PAKISTAN'S ENERGY RESOURCES AND POLICIES

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AND

POLICIES

with particular reference to present energy crisis & its solutions

By

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INTRODUCTION

1. In Pakistan first gas field was discovered in 1952 near Sui in Balochistan. Being a cheap source of energy it was used for power generation, industry and manufacture of urea fertilizer. An extensive gas distribution network was built and now 20% of households have access to piped gas.

For electric power generation, transmission and distribution, WAPDA, Water & Power Development Authority, was established in 1958. With the completion of Mangla & Tarbela dams plenty of cheap hydroelectric power became available. This was augmented by cheap thermal power generated by natural gas. Thus an energy mix of 70: 30 of hydro and thermal power was established. Availability of cheap gas and hydro power enabled the Pakistani economy a rapid economic growth. During General Musharraf's rule Pakistan was in a position to export 4,000 MW of electricity to India.

This prosperity did not last very long. After completion of Tarbela dam in 1974, the successive Governments, whether military or civilian, did not build a single dam to develop our water storage and hydroelectric resources. In this respect, our eternal enemy, India, bent upon undoing the creation of Pakistan, continues to spend billions of rupees to bribe traitors, in the ranks of Pakistani politicians, not to allow Pakistan Government to develop our water and hydroelectric resources. That is how construction of Kalabag & Akhori dams is being prevented. Extravagant and inefficient use of natural gas for power generation and CNG has created a severe shortage of gas. Gas reserves are depleting fast. Current production is 4.0 bcfd whereas demand is 6.0 bcfd. New discoveries are not keeping up with demand which is expected to rise to 8.0 bcfd in a few years. 80% of the population still has no access to piped gas and 30% have no access to electricity.

Meanwhile due to pressure of International Finance Institutions, World Bank, IMF & ADB, WAPDA was unbundled. WAPDA's role was restricted to development of water and hydel power resources and operation of hydel power stations.

New entities, PEPCO – Pakistan Electric Power Company, NTDC – National Transmission and Distribution Company and regional DISCOs – Distribution Companies (to be privatized soon) were created. Large WAPDA owned thermal power stations like KAPCO – 1638 MW were privatized. A new entity the IPPs (Independent Power Producers) were created during Peoples Party's regimes. They were granted high tariffs, maximum capacity charges backed by sovereign guarantees and 18% return on invested capital. The IPPs sole objectives are profit. Due to Circular Debt most of them are making hefty profits by not delivering a single Kwh to the National Grid. Circular Debt, due to steep rise in the price of furnace oil and currency devaluations has given birth to high tariffs and electric load shedding. The energy mix changed to 30: 70 hydro and thermal. Decrease in economic growth, due to energy crisis, has pushed Pakistan into an increasing DEBT TRAP. Load shedding is costing the economy about Rs.450 billions a year.

The following measures are necessary to bring the energy mix back to 70: 30 renewables and thermal and the tariff to an affordable level.

a. Timely Completion of Tarbela 4th extension- 1,410 MW, GOLAN GOL-106MW, Neelum-Jehlum 969 MW, Patirnd 147 MW and Gulpur (AJK) 100 MW by the end of PML(N) tenure in 2018. Expedite construction of 4,320 MW Dasu Hydro, Karot 720 MW, Suki Kinari 870 MW, Kohala Hydro-1100 MW and Tarbela Fifth Extension-1,410 MW. These projects total- 11,152 MW.

b. Diamir Bhasha- 4,500 MW work is expected to start by end of 2016. Due to uncertainty of finances it may take a long time- about 10 years. But Pakistan must pursue vigorously China's Three Gorges offer of $ 50 billion for development of upper Indus basin cascade consisting of- Diamir Bhasha 4,500 MW, Bunji 7,100 MW, Thakot 4,000 MW, Pattan 2,300 Mw, Munda Dam 740 MW. Three Gorges Corporation offer of $ 50 billion

is in addition to China's $45.6 billion financing under CPEC. China's expertise in building dams is unmatched. Currently Chinese companies and banks are involved in 330 dams in 74 different countries.

c. Kalabagh & Akhori Dams In order to save southern Punjab and Sindh from annual damage due to floods (costing billions of dollars) and generate power from Tarbela (our biggest power station 6,298 MW after completion of 5th extension), in response to DEMAND, instead of power generation as a by-product, when water is released by IRSA for irrigation. While Bhasha and Dasu are going to take 10 to 12 years, KalaBagh storage capacity can be completed in 18 to 20 months with the help of modern machinery. Same applies to AKhori. If nothing else their completion is essential for preventing annual flood damage to agriculture and combat climate change.

2. Coal Power Projects

Timely completion of the following coal fired projects: - Sahiwal 1,320 MW, Pind Dadan Khan 300 MW, Bin Qasim Al-Mirqab 1,320 MW, Siddiqson Energy 350 MW, Port Qasim F.F.C Bin Qasim 118 MW, Jamshoro 1,320 MW, Sindh Engropower 660 MW, Sino Sindh with Shanghai Electric 1,400 MW, K.Electric 700 MW at Port Qasim, HUBCO 1,320 MW, Gwadar 300 MW, Yunous Brothers (Lucky Cement) 600 MW. At least the 2X1, 320= 2,640 MW projects at Sahiwal and Al-Mirqab at Port Qasim are likely to be completed by end 2017.

3. Wind, Solar and Bagasse Power Projects

3.1 The Wind Corridor in Sindh alone has 50,000 MW potential. A lot of Wind power projects are in the pipeline. In addition to the 255.4 MW in operation 1,396 MW will be completed by 2017 in Sindh. In Punjab 4X250 MW wind projects by VESTAS company of Denmark are being setup in RAJANPUR district at a cost of $ 2 Billion.

3.2 Solar Energy 1,000 MW are being installed at Quaid-e-Azam Solar Park in Cholistan- Completion early 2017. A lot of private sector projects, in the pipeline are awaiting tariff notification. A 100 MW P.V. Solar in operation has 17 to 18 MW average availability. Ideally we should go for SOLAR Thermal projects which have 8 hours storage capacity after sunshine.

3.3 Bagasse energy at Sugar Mills There is a potential of 4,000 MW at sugar Mills in Sindh and Punjab. Potential is being realized but at a slow pace. Sugar Mills should be allowed to use coal, in the off crushing season, to enable to generate power throughout the year to make it more profitable and attractive to sugar mill owners.

4. Natural Gas. With local production of natural gas static at 4 billion cfd we have to import 4 billion cfd to meet total demand of 8 billion cfd. 4 Billion cfd will be met by 1.25 Billion cfd from TAPI, 0.75 Billion cfd from IP and 2 Billion cfd through import of LNG. This can only be possible by rapid installation of LNG handling facilities at Port Qasim and Gwadar of 2 Billion cfd Natural Gas, completion of Gwadar-Nawab Shah Pipe line, Gwadar to Iran80 km pipeline for IP project and the 1,100 Km dedicated Karachi-Lahore Pipeline. Only then we can meet demand of the 3,600 MW and 1,000 MW RLNG Power Plants, fertilizers factories and the industry.

5. Ensure efficient power generation achieving 60% thermal efficiency.

This can be achieved by rehabilitation of existing GENCO plants, owned by PEPCO, and private sector plants. An additional 2,500 MW can be generated through Rehabilitation.

6. Solar Thermal Energy its capital cost is much higher than P.V. Solar technology, but it can provide up to 8 hours of energy storage and has much higher availability. P.V. Solar energy is not suitable for large scale grid connected systems. Maximum availability is only 18 MW of 100 MW capacity plant. P.V is suitable for residential and small scale projects as proven in India.

7. Conversion of Existing RFO/Diesel fired plants to Coal/Solar Thermal

Instead of wasting scarce financial resources on conversion to coal, as detailed in my chapter on coal, the plants, that are not combined cycle, should be converted to SOLAR THERMAL instead of coal. We don't have the railway infrastructure to transport imported coal to far-off RFO/ Diesel Power stations.

8. Reduce transmission and distribution loses- Costing RS 100 Billion a year

9. Stop theft of Electricity and Gas. Loss due to electricity theft alone is costing RS 90 Billion a year. Create an independent department to deal with electricity and gas theft and non-payment of bills. It is not the job of police and local civil administration to deal with this very important matter.

10. Energy Conservation Bring in energy conservation measures specially replacement by Energy savers of the bulbs and tube lights by duty free import of A-Plus Quality LED lights from China. It can save us 3,000 MW. LED light saves 16 Watts compare to energy savers.

11. 18th Amendment There are the dangers of 18th amendment about energy resources tearing the nation apart. All natural resources should be shared by the nation equitably and at uniform prices.

12. Merger of the ministries of water and power and petroleum resources

The two ministries should be merged into a single ministry- energy ministry. *AN ENERGY CZAR RESPONSIBLE FOR LEADING ALL ENERGY SECTORS HAS TO BE APPOINTED. HE MUST HAVE A CLEAR ROAD MAP WHICH SHOULD BE APPROVED BY THE CABINET AND IMPLEMENTED.*

13. Climate Change

Early completion of KALABAGH, AKHORI, DIAMIR BHASHA and MUNDA Dam to protect against floods due to climate change and rapid melting of glaciers.

14. Local Oil and Gas Production Pakistan currently imports oil products of 19.63 million tons including 6.6 million tons furnace oil, 2.6 million tons diesel, 2.3 million tons Petrol , Jet fuel and 8 million tons of crude oil. At $ 100 per Barrel prices import bill used to be $ 15 billion. Recent discoveries in KPK, Sindh and Punjab have increased local crude production to 100,000 Barrels per day (3.85 million tons) meeting only 20 – 22 % of Pakistan's demand. But we need to do much more to expedite local production of oil and gas. Discoveries in KPK in oil and gas in TAL Block are very encouraging. If exploited to full KPK gas discoveries would be equal to Sui discoveries of 1952. We need to establish additional Refining Capacity to end our dependence on import of furnace oil, diesel, petrol and jet fuel. We need to invest billions in oil and gas exploration. Self sufficiency in energy is the major factor in increasing the standard of living of the common man.

The above projects are going to take at least 4 - 5 years to materialize. We must be patient and manage to live with the gas and electric load shedding by load management and energy conservation so that the industry and essential services are not harmed.

ENERGY RESOURCES AND BOTTLENECKS TO THEIR DEVELOPMENT

2.1: Energy

Primary Thermal Resources are OIL, GAS, COAL and NUCLEAR. Energy conservation is called the FIFTH FUEL-saving 20%. Renewable energy resources in Pakistani context are HYDROELECTRIC, SOLAR-THERMAL, SOLAR-PHOTOVOLTAIC, WIND, BIOMASS and GEO THERMAL.

Resources shortcomings

We have very serious shortcomings in all the resources. This is gulping more than 50% of our export earnings. If we add the import bill for cooking oil $ 2 Billion and fertiliser DAP and Urea it leaves very little for import of capital goods and services for the economic development of Pakistan.

Oil

We require 450,000 barrels of oil per day whereas our domestic production has recently got back to 100,000 barrels per day from 67,000 per day. We have very low oil reserves and work on finding new reserves is at standstill due to the law and order situation in areas where reserves are located.

Present Crude Oil Imports Per Year- 19.63 million tons of OIL PRODUCTS which include 8 million tons of Crude. Local crude production 100,000 Barrels per day is only 3.85 million tons.

Saudi-$ 7.5 billion, Kuwait $ 2.5 billion.

Approximately $ 4 billion of finished products of diesel and petrol.

Total imports $ 14 to 16 billion per annum at $ 100 per Barrel prices.

Gas

Pakistan has a highly developed gas distribution network. Gas reserves are dwindling very fast. In eight years reserves will be exhausted if new reserves are not found. Current gas production has dropped to 4.0 bcfd whereas demand is 6.0 bcfd. Current gas reserves only 26.65 tcf. New discoveries of gas are nullified by depletion of existing gas fields. Local gas production is remaining static at 4.0 billion cfd.

Work on the Iran-Pakistan Gas pipeline is held up due to U.S sanctions fear.

Work on the onshore infrastructures for importing of LNG has started.

Due to non-availability of natural gas to Urea fertilizer plants we are having to import urea fertilizer.

The price of urea to farmers has tripled in spite of government subsidies. In better times we were completely self-sufficient in urea and were able to export during some years.

At present 27% of our electricity is being produced on Gas. As gas supplies dwindle these power stations will have to shift to imported oil. This will put more pressure on our meager foreign exchange resources. We are now having to import NLG going up to 2.0 Billion cfd, whereas our plans to import gas from TAPI and IP pipelines- 1.25 + 0.75 Billion cfd respectively are in progress. Once the LNG, TAPI and IP projects are completed than only we shall be able to meet the total domestic demand of 8.0 billion cfd.

Coal

Pakistan possesses world's sixth largest coal reserves estimated at 185 billion tons. Yet only 0.14% of electricity is being produced from coal.

Over 15 years there has been only TALK and TALK on utilising vast resource. Thar coal reserves were discovered in 1992. Proper exploitation of coal resources would make us self sufficient in all forms of energy for centuries to come.

Only hope of help is from China which has materialized as part of CPEC. Mining operations started on two Blocks and projects for onsite generation of 660 MW and 1400 mw are in progress at Thar coal fields.

New coal technologies are clean and not injurious to the environment.

Nuclear

Pakistan is the Seventh country in the world which possesses complete nuclear technology from mining to fuel fabrication. France is producing 78% of its energy from nuclear power at 2.54 cents/ unit. Nuclear power is free of pollution. Pakistan has so far only three Nuclear power plants i.e. KANUPP 125MW at Karachi- a PHWR, due to be de-commissioned in 2019 (supplied by Canada) and at CHASHMA two plants (PLWR type) of 325 Megawatt each supplied by China. Chashnupp-3 and 4 of 340MW each are under construction. Chashma nuclear power plant-1,000MW is a proposed project. It is a great pity we have not been able to exploit nuclear energy in spite of having our own trained human resources and vendor industry capable of supplying the hardware. Fortunate for us China National Nuclear Corporation has signed an agreement in October, 2013 for construction of 2 x 1100 MW plants to be located in Karachi.

2.2: RENEWABLE ENERGY

Pakistan is blessed with enormous renewable energy resources.

2.2.1: HYDROELECTRIC

Until the large scale induction of thermal power plants, hydroelectric power contributed 70% to the total energy mix- a cheap and environmentally friendly source. As per IAEA 1976 Nuclear power planning study, Pakistan has a 50,000 MW hydroelectric potential on the Indus River alone. Pakistan's total hydro power potential is 60,000 – 120,000 MW. Very little of this potential (currently 6,720MW) has been achieved. After Tarbela no new dams were built resulting into change of hydro/thermal mix to 30:70. This has resulted into steep

rise in the cost of electricity to domestic, industrial and agricultural consumers. The poor Pakistani people are now having to pay a tariff higher than the U.K. while the average household income in the U.K. is £26,000=Rs 3,900,000 per annum and that of Pakistani household Rs 120,000 per annum. UK tariff is Rs 30 per unit whereas Pakistan is Rs 14 per unit.

For Pakistanis an affordable tariff should be not more than Rs 5.00 per unit (inclusive of all taxes). To prove this point here is a cost analysis of the per unit cost during August 2013, wherein hydel share was 40.75%. Average cost per unit during August 2013 was Rs.7.0. If hydel share was raised back to 60% average cost per unit would drop to Rs.4.3 per unit.

List of operational hydro power stations is in section 4.8.1.

2.2.2: AUGUST 2013 POWER GENERATION DATA

MAXIMUM HYDEL GENERATION DURING AUGUST 2013
% SHARE OF TOTAL

		Cost/unit	**Total Price**
Hydel	40.75	1.39	56.642
Furnace Oil	33.55	15.28	512.644
Gas	18.92	4.96	93.843
Nuclear	4.42	1.32	5.834
H.S.D	1.43	21.15	30.244
Wind	0.36	3.61	1.299
Coal	0.14	3.61	0.505
Totals	99.57		701.013

Average cost per unit during August 2013 is = Rs.7.040

IF HYDEL POWER SHARE WAS 60% AND FURNACE OIL SHARE WAS REDUCED TO 13.55%

THE COST PER UNIT WOULD BE ABOUT RS.4.3 PER UNIT.

Alas the PPP Government during its 5 years had concentrated on building hydel power stations instead of paying trillions of rupees subsidy indiscriminately, we would have been able to generate electric power at Rs.4 per unit.

LATEST GENERATION COSTS PER UNIT JAN 2014

FUEL	RS	
Hydel	2.5	
Natural Gas	5.0 at present at price of locally produced gas	
Thermal RFO	14 to 18	Based on $ 100 per barrel Prices
Diesel	23 to 28	
Nuclear	7 – for the present KANUPP & Chashnupp-I, II, III & IV RS 4. Per unit	
	P.S. K-2 & K-3 RS 9.59/unit-upfront tariff	
Wind	14-now reduced to Rs 10.6 per unit	For year 2016 & onwards
Solar (P.V)	19-now reduced to 9.25 Cents per unit	
Bagasse	10.5	
Coal-Local	8.75 Cents-upfront tariff	
Coal-imported	7 Cents-upfront tariff	

P.S. Fuel Cost for 1,000 MW-Thermal plant running on RFO is $ 1.0 Billion per annum

2.2.3: SOLAR-P.V. (Photovoltaic)

The P.V. cells catch 8 to 10% of solar energy. With large scale production of solar cells the price of this technology has become economic- an unsubsidised rate of Rs 7 per unit. The current desperate

load shedding is 15 to 20 hours. The government will take at least 5 years to bridge the gap. P.V-solar installation can be completed in 1 to 2 year's time. Snag- Its energy, without storage, is available only during sunshine hours.

2.2.4: SOLAR THERMAL

Unlike the P.V. technology the solar thermal technology captures most of the sun's energy falling on its surface area. This energy, generally, heats a non-oxidising oil / water which are used to generate steam which generates electricity with conventional technology. Unlike the P.V. technology its energy can be stored up to 8 hours to generate electricity even when there is no sunshine. In the U.S. a 400MW plant has been operating with solar thermal technology. In Spain large capacity plants are operating. Solar thermal technology power plants can also be set up quickly compared with conventional power plants. Erection and operation can be achieved in two years.

2.2.5: WIND ENERGY

Wind is an important source of energy. There are about 200,000 Wind Turbines operating in the World. 75,000 MW in China, 60,000 MW in USA, 31,000 in Germany, 19,000 in India. Denmark meets 28% of its energy from wind power. There is a wind energy potential greater than 50,000 MW. Wind energy regimes exist in the Coastal belts of Sindh and Balochistan provinces. The technology is well proven, being used in California, Germany, U.K, China, India and the Scandanavian countries-Denmark, Norway. Wind energy plants are being installed by local companies, Chinese and Turkish companies in the Sindh province. Like solar technologies wind energy projects can be installed and operated very quickly in a year/two year's time. G.O. Punjab is setting up 4 x 250 MW project at a cost of $ 2.0 Billion in Rajanpur District.

In order to bridge the load shedding gap quickly this is also a suitable technology.

2.2.6: BIOMASS ENERGY

BAGASSE AND COTTON STICKS

In this area nature has blessed Pakistan with a tremendous resource in the form of 12 million tons of sugar cane bagasse and 22 million tons cotton sticks. This has a potential of producing 3,000 MW of electricity. The 12 million tons of bagasse can be doubled if the sugar cane tops and the cane waste, left in the fields, are also harvested. This is being practised in India, who is miles ahead of us in this technology. The cane trash with tops is being collected by many countries like Hawaii, Cost-Arica, Dominican Republic, the Philippines and Thailand. This enables sugar mills to produce electricity throughout the year. By growing special varieties which produce more bagasse we can maximize electric production. If bagasse or cotton sticks are co-fired with coal using air staging/fuel staging it reduces oxides of nitrogen, sulphur and carbon yielding clean energy. Co-firing bagasse/cotton sticks with COAL will generate energy throughout the year instead of a season of 4-5 months.

Based on Indian data, sugar mills producing electricity, in the season, are making more money selling electricity to the national grid than making sugar. Fortunately this 4-5 months seasonal electricity comes during the period November-April when hydroelectric production from Mangla and Tarbela goes down due to lack of stored water during winter months.

Producing electricity from bagasse will involve the installation of high pressure boilers and more efficient steam turbines. Retrofitting sugar mills will take at least two years.

Again power from bagasse like wind and solar power can be achieved in two years, so that the public could get an early relief from load shedding.

2.2.7: ETHANOL FROM SUGAR CANE

Pakistan is the fifth largest producer of sugar cane producing 50 million tons of sugar cane and 12 million tons of bagasse.

In the sugar making process 3 million tons of molasses are produced. Some of it is converted into ethanol earning $292 million in export every year. The rest is exported as molasses to western countries.

All of the 3 million tons of molasses should be converted into ethanol and 10% of it blended into petrol to make E-10. A 10% blend into petrol does not need any engine modification. This would provide us with led free petrol. This would save us more than $500 million in imports. This blend has been mandatory in India by law decades ago.

We can also produce ethanol from sorghum and maize crops and directly from sugarcane.

Ethanol is a gift of a renewable energy from God Almighty.

2.3: NEW ENERGY TECHNOLOGIES

After the seventies energy shock the industrialised world started huge research programmes to replace oil energy. Largest programmes were undertaken in the U.S.A spending billions of dollars. Japan undertook SUNSHINE energy programme. The European community launched its own joint energy programme.

By the year 1989 they had come through research, demonstration and commercially viable energy projects. Most of these technologies were from renewable but also new electric power technologies like more efficient gas turbines achieving 48% thermal efficiency-clean coal technologies like circulating fluidised bed combustion FBC -Integrated Gasification and combined cycle-IGCC.

In 1989 most of the renewable technologies were commercially viable if the price of oil went above $18 per barrel.

Now with the price of oil above $100 per barrel all those proven technologies are now viable.

Pakistan need not waste time and resources on research and development. We can take advantage of the proven technologies from

the USA, European community and Japan and adapt these to our own conditions and circumstances.

2.4: ACTION PROGRAMME

Unless Pakistan curtails its energy imports bill through conservation, proper management and optimum exploitation of its indigenous energy resources, coal, hydel and renewables, it would remain mired in ENERGY CRISIS and ever increasing DEBT TRAP.

We have wasted four decades-40 years-doing nothing about our energy requirements. In order to catch up with lost time we have to make a quantum jump like China and the whole nation has to put its heart and soul into becoming self-sufficient in energy, if we want to remain a sovereign nation. Due to energy deficiency, and gas and electricity load shedding we have destroyed our industry and agriculture and fabric of our society.

2.5: THE BOTTLENECKS TO ENERGY DEVELOPMENT.

2.5.1: LAW AND ORDER AND SPEEDY JUSTICE

In order to bridge the energy gap we are going to need lots and lots of foreign investments. Many engineers and technicians will have to come to Pakistan to work at the sites. With the present situation of law and order no one will invest or come to Pakistan to work-not even our friend China. We must stamp out this terrorism and disorder with iron hands. Our armed forces must join hands with the civil authorities. Otherwise no one will come to our rescue and we will approach fast into a failed state of anarchy. GOP has tackled the security problems for CPEC projects by raising 9 battalions of army and 6 battalions of CAF (Civil Arm Forces). Same type of security should be supplied to oil and gas exploration companies if we aim to attain self sufficiency in oil and gas.

We will now come to specific details, with solutions, in respect of all areas of energy technologies in the following chapters.

2.5.2: PAYMENT OF ROYALTIES TO PROVINCES FOR NATURAL RESOURCES

All natural resources belong to the whole nation. It was in the 1973 constitution that Mr Z. A. Bhutto imposed the curse of payment of royalties for natural resources to the provinces, found in the respective provinces, to please anti-federation political parties. It had only caused bad blood between the federal government and the provinces and given vent to provincial rivalries and provincialism. It has led to huge delays in exploiting natural resources, otherwise THAR COAL would have been exploited 15 years ago. The KPK has constantly opposed the construction of Kalabagh dam because of its location in the Punjab and that its royalty would not be paid to KPK. Otherwise the main beneficiary of Kalabagh dam would be KPK because of irrigation facilities to 800,000 acres in Bannu and D.I. Khan regions. The Kalabagh water for KPK would have made a food deficient province into a self-sufficient province. Due to storage at Kalabagh, without releasing it down stream, it would result into optimum use of Tarbela, Diamir Bhasha, Dasu, Pattan and Thakot of 19, 208 MW capacity.

With the present policy of paying royalties to provinces KPK would be the only beneficiary of all power produced, except for 50% share of Gilgit Baltistan, for 4,500 MW of Diamir Bhasha. Bill paying population of Pakistan bears the Brunt of these royalty payments.

Instead of paying royalties to provinces, if we were to follow the Islamic system it would bring great prosperity and Rehmat of Allah S.W.T.

According to the Holy Quran all resources grown on land or extracted from underground have a 10% Zakat due which is Haq Allah S.W.T. The only Muslim country which has followed Allah S.W.T's order is Malaysia, due to which there is great prosperity in that country.

The right thing to do is to Levy 10% Zakat on mineral, gas and oil resources. First right on this Zakat is that of the local people, in whose area this resource is found and NOT the province. Whatever is the balance should be deposited into Bait-ul-mal and by giving to the

deserving, as prescribed in the Holy Quran, we can wipe out poverty from our society and bring prosperity to the whole nation.

There is absolutely no justification for paying royalties to provinces for power generation by hydel resource. Water is a gift of God Almighty and the whole nation is entitled to its benefits equally.

2.5.3: 18th Amendment of the constitution regarding first right to natural resources to the province where the resources are found.

The recent 18th amendment of the constitution, passed during last PPP regime, is much worse than the earlier-right of royalties to the province. This negates the very concept of a united nation. Provinces might as well become independent sovereign states. This is most impractical. Majority of the nation's population, 65%, lives in the Punjab. Major Gas resources are in Sindh, Balochistan and KPK. Hydroelectric resources are in KPK. If the 18th Amendment, as per the law, is followed there would be no gas and electricity load shedding in KPK, Sindh and Balochistan, whereas the brunt of gas and electric load shedding would be borne by the 65% bills paying population of the country living in the Punjab. How unfair and unjust to a province which produces all the wheat, cotton and other crops to sustain the economy of the country. During the winter months even the domestic consumers of Punjab are denied gas. This is inhuman and most unfair. This is creating feelings of animosity.

Until this section of the 18th Amendment is abolished, the economy and the Federation cannot sustain itself. All the natural resources, in whichever province are found, should be shared fairly, equitably and justly. This is indeed a very bad and dangerous legislation designed to tear the nation and country apart. I am surprised how PML (N) became a signatory to such a conspiracy against Pakistan. Example – the recent Government decision to deny CNG for vehicles in Punjab during November, December & January whereas Balochistan, Sindh and KPK will be exempt because they produce natural gas more than their requirement. At present there is no gas load shedding in KPK, Balochistan and Sindh for industry, domestic and CNG.

With no load shedding for industries in KPK and Balochistan, they can produce power at Rs. 6/- per unit through self generation. Whereas, the industry, in Punjab receive gas for 8–10 hours daily. The power tariff has increased from Rs.9.25 per unit to Rs.14.84 per unit – an average increase of 63%. Using grid power, instead of self generation, the industries in Punjab will have to pay an extra Rs.100 billion in power tariff hike. This does not afford A LEVEL PLAYING FIELD TO THE PUNJAB INDUSTRIES. WITHOUT ENDING THIS DISCREMINATION IT WILL CRIPPLE PUNJAB INDUSTRIES – THE MAJOR EXPORTER AND EMPLOYER OF THE COUNTRY. The 18th Amendment will only cause BAD BLOOD amongst the provinces and cripple our exports and the economy. If we want to develop the economy and bring prosperity to the common man this Amendment must be removed from the Constitution of Pakistan.

ACTION PLAN TO DEFEAT GAS AND ELECTRICITY LOAD SHEDDING

3.1: ESSENTIAL DATA ABOUT ENERGY:

Before coming to the subject we would like to enumerate some facts and figures as per year 2012 about the energy situation to assist the reader in getting down to the real reasons and how to overcome the energy crisis:

- Total electric generation required by 2025 would be 49,078MW if GDP grows 7.5%PA.
- Present Installed capacity for power generation-22,297MW.
- Maximum demand during summer 2012-18,713MW.
- Maximum power generated by the system-15,000MW.
- Installed hydroelectric capacity-6,720MW.
- Total hydel potential - 59,796 MW .
- Total hydel potential KPK and GB - 45,861 MW - 76% of Pakistan's total hydel potential.
- Seasonal variation in hydroelectric generating capacity- 6720 MW down to 2414MW.
- Pakistan's energy % mix Gas-27, Oil-41, Coal-0.14, Hydro+Nuclear-32.
- Worldwide % use of coal. Primary energy-26, Electricity- 40.
- Coal meeting total energy requirements : China-78%, USA-60%.
- Pakistan growth in electricity demand every year- 8% = 2,000MW if GDP grows 7.5% /year.
- Investment required to add 2,000MW/year- U.S. $4.0 Billion.
- Cost of production of electricity with furnace oil-Rs 16.5/unit.
- Existing electricity tariff- Rs 9.50/unit before the current increase comes into force.
- Current cost of hydel power is Rs.1.39/unit.
- Cost of hydel power from Kalabagh dam if it had been completed by 2013 – Rs.1.54/unit.
- Pakistan's total coal deposits- 185 billion tons-Sixth largest coal rich country.

- % Use of coal for power production: China 78, India-69, USA-49, U.K. 44, Pakistan 0.14.
- Local production of oil 100,000 barrels/day. Oil reserves 300 million barrels. Oil production expected to rise to 130,000 barrels/ day in 1 to 2 years time.
- Total oil requirement 450,000 barrels/day – consuming 60 – 65% of Pakistan's export earnings - $16 billion.
- Gas reserves: 24 tcf.
- Current gas production: staying at 4.0 bcfd inspite of new discoveries due to depletion of existing gas fields.
- Current gas demand: 6.0 bcfd increasing to 8.0 bcfd in coming years .
- OGDC will add in 2014

  Oil 45,000 barrels/day. OGDC and other companies planning to drill 110 exploration & production wells for gas and oil during 2014.
  Gas 339 mmcfd.
  LPG 780 tons/day.
  Government planning to drill 400 wells in next 4 years.

- Shale gas reserves 105 TCF Shale oil 9 billion barrels. US AID study on shale reserves will take 5 years to complete. First 3 discoveries and production of shale gas to get $ 12 mm Btu.
- Tight gas reserves have been discovered. 20 MMCFD is being produced from Balochistan. In Sindh, tight gas has being produced.

3.2: ELECTRIC LOAD SHEDDING, HUB POWER COMPANY GROWTH PLAN AND CIRCULAR DEBT

The present situation of 18-20hours load shedding is not going to be solved simply by paying circular debt, preventing electricity theft, collecting unpaid bills and installation of pre-paid meters. We do not just want the load shedding to vanish but most important-an affordable tariff for the 85% low income population-at a level of Rs 5/unit. This would be only possible by correcting the energy mix and exploitation of indigenous resources-HYDEL, COAL, SOLAR, WIND and BIOMASS.

As long as the energy mix was 70% hydel and 30% thermal (mainly indigenous natural gas) the tariff was affordable for the masses and there was very little theft. The moment thermal generation started to shift to imported oil with rise in price of oil and devaluation of the Rupee the cost of production rose to Rs 18/unit. The hydro power was cheap. The most recent GHAZI BAROTHA price was Rs 1.50/ unit whereas Tarbela and Mangla cost was in Paisa's/unit. The present average cost of hydel power is Rs.1.39/unit.

