling the gap of supply and demand of electricity, providing affordable energy to growing population and enhancing security of energy supply. With successful experience of safe operation and availability of generous project financing, Pakistan needs to expedite installation of the nuclear power plants to meet the targets of 8,800 MW by 2030 and 40,000 MW by 2050.

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CHAPTER-8

Hydro-Power: An Affordable and Sustainable Option for Pakistan

Dr. Shaheen Akhtar

Introduction

Pakistan is currently facing energy crisis resulting in frequent and long power breakdowns, shutting down of industrial units, affecting economic growth, creating social chaos and political instability. The energy crisis has been created by a variety of reasons, in particular, increased shift from hydro to oil-based expensive energy mix, widening demand-supply gap and lack of integrated energy strategy and bad energy governance. It is estimated that the national demand of electricity would keep on growing rapidly, at about 10 per cent annually, due to rising population and economic development requirements. Pakistan is faced with a big challenge of rebalancing its energy mix which makes hydel power a very attractive option.

Hydropower is the cheapest and the cleanest, renewable source of energy. Pakistan is endowed with rich hydro power potential of 60,000 MW which can be tapped to meet its current and future energy requirements. The 2013 energy policy focused on shifting Pakistan's energy mix towards low cost sources such as hydel, gas, coal, nuclear and biomass. The paper looks into the hydropower potential of the country and various issues impeding the optimum utilisation of the hydro resources of the country. It argues that the country needs to rebalance the energy mix in favour of hydropower, prioritize run- of- the- river and micro-hydropower projects while building national consensus on the large storage dams that are also very important in power generation as well as for irrigation needs of the country but require huge capital and long gestation period.

Worsening Energy Crisis

Pakistan is experiencing the worst-ever energy crisis with peak load shedding of 18-20 hours in urban areas and 22 hours in rural areas. An

average power gap in FY 2011 was over 3,500 MW that shot up to 5,000MW in FY 2012. The shortfall goes as high as 7,000 MW depending on the weather and availability of hydel power[1]which fluctuate due to seasonal variation in rivers' flow due to monsoons and the absence of storage reservoirs. Currently, the total installed power generating capacity in Pakistan is 21,375 MW, of which 7,097 is hydel power; 6,902 is generated in the public sector and 195 MW produced by the private sector. The demand for electricity is growing rapidly. Growth in population, increased urbanisation and the increased use of luxury appliances have taken the domestic usage to a staggering 46 per cent of the total electricity consumption.[2] This is despite the fact that average per capita consumption in the country is only 482 units which is very low in the world. About 66 per cent of total electricity is consumed in Punjab, 16 per cent in Khyber Pakhtunkhwa (KPK), 12 per cent Sindh and 6 per cent in Balochistan which is sparsely populated and lags in economic development. The Planning Commission estimates that even if all the power projects currently under development are completed within the stipulated timeframe, the load shedding will persist and there will still be a 1,544 MW shortfall during FY 2019-20.[3]

According to Hydrocarbon Development Institute of Pakistan, in 2011-2012 electricity generation by source was: oil 35.1 per cent ; hydel 33 per cent ; gas 27 per cent ; nuclear 6 per cent ; coal 0.1 per cent and imported 0.3 per cent.[4] The total share of hydroelectricity in energy mix in 2007-08 was 11 per cent while that of gas was 48 per cent; oil 31 per cent; coal 9 per cent and nuclear 1 per cent. The contribution of Hydel in electricity generation has marginally increased from 29.4 per cent in 2009-10 to 33.6 per cent in 2010-11.

[1] Hassan Jawwad, 'Hydel, coal plants can down power generation cost', *Nation,* January 9, 2014.
[2] Ibid.
[3]'A dim future', *The News,* March 21, 2013.
[4]*Pakistan Economic Survey 2011-12,* available at http://www.finance.gov.pk/survey/chapter_12/14-Energy.pdf 208.

Existing Generating Capacity

Type of Generation	Installed Capacity (MW)	Derated/ Dependable Capacity (MW)	Availability (MW)	
			Summer	Winter
Hydro (WAPDA)	6902	6902	Min 3340 Max 6902	1521 4874
Hydro (IPPS)	195	195	Max 195	195
GENCOs	4829	3580	Max 3250	2960
IPPs	8678	7955	Max 5340	5230
Nuclear	665	615	Max 615	615
Wind	106	106	40	40
Total	**21375**	**19353**	**Min 12700 Max 16302**	**10227 13874**

Source: http://www.wapda.gov.pk/htmls/power-index.html

Energy crisis in Pakistan that was brewing since 2007, assumed critical proportions in 2012, and is adversely affecting the economic growth and employment. Power shortage is badly affecting the industrial, agricultural and domestic sectors. In a study, Dr Afia Malik at the Pakistan Institute of Development Economics has estimated that to sustain a one per cent growth in GDP, a 1.25 per cent growth in installed electricity capacity is required. Since GDP growth during the period 2002-07 was seven per cent annually, an 8.8 per cent annual growth in installed capacity was required. However, the Musharraf government increased installed capacity by only 2.2 per cent annually during that period[5] which widened the gap between energy demand and supply. The demand for energy in the developed world is expected to grow at about 2.2 per cent until 2030, while Pakistan expects an energy expansion by a factor of over seven by 2030.[6]

[5] Dr Akmal Hussain, 'Anatomy of the power crisis', *The Express Tribune*, 22 April 2013.

[6] Vision 2030, Planning Commission, available at http://www.pc.gov.pk/vision2030/Pak21stcentury/Chapter%20Wise/Ch%209,%20Energy%20for%20Growth,%2081-90.pdf

Forecast of Demand 2009-2030 (as April 2011)

Fiscal years		2009	2010	2015	2020	2025	2030
Net Dependable Capability	MW	17008	19477	27000	40000	70000	90000
	Growth Rate	9%	15%	9%	10%	8%	8%
Peak Demand	MW	20594	22353	32704	48843	72169	101478
	Growth Rate	7%	9%	8%	9%	8%	7%
Surplus/ Deficits		-3586	-2876	324	4066	4031	5087

Source: Dr. M. Arshad Javaid, et.al. 'Electrical Energy Crisis in Pakistan and their Possible Solutions', International Journal of Basic & Applied Sciences IJBAS IJENS Vol: 11 No: 05, October 2011. http://www.ijens.org/vol_11_i_05/110505-9393-ijbas-ijens.pdf 32

The successive governments especially since 1990s have tilted towards expensive power generation using furnace oil than hydropower that was the case a few decades ago. As a corollary, the percentage of total electricity supply generated by hydroelectric power fell from 60 per cent in 1962, to 30 per cent in 2009-10.[7] This adverse change in the composition of electricity supply resulted in sharp increase in the average cost of electricity production, which accelerated as oil prices rose sharply in 2007-08. Consequently, the government paid out over Rs. 650 billion in subsidies in the 2012 fiscal year alone to the distribution companies.[8] This led to the emergence of vicious cycle of circular debt. As the government failed to pay the full dues to the distribution companies, they failed to pay the dues to the power production companies, who then failed to pay the dues to the oil suppliers. The resultant fuel shortages induced further underutilisation of the power production capacity and thereby an intensification of the problem of power outages. By 2013, the total circular debt had grown to about Rs. 870 billion.[9] Soon after coming into power, the Nawaz Sharif government settled the circular debt of more than Rs.480 billion but the problem has resurfaced in little over a year and the IPPs had

[7] Dr Akmal Hussain, 'Anatomy of the power crisis',
[8] 'Where there is a will …', Editorial, *The Express Tribune,* April 12, 2013.
[9] Dr Akmal Hussain, 'Anatomy of the power crisis',

to be paid dues of Rs. 230 billion. The circular debt has again swelled to Rs. 280 billion.

The power shortages have telling impact on Pakistan's economy. The estimated cost of power crises to the economy is approximately Rs. 380 billion per year, around 2 per cent of GDP, while the cost of subsidies given to the power sector from 2008 to 2012 was almost 2.5 per cent of GDP i.e. Rs. 1100 billion. The liquidity crunch in the power sector has resulted in underutilisation of installed capacity of up to 4000 MW.[10] A joint study carried out in 2013, by USAID and Planning Commission (PC) on causes and impact of the power sector circular debt in Pakistan observed that the country had lost 10 per cent of its GDP (two per cent per annum) in the last five years only in the power sector.[11]

Hydropower is a cheaper and cleaner source of energy. The cost of hydel electricity is Rs 1.59 per unit while furnace oil units produce one unit at the cost of Rs 18.[12] Neelum-Jhelum Project is estimated to produce electricity at a cost of 14.5 cents per unit. The electricity cost of Diamer-Bhasha dam has been estimated at eight cents per unit, compared with the current average tariff mix of about 12.5 cents.[13]

Hydropower Potential of Pakistan

Pakistan is endowed with abundant hydropower resources - about 60000 MW. According to WAPDA report on *Hydro Potential in Pakistan* (2010) the hydropower potential in the country is over 100,000 MW with identified sites of 55000 MW. Almost all of it lies in the mountainous areas in northern region in the Khyber Pakhtunkhwa -24736 MW; Gilgit-Baltistan - 21725 MW; Azad Jammu & Kashmir (AJK)- 6450 MW and Punjab- 7291 MW. The hydropower resources in the south are scarce and mainly comprise of small to medium schemes on barrages and canal falls. Just over 11 per cent of gross or about 16 per cent of exploitable resources have been

[10] *Economic Survey of Pakistan 2011-12*
[11] Khalid Mustafa, 'USAID, Planning Commission blast PPP govt', *The News*, March 27, 2013.
[12] 'Hydel power generation has dropped to 2,800MW, LHC told', *The News,* April 16, 2013.
[13] Khaleeq Kiani, 'Govt wants to divert water project funds', *Dawn*, 22 April 2013.

realised. About 89 per cent of this hydropower potential is still untapped and yet to be harnessed.[14]

WAPDA identified about 150 potential sites, with a total capacity of 18698 MW across the country on the basis of high, medium and small head. Out of these, 17 projects are in operation, 6 sites are under implementation in the public sector and 1 site has been offered to the private sector. These are mainly run-of-river sites, with some as daily storage projects. In Khyber Pakhtunkhwa, about 142 hydropower project sites, with a total capacity of 24736 MW have been identified having high, medium and small heads. In Punjab, the main potential for power generation is on barrages and canal falls. About 296 potential sites with a total estimated capacity of 7291 MW have been identified. In AJK identified hydropower resource is about 6450 MW. In GB identified hydro potential is 21125 MW. In Sindh, 18 hydropower project sites of an estimated total capacity of 193 MW have been identified with medium and low head at different locations of barrages and canals.[15] River wise identified hydro potential is: Indus 39717 MW; Jhelum 5624MW; Swat 1803MW; Kunhar 1480 MW; Punch 462 MW; Kandiah 1006 and others 9704 MW.

[14]*Hydro Power Resources of Pakistan*, Private Power & infrastructure Board, February 2011.
[15]*Hydro Power Resources of Pakistan*, 3.

Hydropower Resources in Pakistan

Province/ Territory	Projects in Operation (MW)	Projects Under Implementation			Solicited Sites (Projects with Feasibility Study Completed) (MW)	Projects with Raw Sites (MW)	Total Hydropower Resources (MW)
		Public Sector (MW)	Private Sector (MW)				
			Province Level	Federal Level			
Khyber Pakhtunkhwa	3849	9482	28	2370	77	8930	24736
Gilgit Baltistan	133	11876	40	-	534	8542	21125
Punjab	1689	720	308	720	3606	238	7291
AJK	1039	1231	92	3172	1	915	6450
Sindh	-	-	-	-	67	126	193
Balochistan	-	-	-	-	1	-	1
Total	6720	23309	468	6262	4286	18751	59796

Source: Hydro Power Resources of Pakistan, Private Power & Infrastructure Board (PPIB), February 2011.

Hydropower Development in Pakistan

Globally, there are over 11,000 hydroelectric power plants operating in 150 countries, contributing about 20 per cent share to total energy-mix. Hydropower share of national power generation in Norway and many African countries is as high as 99 per cent; Brazil has 84 per cent; Venezuela 74 per cent and Canada 59 per cent of the total grid-based electricity.

At the time of independence, Pakistan inherited a very small power base of just 60 MW hydel capacity for its 31.5 million people. Hydropower development in the area started in 1925, with the construction of the micro hydel 1MW Renala Khurd power station. After a decade, the 1.7 MW Malakand-I micro hydropower station was built, which was later upgraded to a 20 MW capacity. Subsequently, in 1953, the 20 MW Dargai hydropower station was commissioned.[16] At the time of creation of WAPDA in 1958, the country's total hydel capacity was enhanced to 119 MW. Subsequently, 240 MW Warsak project with the Canadian assistance under the Colombo Plan was completed in 1960. Under the Indus Water Treaty (IWT) signed with India in 1960, Pakistan got entitled to 142 MAF of water in the western rivers: Indus 93, Jhelum 23 and Chenab 26. As part of the treaty, 1000MW Mangla on the river Jehlum and 3478MW Tarbela Hydropower Project on the river Indus were completed in 1967 and 1976 respectively. The funding was provided by World Bank and Asian Development Bank. These projects substantially increased the portion of hydel power in the energy mix of Pakistan. Since then, there has not been much focus on the hydropower development and much time has been wasted on the construction of the controversial Kalabagh dam project.

Currently, there are 19 hydel power stations in operation in Pakistan. Besides, Mangla, Terbela and Warsak, they include 1450MW Ghazi Barotha, 184MW Chashma, 81 MW Malakand-III, 30 MW Jagran and 18 MW Naltar hydropower projects. In 2013, 96MW Jinnah hydropower project and Satpara Dam (17.6MW) in Gilgit Baltistan were completed adding meagre 113 MW. In 2014, another three hydropower projects- 17.4-MW Gomal Zam Dam, 22MW Jabban hydel power station and 130-MW Duber Khwar hydropower project were commissioned, adding a total of 170-MW of hydroelectricity in the system. Satpara and Gomal Zam were

[16] *Hydropower Resources of Pakistan*, 1.

completed with US assistance and will help mitigate floods, and store water for irrigation.

Major hydropower projects under construction are Neelum- Jhelum 969 MW, Allai Khwar 53 MW and Khan Khwar 72MW. The 4th extension project of Tarbela with a generating capacity of 1,410 MW would be completed till 2017 at a cost of $928 million. The World Bank would provide $840 million financial assistance. It is planned to increase the total generation capacity of the Tarbela hydropower station to 4,888 MW and it would be helpful in reducing loadshedding in the country. The estimated annual benefit from the project would be around Rs. 30 billion and once completed it would pay back its cost in just three years.[17] Work on Dasu-stage-1 with a capacity of a 2,160 MW is also underway. A number of hydropower projects are under study including Harpo, Palas, Spat Gah, Basho, Pattan and Thakot. However, an abundant hydel potential is still untapped which needs to be harnessed.

The Hydel Vision in Pakistan's Energy Policy

Energy security has been a great challenge for policy planners of Pakistan as the country searched for reliability, sustainability and affordability of its energy supply. The National Power Policy 2013 gives the country's energy vision as: "Pakistan will develop the most efficient and consumer centric power generation, transmission, and distribution system that meets the needs of its population and boosts its economy in a sustainable and affordable manner."[18] The policy laid emphasis on inexpensive and affordable power generation and exploitation of indigenous resources including hydro resources of the country.

Although hydro power generation has been the stated priority in the government energy policy since the very beginning, it has always lagged behind for different reasons. The creation of WAPDA and signing of Indus Water Treaty (IWT) allowed Pakistan to increase its hydropower generating capacity substantially, but a major constraint emerged as it competed with irrigation needs of the country, especially in the lean period. Further, as almost all of power generation in the 1960s and 1970s came from hydroelectric power, any rain shortfalls reduced river flows and caused

[17] 'PM opens work on Tarbela Dam extension project', *Dawn*, February 27, 2014. http://www.dawn.com/news/1089795

[18] National Power Policy 2013, GoP, http://www.ppib.gov.pk/National%20Power%20Policy%202013.pdf

disruption of power generation. This required stand by thermal electricity plants which could meet the shortfall resulting from seasonal variation in hydel power generation. Thus more natural gas-fired thermal power plants were built during the 1960s and early 1970s. The gas plants however, were meant to 'serve as a bridge technology while the country waited for development of an estimated 10,000 to 20,000 MW of hydroelectric potential' which did not happen. [19] As limited gas reserves started depleting, the oil became alternative to thermal power generation. The oil shocks of 1973 and 1979 and hike in oil prices further deteriorated the situation. In the 1980s and 1990s, private investment was made in the energy sector that mostly went into thermal power sector. The 1994 and later the 2002 power policy sought to attract private power companies to invest in the energy sector of the country. The 1994 power policy gave incentives to private investors in the thermal power sector. Private Power & Infrastructure Board (PPIB) was created in August 1994 to promote private investments in power sector.

In 1995, government's hydel power policy called 'Policy Framework and Package of Incentives for Private Sector Hydel Power Generation Projects in Pakistan' was announced. It encouraged private investment in hydel sector as it was done in the thermal power sector. The policy gave incentives for all feasible hydropower plants up to 300 MW and above that were to be considered on case to case basis. Investors were free to propose hydel power plants on tributaries and canal systems at any location and opt for any type of equipment. They were given financial incentive and security package.[20] Applications were received for development of some 2,000 MW of hydropower projects[21] but except for the New Bong Escape all other projects could not survive due to snags in implementation of the policy and domination of public sector in hydropower generation. The 2002 power

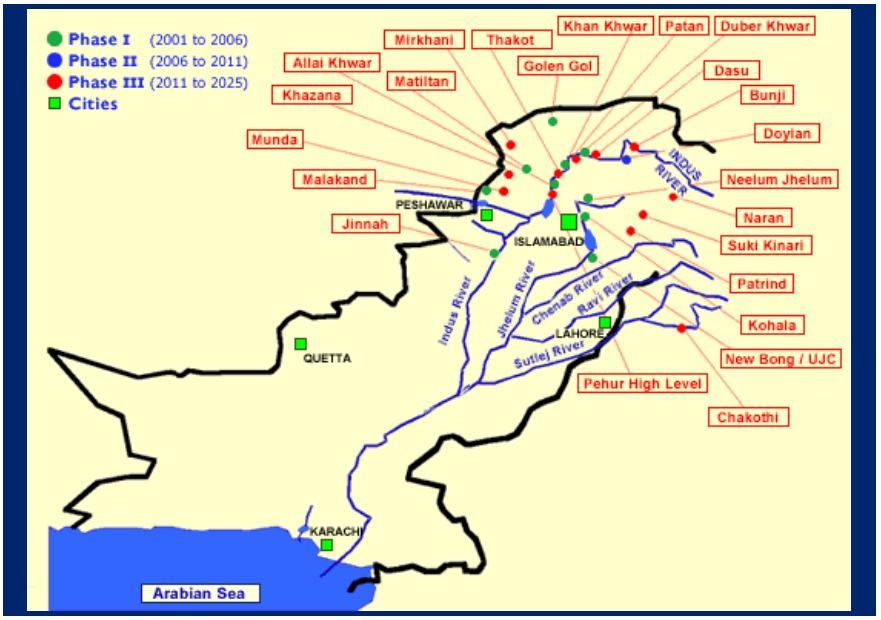
[19] Charles K. Ebinger, *Energy and Security in South Asia: Cooperation or Conflict?*,(Cambridge University Press, India New Delhi), 2011. 64.

[20] *Policy Framework and Package of Incentives for Private Sector Hydel Power Generation Projects in Pakistan*, May 1995. http://waterinfo.net.pk/sites/default/files/knowledge/Hydel%20Power%20Policy%20Brief-%201995.pdf

[21] Shoaib-ur-Rehman Siddiqui, '84MW New Bong Escape hydropower project: Country's first hydel IPP begins operation', March 31 2013. http://www.brecorder.com/top-news/108-pakistan-top-news/113047-84mw-new-bong-escape-hydropower-project-countryE28099s-first-hydel-ipp-begins-operation.html

policy also stated that hydel projects in the private sector will be implemented on Build-Own-Operate-Transfer (BOOT) basis.

In 2001, WAPDA prepared a 'Hydropower Development Plan: Vision 2025' that envisaged development of 34,885MW power of which 22,555 MW was to be hydro power. It identified 41 hydro projects of various capacity spread over short term, medium term and long term plans. There were 9 projects in the short term with a capacity of 792MW that were to be completed between 2004 and 2007. In the medium term of over 15 years were 17 hydropower projects with a capacity of 6,130 MW; 10 of them were to be completed by 2015. These included 969 MW Neelum-Jhelum and 740 MW Kohala that were set to be completed by June 2010. In the long term plan there were 16 projects with generation capacity of 15,633 MW to be completed in 2008-2020. These included Bhasha, Bunji and Dasu. Identified projects were to be implemented by the public sector, private sector, or by public-private partnership.[22] The plan included 5 mega hydropower projects with generation capacity of 9,500 MW to be completed by 2016. The vision, however, could not be materialised for all these years.



http://wapda.gov.pk/vision2025/

[22] *Policy for Power Generation Projects, 2002,* See Schedule 1 & 2. Available at http://www.ppib.gov.pk/PowerPolicy2002.pdf

Hydropower development was given In 2005, the government envisaged an energy security action plan for 2005-2030. It was part of the broader 'Vision 2030' policy document, spanning over social, economic, financial, demographic, political, energy, climate change and security arenas. It called for enhancing energy security through an optimal mix of all domestic energy resources i.e. coal, oil, gas, hydro and renewable energy. It acknowledged hydro as one of the major economic energy supply options for increasing the energy security of the country. It endorsed the 'plans to develop the hydro resources on a large scale through storage and run – of – the – river projects.'[23] As part of the action plan, the government announced National Energy Conservation Policy 2005. Subsequently, in 2006, the government launched renewable energy policy for power generation with focus on small hydro, wind and solar power.[24] The Alternative Energy Development Board (AEDB) established in 2003, as an autonomous body with the aim of promoting and facilitating the exploitation of renewable energy resources was designated as 'one-window' facility for processing RE power generation projects including hydel projects below 50 MW capacity.

The 2013 power policy underscores a significant push towards building medium and long-term hydel capacity in the country. Six projects totalling 388MW of hydel power are expected to be completed by February 2015. An additional 969MW is anticipated from the Neelum-Jhelum HPP project by November 2016. The smaller Patrind and Gulpur hydropower projects are expected to be completed by December 2017 and will add 247MW to the grid. A number of hydel projects are expected to come online in 2017 including the 4th and 5th Tarbela extensions which have the potential to add 1,910 MW (1,410 MW in 4th extension, 500 MW in 5th extension). In the long run, large infrastructure programmes including the Indus Basin Cascade will be developed. Dasu has a potential of generating 2,160MW, Pattan 2,800 MW, and Thakot 2,800 MW. The detailed engineering design for these projects is being carried out and will optimally be constructed using a BOT PPP method. Other longer-term projects are also under consideration, such as Bunji (7,100 MW potential) and Diamer-Bhasha (4,500 MW potential) whose completion by 2020 could ensure the

[23] *Pakistan in the 21st Century: Vision 2030*, Planning Commission, GOP, 2007. 85. http://www.pc.gov.pk/vision2030/Pak21stcentury/vision%202030-Full.pdf

[24] *Policy for Development of Renewable Energy for Power Generation*, 2006, Government of Pakistan. http://www.aedb.org/Policy/REpolicy.pdf

energy independence and security of Pakistan. [25] This is a very ambitious plan that needs to be implemented efficiently.

In May 2014, the National Economic Council (NEC) approved an ambitious 10-year plan called Vision 2025, envisaging Pakistan to be among top 25 world economies and doubling power generation to 45,000 MW by 2025. It seeks to provide uninterrupted, affordable and clean 'energy to all'; increase storage capacity and improve efficiency of water usage in agriculture by 20 per cent.[26] Within this context, a draft hydel power policy is being prepared to attract investment in hydel power generation. The policy has sought local and foreign investment for small and medium size run-of-the river hydel projects. Selected hydel projects under development will be positioned for privatisation. Multilateral agencies would be invited to partner in large infrastructure hydel projects. The policy will provide for upfront tariff to international investors. The policy will also address environmental aspects in addition to technical and financial aspects. [27]

Fast Tracking Run-of-the River & Micro Hydro Projects

Run-of-the-river hydel projects hold great potential to rectify energy mix of Pakistan in favour of cheaper hydro power in the country. The PPIB has identified about 150 potential sites with a total capacity of 18,698 MW on the basis of high, medium and small head. KPK, AJK and GB have lot of potential to develop run-of-the river projects. In KPK out of 142 identified sites for projects, 19 projects are in operation on those sites, 27 projects are under implementation in the public sector, whereas 10 projects are under implementation in the private sector on the identified sites. Most of these are run-of-river sites. In AJK about 68 hydropower sites with a total potential of 6450 MW have been identified with high, medium and small heads. Out of these 68 hydropower sites, 10 projects with a capacity of 1136 MW are in operation, 23 sites are under implementation in the public sector and 21 sites in the private sector- many of them are run-of-river sites. In GB, about 278 project sites with a total capacity of 21,125 MW have been identified having high, medium and small heads. Out of these, 98

[25] *National Power Policy 2013*, available at http://www.ppib.gov.pk/National%20Power%20Policy%202013.pdf
[26] 'Electricity generation to be doubled in 10 years', *Dawn*, May 30, 2014.
[27] Draft hydel power policy being made', *Dawn*, September 7, 2014. http://www.dawn.com/news/1130313

projects are in operation, 31 projects are being implemented under the public sector through Northern Areas Power and Water Development (NAPWD) and one in the private sector. Except Diamer-Bhasha, Bunji, and Skardu dam, most of these sites are run-of-river. In Punjab, at different canals and barrages, about 324 potential sites with a total capacity of 5895 MW were identified with medium and small head. In Sindh, six potential sites of an estimated total capacity of 178 MW, with medium and low head at different canals have been identified. Presently, no hydel projects are in operation or under implementation in the public sector, and no projects are being undertaken by the private sector.

Indus Cascade: The 2013 energy strategy has emphasised the development of the Indus Cascade which can add about 12,000 MW of hydropower to the system and bring down the cost of power generation. The plan spanning over next 15-20 years envisages development of Indus Cascade between Tarbela and Diamer-Bhasha that would add about 10,000 MW of electricity generation annually. Total cascade installed capacity is going to be about 22,000 MW.[28] The funding is going to be a big challenge. This new capacity would help in substantially shifting the energy mix in favour of hydropower. The detailed engineering design for Dasu, Pattan and Thakot projects is being carried out and will optimally be constructed using a BOT PPP method. The work on the projects needs to be fast-tracked.

[28] *Dasu Hydropower Project: Environmental and Social assessment*, Report by Independent Environmental and Social Consultants WAPDA, April 2014. http://www.wapda.gov.pk/pdf/Dasu_ESA%20%28Main%20Report%29.pdf

Indus Cascade – Hydropower Development

Diamer-Bhasha (Planned) Installed capacity: 4,500 MW Annual Generation: 18 billion KWhs Cost: US$13-16 billion	Inflow: 49 million Acre Foot (MAF) Storage: 6 MAF Completion in about 12-15 yrs
Dasu Hydropower (Planned) Installed capacity: total 4,300 MW Phase I: 1,080 MW; 8 billion KWhs Phase II: 2,160 MW; 12 billion KWhs Total: 4,320 MW; 18 billion KWhs With Bhasha: 21 billion KWhs	Inflow: 54 MAF Storage live: 0.7 MAF, Dead 0.4 MAF Phase-I completes in 5 years (US$3.6 B) Phase by 6-7 years (US$0.8 B) Remaining phases depending Available Financing, 7-8 yrs
Pattan (Planned) Installed Capacity: 3,000 MW Generation: 15 billion KWhs	Inflow: 58 MAF Storage: about 0.5 MAF Cost: about US$6 billion
Thakot (Planned) Installed Capacity: 3,000 MW Generation: 15 billion KWhs	Inflow: 60 MAF Storage: about 0.5 MAF Cost: about US$6 billion
Tarbela (Existing) Installed Capacity: 3,750 MW already in operation; about 14 B KWhs generated annually **Tunnel 4 ongoing; 1470 MW; 3.5 B** KWhs Tunnel 5 Possible: 1000 MW; ~2 BKWhs	Inflow: about 61 MAF Storage: 6.7 MAF
Ghazi-Barotha (Existing) 1450 MW; 6.5 B KWhs Possible increase by 150 MW	

Source: *Dasu Hydropower Project: Environmental and Social assessment*, Report by Independent Environmental and Social Consultants WAPDA, April 2014. 5.

- **Dasu Hydropower Project** will 'kick start the development of the Indus Cascade that is crucial for reducing the overall cost of electricity generation based on domestic resources.'[29] Dasu is a run-of-river project located on the Indus River about 240 km upstream from the Tarbela dam, close to Dasu town, in Kohistan district. The project has got favourable response by the international donors. In June 2014, the World Bank approved a financing package from the International Development Association (IDA) for the Dasu Hydropower Stage-I Project (DHP-I). The package consists of an IDA Credit of $588.4 million and an IDA Partial Credit Guarantee (PCG) of $460 million to help mobilize commercial financing for the project. DHP-I cost is estimated at about $4.2 billion and it would generate 2,160MW of hydropower, which can be expanded to 4,320 MW in future with low additional cost.[30] This is the first attempt by the World Bank Group to finance a large infrastructure project on sequential basis through a combination of credits and guarantees to mobilise the full financing over the construction period. DHP has limited social and environmental impacts primarily because of having a small reservoir. The project is located in a remote and thinly populated and mountainous area so it does not involve much dislocation of people.
- Dasu is a strategic investment as it would (i) improve energy security and affordability through a structural shift to a low cost, low carbon fuel mix and reduce cost of electricity generation; (ii) it would reduce the sector deficit and save foreign exchange of Pakistan by displacing high cost imported fuel; (iii) it would also build the institutional capacity of WAPDA to harness the hydropower potential of the country in a sustainable manner, in particular the development of the Indus Cascade; and (iv) it would provide a financing and investment model that could be followed for other large hydropower projects in Pakistan. [31] It would provide more electricity during the summer months when capacity

[29] 'World Bank Approves Dasu Hydropower Stage I Project', http://www.worldbank.org/en/news/press-release/2014/06/10/world-bank-approves-dasu-hydropower-stage-i-project
[30] Ibid.
[31] Ibid.

shortages are most severe and indirectly contribute to higher productivity and employment, particularly in the industrial sector.

- **Thakot & Pattan:** Thakot and Pattan are important components of Indus Cascade and are run-of-the-river projects and will together contribute 6000MW which eventually meets the almost peak shortfall of the energy in the country. The $1.8bn Pattan hydropower project would be taken to the market for financing in June 2016 and will be completed in June 2022, while the $8bn Thakot project will hit the market in June 2017 and will be completed in June 2023.[32]
- **Diamer-Bhasha Dam:** Diamer-Bhasha project on the Indus is considered a 'lifeline' for the national economy as it would go a long way in providing water for agriculture and electricity for domestic and industrial use. The dam has three important objectives: flood control, power generation and water storage. The gigantic project will generate 4,500MW of electricity and store over 8 million acre feet of water to meet growing power and irrigation needs of the country. It will cost $12-15 billion and will be completed in 12-14 years.
- **Bunji Hydropower Project**: Wapda has completed detailed engineering design and tender documents of 7100 MW Bunji hydropower project. The project is ready for construction subject to availability of funding. It is the largest hydropower project located on Indus River near Gilgit. The project was initiated in 2007 and was to be completed by 2010. [33] In 2009, Pakistan and China signed a memorandum of understanding for the Bunji Dam; the accord was signed between the Ministry of Water and Power and Three Gorges Project Corporation of China. The dam site area is located 83 km from Gilgit on Skardu road near Asmani Mor. The proposed powerhouse is located in the Bunji village. The cost of the project is $11.5bn. The Bunji Dam will be completed in December 2024. Both Bunji and Bhasha dams would greatly help in overcoming the irrigation needs as well as the power shortage in the country.

[32] Khaleeq Kiani, 'Commercial financing of dams', *Dawn*, July 28, 2014. http://www.dawn.com/news/1121991/print/print

[33] http://wapda.gov.pk/vision2025/htmls_vision2025/bhp.html

- **Small & Micro Hydro Projects** can also make significant contribution to the national energy supply. Some 300 micro and mini hydroelectric plants, installed by the private and public sector in the northern hilly areas, are supplying electricity to areas not connected with the grid, and more have been approved recently. Dr. Musaddiq Malik, as a Caretaker Minister for Water and Power, observed that around 20,000MW of electricity can be produced with small hydropower projects.[34] Khyber-Pakhtunkhwa has approved the construction of 356 micro hydel stations with a power generation capacity of 35 MW in various parts of the province with the total cost of Rs. 4.7 billion from Hydel Development Funds (HDF).
- **Building Storage Dams:** The storage dams are also very important as they will add to both power generation and water storage capacity of the country which is fast depleting due to sedimentation. Currently, the storage capacity is up to 13 per cent of the annual flow of rivers which is just for 30 days while that of India is between 120 and 220 days and US 900 days. The original live storage capacity of Tarbela, Mangla and Chashma was 15.74 MAF which by 2009 had gone down to 11.61MAF. With a cumulative loss of live storage of 5.82MAF, it will decline to 9.92MAF in 2025. The depletion has not only reduced the power generation capacity of the dams, but has also proved detrimental to the country's agriculture. Over the last 30 years, the storage capacity of Tarbela has been reduced by 27 per cent. Mangla Dam has added 2.88MAF to the existing storage capacity. The Gomal Zam dam has added 0.89MAF; Kurrum Tangi, 0.90MAF; and Dasu, 0.8MAF can add very little to the existing storage. Diamer-Bhasha with 6.40 MAF storage capacity can make a strategic difference. The government has decided to go ahead with Diamer project as well but it involves huge cost of $12-15 billion and a construction period of 12-14 years.

[34] 'Over 20,000MW can be generated thru small hydropower projects', *The Nation,* May 14, 2013.

Challenges & Prospects

The development of hydropower faces three major constraints: the seasonal variations in river discharges, which are of a relatively greater proportion compared to most other countries, due to extreme climatic and precipitation conditions in Pakistan; huge capital cost for the mega projects and technical constraints emerging from the remote hilly locations of the plants. Thereby, development of hydropower projects poses numerous technical and economic challenges to the investor and the developer. The policy issues and bureaucratic delays affect the implementation of the projects.

- **Financial Constraints:** Funding for the mega projects remains a critical issue. Big hydro projects involve huge capital cost which does not easily come through. Delays further increase the cost manifold. Major water and power sector projects, which are in different stages of construction, need a total of Rs1.67 trillion between 2014 and 2020. This requires financing of over Rs. 960 bn from international lenders which is yet "un-committed". The cost of 4,500MW Diamer-Bhasha has gone up from $6.5bn in 2005 to $12.5 bn in 2012 and now stands at $14.5 bn. The project originally estimated to be completed by 2016-2017 is now expected to be delayed till 2023.[35] Even the cost of land acquisition and resettlement of affected people has increased from Rs. 60 billion to Rs. 116 billion. The government has prepared a funding plan for Diamer-Bhasha with resources coming from external and internal sources- ADB $ 4 bn; USAID $2 bn over eight years; Japan and EU $1.5 bn; Islamic Development Bank $ 1.5 bn, GOP $1.5 bn; WAPDA $1 bn; PSDP $ 1bn. In 2014, the government earmarked more than Rs10 billion for the purchase of land for the Diamer-Bhasha Dam.

  The 969MW Neelum-Jhelum hydropower project is also facing serious financing problems and none of its units is likely to become operational by 2016 as projected by the government. The estimated cost of the project has increased from the original Rs. 84 bn to about Rs. 275 bn due to change of its design after the earthquake; involvement of tunnel boring machine; and overall project delays.