AVAILING HUB POWER COMPANY GROWTH PLAN

The HUB power company has been engaged in power generation for several years and has proven to be a reliable supplier of electric power. Instead of running around with a begging bowl from various countries and international financial institutions it would be prudent to avail the HUB POWER COMPANIES growth plan given as follows

1,320 MW-coal based on imported coal

2,400 MW- LNG based combined cycle

1,200 MW mine mouth power in THAR coal fields

700 MW at ASHKOT – NEELUM VALLEY AJK

1,000 MW- solar and wind projects

Total 6,620 MW

Circular debt causes non-production of power from IPP's and GENCOS which constitute 7,070 and 4,811 MW of total generating capacity of about 22,000MW. If their bills are not paid they cannot buy fuel and hence cannot generate power. And if this happens during the winter months hydel power can contribute only 2414 MW, it increases the supply gap because of lower generating capacity. This is how the country has been experiencing massive load shedding. NON PAYMENT OF IPP BILLS CAUSES DOUBLE DAMAGE TO THE NATION – WE FACE LOAD SHEDDING BUT STILL THEIR CAPACITY CHARGES HAVE TO BE PAID.

The new government of Nawaz Sharif has paid the circular debt and another 1,800MW capacity has been added to give relief to the public. Most of the Rs.500 billion, paid to the IPPs, was capacity charges without getting any electric power. IPP bills were paid without any audit. In the last 3 months the circular debt has again gone up to Rs.157 billion. But CIRCULAR DEBT will continue to reappear UNLESS:

- Difference between cost of production and tariff is eliminated.
- Technical and managerial inefficiency of government, generating and distribution companies-GENCOS and DISCOS, overstaffing, free electricity to all employees of DISCOS and WAPDA, poor maintenance, obsolete technologies, mismanagement and corruption, all add up to the cost of electricity- have to be eliminated.
- NTDC to allow power wheeling at specified rates.
- Difference between cost of power delivered from each feeder and actual amount realised from the bills be eliminated.
- Theft and line losses- 40% specially in DISCOS of Hyderabad, Peshawar, Sukhur, Quetta and FATA are controlled.

  As detailed in a separate section –A separate authority be established to control THEFT OF GAS AND ELECTRICITY. It should not be left to police and local administration. It is not their job.
- Poor bill collection from federal and provincial governments. Provision of deduction at source from NFC awards is ensured.
- Non-payment by well-connected individuals and parliamentarians is recovered.
- Divert generation only to those IPPs, who can produce power at 60% thermal efficiency instead of GENCOS and inefficient IPPs.
- Repair and retrofitting GENCOS to produce efficiently should be undertaken. Present generating capacity only 1800 MW against installed capacity of 4811 MW. Thermal efficiency of 60% must be achieved.
- Electricity conservation be undertaken

The above measures will only buy us time and these are not going to give us SUSTAINABLE supply to end load shedding and an affordable energy price.

3.3: MEASURES REQUIRED FOR SUSTAINABLE SUPPLIES AND AFFORDABLE PRICE

- CURTAILMENT OF ENERGY IMPORT BILL, through optimum exploitation of INDIGENOUS resources- Hydel, coal, wind, solar and biomass. Only then we will come out of ever-increasing DEBT TRAP.
- Massive government investment in Hydel power and coal- possible only if China's Three Gorges Corporation offers of $ 50 Billion is implemented.
- Help in capital formation, to private sector to invest in Bagasse power, solar and wind energy.
- Combination of enormous tax collection effort and major restructuring of public sector development programme. It will require some low priority projects to be abandoned.
- Suspend supply of locally produced gas to CNG stations and allocate for power generation and fertiliser manufacture. However, import bill for diesel and petrol will increase by USD 1.4 billion per month during December to January. CNG industry's investment Rs.450 billion – requires 690 mmcfd gas. There should be no objection to their using imported LNG. Use of CNG in urban areas is essential to reduce air pollution.
- Equitable supply of gas and electricity to provinces at uniform prices.
- Legislation to make provinces pay for the electricity and gas supplied to distributing companies in their province, otherwise deduction at source from their NFC award.
- K. Electric gets cheap power from NTDC instead of using their own power plants. Supply of 650MW at subsidised rate to K.E from NTDC be stopped. Why should the rest of Pakistan subsidise richer Karachiites.
- Conversion of gas and oil consuming IPPs and GENCOS to synthetic gas from coal or solar thermal. Conversion to coal

concept is not feasible because we do not have the road or rail infrastructure to move million of tons of coal from Karachi port and Southern coal fields to Muzaffargarh and other stations.

- Stop supply of gas to captive power plants at subsidised rates. Most of the CPPs are inefficient. They should use DISCO's supply. It is mostly the textile industry who think the entire country owes a living to them and that Pakistan came into existence for them only. Gas supply to CPPs should be subject to achieving 60% thermal efficiency.
- Introduce serious demand management strategy-DSM.
- Import of 1000 MW each from Iran, Tajikistan and Turkmenistan. Iran willing to increase supply to 3,000 MW.
- Chinese offer for supply of 3,200 MW.
- MOST IMPORTANT- PAKISTAN ELECTRIC GRID SHOULD BE CONNECTED WITH CHINA'S GRID
- CASA 1000 – World Bank sponsored energy from Central Asian countries. Also an extra 1200 MW from Tajikistan through Rogun-Khorog-Wakhan-Baroghil Pass – Chitral.
- Import of electricity from India only if there is national consensus
- Timely use of US-AID to produce 1200MW by 2014
- Pakistan's industrial sector is using energy wastefully- for each dollar of GDP we use 15% more energy than India. Major gains can be realised from energy efficiency-savings of 25% are possible.
- An ADB report says-Pakistan's energy imports up until 2009 were at US $10 Billion. Requirement by 2016 will jump to US $38 Billion whereas exports will only grow to US $26 Billion. Assumption Crude prices at $ 100 per Barrel.

It is obvious we have to shift to indigenous resources. We have 185 billion tons of coal reserves, 60,000 MW potential for hydel power, 50,000 MW potential of wind power and endless MWs of solar energy.

Our coal usage at present is 0.14% and hydro usage is only 14% of potential. We are only beginning to use our vast WIND and SOLAR energy resources.

ENERGY GENERATION MUST SHIFT FROM IMPORTED ENERGY TO LOCAL ENERGY RESOURCES.

- SOLAR ENERGY For short term generation SOLAR is the best option with shorter gestation period and does not need any additional infrastructure as electricity generated can be plugged straight into 11 KV distribution lines-easily more in step with demand. Demand is maximum during day and PV solar system is at its MAXIMUM when the sun is shining. Solar farms can be put up near load demand centres.
- WIND ENERGY A number of local, Chinese and Turkish companies have set up wind turbine projects. This sector will grow very fast. Government should provide maximum facilities to small investors.
- Improve the fuel efficiency of GENCOS (power stations in public sector) and IPPs AND BRING DOWN THEIR COST OF GENERATION BY INSISTING ON 60% THERMAL EFFICIENCY.

GENCOS have a total installed capacity of 4,811 MW. Most of these power stations have very poor fuel efficiency as low as 30%. Whereas more efficient gas turbines achieve 48% efficiency and if operated in combined cycle mode i.e. gas turbine coupled with steam turbines very high fuel efficiency of 60% can be achieved. Our IPPs and GENCOS are consuming 40% more furnace oil compared with plants around the world.

Thus up-gradation would add an additional capacity of 2,500MW. GENCOS are a valuable asset and rather than invest on new generating capacity, taking 3 to 4 years, it would be prudent to upgrade these in 1 to 2 years.

The fuel efficiency would be improved and increase the capacity from existing 4,811MW to 7,311MW. Ideally these should be operated on local gas/imported LNG.

- LACK OF LEADERSHIP in the energy sector during the last decade is the major cause of the energy crisis. MOST POSTS IN MINISTRY OF Water & POWER ARE HELD BY ACTING

CHARGE EXECUTIVES. THIS PRACTICE IS STILL DOING GREAT DAMAGE.

The ministries of water and power and petroleum should be merged into one ministry-The energy ministry.

- An energy CZAR, responsible for all energy sectors, should be appointed.
- Coal power generation projects

  Rapid Implantation of ENGRO's SECMC and SINOSINDH plan to generate 660MW and 1400 MW on THAR coal. Plus coal power projects under CPEC programme.

- 1200 MW COAL FIRED PLANTS AT JAMSHORO WITH ADB AND IDB FINANCE. PROGRESS IS VERY SLOW.

- HUGELY INEFFICIENT IPPs

  These are gulping from 24 kg to 46 kg of furnace oil to produce 100 Kwh of electricity. Whereas the world outside Pakistan produces 100Kwh with 14kg.Their bills are paid without any scrutiny/audit. The PPP government also jacked up their tariff when compared with Bangladesh and India. Under the power policy, the electricity tariff is calculated on the assumption that IPPs will earn an 18% rate of return. IPPs and K.E listed on Stock Exchange are raking in annual profits of up to 42%.

THE IPP CONTRACTS HAVE PRODUCED ONLY TWO LOSERS-PAKISTAN AND THE POOR CITIZENS OF PAKISTAN.

IPPS should be forced to improve efficiency and produce cheaper electricity. Contracts of IPPs should be thoroughly examined and renegotiated to protect the consumer's interests. If contracts are considered to be un-affordable and signed in politically dubious circumstances these should be declared UNCONSTITUTIONAL AND VOID. This is how CIRCULAR DEBT CAN BE REDUCED.

3.4: HYDEL POWER-DIAMIR BHASHA/KALABAGH/ AKHORI DAMS

Hydel power is an affordable source of power for the low income population of Pakistan. Even new hydel projects can produce power at Rs 2.5 to Rs.3/unit.

We must start construction on at least one combined water storage (to make up for lost storage capacity due to silting) and hydropower project. There are three choices Diamir Bhasha or Kalabagh or Akhori dam. Diamir Bhasha project requires a long gestation period of over 10 years because it is still at feasibility and design stage, a 223km road, costing $6billion capable of transporting heavy machinery to the site, has to be built and infrastructure for the construction site. THE OTHER BIGGEST RISK IS EARTHQUAKES OF UPTO 9, ON RICHTER SCALE. The Kohistan area, where dam is to be sited, is susceptible to violent earthquakes. During our living memory Kohistan region suffered a very severe earthquake. If the dam suffered a high Richter scale earthquake, the damage will be immeasurable – beyond imagination and it will demolish everything enroute up to Keti Bunder and Shah Bunder. UNTIL VERY THOROUGH INVESTIGATIONS ARE DONE THIS PROJECT SHOULD NOT BE UNDERTAKEN. THERE IS ALSO THE ADDITIONAL COST OF LAYING AND MAINTAINING POWER TRANSMISSION LINE IN VERY DIFFICULT MOUNTAIN COUNTRY.

However run of the river projects should be built on Indus river-like BUNJI, DASU, PATTAN, THAKOT and ALSO DIAMIR BHASHA.

On the contrary Kalabagh is ready for tender. No infrastructure or access roads need to be built. Project can be completed in 5-6 years. The water storage part can be built in 18 to 24 months with modern machinery.

There is another extremely important matter – Annual drop of roughly 4,000 MW in the hydel Generation capacity during winters due to low water level in the two main dams and annual

closure of irrigation canals for 6 weeks. This situation causes severe load shedding during the two winter months every year. To bridge this gap we cannot use natural gas for thermal generation – because during these two winter months gas demand goes up to 8 bcfd against production of 4.0 bcfd. So during this period we face a severe gas loading shedding too when no gas is available for industries, fertilizer plants and CNG Stations.

To meet the cheap hydroelectric supply gap there are a number of following options:-

- Thermal generation at sugar mills using bagasse. This option will take at least two years to implement. Its upfront cost given by NEPRA is very high – 11 cents/units.

- The three other options are to build water storages:-

  o Kalabagh / Akhori – downstream of Tarbela dam

  o Diamir Bhasha – upstream of Tarbela dam

  Kalabagh storage dam is the cheapest and quickest (18 to 24 months) solution to bridge the generation gap for the annual irrigation canals closure of 6 weeks. During this period Tarbela can continue to generate cheap power by discharging its water into Kalabagh storage dam, this water will be stored until required for irrigation.

For the KPK there are two main advantages-Irrigation of about 800,000 acres of Bannu and D.I. Khan region will make KPK self sufficient in food, secondly Tarbela's maximum generating capacity 4,888MW (with 4th Extension) can be used most time of the year and earn maximum royalty without discharging water for agriculture. Additional hydel generation will bring down overall cost/unit. Tarbela's capacity will increase to 6,298 MW when Fifth Extension is completed.

Punjab can build Kalabagh from her share of water as per 1991 Water Accord. In the chapter on WATER RESOURCES I have fully explained India's designs on preventing Pakistan from developing

water resources. Opposition to construction of the Kalabagh Dam is made by friends of India in Pakistan. These traitors are in India's regular payroll for preventing Pakistan from developing the water resources. This came to light recently from India's water board who have spent IND RS 18 billion on this nefarious project.

The timid top leadership of the PML (N), elected by 65% population of Pakistan –giving them once again a heavy mandate, are afraid to do the right thing. They know in their hearts that Kalabagh is the right option. Fearing a small minority in KPK and Sindh they are going to do billions of dollars of damage by abandoning Kalabagh.

IN VIEW OF THE LONG CONSTRUCTION PERIOD OF MORE THAN 9 YEARS AND FEARS ABOUT EARTHQUAKES AT DIAMIR BHASHA SITE WORK SHOULD NOT BE STARTED ON DIAMIR BHASHA.

Only run of the river Dasu project (capacity 4,320MW) should be started. This way at least one major hydel project of 4,300MW would be completed in the life time of the present government.

But by delaying Diamir Bhasha or Kalabagh or Akhori dam we will not be able to add water storage, absolutely essential for water for agriculture and flood control. Due to lack of storage for flood we lost US $10.0 Billion and two thousand human lives during 2010 flood. This loss of human life and crops will continue until we build additional water storage. Building the three dams for water storage is paramount necessity for combating CLIMATE CHANGE AND FLOODS.

Diamir Bhasha costing US $14 will store 8.5 MAF of water, generate 4,500MW electricity extend Tarbela Dam's life from 35 to 50 years, help in flood control and increasing generation capacity of Tarbela, Ghazi Barotha and Chashma hydro power. HOWEVER WORK ON DIAMIR BHASHA SHOULD BE STARTED ONLY WHEN THOROUGH INVESTIGATION ON EARTHQUAKE RISK IS ABSOLUTELY SATISFACTORY.

So the need for water storage dam whether it is in Kalabagh or Akhori is an absolute must to ensure a prosperous agriculture.

In view of opposition to Kalabagh an alternative plan would be to construct run-of-river Dasu hydel power plant capacity 4,320 MW – cost US$ 6-0 billion (for which ADB, World Bank and USA are willing to finance) and Akhori dam for water storage – capacity 7.0 MAF and hydel power capacity 600MW costing US$4.4 million. Akhori dam will have no road access and infrastructure costs- Construction time much shorter than Diamir Bhasha. Only shortcoming – storage capacity is 1.5 MAF less than Diamir Bhasha's 8.5 MAF. Akhori dam site has excellent ROAD & RAIL access. Like Bhasha there is no cost and time required for construction of 223 Km of mountain road from Havelian to Bhasha dam site and transmission line. However, it can be argued that this road is anyway part of the KASHGAR – GWADAR road corridor. But time saving is essential to solve the energy crises. Construction of road access via BABUSAR PASS is going to take long time being a mountain road. Dasu and Akhori dam is the least cost option. Dasu – Akhori combination is a total cost of US$ 10.4 million.

For Diamir Bhasha dam, after the investigation about earthquake risk proves to be safe the project should be UNBUNDLED into two parts. The water storage should be constructed in the first stage so that this very urgent need is met in the shortest time. In the second stage the power generation facility should be constructed. Meanwhile the completion of NEELUM – JHELUM 969MW, Tarbela Forth Extension 1410 MW, a number of smaller hydel projects of about 500MW and Dasu 4,320 MW would have been completed during the present government's tenure. This would result into a cumulative addition of 11,230MW of hydel power in five years.

3.5: PRIORITY HYDEL, THERMAL, NUCLEAR, WIND AND SOLAR PROJECTS

Leaving Kalabagh for the people to decide, we should pursue the hydel and thermal projects under construction so that it can bring relief to the poor population. The projects are following. All financial and managerial resources be employed for early completion of these projects.

- UCH-II – 404 MW- completion 2014 – Still awaiting supply of Gas and proper transmission line.
- Nandipur 525 MW thermal plant- needs upgrade to full generating capacity.
- Neelum Jhelum-969MW-Bring its completion to June 2017
- Tarbela Fourth extension-1,410MW Completion June 2017
- Tarbela Fifth extension-1410MW early Completion is required
- Mangla extension-310MW to extend to 1,310MW
- PPP-Gulpur on PoonchRiver-100MW- completion 2018
- PPP-Mahl-AJK and Punjab-600MW
- Jagran II-48MW- to be retendered 8/2/2015
- DASU-G.Baltistan-4,320MW-Run-of-river only first stage 2,160 MW being constructed.
- Keyal Khwar-128MW
- PPP-Lower spat Gah-496MW (South Korean company)
- PPP-Lower Palas Valley-665MW (South Korean company)
- Punjab-5x small Hydro-24MW
- Punjab 30x small Hydro-308MW
- GOLAN GOL – CHITRAL – 106MW
- PPP-MATILITAN-SWAT-84MW- On Ushu River
- SHARMAI-CHITRAL-115MW
- PPP-PATRIND-KUNHAR-147MW- Completion 2017
- AJK-KOTLI-1OOMW- Completion 2018
- AJK-SEHRA- 130MW
- AJK-22 medium and small-262MW
- G.Baltistan-248MW
- KPK- Mahandri-13MW
- KPK-Tangar-13MW
- Gilgit HANZAL-40MW
- Rental Power Projects Reshma 210 MW-GULF 85 MW Their terms are better than IPPs since there is no capacity charge and other financial obligations for the government.
- BASHO-28MW
- HARPO 33 MW
- Kaigah near Dasu in Kohistan-548MW
- Kurran Tangi dam-83MW

- Taunsa – Low Head – 125 MW
- Suki Kinari – Kunhar river – 870 MW
- KAROT – 720 MW
- KOHALA – 1100 MW
- GUDDU 747 MW
- WIND Projects will contribute 1,651 MW by 2017-more are in pipeline
- SOLAR at Quaid-e-Azam solar power 1000 MW will be completed by early 2017.
- NUCLEAR Chashma III and IV 340 MW each. Chashma III likely to come into operation by summer 2016.
- Conversion of existing boiler based plants (running on RFO) to be converted to Solar Thermal instead of coal.

3.6: TOTAL HYDEL POWER CAPACITY EXPECTED TO BE COMPLETED DURING PRESENT GOVERNMENT'S 5 YEAR TENURE.

DASU hydel project –4320 MW is a long term project, started during PML (N) tenure. However, other above mentioned projects make up 11,539 MW. These are well within the present Government's capacity to complete in 5 years tenure. It is an achievable target. All out efforts should be made to complete these projects. Only this addition of hydel capacity will ensure an affordable price to our poor masses.

As shown in section 2.2.2, the generation data for August, 2013, the average cost of generation was Rs.7/unit when hydel share was 40% - capacity 6000MW. With addition of extra 9500 MW of hydel power in the national grid – Hydel share will remain an average of 70% throughout the year. The average generation cost as shown in section 2.2.2 will be down to Rs.4.3/unit – an affordable price for the masses.

3.7: BAGASSE POWER

We have dealt with this subject in detail under renewable energy.

This has a 2-3 years gestation period.

With its 3,000 to 4,000MW power in the winter will compensate the drop of 4,500MWof hydel capacity during winter.

3.8: WIND, SOLAR THERMAL AND SOLAR PV

All these technologies have 1 to 3 years gestation period. Therefore these should be pursued with full force. We have dealt with these under Renewable Energy chapter. Quaid-e-Azam solar energy park in CHOLISTAN will be going up to 1000MW. Wind energy projects in Sindh are notable. Wind energy potential of 50000MW is beginning to be exploited in Sindh Province. We have endless solar energy potential. P.V. (Photovoltaic) solar energy is being exploited. Real breakthrough is in SOLAR THERMAL. This technology needs introduction based on USA and Spanish models.

3.9: LNG (LIQUID NATURAL GAS)

It is available from many sources worldwide USA, Libya, Russia and Gulf States.

Only needs on shore infrastructure-maximum 2 years- Already dealt in a separate chapter. The injection of imported LNG into the country gas distribution system started in March 2015. In the 1st year 200mmcfd LNG will be injected to the system. The next year another 200mmfcd will come in. In total the Government wants to import 2.0 billion CFD into the country. With growing LNG supply on the world markets the price will go down to USD 4/MMBtu. This option may prove to be cheaper than the Iranian gas. This will eliminate present gas shortages. + Construction of 1,100KM DEDICATED Gas pipeline from Karachi to Lahore for supplying RLNG to Punjab. Russia inked 2.5 billion project for the pipeline.

3.10: IRAN-PAKISTAN GAS PIPELINE

Iranians have brought the gas pipeline right up to our border. It will take only 22 months to complete. All it needs for Government of Pakistan to pick up the courage to face the U.S. pressure or persuade the U.S. not to stand in the way. Chinese are to lay the 780 KM pipeline from GWADAR to NAWAB SHAH. HOWEVER, UNDER THE EXISTING GSPA – GAS SALES AND PURCHASE AGREEMENT – THE IRAN PAKISTAN GAS PROJECT IS NOT VIABLE. The

existing GSPA is linked with JAPAN CUSTOMS CLEARED CRUDE (JCC), a crude oil price index and is subject to periodic revisions in accordance with the prevailing market conditions. The GSPA should be renegotiated with Iran before laying the pipeline. It must be a flat rate price like the Iran – Turkmenistan price of $4/MMBtu. Over the years market conditions have changed dramatically since supply of SHALE GAS on the world markets. The Iranian gas price cannot match the current rate of Rs.488.23/MMBtu to GENCOS and KE. Iranian gas price is 150% higher than the basket price of domestic gas in Pakistan. The Iranian gas price should enable us to generate electricity @Rs.5/ unit. Iran has sold gas to China @$5.5/MMBtu. Why can't Pakistan get a similar deal from Iran? In year 2007 the average gas production price in Pakistan was $2.6MMBtu.

By end of 2012 Henry Hub (US Natural Gas Benchmark price) prices of gas dropped to $2.76/MMBtu. The LNG import price after incurring the shipping and re-gasification cost was around $4.14/ MMBtu – transportation 3% - liquefaction 20% and re-gasification 30%. This should identify the price of IP gas which is costlier than the LNG price.

Failure in completion of IP pipeline will cause tremendous distress to our domestic consumers, industry and power generation.

3.11: PAKISTAN'S OIL AND GAS EXPLORATION AND PRODUCTION PROJECTS HELD UP DUE TO LAW AND ORDER SITUATION AT SITES

While we are planning to import LNG and Gas there is no effort being made to make the areas safe for exploration work. If we make headway in exploration of gas and oil we can increase our meager power resources and reduce our imports of LNG and gas. A number of projects are held up due to litigation in the courts. In the national interest decision on these cases should be expedited.

As regards law and order and security for exploration activities, it should not be left to levies/frontier corps. Resources permitting, Pakistan army should be employed to secure and guard the sites,

equipment and personnel. Similar to the force raised to secure CPEC projects.

The nation would be surprised to see the success. This will encourage foreign oil and gas companies to come and work on oil and gas development.

HYDEL PROJECTS-There are some projects in MOHMAND AGENCY (MUNDA DAM), SWAT and other parts of KPK-these also need Pakistan Army protection.

3.12: SHALE OIL AND GAS AND TIGHT GAS

If serious efforts are made to bring in US companies, through US A.I.D or China to help Pakistan to explore and develop our shale oil and gas resources, Pakistan can become self sufficient in oil for 68 years and gas for 73 years within the 5 year tenure of the present government. This subject has been described in detail in a separate chapter.

This is a venture worth taking up. Pakistan would no longer need to import gas and LNG. So far only OMV are drilling for TIGHT GAS in KHAIRPUR district Sindh province. 20 mmcfd tight gas from Zarghoun South Block in Balochistan by MARI Petroleum is being produced. There would be no need to convert the existing GENCOS 4,811MW and IPPs 7,311MW to coal.

This would also save billions of dollars, to be spent on transport infrastructure, to supply 277,000ton of coal per day to the coal fired power stations.

3.13: USA HELP

During recent visit of Prime Minster the USA has promised to develop a US Technical Assistance Programme to support the development of Pakistan's domestic natural gas reserves. Under the above programme our government should request assistance in exploring shale gas and oil resources. The US is the foremost country specialised in this technology. US have added 50% increase in Gas supplies from the SHALE GAS technology.

3.14: EXISTING COAL POWER STATIONS

While there is so much talk about using coal, the only two coal power plants- 150MW at LAKHRA and 15MW in QUETTA are closed due to refurbishment. Both these plants should be brought back into operation.

3.15: NANDIPUR 525MW, UCH-II 404 MW& CHECHO-KI-MALLIAN 525 MW COMBINED CYCLE PROJECT (Completion Jan. 2014).

The 525MW combined cycle project had been delayed for several years due to the PPP government's refusal to co-operate because of its location in the Punjab province. Much of the construction work was already completed. This is the only, under construction, thermal plant- located in the demand centres of industrial cities of Gujranwala, Sialkot and Gujrat. Its operation will bring much relief to these industrialised areas.

3.16: HUB POWER GROWTH PLAN

While we are going begging all over the world for financing power projects we have the possibilities of utilizing HUB POWER GROWTH PLAN.

HUB POWER was the first private power project which is supplying 16% of our total electric power very well. Serious consideration merits availing their following growth plan

1,320 MW-Coal based on imported coal

2,400 MW-LNG combined cycle

700 MW-Hydro Electric

1,200 MW-Mine Mouth Power in THAR-Coal fields

1,000 MW-Solar and wind

The total comes to 6,620 MW

Initially the HUB project was financed by a SAUDI ARABIAN Company. The GOP can request the SAUDI govt to encourage private SAUDI Companies to come forward for investment in the HUB POWER GROWTH PLAN.

3.17: NUCLEAR POWER

All information is contained in a separate chapter. KANUPP power plant, now delivering only 100MW, is due for decommissioning in 2019. Apart from the two CHASHNUPP power stations producing 600MW. WE have CHASHNUPP 3 and 4 of 340MW capacity each under construction. These are due for completion in 2016 and 2017.

The other plants are only PROPOSED status. One CHASHNUPP-V 1000MW due for completion in 2020. CHINA NATIONAL NUCLEAR CORPORATION HAS SIGNED AN AGREEMENT IN OCTOBER 2013 TO INSTALL 2 X 1100MW NUCLEAR POWER STATIONS IN KARACHI – COSTING $9.6 BILLION.

- Civil nuclear agreement with France/USA/Japan on the same lines as India-US agreement will hasten our nuclear energy-specially the French 600MW type plants which have excellent safety, reliability and production record.
- There is also the possibility of constructing small nuclear plants like the KHUSHAB 50MW using our own engineers and local industry.

3.18: CONVERSION OF CEMENT PLANTS FROM FURNACE OIL TO COAL

There are 23 cement plants producing 16-18 million tons of cement. These plants consume 2.1 million tons of furnace oil/annum costing Rs 2.0 Billion in foreign exchange. Use of coal instead of furnace oil should be made MANDATORY. Cost of cement production consists of 68% of energy resource. It is an energy intensive industry. Two leading cement producers use CPP (Captive Power Plants) to meet their total energy requirements instead of using national grid power.

3.19: INSUFFICIENT TRANSMISSION CAPACITY AND TRANSMISSION AND DISTRIBUTION LOSSES OF THE NATIONAL GRID + LOSSES DUE TO THEFT

Maximum electricity demand, during summer, has been reported as 18,500MW but the national transmission system's capacity is only 16,000MW as per recent report of the Ministry's minister of state. While net power generation increased by 78% the transmission system could only achieve 49% growth. There is an urgent need to extend, upgrade and integrate electricity transmission infrastructure. Sustainability, reliability and security of power supply is of paramount importance for the socio-economic development. So even if we manage to increase the production capacity to meet the demand, inadequate transmission capacity will become a bottleneck. So investment in transmission capacity should be the first priority. Transmission and Distribution (T&D) losses are higher than 117 countries of the world @25%. World average for T&D losses are 8.8%. Loss of 1% equals to a loss of Rs.6 billion. We are losing Rs.100 billion a year due to losses above 8.8% - the world average. If T&D losses are brought down to 8.8% the system will have additional 17% power i.e. 1870MW. This will reduce load shedding to 1 -2 hours/day. THEFT at 15% is costing another Rs.90 billion.

Distribution lines, when overloaded, consume 20% more electricity. This is one of the contributing factor in the 40% losses due to transmission and theft losses.

Similarly on many occasions, when power is available from a power station, lack of transmission capacity becomes a bottleneck.

Plus transmission capacity has to be constructed to far off power stations along the Indus River like Bunji and Dasu and Kohistan region. One of the constraining factor in developing hydro power in CHITRAL, DIR, AJK and Gilgit Baltistan, where there is tremendous potential, is lack of transmission facilities to carry electric power to demand regions. Under CPEC programme China is constructing two 600UHV-DC transmission lines from MATIARI to Lahore and

Faisalabad. Transmission lines for evacuation of Neelum Jhelum, Patrind, Mahl and Azad Pattan are being constructed.

3.20: ETHANOL PRODUCTION AND MANDATORY BLENDING IN PETROL

At present all efforts are targeted to narrow the demand and supply in electricity and gas sectors. But no less important is to close the demand and domestic supply gap in the oil sector. It is ignored because it can be imported from the world markets. But increasing cost of imported oil has been fuelling INFLATION on such a huge scale that it could TOPPLE THE GOVERNMENT. Local ethanol production from molasses, sorghum, maize and directly from sugar cane (like Brazil) should be increased to lessen our load of imported oil. This topic is detailed in BIOMASS energy chapter.

3.21: IMPORTED INFLATION DUE TO LACK OF BOOSTING OIL & GAS PRODUCTION

Even with the recent discoveries in KPK in Tal and NASHPA fields our present meager oil production of 67,000 barrels per day is touching only 100,000 barrels per day that will meet only 20% of total needs of 450,000 barrels a day. The daily rising prices of oil on the international market can cause IMPORTED INFLATION. Due to load shedding there is tremendous attention and action for gas and electricity supplies. Home production of oil is a neglected sector. It is doing as much damage to our economy as lack of gas and electricity. Galloping inflation in all sectors of the economy is due to monthly rising prices of oil. When CNG is denied for vehicles during the three winter months our import bill on diesel and petrol will rises to $1 billion per month.

3.22: OFF - SHORE – PROSPECTING FOR GAS & OIL IN THE ARABIAN SEA

Since gas and oil have been found in lower Sindh, there are definite chances in off - shore areas. THIS PROJECT WILL NOT FACE ROYALTY, 18TH AMENDMENT AND LAW & ORDER ISSUES.

India has made discoveries off – shore in this very region. SIR CREEK is another potentially rich area.

Existing efforts on oil and gas exploration and production should be doubled.

3.23: COAL TO LIQUID – CTL TECHNOLOGY

China in Inner MONGOLIA is producing 20,000 barrels per day from coal. South Africa has also mastered this technology. We should go for CTL (coal to oil) production in all provinces especially in the Thar Coal fields. South Africa has already offered assistance in coal technologies which should be availed. By 2020 China plans to raise capacity to 50million tons of coal producing 286,000 barrels of oil per day.

- Exploration of SHALE GAS AND OIL should be started on war footing. If big oil companies from USA do not come to Pakistan, we should invite small oil companies in the U.K and elsewhere who are finding tremendous local resistance in SHALE EXPLORATION to come to Pakistan.