[35] Finding funds for projects', *Business Recorder*, May 6, 2013. http://www.brecorder.com/editorials/0:/1183071:finding-funds-for-projects/?date=2013-05-06

The fiscal problems stem from inability of the Economic Affairs Division to arrange $475 million (Rs47.5 billion) from local or international banks and financial institutions for more than four years now. The project has also consumed Rs. 34bn generated through electricity bills in the shape of Neelum-Jhelum surcharge. Another Rs. 23bn would come from the surcharge over the next two years. As liabilities of the contractors and suppliers piled up, the prime minister's personal intervention led to release of Rs. 14 bn in May 2014 which allowed the construction work to go on for about three months. After completion, the project is estimated to produce more than Rs. 45bn worth of "cheaper and cleaner" energy every year and contribute over Rs. 5bn per annum to Azad Kashmir government, besides improving Wapda's financial position and replacing some of the expensive thermal projects being run on imported furnace oil.[36]

- **Inordinate Delays:** Delays in the implementation of the projects have also contributed to worsening of energy crisis beside escalation of the cost of the projects. The projects have suffered inordinate delays of three to seven years, primarily due to poor planning, ineffective monitoring, lack of transparency, absence of political will, uncertain law and order situation and financial constraints.[37] Besides Neelum-Jhelum, Chakothi-Hattian and Kohala projects on the Jhelum River which were scheduled to be commissioned in June 2010 have been delayed. The 106 MW Golen Gol Hydro Power Project in Chitral district scheduled for commissioning in 2009 has been delayed. It will be completed in 2017, and the cost has shot up from Rs. 7 billion to Rs. 28 billion.[38] The Keyal Khwar hydropower project of 122 MW has already been delayed by seven years. Hydropower projects that suffered long delays in the recent past include Jinnah, Duber Khwar, Allai Khwar, Khan Khwar and Satpara, with a cumulative installed capacity of 428MW. The Jinnah project of 96MW in Mianwali district was planned for construction in 2006, with a completion

[36] Khaleeq Kiani, 'Neelum-Jhelum project facing financial problems', *Dawn,* September 4, 2014.

[37] Engr Hussain Ahmad Siddiqui, 'Long-delayed Wapda hydropower projects', *Dawn*, September 1, 2014. http://www.dawn.com/news/1129091

[38] 'Delay increases cost of hydropower project: PML-N leader', *The News,* July 23, 2014.

deadline of four years, but it was commissioned in September 2013. Gomal Zam Dam, having a 17MW powerhouse, has been completed after a delay of eight years. The rehabilitation of 19.6 MW Jabban hydropower station which ceased operations in 2006 after a fire was completed last year. The status of small projects is equally unsatisfactory. WAPDA has planned to construct a series of small and mini hydropower stations in regions that are not connected to the national grid. In the first phase, 12 small dams with a total installed capacity of over 43MW were to be constructed in all four provinces during 2005 and 2006 at a cost of Rs. 30bn, to be completed in three years. Just one project — Darawat Dam in Sindh — is nearing completion, while a number of others have run into snags even before take-off. All these projects are now rescheduled for implementation in 2015.

- **Public-Private Partnership:** The participation of IPP in hydropower sector has not been encouraging due to issues related to policy implementation and bureaucratic delays. About 35 hydel power projects were provided licence in 1995, but due to changing of governments and changes in policies, only three of them survived and among them only 84MW New Bong Escape Hydropower Project located about 7 kms downstream of Mangla Dam became operational in 2013. The project, which started on December 28, 2009, has been established with an investment of $233 million at 75:25 debt-equity ratio. The project has been built by EPC contractors of Sambu Construction Company of South Korea. The energy generated by the project is being purchased by a single buyer i.e. Pakistan's National Transmission and Despatch Company Limited (NTDC) under a long term Power Purchase Agreement (PPA). Under the PPA the hydrological risk is borne by the Power Purchaser through guaranteed payment for fixed costs like debt servicing, O&M, ROE and insurance. A cost-plus-tariff mechanism is in place under the PPA and the project has been allowed a tariff of Rs. 6.8362/KWh (cents 8.5256/KWh).[39]

[39] '2630 MW private power projects approved', *Daily Times*, March 6, 2014. http://www.dailytimes.com.pk/business/06-Mar-2014/2630-mw-private-power-projects-approved

- In March 2014, the PPIB approved power projects totalling 2630 MW in the private sector, majority of them are in the area of hydropower. The Board approved issuance of Letter of Interest to a consortium of CWE Investment Corporation China and Trans Tech of Pakistan for establishing 590 MW hydropower project, to be located on Jhelum River at dual boundary of Punjab and AJK. PPIB invited Expressions of Interests for 132 MW Rajhdani hydropower project to be located on Poonch River in Kotli district. Nekherdim-Paur and Turtonus-Uzghor hydropower projects of 80 MW and 58 MW respectively in Chitral were also approved to be processed by inviting Expressions of Interest. The Board also approved invitation of proposals through competitive process of 350 MW Athmuqam raw site hydropower project to be located at river Neelum, AJK. In order to improve coordination and fast-track implementation of IPPs, the government has decided that PPIB should execute and issue tripartite Letters of Support (LOS) with concerned entities of the provincial governments of Azad Jammu & Kashmir, Gilgit, Baltistan and sponsors as co-signatories, for existing as well as future "private" or "public private partnership" power projects being implemented by these entities. China has shown keen interest in the development of a number of hydropower projects in Pakistan which include 640 MW Karot hydropower project at Jhelum River, near Kotli. PPIB is processing a mega hydropower project i.e. Suki Kinari hydropower project with a capacity of 840 MW on Kunhar River in Khyber Pakhtunkhwa, PPIB has earlier issued LOS to 100 MW Gulpur hydropower project located on Poonch river in AJK; the project is sponsored by Korea South East Power Company (KOSEP), Sambu & Lotte, the 148 MW Patrind hydropower project on Kunhar river in AJK is sponsored by K-Water and financed by IFC, ADB, K-Exim Bank; the construction of project is in full swing. Three investors M/s CWE Investment Corporation, China, M/s Ratchaburi Electricity Generating Holding PCL, Thailand and M/s Sachal Engineering Works (Pvt) Ltd, Pakistan has submitted proposals for 100 MW Kotli hydropower project.
- **Environmental & Displacement Challenges:** Displacement and ecosystem integrity are emerging as big issues in the hydropower development. Many of the hydro power projects are located in

mountainous areas that are not densely populated but there have been issues around the resettlement of the people dislocated by the big dams. Tarbela displaced about 96,000 people while Mangla alone dislocated 44,000 persons. Earlier, the construction of Mangla dam dislocated 110,000 people from the area. Diamer-Bhasha dam would require resettling 24,000 people while Akhori dam about 50,000 people.

- There is also challenge of climatic impact on the development of hydel resources in the country. The fluctuation in the flow of rivers, impact of drought, competition with irrigation needs have to be addressed as the country harnesses its hydro resources. On the positive side, the global warming will lead to faster glacier melt and spells of flooding which can be exploited for power generation as well as irrigation if the country builds more reservoirs on fast track basis. There is also the issue of sedimentation of big dams which are losing their storage capacity. The Indus and Jhelum rivers carry a very high sediment load. Siltation has reduced the capacity of Tarbela and Mangla. Warsak is almost completely silted up because of high rates of sedimentation in river Kabul. Now it is operating like a Run-of-River project.
- **Political Constraints:** Big dams, especially Kalabagh dam, become politically unviable due to lack of consensus amongst all the provinces on the construction of the dam. A lot of precious time was lost in staying focused on the Kalabagh dam. Many in Khyber Pukhtunkhwa are opposed to future big dams in their area. Diamer-Bhasha has evoked some local opposition. India has also lobbied against the dam and tried to block ADB funding for the project saying it is located in the disputed territory and requires NOC from India. Many in Sindh province believe that upstream dams would reduce flow of Indus river and oppose further dam building.

Conclusion

Rebalancing of the energy mix by increasing share of hydroelectricity offers a way out of the existing energy crisis. Run of the river along with small hydro projects should be prioritized as they are relatively cheaper, take less construction time and are environment friendly. The government's new National Energy Policy 2013-18 seems quite ambitious both in terms of bridging the supply-demand gap and changing the energy mix in the next

few years. There is urgent need to remove all bureaucratic bottlenecks and arrange funding for the mega projects. Public-private partnership in hydropower sector should be reinvigorated. A proactive hydro-diplomacy and conducive investment environment is required to fast-track funding from International Banks such as World Bank, ADB, Islamic Development Bank and donors like Japan, China, France and Canada. This will help in raising financial resources for these projects. Political consensus on the big hydro projects should be developed. The formation of a single ministry in charge of the entire energy sector, the formulation of a long-term integrated policy and complete autonomy to regulators coupled with intense drive to increase public awareness about energy conservation offers a way out. A comprehensive hydel power policy is still lacking and needs to be developed on priority basis.■

CHAPTER-9

Diplomacy and International Dimension of Energy Management: Progress and Development since December 2013

Dr. Nazir Hussain

The energy crisis in Pakistan has a chronic history mainly due to the absence of a long term energy vision and ever-increasing gap between demand and supply. When the present government took office in May 2013, it envisioned a priority based policy to overcome the energy shortage. However, electricity theft, line losses, default payments by government ministries and wrong priorities kept the country with the chronic issue intact. Therefore, during the last one year nothing substantial has come out despite the fact that the government conceived various short and long term measures. Interestingly, during the last one year two severe energy crisis erupted: fuel shortage in the entire country (December 2014) and 80 per cent blackout of electricity in January 2015. Importantly, the energy shortage has increased rather than decreasing; gas load-sheading has started to hit the domestic consumers as well after the closure of CNG stations for public/private transport; the electricity shortfall has increased to 5,000MW in winter, which is likely to increase in summer when the consumption is high.

The paper on the subject presented last year suggested some options for the government to meet the energy challenge, mainly in the realm of international dimension of energy management. Therefore, this paper endeavours to highlight the progress made in various projects so far.

Iran-Pakistan Gas Pipeline

The revised IP gas pipeline was to provide Pakistan with 750mcf of gas per day and the supplies were to begin in December 2014, failing which Pakistan had to pay the penalties. Despite the fact that the IP gas pipeline would have provided around 25 per cent of Pakistan's energy demands and the Iranian side of the pipeline has been completed, Pakistan is reluctant to start the work on its side due to international sanctions on Iran and Saudi

opposition. However, in December 2014, Iran and Pakistan signed a new agreement that stipulated the waiver of penalties on Pakistan.

Pakistani officials continue to claim that the project is on and as soon as the sanctions are removed Pakistan would start laying its part of the pipeline. However, the project is virtually stalled denying Pakistan an opportunity to overcome its acute energy shortfall.

Trans-Asia Pipeline: TAPI

The 1,680km trans-Asia or Turkmenistan-Afghanistan-Pakistan-India gas pipeline with an estimated cost of $7.6 billion was to provide 90 million cubic meter of gas per day; Pakistan can generate around 5,600MW of electricity by getting its share of 30MCM of gas per day.

This project is preferred over IP gas pipeline by the United States and its feasibility was sponsored by the Asian Development Bank with a cost of $100 million in 2010; the estimated completion date is set to be 2017-18. However, despite many agreements no substantial effort is seen on this project and it remains so far on the paper. Therefore, yet another opportunity to Pakistan to meet its energy requirement remains unavailable.

Liquefied Natural Gas (LNG)

In 2005 a private deal of $25 billion between Pakistan and Qatar was signed to transport LNG but the deal was struck off by the Supreme Court of Pakistan, and the two countries resolved to transport LNG on government-to-government basis. Pakistan was willing to import 500 million cubic feet of LNG to produce 2,500MW of electricity. The cost effectiveness, pricing and infrastructure development were the major hurdles. However, these issues have been resolved and Pakistan is ready to import LNG in the very near future.

In December 2014, Pakistan signed an energy deal of $1.7 billion with Russia for laying the Liquefied Natural Gas (LNG) pipeline from Karachi to Lahore. The LNG terminal is in progress and the supply through this pipeline would be available in March 2015. Pakistan is currently working on two LNG pipelines as an alternate to the Iran-Pakistan (IP) gas pipeline project. This includes LNG Gwadar Pipeline and South Pipeline from Karachi to Lahore. Pakistan had offered China and Russia to lay the IP gas pipeline but both these countries refused under international sanctions on Iran. The OGDCL would invest around $1 billion (SNGPL $750 Million

and SSGC $300 Million). This pipeline is to be linked to the Gwadar pipeline to import gas and LNG from Iran. Another agreement to lay Gwadar Pipeline is being finalized with China to import LNG from (to be built) Gwadar Terminal.[1]

Moreover, the federal government conceived a plan to build LNG-based power plants in Punjab to generate 3,600MW of electricity. These plants would be constructed in next two years at Haveli Bahadur Jhang, Balloki, Bhakki near Lahore. The government is contemplating to import 2 billion cubic feet of LNG per day in the next two years. The plan is based in the backdrop of 18th Constitutional Amendment which gives right to provinces to produce electricity from their own resources. Punjab is the most population concentrated province and has the largest shortfall of electricity. The Chinese have shown their willingness to finance these plants.[2] The government plans to generate 3-5,000MW of electricity in the short and long term plans for energy production. Some of these and other plans are being built in the Pak-China energy corridor vision for the region.

Nuclear Power Plants

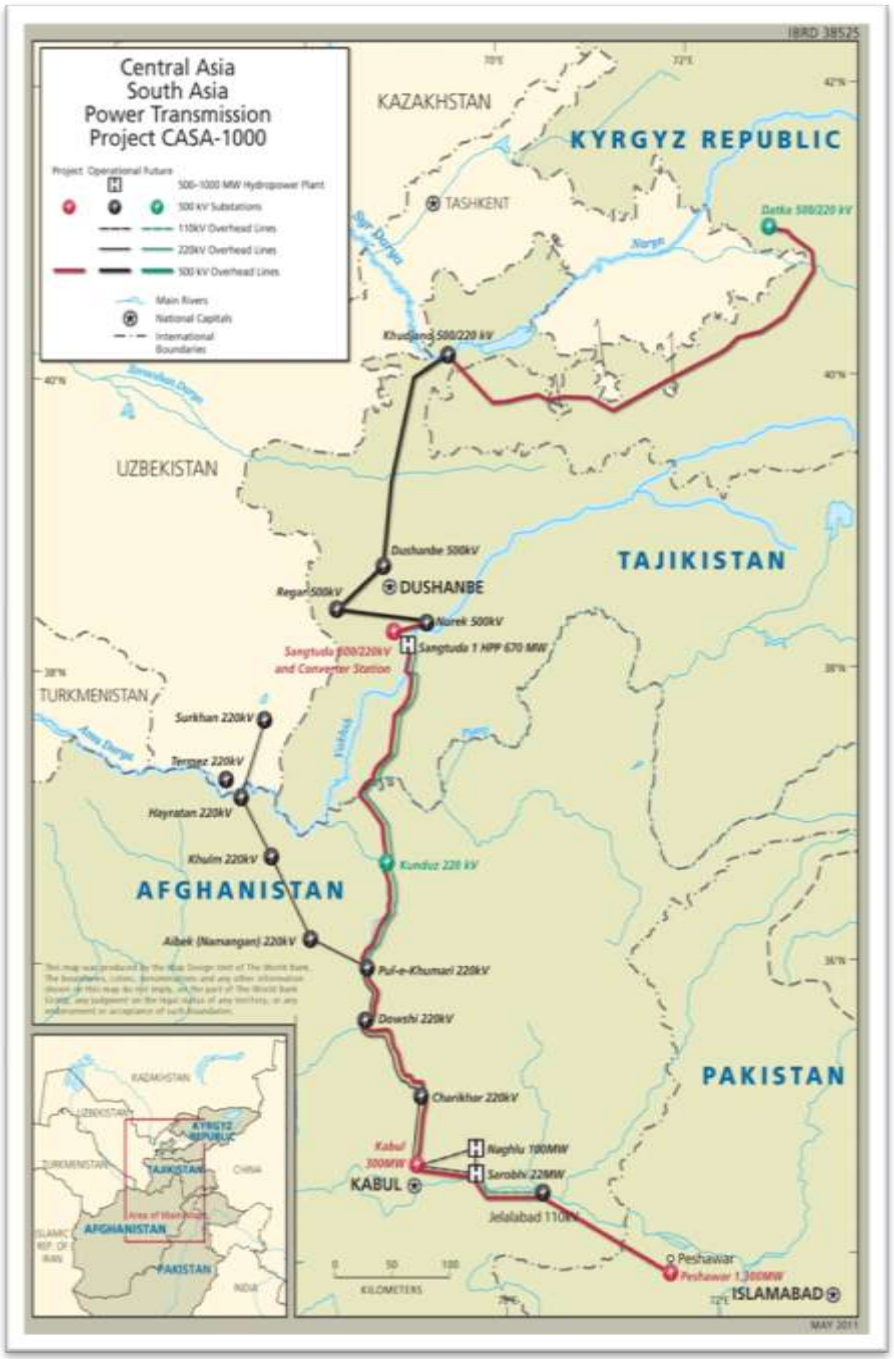
Pakistan is generating electricity from existing nuclear power plants at KANNUP (137MW), Chashma-I (325MW) and Chashma-II (325MW). Constructions of additional power plants have started at Chashma-III (340MW) and IV (340MW), which would be expected to be operational in 2016-17. The construction of K-3 (1100MW) and K-4 (1100MW), at Karachi Nuclear Power Plants (KANUPP) is also under progress; both projects are likely to be completed by 2019.[3] K-3 and K-4 projects are financed by China's Exim Bank and Pakistan.[4] The Karachi and Chashma Nuclear Power Plants would produce 2880MW of additional electricity by 2017-18. Electricity generation through nuclear source would contribute to meeting the country's pressing energy needs.

[1] Zafar Bhutta, 'Pakistan, Russia ink $1.7 billion energy deal' *The Express Tribune*, December 23, 2014.
[2] Shahbaz Rana, 'Govt plans LNG-based power plants in Punjab' *Express Tribune*, January 3, 2015.
[3] See the official website of Pakistan Atomic Energy Commission at www.paec.gov.pk/NuclearPower
[4] Kalbe Ali, 'Work begins on nuclear plant project' *Dawn*, December 28, 2014.

CASA 1000 Electricity Transmission Trade

The two Central Asian States, Kyrgyzstan and Tajikistan have surplus energy and the two South Asian states, Afghanistan and Pakistan are suffering from chronic electricity shortage. A new electricity transmission system to connect all these four countries, called CASA-1000 was planned and substantive progress has been witnessed. The project cost is estimated at $1 billion. The CASA-1000 project will be based on 1,200km transmission line to trade 1,300MW of electricity between Central Asia and South Asia. The 220-500 KV transmission line would start from Datka to Dushanbe and into Kunduz, Kabul-Jalalabad to Peshawar. Between October to December 2014, various agreements were signed concerning the electricity rates, transit fee etc.[5] The project is likely to be operational in the near future. However, the project has a major drawback that it can only provide electricity in summers and during winters the electricity supply would be reduced substantially.