Government of Pakistan should make special request to the Chinese and US government to help us in shale oil and gas exploration.

Inflation caused by imported oil has greatly eroded the value of our currency. We are now not able to trade with majority of countries in the world. We used to be at par with Indian currency. Now to buy 100 Indian Rupees we have to pay 165 Pak Rupees. In the sixties US Dollar was Rs 4.5, Pound sterling Rs 13.35. Rising cost of imported oil has brought all this havoc in our society. A student from a middle class cannot go for studies abroad now. This is a great loss as our young generation is deprived of exposure to the international science and engineering. We cannot buy any decent imported item. This is a great loss. Most of the machinery imported by private sector is in the form of scrap.

3.24: LATEST RUSSIAN OFFER FOR DEVELOPMENT OF ENERGY RESOURCES

The Russian Federation's presence and influence in the Middle East and North African countries has been wiped out except for SYRIA. Russia is in the process of regaining its past role of USSR as a counter to the USA domination of the world scene. India with its relations with USA is not solely dependent on Russia. It is in this context that the Russians want to cultivate their influence and trade in Pakistan. We should welcome it and take advantage of their broad based offerings in the ENERGY SECTOR – where we need help and cooperation from all countries to make a quantum jump in the energy sector to revive our economy.

Recent Russian offer, by their Deputy Minister of Energy, covering all sectors of energy, merits serious consideration and to be pursued with vigour. The areas for cooperation are :-

1. Construction of Karachi-Lahore 1100 KM dedicated gas pipeline and help in TAPI gas pipeline. Russia has agreed to lend $ 2 Billion for this project.

2. Supply of LNG

3. Supply of 5000 MW electricity through Afghanistan from its generation in KYRGYZSTAN as part of the CASA – 1000 electricity trade programme.

4. Install a 600 MW coal fired power station at JAMSHORO and offer 100% technical and financial solutions for Jamshoro and Muzaffargarh Power plants.

5. Participation in the 6600MW coal based GADANNI Energy Park.

6. Install power projects based on Thar lignite coal

7. Investment in Oil and Gas exploration

8. Investment in other energy sectors of Pakistan – SPECIALLY OFF – SHORE DRILLING OF OIL AND GAS IN ARABIAN SEA.

9. Russia is interested to lay a Gas Pipeline to supply Pakistan through Iran.

We must add that initially it was the Russian help that OGDC was set up. At that time no other western country was prepared to help Pakistan. The OGDC has now become major player in the oil and gas sector of Pakistan only due to the initial help given by Russia. Recently Russia has signed MOU with OGDC and KPK oil & Gas Corporation for oil and gas exploration.

3.25: CHINA"S $ 45.6 BILLION FOR CHINA PAKISTAN ECONOMIC CORRIDOR

At present china's sea trade route to Europe is 19,000 Nautical miles. The Gwadar sea trade route to Europe is only 9,000 Nautical miles. Distance from Kashgar rail head to Gwadar is only 3,000 Km. Therefore China, in cooperation with Pakistan, has decided to build a Road and Rail corridor from Kashgar to Gwadar. China has signed an agreement which covers Energy and Infrastructure as follows:-

$ 33.8 Billion for energy projects in two phases

Phases I- Coal, Wind, Solar and Hydroelectric projects covering 10,400 MW- to be completed by 2017 as EARLY HARVEST cost $ 15.5 Billion

Phase II for addition 6,120 MW costing $ 18.2 Billion for completion by 2021

Infrastructure projects Costing $ 11.8 Billion covering development of Gwadar sea port, International Airport at Gwadar, LNG terminal at Gwadar, Gas pipeline from Gwadar to Nawab Shah, Two 600 UHVDC transmission lines from MATIARI to LAHORE & FAISALABAD. Optic Fiber link connecting Pakistan with KASHGAR.

$ 3.7 Billion for upgrading Railway-KARACHI- LAHORE-PESHAWAR Upgrade KKH Road up to Islamabad, Karachi- Lahore Motorway Urban Railway- Orange Line in Lahore city. Motorway Link from Gwadar to Sukhur and Western route linking Gwadar to Quetta-Zob-D.I.Khan- Mianwali- Hasanabdal with KKH. Allocation for Roads is $ 5.9 Billion.

DETAIL OF THE PROJECTS COVERING $ 45.6 BILLIONS TABULATED BELOW

No	Project	Cost in $ Billions
1	Coal Mining Project Thar Block II	0.86
2	Coal Mining Project Thar Block I	1.3
3	1100 MW Kohala Hydro	2.4
4	720 MW Karot – Jhelum	1.42
5	873 MW Suki Kinari on Kunhar river	1.8
6	250 MW 3 Wind projects	0.75
7	Orange line metro in Lahore	1.6
8	Multan Sukhur 387 Km Motorway	2.6
9	K.K.H – Raikot to Islamabad Road	3.5
10	Rehab – Karachi – Lahore Railway track	3.7
11	CPEC – Corridor secretariat	0.409
12	Development of Gwadar port	N/A
13	Gwadar to Nawab Shah 42” Gas pipe line to carry 690 MM CFD	1.0
14	Gwadar LNG terminal including regasification plus LNG storage	2.0
15	Lahore- Karachi motorway project including Multan – Sukhur	

COAL

No	Description	MW
1	Port Qasim	1320
2	Sahiwal	1320
3	Engro Thar	660
4	Hubco	1230
5	Gwadar	300
6	RYK- NISHAT GROUP	1320
7	Sino Sindh Resources Limited with China power international Thar	350 x 4
8	Salt Range Pind Dadan Khan	300

HYDRO

No	Description	MW
1	Suki Kinari	870
2	Karot	720
3	Kohala	1100

SOLAR

No	Description	MW
1	Quaid – E – Azam Solar park	1000

WIND

No	Description	MW
1	United Energy	100
2	Dawood	50
3	Sachal	50
4	Sunnec	50

ADDITIONAL PROJECTS

No	Description
1	Gwadar Airport
2	East Bay Expressway
3	Fiber Optic link from Pakistan to Kasghar
4	Two x 600 UHVDC Transmission lines from Matiari to LHE and Faisalabad

Second Phase – 6, 120 MW at cost of $ 18.2 billion by 2021

3.26: CHINA'S THREE CORGES COR'PN $ 50 BILLION FINANCE OFFER FOR DEVELOPMENT UPPER INDUS CASCADE - 7 TO 8 PROJECT

China's Three Gorges Co'rpn have made the above offer to the Gov't of Pakistan. No formal agreement has been reached yet. This offer is in addition to China's $ 45.6 Billion package which is being executed for completion by 2017. Three Gorges Corpn offers development of following Hydroelectricity projects:-

Project	Capacity MW	Cost $ in Billions
Diamir Bhasha	4,500	15
Bunji	7,100	6.8
Thakot	4,000	6.0
Pattan	2,300	6.0
Munda Dam on Swat River	740	1.4
Total	18,640 MW	

Potential-Indus Cascade starting KHAPLU in GB to Tarbela 40,000 MW

3.27: CHINESE COMPANIES BECOMING IPPs FOR HYDRO PROJECT

This idea, if realized, would not only strengthen cooperation but would become an effective long-term strategy for energy security for the two countries. Pakistan's long-term energy goals are towards RENEWABLE Energy with a special emphasis on HYDROPOWER of which estimated potential is 120,000 MW.

We should try for investment by Chinese in Hydropower as IPPs. If the two countries can strike a fair deal, Chinese companies could become IPPs in Pakistan in order to fully exploit Pakistan Hydroelectricity potential. 20% of electricity produced could be given to Xinjiang region leaving 80 % for Pakistan's Grid.

3.28: ELECTRIC GRID CONNECTIVITY BETWEEN PAKISTAN & CHINA

Building infrastructure and improving Communication and energy linkages between China and Pakistan and the rest of the global markets is a positive step for Pakistan. Large scale investment by Chinese companies in Pakistan's Hydroelectric potential will only be possible if we are ON THE SAME GRID. It will be possible for Pakistan to explore connections with Kazakhstan, Russia and Mongolia through Chinese ULTRA HIGH VOLTAGE DC transmission grid.

3.29: CHINA'S HIGHER EFFICIENCY AND LOWER EMISSION (HELE) TECHNOLOGY

Pakistan must ask China for CLEAN COAL TECHNOLOGY. At 50 % thermal efficiency of coal plants carbon emission are dramatically low. China is global leader in coal water slurry in China. WANGQU 1 and 2 plants operate at 41 % thermal efficiency. Integrated gasification and combined cycle technology and super Critical High Pressure Boilers should be used.

3.30: **CHINA** made a firm offer for 3,000 to 4,000 MW supply from KASHGAR including Transmission lines.

3.31: US A.I.D through its clean energy partnership programme plans to finance 3,000 to 4,000 MW clean energy projects between 2016 up to 2019. In Sept 2015 OPIC signed financing of 250 MW Wind Energy Projects in Sindh.

3.32: TAJIKSTAN has signed an agreement to supply 1,300 MW under CASA- 1000 programme, sponsored by World Bank. The transmission line will run through Afghanistan by paying a transit fee of 1.25 Cents/ Kwh. Afghanistan will receive 300 MW. Work on the project will start in 2016- completion in 2 years. Tariff agreed is 9.41 Cents per unit. Tajikistan is offering an additional 1,200 MW via the WA KHAN STRIP through CHITRAL crossing BAROGHIL pass. Tajikistan has huge hydroelectric potential and can sell cheap electric power. Power purchases can be paid through exports from Pakistan. Direct route will pass through ROGUN, KHORUGH, WA KHAN STRIP, BAROGHIL PASS to CHITRAL Distance 650 Km – 765 KV line- cost $ 240.5 million.

3.33: IRAN is already supplying 100 MW to the border areas of Balochistan. NTDC has signed an agreement for 1,000 MW for a transmission line to be built by NTDC from Zahedan to Quetta with only 2% line losses & Iranian finance of 70% of the cost. Iran is now offering 3,000 MW at good rates. Present rate is Rs 10/unit. NEPRA has approved Rs 8 to 10/ unit for the 1000 mw supply. It is a 700 km power line at 500 kv from Zahedan with $ 800 million credit.

3.34: TURKEMANISTAN has offered 1,000 MW transiting through Afghanistan along with the TAPI gas pipeline project.

3.35: FRANCE is ready for civil nuclear cooperation with Pakistan. French nuclear power stations have the best safety record and are producing electric power at cheapest rate. We can learn a lot from them. French civil nuclear energy cooperation has to be in line with protecting international obligations. We should try to enhance civil nuclear cooperation with France. France has recently signed an agreement with India to supply 6 Nuclear Power Plants. Pakistan

should continue to pursue France for civil nuclear cooperation with Pakistan.

3.36: INDIA considering the past relations starting from 1947, India is a historical enemy. Under no circumstances we should try to buy electricity/ gas from this country. If in any doubt about Pakistani nations views GOP should conduct a referendum.

3.37: SOUTH AFRICA produces 93% of its electricity from coal. It has complete technology of CTL (Coal to Liquid). South African Government has offered its cooperation to Pakistan for producing electricity from Coal.

3.38: TURKEY is the most reliable friend of Pakistan. Turkey is already cooperating with Punjab and Sindh provinces in various sectors. Turkish economy is in a strong position and very friendly relations between the two governments. We should be able to get a lot of help in communications and energy sector from Turkish companies. Turkish company was the first investor in wind power in Sindh. Turkish construction group called STFA completed a most difficult bridge project over river Indus at Attock, a section of M2 motorway and several other projects in the past. STFA could be an ideal partner for the motorways, tunnels, bridges and wind power projects. Similarly Turkey's SANCO Holdings AS and TEYO AS have signed an MOU with Sindh Government for development of THAR Coal and produce 200 to 10,000 MW electricity in various phases. There were a lot of Turkish construction companies working in Russia. Due to tensions between Russia & Turkey these companies have been asked to stop work in Russia. Pakistan could take advantage of this situation and offer opportunities to Turkish construction companies.

3.39: JAPAN had offered a $ 850 million credit to upgrade LAKHRA Coal power station to 600 MW. It needs a follow up by the minister for Finance & EAD.

3.40: SOUTH KOREA a number of South Korean companies are working on hydroelectric projects on tributaries of Indus River under

PPIB private public partnership. There is tremendous potential for South Korean companies in hydroelectric and communication projects. Korean construction companies have been very active in Saudi Arabia in building up their communication infrastructure. Korean companies have experience in major infrastructure projects like roads, chemical plants, tunnels, hydro power projects and thermal power projects.

3.41: HOW TO ELIMINATE ENERGY CONSEQUENCES OF 18th AMENDMENT on PUNJAB PROVINCE

We have vehemently opposed the 18th Amendment in the constitution in our introductory chapter, regarding the respective province's first right to the resources found in a province (like oil, gas and hydel power) and suggested for abolishing these clauses. Same applies to mineral resources.

As long as these clauses remain in force the province of the Punjab with 65% of Pakistan's total population, major producer of food and cotton for textile exports would be at great disadvantage. So much so that domestic consumers & CNG stations have no gas during 4 months of winter.

KPK has the major hydel power resources, oil and gas. Sindh is abundantly endowed with coal, oil and gas resources. Balochistan has coal, oil and gas.

If the province's, first right to resources, found in that province, clause is strictly applied Punjab's industry and agriculture would be crippled and hence the country's economy. During winter, KPK consumers have the 1st right to use gas and it may not be available for consumers in Punjab. Following action plan can mitigate the 18th Amendments consequences for Punjab.

- Go for exploration and production of TIGHT GAS, SHALE GAS AND OIL. Recent Gas discoveries in Mianwali near Kalabagh and oil in Kot Sultan in district Attock are encouraging news. Production of gas and oil should be expedited. Kot Sultan oil

discovery in district Attock is as big as Nashba and Tal discoveries in KPK.

- It is suggested that government of the Punjab should get lease of at least one Block in Thar coalfields, generate the power at site and wheel it into Punjab through NTDC network, using UHV DC transmission. Minimum capacity should be 6000MW.
- Ethanol production through molasses, sorghum, maize and direct Ethanol from additional production of Sugar cane in the Riverine areas (to save canal irrigation water) should be given high priority.
- Energy conservation measures will save 25% of energy
- Solar Thermal Technology. This technology is thermally more efficient than P.V. technology due to its capability to store energy for 8 hours after sunshine. Solar thermal systems can provide energy almost during 24 hours of the day. For Punjab this technology should be widely used for Grid supply as being done in Spain, Morocco, USA and South Africa. This can compensate Punjab for lack of Oil, Gas, Coal and hydro resources. Unfortunately Government of Punjab has adopted P.V. technology for Grid supply. P.V capacity factor is not more than 17.5 %. Therefore Punjab should set up Solar Thermal plants on large scale.
- PV Solar projects-close to demand centres. Introduce net meters for residential and industrial areas. PV solar is more suitable for residences, schools, officers and hospitals instead of Grid supply.
- Develop Coal resources by setting up state of the art model mines, producing synthetic gas for power production and liquid from coal.
- Adopt modern circulatory fluidised bed combustion and IGCC (integrated gasification and combined cycle technologies for power from coal found in Punjab.
- Introduce PRECISION LAND LEVELLING-100% and cropping on ridges. It will save energy and water and increase production at least 25%. Water conservation techniques will save at least 40% of the available water that is currently wasted. These will cost only 5% of the price of building a mega dam. Increase Water availability by at least 40% if all the irrigation canals are lined. With precision land levelling there will be 30% less use of water.

This will cost only a few billions and increase the cultivated area by 20 – 30% and increase the agricultural productivity.

- CONSTRUUCT AKHORI DAM – STORAGE CAPACITY 7 MAF – HYDEL POWER 600 MW COST $4.4 BILLION OUT OF PUNJAB'S SHARE OF WATER AS PER 1991 WATER ACCORD.
- CONSTRUCT KALABAGH DAM STORAGE 6.1 MAF HYDEL PWOER 3600MW COST $12 BILLION.

If other provinces do not agree to abolishing gas, oil and electricity clauses from the 18thAmendment they should at least agree to allow Punjab to construct Kalabagh and Akhori dams to meet their electricity requirements for agriculture, industry and domestic needs.

- **HYDEL PROJECTS. KALABAGH 3600MW AND AKHORI – 600MW SHOULD BE THE TOP PRIORITIES.**

Apart from completion of 30 small hydro projects of approximately 308 MW the following projects should be given TOP PRIORITY.

TAUNSA LOW HEAD – 125MW

MAHAL ON JHELUM – 600MW – A JOINT PROJECT OF AJK AND PUNJAB

KAROT ON JHELUM DISTRICT RAWALPINDI – 840 / 720MW

CHASHMA – JHELUM LINK OUTFALL – 44MW

- **BAGASSE POWER**

Punjab sugar mills have a minimum capacity of producing 1400MW from bagasse. This power will be available during the winter months of acute shortage of electricity i.e. mid November to mid March. However, if coal and cotton sticks are also used this capacity of 1400MW can produce power throughout the year.

- **Irrigation Tube wells**

Having sweet underground water for irrigation the tube wells are an important source of irrigation for Punjab farm lands. In order to fend

against load shedding, dedicated feeders should be provided. In every village tube well electric supply lines should be separated from the rest of village supplies. Interest free loans for Solar pumps for tube wells is a good idea but it does not provide 24 hour supply which is essential during RICE cultivation. Subsidy for Precision Land Levelling in tube well irrigated areas should be high priority as tube well irrigation is very expensive compared to Canal irrigation.

- Tube wells operated by diesel fuel should receive a subsidy to make these equal in expense to electric driven tube wells.

- Cost of electric driven tube wells, fertilizers and other inputs should be equal to those in the Indian Punjab.

- Cost of fertilizers i.e. Urea, DAP and Potash should be equal to those paid by Indian Punjab farmers.

Above measures will provide a level playing field to Punjab farmers if agricultural products are to be imported from India.

WATER RESOURCES

4.1: HISTORY

Water is the life line of the Pakistani nation. Agriculture and Hydro power depend on water. Without water and its largest irrigation system in the World, Pakistan would become a semi dessert country-unable to support such a large population. The Quaid-e-Azam was forced to accept the Partition of the Punjab and Bengal provinces. If the Quaid had not accepted the truncated and moth eaten Pakistan, in his lifetime, the Hindus and the British would have never allowed the sovereign state of Pakistan to come into existence at all. The Indian leaders did not expect Pakistan to last more than 5-6 weeks. IN FACT, FROM DAY ONE OF THE CREATION OF PAKISTAN, INDIA HAS CONTINUED TO WAGE AN UNDECLARED WAR AGAINST PAKSITAN (IN VARIOUS MODES) TO ELEMINATE PAKSITAN FROM THE MAP OF THE WORLD. DISMEMBERMENT OF PAKISTAN IN 1971 WAS INDIA'S FIRST ACHIEVEMENT AS ADMITTED BY ITS PRIME MINISTER NARINDRA MODI ON HIS VISIT TO BANGLADESH. The economic pressure of forcing over 6 million refugees from East Punjab into Pakistan and withholding Pakistan's share of its liquid assets (not paid until today) was to ensure collapse of Pakistan soon after its birth.

But, by the grace of God Almighty, Pakistan continued to exist and prospered. By 1948 India, due to drought conditions, had to devalue its currency but Pakistan did not devalue.

The Hindu leaders from India, disappointed at Pakistan's survival, engineered another plan-to deprive Pakistan of its share of water as a lower riparian of BEAS, SUTLEJ and RAVI rivers. The Hindu leaders thought that as long as Pakistan continued to receive its share as 21 MAF of water of the three rivers, as a lower riparian, it will continue to grow plenty of food to feed its population and exist economically.

The partition of the Punjab province cut through the fully integrated irrigation system across the Indo-Pakistan national boundaries-Madhopur headwork's on river RAVI, from which the UPPE BARI

DOAB CANAL originates, was given to India. This was due to illegal and unfair allocation of district GURDASPUR, a Muslim majority district, to India. The entire Lahore district was irrigated by Upper Bari Doab canal.

Again the Ferozpur Headworks on river SUTLEJ which also supplied the Depalpur canal in Pakistan-The allocation of the Ferozpur headwork's to India was a last minute conspiracy between Lord Mountbatten, the last Viceroy of United India with Lord Radcliff, chairman Boundary commission. Initial border demarcation between India and Pakistan, Tehsils ZIRA and Ferozpur of District FEROZPUR, a Muslim majority area, were earlier allocated to Pakistan, but was changed as a result of last minute conspiracy of India. The Ferozpur Headwork's was located in these Tehsils so the control of the Headwork went to India. Depalpur canal irrigated huge areas along the west bank of river SUTLEJ. Documentary evidence of the last minute conspiracy and the change of boundary are in the Governor of Punjab's records.

Initially far side of SULEMANKI Headworks on river SUTLEJ was illegally occupied by Indian Armed Forces which reverted to Pakistan in 1965. Sulemanki, Islam and PANJNAD Headworks were dependent on the waters of Rivers-BEAS, SUTLEJ and RAVI. Only Panjnad Headworks got some of its water from Chenab and Jhelum River in addition to the three Eastern Rivers.

The classic Indus Basin constitutes the provinces of undivided Punjab and Sindh. The great plains are traversed by river Indus and its five tributaries the Jhelum, Chenab, Ravi, Beas and Sutlej. The British built one of the biggest irrigation networks in these plains through barrages and head works on rivers from where canals took water to huge tracks of land in what was known as –Granary of United India.

The productivity of this gift of Allah Almighty- can produce 19 maunds of wheat (760kg) from one acre foot of water from a well ploughed field without any special inputs like fertilizer etc…

The Indian Independence Act set up a Punjab partition committee to adjudicate upon disputes about division of assets between the two

provinces in the divided province of Punjab. Committee B of this partition committee was formed to deal with the division of river and canal waters between the two provinces.

Representatives of both East and West Punjab agreed before this committee that the position existing at the time of partition will not be disturbed and shall be taken as the division of water between the two countries.

The representative of West Punjab, from the irrigation department, committed great negligence and failed to get this agreement in writing and register it with the Arbitration Tribunal as required. Consequently when the Arbitration Tribunal expired on 1stApril 1948 the East Punjab government denied any agreement and stopped the supply of water from canals whose head works were located in East Punjab.

On part of the West Punjab, representative from irrigation department, there was neglect of duty, complacency and lack of common prudence which had disastrous consequences for Pakistan for generations to come. Pakistan lost its right to perennially flowing waters of river RAVI, BEAS and SUTLEJ to the tune of 21 MAF as a lower riparian. "This was Pakistan's agreed share of river waters at the time of partition in Aug 1947"

The estimated total flow in the Indus River system was 175 MAF-Comprising of Indus 93, Jhelum 23, Chenab 26, Ravi6, Beas 13 and Sutlej 14 MAF. Out of this total 167 MAF entered Pakistan with 8 MAF drawn into canals in the East Punjab. Another 4 MAF was reserved for BHAKKRA Dam on SUTLEJ which was under construction at the time of partition in 1947. Pakistan's agreed share, before the partition committee, stood at 163 MAF which was not registered with the Arbitration Tribunal by the representative of West Punjab.

Thus we lost our right to 21 MAF of perennially flowing waters of RAVI, SUTLEJ and BEAS as a lower riparian. If we had our 21 MAF of water we could produce 16 million tons of wheat every year without using any fertilizers.

After 1st April 1948 India stopped the flow of water to the canals which had headworks in India. The dispute on stoppage of canal waters brought India and Pakistan to brink of war on more than one occasion. This prompted the World Bank to intercede in the matter. All successive governments of Pakistan refused to make any compromise on its sovereign right of its share of water as a lower riparian until the first military rule of Gen Ayub Khan through martial law of 1958.

Immediately after the stoppage of water in 1948 a delegation, consisting of Nawab Muzaffar Ali Qizalbash and Sardar Shaukat Hayat, from Pakistan met the Indian Prime Minister Pandit Nehru in Delhi. Since Nawab Muzaffar was personally affected due to stoppage of water to his vast estate near Lahore (called ILAQA NAWAB SAHEB) the Pakistani delegation was forced to sign a declaration accepting India's exclusive right to the waters of river Ravi, Sutlej and Beas. Then only the supply of water to canals was resumed. India tried to register this document, unsuccessfully, with the U.N. However from April 1948, until signing of the Indus Basin water treaty in 1960, India continued to supply water to the canals making up the total quantity every year in such a manner that water to canals would be withheld, when required, and released, when not required. This caused so much damage to the Pakistani Agriculture that, being a surplus producer of wheat, Pakistan had to import wheat from the USA during these years.

4.2: ANALYSIS

The Indus River system is the lifeline of Agriculture in Pakistan which is the backbone of national economy. Nations put at stake their very existence but refuse to part with their sovereign water rights to perennially flowing waters, as a lower riparian. Military Dictator, General Ayub, without consulting water experts and the politicians, sold our rights to perennially flowing water, as lower riparian for a pitiful 900 million dollars in 1960 through the infamous Indus Waters Treaty in 1960.

General Ayub gave up our sovereign rights to perennially flowing waters of BEAS, SUTLEJ and RAVI, for stored waters, in the form of Mangla and Tarbela dams. Dams have limited life whereas perennially

flowing waters are forever. Already within 40 years the storage capacity of Mangla and Tarbela dams has been reduced by 6 million acre feet.

Perennially flowing rivers have numerous environmental benefits. Underground aquafurs are regularly recharged with sweet water. River beds do not silt up. Dry river beds of RAVI and SUTLEJ, which are silted up, cause enormous damage during floods. Level of underground water, used for agriculture, is going down fast.

General Ayub forced the Indus Waters Treaty on the Pakistani nation. No Pakistani politician would have made any compromise on its sovereign right to the water as lower riparian. By this time General Ayub had already put the prominent politicians out of politics through EBDO – Elective Bodies Disqualification Ordinance.

It reminds me if the famous couplet of Dr. Iqbal on selling of Kashmir by the British to Dogra Raja.

قومے فروختند چه ارزان فروختند

(They sold a nation. Alas at what a low price!)

General Ayub has repeated to the Pakistani nation by selling its water what the British did to the people of Kashmir. India paid only $170 M to Pakistan as compensation for the loss of 21 M acre feet perennially flowing waters from the 3 eastern rivers.

After signing the Water Treaty in 1960, India continued to develop its Agriculture and Industries, India completed BHAKKARA dam (second highest in the world), NANGAL dam and RANJIT SAGHAR dam. It also completed the RAJISTHAN/BIKANER canal to take the Indus Waters out of its Basin. The flows into Indus River System have completely dried out from RAVI, SUTLEJ and BEAS.

Pakistan's entire resources were engaged in building the replacement dams at Mangla and Tarbela, 9 replacement canals, (cutting across the entire drainage system of the Punjab) and several barrages and headworks. It took us some 15 to 20 years to complete the replacement

works. Tarbela dam was completed in 1974. A map showing the Indus Basin Replacement Works is enclosed.

India has fully completed its diversion plans on the three eastern rivers. But its quest to turn Pakistan into semi-deserts and bring the Pakistan nation to its knees continues with full speed. It has been quickened after Pakistan became India's equal as a nuclear power.

War with Pakistan is not possible now so the best method is to slowly deprive Pakistan of its rights to the waters of Chenab, Jhelum and Indus, given to it under Indus Water Treaty.

4.3: STORAGE DAMS

Theoretically Pakistan is left with 142 MAF of river waters (Indus 93, Jhelum 23 and Chenab 26).

First violation of the water treaty took place during another dictator's time-1980-General Zia-Construction of SALLAL dam (113 m high) on Chenab, only 25 miles upstream of the Marala Headworks on Chenab.

India is in the process of completing some 62 dams on River Chenab and its tributaries in Kashmir and Himachal Pradesh (In India). The list is enclosed on Section 4.4. India is also trying to divert NEELUM River (a tributary of Jhelum) through KISHNGANGA dam. The Wular lake Barrage project will enable India to store Jhelum river's waters up to 40 days.

All this is being done under the guise of RUN-OF-THE RIVER Hydroelectric schemes, allowed in the Indus Water Treaty. In fact these projects are STORAGE dams, designed to deny waters of JHELUM and CHENAB to Pakistan and gain full control over the flow. It is common knowledge that India has either started construction or has planned over one hundred dams on the Western Rivers, posting a serious threat to Agriculture and hydel projects in Pakistan. These include 24 projects on river Chenab, 52 on river Jhelum and 18 on river Indus.

These dams are due for completion in next 3 to 4 years.

India is clearly violating the Indus Water Treaty. Before it becomes too late Pakistan should openly abrogate the treaty, demand the restoration of its 21MAF water from the three rivers as its sovereign right as lower riparian and stop India by FORCE from interfering in the waters of Indus, Jhelum and Chenab.

PAKISTAN HAS ONLY TWO OPTIONS:-
SLOW DEATH AT THE HANDS OF INDIA'S WATER WAR
OR
FACE IT WITH A RESLOVE-NOT TO LET INDIA DEPRIVE US OF OUR RIGHT TO WATERS OF CHENAB, JHELUM AND INDUS

Theoretically Pakistan is left with only 142 MAF (Indus 93, Jhelum 23, Chenab 26). Out of this 34 MAF goes down to the sea. Hence the necessity of building more storage dams to compensate for decreasing storage capacity of Tarbela and Mangla dams, flood control, generation of cheap hydroelectric power and develop new lands to meet the food for the rising population at 3% per annum.

So construction of Bhasha Diamir and Kalabagh on Indus, Munda dam on SAWAT River and AKHORI dam on Indus River are very urgent. No storage dams have been built after Tarbela dam-1974 almost for 40 years.

Some 41 MAF is being wasted in the canal networks due to the percolation and seepage. This wastage has created the menace of water-logging and salinity rendering thousands of acres of fertile land useless. This has also caused a rise in the sub-soil water level greatly impairing the fertility of the land.

To conserve the waters within the canal networks, suffering stupendous losses, we should line the canal networks. Lining of canals involves only indigenous materials and will save around 9 MAF of water which is more than Kalabagh/Tarbela dam. Availability of this water will solve the water disputes between Punjab and Sindh.

The improvement of On-Farm water channels, precision land levelling and adopting growing of crops on ridges will save water and raise per acre productivity. Select crops that require minimum volume of water. Precision land levelling saves 30% water and ensures optimum use of seeds, fertilizers and water. Helping of small farmers to precision land level their lands is the best help government can render to poor farmers and raise agriculture's production by 50% and hence national wealth.

Rice crop needs 17 MAF of water. Reduce the acreage of rice and grow wheat, oil seed and cotton crops. Similarly sugar cane consumes enormous quantity of water, its cultivation should be restricted to Riverine areas in Punjab, where water is required for 2-3 months. Once the roots go down these use residual moisture in the ground.

4.4: INDIA'S CAPABILITY OF COMMITTING WATER TERRORISM

India, having obtained full control of water of the three Eastern Rivers, RAVI, SUTLEJ AND BEAS and also that of CHENAB and JHELUM (by building storage dams), is now fully capable of committing water terrorism as it has demonstrated in summer 2013 by releasing 117,000 cusecs in Sutlej River, 117,600 cusecs in Ravi and 500,000 cusecs in Chenab River. This results into Billions of Dollars of loss of human and animal lives, property, infrastructure and crops.

Similarly India is also capable of stopping Chenab River's flow and cause drought in Central Punjab's most fertile lands.

Similarly by obstructing flow from WULAR Lake, India will be capable of stopping Jhelum River's flow for 40 days whenever she likes. As per Indus Water Treaty, India is required to give Pakistan 5 days prior notice before releasing the water. But India informs Pakistan only after releasing the water from its dams. This is a clear

violation of the treaty and PK should claim damages at every breach in the International court of justice.

This is a life and death situation and our government and politicians should wake up and take proper measures.

Only a strong Pakistan can force India from preventing this terrorism. In order to finish Pakistan India does not have to go to war against Pakistan, they have the water weapon at their disposal. They can use it when they please to do so.

Negligence on part of successive governments of Pakistan has brought the nation to this stage.

4.5: 62 DAMS ON RIVER CHENAB AND CONTROL ON THE FLOW OF CHENAB AND JHELUM RIVERS TO PAKISTAN

In gross violation of the Indus Water Treaty of 1960, in which India got complete water resources of the three Eastern Rivers, Beas, Sutlej and Ravi, and Pakistan Chenab, Jhelum and Indus, India started to construct dams and power stations on both rivers Chenab and Jhelum. The aim is to gain complete control on the flow of the two rivers, so that whenever India wants to stop the flow it can do so to the detriment of Pakistan's agriculture. She can stop the flow when Pakistan needs the water and release the flow when Pakistan does not need it.

India has been demonstrating its capability to destroy crops, property, infrastructure and human lives during the last couple of years, during the monsoon season. India will have complete control on the flow of all the five rivers-Sutlej, Beas, Ravi, Chenab and Jhelum as soon as the projects on Jhelum and Chenab are completed. This is how India is achieving control on the flow.

JHELUM RIVER

WULAR LAKE is one of the largest natural water reservoirs. The lake is capable of storing the Jhelum river flow up to forty days by constructing the Wular Barrage. In order to get control of Neelum

river, India is constructing the KISHINGANGA dam on it and a 100km channel and a 27km tunnel, to divert its flow to join the WULLAR lake at BANDIPURA. Once these two projects are completed India will have complete control on the flow of Neelum and Jhelum rivers and can stop their flow for 40 days. If Neelum's flow is diverted our investment on the 969MW Neelum-Jhelum Hydropower project would be in danger. The diversion should be stopped by force if negotiations fail.

CHENAB RIVER

India plans to store 20 MAF water on Pakistan's rivers for power generation projects. The total flow of Jhelum and Chenab is 23+26=49 MAF. If water is stored in various dams-along its course Chenab alone will suffer a loss of 20% of its water due to evaporation losses and other reasons.

India started its plans by first constructing SALLAL dam on River Chenab, just 25 miles upstream of MARALA Headworks, in 1980 during Gen Zia's dictatorship. India has since accelerated its plans and has started dams on Chenab's tributaries in Himachal Pradesh province of India as well. Some of the projects on river CHENAB and JHELUM are following:-

Completed projects

Project	Capacity in MW
SALLAL DAM on CHEENAB	6×115=690 MW-113m high
URI-I on JHELUM	480-on Jhelum river
Baghlihar I on CHEENAB	450
RANJIT SAGAR DAM on River BEAS	120 MW-Control of Sutlej river's overflow
DULHASTI on CHEENAB-DODA	390 MW
Lower Jhelum upstream of URI	106 MW

Projects to add 7,036.5MW during 2012-2017-12th Plan

Baghlihar II on Chenab	450
Swalakote I & II – on Chenab	1,200
Kirthai I – on Chenab	240
Kirthai II – on Chenab	900
Lower Kalnai – on Chenab	50
New Ganderbal	93
Parnai	37.5
Kero – on Chenab	600
Kawar	520
Kishanganga on Neelum	330
Ratle – on Chenab	850/690
Pakkal dul – on Chenab	1,000
Ujh	280
Bursar	1,020
URI-II Baramula	250-on Jhelum River

India has built 14 dams on River Jhelum and Chenab

After completion of these dams, some 6.516 million acres of land in Pakistan's eighteen districts would suffer acute shortage of water while 406 canals and 1,125 distributaries would become completely dry. The affected areas are the most fertile irrigated lands of Pakistan, producing bulk of cotton, wheat, rice, maize and sugar cane in Pakistan. The effected districts are following:-

SIALKOT, NAROWAL, GUJRANWALA, SHEIKHUPURA, DEPALPUR, OKARA, MULTAN, JHANG, FAISALABAD,

GUJRAT, HAFIZABAD, VEHARI, BAHAWALNAGAR, BAHAWALPUR, LIAQATPUR, SAHIWAL, KHANEWAL AND RAHIMYAR KHAN.

Another row of 60 back to back water cum power projects are coming up in the river Chenab basin of Himachal Pradesh Province in India and Indian-held Kashmir. These projects have been initiated without considering any cumulative impact assessment in terms of ecology, geology, disaster and climate change impacts. In this World's largest HIMALAYAN range such huge constructions can bring destruction to the environment. It can become world's largest dangerous region and bring a disaster.

Some other Hydro projects finalised, completed or under various phases of completion by India in Indian held Kashmir or Himachal Pradesh Province of India, located in the Chenab river basin are as follows:-

Project	**Capacity in MW**
Sewa I	120-KATHUA district
CHUTAK	44-In KARGIL
Parkochok	30-In KARGIL
SELI	450- In LAHUL and SPITI district of Himachal Pradesh
SHAMNOT	4x92.5-In DODA district
BARINIUM	2x120
Lower Kalnai, Doda	50
Lower Ans, Udhampur	37
Parnai, Rajouri	37
Mandi, Rajouri	37
Bichllery, Rajouri	36

Project	**Capacity in MW**
Sonmarg, Srinagar	83
New Ganderbal, Srinagar	50
Sewa II, Kathua	90
Mawar Hydel, Handwara	6
Boniyar Stage II, /Baramulla	6
Lidder, Anantnag	30
Vishar, Kulgam	15
Aru Hydel, Anantnag	30
Wangat Hydel, Srinagar	30
Sandarn Hydel, Anantnag	6
Lassipora, Handwara	4
Kahmil, Handwara	4
Chingus II, Rajouri	2
Neeru, Doda	25
NAIAGUH	200-KISHTWAR-Doda district
NIMO BAZGO-on INDUS LADDAKH	45
DUMKHAR DAM on INDUS LADDAKH	45

Several other projects in Himachal Pradesh Province on Chenab River are:-

GYPSA, CHATTRU, SHANGLING, MIYAR 120 MW on Chenab, REOLI DUGLI, BARDANG, PATAM, TINGET AND PURTHI.

Another five projects on Chenab River have been inaugurated by the President of India recently. These projects have been termed as TEMPLES OF ENERGY- GONDALA, MIYAR, PURTHI, JEHYA

AND REOLI (already mentioned in the list of Himachal Pradesh projects).

Currently five major water projects – Kishanganga, Ratle, Miyar, Lower Kalnai hydroelectric project, Wular barrage and Tulbul navigation are of immediate concern. India has already utilised the 33MAF of the allocated share of three eastern rivers Ravi, Sutlej and Beas for irrigation and power generation. India is building 53 hydropower projects and 7 dams on river Chenab. India has constructed 16 projects and four are in construction phase.

ON KISHANGANGA PROJECT THE ARBITRITION TRIBUNAL'S DECISION WAS NOT IN FAVOUR OF PAKISTAN – FORBIDDING INDIA TO CONSTRUCT WALL ON THE RIVER BED IS NOT BEING IMPLEMENTED BY INDIA. THIS WILL PUT OUR 969 MW NEELUM JHELUM PROJECT IN JEOPARDY. INDIA WILL NOT ABIDE BY THE 1960 INDUS WATER TREATY. ONLY WAY FOR PAKISTAN IS TO PROTECT ITS WATER RIGHTS BY FORCE.

4.6: ADVERSE EFFECT OF CLIMATE CHANGE

Pakistan ranks eighth on Global Climate Risk Index. Although Pakistan's contribution to green house gases is only 0.8 Percent but she is at great risk from global climate change. Already Pakistan experienced great damage to agriculture, human life and infrastructure during 2010 floods costing $ 10 Billion. Pakistan's main stay is on agriculture and erratic rainfalls patterns, due to climate change, are affecting agriculture. Frequent floods, due to erratic rainfalls and rapid melting of glaciers in the Himalayas, are the greatest dangers to agriculture and infrastructure. In order to protect against these risks Pakistan should seek international help in rapid completion of the three dams namely Bhasha, Kalabagh and Akhori and colossal drive in installation of P.V. Solar and Solar thermal resources in addition to hydroelectric resources of 60,000 MW and wind energy potential of 50,000 MW. Efficient use of water in agriculture by adopting precision land levelling and eliminating losses in canal irrigation system. Pakistan should develop clean Coal energy by using Super

Critical technique and Integrated Gasification and Combined Cycle (IGCC) technology for use of coal energy. Diesel powered irrigation pumps will have to be replaced with electric motors and solar pumps.

Pakistan's neighbour, India, is the world's third largest polluter producing 68 % of its electric energy from coal. The erratic rainfall pattern and increasing melting of glaciers is mainly due to rapidly increasing use of coal by India. The world community should be requested to recognize this fact and India should be made to pay Pakistan for the damages incurred due to erratic rains, floods and smog during the two months in winter.

4.7: HYDROELECTRIC POWER

Pakistanis being poor can only pay an affordable price of electricity. As long as the power mix remained 70:30 Hydro and thermal, rates remained affordable to the general public. Industry and agriculture prospered.

The World Bank started pressurising our government to increase the electricity rates so that it is attractive enough for foreign companies. That is how the foreign investors came into Independent Power Production (IPP) into Pakistan. The price of furnace oil was only Rs 6000 per ton. It was the quickest way to establish IPP's, requiring only 2 years to start production by using furnace oil. This programme started from the first tenure of the P.P.P government of Benazir Bhutto. There were great opportunities for Mr. Zardari to make 10% commission from these IPP projects. Rates, terms and conditions granted to IPP's were most unfavourable to Pakistan. For paltry commission of 10% by Mr.10% thermal IPP's were forced on Pakistan. Pakistan will continue to suffer, for decades to come, from IPPs tariff for the paltry commissions earned by Mr. 10%. Meanwhile, due to successive devaluations and rise in price of oil on World markets, the price of furnace oil rose from Rs 6,000 to Rs 68,000 per ton. The price of electricity to PEPCO (Pakistan Electric Power Company) has shot up to Rs 14/unit, whereas government had to subsidise the domestic consumers by charging only Rs 9/unit. That is how the PSO, IPP's and gas companies got entangled with circular debt of Rs 500 Billion. Mr

Nawaz Sharif's government has cleared the debt but it will continue to appear every month until subsidies and theft of gas and electricity are not eliminated.

Pakistan's existing generating capacity at 22,000MW is capable of meeting the maximum peak demand of 18,000MW provided tariff subsidies, transmission and distribution losses and theft of 40% and mismanagement at GENCOS and DISCOS is eliminated.

Government has already started to work on war footing to bring the tariff to an affordable level and eliminate load shedding. But there is no quick solution. We have to face load shedding for the next 3 to 5 years. We must not deceive ourselves. These technologies will not come into operation immediately. Meanwhile we must plan and manage the load shedding so that it does not hurt industries (affecting our exports), agriculture and vulnerable services like urban water supplies, street lights, universities, schools, hospitals and courts by establishing separate supply lines for the above sectors.

From the 1987 era of PPP government until 2013-a period of 25 years-we did not build a single hydro power project after Tarbela and Gazi Barotha. The construction time for hydroelectric projects requires 10 to 15 years. But until we are able to construct hydroelectric projects and bring in renewable energy projects we cannot bring the tariff to an AFFORDABLE level for the people and economy of Pakistan. We have to eliminate LOADSHEDDING for good at the same time bring the TARIFF to an AFFORDABLE level i.e. Rs 5/unit, otherwise our exports will become UNCOMPETITIVE in the world markets.

4.8: STORAGE OF WATER FOR IRRIGATION AND HYDRO POWER GENERATION

Mangla and Tarbela dams were built as water storage dams as replacement for the loss of the three Eastern Rivers waters under the Indus water treaty. The last dam, Tarbela, was completed in 1974. Storage capacity of both the dams is fast decreasing due to SILTING. Raising of Mangla dam has been completed this summer in 2013. This will only compensate for silting during the last 40 years. It is estimated

that new storage capacity of 6.2 MAF is needed every 5 to 10 years. We have increased nothing, except for Mangla raising for the last 40 years. Total quantity of available water is 145 MAF. Our live storage is only 14.10 MAF. 30 to 34 MAF is going to sea whereas we require only 8.6 MAF to be released to sea downstream of Kotri Barrage so 22 MAF should be stored.

Pakistan is wasting 34MAF of water to the sea every year. Pakistan is included in the list of 15 countries who are experiencing water shortage. As per an ADB report – "as per international standards Pakistan has the capacity to store water for 100 days requirement but it has only 30 days storage capacity at present – 14.1 MAF". Floods do billion of dollars damage every year due to our not building storage dams. Shortage of water will cause internal security problems, a danger to region's peace and shortage of food.

The two dams are basically to store water for agriculture. Water is released in response to demand from agriculture. Hydroelectricity is produced as a by-product when water is released for agriculture. Electric power cannot be generated in response to demand from the National Grid. More than half of the annual median flow occurs in the flood season of June, July and August. During this period no principal crop is either sown or matures. Rabi (HARI- winter) crops are sown in September and harvested in April. Kharif (SAWANI- Summer) crops are sown in March and harvested by June. In the three rivers (Indus, Jhelum and Chenab) 57% of the total annual flow occurs in June to August when the irrigation demands are minimal and it is during this time that the reservoirs at Mangla and Tarbela are filled. It is during September to June period that the dams discharge the water. Annual canal closures for 6 weeks take place during December and January. During these 6 weeks no power can be generated. Also the months of November and March and April are of low releases of water hence generating capacity goes down. Irrigation requirement for KHARIF (Summer Crops) April to September are met easily. Shortage occurs for RABI (Winter Crops) when Wheat, the main staple food of Pakistan is cultivated.

Inspite of above limitations we have the possibility of generating power in response to National Grid demand. The demand for electric power has seasonal as well as daily variations. The peak demand is usually met from thermal sources i.e. gas turbines costing more than Rs 18/unit. But by using the method described below we can meet peak demand at less than Rs 1.5/unit.

When Bhasha Diamir and Kalabagh are completed both Bhasha and Tarbela can be used for meeting peak demand even when water is not required for release to agriculture.

Tarbela can hold the water released from Bhasha and Kalabagh can hold water released from Tarbela. But water from Kalabagh would only be released when required for agriculture. By this method we can use the full generating capacities of Tarbela - 4888MW (after completion of fourth extension of 1410MW) and Bhasha which comes to 9,388MW. After completion of Tarbela fifth extension total capacity will rise to 6,298MW at Tarbela. When Bhasha water is released DASU's run of the river capacity of 4,320MW can also be used. Plus THAKOT 4,000MW, PATTAN 2,300MW-Run of river. The three run of the river projects add up to 10,620 MW. The total comes to 21,418 MW.

Therefore in order to get maximum benefit from our hydroelectric resources we must complete Kalabagh-storage 6.1 MAF, generating capacity 3,600MW and Bhasha storage 8.5 MAF, generating capacity 4,500MW. We must muster all our resources to complete Kalabagh and Bhasha dams as early as possible. Akhori dam near ATTOCK can add storage of 7.0 MAF.

Mangla Raising- Raised by 30 Feet Maximum Height 1242 Feet above mean sea level. Original dam completed June 1967- Capacity 5.88 MAF- capacity reduced 20% to 4.7 MAF. Raised Capacity increased to 7.48 MAF- increase in capacity 2.78 MAF. Raising project started 2004 completed 2009. Raising provided great Relief in September 2014 floods.

Province-wise hydro power details, both operational and under construction are enclosed on next pages. Projects in the Kohistan region and on the Indus, above Tarbela are detailed separately. Section 4.13 contains estimated cost of major hydroelectric projects to be constructed.

4.9: HYDEL POWER PROJECTS

4.9.1: LIST OF HYDRO ELECTRIC PROJECTS IN OPERATION THROUGHOUT PAKISTAN

Project		MW capacity
Tarbela	3,478	
	Fifth extension will increase capacity by 1410 MW.	Fourth extension 1410MW under construction will increase capacity to 4,888MW
Gazi Barotha	1,450	
Mangla	1,000	310 MW extension will increase to 1,310 MW
Warsak	243	
Chashma	184	Low head
New bong	84	The first IPP project
Khan Khwar	72	
Jagran I	30.4	
Rasool Barrage	22	
Malakand I	22	
Dargai- Malakand II	20	

Project	**MW capacity**	
Shadiwal	14	
Chichoki Mallian	14	
Nandipur	13	
Kurram Garhi	4	
Renala Khurd	1	
Gomal Zam	17.4 Water storage capacity 1.2 MAF. Will irrigate 200,000 acres in district Tank and Tehsil Kolachi of district D.I Khan	Inaugurated in September 2013
Satpara G.B	16	
Malakand III	81 Jaban-Sawat Canal	Completion October 2013
Allai Khwar	121	
Duber Khwar	130	Completion October 2013
Jinnah	96	Low head
Total	**6,789**	

N.B Neelum Jhelum 969 MW First turbine to be operational by June, 2017 rest by December, 2017.

Tarbela Fourth extension 1,410 MW to be operational by June 2017

Note: Total Hydroelectric potential on Indus River 60,000MW.

Pakistan's total hydroelectric potential- 100,000 to 120,000MW.

Potential in use about 14%-achieved in 55 years 1958-2013.

4.9.2: HYDEL PROJECTS-AJK AND GILGIT BALTISTAN

				Capacity in MW
	1	Mangla Dam	Once 310MW extension completed	1,310
	2	LARAIB Energy IPP (HUB Power)	New Bong Escape-Mirpur	84
	3	Neelum Jhelum		969 new completion date June 2017
PPP	4	Gulpur	Poonch river-2017/ 2018	100
PPP	5	KOLTI	Poonch river-2018	100
	6	Sehra	Completion Dec 2018	130
	7	Azad Pattan	2020	640
	8	CHAKOTHI-HATTIAN	2020	500
	9	KOHALA Cost $ 2.2 Billion Three Gorges project-China	2020	1,100
	10	HARI GEHL-District BAGH	AJK project	53
	11	JAGRAN-DAM I		30.4
	12	JAGRAN DAM II	AJK project	48- retendered 8/2/15
	13	Shunter		48 MW
	14	Dowarian		40
	15	Naghdar		35
	16	JAGRAN IV		22
	17	RAJDHANI ON POONCH RIVER		132
	18	ATHMUQAM on Neelum river		350
	19	DUDHNIAL-Neelum river		960
	20	KUNDAL SHAHI		700
	21	JAGRAN III		90
	22	ASHKOT Neelum Valley	Laraib/Hubco	700

GILGIT BALTISTAN

				Capacity in MW
	1	G.B-Many small, mini and micro projects		248
	2	HANZAL GILGIT		40
	3	Tangar- Chilas		15
	4	SATPARA LAKE		17.3
	5	PHANDER		80
	6	SHAGHARTANG		26
	7	GHOWARI - GANCHE		30
	8	NALTAR V & III		30
	9	NALTAR IV		18
	10	Doyian- ASTOR River		490

4.9.3: MAJOR PROJECTS ON INDUS RIVER – TARBELA AND UPSTREAM

			Capacity in MW
1	SHYOK	A tributary of Indus near KHAPLU	520
2	SKARDU DAM		1,200 $ 3 Billion
3	BUNJI	Run of river	7,100 $ 13.5Billion
4	Diamir Bhasha Dam	8.1 MAF – RCC 272 M height	4,500 $ 15 Billion
5	DASU	(phase 1-2160MW) completion 5 years	4,320
6	PATTAN	Run of river	2,300 $ 4.2 Billion
7	THAKOT	Run of river	4,000 $ 7.0 Billion
8	TARBELA DAM	Existing	3,478

			Capacity in MW
9	TARBELA DAM	Fourth extension Completion 2017	1,410 $928 Million
10	TARBELA DAM	Fifth extension	1,410 $790 Billion
11	YULBU-SKARDU	140 M high	2,800 $ 5.8 Billion
12	TANGUS-65 downstream of Skardu	127 M High	2,200 & 5 Billion

Tarbela up and running- 3,478MW

Tarbela fourth extension-1,410MW

Tarbela fifth extension-1,410

Tarbela total- 6,298MW

Soon under construction:

DASU-4,320MW Project approved by ADB, World Bank & USA US$700 million being approved by World Bank. (Only phase-1-2160 MW will be started April 2014)

Diamir Bhasha-4,500MW Construction will start end of 2016

BUNJI-7,100MW

Total- 22,218MW

4.9.4: HYDEL PROJECTS ON TRIBUTARIES OF INDUS IN KOHISTAN AREA AND BALTISTAN

				Capacity in MW
	1	Khan Khwar (in operation)	Bisham Qila	72
	2	Allai Khwar (in operation)		121
	3	Duber Kwhar (in operation)		130
	4	Keyal Khwar Rs 278 Billion Completion 4 years		128
PPP	5	Lower Spat Gah Government-PVT-SOUTH KOREAN COMPANIES		496
PPP	6	Lower palas valley Government-PVT-SOUTH KOREAN COMPANIES		665
	7	Kandiah river near DASU		548
	8	HARPO-75 km west of Skardu in BALISTISTAN	$ 44 Million Chinese Company	33
	9	KARANG-entails underground power station		458
	10	KARORA- on Khan Khwar river near Karora distt. Shangla		11.8
	11	BASHO-40 km downstream of Skardu BALISTISTAN	$ 40 Million Chinese Company	28
	12	TANGAR		13

Middle and upper Spat Gah Capacity 778 MW

Middle and upper Palas valley Capacity 555 MW

4.9.5: HYDEL PROJECTS IN PUNJAB

		Capacity in MW
	1 CHASMA-JHELUM LINK outfall	44
	2 30 small hydro projects	308
	3 Kalabagh-if constructed by Punjab from its own share of 1991Water Accord	3,600
	4 Ghazi Barotha-Run of river	1,450
	5 Rasul Barrage on Jhelum	22
	6 Shadiwal-upper Jhelum	14
	7 Chichoki Malian-Upper Chenab	14
	8 Nandipur-Upper Chenab	13
	9 AKHORI Dam	600
	10 TAUNSA-Low head	125
	11 Guddu-Low head	33 IN SINDH PROVINCE
	12 Five small projects government of Punjab	24 24
	13 Chashma Low head-In operation	184
	14 Jinnah Barrage low head-in operation	96
	15 KAROT-Jhelum river Distt: Rawalpindi	732 Chinese funded cost $2 Billion
	16 MAHL- Joint project of AJK & Punjab	600

PUNJAB POWER DEVELOPMENT BOARD HYDEL PROJECTS

LOCATION	MW
LCC	7.55
Khanki New Barrage	27
Qadirabad	23
UCC	3.58
QB Link	7.68

4.9.6: HYDEL POWER PROJECTS KPK

CHITRAL AND DIR

			Capacity in MW
PPIB	1	GOLAN GOL- on Tributary of Mustuj River. Completion end-2015	106 WAPDA Project
	2	NECKHERDIM on Mastuj River	90
PPIB	3	TURTONUS UZGHOR on Golan Gol	58
PPP	4	LAWI-Shishi River Tributary of CHITRAL River	70 PEDO Project
	5	SHARMAI Panjkora River Dir.	115
PPIB	6	Shurghai Zhendolli.	144
PPIB	7	Shogo-Sin	132
	8	Arkari Gol – PEDO Project	79
	9	Istaru Booni – PEDO Project	52
	10	Majigram-shoghore – PEDO Project	51

SWAT

			Capacity in MW
PPP	1	MUNDA DAM-Swat River-Held up due to resistance to relocation by LOCALS. Storage capacity 1.29 MAF	740
	2	AsritKedan-Swat River Younas Bros. And South Korean Companies	215
	3	KALAM Asrit–Swat River	197
	4	Gabral KALAM-Swat River	101
	5	Matilatan-Gorkin 8 km from Kalam on USHU river	84 PEDO project
	6	MADIAN-Swat River	157
KAGAN VALLEY	7	PATRIND-KUNHAR RIVER NEAR MUZZAFARABAD	147
KAGAN VALLEY	8	SUKI-KINARI-KUNHAR-RIVER 10 Km upstream of Kaghan SK Hydro Pvt Ltd	870 $ 1.8 Billion Completion 2020
KAGAN VALLEY	9	Mahandri – Manur Nullah Mansehra	13
	10	Daval Khwar Swat	40
	11	Tangar – Mansehra	12

OTHER KPK

		Capacity in MW
1	WARSAK KABUL RIVER-SILTED UP-ONLY RUN OF RIVER-BEING REHAB	243 after Rehabilitation
2	Malakand III	81 JABBAN
3	DARGAI (Malakand II)	20
4	KURRAM GARHI	4
5	GOMAL ZAM-WAZIRISTAN	17
6	KURRAM TANGI DAM storage 1.2 MAF Will irrigate 16,380 acres	19
7	TANK ZAM	25.5
8	SHYDO-13 projects	370
9	SHOZHOSIN	132 PEDO PROJECT
10	Malakand I	22
11	TRAPPI-SIRRAN RIVER nr MANSEHRA	32
12	Pehur- Swabi High Level canal	18
13	Naran	210
14	Balakot	190
15	Batakundi	65

29/1/16 PEDO has following Hydro projects in operation Malakand III 81 MW, PEHUR 18 MW, Reshun 2.8 MW, Shishi 1.8 MW Total 105 MW, Total Income for KPK Rs 3 Billion per Annum

Under Chinese finance following projects have been advertised for participation by Private sector.

S #	Name of Project	District	Capacity MW
1	Naran Hpp	Mansehra	188
2	Shigo Kas Hpp	Dir Lower	102
3	Arkari Gol	Chitral	99
4	Bata Kundi	Mansehra	96
5	Ghorband Khwar	Shangla	21
6	Nandihar Khwar	Batagram	12

Following project are under construction:-

Ranolia	– Kohistan	–	17 MW	Completed 2015-16
Machai	– Mardan	–	2.6 MW	Completed 2015-16
Daral Kahawar	– Sawat	–	36.6 MW	
Koto	– Lower Dir	–	40 MW	
Jabori	– Manshera	–	10.2 MW	
Karora	– Shangla	–	11.8 MW	
Matilitan	– Swat	–	84 MW	
Lavi	– Chitral	–	69 MW	

ECNEC approved following projects in December, 2013 under private/ public participation.

Sharmai – Dir	- 150 MW
Shusghai Zhendoli-Lower Dir.	- 144 MW
Shogo Sin –Chitral	- 132 MW
Total	- 426 MW

KPK Energy Plans under PEDO

Balakot	-	Manshera Distt	- 300 MW
Ghorband	-	Shangla	- 18 MW
Matilitan	-	Swat Ushu River	- 84 MW
Lawi	-	Chitral	- 69 MW
Nandihar	-	Distt Batagram	- 10 MW
Mujigaram Shaghore	-	Chitral	- 51 MW
Istaro Booni	-	Chitral	- 52MW
Arkari Gol	-	Chitral	- 79MW

KPK Feasibility Completed Phase 1

S #	Location	Capacity MW
1	Balakot	300
2	Naran	188
3	Bata Kundi	105
4	Bari Kot Patrah	47 Dir
5	Patrah- Shangrail	22 Dir
6	Shogo Kaas	102 Dir
7	Gorband Khwar	20.8 Shangla
8	Nandihar Khwar	12.3 Batagram
9	Arkari Gol	99 Chitral
10	Mujigram Shoghor	64 Chitral
11	Istaru Booni	72 Chitral
12	Ghrait- Swir	377 Chitral
13	Booni- Zaith	350 Chitral
14	Jamshil More Lasht	260 Chitral
15	Laspur- Murigram	230 Chitral
16	Total	2,249 MW

Phase II

17	Kari Mushkar	449 Chitral
18	Tor Camp Godobhar	409 Chitral
19	Gabral Kalam	110 Swat

Pre-Feasibility Completed Various Small Schemes of 10 sites of 115 MW

In addition to above 500 mini hydro projects are being executed through Agha khan rural support program.

4.10: SLOW PROGRESS OF PROVINCIAL HYDRO POWER PROJECTS

Progress on projects, which are governed by the governments of AJK, Punjab, KPK and Gilgit Baltistan, is very slow. These projects need to be provided technical help and monitoring by WAPDA and financial help by the federal government. These might be small projects but it takes drops to make the ocean. Any slow progress/shortcomings will affect the realisation of the exploitation of Pakistan's total Hydro power resources .These projects need professional monitoring from Federal Government.

4.11: MONITORING PROGRESS AND BOTTLENECKS-HYDEL PROJECTS

A high powered monitoring cell should be created based at Islamabad which would report progress and measures required to remove bottlenecks to the Minister of Water and Power and the P.M. It should include professionals seconded from WAPDA and serving/retired officials from Pakistan Army corps of Engineers. The cell/team should have the transport facilities including helicopters (from Army aviation corps) and rugged four wheel drive vehicles to carry out frequent monitoring of all the hydel projects in the country. If necessary it could be split up into several teams monitoring specific regions i.e. a team for projects in KPK, Kohistan, Chitral and G.B. and AJK. Another team for Punjab and major projects on the Indus River. Wide publicity

should be given, in print and electronic media, of the progress reports to make the whole nation aware of the efforts and get the nation's total support in getting electric power to the masses at an AFFORDABLE level.

Similar monitoring cells should be created to monitor progress on coal conversion of thermal plants. Coal, wind energy, biomass energy from sugar mills, P.V. solar energy, and solar thermal energy projects.

COMPOSTION OF THE TEAMS AND FACILITES

The teams should consist of paid professionals but led by experienced and professionally qualified-VOLUNTEERS. Only such volunteers can do this job. The government should only provide office, accommodation and transport facilities to these VOLUNTEERS.

Pakistan has enough talent of Pakistanis within and overseas to find suitable VOLUNTEERS to lead these teams.

4.12: SEVERE SEASONAL VARIATIONS IN GENERATING CAPACITY OF MANGLA, TARBELA AND OTHER STORAGE DAMS (TO BE BUILT)

One of the big snags of Hydro generation is their severe variation in generating capacity. During winter months the generation capacity drops from 6,761MW to 2414MW when the dams reach just above their dead water level. This situation will be encountered in future storage dams as well. This phenomenon particularly occurs in the Indus River where the bulk of its flow is from melting of snow from glaciers which starts in the third week of April. This is most advantageous as it is the very time it is very hot in the plains and water is required for irrigation.

But nature comes to Pakistan's rescue. During this very period of November to Mid April when Hydel generation is at its lowest, we can generate 3,000MW from our sugar mills using bagasse, cotton sticks and coal. By using the sugar tops and field waste and growing sugar cane varieties producing more biomass we can increase this capacity to 4,500MW and thus make up the entire gap of hydel power.

4.13: FOREIGN ASSISTANCE AND MOBILISATION OF DOMESTIC RESOURCE TO MEET THE 2025 TARGET OF 20,000MW OF GENERATING CAPACITY-HYDEL POWER SECTOR.

Pakistan's present total generating capacity is about 21,000MW. Actual power produced is never more than 15,500MW due to de-rating, lack of supply of oil, gas and transmission capacity bottlenecks. Present installed hydropower capacity is 6,792MW which has to be increased to 27,157MW by implementation of a number of hydropower projects. We have achieved a capacity of 6,792MW starting from 1968 to 2013 a period of 45 years. Now just over a period of 12 years up to 2025 we have to increase the installed capacity by 20,365MW. It is a quantum jump.