[5] For details see www.casa-1000.org



Proposed Electricity Transmission Lines of CASA-1000 Project

Gadani and Jamshoro Power Plants

Other projects to generate electricity were also planned. In 2013 a massive power park project to generate 6600MW of electricity at Gadani (Balochistan) of 660X10 coal based production was planned with the cooperation of China. Initially, China and Qatar showed their willingness but later both withdrew. Therefore, the project could not be initiated due to the non-availability of potential investors,[6] and is likely to be shelved by the government.[7]

Another project at Jamshoro with two power plants of 660MW imported coal based electricity production was also initiated with $900 million loan from the Asian Development Bank in February 2014.[8] The project is likely to be completed in 2017 and could lead to other coal-based projects in the country to meet the growing electricity demands.

Conclusion

The present government is serious in improving the energy sector but its focus is more on short term efforts, especially on imported, readymade solutions. It is more political than strategic. There is a need to look into a long term comprehensive solution. Following suggestions should be seriously considered and implemented:

1. A National Energy Vision (NEV) involving all stockholders; politicians, bureaucrats, foreign investors, businessmen etc.
2. Bipartisan political support through parliament to pass legislation to produce it as a consensus document
3. Strong implementation mechanism with no political, economic and bureaucratic red-tapism
4. Utilisation of all available options
    a. Imported: Iran-Pakistan Gas Pipeline, TAPI, LNG (Qatar), Coal (China)
    b. Indigenous: hydro, thermal, nuclear, renewable, coal-based, wind and solar

[6] Hussain Ahmad Siddiqui, 'Gadani power projects: challenges' *Dawn*, November 10, 2014.

[7] Ahmad Ahmadani, 'Federal govt all set to abandon flagship 6,600MW Gadani Coal Power projects' *Daily Times*, January 17, 2015.

[8] 'Pakistan to get $900mn from ADP for Jamshoro coal power project' *The News*, February 12, 2014.

5. Availability of financial resources and priority-based approach to deal with National Energy Vision.

The half-hearted and politically motivated efforts would not bring out Pakistan from the acute energy crisis. Only a visionary long-term energy plan can work-out to meet the growing demands of electricity not only for keeping Pakistan illuminated but also to keep on running the industrial part of Pakistan to put the country on sound economic footings.■

CHAPTER-10

Universities and Think Tanks as Drivers of Energy Conservation in Pakistan

Muhammad Mustansar Billah Hussain

Background

For the last couple of years, Pakistan's economic progress has been affected by the so called war on terror, law and order situation, and energy starvation. The first two were the result of external developments but energy starvation is a phenomenon that the nation has been suffering from due to poor policy planning in the last decades. For some years now the country has experienced power shortages affecting domestic, industrial as well as commercial sectors. Similarly, the country also has faced gas shortages. These shortages have negatively impacted the country's economic growth, political stability and social order. One factor in the unpopularity of the last government was its inability to stem and mitigate energy shortages in the country. Choices available to the decision makers in the country are to enhance energy supplies or to reduce energy demand or a blend of both in order to reduce the supply-demand gap.

Why Energy Conservation is so Important?

Conservation of energy means simply reducing the use of energy. Through energy conservation energy shortages can be mitigated. This is perhaps the swiftest way to overcome the present shortfall. It is the cheapest solution as well. Lessening the need of energy usage is possible through responsible behavior, e.g. using day light more for work, keeping unnecessary lights and other devices switched-off, and curtailing the use of energy where it is possible. Improving efficiency of energy usage can also contribute to energy conservation particularly in a country where the usage of inefficient domestic devices and industrial operations has been a huge drag. Improving efficiency and simple conservation steps can play a big role in minimising the supply-demand gap that had been on the rise since surfacing in 2004.

There is no denying the fact that Pakistan's per capita energy use is far lower than developed and many developing countries. It is therefore expected that in the coming years and decades Pakistan would require far more energy supplies as compared to contemporary requirement. Therefore it is an imperative to enhance energy supplies, particularly power generation capacity. However it is a fact that even with the help of financially strong and technologically advanced China, it would take some years to overcome the current energy crisis. Whereas supplying adequate amount of energy is a time and resource demanding phenomenon, curtailing demand through conservation is theoretically possible and practically achievable. According to ENERCON, which is a government body for conservation of energy, there is potential for conserving 25 per cent energy in Pakistan. It is estimated that if full potential for conservation is exploited, the current energy crisis could be tackled to a great extent.

Why contemporary Pakistan Needs it?

Energy conservation is a phenomenon that would have its dividends in all environs and times. However in certain contexts, energy conservation becomes more important than others. It is thus important to evaluate why conserving energy at this particular time in Pakistan is more important. At present the installed capacity for electricity production exceeds the peak demand in the country. However, the country still experiences huge power outages due to the high cost of production. The energy supplies mix of Pakistan in general and electricity production in particular presents stark conclusions: Pakistan can generate enough power supplies if it is rich in hydro carbon resources, or if it is rich enough to import such fuels without having negative impact on its national economic life, or if Pakistanis could afford to pay their energy bill as per the generation cost. However if none of these is possible, governments would have to pay for the balance between generation expenditure and revenue generated through billing. In such a scenario, masses would be unhappy and dissatisfied with the government for high power tariffs whereas the international monetary institutions would be unhappy with the country for high level of subsidies.

Putting the energy scenario of Pakistan in the spotlight shows that the winter peak demand of energy is far lower than the summer peak. However in the winter season, a huge share of hydro energy is cut-off due to low water flow in rivers caused by extreme cold in the northern parts of the country from where the major rivers come. Therefore, the dependence on

energy generated through thermal production stays high even in winter season, which in turn makes energy generation a high cost endeavour. In contrast, high water flow in rivers in the summer gives an opportunity to get low cost hydroelectricity in summer. But due to harsh weather conditions in summer, the peak demand for electricity also soars. This surge in demand requires the continual dependence on thermal generation in summer as well. The net result is that in both seasons, the country has to depend heavily on expensive thermal power generation, which results in imbalance between costs incurred and revenues generated.

Until the country is able to produce low cost power, lowering the demand through conservation can play an important role in resolving the complex problem of power outages. If the conservation potential is harnessed to the full, the country can lower power generation through oil based thermal facilities which produce expensive power. By this way, the imbalance between generation costs and revenues earned could be curtailed. Though such a solution would not be successful in the long run given the potential increase in demand, it could be useful for a couple of years. This window of opportunity is highly important during the period in which the country envisages to enhance its low-cost power generation facilities with the help of China.

Efficiency-conservation Linkage

As noted above, Pakistan's per capita energy usage is low, which in itself is an indication that if industrial growth takes place the country would require far more energy. At present, Pakistan's energy use is inefficient too. From household devices to industrial equipment and from transportation to the commercial sectors, the prevailing energy use offers opportunity for conservation through enhancing efficiency. Hence there is a strong linkage between efficiency and conservation in Pakistan. The developments in energy technology globally have to be monitored and adopted. Along with increasing efficiency in energy usage, inculcation of culture of conservation during this time would have its dividends for future as well.

What Universities have Done Thus Far?

The Higher Education Commission of Pakistan recognizes ninety-one public sector and seventy private sector universities in the country. A survey of universities' websites shows that though there have been some

activities on energy conservation by some universities, generally it could be said that universities have not contributed in energy conservation as per their potential. It shows that our universities are not prepared yet to transcend from their traditional role. They are not ready to realise the nature of a national challenge and come up with their own innovative action plans for helping the nation grapple with the grave challenge of energy poverty in the country.

Some good work has been undertaken by universities in the field of energy security in general. More emphasis however is required on energy conservation. But even more emphasis would be needed to translate words into actions and triggering a culture of conservation as well as designing conservation on-campus and outreach campaigns.

What Think Tanks have Contributed Thus Far?

Similarly, a survey of think tanks' websites shows that generally think tanks in Pakistan have not been able to generate appropriate ideas for energy conservation in Pakistan. They also have remained unable to affect mass thinking about energy conservation as well as in pushing governments to launch conservation campaigns that are effective and result-oriented.

What are the Possible Avenues for Conservation?

In energy conservation field there are many ways that universities and think tanks can contribute to. Since conservation is an idea for modifying energy users' behaviour, universities and think tanks can be highly effective in their promotion. This promulgation can be best made through exhibiting its benefits by becoming a model. If university campuses are conserving energy and exhibiting its dividends, such institutions would be in a position to affect the behaviour of adjacent communities as well as other institutions. They would also be in a position to influence energy decision-making positively in the industries in their neighbourhood as well.

Universities can help in energy conservation through university-industry partnerships in developing affordable and conservation-friendly devices as well as renewable energy equipment. Similarly, they can develop and promote affordable agricultural equipment and practice manuals that could help conserve energy.

Inculcating sophisticated information technology practices in industrial and service sectors is another area where universities can help in

energy conservation. Lastly but perhaps more importantly, universities can help the nation in adoption of a culture of conservation of energy. Universities' energy conservation walks and out-reach campaigns can generate and boost a truly national drive for energy conservation in an effective way. Helping domestic consumers understand benefits of conservation could be very productive as it is the domestic usage of energy that has grown more rapidly than other sectors in Pakistan over a period of last three and a half decades. Similarly, think tanks can play an important and effective role in energy conservation by triggering policy makers' emphasis on the subject through conferences, seminars, publications, memos and policy briefs.

How it should be done – Recommendations

Since energy conservation can help in mitigating the prevailing energy crisis, it must be pursued as a national campaign. More emphasis is required during the years in which the country seeks transition from high-cost to low-cost power generation. In this regard:

- Universities and think tanks being the responsible institutions to guide behavior at governmental, non-governmental and individual levels, owe responsibility which must be realised true to the gravity of the challenge and the mitigation potential of conservation.
- Universities should make efforts for lowering their energy usage. They should adopt self-assessment by having regular energy audits.
- Energy audits should be made mandatory for universities by the Higher Education Commission of Pakistan.
- Universities should pursue conservation through technology development and its promotion, affordable-marketable solutions, and outreach programmes.
- Think tanks should organise conferences and seminars and publish material on conservation dividends. They should pursue relevant ministries and institutions for taking result-oriented actions for energy conservation.
- Universities should organise conservation weeks for promotion of conservation among their students and faculty members. In such weeks, lectures, poster and quiz competitions, dramas and other innovative ways should be employed for the promotion of conservation on campus.

- For the promotion of energy conservation culture in adjacent communities, universities should organise awareness walks and outreach programmes for promotion of understanding of energy conservation in their neighbourhoods. Because universities can talk in local language and understand cultural sensitivities, what they can devise for local campaigns would be more effective than just printed tips for energy conservation on electricity and gas bills, or web based tips that a large illiterate segment of population cannot access. They also should involve media and local politicians in such activities.
- Universities have a soft power in local communities. This soft power of persuasion should be utilised to the full by presenting replicable models for energy conservation. For example, making university campuses 100% day-lit can help in energy conservation at campus level and promotion of the conservation drive at societal level.

  The Higher Education Commission (HEC) should consider giving weightage to LEED (Leadership in Energy and Environmental Design) or any similar certification in the new constructions in universities for issuing its rankings of universities. The higher LEED certification in the new constructions should win more points in HEC rankings for universities. Through this initiative, a healthy competition among universities for energy conscious building for future could be prompted.■

CHAPTER-11

Solutions for Energy Crisis in Pakistan: Energy Efficient Buildings

Dr Ashfaq Ahmed Sheikh

Abstract

The use of energy in human life has been increasing with the growth of civilization. Significant changes occurred in the past half century or so as advances in productivity and technology enabled higher living standards. All these developments are transforming the energy landscape. On average, the poorest 2.5 billion people in the world use only 0.2 TOE (tonnes oil equivalent) per capita annually while the billion richest people use 5 TOE per capita which is 25 times more. Despite low per capita energy and electricity usage, Pakistan is facing acute shortage where load shedding at household level ranges from 6 to 18 hours a day and industrial sector is facing complete or partial closure from 2 to 3 days per week. Besides, developing new power sources, minimising line losses and circular debt issues, the energy conservation and efficiency in supplies and consumption are equally important for industry as well as for household sector. On average, 4000 to 6000 MW electricity shortage is still being faced. Gas shortage is severe during winters. Through energy conservation and efficiency measures, significant amount of energy can be saved. Energy efficient buildings with little modification in the design can save significant amounts of energy. Time has come to make every possible effort for conservation, so that the growing demand could be met. A carefully designed home with proper orientation, layout, daylight entry, and ventilation, coupled with careful selection of building material and construction techniques can help save energy by as much as 30 per cent, without adding extra cost. The way forward in this context lies in the implementation of the Building Energy Code of Pakistan which has already been launched in 2013 as mandatory requirement. This code facilitates guidelines for new as well as old buildings.

Rationale

The use of energy in human life has been increasing with the age of civilization. Access to energy is fundamental to fulfil basic social needs, driving economic growth and fuelling human development. With the passage of time, the growing needs for improved living standards have increased the need to explore and acquire more energy resources. Significant changes occurred in the past 50 to 60 years, as advances in productivity and technology enabled higher living standards and better lifestyles for the people (Exxon, M., 2013). The population of the world will rise by more than 25 per cent from 2010 to 2040, reaching nearly 9 billion. All these developments are transforming the energy landscape. On average, the poorest 2.5 billion people in the world use only 0.2 TOE (tonnes oil equivalent) per capita annually while the billion richest people use 5 TOE per capita per year, which is 25 times more. In 2011, per capita energy consumption in the US was 7.28 TOE as compared to 0.45 TOE in India and 0.487 TOE in Pakistan (USA Energy Efficiency Report, 2012). However, per capita electricity consumption for USA is about 1.0 TOE whereas in India and Pakistan it is 0.064 TOE and 0.035 TOE, respectively.
The household sector accounts for 15 to 25 per cent of primary energy use in developed countries whereas this share is relatively higher in developing countries (Oleg D. and Ralph C., 1999). The estimates show that 2.6 billion people still lack access to modern cooking fuels even though electricity generation has grown fast over the last two decades. A significant per cent of population (Figure 1) is still using biomass for cooking and heating in developing countries (Modi et al., 2005). The household sector although it does not have major share in total energy consumption but plays a central role in demand and supply perspective. Household consumption per capita varies by region and reflects dramatic differences where a variety of factors are involved. The climatic conditions in which we live, our incomes, and the efficiency of our homes and appliances, all play pivotal role in our household energy consumption. According to the US Energy Information Administration (EIA), homes built since 1990 are on average 27 per cent larger than homes built in earlier decades. From now till 2040, residential demand in the OECD countries (Organization of Economic Cooperation and Development) will decrease, whereas in the Non-OECD countries it will go up by about 35 per cent (Exxon M., 2013). Heating and cooling are the main energy usages in buildings. The use of air conditioners is

estimated to triple by 2030. Most of this energy is wasted due to inadequate insulation.

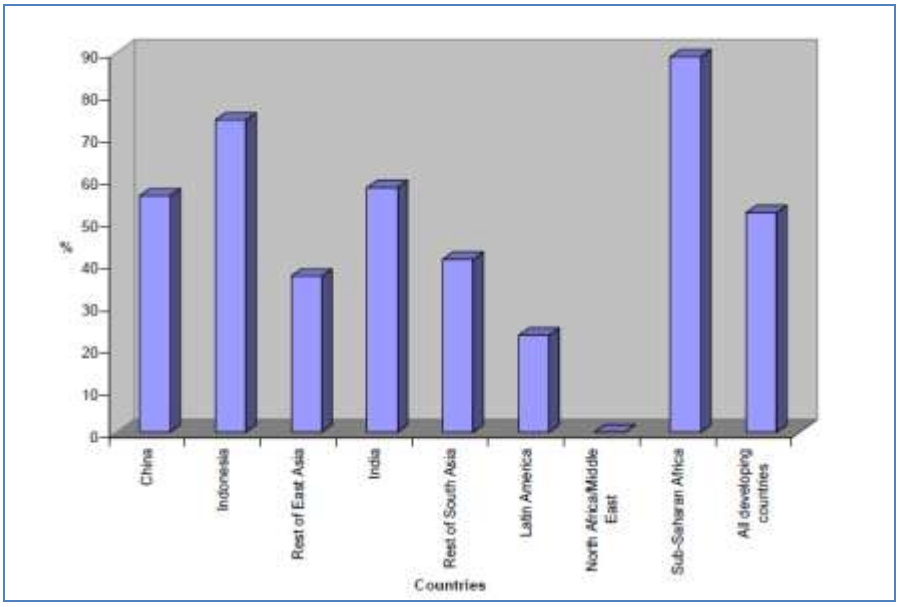


Figure 1: Per cent of Population using Biomass for Cooking and Heating in Developing Countries

Despite low per capita energy and electricity usage, Pakistan is facing acute shortage where load shedding at household level ranges from 6 to 18 hours and industrial sector is facing complete or partial closure from 2 to 3 days per week. Besides, developing new power sources, minimising line losses and circular debt issues, the energy conservation and efficiency in supplies and consumption are equally important for industry as well as for household sector. On average, 4000 to 6000 MW electricity shortage is still being faced. The gas shortage is reaching to maximum level during winters. Through energy conservation and efficiency measures, significant amount of energy can be saved. Even the design of energy efficient buildings or with little modifications in the design can save significant amount of energy. Time has come that with every effort for development, management and conservation, the growing demand for energy is met.

Energy consumption in houses is highly dependent upon design besides energy use habits. Building design with less energy consumption is not just the outcome of applying one or more isolated approaches or

technologies but it is an integrated process that requires optimal combination of building layout, architectural design, materials, appliances and implementation (Department of Energy USA, 2001). According to an analysis, a building design with good energy saving provisions may cost extra 15 – 20 per cent whereas it can save 30 per cent or more in energy costs over a conventional building design. Since energy development and management is merely regulated by the government sector, therefore, the future demands and sustainability of energy resources require safe and energy efficient building design, in accordance with recent strengthening of regulation and standards under ISO 50001, an international standard for energy management issued in June 2011. It is absolutely imperative that we improve energy efficiency in buildings by incorporating international best practices appropriate to our environment, together with traditional materials, technologies and craftsmanship developed indigenously over time.