4.14: DEVELOPMENT OF ROAD AND RAIL FACILITIES TO NORTHEN AREAS AND WITHIN PAKISTAN

Almost all the hydropower projects are on the Indus River in the Northern area. It was a great foresight of General Ayub and successive governments that KKH highway was developed up to China's border by Chinese and PK Army Corps of engineers, offering tremendous sacrifices in human life in such inhospitable mountain terrain. For Diamir Bhasha we need to improve 223km of road from HAVELIAN to the site. Matters will be helped by Chinese and Pakistani plans to develop rail and road links from Gwadar Port to KASHGAR'S rail head in China. We cannot wait that long for this project to be completed. For TRANSPORTATION OF HEAVY MACHINERY TO CONSTRUCTION SITES KKH is not suitable. Work on extending M.1 motorway to ABBOTABAD and ONWARDS TO CHILAS via KAGHAN-BABUSAR PASS and from MANSEHRA to THAKOT and on to DASSU should be started immediately. Foreign road construction contractors, preferably from China, Turkey and Iran AND PK Army Corps of Engineers units plus FWO and NLC should be assigned these tasks. No time should be wasted. Work should be carried out on WAR footing DAY AND NIGHT. A great benefit would be provision of employment to our stagnant economy. AIRPORT facilities closer to Diamir Bhasha and DASSU construction sites

should be built. Note: Airport near Mansehra has been sanctioned by GOP.

The GOP has already approved following projects:-

- Karachi to Lahore – 1160KM Motorway
- Muzaffarabad – Mirpur – Mangla N-5 Expressway
- Athmuqam- TAOBAT- Highway
- KEL- RATTU Road via SHUNTER PASS TUNNEL
- Havelian –Thakot- 120 KM
- Burhan – Mianwali – D.I. Khan Motorway 258 Km Rs. 124 Billion
- D.I. Khan – Zob – Quetta 4 Lane Expressway N-50
- Gwadar – Sukkur Motorway M-8
- D.G. Khan – Qila Saifullah – N-70
- Thakot- Raikot
- Astor- Jaglot An important link road from Neelum valley to ASTOR and on to Bunji/ Jaglot
- Upgrade GILGIT- SKARDU to expressway standard 167 km from JAGLOT-SKARDU cost RS 44 Billion under CPEC funding.
- GILGIT-CHITRAL upgrade RS 88 Billion.
- Babu Sar pass via Chillas as an alternative route to KKH via Kaghan valley
- A 4 lane motorway from Burhan (M-1 Interchange) to Mansehra is being funded by ADB. Phase I Burhan- Havelian. Phase II to Mansehra
- Expansion of Islamabad – Murree Expressway to Kohala.
- PAK – China Transit Facility – Railway from Khunjerb to Gwadar. Chinese firms – a consortium of two leading Chinese constructions

companies, China Railway Engineering Cooperation (CREC) and Sinotec, has offered to construct strategic Gwadar – Khunjerb rail link at estimated cost of Rs250 Billion, including Rs160 Billion for infrastructure and Rs90 Billion for locomotives on electric tractions basis in four years on soft loan terms.

In addition to rail link with China, this will link central Asian Republics with Pakistan Railway's Network and boost trade. The rail link will enhance Pakistan's security and stabilise the region.

ISLAMABAD – MUZAFFARABAD RAIL LINK. This rail route can be linked to the China rail corridor along Kunhar River of Kaghan. Kashmir railways established in the 2014/15 Federal budget. Chinese rail corridor should be routed from Balakot to Muzaffarabad and onto Rawalpindi / Islamabad instead of Balakot to Havelian. From Muzaffarabad it should be aligned along River Jhelum to reach Rawalpindi. Instead of Balakot/Havelian this would be the cheapest and easiest route to Rawalpindi. Eventually the Muzaffarabad rail can be linked to the railway system of the Indian held Kashmir to Baramula. This will give tremendous boost to international tourism in the whole vale of Kashmir. Indian held Kashmir Rail network is connecting JAMMU-UDHAMPUR-BANNIHAL-QAZIGOND-BARAMULA 338km. Only KATRA-BANNIHAL section 125km is awaiting completion due to bridge on river CHENAB-completion 2017.The network will be extended from BARAMULA up to the LOC at CHAKOTHI. If the SIALKOT-JAMMU Rail link is re-established it will complete a circular railway starting from SAILKOT via SRINAGAR-MUZAFFARABAD - RAWALPINDI and back to SIALKOT. It will make one of the most scenic railway in the world, giving tremendous boost to tourism.

Work on the Karachi – Peshawar railway track up gradation has begun. This will increase the speed to 120KM/hour from the present 92KM/hour. Up gradation project cost is Rs380 Billion. Dual track of the missing link from Karachi to Raiwind has been completed. Dual track from Lahore to Rawalpindi and Peshawar is a must now.

- Existing KKH from THAKOT to BHASHA site (which will serve DASU project also) has to be widened, rehabilitated, dozens of curves straightened and numerous crossing and parking bays have to be constructed before the road could be used to carry construction materials to Dasu and Basha dam sites. Upgradation of the entire KKH is being undertaken by GOP to make it an all weather road of international standard but GOP in its own interest should KICKSTART both the Dasu and Basha projects and at the same time must start road works immediately.

- Reference Section 4.8.3 – Major Hydroelectric projects on the Indus River (upstream of Tarbela Dam) – there are following sites Shyok near Khaplu – 520 MW, Skardu Dam – 1200 MW, Yulbu near Skardu – 2800 MW, Tangus – downstream of Skardu – 2200 MW, Bunji – 7100 MW. All these site are close to Skardu. Only Bunji's approach is nearest via Astor Valley Road through the Neelum Valley Road. Compared with KKH, approach through Neelum Valley from Islamabad – Muzaffarabad is the closest to Skardu and Bunji and is free from terrorist attacks. Total distance from Islamabad to Kel is 300 km. Islamabad to Muzaffarabad – 145 Km with completion of lower Topa-Kohala expressway, soon to be the expressway right up to Muzaffarabad. Muzaffarabad to Kel is 155km. The road from Muzaffarabad to Authmagam – 86km is excellent, better than KKH. Only Authmagam to Kel – 69 Km and Kel to Taobat – 54 km needs to be brought up to standard.

- THERE ARE THREE APPROACHES TO GILIGIT BALTISTAN FROM KEL TO TAOBAT SECTION.

1. Kel to RATTU Road-ASTOR VALLEY through Shunter pass tunnel. A tunnel like the Babusar pass is required to cross the Shunter pass (Height 5000 metres). This is the quickest route to Chilas. A better alternative to Chilas via Kaghan Valley and far better than KKH and being safe. Shunter pass tunnel has been approved by GOP and is now NHA project. Pakistan Army corps of Engineers are already working on the 37 km road from Kel to Shunter pass.

2. Taobat/KAMRI to Astor Valley Road. In pre-partition times this was the only approach into GB from Srinagar (developed by the British during their lease of the Gilgit Agency). The road follows Gurais-Kamri-Rattu-Astor route to Bunji. Total distance from Islamabad to Taobat/Gurais is only 354 Km. It is the shortest, quickest, safest and easiest route to Bunji from Islamabad. Muzaffarabad to Taobat road is approved by GOP in addition to Kel-Astor via Shuntar Pass.

3. Taobat-Pashwari-Minimarg-Burzil pass -CHILAM CHAUKI to Skardu through Deosai plains.

   Burzil Pass at 4,199 meters remain snow bound during winter, A tunnel through Burzil Pass, like the tunnel through Shunter pass from Kel to Rattu Road, is a prerequisite for being able to use this route. This will become a link Road between Gilgit Baltistan and Neelum Valley.

IMMEDIATE ACTION: The 209 Km Road from Muzaffarabad to Taobat has been designated and approved as NHA road and NHA has been tasked to bring this road to a highway standard. This is because there are a number of hydroelectric projects in this valley (detailed in section 4.8.2) in addition to Neelum Jhelum 969 MW project.

The road from Taobat to Chilam Chawki (via Burzill pass) and on to Sakrdu via Doesai Plains needs to be brought upto highway standards. The total distance from Chilam Chawki (via Doesai Plains) to Sakardu is 65 km and Taobat (via Burzil Pass) to Chilam Chawki is approximately 60 km.

TOTAL DISTANCE ISLAMABAD to SKARDU via Muzaffarabad-Taobat-Burzil Pass/ Shuntar Pass- Chilam Chawki is

Islamabad	– Taobat	– 354 km
Taobat	– Chilam Chowki	– 60km (Approx)
Chilam Chowki	– Skardu	– 65 km
Total Distance		– 479 km

Whereas Islamabad –Sakardu by KKH is 793 km –22 hours journey by bus.

A saving of 793-479=314 km. Similarly Islamabad- ASTOR by KKH is approximately 628 km.

Islamabad- ASTOR via Muzaffarabad is 467 km- saving of 161 km. Similarly saving to BUNJI from Islamabad via Muzaffarabad is 581-464 = 117 km. Work on the 209 km Road, tunnels and the roads into GB via Neelum valley should be given highest priority as these are going to take long time in completion being mountain roads. This will open up vast tourist opportunities, open routes between AJK and GB and provide access to hydroelectric sites.

NOTE: Taobat to Mangla- highway is now an NHA project. Only Taobat to Muzaffarabad Road project has been approved.

- DIRECT ACCESS TO TAJIKSTAN VIA CHITRAL ALONG YARKHUN RIVER-BAROGHIL PASS-WAKHAN STRIP (In Afghanistan) along AB-I-WAKHAN RIVER ON TO PANG RIVER (In Tajikistan) ISKASIM – CHORUG

Pakistan is going to get 1,000 MW from Tajikistan via Afghanistan through the World Bank sponsored CASA 1000 energy trade programme. Govt of Tajikistan has offered an additional 1,200 MW through the above mentioned direct route via Bargohil pass and Chitral.

Reference Section 4.8.6 Chitral has tremendous Hydroelectric potential. There are various projects totalling 900 MW under different stages of construction and many other potential sites. We will have to construct transmission lines to evacuate this generation capacity. A road and transmission line along the above route is feasible as per NHA's investigation. This will establish direct links with Central Asian states without going through unstable Afghanistan. But for this

to happen early completion of Lowari tunnel is necessary. A good road from CHITRAL-MASTUJ-BAROGHIL pass needs to be constructed and a tunnel through Baroghil pass. Apart from energy trade this road will have tremendous potential for trade with Central Asian states and provide secure communication to create stability in DIR and Bajaur area along the Afghan border. Trade with BADAKHSHAN province of Afghanistan with Chitral will prosper. Govt of KPK has already announced construction of 81 Km expressway from M-1 interchange of Swabi to Chakdara. This will become part of Sawat express way. FWO to start work in June 2017 and complete by December 2017.

- PESHAWAR-KABUL-MOTORWAY. GOP has already assisted Afghanistan by construction of Torkhum-Jalalabad dual carriageway by PK Corps of Engineers. FWO is going to complete the second lane to make it a four lane expressway. GOP has now called for consultancy for the Peshawar-Kabul Motorway. Completion of this project will stimulate trade with Afghanistan and Central Asia right through to Moscow, under CASA the 1000 MW transmission line will follow this route.

- No less important is our link to Afghanistan via Chaman. This road is very important for trade with Afghanistan and bringing minerals like Iron ore and Coal from Afghanistan. A recent agreement between NHA and US AID to rehabilitate 247KM of KALAT-CHAMAN road is important for regional trade linking KANDHAR to QUETTA to port of KARACHI.

- Iran is planning to extend rail link from Mashad to Herat. Only Chaman to Herat will remain without rail link.

- Quetta – Taftan rail track has to be laid afresh. Pakistan railways looking for private-public investment to rehabilitate the track. Only then regular rail service between Pakistan, Iran, Turkey and Europe can start.

- Torkham-Jalalabad Rail link Extension from Landi Kotal The PM has announced his intention to extend rail link to Jalalabad.

4.15: Typical cost estimates in U.S. Dollars for Hydro Power Projects.

	Project	Storage Capacity	Capacity in MW	Estimated cost ($Billions)
1	BUNJI		7,100	6.8
2	DASU		4,320	6.0
3	PATTAN		2,800	6.0
4	THAKOT		2,800	6.0
5	DIAMIR BHASHA	8.5 MAF	4,500MW + construction of 223 km road from Havelian to dam site.	14.0/12.0 completion time 12 years
6	KALABAGH	6.1 MAF	3,600	3.4in1987. Present 12.0
7	KOHALA		1,100	2.155
8	AZAD PATTAN		640	1.446
9	CHAKOTI HATTIAN		500	1.2465
10	AKHORI	7.0 MAF	600	4.4
11	MUNDA	1.29 MAF	740	1.4
12	TARBELA 4th Extension		1,410	N.A
13	MANGLA Extension		310 from 1000 MW to 1310 Mangla raising by 30 feet increased storage capacity by 2.9 MAF	N.A
14	MAHL-Run of River		600	N.A

Note: These sums look huge, but pay back on water storage for agriculture and hydropower will be very fast. By increasing exports Pakistan will be able to repay these loans quickly and bring prosperity to the common man of the country.

Even for starting construction of Diamir Bhasha, Kalabagh, Bunji and Dassu projects 19,520MW the financial commitment comes to 14+12+6.8+5.3=$38.1Billion. Taking on Kohala, Akhori, Azad Pattan and Munda projects 3,080MW involves 2.155+4.4+1.446+1.4=$9.401 Billion. It will be only possible if the China's Three Gorges Corporation's offer of $ 50 billion materializes.

4.16: FINANCES REQUIRED FOR THE HYDROPOWER PROJECT

Huge financial resources would be required to start THAR coal mining, coal power stations, conversion of existing oil and gas fired power stations to coal / Solar thermal/ synthetic gas, Wind energy, SOLAR energy-P.V. and Solar Thermal and conversion of sugar mills to electric power production. Fortunately the CPEC 45.6 Billion Chinese financing will help to implement these projects.

But Hydropower development will have to be taken in Public sector. Financing will have to involve World Bank, ADB, Islamic Development Bank and friendly countries like China, Turkey and the USA, Russia and Supplier's credit from foreign contractors. Best sourcing of these projects is to finalize China's Three Gorges corpn's offer of $ 50 million for hydro projects on Indus River.

Another method would be by raising bonds, assuring adequate return, for the Pakistani Diaspora in the Middle East, Europe and the USA. But the expatriate Pakistanis have not forgotten the foreign currency accounts saga of previous Nawaz Sharif regime executed by his Minister of Finance Mr. Ishaq Dar.

COAL ENERGY

5.1: General – Coal Energy Development

Presently coal is providing 26% primary energy and 40% of electricity worldwide. China is the World's largest producer and consumer of coal-accounting for 78% of its total energy requirement- meeting 60% of its electric energy from coal. USA is the second largest producer of coal in the World. Production of electricity from coal is a major cause of pollution to the environment. Now clean coal burning Technologies of CFB- Circulating Fluidised Bed – with lime addition gets rid of sulphur and IGCC- Integrated Gasification and Combined Cycle are available. IGCC technology is suitable for high moisture lignite coal for power generation. With latest technology coal fired thermal plants are achieving forty percent efficiency. China and Japan are the world leaders in the introduction of clean coal technology. Apart from CTL (coal to liquid) Coal can be used for producing synthetic gas, LNG and urea fertilizers. Australians will be soon exporting LNG from coal.

COST OF GENERATION THROUGH IMPORTED COAL IS 50% OF OIL. WITH LATEST TECHNOLOGY COAL THERMAL PLANTS CAN ACHIEVE 40% THERMAL EFFICIENCY. DAILY REQUIREMENT OF A 600 MW COAL PLANT IS 5000 TONS/DAY-1.8 MILLION TONS PER/ANU. THEORETICALLY HIGHEST THERMAL EFFICIENCY AT 45 % USES ONLY 320 GMS/ KWH.

Pakistan's coal resources are 185 Billion tons against India's 140 Billion tons. Against a very small utilisation of coal by Pakistan, India is producing 69% of the electricity from coal. With total coal reserves of 185 billion tons, 175 billion tons in THAR in SINDH alone, Pakistan is the SIXTH LARGEST coal rich country in the world. Only a small quantity of coal, of little significance in Pakistan's total energy is being used - in brick kilns, cement manufacture and electric power – 150 MW in LAKHRA & 15 MW in Quetta.

Many years have been wasted in quarrels between the Federal and Sindh governments to decide ownership and responsibility for developing the Thar coal reserves.

It is only in recent years, when the depleting Gas resources and 80% of our total electric energy, gobbling up 60-65% of our total export earnings, that the government has made up its mind to use coal reserves. The only two coal power stations 150MW in LAKHRA and 15MW in QUETTA are closed-awaiting REFITTING. Our energy demand was growing by 2,000 MW per annum when GDP growth was 7.5% per annum. Government's inability to take appropriate and timely decision to meet the growing energy needs has caused decline in GDP, industrial production, increased unemployment and stagnating exports.

UNLESS PAKISTAN CURTAILS ITS ENERGY IMPORT BILL THROUGH OPTIMUM EXPLOITATION OF INDIGENOUS RESOURCES, IT WOULD REMAIN MIRED IN ENERGY CRISIS AND EVER INCREASING DEBT TRAP. COAL, HYDEL POWER AND RENEWABLE ENERGY ARE THE MAIN RESOURCES CAPABLE OF GETTING THE COUNTRY OUT OF ENERGY CRISIS.

Thar's lignite coal is one tenth the cost of furnace oil in terms of heating value. Per unit price of electricity, generated from furnace oil, is not viable for industrial and domestic consumers. Present installed capacity of some 15,000 MW (60%) of the total 22,000 MW is based on Gas and Oil. Heavy reliance on imported oil and depleting Gas resources is a clear energy security threat. Total demand of electricity will be 50,000 MW by 2025, if GDP growth gets back to 7.5% per annum. Supply and demand gap is continuously widening inspite of 30% of rural areas being without electricity and 80% without piped gas. Rural electrification will be a major demand of the deprived rural population. If we complete all the new Hydel power projects of some 15,000MW by 2025 Hydel share-will be about 40% of the total 50,000 MW.

The biggest challenge is to REDESIGN the electricity portfolio and substitute the oil and Gas with abundantly available and cheap indigenous Coal, Wind, hydropower and Solar Energy resources to meet our future demand. This entails substitution of the existing

15,000 MW of oil and Gas fired plants with coal/ Solar thermal/ synthetic gas from coal and installation of another 17,000 MW also on coal, wind and solar energy. Including the new hydro power capacity, this amounts to installation of 32, 000 MW in 12 years.

If the government has the firm intention, planning and capacity to implement we will overcome the energy crisis. IF WE ARE SELF-SUFFICIENT IN ENERGY, AGRICULTURAL FERTILIZERS AND FOOD WE CAN JOIN THE RANKS OF SUCCESSFUL AND PROSPEROUS NATIONS. Nothing should deter us from pursuing these two objectives. We need to follow the Chinese model----put our heads down and not let other issues deviate us from the two objectives and make ourselves economically sound.

South Africa (using 93% coal), Poland, China, Australia, Czech Republic, Kazakhstan, Germany, USA, UK, Turkey, Ukraine and Japan are generating electricity from coal. Pakistan, with 185 billion tons of coal, is the only country-in the world producing a negligible amount of electricity from coal-165MW out of the total installed capacity of 22,797MW.

The coal deposits in THAR alone are estimated to be 175 billion tons. We can produce electricity and oil (Methanol and synthetic gas) from Thar Coal. With Thar Coal we can produce 100,000MW of electricity for thirty years and more. Thar coal is different from the rest of available coal found in Pakistan.

It has about one percent sulphur and less than 10% Ash which makes it ideally suited for power generation. Higher inherent moisture from 29 to 55 is no problem. Water, extracted, can be used for drinking and agriculture after filtration. It can be dried to 14% through natural sun drying in the desert before despatch to power plants. Technology to dry coal in steam heat exchangers is now available. Thar's lignite coal-power stations should be sited at the mine sites because Thar coal's low energy and high moisture do not justify transportation costs. One possible solution, if economically viable, is to convert Thar coal into synthetic gas at the mines and pipe the gas to the power stations at LAKHRA and JAMSHORO.

5.2: IMPORTED COAL VS LOCAL COAL

If we want to avail ourselves of cheap electric power, of Rs 4/unit, from Thar coal we must give immediate and serious consideration to above, before going ahead with coal fired power stations based on IMPORTED COAL. Otherwise this decision may land us into the same situation as of PPP's oil fired IPPs which bound the nation for years to come, in lieu of the paltry commissions that PPP top leadership received.

Recently NEPRA has notified upfront tariff for coal fired power plants to be established before June 13th 2019. The notified tariff is 7 cents per unit. This tariff is very high and until it is brought down to Rs.5 per unit the common man will be faced with the same high tariff as at present. A low tariff will only be possible if we use the THAR coal or convert it into synthetic gas. Low tariff will be achieved only by using indigenous coal instead of the imported coal. Imported coal has added costs due to sea freight and local handling at the time of import.

The rest of 10 Billion tons of coal located in Sindh, Punjab, Balochistan, KPK and Kashmir is semi-bituminous to bituminous– contains higher sulphur and ash and requires pre-treatment of de-ashing and de-sulphurization prior to use in power stations. Addition of lime, available in plenty in Pakistan, with circulating fluidised bed combustion technology can overcome these problems. Thus we can use the coal in Sindh (other than THAR), Punjab, Balochistan and KPK for power generation at mine mouths or only produce synthetic gas / liquid for power generation.

5.3: TYPICAL COSTS

NEPRA- upfront tariff Rs 8.12/unit for foreign funded plants and Rs 7.05 for locally funded plants.

Thermal efficiency for 600 MW-42%

Construction Costs for

200 MW- $ 212.4 million
600 MW- $ 585 million
1000MW- $885 million

5.4: FURNACE OIL AND GAS PLANTS - CONVERSION TO COAL FIRED

Government plans to modify all the 15,000MW power stations (IPPs and Government), currently using oil and gas, to coal fired are not practical. It entailed furnaces and boilers to be replaced with pulverised coal. IN VIEW OF THE AVAILABILITY OF CHEAP LNG THIS PLAN IS NOT FINANCIALLY VIABLE FOR POWER STATIONS LOCATED INLAND AWAY FROM COSTAL AREAS.

Initially, imported coal can be used in these power stations until THAR coal is extracted. After the availability of THAR coal, imports can be stopped. HOWEVER, THIS PLAN IS NOT FEASIBLE, OTHER THAN COASTAL AREAS. DUE TO ROAD AND RAIL TRANSPORT INFRASTRUCTURE NOT BEING AVAILABLE.

The coal-water slurry technology, practised in China, is useful for high sulphur coal. Use of coal-water slurry technology can reduce the cost of coal up-gradation for the rest of the Pakistani coal other than THAR coal. This technology should be tested on a pilot plant, although China is using it successfully.

By the year 2025, when we should be generating 31,500MW of electricity with coal, if GDP growth is 7.5% per annum, we would need 500,000 tons of coal per day delivered to plants in various locations.

5.5: AN ALTERNATIVE PLAN FOR CONVERSION

As long as we are going to rely on imported coal we should confine ourselves to sites near Karachi. For this reason we should select HUBCO, Tapal and Gul Ahmad from IPPs and JAMSHORO from GENCOS making up 2,037MW.

We should not neglect K.Electric in Karachi-population more than 10 million and Pakistan's hub of trade, industry and finance. If conversion to coal is going to give the population a relief in the cost of electricity why should Karachi and its people be neglected? K.Electric

is similar to IPPS. Instead of going for conversion to far off places like Muzaffargarh, Multan, Faisalabad, Sheikupura we should include K.Electric in coal conversion plan.

K.Electric installations are as follows:

Bin Qasim I	- 1,260MW
Bin Qasim II	- 560MW
Korangi Thermal	- 316MW
Korangi G.T.	- 80MW
SITE G.T.	- 100MW
Total	**= 2,316MW**

Total IPPs Karachi + K.Electric equal to 4,353 MW

This is exactly equal to PPIB's plans to convert 4,347 MW capacity to coal.

5.6: OVERVIEW/CONCLUSION ON COAL CONVERSION

- We have gone over the coal conversion of the existing 15,000MW thermal capacity and the selected 12 public sector and IPP of the 4,347MW capacity and three ear marked projects of 2,840 MW.

Conversion of oil fired plants on imported coal should provide that these can be changed to Thar coal when it becomes available in 5 to 8 years.

5.7: SYNTHETIC GAS FROM COAL - ALTERNATIVE PROPOSAL

IDEAL AND MOST PRACTICAL SOLUTION INSTEAD OF CONVERSION TO COAL

Since we do not have transport infrastructure for coal and neither the financial resources to build such facilities, we should concentrate on

providing synthetic gas from THAR coal fields and other mine fields and pipe the gas to the power stations. SOUTH AFRICAN AND CHINESE HELP AND TECHNICAL EXPERTIES WILL MAKE IT POSSIBLE.

5.8: SHALE OIL AND GAS OPTION

Logistics required for handling and transporting coal are enormous and will cost at least more than 6-10 billion dollars. Apart from the DO-ABLE coal conversion of 4,353MW, we should not waste our time and scarce financial resource on the wholesale conversion of the entire 15,000MW capacity. Pakistan should put those billions in exploring and production of SHALE gas and oil.

We possess a countrywide network for gas transmission and even oil pipelines to Kot Addu and Sheikupura. If SHALE gas is discovered we will not need to spend billions on railways and coal infrastructure. While we are prospecting for SHALE oil and gas we should build handling facilities for importing CHEAP LNG, which is becoming available in the World Markets, and waste no time in connecting ourselves to Iranian gas pipeline (provided price is viable) already at our border.

5.9: CONVERSION OF CEMENT PLANT FROM FURNACE OIL TO COAL

There are 23 cement plants-capacity 16-18 million tons. These plants guzzle2.1 million tons of furnace oil. Energy constitutes 45% total cost of producing cement. The coal containing high sulphur and ash can be used in cement plants. Therefore the coal in Balochistan, Punjab and KPK can be used to replace furnace oil. USE OF COAL instead of furnace oil should be made MANDATORY for cement plants. An average 2000 tons/day capacity cement plant consumes 340 tons/day.

5.10: DATA COAL RESERVES

Pakistan's province wise coal reserves

	In million tons
Sindh	184, 623
Balochistan	217
Punjab	235
KPK	91
AJK	9
Total	**185, 175**

COAL RESERVES IN SINDH

	In million tons	
Thar	175, 506	Lignite, Low sulphur, below 1%, low ash 10%
Lakhra	1,326	Sub-Bituminous to Bituminous. Lakhra coal field fully developed-High sulphur
SondaThatta-Jherruk Oagar	5,523	
Jhimpir	473	
Indus East	1,777	
Badin	161	
Total	**184,623**	

COAL RESERVES IN BALOCHISTAN

	In million tons	
Sor Range and Degari	76	Close to Quetta and Railhed
Khost, Sharigh, Harnai and Pir Ismail Ziarat	34	Bituminous
Mach-Abagum	23	
Duki	12	
Total	217	

COAL RESRVES-PUNJAB

		In million tons
Bituminous & high sulphur	Salt Range	213
	Makarwal	22
	Total	235

Latest estimates show 440 million tons but this is not confirmed by GSP. Australian Study estimates 500 Millions tons. This study is not reliable. New estimate is 600 M Ton

COAL RESERVES AJK

		In million tons
KOTLI Khilla near Muzaffabad	9	

COAL RESERVES KPK

		In million tons
Hangu	81	High quality iron ore and coal reported in CHITRAL No confirmation from GSP available.
Cherat	10	
Total	**91**	

5.11: LIST OF THERMAL POWER PLANTS – IPPs, GENCOS & K.Electric

List of IPPs

COMPANY	LOCATION AND FUEL	MW CAPACITY
Hubco	Karachi- RFO	1292
AES Lalpir	M'garh -oil Fired steam turbine	362
AES PAK GEN	Muzzafargarh –RFO	365
Altern	Fateh Jang Attock – Gas	29
Fauji	Kabirwala-Gas	157
Gul Ahmad	Karachi- RFO	136
HabibUllah Coastal Quetta	Balochistan –Gas	140
Japan Power	Lahore –RFO	120
Koh-e-Noor	Lahore –RFO	131
TNB Liberty	Daharki-GAS	232
Rousch Power	Khanewal-GAS	412
Saba	Sheikhupura-RFO	114
Southern power Raiwind	Lahore-RFO	110
Tapal	Karachi-RFO	126
Uch I & II	Nasirabad-GAS	586 + 425
Atlas	Sheikhupura	225
KAPCO	KotAddu- Gas/RFO	1, 638
SAIF	Sahiwal- Gas comb Cycle	225
Nishat	Chunian	200
Engro Power Gen	Gotki-Gas	200
Foundation power	Daharki-Gas	177
Hub power	NAROWAL-RFO	220
Orient	Balloki-Gas comb cycle	229

COMPANY	LOCATION AND FUEL	MW CAPACITY
Saphire Raiwind	LAHORE	225
Attock Gen		165
Halmore Com Cycle	Bhikhi-Sheikhupura-Gas	225
Nishat Power	Lahore	200
Sitara	Faisalabad	80
Liberty Powr Tech	Faislabad- Oil comb cycle	200
	TOTAL	

Under-construction

- Grange holding power-Oil-Arifwala 161 MV-Oct 2014
- Star-Daharki-134 MV-July 2016-based on low Btu natural gas from Mari gas field(Mari deep reservoir)
- KANDRA Gas powered – Sukhar
- Fauji Foundation 150 MW- Korangi Comb Cycle

LIST OF THERMAL POWER STATIONS

Public sectors Gencos

Location	Type	Capacity MW
Nandipur Gujranwala	Combined Cycle-Gas/RFO	Upgraded to 525
Shahdara Lahore	G.T	59
Faisalabad	Steam Power	132
Faisalabad	G.T	244
Multan	Gas power	195
Muzaffar Garh	Thermal	1350
Guddu	Natural Gas	1, 655 + 747 =2402

Location	Type	Capacity MW
Kotri	G.T.	174
Jamshoro 1 x 250 3 x 200	Thermal	850
Larkana	Thermal	150
Quetta	Thermal/Gas	35
Panjgur	G.T.	39
Pasni	Thermal	17
Chicho-Ki-Mallian	Combined cycle	525 to be constructed

REGASSIFED LNG- POWER PLANTS-3,600 MW AND 1,000 MW

GOP has launched a 3,600 MW project based on imported LNG. Completion within two years by end 2017

Thermal Efficiency 61%- Lowest Capital cost $ 0.5 Million/MW

Tariff 7.5 Cents/unit at current LNG prices

- Government of Punjab funded at Bhikhi – Sheikhupura- 1200 MW
- GOP funded Balloki near Kasur 1200 MW Cost Rs 93 Billion
- GOP funded Jhang 1200 MW Cost Rs 98.3 Billion
- NEPRA upfront tariff Rs 6.58 for gas Rs 10.67 on HSD
- 1000 MW RLNG plants in Pvt Sector locations Sukhar, Multan, Lahore , Faisalabad and Multan
- Atlas Power SK'PURA – 220 MV-RLNG

COAL FIRED POWER PLANTS

EXISTING PLANTS

Location	Capacity MW	Notes
LAKHRA	150	Alongside existing plant a 660 MW plant with $850 million Japanese finance
Quetta	15	

PLANNED/UNDER CONSTRUCTION

- Engro Power Gen Thar Coal ..... 2x330 to be expended to 1320 MW- CPEC
- Sino Sindh Resources in collaboration with Shanghai Electric 350 x4- CPEC
- Coal Mining-Sindh Engro coal Mining Co- 3.8 million Tons/ annum Thar Block II- CPEC
- Coal Mining-Sino Sindh Resources Block I- Subsidiary of Global Mining of China 6.5 million tons/annum-CPEC
- LAKHRA 660 MW JICA Japan funding $ 850 million.
- Jamshoro 2x660 MW- imported coal- ADB and IDB funding.
- Almirqab of Qatar with Chinese BIN QASIM 2x660 MW- Completion end 2017-CPEC
- Hubco – imported coal own Jetty 2x 660 MW- Completion Dec 2020-CPEC
- F.F Bin Qasim at port Qasim 118 MW
- Siddiqson Energy at Port Qasim 350 MW
- K-Electric at Port Qasim by Harbin Electric 2 x 350 MW
- HUBCO – 330MW – Thar Coal
- THAL POWER – 330MW – Thar Coal

- Government of Punjab Sahiwal 2x 660- Completion 2017-CPEC cost $ 1.5 Billion
- Government of Punjab Pind Dadan Khan- Local Coal 300 MW-CPEC
- K.Electric/ Bahria- 500 MW-250 MW Coal 250 MW gas
- Gwadar- 660 MW
- LUCKY ELECTRIC (Lucky Cement)- 660 MW- Completion 2017
- Dr. Samar Mubarik Mand pilot project- U/ground Gasification- 100 MW- Thar Block V
- Oracle Coalfields- Thar Block VI- 300 MW
- Harbin Electric mining 6.5 mtpa- Block IV- 2x660 MW
- Asia Power Group Block III A & B- 6.5 mtpa – 1100 MW
- Maple Leaf Power Ltd at Iskandarabad at Mianwali- Owner ML Cement Co- 40 MW
- Government of Punjab- Rahim yar khan- NISHAT Group 2x660 MW cost $ 2 Billion – Imported Coal CPEC
- KAPCO- 650 MW at Mahmood Kot- Distt M,Garh
- 16/12/15 UAE and a Chinese Co to invest $ 5 Billion. Agreement signed at BOI setting up 3 coal fired plants at Port Qasim Capacity 3960 MW- Sponsors UAE Metal Investment Holding Corp and Power China E & M International.

JUDICIOUS USE OF 4 BILLION CFD LOCALLY PRODUCED GAS AND IMPORTED LNG TO BEAT ELECTRIC LOADSHEDDING

1. **Stop use of N. Gas for CNG Stations in all provinces.** It will save 690mmcfd. CNG can be replaced by Petrol and Diesel

during winter months to supply domestic consumers. However CNG stations should use imported LNG.

2. **Domestic use of N. Gas** to be replaced by LPG as being practiced in India. Import LPG to augment the domestic production of LPG.

3. **Gas for industry** only to those captive power plants who achieve 60% thermal efficiency. However gas required for process heat for industry should be allowed.

4. **Increase Thermal Efficiency of Power Stations** to 5o to 60 % compare to present 35 to 45%. Thereby reduce cost of production to Rs 5/ unit using local gas.

GAS SUPPLY PRORITY FOR FOLLOWING POWER PLANTS

S #	Company	Capacity MW
1	Guddu	1,655 + 747 = 2408
2	KAPCO	1,638
3	K-Electric- Bin Qasim II	560
4	Uch I & II	586+425=1,011
5	Orient Balloki	225
6	Saif Sahiwal	225
7	Sapphire- Raiwind	225
8	Halmore SKP- Bhikhi	225
9	Fauji Kabirwala	157
10	Habib Ullah Costal	140
11	Liberty	232
12	Rousch Khanewal	412
13	Engro Power Gen-Qadirpur	200
14	Foundation-Daharki	177
15	Star-Daharki	134

16	Kandra- Sukhar	120
17	Fauji Foundation-Korangi	150
18	Nandipur	525
19	Shahdara	59
20	Faisalabad	244
21	Multan	174
22	Kotri	174
23	Jamshoro	850
24	Liberty Power Tech-Faisalabad	200
	Total	**10,465**

If the above priority list is adhered to there is no reason why we can't bring down the per unit cost of electricity to the poor masses and the industry which has become uncompetitive in the international market.

K-ELECTRIC-KARACHI

Location	Type	Capacity MW
Bin Qasim I	Thermal	1,260
Bin Qasim II	Comb Cycle	560
Korangi	Thermal	316
Korangi	GT	80
SITE	GT	100
	Total	2,316

Note: Bin Qasim-I-210×2 is being converted to coal fired.

Korangi Thermal Unit 3-125 MW.

SITE no 2-25 MW.

Korangi GT Unit 3-25 MW.

The above 3 units total 175 MW are being decommissioned.

K-ELECTRIC also putting up a 700 MW coal plant with Chinese help

BIOMASS ENERGY

Pakistan is blessed with good biomass resources. Unfortunately very little of these resources are being put to commercial use. India is way ahead of Pakistan in the use of biomass resources. Since conditions in Pakistan are similar to those in India we should learn from their system and technologies. We describe these resources in the order of priority to bridge the electricity supply gap in the quickest manner.

6.1: ELECTRICITY FROM BAGASSE- FROM SUGAR MILLS- UPFRONT TARIFF RS. 10.5

Pakistan is the fifth largest producer of sugarcane. Pakistan's sugar industry has produced surplus sugar for the third consecutive year. The domestic demand is limited to 4.6 to 4.7 million tons. In year 2012-13 1.2 million tons were exported. In year 2013-14 a surplus of 1.5 million tons was available for export -- production is estimated in excess of 6 million tons. This is in spite of the average sugarcane yields being lowest amongst the sugarcane growing countries of the world. The Sindh province, because of its favourable coastal climate, has the potential of producing 3,000 mounds (120 tons) per acre whereas the average yields per acre are only 800 mounds (32 tons). Similarly the Punjab province has a much better potential if the sugarcane planting areas are located along the riverine areas where requirement for irrigation water is minimal. Thus savings of irrigation water can be applied to less water intensive crops like wheat, cotton, oilseeds and maize. If the farmers are guided & helped to adopt modern cane production technologies and receive prompt payment of their cane deliveries from the sugar BARONS, our production of sugar can be doubled within a few years. The potential of producing 3,000 MW from bagasse can be raised to 6,000 MW. A rise in the yield per acre will boost the rural & industrial economy. Doubling the sugar cane yield will have following four benefits.

1. Increased sugar production can jack up the exportable surplus from present 1.5 million to about 6 million tons fetching $2.88 billions in export earnings.

2. Estimated power from bagasse will increase from 3000 MW to 6,000 MW & save $3.0 to 6.0 Billion from the import of furnace oil.

3. If all the molasses are converted to ethanol, export value will go up from present $600 to $1.0 Billion.

4. A corresponding increase in Biogas production from the spent wash of distillery. Biogas will be used for power production, steam & chilled water.

At present Pakistan produces about 50 Million tons of sugar cane. 6 million tons of sugar and about 12 million tons of bagasse. Current crushing capacity of the 84-87 sugar mills is 65 million tons of sugar cane.2013-14 target for sugarcane is 68.8 million tons. Sugar mills in the Punjab are 45, some having crushing capacity of 6,000 tons per day. The Punjab sugar mills can generate 1,500 MW from bagasse. At present all the bagasse produced in our sugar mills is consumed in the mills, using inefficient low pressure boilers (24 Bar) and primitive back pressure turbines. Crushing season starts in late October & lasts up to 120 days. This is exactly the period i.e. November to March, when our hydroelectric generation capacity drops from 6,761 MW down to 2,414 MW due to annual canal closures for repairs & low release of water in Tarbela and Mangla dams due to low demand for irrigation water. Nature has provided Pakistan Renewable Source in the form of bagasse to fill the hydroelectric gap during winter if we can use the bagasse efficiently and generate surplus power to feed into the National Grid.

Considering this huge potential, available during winter month, the GOP formulated the National Policy for Power Co-generation in 2006. GOP offered the same incentives as to IPPs. There was little response from the SUGAR BARONS so the GOP modified the terms in the National Policy for Power Co-Generation by Sugar Mills in 2008(the Co-Generation Policy). Still there was little response from SUGAR BARONS. The Economic Co-ordination Committee (ECC) of the Cabinet approved the framework for Power Co-Generation 2013 for bagasse and biomass as an addendum to the Renewable Energy Policy

2006 on 6 March 2013. NEPRA has already approved the upfront tariff of Rs 10.5/unit for power generation by Sugar Mills by using sugarcane bagasse. The NEPRA tariff was approved to encourage Sugar Mills to generate around 1,500 MW on fast-track basis.

In order to produce surplus power for the National Grid the sugar mills have to be retro-fitted using efficient high pressure boilers of 110 bar and extraction condensing steam turbines. This technology is being used in BRAZIL, INDIA, HAWAI & MAURITIUS and several other countries.

India is already producing 3,500MWfrom bagasse. We can use Indian sources of supply to retrofit our sugar mills in 1.5 to 2 years. This way we can bridge the load shedding gap in hydro production during winter months in 2 years.

The use of bagasse for electricity generation can save the country more than $.1.5 billion in the import of fuel. A start has been made by ALMOIZ sugar mills in D.I. Khan, JAMALDIN WALI sugar mills in R.Y. KHAN and SHAKARGANJ Sugar Mills. JDW sugar mills have applied to NEPRA for 2x26.35MW plants for setting up in MACHI Goth Sadiqabad Punjab and the other in GHOTKI in Sindh province.

It is suggested that sugar mills should produce electricity throughout the year by using some of the 22 million tons of cotton sticks, coal, rice husk and cane trash including sugarcane tops from the field (10% of the sugar cane weight). The sugar mills will be making more money from selling electricity to the grid whereas sugar making will become a secondary activity. Co-firing of bagasse or cotton sticks with coal, would reduce staging and fouling rate and extend the generation period to 180 days per annum by using imported or local coal.

WE CAN INCREASE THE TOTAL QUANTITY OF AVAILABLE BAGASSE BY INTRODUCING SUCH VARIETIES OF SUGAR CANE WHICH CAN PRODUCE MORE BAGASSE.

As for collection and compaction of field trash and cane tops (for easy storage for use during off season as boiler fuel), Indian sugar mills

have started this practice. US AID Energy programme has done a lot of pilot work in this field, in India and other countries.

6.2: PROBLEMS AND BOTTLENECKS

Majority of sugar mills are owned by politicians, MNA's and MPA's and big industrialists. The SUGAR BARONS made tons of money and are still making by manipulation of the government's sugar policies, withholding small farmers monies, for supply of sugar cane, for months and years. They are so greedy that 20% Internal Rate of Return is not enough for them. In Indian Punjab the highest rate offered is Indian Rs 5/unit. Many sugar mills in other Indian provinces are making good profits from Indian Rs 3.5 to 4/unit rate. Whereas the Pakistani Sugar Mills Association are not happy with even an upfront tariff of Rs 10.5 /unit.

The AEDB should facilitate the PSMA by helping in capital financing and other facilities i.e. TAX holiday, free of taxes import of Retrofitting machinery etc… AEDB should arrange for visits of mill owners to the ALMOIZ and JAMALDINWALI plants in Pakistan, India, Mauritius and BRAZIL. Arrange for feasibility and consultancy costs through AEDB.

But I feel the PSMA will continue to drag their feet. Use of bagasse for power production is in PUBLIC INTEREST. The government of Pakistan should set up a deadline through its legislation. THOSE SUGAR MILLS THAT DO NOT COMPLY SHOULD BE MADE TO PAY FINES AFTER THE DEADLINE.

Lately there has been considerable progress by sugar mills in producing surplus power for the National Grid. The following projects are under progress.

1. Fatima Energy Ltd (FEL) has been issued a Power Generation License by NEPRA for setting up 120 MW Biogas/ Coal fired plant in Punjab. Scheduled to start operating by June 2016-It will use Bagasse/ Biomas as the main fuel during the Cane Crushing season or till the time Bagasse/Biomass lasts. Imported coal will be used as an alternative/supplemental fuel.

Location: Sanawan, Mehmood Kot, Tehsil KOT ADDU Distt. Muzaffargarh Punjab.

2.1. Jamal Din Wali-JDW Sugar mill is setting up 2x40 MW independent power plants to generate power for the National Grid for 180 days per annum using Bagasse & imported coal.

2.2. The above is in addition to its existing 22 MW facility producing 10 MW surplus for the National Grid.

2.3. JDW Sugar Mills have applied to NEPRA for setting up 2x26.35 MW in Machi Goth Sadiqabad Punjab and GHOTKI in Sindh.

3.1 The following sugar mills are producing surplus power for the National Grid.

Name of Sugar Mills	**Capacity MW**	**Surplus for National Grid**
Layyah Sugar Mill	9.2	4.0
Hamza Sugar Mills	23.6	Not known
Shakarganj	20.0	Not known
AL Noor	21.8-will increase to 36.8	Not known
R.Y.Khan Sugar Mills	18	10
AL Moiz-D.I.Khan	27	15
JDW Sugar Mill	22	10
RAMZAN Sugar Mill	Not known	2

3.2 NEW Entrents PPIB Co-Generation Projects updated on 4 Nov 2013

No	**Project**	**Capacity MW**
1	Jamal Din Wali	80
2	Ramzan Sugar Chaniot	100

3	Janpur Energy RYK	60
4	Chistian Co-Gen SillanWali Sargodha	65
5	Dewan – Sujawal – Sindh	120
6	Ittehad Karamabad RYK	60
7	Fatimah Kot Addu	120
8	SSJD Bagasse Energy-Jhimpir	50
9	Bandhi Power Gen Sub. of Bandhi Sugar Mill	30
10	Ansari Power Gen (Pvt) Ltd Sub. of Ansari Sugar Mills	30
11	TAY Power Gen Co Tando Allah Yar Sugar Mills	30

Bagasse Power Projects- 271 MW Issued letter of Intent to following Sugar mills by AEDB

Company	**Capacity MW**
Ettihad	6
Layyah	41
Almoiz D.I.Khan	36
Hamza	15
Alliance Sugar	19
Safina Sugar	20
Shahtaj	15
Chanar	22
RYK Energy	36

6.3: PRODUCTION OF ETHANOL FROM MOLASSES AND MANDATORY BLENDING WITH PETROL

Pakistan produces 3 million tons of molasses every year. This is a by-product of the sugar making process. There are 19 distilleries, mostly in Sindh, producing 400,000 tons of ethanol from molasses (earning $292 million in export). The rest of molasses are exported.

The country depends on imported crude oil and diesel. Local crude production of 100,000 barrels/day meets a small percentage, 20 to 25%, of our total requirement. It is argued that, by converting all the molasses into ETHANOL and blend it with petrol to make blended petrol E-10, will save $1.0 Billion on import of fuel. A 10% blend of ETHANOL into petrol does not need any modification in petrol engine. BRAZIL, a major sugar cane producing country, is running its cars, tractors and trucks with 100% ethanol fuel. In fact they have a very clever policy-when sugar prices are high on the international market they produce sugar for export when international sugar prices are low they convert the sugar cane into ethanol. In BRAZIL there are factories which produce only ETHANOL from sugar cane.

In India they have been blending ETHANOL with petrol for the last 15-20 years by LAW.

Simply putting an export duty on molasses is not enough. Government should make it mandatory to blend ethanol with petrol. The E-10 blend should be available from petrol stations.

It is in national interest to BAN the export of molasses. If with 3 million tons molasses the country cannot meet the requirement for blending all the petrol by 10% ethanol, the shortfall in the total ethanol requirement should be imported.

6.4: BIOMASS AND BIOENERGY PROJECTS

The AEDB (ALTERNATIVE ENERGY DEVELOPMENT BOARD) has initiated the following projects

1. 12 MW-JHANG-Lumen Energia Pvt cost $ 14.38 Million.

Fuel input-90-110 thousand tons of biomass consisting of cotton sticks, Rice Husk, sugarcane trash, bagasse, wheat chaff and other crop residues.

Levelized tariff-13.3573 cents per KWH.

2. 12 MW-Mir Wah Gorchani Town MIR PUR KHAS SINDH. Sponsors-US and local entrepreneurs-based on AGRO wastes Tariff 13.0511/KWH.

3. 9 MW-biogas plant-Pak Ethanol Private Limited-A state of the art ethanol distillery at MATLI SINDH.

Biogas from spent wash of distillery. In addition to power will also produce steam and chilled water.

4. 12 MW-biomass-FIASALABAD
Biomass power generation limited-sponsor Masood Textile Limited.

5. 12 MW-Greensure Environmental Solutions Pvt Limited MARDAN-KPK
Municipal waste of MARDAN city.

6. GOVT. OF PUNJAB BIOMASS PROJECTS

6.1. 15 MW biomass plant with technical assistance of Indian Punjab.

6.2. A German company will produce power from solid waste.

6.5: RICE HUSK

The next most important biomass resource is rice husk. Like bagasse it is a by-product in the rice milling process. Total production is 1 million tons equal to 20% in weight of the rice paddy.

Unlike most biomass material it is available in large quantity in the rice mills. A typical rice mill processing 40 tons/day of rice paddy produces 8 tons/day of rice husk. Due to gas load shedding a lot of boilers are using rice husk. It is a very BULKY material, uneconomic for transport

over long distance. It is now being used in rice PARBOILING plants to produce PARBOILED RICE for export to the Middle East. Its best use is to burn it in situ. This resource is being utilised 100%.

6.6: COTTON STICKS

Cotton being one of our major crops-gives us 22 million tons of cotton sticks. Presently it is used as a fuel for cooking in rural areas. It is not available in large quantities in one place like rice husk and bagasse. It will have to be collected. Once its use in sugar mills along with bagasse is introduced it will become a valuable commercial fuel. Biogas from animal waste could replace cotton sticks as fuel for cooking.

6.7: MAIZE (CORN) STALKS AND COBS

After wheat and rice, maize is becoming our third most important cereal crop. There is tremendous demand for Maize grain by animal and poultry feed industry, cooking oil, glucose and other food items, industry and as silage for the dairy industry.

Recently, due to Hybrid seed, the area under cultivation is growing. So there will be maize sticks and cobs as an important biomass source.

Data of exact quantity is not available.

6.8: RICE STRAW AND WHEAT STRAW

Some 24-25 million tons of wheat straw is produced. An estimated 2 million tons of rice straw is produced. Wheat straw is in great demand as a filler for the livestock fodder. Rice straw is also used for animal feed.

During the last 15 years use of combine harvesters with no system of collecting wheat/rice straw is doing great damage to the soil. Usually farmers, who have their crops harvested with combine harvesters, burn the crop residue. Burning also destroys friendly insects and worms thus degrading the farm land.

UNIDO to setup a 1 MW Rice Husk Gasification plant in Bhawalnagar. NUST cooperating with UNIDO and local manufacture of Biomass Gassifiers.

6.9: ETHANOL FROM MAIZE

Maize, after rice and wheat is the third most important cereal crop. There is tremendous growth in Maize production due to its tremendous demand by the animal and feed industry, Maize oil and other food products and for silage for the growing modern dairy industry. This has come about due to imported hybrid seed from the USA and tremendous improvement in production technology. A good spring crop can yield 4 tons of maize per acre in 120 days. At present we are growing mainly the spring crop. Production cost of summer crop is lower than spring due to help of Monsoon's rains. So by growing two crops i.e. spring and summer a year the production can be doubled.

In the U.S.A oil companies are getting farmers to grow maize for ethanol production to blend it in petrol. Since we can grow two maize crops a year we can also get our oil companies to create a demand amongst our farmers to grow for ethanol production. The maize residue from ethanol production is being used to feed the cattle. This is a very profitable venture for oil companies and farmers and WOULD REDUCE OUR DEPENDENCE ON IMPORTED OIL.

6.10: ETHANOL DIRECTLY FROM SUGAR CANE

Ethanol from 3 million tons molasses is not enough. There is tremendous potential almost 150% for increasing per acre yield of sugar cane in the Sindh province due to coastal climate.

Present production of 5 million tons of sugar is enough to meet the country's need. With increased per acre yield we can follow the BRAZILIAN model-direct production of ethanol from sugar cane. Surplus quantities of ETHANOL can be exported to World MARKET'S where it is in great demand.

6.11: SORGHUM FOR ETHANOL

Sorghum is a very important and successful crop for the Rain fed (BARANI) areas of POTHOHAR region of the Punjab. Due to adequate rainfall of about 40 inches during the rainy season the farmers grow sorghum with a very small cost of production. At present it is used as animal fodder as green and as dried during the long intervening period before the next year's rainy season.

There is a tremendous opportunity of producing ethanol, as being done in the U.S., provided hybrid short straw variety is grown and harvested by combine harvesters. Sorghum grain can be used for production of ethanol.

The POTHOHAR region consists of vast tracts of land consisting of Rawalpindi, Attock, Jhelum, Chakwal and Talagang districts.

Wheat crop is a chancy affair in POTHOHAR region. One can raise an excellent crop of wheat if there are good rains during the winter, otherwise, during drought years, farmers cannot recover even the inputs costs i.e. tillage, seed and fertilizer.

The introduction of short straw hybrid sorghum for grain can change the destiny of the poor POTHOHAR farmers whose sustenance is based on livestock i.e. cows and goats.

6.12: ANIMAL MANURE AND BIOGAS

Pakistan is in the world's big league for milk production and livestock population. Livestock contributes more than 50% to the 23% share of GDP for agriculture and livestock. We can produce biogas from animal manure with biogas plants.

G.O. Punjab setting up biogas plants in rural areas to run tube wells and supply to domestic consumers.

Due to this resource being widely dispersed we cannot make effective use of this valuable resource. Even the small biogas plants have not made much impact in the rural area.

With the introduction of tube wells, tractors and combine harvester, livestock, which was an integral and most important way of returning agro-wastes to the land, on the farms has completely disappeared.

But fortunately, in the irrigated area, a new thing, the dairy industry, has come up consisting of 50 to 400 milking animals. This is a replacement of the loss due to mechanisation.

These are the companies which should be targeted and encouraged to produce biogas for electricity and cooking in rural areas.

The government has been ill-advised to go for biogas plants for small farmers and tube wells. Why should we repeat a failed strategy again? Biogas plants should be targeted to Dairy Farms having at least 30-40 animals. The department of Agriculture in Punjab is notorious for misleading farmers and the Government and they are doing so in the case of biogas technology as well.

6.13: JATROPHA plant and PALM OIL for Bio-Diesel

Renewable and Alternative Energy Association of Pakistan says one acre of land can produce enough Jatropha seeds for 2000-2500 litres of Bio-Diesel besides value added products- methane gas, glycerine and natural fertiliser. Over 100 countries including USA, Brazil, Australia, Thailand, Philippines, Malaysia, India and China have been cultivating Jatropha plant. Agriculture research council needs to study the feasibility for adopting this plant for mass production of Bio-Diesel. Palm oil can produce 1,600 Gallons of diesel/ acre/ annum. Malaysia is using palm oil for biodiesel for B7 biodiesel blend program to raise palm oil percentage in diesel.

SOLAR ENERGY

Pakistan is blessed with abundant SOLAR ENERGY. Solar Energy potential is 4.9 to 7.0 Kwh/m2 per day and can produce 1,920 Kwh/m2 per annum. The provinces of Sindh, Balochistan and Punjab hold tremendous potential. KPK province, too, has great potential for harvesting energy in Dera Ismail Khan region where the sun shines abundantly throughout the year.

The solar energy comes in two forms i.e. Photovoltaic (PV) solar cells and solar thermal energy. We will describe these two separately. Both technologies hold the potential of harnessing solar energy at mega scale. However it is the solar thermal technology which really holds the potential of harnessing solar energy at mega-scale. The government of Punjab is investing in P.V. solar energy, but solar thermal has been completely neglected, whereas from indigenous point of view it should be preferred.

7.1: SOLAR THERMAL ENERGY TECHNOLOGY

Solar thermal technologies utilise the sun's heat, rather than the sun's light, to produce electricity. It is true that all solar technologies produce electricity only when the sun is shining. The solar thermal technologies have an advantage over solar cells (PV). Solar cells require extremely expensive batteries to store electricity for night time use. The solar cells capture only a small amount of the sun's energy from the sun's light, i.e. 8 to 10% whereas solar thermal technology by utilising the sun's heat can capture 60% of the sun's energy economically. Solar thermal technology captures sun's heat by an array of CONCAVE MIRRORS which heat the heating medium like molten salts/non oxidising oils at a very high temperature. These materials can be stored. The heating material produces steam through a heat exchanger and the electricity is produced through the conventional steam turbine. Therefore solar thermal energy can be stored and can produce electricity twenty four hours a day. This technology was developed jointly by Germany, France and the U.S. The parabolic troughs can focus the energy from the sun directly on to the heating medium, to generate steam which is used to drive steam turbines to generate electricity.

By 1989 the U.S. had a 400MW solar thermal power station, operating commercially, in the Mojave Desert. Further plants have been established successfully in SPAIN, Morocco, and South Africa at the edge of KALAHARI desert in northern cape province – a 1000 MW plant.

Pakistan has some most suitable sites in Rahim Yar Khan and Dera Ismail Khan. We should establish, to start with, at least three solar thermal electric plants of 100 to 200MW.

7.2: PHOTOVOLTAIC (PV) SOLAR CELLS TECHNOLOGY

Photovoltaic (PV) technology is direct conversion of light, known as photons to the physicist, into electricity. In other words, it is about capturing and transformation of the energy of photons, contained in the sun's light, into electricity-robbing energy from daylight for energy. The amount of PV electricity, that can be generated on our planet, is limited by the amount of suitable semiconductor materials which we can produce.

The main advantage of PV solar system- it can be set up in 6 months to 2 years. It is the quickest way to fill the present supply gap. The government of the Punjab has started a Mega project, with Chinese help, in Cholistan area of Bahawalpur. Land for an 11,000 acre solar energy park has been allocated in Cholistan, called the Quaid-e-Azam Solar Energy Park. Chinese company is ready to create a $3 billion solar fund for Pakistan. A German renewable energy company CAE plans to invest €100 million in setting up the first solar panel manufacturing facility in Pakistan, located in Faisalabad. The CAE is owned by four partners-Pakistani, German, Swiss and Italian. An MOU has been signed between CAE and the government of the Punjab for manufacture of solar panels, solar cells and batteries and assembly thereof.

The PV industry requires a cruder grade of crystalline silicon than the microelectronics requirements. A one Megawatt (MW)-peak grid connected PV farm, with a twenty five year's performance warranty for the photovoltaic panels, can at present be deployed in Europe for

a turnkey installation cost of one million Euros. The deployment costs are still falling, thanks to a cut throat competition in the Global Market.

Solar energy prices are rapidly becoming more competitive with thermal energy. By 2013 solar energy will become economically viable without any government subsidies. Consumer financing will soon be available from the banks. The instalments would be tailored to be equal to house holder's monthly electric bill. Already the government of the Punjab has introduced P.V. solar energy throughout the province by distributing solar lamps to deserving students. Batteries, solar panels and cells are being imported. In order to introduce the solar technology custom duties on all items, required for solar energy, have been abolished.

The Chinese company and CAE can provide off-Grid solar systems for domestic and industrial consumers and also grid solar systems. Solar panels for irrigation tube wells for agriculture will be introduced. The potential of PV solar in summer is 7 to 7.5 kwh/m2/day in Balochistan, 6 to 6.5 kwh/m2/day in Sindh, Southern Punjab and G.B. It is 5.5 to 6 kwh/ m2 /day in the rest of the country. In winter the capacity is half of the stated potential.

CAE would consider projects for setting up 400MW projects at Faisalabad, Sialkot, Gujranwala and Lahore and a 150MW power plant along the Pindi Bhattian-Faisalabad Motorway-M3.

Suitably placed PV farms in Pakistan can generate electricity at an UNSUBSIDISED cost of Rs 7/kwh. P.V Technology is more suitable for residential and industrial sites as proven by Indian experiences. We should introduce net metering to encourage industrial and domestic consumers to set-up small scale grid connected PV Solar plants. All sorts of duties on PV equipment should be removed.

NEPRAS HAS AWARDED 9.25 CENTS/UNIT FOR 2016 AS PER INDIAN AND UAE TARIFFS. NOTE–DUE TO CHEAP CHINESE SOLAR PANELS THE COST DROPPED FORM 18 CENTS TO 5 CENTS/UNIT INTERNATIONALLY. HOWEVER FOR Q.A. SOLAR PARK CAPACITY 1000 UPFRONT TARIFF WAS AWARDED AT 13.9 CENTS/ UNIT.

7.3: CURRENT PROJECTS

1. CAE-(German) based in Faisalabad-Assembly and manufacture of solar panels, solar cells and batteries.
2. Solar Energy Pakistan Thatta Ltd-35MW
3. First Solar Punjab- 2MW
4. AM Pakistan Energy- Punjab- 50 MW
5. Wah Industries- 1MW- Inaugurated 20/2/15
6. Tech Access Solar-10 MW
7. CWE Cholistan-50 MW
8. Roshan Power KASUR-10 MW
9. BAKSH Energy LODHRAN-20 MW
10. DACC LCC Canada-50 MW
11. Government of the Punjab Energy Council has sanctioned a 100 MW project at the 11000 acres Quaid-e-Azam Solar Energy Park in CHOLISTAN consisting of two solar parks of 50 MW each at LAL SOHANRA and DIN GARH. Power production of 100 MW started in May 2015, the balance 900 MW is under construction by Chinese Company-CPEC funded.
12. A plan to install a 1.8 MW solar energy plant in the Parliament House has been completed.
13. Government of Balochistan signed a 300MW solar energy contract with a Korean company cost $700 million.
14. The government of AJK with help of GOP is starting a private-public sector solar energy programme.
15. Bakhsh energy-30 MW solar thermal plant at Lodharan.
16. 2 MOUs for Russian investment for solar power plant.

17. TRA(USA)-100 MW solar plant in Cholistan desert.

18. Canadian company has signed for a 500 MW solar project. Will start 200 MW to be followed by 300 MW in CHOLISTAN solar energy park.

19. Pan Africa UK signed MOU with government of Punjab.

20. French power corporation to set-up 100 MW in Q.A. Solar park Cholistan – Sponsors TOTAL plus SUN power corporation

21. Siddiq Sons in Karachi

22. Co energy Solar Project Bahawalpur- 50 MW

23. Scatec Solar Sindh- Norwegian Co- 150 MW

24. Tech Access Solar Punjab

A number of private sector solar energy companies have started to install solar energy systems in residential areas.

- G.O. Punjab- 40,000 schools to go solar. Basic Health units and tube wells to be converted to Solar.
- G.O. Punjab plans to setup 49 separate smaller solar projects of 1 to 50 MW capacity throughout the province totalling 215 MW. Projects sites are already selected.

7.4: **Projects Awaiting Tariff Notification**

Harrapa Solar
AJ Power
Safe Solar
Access
Sanjwal Solar
Blue star Hydel
Blue star electric
Bukhsh Solar
Access Electric

Following have been issued LOI (Letter of Intent) by AEDB:

Company	Capacity MW	Location
Access Solar (PVT) LTD	11.52	Pind Dadan Khan
Bukhsh Solar Ltd	10.0	Dharanwala Distt Bahawalpur
Sanjwal Solar	5.04	Sanjwal Punjab
Integrated Power Solar	50	Nooriabad Sindh
Jafri & Associates	50	Nooriabad Sindh
Solar Blue Ltd	50	Nooriabad Sindh
Safe Solar Power Ltd	10	Bahawalnagar
Access Electric Ltd	10	Pind Dadan Khan
R.E. Solar I Ltd	20	Dadu
R.E. Solar II Ltd	20	Dadu
Jan Solar	10	RYK
Janpur Energy	10	Muzaffargarh
Blue Star Hydel	1	P.D.Khan
Nizam Power	11.3	C.College Larkana
Nizam Energy	5.65	Sadiqabad
Nizam Energy	5.65	Larkana
Ayan Energy	50	Jhelum
Blue Star	1	P.D.Khan
Total Energy	100	QA Solar Park
Siddiq Son	50	Chakwal
Harrapa	18	Sahiwal

Company	Capacity MW	Location
AJ Power	12	Adhi Kot- Khushab
Adamjee Power	10	Norsar Bahwalnagar
Forshine	50	Gharo
E T Solar	50	Fateh Jang Road Attock
E T Solar	25	Gharo
Act Solar	50	Sindh
Crystal Energy	2	Sambrial- Sialkot
Asia Petroleum	30	Punjab
First Solar	2	Kallar Kahar Chakwal

WIND ENERGY

8.1: General

Wind is an important source of energy. There are about 200,000 wind turbines operating in the world. China – 75,000 MW, USA – 60,000 MW, Germany – 36,000 MW and India – 19,000 MW. Denmark meets 28% of its energy from wind.