Best Practices for Energy Efficient Building Design

The energy efficiency in buildings is not only possible through energy efficient design but it is also dependent on the management and operational practices to conserve energy and enhance overall system efficiency. The design and management considerations are more or less similar for the designing of new as well as for the existing buildings.

Energy Conservation through Management

In an energy efficient house, it is possible to reduce annual energy bills by up to 40 per cent as compared to an average built house. Under present and future energy situations, home owners should consider developing an energy conservation plan for their homes, which is not only environment-friendly but also economically sound. Even it is possible in the existing homes to adopt energy saving approaches, as one is given below:

- Identify the areas in home where energy is being lost or inefficiently used;
- Prioritize the areas according to how much energy is being lost or inefficiently used; and
- Step by step fix the problems according to the limits of your energy saving budget.

The following process is being widely followed in developed countries incorporating performance based redesigning of buildings with focus on energy conservation and efficiency, which is very much in line with the above approach starting from diagnostic analysis of facility, developing energy conservation plans in the light of financial options, implementation, then measuring and verifying the changes/ system efficiency towards savings and rebates.

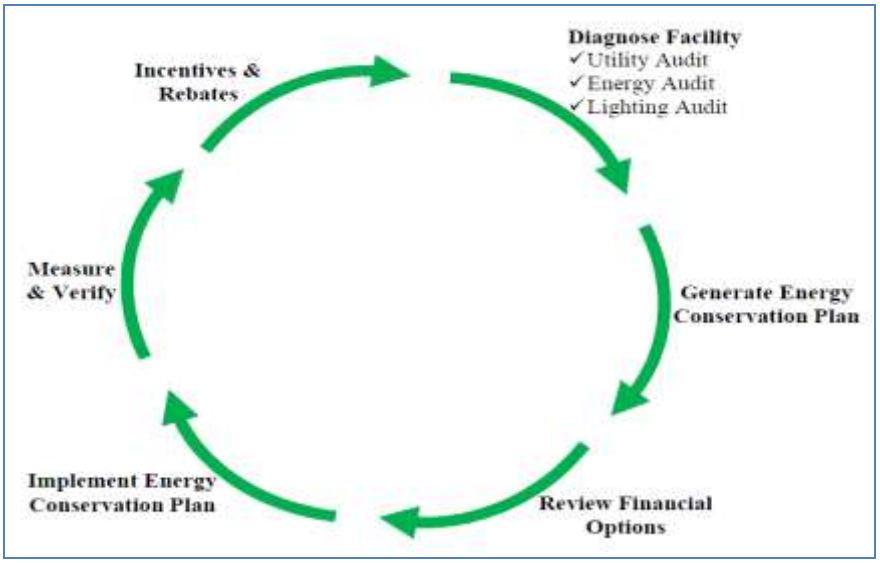


Figure 2: Result-oriented Energy Efficiency Process

As a case study, the management measures taken by Pakistan Engineering Council in 2009, starting from energy audit of its headquarters building at Islamabad and replacing ordinary lightning with energy efficient lighting (LEDs and energy savers), helped saving up to ten times the existing lighting load as well as energy bills.

Energy-Efficient Building Design Considerations

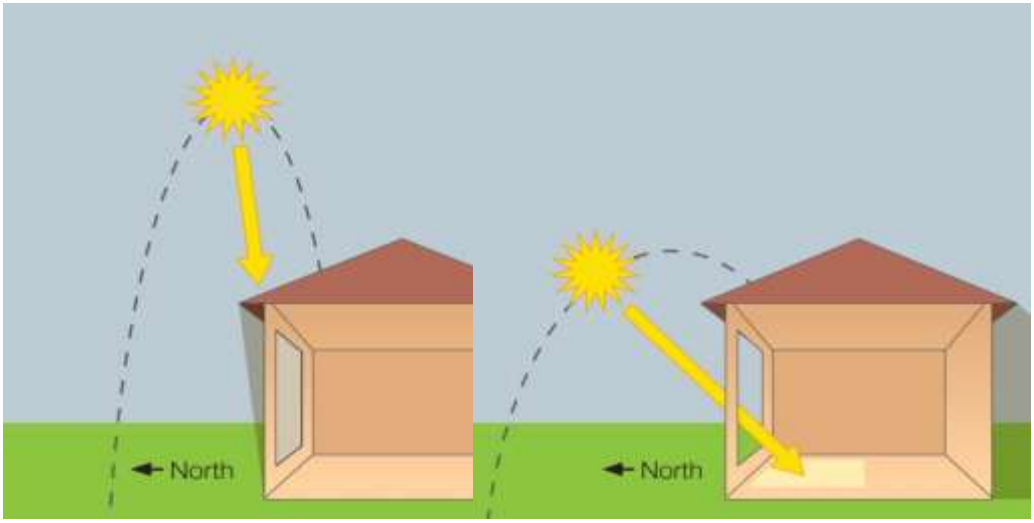
The design of an energy-efficient building may range from a sophisticated multistoried mall to a double story residential house. Bringing existing homes up to energy high performance will be a major challenge in the years to come. The homes can be brought to various levels of efficiency, ranging from simple weatherization to extensive remodelling where deep energy savings and rebates are available. For a home to be energy efficient, it needs

to have all the right elements of design including the following considerations:

a. Building Orientation, Form and Layout

The theoretical direct solar radiation incident on differently oriented surfaces should be analysed in building design especially with energy saving consideration. The home should be orientated and located on a block to maximise the amount of sunlight it receives. When selecting a block of land, consider the size, orientation and slope of the block to maximise sunlight entry; tree coverage and height to avoid too much shading; and height and proximity of surrounding buildings to avoid overshadowing. The ideal orientation for the building is therefore identified by checking the chosen building form i.e. single storey, long and narrow building etc. and suitable orientation, and determination of the exact heat and/or coldness. The ideal location is with the daytime living areas facing north and the long axis of the house running east to west.

Daytime living areas should be located on the north side with large north-facing windows to capture the winter sun. Bedrooms and utility areas should be located on the south side (Figure 3). If the design allows it, bedrooms and other rooms can also face north. Variations on house orientation can occur if the house cannot be located where it faces north, up to 30 degrees east or 20 degrees west of true north. In these cases, extra shading may need to be considered for summer. Large windows on the north side of the house let the sunshine in during winter because of the low angle of the sun. Eaves prevent sunshine entering the house in summer because of the high angle of the sun.



Summer sun: The sun is higher as it moves across the sky in summer

Winter sun: On winter days the sun is low in the sky as it moves from east to west

Source: www.sa.gov.au

Figure 3: Building Orientation for Summer and Winter

b. Lighting

Preference should be given to design a building where no artificial lights would be needed in daytime. This is more complex than it sounds because artificial lighting is required even in buildings where window areas for adequate day lighting have been provided. It has been experienced that many people prefer to switch on artificial lights after blocking out all natural light by curtains, particularly in summer.

The culprit for this seemingly irrational behaviour is glare from window areas: large or small. Glare is not a function of brightness or size of light source but of contrast. Car headlights cause acute glare on a dark road, much less on a properly lit road and are barely perceptible during daytime. Office spaces, day-lit from one side (Figure 4) will always suffer from glare problems because of the contrast between the window and the window wall. In the absence of supplementary artificial lighting, such spaces will bear a 'gloomy' character. The problem can be rectified by lighting a

workspace from two opposite or adjacent walls (Figure 5). Unless specially designed, skylights can also cause glare.

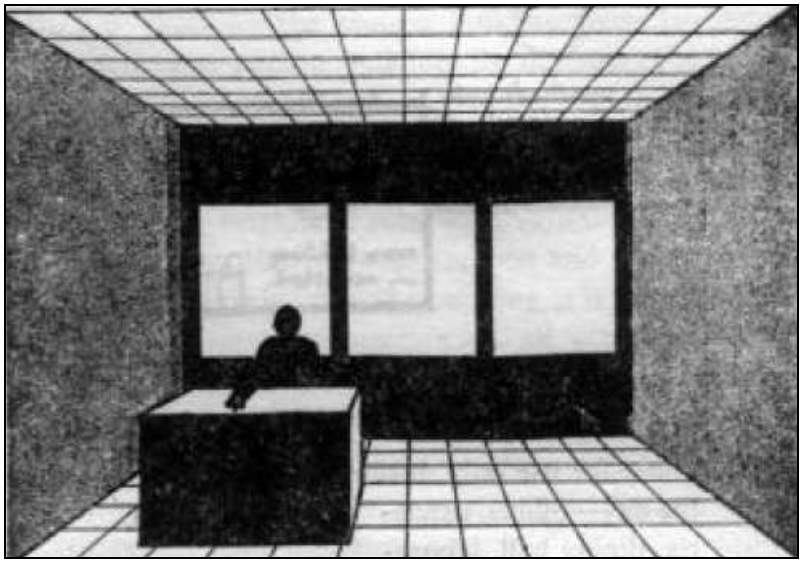


Figure 4: Glare due to day lighting from one side

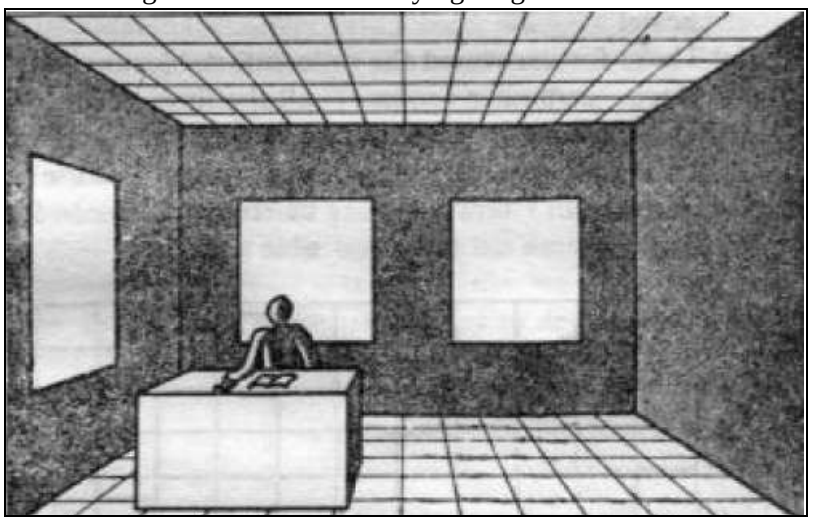


Figure 5: Improved lighting with windows on two walls

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c. Space Cooling and Thermal Comfort

Thermal comfort for human beings depends upon air temperature, mean radiant temperature, relative humidity and air velocity. Machines, however, are affected mainly by air temperature and in exceptional circumstances by the mean radiant temperature or relative humidity. The design of the buildings for people, therefore, is somewhat different from that for machines. Ceiling fans (for example) will affect the comfort level of people but not of machines. Because people can move about from one space to another and can put on additional clothing or take them off. The comfortable working conditions for machines which are stationary are usually more demanding than for people. Therefore, the design of built up areas should be considered according to the time of use as follows.

S.No.	Space	Comfort Criteria
1	Those for use only during the day (offices, cafeteria, dining hall, laboratories, etc.)	night-time temperatures do not matter
2	Those for use only at night (bedrooms)	day-time temperatures do not matter
3	Those for use round the Clock (computer rooms)	comfortable range needed all the time
4	Those for intermittent use only (auditorium, lecture rooms etc.)	not very rigid comfort requirements, as use can be restricted to comfortable periods

d. Ventilation

Structural ventilation of buildings at night helps to cool down the building and the building mass so cooled warms up slowly the next day. During daytime, when the outdoor air temperature is high it is best to minimise ventilation. Natural ventilation of day-use spaces (offices and laboratories) in summer is therefore of no use whatsoever. Improper ventilation is generally the reason poorer thermal performance of office buildings as compared to houses.

Offices tend to be ventilated during daytime and closed up at night for security. To make use of the cooling effect of night ventilation, it is necessary to organise ventilation apertures so that they could be left open at night without fear of thieves or of wind blowing away papers etc. Special precautions are necessary to prevent birds or animals from entering the building.

e. Air-Conditioning

Electricity is required only for blowers and pumps. Such a system is ideally suited for spaces which are in use only during daytime as very little energy storage is then needed. The solar collectors normally occupy an area one to one and a half times the floor area to be cooled. For twenty-four hour operation of the cooling plant, the solar collector area will be twice as much and even then a stand-by energy source is required for cloudy (but hot) days. The installation costs of such a system become uneconomical and the reliability is also poor.

f. Building Material and Construction Techniques

Massive construction results in a lower daytime temperature inside the building, but may become uncomfortable at night when the heat absorbed in the structure finally reaches the inside space. Light weight construction results in high daytime temperatures but cools down quickly in the evening when it will be more comfortable than the massive structure. Buildings for predominant daytime use should, therefore, be of massive construction whereas areas such as hostel bedrooms, used mainly at night, should be built from light-weight materials.

Spaces for round-the-clock use present special problems. Spaces for casual use need no special consideration, as it is possible to restrict their use in the comfortable periods of the day.

All of these buildings, however, should be designed to prevent over-heating of internal spaces. In warm climates, the most important factor that causes over-heating of a building is solar radiation. Absorption and inward transmission of solar radiation can be reduced by choosing an appropriate building form and

shading devices. Further heat removal from the building can be affected by natural or induced ventilation, evaporation of water and use of heat sinks.

g. Insulation against Heat and Cold

Insulating your home is the most important measure for making your home energy-efficient. Windows and other glazed surfaces in an average insulated home can account for more heat gain or loss than any other aspect of the building fabric. Choosing the right size windows and the right glazing material can significantly improve the efficiency of your home.

Ideally all north facing windows should be full length to allow the heat from the winter sun in. East and west facing sides should have a minimum area of glass or none at all. Sunlight shining directly on north, east and west facing windows produces the same amount of heat per square meter as a one bar radiator. As a general guide, the total window area should be less than 25 per cent of the total floor area of the house. A guide to the percentage of window area to wall area for each direction is:

- North facing 60 per cent
- South facing 30 per cent
- East facing 15 per cent
- West facing 0 – 7 per cent

h. Use of Alternate Energy

The renewable energy resources may also be used in contrast to conventional energy resources. Solar energy may be used for electricity generation, water heating and cooling purposes. These resources are not only environment friendly but also promote use of energy more efficiently. As the energy resources are becoming scarce worldwide, the incorporation of renewable energy resources is becoming mandatory part of energy efficient design is also being imposed by the housing regulatory and development authorities.

Building Code Of Pakistan (Energy Provisions-2011)

Although there are some standards for load connectivity and design layout being followed loosely in Pakistan but the energy efficiency and conservation in building design is a far cry. The recent development of Building Code of Pakistan-Energy Provisions 2011, is a significant step promoting energy efficient building design. The Code has been implemented through statutory order in 2013 for adoption by all relevant building authorities and thereby must be incorporated in the design layout and approvals.

The Energy Code as its Phase-I is applicable to buildings and building clusters that have a total connected load of 100 kilowatts or greater, or a contract demand of 125 kVA or greater, or a conditioned area of 900 m^2 or greater, or unconditioned buildings of covered area of 1,200 m^2 or more. The scope of the Energy Provisions is applicable to provide minimum energy-efficient requirements for the design and construction of new buildings and their systems; new portions of existing buildings and their systems, if the conditioned area or connected load exceeds the prescribed limits; new systems and new equipment in existing buildings; and increase in the electricity load beyond the set limits.

These Energy Provisions are compatible with relevant standards of ASHRAE, ANSI, ARI, ASTM etc. The only exception is Section-4 Building Envelope, which has been developed keeping in view Energy Codes of regional countries and the local environment. The Code extends over nine different sections to cover the regulatory and building design aspects while maintaining minimum energy-efficient requirement.

Section – 1	Purpose
Section – 2	Scope
Section – 3	Administration and Enforcement
Section – 4	Building Envelope
Section – 5	Heating, Ventilating and Air Conditioning
Section – 6	Service Water Heating
Section – 7	Lighting
Section – 8	Electrical Power
Section – 9	Definitions, Abbreviations and Acronyms

The Code is not applicable to the buildings that do not use either electricity or fossil fuel, government notified historically significant and heritage buildings, and equipment and portions of building systems that use

energy only for manufacturing processes. The purpose of Energy Provisions-2011 is to provide minimum requirements for energy-efficient design and construction of buildings. This would help developing a culture for energy saving in construction of buildings and thereby saving on energy bills. The future development of Energy Provisions-2011 shall encompass low-end users and buildings, if deemed necessary up to 10KW and/or of appropriate covered area.

For the effective implementation of the energy provisions, besides extensive training programmes, the Implementation Handbook is being updated for the users and designers. Through a joint country-wide programme by ENERCON and Pakistan Engineering Council, a large number of engineers and professionals have been trained for Energy Audit Tools and Techniques. The business community has also started working on energy insulation materials for the buildings. ENERCON has also started working on labelling of electronic products especially fans.

Concluding Remarks

The availability of energy is becoming scarce in the wake of growing needs for various human requirements. At the same time, there are changing trends of energy usage from developed to developing countries in the context of energy efficiency and conservation. The energy use at household level although accounts for 25 per cent of total primary energy but its efficient use may help both the consumers as well as the energy producers to maintain balance between demand and supply.

A carefully designed home taking consideration of its orientation, layout, daylight entry, and ventilation, coupled with careful selection of building material and construction techniques, may help save the energy significantly without adding extra cost but facilitate comfort living and saving on energy cost. The way forward in this context is the implementation of Building Energy Code of Pakistan which has already been launched as a mandatory requirement. This code facilitates guidelines for new as well as retrofitting of old buildings.■

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CHAPTER-12

Legislation for Energy Conservation in Pakistan: The Judicial Response in 2014

Barrister Aemen Zulfikar Maluka

Introduction

In my last year's submission to this amazing group of scholars and practitioners in the field of energy, my focus was on the shortcomings of our promising yet practically dysfunctional ENERCON. There is a new bill for 2014 published on their Website[1], which claims that the National Energy Conservation Centre is now on its way to becoming an independent authority. As it is too early to comment upon the impact of this new bill on progress of this organisation based on its road to becoming more efficient through organisational independence, I have decided to focus this year's submission to identifying the more practical reasons for the energy crisis, which are currently facing Pakistan. The aim is to examine the judicial response in this regard.

The joined cases of Engineer Iqbal Zafar Jhagra And Senator Rukhsana Zuberi vs Federation Of Pakistan and others 2014 P T D 24, and OGRA through Secretary vs MIDWAY II, CNG STATION 2014 SCMR 220

In my view, from a judicial point of view, 2014 has been promising as there have been major shifts in the way the courts are choosing to take up and discuss the basic elements leading to the energy crisis. For this purpose, for this year's submission I have chosen to focus on a few judgments, which have recognized that energy and access to it, is an actual human right. In the recent case of **Engineer Iqbal Zafar Jhagra and Senator Rukhsana Zuberi Vs Federation Of Pakistan and others 2014 P T D 24,** Article 38 of Constitution of Pakistan was invoked, based on the need for promotion of social and economic well-being of the people, the court acknowledged

[1] http://www.enercon.gov.pk/

that the availability of energy and the progress of a nation/State were inextricably linked. Article 38 of the Constitution states that, "The State shall... secure the well-being of the people... by raising their standard of living..."Based on this, the Supreme Court observed that without energy, there could be no progress, no development which could raise the standard of living of the people as commanded by Art.38 of the Constitution. This is one way of looking at the matter of the energy crisis we are currently facing. Additionally, Article 9 (Right to Life) Constitution of Pakistan was also invoked in order to assert that the provision of electricity came under the guarantee of the right to life, which is enshrined under Article 9 of the constitution. Corruption in rental power plants has been dealt with previously in **2012 SCMR 773** and **Shehla Zia vs. Federation of Pakistan PLD 1994 SC 694 ref**, where this right was also invoked. This was heard collectively with **OGRA through Secretary vs MIDWAY II, CNG STATION 2014 SCMR 220,** which was also taken up as a human rights case. In a review under S. 7, Constitution of Pakistan, Articles 38 and 184(3) – a human rights case – the Supreme Court took action based on newspaper clippings regarding unprecedented load shedding in the country and an increase in electricity prices, and the fixing of the price of petroleum products. It was noted that the increase in domestic price of petrol despite a steady decrease in petrol prices in the international market. The court said that no policy justification existed for such an increase – prices of petrol, diesel, petroleum products, etc., were being fixed arbitrarily by the Oil and Gas Regulatory Authority without taking into consideration the rate in the international market – and that petrol prices should be set in consonance with the international market. The court said that Article 38 of the Constitution directed the State to act for the welfare of the people – fixing high petrol/diesel rates without justification was clearly not in the welfare of the people – the Supreme Court directed that in future all necessary steps should be taken in such behalf to fix prices strictly in accordance with the prevailing rates in the international market. By 30 November 2014, after much political pressure and similar legal lobbying, the current government has decreased the oil and petroleum prices significantly. However, a backlash occurred when a countrywide shortage was created by unscrupulous petrol mongers in January 2015, literally paralyzing the entire transport system of the country.

What is extremely encouraging to see in this case is the way the courts are willing to take up the energy crisis as a fundamental breach of human rights. Basically in this case the court was taking up a number of

matters including a suo moto notice of newspaper clippings regarding unprecedented load-shedding in the country and increase in electricity prices, the gap between demand and supply of electricity, electricity theft, non-availability of Residual Fuel Oil (RFO) and gas, power plants performing below-capacity, national non-preference of hydro-power and overall state mismanagement of the energy crisis.

One of the core challenges to Energy Conservation today is electricity theft. Large sections of population, especially rural farms with hundreds of tube wells, government departments, residents of Federally Administered Tribal Areas (FATA), Karachi, Sindh, Seraiki belt, Khyber Pakhtunkhwa (KPK) and Balochistan, and many industrial and production units, etc., were either not paying electricity bills at all or not according to the cost of electricity they consumed. In 2013 alone, a loss of Rs.750 billion was caused to the exchequer. The common consumer often has to pay exorbitant bills to cover-up the losses that were caused by electricity theft. The courts have now duly acknowledged that this type of theft is like stealing a valuable natural resource from the people with impunity and that the state should take strict action.

Another issue, which has been pinpointed and acknowledged by the latest decisions of the Apex court, is the alarming differential between the production capacity of power plants and the amount of electricity that they were actually generating despite the fact that the existing resources/capacity at the system's disposal were sufficient to overcome electricity shortfall faced by the country. Another reason for load shedding crisis as reviewed, has been the non-availability of Residual Fuel Oil (RFO) and gas. Plants operating on such fuel and gas were not producing electricity in consonance with their full potential. The RFO problem is tied in closely with Independent Power Producers (IPPs) failing to honor the terms of agreements that they were bound by. Seemingly the IPPs have been taking undue and deleterious advantage of the weak financial position of Pakistan Electric Power Company Limited (PEPCO). It seems that the IPPs have slowed down their production and assigned various reasons for non-payment of electricity. One reason that could be countenanced as valid in such regard was the non-availability of Residual Fuel Oil (RFO) and gas but still there is no reason to pin the blame solely on PEPCO. In terms of the low efficiency of WAPDA, the main reason has perhaps been the decentralization of WAPDA into different generation companies (GENCOs) creating problems in administrative efficiency, its increased reliance on Residual Fuel Oil (RFO) and gas powered IPPs, as well as the

seasonal constraints on hydroelectric power. Perhaps the main energy policy failure occurred where instead of increasing and enhancing the facilities available to harness hydro-electric power such as dams, barrages etc., the government seemed to be engaged in a policy of promoting Residual Fuel Oil (RFO) as a basis for producing electricity.

The right to life (Article 9) prompted the court to direct authorities to stop discriminating between rural and urban regions and to ensure that load shedding was managed by controlling all kinds of losses after supply of generation like line losses, theft, etc., for example, by using modern devices like introducing smart meters and supplying electricity only to consumers, who were ready and willing to make payment; that efforts should be made to persuade all kinds of unauthorized consumers to make payments of bills, failing which action under relevant laws/rules should be taken against them. It was further suggested that National Transmission and Despatch Company Limited (NTDC) and distribution companies (DISCOs) must update their policies accordingly. While looking at Captive Power Plants another risk to energy stability was identified as these were getting gas at subsidised rates and then selling electricity at marked-up prices to the National Transmission and Despatch Company (NTDC) making power expensive than normal rates and that this mode of supply was being used for provision of an uninterrupted supply of electricity to affluent cooperative societies. While it would be impractical and unfair to withdraw these subsidies, it is still worth looking at the fact that the purpose of such subsidies is being wasted whenever a set, affluent minority of people is benefitting from it. Due to this, as affected classes were not benefitting from the arrangement, such concessions and subsidies in case of Captive Power Plants were also in violation of the national gas allocation policy.

Another issue, which has been duly discussed by the judiciary in 2014, has been the fact that Petrol Prices in Pakistan have been unstable at a point when those in the international market are steadily decreasing. While the courts tried to do their bit to get the petrol prices to come down, the reduction was only a short blessing and as at January 2015, Pakistani people are going through an artificial fuel shortage, paralyzing their daily lifestyles. It is not that we do not have the resources and capability to overcome load-shedding but that we lack the requisite policy infrastructure to use the existing resources, while giving priority to capacity building of hydro-electric power, in order to challenge this crisis. This crisis is a result of the good will direction of the government regarding the reduction of prices of petrol, diesel, petroleum products, etc. which were invariably and arbitrarily

being fixed by OGRA without taking into consideration the prices in the international market.

Other Case Updates in the Spirit of Energy Solutions for Pakistan

2014 PLD 206 SUPREME-COURT (MUHAMMAD ASIF vs THE FEDERATION OF PAKISTAN)

This was a constitutional petition under Art. 184(3) of the Constitution relating to award of a project by Sui Southern Gas Company Limited (SSGCL), to State enterprise Jamshoro Joint Venture Limited (JJVL) for extraction of Liquefied Petroleum Gas (LPG). The court took notice of gross criminal negligence, lack of transparency, corruption and corrupt practices committed in the bidding process and award of project. Undue and illegal favours extended to JJVL by SSGCL were found to have caused losses worth billions of rupees. Bearing this in mind, the Supreme Court of Pakistan set aside the project in question and constituted a two-person Committee to determine certain issues in relation to the project and give its suggestions thereupon. It is expected that we will be hearing more in this regard during 2015 -2016. The court in this decision also had something significant to say about Arts. 172(2) and (3) of the Constitution, that is, that the ownership of natural resources, (mineral oil and natural gas) was ultimately vested in the people of Pakistan through their governments and state enterprises.

2014 SCMR 287 SUPREME-COURT

The Supreme Court of Pakistan took action under Rule 35 & 199(3) – Oil and Gas Regulatory Authority Ordinance (XVII of 2002), Ss.23 (2)(b) & (d) – and Mineral Industrial Gases Safety Rules, 2010, Rr. 80 & 143, the Petroleum Rules, 1985, R. 21, The Penal Code (XLV of 1860), Ss. 300 & 301and the Constitution of Pakistan, Art.184 (3) (as a human rights case) on a news clipping regarding an incident of the burning of a school van in which sixteen children and one school teacher lost their lives; the cause of incident being the spillage of petrol from the petrol cans kept on the floor of the vehicle which ignited a fire due to contact with the hot engine surface, short circuiting of wiring and the fact that the driver was smoking. The court ordered compensation to be paid to the aggrieved families and

directed that owners of all commercial vehicles should remove CNG cylinders from their vehicles, which had not been fitted by the approved companies/authorised dealers, and that the Provincial Inspector General Police should take appropriate action against persons who were responsible for letting the present incident happen. It is felt that more could have been done in this case, however, regarding the health and safety measures through which Petroleum and Gas for transport is handled and approved for use.

2014 PLD 350 SUPREME-COURT (APPLICATION BY ABDUL HAKEEM KHOSO, ADVOCATE)

This was a well-known constitutional petition under Art. 184(3) of the Constitution regarding contractual and legal obligations of oil Exploration and Production (E&P) companies, which are operating in Pakistan, towards the environment and welfare and uplift of areas of their operation. The case focused on the financial and social welfare obligations of oil Exploration and Production (E&P) companies and the under-utilisation of social welfare funds provided by Exploration and Production (E&P) companies in lieu of exploration rights and privileges. The court, amongst other directions and findings, directed that the DG PC (Director General of Petroleum Concessions) should use his enforcement powers under the petroleum Concession Agreements actively and diligently to seek compliance with the terms of such agreements, and that the Ministry of Petroleum and Natural Resources should ensure implementation of the Prime Minister's directive of 15-9-2003 and provide gas to "all the surrounding localities/villages falling within the radius of 5km of all Gas Fields, on priority basis" as directed, in accordance with the law.

Conclusion

In the author's opinion, the idea that the energy crisis is a serious infringement of human rights of the Pakistani nation is only the first step in recognizing the mess, which has been created by political greed and bureaucratic corruption. It is encouraging to see that the courts are ready to study the impact of such state failures in responding to basic energy crises on the common man and taking up such matters as a national emergency. It is currently unknown whether the current Supreme Court will be courageous and dynamic enough in 2015 to question the state and the

petroleum mafia about the current petroleum shortage as well as continued supply of electricity to affluent housing co-operative schemes, without any regard for the 'rest' of Pakistan.■

Cases Consulted

- Muhammad Asif Vs The Federation Of Pakistan 2014 PLD 206 SUPREME-COURT
- 2014 SCMR 287 SUPREME-COURT
- Application By Abdul Hakeem Khoso, Advocate 2014 PLD 350 SUPREME-COURT
- Engineer Iqbal Zafar Jhagra And Senator Rukhsana Zuberi Vs Federation Of Pakistan and others 2014 P T D 24 ,
- 2012 SCMR 773
- Shehla Zia v. Federation of Pakistan PLD 1994 SC 694
- OGRA through Secretary vs MIDWAY II, CNG STATION 2014 SCMR 220,

CHAPTER-13

Recommendations

At the end of the national workshop Mirza Hamid Hassan summed up and presented the following recommendations:

- The participants unanimously agreed that there existed gaps between policy and implementation relating to the solution of energy crisis in Pakistan. There is a need to differentiate between energy and power. Pakistan has formulated a power policy but there is no energy policy. Only statements and plans for energy development are available but there is a need to develop a comprehensive energy policy covering all sectors of energy such as hydrocarbons (oil and gas sectors), alternate energy resources and nuclear energy.
- There is a need to formulate an integrated national energy policy with national commitment and provincial backup. The policy needs to be more transparent.
- The government should review power policy for proper implementation to overcome demand and supply gap, rising tariff linked to greater thermal power generation, non-availability of funds for new projects with low tariff, institutional disarray and circular debt.
- The SROs of FBR on the energy sector should be rationalized.
- The Board of Investment should allow 'automatic route' investment in energy sector by cutting down procedural formalities.
- The custom duty on the import of renewable technologies needs to be revisited.
- Biased corporate taxation slabs should be discouraged as they reduce the domestic investment in energy sector.
- The Government of Pakistan should emphasise more on clean energy producing resources and strategies to avoid dangerous carbon emissions.
- DISCOs' code of corporate governance for public companies needs to be implemented.

- Energy conservation needs attention. The energy conservation bill and theft bill should be passed and proper conservation of energy drive should be initiated. The remedy of energy crisis would require a national vision and mission to undertake reforms in power and energy sectors with adequate legal support and enforcement.
- There is a need to set our priorities right by creating a balanced energy mix, exploring indigenous resources and enhancing energy conservation mechanism as well as conservation awareness.
- We need to improve the institutional performance. Tangible steps include capacity building, equipping, training, supporting and facilitating institutions.
- The regional options to meet energy needs should not be overlooked as improving law and order situation could attract high investment and could overcome the challenge of arranging funds.
- The institutional disarray should be addressed by taking into confidence all institutions related to energy and power sectors within the bounds of constitutional provisions.
- It was noted that the investment in oil and gas sectors was reduced after 18th amendment. There is a need to take measures for reviving energy and power sectors.
- The rebalancing in energy mix with increased focus on hydroelectric offers a way out of energy crisis. Run-of-the-river along with small hydro projects should be prioritized as they are relatively cheaper, take less construction time and are environment friendly. Political consensus on the big hydro projects should be developed.
- The public-private partnership in hydropower sector should be reinvigorated. This will help in raising financial resources for these projects. A proactive hydro-diplomacy and conducive investment environment is required to fast-track funding from the World Bank, Asian Development Bank, Islamic Development Bank and important donor countries such as Japan, China, France and Canada.
- There is a need for tariff setting reforms and regulatory processes regarding reliance on producers' data, lack of independent and expert inputs and capacity-building expert services to NEPRA.

- There is a need to constitute a Regulatory Advisory Committee at NEPRA that can provide an institutional mechanism to elicit response and inputs of the stakeholders.
- As there is sufficient potential for energy conservation, universities should make it a priority for them and should launch a campaign for energy conservation at the national level.
- The universities should voluntarily have regular energy audits.
- The universities should organise training sessions/lectures on energy conservation for their students and faculty. They can also organise conservation week, debates, dramas and other activities for promotion of energy conservation.
- The Higher Education Commission should consider giving weightage to LEED (Leadership in Energy and Environmental Design) or any similar certification in universities for determining their rankings among universities.
- Facilitate the energy market in order to increase electricity production.
- Imported coal is much cheaper i.e. 2.83 US dollars per ton. It can reduce the production cost.
- The present government is serious in improving the energy sector but its focus is more on short term solutions. There is a need to look into long term comprehensive solutions.
- There is a need to have a national energy vision that can include all stakeholders including politicians, bureaucrats and foreign direct investors.
- There is a need to complete Iran-Pakistan gas pipeline as soon as possible. TAPI and import of LNG from Qatar will reduce energy shortfall in the country.
- There is a need to utilise indigenous resources including hydro, thermal and coal reserves.
- The crisis of gas shortage is manageable through efficient allocation, rationalization of gas prices, capacity building of regulators and improving management.
- There should be a separate Ministry of Energy which should be responsible for planning and implementation of all energy related projects.■

Appendix

National Power Policy

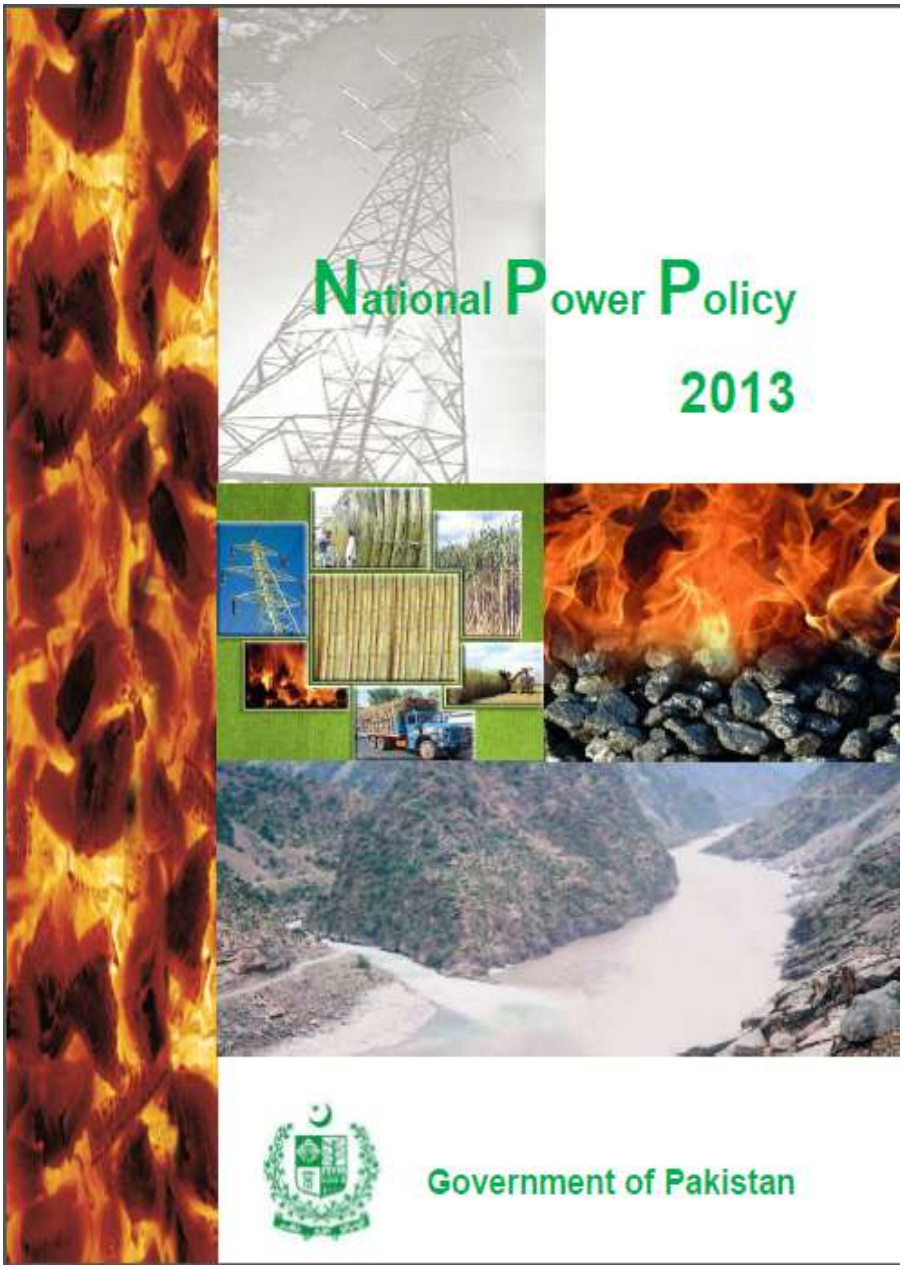


TABLE OF CONTENTS

1. INTRODUCTION

The Ministry of Water and Power of the Government of Pakistan has developed an ambitious power policy to support the current and future energy needs of the country. This bold strategy will set Pakistan on a trajectory of rapid economic growth and social development. Simultaneously, it will address the key challenges of the power sector in order to provide much needed relief to the citizens of Pakistan.