USA (California in particular), U.K., Germany, Norway, Denmark, India and China who possess excellent wind regimes are making tremendous use of wind energy both INLAND AND OFFSHORE. Denmark, Germany, U.K., China and India have big wind energy industries supplying wind energy equipment Worldwide. Wind energy technology has fully matured.

Pakistan has excellent wind energy regimes in coastal areas of Sindh and Balochistan provinces. In Sindh just GHARO-KETTI BUNDER corridor alone is capable of producing 50,000MW of electricity. In Punjab Kallar Kahar corridor 10-20 Km wide, 250 km long-potential 1000 MW. After initial investment the maintenance cost is very low. There are no fuel costs like the Thermal energy and it is environmentally friendly. Sindh's wind corridor is 60 km wide and 180 km long.

Similarly in Rajanpur district on the KOH-E-SULEMAN range there is enough potential to start 1000MW capacity wind mills. G.O. Punjab has sponsored VESTAS of Denmark for 4x250MW wind turbines.

Wind power plants are being installed at Jhimpir, Gharo & Ketti Bunder in Sindh. Zorlu energy of Turkey, Fauji Fertilizer co and a Chinese company are constructing wind farms. Gharo project involves 2.5x 40 Nordex wind turbines.

A suitable wind regime, worldwide, is 8 - 14m/second to 6.9m/s. Wind speed in the Sindh corridor is 7.5m/s to 7.7m/s. The government plans to generate 3,000 to 3,500 MW electricity from wind energy by 2018. According to a recent report of the US A.I.D., Pakistan has the potential to produce 150,000MW of wind energy. According to official estimates the country has the potential to generate 143,000MW with

solar and wind energy. The government has set a target to produce 10% of its energy through renewable, other than hydel power which is already contributing 29% to the total production of electricity in the country.

LOCAL CONTENT like the Agricultural Tractor industry in Pakistan – a deletion programme should be agreed with Wind Energy companies, investing in Pakistan since the potential is up to 50,000 MW. The Wind mill's structure, blades and gears can be manufactured locally. This will utilise the local steel fabrication industry and save foreign exchange component. Already the German Co-CAE are planning local manufacture of P.V. cells and solar panels.

Similarly a Chinese Wind Farm Company is starting local manufacture of Windmill structure and parts at its Jhimpir site.

GOVERNMENT HAD ANNOUNCED AN UPFRONT TARRIF OF RS. 14/UNIT – NOW REDUCE TO RS. 10.6

8.2: Current projects near completion/under construction

- Fauji FFCEL-Jhimpir- 49.5MW costing $135 million
- Zorlu Energy from Turkey-56.4MW
- Tapal Wind Energy-Jhimpir Sindh- 30.0MW
- China Sunec Energy PVTLTD-Jhimpir- 52.4MW
- Foundation Wind Energy I and II- 2 x 50MW in Gharo using 2.5 x 40 NORDEX wind turbines.
- Malaysian firm to invest $75 million at Bin Qasim port-150MW
- Pakistan and US sign wind power project-US $150 million
- Yunus Energy 50 MW, cost $35 million
- SAPPHIRE Wind Power Company Ltd. – 50MW – OPIC – USA provided 100% finance. OPIC signed $95 million

agreement for 50MW project for Gharo- Keti Bandar wind corridor.

- Govt of Punjab plans an 8 MW project at KALLAR KHAR
- China International water and Electric Corp – 50 MW
- Wind Eagle Ltd- 50 MW
- Al-Abbas steel Group – 50 MW
- Green Power (Pvt) Ltd – 50 MW
- Beacon Energy – 50 MW
- Master Wind Energy Ltd- 50 MW
- Zephr Power (Pvt) Ltd - 50 MW
- Lucky Energy Ltd- 50 MW
- Dawood Power Ltd- 50 MW
- Iran Pak Wind Power Ltd- 50 MW
- Hawa Energy Ltd- 50 MW
- Deewan Energy Group- 50 MW
- Find Energy Ltd- 50 MW
- Hartford Alternative Energy Ltd- 50 MW
- Tricon Boston – 150 MW
- Titan Energy Ltd -10MW
- Ismail Power Ltd- 10 MW
- Akhtar and Sons Group- 10 MW
- PK Wind Energy Ltd -5MW
- NBT Wind Power- 500 MW

- G.O. Punjab 4x250MW in Rajanpur District by VESTAS OF DENMARK cost $ 2.0 Billion.

NEPRA'S tariff for Wind Power

NEPRA'S tariff has been very high when compared to other countries in this region. Wind tariff should be based on capital cost and velocity of wind at the site. Current wind energy equipment prices the world over should be taken into account. Costs declined by 58% since 2009 and 15% in 2014.

Capital cost has declined from $ 169 per MWH in 2009 to $ 81 per MWH as per LAZARD report of 2015. NEPRA reduced tariff from Rs 13.19 per unit to Rs 10.6 per unit but it is still very high compared to India. Tariff in Tamil Nadu is equal to Pak Rupees 5.39. This is almost half the tariff that has been granted to wind producers in Pakistan. India's zones where density is 200-25 W/square meter the tariff is PK Rs. 8.07. The lowest tariff where mean wind density for a year is above 400 w/square meter is Pak Rs 5.38. It is hoped that same history of IPPs is not repeated and this poor nation is bound for 10 to 20 years.

8.3: Foreign Investment

At the moment the Wind Energy sector is attracting the most foreign investment. Other than investors, international equipment suppliers, manufacturers and O and M operators are taking interest in Pakistan's Wind Energy. OPIC signed an agreement $95 Million for 50 MW Project for Gharo Keti Bandar wind corridor.

8.4: Wind Energy Projects will have 1,396 MW by 2017

TARIFF by NEPRA at Rs 10.6/ unit reduced from Rs 13.19/ unit

4 Operating Wind Projects

- China's Three Gorges Co First Wind - 50 MW
- Zorlu Energy Turkey - 56.4
- Fauji FFCEL – Jhimpir - 49.5 MW- Cost $ 135 million

- Foundation (Fauji) - 100.0 MW
  Wind Energy
  Total - 255.9 MW

9 Projects that have achieved financial close

- Sapphire- OPIC funded - 50 MW
- Yunous Energy - 50 MW
- Metro Power - 50 MW
- Tapal Energy - 30 MW
- Gul Ahmed - 50 MW
- United Energy China UEP - 100 MW
- Hydro China Dawood - 50 MW
- Master - 50 MW
- Tenaga - 50 MW
  Total - 477 MW

14 Projects in different stages of implementation- 664 MW for completion by 2017-18

- Dawood Power PVT Ltd - 50 MW
  GHARO
- Sachel - 54.9 MW- $107mm
- Sunnec China - 50.0 MW
- Wind Eagle - 50 M

Wind Projects AEDB LOI

Company	**Capacity MW**	**Location**
Tenega	50	KHI
Foundation	50	KHI
Hydro China Dawood	50	KHI
Master Wind Energy	50	Lahore
Zaphya Power Ltd	50	KHI
Foundation Wind Energy	50	RWP

Company	Capacity MW	Location
China Three Gorges	50	IBD
Sachal	50	IBD
FFC Energy	50	FFC Sona Tower RWP
Yunus Energy	50	KHI
Metro	50	KHI
Gul Ahmad	50	KHI
Zorlu	56.4	KHI
Sapphire Wind Power	50	KHI
Wind Eagle	50	IBD
Wind Eagle	50	IBD
United Energy Ltd	100	KHI
Hawa Holding	50	IBD
China Summer Energy	50	IBD
Hartford Alt Energy	50	USA
United Energy	350	KHI
Trident Energy		IBD
Burj Wind Energy	14	KHI
Tricon Boston Com Corp	50	USA
Tricon Boston Com Corp	50	USA
Tricon Boston Com Corp	50	USA
Western Energy	50	KHI
Tapal	30	KHI

Company	Capacity MW	Location
Jhimpir Wind Energy	50	KHI
Hawa Energy	50	
Dewan Energy	50	
Titan Energy	50	
Finerji Energy	50	
Finerji (PVT)	50	
Tricon Boston Corp	50	
Zephyr Power Ltd. Bhambore	50	
Thatta Power Plant	50	
AM Pak Energy- Punjab	50	
Gharo Wind Power	50	

Following are also in the Race

- China International water and Electric Corpn
- Al-Abbas Steel Growth
- Green Power Ltd
- Beacon Energy
- Lucky Energy Ltd
- Iran Pak Wind Power Ltd
- Ismail Power Ltd
- Abbas and Sons Group
- PK Wind Energy
- NBT Wind Power
- Sindh Renewable Energy Co
- Koonj
- Tawa
- G.O. Punjab signed agreement with a Danish Co to install wind turbines in QA wind park KALLAR Kahar corridor.

NUCLEAR POWER

9.1: General

Nuclear Energy is one of the best solutions to meet our energy needs. The demand for electric power is growing at 8% per annum due to population growth and increase in domestic electric appliances like A/C's, Refrigerators and T.V.

Nuclear energy, at present, contributes about 16% of the World's electric energy provided by 400 nuclear power plants in 31 countries such as America, France, Japan, Russia, China, India etc... The U.S. alone has 104 Nuclear Power Stations.

Technological developments in Nuclear Power generation and fission research have lessened the number of problems in reactor construction, operation and increased efficiency. As a result, it has become a safe and attractive source of energy. Had it not have been for the Chernoble accident in UKRAINE and the recent Reactor Meltdown in Japan there would have been an increase of 60% in Nuclear Power Reactors around the Globe by 2030 as per IAEA-International Atomic Energy Agency. The two accidents were due to not meeting IAEA safety standards.

Pakistan has been helped by China in the Nuclear Technology. Apart from KANUPP 137MW power plant from Canada, China has supplied 2x 325MW plants and has 2x340MW plants under construction at Chashma on the River Indus. The Chinese plants are PLWR (Pressurised Light Water Reactor) type. KANUPP is a heavy water reactor.

Amongst the Nuclear Power producing countries France has the most advanced, successful and safe technology. France derives 78% of its electricity from 59 Nuclear Power Reactors. Benefitting from France in this field will have excellent impact on our Nuclear Power production. Even the Chinese are so impressed with French design that they have had 600 MW and 1000 MW plants built by France. Recently the French ambassador said "France is ready to consider Pakistan's

request for enhancing cooperation in the area of civil nuclear energy in line with protecting international obligations".

Nuclear Power is free of pollution and has no environmental effects such as greenhouse gases or acid rain. It is highly competitive in cost and can provide continuous electric supply throughout the year. Continuous supply is achieved because Nuclear Plants are independent of seasonal effects like Hydroelectric Plants. The latest plants are smaller in size, 600 to 1000MW, and more efficient. Another advantage with Nuclear Plants is that they do not need constant re-fuelling/ charging. The plants need to be re-charged once a year as opposed to Thermal/coal plants which need charging all year around requiring huge infrastructure of transportation of fuels to the generation sites.

9.2: OECD – GENERATION COSTS

A 2005 study by OECD comparing Kwh power costs based on oil prices in 2010 at $50 per barrel of oil.

Country	**Costs in Cents/Kwh at 85% load factor**		
	Nuclear	**Coal**	**Gas**
France	2.54	3.33	3.92
Japan	4.80	4.95	5.21
Canada	2.60	3.11	4.11
USA	3.01	2.71	4.67

THE PAEC LATEST COST IS RS. 7/UNIT BASED ON CHASHNUPP 1 & 2 COSTS

From the above data it is evident that if oil prices increase it will have a corresponding increase in Gas.

However Nuclear fuel cost being only 20% of electricity generation cost will not have similar rise in generation cost like cost of fossil fired power plants where fuel costs are 50 to 70% of total generation costs.

China is experiencing a huge energy growth and is expanding its Nuclear Power. Four reactors were under construction in 2006 and plans for a fivefold expansion by 2020. India's plans include an 8-fold increase by 2022 providing 10% of its total energy and a 75-fold increase by 2052 to reach 20% of its total supply. India has made a civil nuclear agreement with the U.S. to achieve these goals and now trying to get Japanese Cooperation. Australia is to supply India with Uranium fuel.

France went back on its agreement in 1970s for Uranium Re-processing plant during Z.A. Bhutto's government due to U.S. pressure. Pakistan should try to get a civil nuclear agreement with the U.S., similar to India. Failing with the US, we should try to get a civil nuclear agreement with France and Japan and try to get at least a 600MW nuclear power plant built by France. We possess, already, a lot of expertise in using our own engineers and local supplier in building the 50MW KHUSHAB reactors.

26/1/16 France has agreed to supply India 6 Nuclear Power plants.

9.3: NUCLEAR POWER PROJECTS – OPERATING, UNDER CONSTRUCTION & IN PIPELINE

Pakistan present capacity

			Capacity in MW	
	KANUPP-PHWR from Canada	Due for decommissioning n 2019	125	In operation
PLWR	CHASHNUPP I		300 net	
	CHASHNUPP II		300 net	
	CHASHNUPP III	April 2009. Under construction.	340	Completion 2016
	CHASHNUPP IV	2011	340	2017
	CHASHNUPP V	2014	1,000	2020 Proposed

			Capacity in MW	
Karachi	K-2 K-3	China national nuclear corporation and the government have signed an agreement in October, 2013.	1,100 1,100 Completion-72 months	Cost $ 9.6 billion. Tariff 8cents/unit
KHUSHAB	Designed & Constructed by Pakistani Engineers.		50 x 4 MW	

According to Planning Commission in 2005 PAEC was to enhance capacity to 8,800MW by 2020 comprising the following:-

2x300MW-600

2x600MW-1,200

7x1000MW-7,000

This will bring the share of Nuclear Power to 8% by 2030. If the machinery is prepared locally, as it was done in the case of the 50MW Khushab Reactors, a vast amount of foreign exchange would be saved and will result in a massive decrease in the installation cost of Nuclear Power Plants. It will provide much needed employment opportunities.

26/1/2016 -Present Capacity 753 MW. With completion of C3, C4, K2 & K3 capacity will be 3,535 MW by 2021. After 2021 one plant/ year will increase capacity to 40,000 MW by 2050.

The ground breaking ceremony of the two 1100 MW – Coastal Nuclear power stations was performed by the P.M. in end Nov 2013. Third Generation technology will be used for the two power stations meeting international safety standards. Double- shell containment is to be used. K-2 & K-3 are Advanced- PWR design of III generation. China's Pressurized-1,000 Reactors are an advanced version of French M-310 design. CPR 1,000 design is based on French M-310.China is using some important critical components for its own power stations from France. But these components from France cannot be used for

the K-2 & K-3 because Pakistan is not a member of NSG (Nuclear Supplier Group). China is a NSG member so China can import components for its own use from NSG members. China is providing 82% finance for K-2 & K-3.NPP levelized cost worldwide is Rs 5 to 8 per unit. Whereas NEPRA have announced a Rs 9.59 per unit upfront tariff which is very high when compared with world standard cost. AT PRESENT PAKISTAN IS HAVING TO PAY $ 1.0 BILLION IN OIL IMPORT FOR RUNNING A THOUSAND MW THERMAL STATION FOR ONE YEAR.

The designed life will be 60 years and refuelling cycle time – 18 months. Under the PAEC 2030 plan the target for nuclear power was 8,800 MW, which is being revised upward. A new target for 2050 will be to generate 40,000 MW nuclear power. Under the 2030 plan PAEC has selected six sites in line with the recommendations of Pakistan Nuclear Regulatory Authority (PNRA) and IAEA.

The six sites selected for installation of more nuclear plants are:-

1. Qardirabad – Balloki link canal near Qadirabad Headworks
2. Dera Ghazi Khan canal near Taunsa Barrage-ECNEC-Approval soon for one PC-1 Out of the 3-PC-1 submitted for approval by PAEC.
3. Taunsa – Panjnad Canal near Multan
4. Nara Canal near Sukhur
5. Pat Feeder Canal near Guddu Barrage
6. River Kabul near Nowshehra

Cost/Unit announced is Rs 9.59 /unit. The tariff will come down to RS 8.0/unit if project completed within 81 months as per PAEC official. As per OECD study of 2005 based on the 2010 prices at $50 per barrel of oil and 85% load factor:- France 2.5 cents, USA 3.10 cents Canada 2.60 cents. Even if the above prices are doubled since the present oil price around $100/barrel, the price would not exceed 5 cents/unit.

Even if costs of construction of presently operating CHASHNUPP I and II was low because the US Dollar was around Rs 50 to 60, the

present cost due to the US Dollar at Rs 100 does not merit going up to Rs 8.0 / unit.

The Cost/unit from the two new 2200 MW plants should not be more than Rs 2.64 to a maximum of Rs 5/unit. This astronomically high price of Rs 9.59/unit has come about due to our P.M. not following the PPRA rules by putting the project open to international competition. The nation will again continue to suffer paying high tariffs for decades to come like the PPP oil fired IPPS. The project cost and generation cost/unit should be investigated by an independent commission.

PAEC-2030 Plan was to bring share of Nuclear power to 8% by 2030. With presently three operating plants, two 340 MW each (under construction) plants and the two plants to generate 2,200 MW, the total nuclear capacity will come to 3,500 MW net. With the six other plants of 1,000 MW each PAEC 2030 plans seem to be on target. With the PM's present efforts there is every hope of the PAEC accomplishing its target.

NATURAL GAS, LNG and LPG

10.1: General

Natural Gas share for electricity generation is 29% at present. According to Pakistan Energy Year Book, 2012, Pakistan is left with 26.65 Trillion cubic feet (TCF) balance of recoverable gas reserves. This is due to extravagant use of gas considering it a cheap local resource. Current gas production is 4.0 billion cubic feet per day (bcfd) and the demand 6 bcfd and hence the gas load shedding -specially in coming years when demand will increase to 8 bcfd. The local production will fall to 1.0 bcfd.

About one third of gas is used for electricity generation. If the LNG and Gas from Iran is not imported there will be no gas for electricity production and Urea fertilizer and there will be severe domestic and industrial load shedding. Unlike the previous PPP leaders, who were only interested in filling their pockets, if the present government acts responsibly and honestly it will take timely measures to fill the 7 bcfd gap by 2020.

Even the gas imported from both Iran and Turkmenistan would provide 2 bcfd. Against the demand of 8 bcfd we will only have 3 bcfd. Planned import of CNG 2 billion cfd will bring total availability to 5 billion cfd. Our foreign exchange resources will not allow us to import LNG to fill the gap, left by cheap locally produced Gas. This points very clearly to exploitation of SHALE oil and gas reserves and use of THAR coal for power generation, synthetic gas and CTL (coal to liquid) technology. CTL was used by the Germans in II World War, by South Africa during apartheid regime and now by China in Mongolia.

The present exploration and production of gas will probably keep the local production at 4 billion cfd.

10.2: Oil and gas companies active in exploration and production of gas in Pakistan

OGDCL- - Oil and gas development company Ltd
PPL - Pakistan Petroleum limited

Mari- - Mari Petroleum
POL- - Pakistan oil fields limited
PGNIC- - Polish Gas Company
MOL- - Hungarian
OMV- - Austrian

10.3: Exploration and Production of oil and gas by various companies/ Provinces

During the last 1.5 years as on November 2014 500 mmcfd gas has been added to the system to compensate for 490 mmcfd depletion during the period.

Sindh province at present is producing 72 % of gas and 57% oil in Pakistan. Badin block alone produces 40% of total oil and gas.

Latest Gas production figures as on 9th November, 2015

Sindh-	2,780 mmcfd
Balochistan-	875 mmcfd
Punjab -	143 mmcfd
KPK-	380 mmcfd
Total-	4,165 mmcfd

KPK's present total gas production as on December 2014

Total Gas Production	- 370 mmcfd
Consumption in summer	- 260 mmcfd

In winter entire quantity is consumed in KPK

KPK now wants to generate 700 MW of cheap electricity with surplus gas. The Ministry of petroleum has allocated G.O KPK 100 mmcfd for power generation. This will leave nothing for deficient province of Punjab – Fruit of the 18th Amendment.

KPK oil and gas production in Kohat division is producing 46,000 barrels of crude/ day from Kohat, Hangu and Karak districts.

KPK- OGDCL – Gas Production targets in mmcfd

2014	2016	2018	2020	2025
380	460	556	673	1,084

Small foreign oil and gas companies are contributing to discovery and production of gas in Pakistan. Some of the details are as follows:-

- In October 2012 gas reserves of 300-400 billion cubic feet have been discovered near Bhit Gas Field in Sindh. This field will produce 30 million cubic feet per day (mmcfd).

- MOL – Hungarian oil company is adding another 144 mmcfd to the existing supply of 300 mmcfd from her TAL Block. In addition they are producing 16,000 barrels/day of condensate.

- OMV an Austrian company is at present producing 400 mmcfd from its four gas fields. It will add 130 mmcfd from SAWAN Gas Field in Sindh making a total of 530 mmcfd.

- OMV is also prospecting for TIGHT GAS in the SAWAN Gas Field area- Distt. Khairpur.

- KPK is producing 510 mmcfd gas against its consumption of 150 mmcfd. For the first time KPK is self sufficient in gas and oil.

- OGDC and other companies are to drill 110 wells during 2014.59 are explorations wells and 51 are development wells.

- GOP is planning to drill 400 wells in the next four years.

- At present Sindh province produces 70% of the total gas produced in Pakistan.

- OGDC is hoping to add 339 mmcfd in 2014.

- PPL- Gas 684 mmcfd.

- OGDCL IS ONE OF THE MOST PROFITABLE COMPANIES IN PAKISTAN.YET THE GOP IS HELL BENT ON PRIVATIZING ITS SHARES.

- NO COUNTRY WAS WILLING TO UNDERTAKE THE PAKISTAN PART OF THE 780 KM GAS PIPE LINE. NOW CHINA IS GOING TO CONSTRUCT THE 780 KM GAS PIPELINE FROM GWADAR TO NAWABSHAH AND BUILD NLG HANDLING FACALITY AT GWADAR PORT.

- 16/12/15 PPL's biggest Discovery in 10 years at Matiari- 56mmcfd further drilling will take it up to 80 mmcfd enough to supply Engro's fertilizer plant which is largest in Pakistan. PPL had 9 discoveries from 11 wells in Gambit block. In august 2014 Sharif X-1 to start producing 42 mmcfd with a potential to rise to 60 mmcfd.

PPL's gas production dropped to 825.48 mmcfd in 2014-15 form 1,000 mmcfd in 2011-12.

It has 6 producing fields in SUI, KANDHKOT, ADHI, MAZRANI, CHACHAR and HALA.

18/9/2015- PPL find gas in Hala block

- 5/12/15 Mari Petroleum will add 200 mmcfd in a few months and add another 100 to 150 mmcfd by end of 2016.

- Polish gas company PGNIC- discovered tight gas. Intents to double/ triple its $ 100 million investment producing 10 mmcfd tight gas- at testing stage potential to take it to 30-40 mmcfd in 2016 to go up to 100 mmcfd by 2020 two discoveries in KIRTHAR jointly with PPL.

- 20/1/2016 MOL Pakistan, the operator of TAL block- at 4,912 meter discovered 40.56 mmcfd gas at Mardan Khel-I in TAL block Hangu.

- MARI Petroleum is producing 20 mmcfd tight gas from Zarghoun South Block in Balochistan.

- Tight gas 12 mmcfd being produced from Miano tight gas field for SNG.

10.4: USA –TECHNICAL ASSISTANCE FOR OIL AND GAS EXPLORATION.

During our PM's recent visit to USA the Americans in order to ease Pakistan's difficulties created due to sanctions against Iranian gas have offered to provide Pakistan with technical assistance to explore domestic gas resources instead of relying on Iran. IT IS THE MOST OPPORTUNE MOMENT TO ASK US TO HELP PAKISTAN NOT ONLY IN GAS BUT ALSO SHALE GAS AND OIL EXPLORATION. Also help being sought for US companies to construct $1.4billion 1100KM gas pipeline from Karachi to Lahore to transmit LNG (converted to gas). Also participation of US companies in joint venture with public sector entities to accelerate exploration and production activities in Pakistan.

10.5: REVISION OF GAS EXPLORATION FORMULA

At present Pakistan is offering $6 to 6.5/ mm Btu whereas India is paying $8.5/annum mm Btu to gas exploration companies. Our rates do not attract investors. Whereas the Government is ready to import LNG at $14 – 15 /mm Btu and buying gas from Iran at $12 mm Btu, it is not prepared to pay gas exploration companies a good rate to explore in Pakistan. Increasing the rates, discoveries caped due to low rates, can increase the gas flows. GOP now agrees to pay $ 6 per mmBtu for local gas production.

Efforts on exploration of gas / oil must be expedited to discover these hidden treasures of Pakistan.

10.6: IMPORT OF LIQUID NATURAL GAS AND NATURAL GAS FROM IRAN AND TURKMENISTAN

Much before the discovery of Natural Gas in the North Sea, the U.K. was the first country to master the LNG technology i.e. its liquefaction, transportation of LNG by ship, handling at the port, storage of LNG (in liquid form) on the land and its re-gasification for transmission into the National Gas Network. This was completed by 1960. Since then a large trade in LNG developed in the World Markets. Japan, China and Europe became big importers.

India started LNG import some years ago. Pakistan lagged behind India because of her domestic gas reserves, which met its requirement for power generation, urea fertilizer manufacture, domestic use (as replacement of Biomass fuel) and CNG for the automobiles. Recently, Pakistan started to face severe load shedding for domestic consumers, specially during winter months so much so that gas supplies to power stations had to be rationed. This affected our textile exports (60% of export earnings) and urea had to be imported. In spite of government subsidies prices of imported urea fertilizer went up THREE TIMES i.e. from Rs 670/50Kg to Rs 1850/50Kg. This has done great damage to agricultural production specially wheat and rice crops. It is evident from 2013wheat and rice production. Pakistan's wheat and rice exports have dropped 50%.

The shortage has occurred due to delay in construction of Gas pipeline from Iran due to US pressure and many years wasted on the proposed TAPI (Turkmenistan, Afghanistan, Pakistan and India) pipeline project. Of course, the deteriorated law and order situation in Balochistan has hampered the exploration and production of domestic gas resources which has partly contributed to the supply gap.

Production of electric power from Gas is much cheaper than Furnace oil. Furnace oil cost is Rs 18-20/unit whereas gas costs are not more than Rs 5/unit-An AFFORDABLE price for industry, agriculture and domestic consumers.

Pakistan has wasted 3 years in simply getting down to construction of infrastructure for handling import of LNG.

To bridge the demand and supply gap the quickest method is to start import of LNG.

Supply of LNG is not restricted to a single source like Gas from Iran. It can be purchased from any country supplying on the World Market. The price of LNG has dropped due to SHALE GAS in the U.S. Compared with spot price of U.S. produced LNG in 2008 dropping to$4/mm Btu from $12/mm Btu. Within the next 20 years 50% of U.S. Natural gas supply will be from shale gas.

It is, therefore, most urgent to construct LNG handling facilities without wasting time on formalities of rules and regulations. LNG is fuel of the future. Global price of Natural Gas has been 10 times cheaper than crude oil. Right now Natural Gas is approx.35 times cheaper. Asian LNG prices have plunged 25%. Therefore natural gas prices are bound to fall.

In Australia, Chevron and EXXON-Mobil are investing $180 billion to liquefy coal-seam gas into LNG and export it. By 2018, Australia would be the largest exporter of LNG.LNG is a buyers' market.

LNG exporting Countries:- 19 including Qatar, Malaysia, Indonesia, Algeria, Nigeria, Australia, Russia, Oman, UAE and Canada.

Pakistan needs a short term and long term LNG strategy. The UK, Japan, Korea, Taiwan and China have been buying spot cargoes at around $4/mm Btu. Over the short term Pakistan should do the same. Over the long period LNG at around $4/mm Btu is the trend.

East Asia Index for March 2015 settled at $ 6.85 per mm Btu. Asian LNG prices are expected to fall up to 30% in 2015. The cheapest LNG cargo landings in China with an average price of $ 3 to 4 mm per Btu from Australia and Indonesia. Between now and 2020- 25 more countries are planning to inject an additional 30% to existing global capacity. By 2023 production capacity is going to be far in excess of demand.

We have already discussed the non VIABILITY OF PURCHASING GAS FROM IRAN AT $12/mm Btu in great detail in section 3.10 IRAN – PAKISTAN GAS PIPE LINE.

Details of the import of Gas and NLG

TAPI	-1.325 billion cfd
IP	-0.75 billion cfd
LNG	-2.00 billion cfd
Total	-4.00 billion cfd

LNG handling facilities are being constructed at Karachi and Gwadar. At present the 780 KM pipeline from Gwadar to Nawabshah will transmit RLNG from Gwadar port. Once the 80 KM gas pipeline from Gwadar to the Iranian pipeline will be connected this pipeline will transmit the gas from Iran.

An agreement with Russia as has been executed to construct an 1100 KM gas pipeline from Karachi to Lahore at a cost of $ 2.5 billion.

Both the IP and Russian pipeline projects are facing problems due to USA sanctions. Turkmenistan is planning to construct another pipeline to Gwadar port (in addition to TAPI) – Capacity 600 mmcfd for liquifaction into LNG for export from Gwadar port.

10.7: CNG-Industry and Automobiles

Just like the large network of Natural gas for domestic consumers initially the government encouraged CNG distribution for the Automobiles. Compared with diesel it is a cleaner fuel and helps to reduce air pollution in Urban areas. Gas is produced in the country so there is no burden on foreign exchange, whereas diesel has to be imported. Unfortunately demand for CNG has exceeded the local resources.

Until we are able to meet demand with import of LNG and Natural Gas from Iran, supply of CNG to stations should be halted. CNG stations should be allowed to distribute petrol, diesel and LPG. There is also a factor of wholesale theft of gas by CNG station owners. If supply of gas for CNG is stopped we can easily generate another 2,000MW of electricity and make life more comfortable for the masses, suffering 16 to 20 hours of load shedding.

CNG industry's investment – Rs.450 billion – requires 690 mmcfd gas. There should be no objection to their using imported energy when it becomes available. But, under no circumstances, they should be supplied cheap locally produced gas. Strict monitoring and control on the THEFT OF GAS by influential CNG station owners should be ensured when they are supplied through the imported LNG since the supply will be through National Gas Grid. Past practice of wholesale

theft by CNG industry has to be stopped. However denying CNG for transport will increase POL imports by $1.4 Billion

CNG FOR URBAN AREAS:

Like the practise in DELHI in INDIA CNG should be supplied for use of transport used in urban areas. This is important for clean environment in urban areas. However use of CNG throughout the country for transport is not a thermally efficient option. Instead CNG stations out of urban areas should be encouraged to sell LPG. Use of LPG in transport should be encouraged even if we have to import the fuel.

PRIORITY OF GAS DURING WINTERS FOR DOMESTIC USE

Domestic consumers use gas most inefficiently. As practised all over India domestic users should use LPG only. Instead the gas saved should be allocated to power stations who can generate electricity at 60 % thermal efficiency. This would help reducing electric load shedding during winters and summers. LPG being a cheaper energy should be imported to meet any shortfall.