This document will frame the broad contours of the energy policy articulating the vision for the power sector, highlighting its key challenges, setting major goals, summarizing policy principles, and highlighting the strategy devised to achieve Pakistan's aspirations. This document does not elaborate on issues surrounding operational strategy, nor does it lay out detailed implementation plans.

The major sections of the report follow:

2. VISION

"Pakistan will develop the most efficient and consumer centric power generation, transmission, and distribution system that meets the needs of its population and boosts its economy in a sustainable and affordable manner."

3. CHALLENGES

Pakistan's power sector is currently afflicted by a number of challenges that have led to a crisis:

1. A yawning supply-demand gap where the demand for electricity far outstrips the current generation capacity leading to gaps of up to 4,500 – 5,500 MW. The supply-demand gap has continuously grown over the past 5 years until reaching the existing levels. Such an enormous gap has led to load-shedding of 12-16 hours across the country.
2. Highly expensive generation of electricity (~Rs 12 / unit) due to an increased dependence on expensive thermal fuel sources (44% of total generation). RFO, HSD, and Mixed are the biggest sources of thermal electricity generation in Pakistan and range in price from ~Rs 12 / unit for mixed, to ~Rs 17 / unit for RFO, and a tremendously expensive ~Rs 23 / unit for HSD. Dependence on such expensive fuel sources has forced Pakistan to create electricity at rates that are not affordable to the nation and its populace.
3. A terribly inefficient power transmission and distribution system that currently records losses of 23-25% due to poor infrastructure, mismanagement, and theft of electricity. The cost of delivering a unit of electricity to the end consumer has been estimated at Rs. 14.70 by the NEPRA. This means that the inefficiencies are costing the tax payers additional 2.70 rupees per unit over and above the cost of generation (~Rs. 12). The Ministry of Water and Power has estimated the true cost of delivering a unit of electricity to the end consumer at greater than Rs. 15.60 after taking into account the collection losses and the real losses to the distribution companies. If the system assumes the NEPRA suggested transmission and distribution loss of 16%, the theft alone is estimated to be costing the national exchequer over Rs 140 billion annually.
4. The aforementioned inefficiencies, theft, and high cost of generation are resulting in debilitating levels of subsidies and circular debt. Reducing these losses would lead to significant improvement in the bankability and profitability of the sector, and could be used to improve the efficiency of the power system / network as a whole.

The limited and crumbling transmission system of Pakistan has created serious issues of access to electricity, particularly in Balochistan and other far flung rural areas of the country.

4. GOALS

To achieve the long-term vision of the power sector and overcome its challenges, the Government of Pakistan has set the following nine goals:

i. Build a power generation capacity that can meet Pakistan's energy needs in a sustainable manner.

ii. Create a culture of energy conservation and responsibility

iii. Ensure the generation of inexpensive and affordable electricity for domestic, commercial, and industrial use by using indigenous resources such as coal (Thar coal) and hydel.

iv. Minimize pilferage and adulteration in fuel supply

v. Promote world class efficiency in power generation

vi. Create a cutting edge transmission network

vii. Minimize inefficiencies in the distribution system

viii. Minimize financial losses across the system

ix. Align the ministries involved in the energy sector and improve the governance of all related federal and provincial departments as well as regulators

A clear strategy has to be articulated for each of the aforementioned goals in order to actualize the power sector's aspirations.

5. TARGETS

Pakistan has set key targets in terms of the demand-supply gap, affordability, efficiency, financial viability and governance of the system. The extent to which the policy can meet these targets will measure the success of the policy and the nation's ability to overcome the key problems afflicting the power sector.

Supply Demand Gap: Goals i and ii pertain to this target

- *Target:* Decrease supply demand gap from 4500 - 5000 MW today to 0 by 2017

Affordability: Goal iii pertains to this target

- *Target*: Decrease cost of generation from 12c / unit today to ~10c / unit by 2017

Efficiency: Goals iv to vii pertain to this target

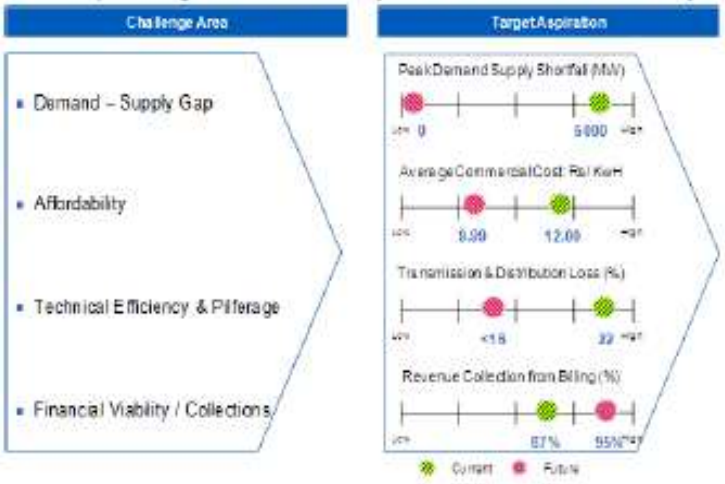
- *Target*: Decrease transmission and distribution losses from ~23-25% to ~16% by 2017

Financial Viability and Collections: Goal viii pertains to this target

- *Target*: Increase collection from ~85% to 95% by 2017.

Governance: Goal ix pertains to this target

- Target: Decrease decision making processing time at the Ministry, related departments and regulators from long to short durations
  - The exact processing times are not currently available; will be established shortly



6. POLICY PRINCIPLES

The process of policy and strategy formulation is informed by the following organizing principles: (i) efficiency, (ii) competition, and (iii) sustainability.

6.1 EFFICIENCY

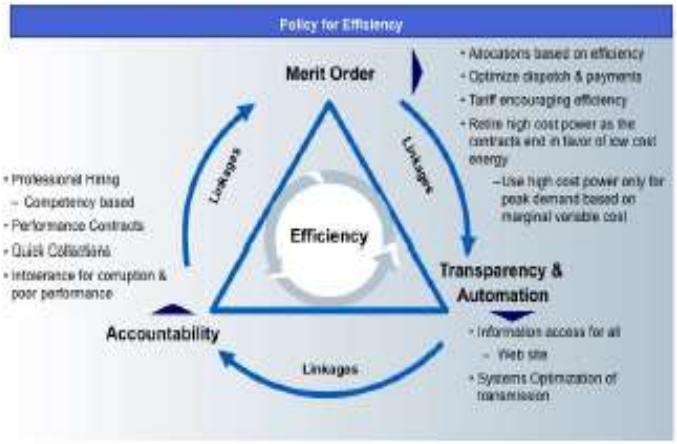
Efficiency is the cornerstone of developing competitiveness. The principle of efficiency will be predicated on three pillars: merit order, transparency / automation, and accountability.

Merit order will be observed all across the system - fuel allocation, dispatch, payments, and power mix. Merit order allocations will obviously come into play once the supply and demand gaps have been minimized.

Transparency will be achieved by providing seamless access to information through a public website

Accountability will be ensured by hiring professionals solely on the basis of competency, signing performance contracts, and exercising zero tolerance towards corruption and poor performance.

The above is illustrated in the following image:



6.2 COMPETITION

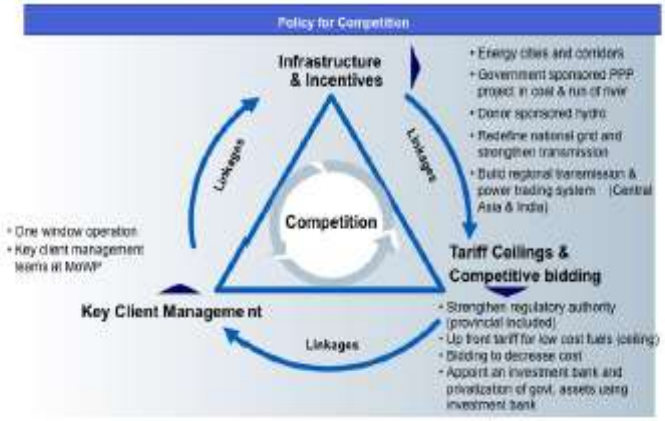
Competition creates the edge essential for developing a robust energy cluster. The principle of competition will be built on three pillars: infrastructure development, up front tariff and competitive bidding, and key client management.

Infrastructure will be developed and incentives provided to attract greater private sector investments. Government would like to limit its role to policy making, and unless necessary, service delivery will be promoted through a fiercely competitive and transparent private sector.

In this light, NEPRA will be strengthened to create a world class regulatory authority with sophisticated and efficient capacity to establish tariffs and set the foundation for a competitive bidding process.

The government will assign "key client managers or relationship managers" at the MoWP who will act as a 'one window operation' for investors in the power sector and ensure the timely completion of investments and projects.

The above is illustrated in the following image:



6.3 SUSTAINABILITY

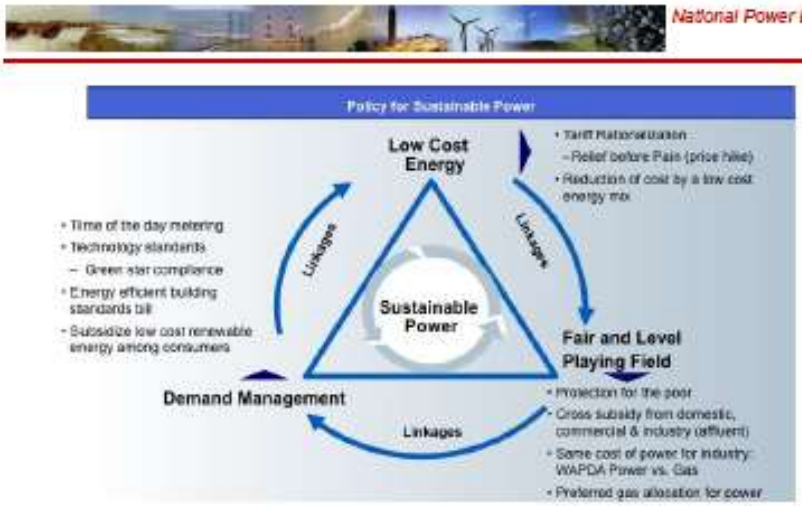
Sustainability is the underpinning of long term transformation. The principle of sustainability will be grounded on three pillars: low cost energy, fair and level playing field, and demand management.

Altering the fuel mix towards less expensive fuels will lead to low cost energy. Investments required for the low cost fuel mix will necessitate rationalization of the electricity tariff.

Fairness will be ensured by protecting the poor and cross-subsidizing their consumption from the affluent. A level playing field will be created by providing power at comparable prices to all industrial users.

Demand management will be introduced through novel policy, pricing and regulatory instruments.

The above is illustrated in the following image:



7. STRATEGY

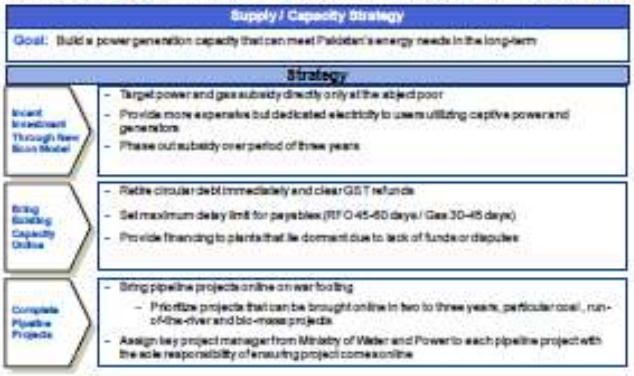
Within the framework of the above policy principles, the GoP has designed strategies for each of the goals listed in section 4 to actualize its vision and overcome the power crisis.

7.1 SUPPLY STRATEGY

The supply strategy will meet Goal (i):

Build a power generation capacity that can meet Pakistan's energy needs in a sustainable manner.

The broad contours of the supply strategy are illustrated in the following figure:



Overall, the strategy to achieve the above goal is focused on attracting and directing local and foreign investments toward rapidly expanding the power generation capacity. Investments can only be encouraged if the sector is made attractive and bankable by eliminating all subsidies, except for those that target the abject poor, to prevent build-up of circular debt. The poor (consumers using up to 200 units) will be protected from any price escalation. To the extent possible tariff rationalization will minimize or eliminate subsidy within the industrial, commercial and bulk consumers.

In developing new power generation projects, a preference shall be afforded to up-front or feed-in tariff which shall set the upper ceiling. In addition, competitive bidding may be used to minimize the cost of generation. Previous policy frameworks (such as 2002 power policy) may also continue to be operational. However, the 2013 power policy shall override any other policy in relation to energy issues to the extent of inconsistencies.

In the short run, the government has already brought the existing capacity online by retiring the circular debt. This action has provided financing to plants that were previously dormant due to a lack of feedstock and / or disputes. The retirement of debt has resulted in an additional supply of over 1700 MW. In tandem, an aggressive rehabilitation and expansion program for the GENCOs is underway which would add 1,447 MW within a year: rehabilitation projects at Guddu, Jamshoro, and Muzzafargarh will yield 700 MW while the expansion of Guddu will add 747 MW.

The maximum delay limits for payables set for RFO and gas (listed in the diagram above) should also apply to hydel IPPs and Wapda in order to ascertain that national power generation capacity does not sit idle in the future.

In the medium term, the MoWP will attract new investments and expedite the pipeline projects on a war footing. A number of projects have reached or will reach financial closure within 2013 – these include 50 MW FFC Energy Limited, 56MW Zorlu Jhimpir project, 50 MW Foundation Wind Energy I, 50 MW China Three Gorges, and 50 MW Foundation Wind Energy II. Thus 256MW have already reached financial closure this year, and an additional 100 MW (Sapphire and Metro) will reach financial closure by the end of 2013. The Uch-II power project (404 MW) has reached financial closure already and is expected to come online by December 2013. Grange Power Holdings is also scheduled to reach financial closure shortly and should be online by October 2014.

In addition to the above listed projects that have reached financial closure, LOS' have been issued for 450MW worth of wind energy projects and an additional 2,276MW of wind projects are currently in the feasibility assessment process. This cumulative 2,726 MW of wind electricity (if deemed feasible) could come online in 2016. At the same time, 341MW of solar energy projects are also currently in the feasibility assessment process and could come online by 2015 if deemed feasible. There is also a push towards Bagasse which could yield 83 additional megawatts of electricity by 2016.

A significant push will also be made towards building medium and long-term hydel capacity in the country. Six projects totalling 388MW of hydel power are expected to be completed by February 2015. The smaller Patrind and Gulpur hydropower projects are expected to be completed by December 2017 and will add 247MW to the grid. An additional 969MW is anticipated from the Neelum-Jhelum HPP project by November 2016. A number of hydel projects are expected to come online in 2017 including the fourth and fifth Tarbela expansions which have the potential to add 1,910 MW (1,410 MW in fourth expansion, 500 MW in fifth expansion).

The government is also poised to announce a coal corridor with a capacity to generate 6000 – 7000 MW in the near future.

In the long run, large infrastructure programs including the Indus Basin Cascade will be aggressively developed. Dasu has a potential of generating 2,160MW, Patan 2,800 MW, and Thakot 2,800 MW. The detailed engineering design for these projects is being carried out and will optimally be constructed using a BOT PPP method.

Other longer-term projects are also under consideration, such as Bunji (7,100 MW potential) and Diamer-Bhasha (4,500 MW potential) whose completion by 2020 could ensure the energy independence and security of Pakistan.

To achieve its medium and long terms goals, the government will develop infrastructure and provide incentives to attract greater private sector investments. The government will set the foundations of energy cities and corridors, and sponsor public-private partnership (PPP) for coal and run of river projects. The government will assign "key client managers or relationship managers" at the MoWP who will act as a 'one window operation' for investors in the power sector and ensure the timely completion of investments and projects.

The government is actively considering innovative business models including various wholesale business models supported by wheeling charges. These innovative business models once

concluded may allow the generation companies to sell electricity to NTDC, DISCOs and the private sector alike. Successful implementation of these models will encourage rapid investments in power generation, bring power generation closer to the load centres, and result in a reduction in electricity prices.

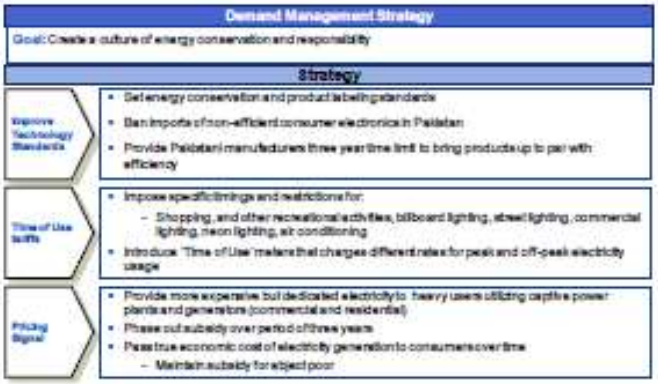
Encouraging the private sector to participate in the utility market necessitates a world-class regulatory function. NEPRA will be strengthened in this regard, and a world-class regulatory authority will control the Tariff and Competitive Bidding process. Up-front tariffs will be set for low cost fuels and competitive bidding will be used to push the costs further downwards.

7.2 DEMAND STRATEGY

The demand management strategy will meet Goal (ii):

Create a culture of conservation and responsibility.

The broad contours of the demand management strategy are illustrated in the following figure:



The GoP will pass energy conservation legislation aimed at three key areas: a) technology / product labelling standards, b) power time of use, and c) improving the energy efficiency of the existing and new infrastructure .

The strategy will set energy conservation and product labelling standards which would ban the import of inefficient electronics into the country. The local industry will be granted a three-year exemption period to bring its product production to the required levels of power efficiency. Green energy building codes will be established and introduced across the Country.

Energy services companies may also be encouraged in the private sector to audit and improve the energy efficiency of the existing industrial, commercial and residential footprint and create a culture of conservation and productivity.

The strategy may also impose timing restrictions for evening commercial activities and introduce 'time of use' metering to discourage utilization during the peak hours by charging different rates for on- and off-peak timings. Solar and alternative power solutions will be encouraged for end users, street lighting, electronic billboards, neon lighting, shop front signage, etc. In addition, the price signal articulated through reducing and targeting subsidy (mentioned in the above section) will naturally optimize demand and utilization.

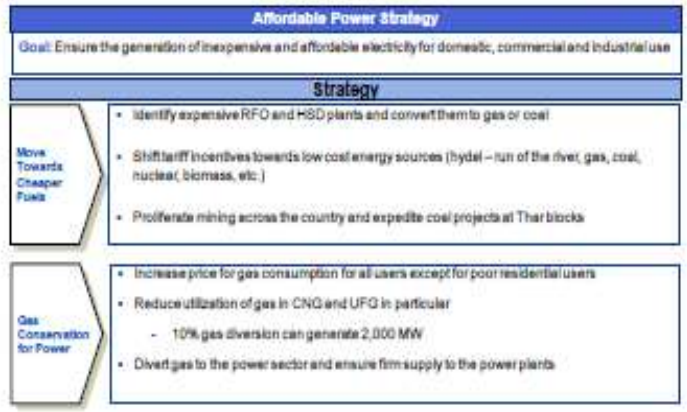
A conservation program based upon energy saver lighting is already underway with a potential of saving 1000 MW if all 50 million consumers were to be converted to florescent bulbs. In addition, technology solutions such conical bafflers for water heaters will be introduced.

7.3 AFFORDABLE POWER STRATEGY

The affordable power strategy will meet Goal (iii):

Ensure the generation of inexpensive and affordable electricity for domestic, commercial & industrial use.

The broad contours of the affordable power strategy are illustrated in the following figure:



The strategy focuses on shifting Pakistan's energy mix toward low cost sources such as hydel, gas, coal, nuclear and biomass. Local and foreign investments will be aggressively sought for

small and medium size run of river hydel projects. Selected hydel projects under development will be positioned for privatization. Multilateral agencies will be invited to partner in large infrastructural hydel projects. LNG terminals will be developed on war footing to rapidly increase the gas supply for the power and industrial sectors. In addition, gas will be preferentially directed to the power sector by eliminating UFG. Nuclear power will be developed in close collaboration with friendly countries such as China. Development of coastal energy corridors based upon imported coal (mixed later with local coal), rapid proliferation of coal mining all across the country – especially at Thar, and conversion of expensive RFO based plants to coal are the central tenets of coal policy. The proposed strategy will change the energy mix of Pakistan in favour of low cost sources and significantly reduce the burden of energy to the end consumer

7.4 SUPPLY-CHAIN STRATEGY

The supply-chain strategy will meet Goal (iv):

Minimize pilferage and adulteration in fuel supply.

Once the relief from load shedding is forthcoming because of a decreased supply and demand gap, this strategy will focus on redirecting the supply of fuel from inefficient GENCOs to the most efficient IPPs. This reallocation alone has the potential of saving Rs 3 billion per month and generation an additional 500MW of electricity. At the same time, the MoWP will sign performance contracts with GENCOs, PSO, and fuel transporters and hold them accountable for the quality and theft of oil. Fuel procurement contracts may be made open sourced to eliminate the power of a single supplier. Leakage will be plugged by building fuel pipelines where possible and open decanting. More specifically a 22 KM pipeline will be constructed to plug the supply chain leakage in Muzzafargarh. In the event that fuel is found to be missing or adulterated, the full economic value of the fuel will be appropriated to the end receiver.

The broad contours of the supply chain strategy are illustrated below:

Supply Chain Strategy

Goal: Minimize pilferage and adulteration in the fuel supply to improve productivity

Strategy

Redirect Supply to IPPs

- Reduce allocation to GENCOs until they are at higher efficiency levels
- Move fuel allocation from GENCOs to IPPs
- Moving 4000 mtoe from GENCOs to IPPs will save Rs 75 billion / year
  - Rs 13 billion / month spent on GENCOs produces 650MW
  - 10 billion / month at IPPs produces 1,150 MW

Accountability Liberalization and Quality Assurance

- Sign performance contracts with GENCOs, PSO, and fuel transporters
- Open fuel procurement contracts through tendering to eliminate role of single supplier
- Eliminate trucking and open decanting by building pipelines (for Muzaffargarh TPS)
- Measure the quantity and quality of fuel moving from the port to GENCO
- Appropriate full economic, value added cost of quality or quantity loss to the end receiver

7.5 GENERATION STRATEGY

The generation strategy will meet Goal (v):

Promote world class efficiency in power generation.

The broad contours of the strategy are illustrated below:

Generation Strategy

Goal: Promote world class efficiency in power generation

Strategy

Provide Fuel to Efficient Plants

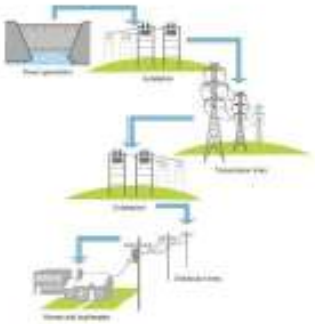
- Establish plant efficiency through heat rate testing
- Prioritize and allocate fuel based upon the efficiency levels
- Make allocations and efficiency levels transparent online
- Monitor the efficiency of these plants on a continuous basis

Privatize GENCOs

- Either privatize, or lease GENCOs to private sector on the basis of O&M contracts
- Pilot two GENCOS immediately
- Prepare the remaining GENCOS for subsequent privatization through corporatization

The strategy focuses on establishing plant efficiency through external heat rate testing, building a merit order accordingly, and allocating fuel to the more meritorious plants. Merit order will privilege fuel allocation on the basis of efficiency and optimize dispatch and payments. Transparency will be achieved by providing greater and easier access to information through a public website. Allocations will be made public online to increase the transparency. The strategy calls for the privatization or O&M based leasing of GENCOs.

7.6 Transmission Strategy



The transmission strategy will meet Goal (vi):

Create *a cutting-edge transmission network.*

The broad contours of the strategy are illustrated below:

Transmission Strategy

Goal: Create a world class transmission and distribution network

Strategy

Optimize Transmission	• Sign performance contracts with NTDC – 2.5% are NEPRA allowed losses; 3.8% are the current existing losses • Dispatch based upon economic order • Install transmission effectiveness analysis software and hardware to optimize transmission – Software already exists but has not been utilized due to lack of technical expertise
Redefine and Redesign National Grid	• Build future medium /small sized power plants closer to load centers to minimize line losses • Expand high voltage transmission lines further North beyond Rawat – Majority of new hydel projects will be situated beyond Rawat – High voltage lines minimize losses • Strengthen 220KV rings around large cities to minimize losses • Redesign merit order to also take into consideration transmission losses of plants
Incent Private Sector Investments	• Create a new business model based upon whole sales transactions, exchanges and wheeling charges • Incentivize the private sector to make investments in transmission, especially for the new generation plants placed off grid or in areas where the grid is weak

The strategy is based on installation of upgraded SCADA software to optimize transmission and monitor its losses. Dispatch will be based on economic order and internal/ audit controls will be established on dispatch and payment.

The transmission strategy requires the redesigning of the national grid in a manner that minimizes line losses. Plants will be built closer to load centers; high voltage transmission lines will be expanded; and the 220kv rings around cities will be strengthened.

Private sector will be provided incentives to build and strengthen the transmission infrastructure. Innovative business and regulatory models will be deployed to weaken the monopolies, increase efficiencies, and decrease costs through competition. Wheeling charges and whole sale markets may be introduced to introduce multiple buyers and sellers in the market place.

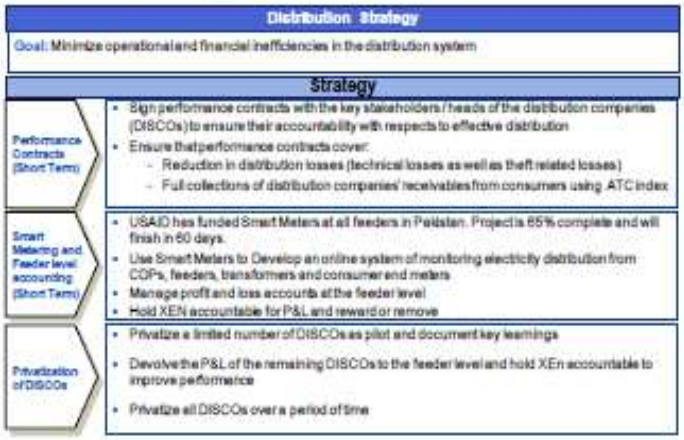
Regional transmission networks may also be encouraged to promote power trade and optimize deficits and surpluses.

7.7 DISTRIBUTION STRATEGY

The distribution strategy will meet Goal (vii):

Minimize inefficiencies in the distribution system.

The broad contours of the strategy are illustrated below:



In the short-term, performance contracts will be signed with the heads of DISCOs (distribution companies) and their respective boards focused on reducing distribution losses due to technical reasons, theft, and lack of recovery / collections. Board independence and appointment of competent board members is the corner stone of improving the performance of DISCOs.

Smart meters will be installed at the feeder and CDP level, profit and loss accounts will to be managed at the feeder level, and the accountability will be appropriated to the Executive Engineer. A regime of reward and punishment will be used to improve efficiency and decrease theft. A Theft Act will be passed that would harshly punish defaulters and other electricity thieves to eliminate theft at the consumer level.

In the medium term, the efficiency will be improved by privatizing a selected number of DISCOs. The remaining DISCOs will be privatized over a period of time.

7.8 FINANCIAL EFFICIENCY STRATEGY

The financial efficiency strategy will meet Goal (viii):

Minimize financial losses across the system

The broad contours of the strategy are illustrated below:

Financial Efficiency Strategy

Goal: Minimize financial losses across the system

Strategy

Collect Receivables	• Automatically adjust already agreed upon amounts owed by provinces and government dept to power sector from the NFC Award and department budgets • Appoint independent, reliable 'Adjuster' to settle payment disputes with provinces and govt depts within a period of three to six months • Agree upon transparent procedure for future billing and collections • Collect GST refunds from FBR and devise a mechanism to avoid future build-ups
Punish Defaulters and Eliminate Theft	• Eliminate transmission and distribution theft • Focus load-shedding in areas where collections are low • Pass legislation that allows for defaulters connections to be severed – Defaulters connections are severed after 60 days of non-payment – Defaulters will only be reconnected with pre-paid card based meters

GST refunds will be collected from the FBR and a mechanism will be built to avoid future build-ups.

The financial efficiency strategy is geared towards punishing private defaulters and proposes severing the electric connections of defaulters after 60 days of non-payment and only reconnecting them to the grid with pre-paid meters. External collection agencies may also be sourced to improve cash flows. At the same time, load-shedding may be focused on areas of high theft and low collections as opposed to the current structure of indiscriminate load-shedding.

The strategy also covers the independent audit of all financial transactions within the power sector. An independent firm will be used to audit these transactions and ensure the greatest degree of financial propriety within the power sector.

7.9 GOVERNANCE STRATEGY

The governance strategy will meet Goal (ix):

Align the ministries involved in the energy sector and improve governance.

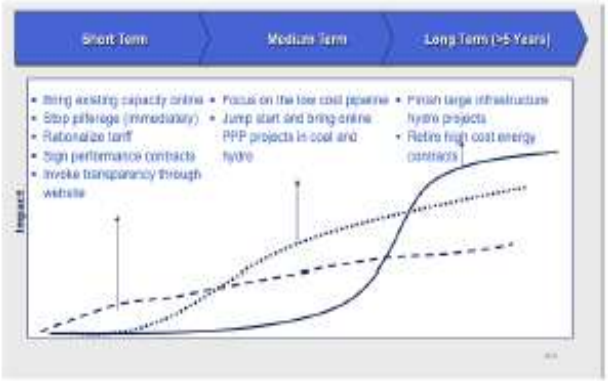
The governance strategy calls for the notification of an Official Coordination Committee comprising the Ministry of Water & Power, the Ministry of Petroleum, the Ministry of Finance, the Ministry of Planning and Development, a member from each province, and a representative from AJK and GB each This council will ensure information integration between all these ministries and will assist in policy formulation and decision making related to energy. The CCI will provide monitoring and oversight to the implementation of the National Power Policy.

The strategy requires the reformation of structural and regulatory aspects of NEPRA and OGRA to improve efficiencies. New business models including power exchanges and wheeling charges will be explored. NEPRA's reform will include a change in the establishment period for the base tariff from 8-10 months to 90 days; the aim of this reform will be to minimize the potential for circular debt accumulation.

Finally, the Ministry of Water and Power will be restructured to strengthen its functional expertise. Directorates will be created for key functions (i.e. generation, transmission, and distribution) and key organizations such as CPPA, PPIB, AEDB, and NTDC will be reformed.

The broad contours of the strategy are illustrated below:

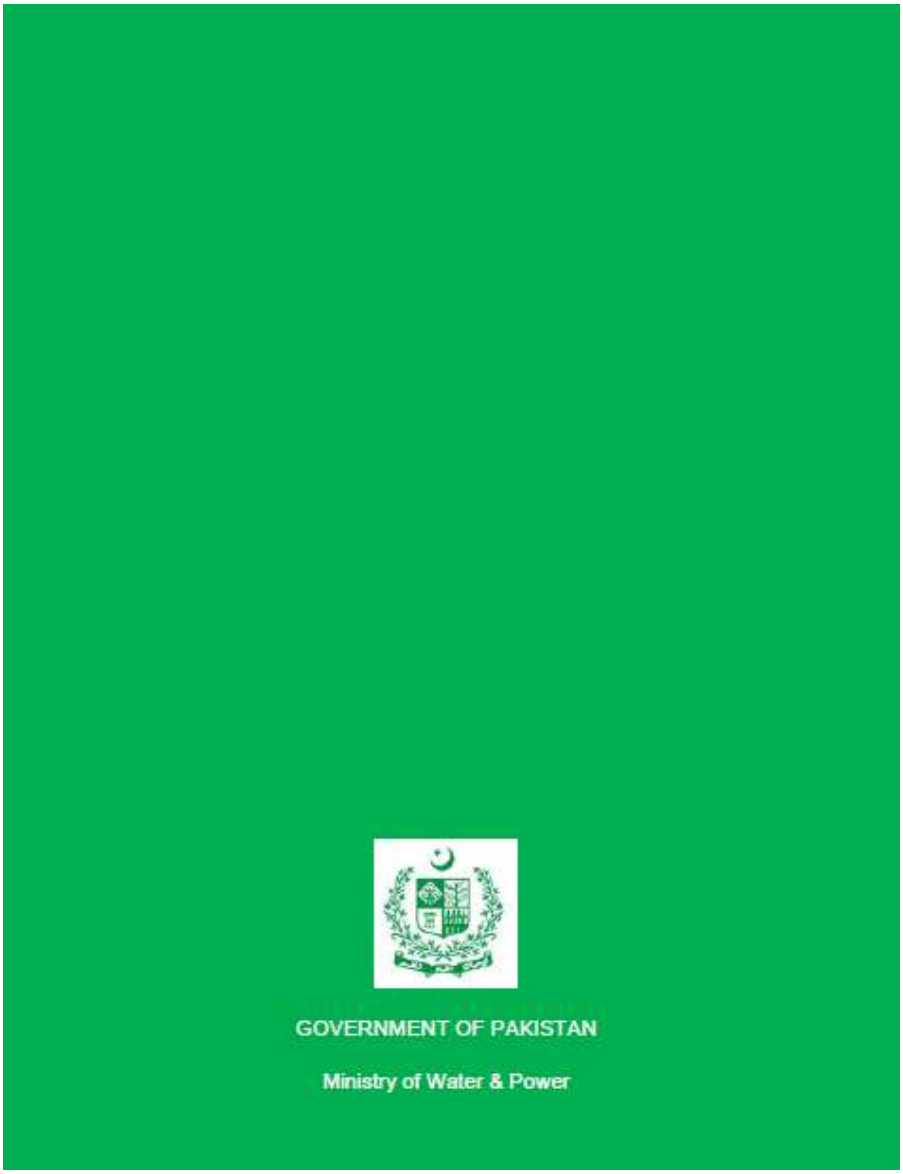
8. PRIORITIZATION



The strategy has been prioritized to maximize the impact of the various strategic initiatives. In the short term we will bring existing capacity online, stop thefts of all form, rationalize the tariff, sign performance contracts, and ensure transparency. In the medium term we will bring low-cost pipeline projects online, and jump start coal and hydro PPP projects. Finally, in the long term we will finish large infrastructure hydel projects and retire high cost energy contracts to ensure that Pakistan moves towards cheap electricity generation

9. IMPACT

The successful implementation of this policy will lead to enormous improvement within the power sector. By 2017, the supply-demand gap could be eradicated completely; and by the end of the five-year term of the current government the country will have a power surplus which can then be regionally traded. In essence, by the end of the decade Pakistan could be transformed from an energy strapped, importer of power to a regional exporter of power. The cost of power generation will be reduced to an affordable amount, and the efficiency improvements in transmission and distribution will decrease the burden of power to the end consumer. In summary, prosperity and social development will become a reality in a Roshan Pakistan.


GOVERNMENT OF PAKISTAN
Ministry of Water & Power

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[*] His paper is not included in this book as it has not been received.

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Index