10.8: HOW TO OVERCOME GAS LOAD SHEDDING

Like electricity Natural Gas has similar peak demands (daily and seasonal) and specially during winter months. Technology for LIQUIFACTION AND STORAGE IN THE GROUND has been available for some 50 years. In order to manage and LOP off the peak demands it is suggested that liquefaction and storage facilities should be established in large cities like Lahore, Faisalabad, Sialkot, RWP, Islamabad, Multan, Gujranwala, Sukhar, Hyderabad and Quetta. In case of Karachi imported LNG should be stored in the ground.

During the peak hours stored LNG can be gasified to meet the demand. The cost of liquefaction is 20% and re-gasification is 30% of the price of gas delivered in bulk to a city. The process will involve use of energy for liquefaction and eventual re-gasification. If it is economically viable it is the best method to meet demand during winter months when gas is short.

Use of LPG air mixing plants, should be resorted to meet peak demand in domestic and industrial areas. Also use of LPG cylinders in lieu of piped gas should be encouraged for areas not receiving piped gas.

10.9: SUPPLY OF CHEAP GAS TO INEFFICIENT CAPTIVE POWER PRODUCERS

Supply of cheap gas to inefficient captive power producers should be stopped. This gas supply should be given to efficient gas powered plant in Private (IPPs) or public sector. Neither should NTDC purchase surplus electric power from CPPs (captive power plants) as the gas allocated by OGRA is specifically meant to meet their own needs and not for sale to make a profit on the gas supplied at cheap rate. Thermal efficiency of most CPP is 18 to 20%. Due to their political pressure they are provided gas during winters whereas electric generation plants of 54% thermal efficiency are denied gas. Siemens H Class Gas Turbines being installed in the U.S. are achieving Thermal efficiency of over 60%.

Some of these beneficiaries of cheap gas have been found selling its own electric power at inflated rates to the national grid and getting cheaper power from the National Grid at subsidised rate. This theft should be stopped. However, if the owners of CPPs can guarantee 60% Thermal efficiency of their plants there is no harm in supplying gas to them at the price it is supplied to gas power plants in private and public sector.

10.10: IP and TAPI Gas Pipelines

In view of the huge gap of 2.0 bcfd (billion cubic feet per day) between supply and demand the need to import gas from Iran and Turkmenistan needs immediate measures to complete the IP Pipeline in the Pakistani sector and start serious work on the TAPI gas pipe line. However the price has to be re-negotiated with Iran as discussed on the Iran-Pakistan Pipeline. Ministry of Petroleum are planning to include a 42 inch gas pipe line ($1.0 Billion) from Gwadar to Nawab shah in the $45.6 Billion CPEC credit. Initially it would carry 690 MMFD gas from an LNG terminal to be set up at Gwadar port (Cost $2.0 Billion). Pakistan has only to construct 80 KM pipeline to connect with Gwadar

and on to Nawab shah. The pipeline can be connected with Iran's once U.S Sanctions are lifted.

10.11: LNG – Liquid Natural Gas – a better option than Gas pipelines

While we have discussed the natural gas pricing, import of LNG from the World markets has become a better option than the IP and TAPI Gas pipelines in view of ample supplies due to Shale Gas. Historically Gas and LNG prices were linked to oil products. However gas prices have gradually decoupled from oil prices. Enhanced supply of gas has resulted into price ratio of a barrel of crude oil to a MMBtu of natural gas rising to over 25:1 on a sustained basis in excess of the 6:1 the ratio based on pricing energy content at parity. The transformed energy landscape across the world has substantially brought down gas market prices. After the first LNG handling plant- capacity 400 mmcfd at Port Qasim a second is in the process of being setup. The third plant at Gwadar is being constructed with Chinese help under CPEC funding.

10.12: Recurring cost of ensuring security of pipelines and uncertain security situation in Afghanistan an Balochistan

As opposed to importing LNG by sea we will have to incur recurring cost of ensuring pipeline security plus uncertain security situation in Afghanistan and Balochistan for the TAPI gas pipeline.

10.13: A better option - $ 2.5 Billion 1100 km Gas pipeline from Karachi to Lahore

A $ 2.5 billion agreement has been signed with Russia for construction of 1100 KM gas pipeline from Karachi to Lahore. Russia has agreed to provide a loan facility of $ 2 billion.

10.14: Increase in indigenous supply of gas.

Efforts are being made to increase domestic supplies of gas. Government had planned to drill 110 wells for oil and gas in FY 2014 consisting of 59 new exploration wells and 51 production wells. This is our best option – to increase domestic supplies by using conventional and Shale Gas technologies to meet our total gas requirement. Our

export earnings at present and near future are not sufficient to pay such huge import bills for IP/TAPI Gas or LNG.

10.15: Use of LPG for domestic and public transport

LPG is also environmentally friendly fuel and cheaper than petrol and diesel. Instead of using Natural Gas for domestic and transport we should encourage use of LPG even if it has to be imported to meet total demand. LPG's domestic production can be increased by bottling it instead of flaring it off at domestic oil and gas fields. Piped natural gas is available at the moment only to 20% of households. New connections should be discouraged, but supply of LPG should be increased by increasing domestic production and through imports. In India all domestic consumers use LPG. Thus available domestic natural gas could be used more efficiently when supplied for power generation, Urea fertilizer and industrial purposes. This arrangement can be used without causing inconvenience to domestic consumers and transport users pending the import of LNG and completion of IP and TAPI Gas pipelines.

- A GOOD NEWS IS A SUBSTANTIAL INCREASE IN LOCAL PRODUCTION OF LPG THIS YEAR.THE PRODUCTION WILL RISE BY 600 M TONS PER DAY FROM THE PRESENT 1300 M TONS PER DAY.THUS LOCAL PRODUCTION OF LPG WILL RISE TO ABOUT 1,900 TONS PER DAY.THE PRICE IS EXPECTED TO DECLINE BY ATLEAST 30% OVER THE NEXT FEW MONTHS.

OIL RESOURCES

11.1: General

The country has struck oil from Nashpa Field near Kohat in KPK which has jacked up our oil production to 100,000 barrels per day from existing 67,000 barrels per day. In the seventies our production rose to 75,000 barrels per day, contributing 25% of our total oil requirement. The total requirement has now risen to 450,000 barrels per day. So our indigenous oil production still stays at 22% of the total requirement. PSO, Pakistan State Oil, plans to construct an OIL Refinery – capacity 20,000 barrels/day near Kohat to process the crude oil production of this region.

Pakistan's total demand for Oil products is 19.63 Million tonnes per annum. Saudia provides 10,000 barrels per day of crude, costing $ 7.5 Billion per annum. Total cost of crude plus oil products import $15 Billion at 100 $/ barrel.

Crude Oil production expected to rise to 130,000 Barrels / day in one or two years. GOP Planning to drill 400 wells in the next 4 years.

Oil companies, even our national ones, are facing difficulties in exploiting oil and gas resources in some regions due to law and order problems and the on-going insurgency in Balochistan. This is not only hindering efforts to make new discoveries but also fully exploiting the existing fields in production.

In spite of the energy crisis, Pakistan is losing Rs 0.5 billion daily for its inefficient production and Rs.2.5 billion daily by flaring gas in the air from its oil fields. LPG allocation, without competitive bidding, is losing billions. **GOP is now planning to incorporate flared gas into the gas network.**

First gas field was discovered in 1952 near Sui Balochistan. Toot Oilfield in Pothohar near MISSA KASWAL was discovered in 1964. In 1981 Union Texas discovered its first field in lower Sindh in 1981. By 1998-99 Lower Sindh started producing more oil than the Pothohar

Plateau in the Punjab. With discovery of oil in KPK three provinces Sindh, Punjab and KPK are producing oil which meets only 22% of the country's 400,000 barrels/day requirement. Great efforts are needed to make us self-sufficient otherwise import of oil and oil products will continue to devour our meager export earnings.

The main players in oil and gas production – Union Texas and Occident Petroleum have long since left the country. It is only OGDC, Pakistan Oil Fields & Pakistan Petroleum Ltd., Mari Petroleum Limited and small foreign oil companies that continue to prospect and produce in Pakistan. DUE TO LAW AND ORDER SITUATION NO BIG FOREIGN OIL COMPANY IS PREPARED TO COME TO PAKISTAN. WE ARE PAYING A VERY HEAVY PRICE – 60 TO 65% OF OUR EXPORT EARNINGS ARE BEING USED TO PAY FOR OIL IMPORTS. THE HEAVY BURDEN OF OIL IMPORTS IS NOT LETTING OUR ECONOMY TO STAND ON ITS OWN FEET AND HAS PUT US INTO PERPETUAL DEBT TRAPP. HOPE THAT PML (N) GOVERNMENT WOULD GIVE THIS SECTOR OF OIL AND GAS THE HIGHEST PRIORITY.

The latest news from the oil sector is very encouraging- production in KPK has risen dramatically.

Nashpa field-20,200 b/day

Tal Block-16,000 b/day

MOL has become second largest producer of Oil at 21,000 barrels per day, Gas 300 MMCFD, LPG 300 tons per day.

There are plans to construct a pipeline to Attock Oil Refinery to Rawalpindi to transport the crude oil from KPK oilfields. OGDCL's present production of 40,205 bpd is a major contributor in oil and gas production. Total oil production has now crossed 96,000 bpd taking the country's oil production to 100,000 bpd by end of FY2014. Sindh Province produces 60% of total oil. With recent US promise of assistance in exploration of oil and gas and shale oil and gas should give a tremendous boost to oil and gas production and relieve pressure

on oil imports bills. But the USA programme is going to take 5 years for investigation of Shale Oil and gas reserves.

11.2: KPK- OGDCL – Plans for oil Production

Year	2014	2016	2018	2020	2025
barrel/day	9,000	48,400	58,564	70,862	1,11,412

11.3: Oil & Gas Discoveries

Sindh	255
Punjab	42
KPK	15
Balochistan	15

Discovery success rate average is 34%

18/9/2015- Mari Petroleum finds oil & Gas in Mianwali- Kalabagh- two discoveries in this Block. Also finds oil in exploratory well Halini Deep-1- KARAK BLOCK oil 1,425 bpd. This is the third discovery in the said block after two discoveries in earlier including X-1 and Kalabagh I-A.

19/12/15- Most significant- PPL struck oil in Dhok Sultan District Attock at 5,827 meters striking the same seam as at TAL & NASHPA in KPK. This has opened a new field in western Pothohar- blocks HISAL and KARSAL production 1,000 bpd.

- OGDCL and other companies were to drill 110 wells during 2014. Exploratory wells 59- development wells 51.
- GOP is planning to drill 400 wells in the next four years.
- PPL-OIL 7,100 bpd.
- 20/1/2016 MOL Pakistan, the operator of TAL block- at 4,912 meter discovered 3,340 barrels / day oil at Mardan Khel- I in TAL block Hangu.
- OGDCL holds largest share of reserves- OIL- 58% GAS 42% OGDCL percentage share of total OIL and GAS production is 52

and 29% respectively. OGDCL- OIL production 43,807 pbd. GAS is 1,145 mmcfd-LPG 85 M Tons per day. Sulphur 96 M Tons per day.

11.4: OFFSHORE OIL EXPLORATION AND COASTAL DEVELOPMENT

The ministry of petroleum and natural resources has signed a number of joint exploration and production sharing agreements (EPSAs) for offshore oil exploration in the Arabian Sea touching Badin, Karachi and Thatta.

Arabian Sea was declared as Zero Zone which comprised of Indus North, Indus X, Indus Y and Indus Z. Approximately an area of 4,170 sq km was given to different multinational companies including British Petroleum (blocks U, V, and W in Indus Delta), ENI (blocks M, N and C), PETRONAS, with partners like TOTAL 40 percent, OMV 30 percent, MGCL 10 percent and subsidiary PETRONAS Carigali Pak Ltd, Tullow and OGDCL (blocks G and H.). It was claimed that an investment of $ 3.19 million is envisaged during the first two years of the project, but no official estimates of the blocks' reserves have been released.

11.5: Oil refining Capacity

Pakistan has 7 oil refineries with total annual refining capacity of 12.8 million tons. We are having to import over 5 million tons of oil products. Pakistan is requesting Kuwait for $ 10 billion deep conversion refinery which will meet the total refining requirement of Pakistan.

OGDC is producing 50% of the total oil production and 29% of the gas production.

SHALE OIL AND GAS, TIGHT GAS AND GEOTHERMAL

12.1: General

Shale oil and gas technology is extraction of trapped oil and gas in sandstone formations. This was not economic until recent development of this extraction technology. Tight Gas is natural gas, found trapped in impermeable rock and non-porous sandstone or limestone formations, typically at depths greater than 10,000 feet below the surface. Production of Tight Gas from Zarghun South Block in Balochistan has started – initial flows 4 MMCFD going up to 20 mmcfd by November 2014. Price as per Tight Gas policy 2011 $6.74 mmBtu, tight gas is also being explored in Sindh at OMV Sawan field in Khairpur Sindh. Tight gas 12 mmcfd being produced from Miano tight gas field for SNG.

While we are faced with fast dwindling oil and gas reserves Pakistan has an estimated 40 Trillion cubic feet (tcf) of gas trapped as tight and shale gas. There is a need to extract and process these gases. The Ministry of Oil and Natural Resources should take necessary steps to harness this resource. This would free us from importing Gas and LNG which is going to be a big drain on our foreign exchange reserves.

20/11/2015 According to US energy administration Pakistan has 10,159 tcf of recoverable shale gas and 2.3 trillion barrels of oil.

Shale –based resources have increased the World's total potential Oil reserves by 11% and Natural Gas by 47% according to a U.S. report released recently. In an initial assessment of Shale Gas Reserves, the U.S. Energy Information Agency said shale deposits could add 345billion barrels of oil to global oil reserves, increasing the total to 3,357 billion barrels.

Shale Gas adds 7,229 Trillion cubic feet (tcf) of natural gas or 32% of World's total, the EIA report estimated.

The exploitation of North American shale deposits has transformed the U.S. oil and gas industry. Other countries with large shale resources,

in addition to USA, are Russia, China, Argentina, Algeria and Libya. China is estimated to have the world's greatest recoverable shale resources at 2,011tcf. Recent drilling in Argentina, Mexico and Poland is shedding more light on resources.

The biggest breakthrough in the Energy Industry has released unprecedented quantities of shale gas. This involves Hydraulic fracturing combined with horizontal drilling.

In 2008 the spot price of U.S. produced gas was $12/mm Btu. In 2012 the spot price crashed to less than $2/mm Btu before rebounding to around $4/mm Btu. The Shale Gas recovery technology released unprecedented quantities of Gas. Currently 25% of US Natural Gas production is Shale gas. Within the next 20 years 50% of US Natural Gas supply will come from Shale Gas.

As of Dec 2011, Pakistan's proven Natural Gas reserves stood at 30 Tcf. According to State Bank of Pakistan the country is left with only 50%Natural Gas reserves due to high consumption in different sectors. Pakistan has only sufficient reserves to last just over 20 years.

12.2: GIFT OF GOD ALMIGHTY TO PAKISTAN

According to U.S. Energy Information Agency (EIA) Pakistan has 586Tcf of Risked Shale Gas in-place. Technically recoverable Shale Gas resource is estimated at 105 Tcf which can last 73 years as Gas supply. Punjab and Sindh hold 95 Tcf SHALE gas deposits as per US Aid.

Similarly according to U.S. EIA Pakistan has 227 billion barrels of oil. Technically recoverable oil is estimated at 9.1 billion barrels. This is 68 years worth of crude oil supply.

Two shale formations have been identified-The SEMBAR shale formation and RANIKOT shale formation. Within the SEMBAR SHALE Dry Gas is in 31,320Sq miles and wet Gas in 25,560 Sq miles and oil in 26,780 Sq miles. 4 Tcf of wet shale gas and 3.3 billion barrels of shale oil. Pakistan has the NINTH largest shale oil reserves in the world.

The gift of God Almighty can be a GAME CHANGER-Abundant and cheap source of energy.

The critical processes involved are Hydraulic fracturing and Horizontal drilling. Disciplines involved are GEO-mechanics, geochemistry, Mineralogy, Rock mechanics, Seismology and stimulation modelling.

The U.S. has all the expertise. There is all important RISK management; i.e. drinking water well contamination and surface water contamination.

Pakistan grows GUAR (cluster beans) which is the essential ingredient in the Shale Gas Fracturing process-Pakistan and India grow 80% of global GUAR PRODUCTION.

We need to acquire SHALE TECHNOLOGY urgently. HEC should be asked to send Engineers to acquire expertise in the above DISCIPLINES and should also get practical training in these disciplines in the U.S./ Europe/In countries like Argentina, Mexico, Poland and China.

High level contacts should be established with the U.S. A.I.D. Energy Programme to provide training to our engineers in above disciplines and ask US A.I.D. for their help, for US shale extraction companies to prospect for SHALE GAS AND OIL in Pakistan.

This technology will take us out of the STONE AGES, to which we are fast approaching, due to lack of ENERGY.

Pakistan can experience similar shale boom as the US. Shale boom in the US is remaking US energy and economy. The US boom is remaking nation's industry and will give her energy independence as the world's biggest oil consumer. It is creating jobs, re-invigorating energy consuming industries and narrowing trade balance. It has provided a boom to several energy – dependant sectors like steel, petrochemicals and cement. Due to this US will become a net exporter of oil by 2030.

A WORD OF CAUTION:- We should not act blindfold on the U.S. Energy Information Agency, as their estimates in case of POLAND

turned out to be untrue. Since it is a costly and major venture the U.S. E.I.A. information should be confirmed from other independent sources before embarking on exploration. The GOP, in order to encourage Shale Gas exploration has announced a Tariff of $ 12 / mmBtu to the first 3 companies venturing into the field.

12.3: GEOTHERMAL ENERGY

There are a number of abandoned gas and oil wells from which geothermal energy can be extracted. A company in Karachi has been registered to undertake geothermal energy projects. Geothermal energy can be as cheap as hydro electric supply. California is leading in this technology. Worldwide there is tremendous development in this source of energy.

13: THEFT OF GAS AND ELECTRICITY

The theft of Gas and Electricity has assumed endemic proportions. Theft and transmission loss of electricity, some of it shown and hidden as line losses, is 40%. This is symptomatic of the deteriorated law and order situation. Since there is no deterrent, the public and industries are openly stealing electricity and gas. Recent raids by the FIA and the local executive have discovered industries stealing gas and electricity in millions of Rupees per month. Huge localities are stealing electricity as a whole community. In the stealing process the gas and electricity personnel up to SDO level have been found in cohort with the power thieves. It is impossible for the consumers to steal without DISCOS and Gas people's knowledge and help. Both the consumers and the distributors are involved in this crime. Pakistan sustains a loss of Rs 4 billion/ year as gas leakages.

TRANSMISSION AND DISTRIBUTION LOSSES AT 25 % ARE COSTING RS. 2.7 PER UNIT WHEREAS AVERAGE COST OF GENERATION IS RS. 12 PER UNIT

POWER THEFT IS COSTING RS.140 BILLION/ANNUM

If there were a deterrent, thefts on such a large scale would not happen. An appropriate example is the conduct of Pakistani motorists

on Motorway and National Highways. Traffic crimes are lesser than on roads in the U.K. and Europe. This is because the Highway and Motorway Police are strict and honest and there is INSTANT DETERRENT-FINES HAVE TO BE PAID ON THE SPOT. **In order to rid the nation of this endemic disease we must create an Independent Authority like the Motorway Police and this Authority should remain in operation till the nation gets rid of this disease.** The Authority should recover the estimated stolen energy bills with fines, without having to go into courts and Police FIR'S. The Authority's budget should be paid from a % of recovery and fines, so that it is self-financing.

There is another aspect of the theft of energy. The burden of these thefts are transferred on the Bill paying consumers as line losses and UFG (un accounted for Gas) or from the Indirect Taxes recovered from the public-paid in the form of CIRCULAR DEBT. This is indeed very unfair to the public. This is clearly a theft in Islamic Sharia. Legislation should be brought in to CUT OFF THE HAND OF LARGE THIEVES OF ENERGY. Then only we can hope to get rid of this national disease.

Exceptionally high tariff is a factor tempting people to steal. Efforts to bring down the tariff to an AFFORDABLE level of Rs 5/unit will decrease theft. But this is going to take 3-5 years to materialise.

It is not a job for the district/Tehsil executive, police and the energy supplier. The extent and scale of theft is so large that it should not be left to the above departments. They should be spared to perform their designated duties. A separate full time federal authority, backed by legislation, is required to tackle this mammoth task.

13.1: STREET LEVEL METHOD OF DETECTING ELECTRICITY AND GAS THEFT

If every street/sections of a road have sub-meters, detection of theft is possible by comparing receipt of bills and actual usage of power by the consumers in that street/road. Any discrepancy should be recovered from consumers of that street/road. This way thieves will be identified.

The difference between the cost of power delivered from a feeder and bills realised should be eliminated in order to get rid of circular debt.

13.2: LOAD SHEDDING BY EACH DISCO IN ACCORDANCE WITH %AGE RECOVERY OF BILLS

Load shedding is here to stay for a minimum of 5 years. Power should be supplied in proportion to the RECOVERY from each DISCO. This method has been successfully employed by K-Electric in Karachi. Consumers on 100% paying feeders have only an hour or two load shedding. Why should DISCO's like Islamabad, Lahore, Gujranwala and Faisalabad should be penalized by electric load shedding where the consumers are paying their bills up to 98%? Load shedding should be made in DISCO's where bills recovery is 30- 40%.

13.3: LOAD SHEDDING ON FEEDERS IN PROPORTION TO PAYMENT OF BILLS.

In addition to the DISCO wise allocation of power in proportion to recovery, a more effective method is to apply this rule to each feeder. Feeder load shedding should be in proportion to recovery of bills.

13.4: LATEST FIGURES ABOUT GAS AND ELECTRICITY THEFT AND % COLLECTION OF ELECTRICITY BILLS

The World Bank report says- 12% of electricity bills worth Rs 105billion are not collected. This is confirmed from the first quarter of FY2014-Rs 65.63billion electricity bills not recovered. If this trend continues for the rest of the year the amount unrecovered will come to Rs 262.52billion. Eventually this amount will be paid up as circular debt. This burden is on poor masses, collected through indirect taxes. Gas theft costs Rs 32billion every year. Thieves are stealing directly from oil and gas pipelines. THIS PROVES MY SUGGESTTION FOR THE IMMEDIATE ESTABLISHMENT OF A SERPERATE AUTHORITY TO PREVENT GAS AND ELECTRICITY THEFT THROUGHOUT PAKISTAN.

CIRCULAR DEBT

14.1: General

Circular debt will continue to appear every month as long as theft of energy, a tariff structure, to get rid of subsidies, and non-payment of bills by Federal and Government departments continues. Government departments are notorious for non-payment of energy bills. *Meters, requiring pre-payment of energy, should be installed in all government departments. Failing above, legislation should be made to recover outstanding Provincial and Federal Government's energy bills through deduction at sources from their NFC awards.*

However for the low income segments of society, a safety net, targeting only the deserving, should be provided.

DEDUCTION AT SOURCE FROM NFC AWARDS SHOULD BE MADE FOR FATA AND PARTS OF BALOCHISTAN, KPK AND SINDH WHERE RECOVERY OF BILLS IS NOT PRACTICAL. RECOVERY OF ELECTRIC BILLS SHOULD BE THE RESPECTIVE PROVINCIAL GOVERNMENT RESPONSIBILITY UNDER ABOVE CASES.

Non-payment of IPPs causes double damage to the nation. IPPs cannot produce electricity due to lack of funds and due to non-payment of their bills which causes load shedding. But the Government is bound to pay their capacity charges. Recent payment of Rs.500 billions to IPPs largely consisted of capacity charges without having received any electric power to the national grid. In order to avoid this double loss Government should ensure timely payment of IPPs bills after proper auditing.

Circular debt appears to be a convenient scam for channelling massive public subsidies to a variety of political, commercial and industrial

interests for producing high cost power (Under guaranteed fuel supply and guaranteed power take off to independent power producers, IPP'S); for not producing any power at all (under various power rental schemes); and for underwriting outright theft and cheating at all levels.

Federal role should be confined to generation and transmission. By privatizing distribution the theft would be taken care of by private distribution companies.

THERE IS AN URGENT NEED TO REVIEW THE CONTRACTUAL TERMS FOR IPP'S CONTRACTS TO ENSURE AN EQUITABLE DISTRIBUTION OF RIGHTS BETWEEN THE PUBLIC AND PRIVATE SECTOR, INCLUDING RENEGOTIATION OR ADJUSTING POORLY DESIGNED GOVERNMENT GUARANTEES IN EXISTING CONTRACTS – GUARANTEED CAPACITY CHARGES AND GUARANTEED OFF TAKE SHOULD BE RENEGOTIATED THAT HAVE CONTRIBUTED TO CURRENT CRISIS.

THE IPP'S SHOULD BE CONTRACTUALLY BOUND TO PRODUCE POWER AT 60% THERMAL EFFICIENCY- THIS WOULD LOWER THE PRESENT COST OF GENERATION- PRESENTLY OPERATING AT 30 TO 40% THERMAL EFFICIENCY AND LOWER OUR FUEL IMPORT BILLS. POWER SHOULD NOT BE PURCHASED FROM IPP'S WHO FAIL TO ACHIEVE 60% THERMAL EFFICIENCY. DEFAULTING IPP'S SHOULD BE MADE TO PAY FINANCIAL PENALTIES. IDEALLY DISCOS SHOULD BE ALLOWED TO BUY POWER FROM IPP'S WHO OFFER BEST PRICES. IT SHOULD BECOME A FREE ENERGY MARKET LIKE THE U.K.

14.2: 200 MILLION POPULATION VS 30 IPPs

Under the power policy, the electricity tariff is calculated on the assumption that IPPs will earn an 18% rate of return on their investment. IPPs listed on stock exchange were raking in profits of up to 42%. It is a total failure on part of NEPRA to watch public interest and is partially responsible for multi billion circular debt. NEPRA HAS BEEN CAPTURED BY THE VERY INDUSTRY IT WAS CHARGED TO REGULATE.

ENERGY CONSERVATION AND AUDIT

15.1: General

In the Energy Industry, Energy conservation (a saving of 20 to 25%) is called the FIFTH FUEL after Oil, Gas, Coal and Nuclear. Government of Pakistan has established an Institution called "ENERCON". Enercon was part of WAPDA where it was getting proper financial support and creating public awareness through the ENERCON BILL 2013.Enercon was established in 1987 and serves as a national focal point for energy conservation/energy efficiency activities in all sectors of the economy namely Industry, Agriculture, transport, building and the domestic sector, a major consumer of electricity.

Enercon spans a whole spectrum of activities i.e. Identification of Energy opportunities including technology demonstration, undertaking pilot projects, dissemination of information, training and education and development of plans and policies for promoting energy efficiency.

Energy demand is growing by 8%per annum doubling every 12 years. Pakistan should encourage energy conservation which would result in significant reduction of primary energy demand. Pakistan's energy utilization per US $ GDP is an indicator of how inefficient we are at utilization of energy as a country. Pakistan's per capita energy will grow from 381kg to 700kg from 2008 to 2022. If a proportion could be saved through efficiency and conservation measures during this period it would reduce our dependency on imports and consequent strain on our foreign exchange resources.

Energy efficiency can be defined as the ratio of productive output to energy use. It is reducing the amount of energy required to produce a given quantity of a product/service.

15.2: Energy Audit

Technical assistance from Germany, through GTZ, should be obtained for Energy Audit and energy efficiency. Internationally Germany is following the best practices in energy efficiency and Audit. In whole of Europe, Germany is adopting renewable energy, solar and wind, technologies to bring Renewable Energy contribution to 35% in a short span of time. We can learn a lot from Germany in this field.

15.3: URGENT TARGETS FOR ENERCON

1. Solar water heating-Financial assistance
2. PEPCO to launch a compact campaign to change from incandescent lamps to fluorescent lamps (energy saver bulbs)-saving 1,000MW of electricity. Introduce LED energy saver bulbs as a mass movement like in India.
3. Building codes to target energy efficiency improvements
4. Enercon programmes-energy audit grants
5. Enercon to carry out economic assessment for using electricity-efficient technologies
6. Government should take the initiative for energy efficiency in buildings, transport and appliances used in government departments and public sector organisations
7. Government to enforce speeds on road to ensure optimum fuel efficiency and monitor trucks emitting smoke i.e. inefficient use of fuel.

Following South African National Energy Efficiency Agency agenda would be very useful.

15.4: ENERGY CONSERVATION AND EFFICIENCY IN AGRICULTURE

Agriculture is the most important sector for our economy. Its contribution in the GDP is 23% in addition to providing raw materials

to the textile industry, the major export earner, and the sugar industry. Tube wells use 1500 MW of power. Through government subsidy all tube wells should be converted to solar pumps replacing electric driven pumps.

Agriculture consumes 16% of the total energy, used for irrigation, diesel fuel for tractors and engines for irrigation and some 5 million tons of urea fertilizer plus imported DAP and Potash fertilizers. The scope for energy conservation and efficiency is tremendous.

- To start with, use of energy efficient electric motors and control gear, used for irrigation, would save 25% of the total electricity consumed.

- Electric tube wells use 1500 MW of electricity. Ideally with some govt financial help all the tube wells electric/diesel driven should be replaced by solar pumps. BEING LOCATED IN RURAL AREAS THE IRIGATION TUBE WELLS ARE SUBJECT TO LONG HOURS OF LOAD SHEDDING. THIS IS BADLY AFFECTING THE PRODUCTIVITY OF CROPS. INVESTMENT ON REPLACEMENT BY SOLAR PUMPS WILL ENSURE CONSTANT IRRIGATION WATER AND BOOST AGRICULTURE PRODUCTION.

- The major efficiency would be achieved from precision land levelling which gives the following benefits:

  A-Reduce the total quantity of irrigation water required by 50%. Hence 50% reduction in the use of electricity and diesel required for irrigation.

  B-Achieve optimum use of seed and fertilizer and increase per acre yield

  C For irrigation UNINTERRUPTED power is a must. Due to UNLEVELED fields irrigation at NIGHT with electricity is not possible. With levelled fields it will become POSSIBLE. Farmers can avail off peak rates and AVOID LOADSHEDDING as at

night uninterrupted power supply is more likely.

- Widespread use of drills for seed and fertilizer would reduce the amount of fertilizer to be applied thereby saving foreign exchange used for import of fertilizers and increase yields by 14%

- Adopting cultivation of major crops like cotton, sugar cane and maize on ridges would save water, hence save energy, and increase per acre yield.

- Adopting optimum tillage practices, using Zero tillage, would reduce tractor use and hence energy. At present a great deal of tractor fuel is wasted for excessive and unwanted tillage.

- Adoption of CHISEL PLOUGH in RAINFED (Barani) areas would reduce use of tractor fuel on tillage, would conserve water for wheat cultivation. Combination of PRESS DRILL, used in Australia as a dryland farming technique, would raise wheat yield at least three times. The use of CHISEL PLOUGH during the dry months of June – July ensures absorption of rain water into the soil during the rainy season instead of run-off in to the streams. The PRESS DRILL ensures placement of the seed about 6 inches below surface in a furrow. This ensures 100% germination due to availability of moisture to the planted seed and pressing of the soil around the seed.

- EFFICIENT AND APPROPRIATE USE OF AVAILABLE WATER-CANAL/TUBEWELL. At present we are growing crops like rice and sugar cane which are highly intensive water consuming. Rice crop alone consumes 17 MILLION ACRE FEET OF WATER PER YEAR. SIMILARLY SUGARCANE CROP IN PUNJAB ALSO USES ENORMOUS QUANTITIES OF WATER. In order to conserve our meager water resources we should concentrate on crops like WHEAT, COTTON, OIL SEEDS, MAIZE AND PULSES WHICH REQUIRE MUCH LESS WATER COMPARED WITH SUGARCANE AND RICE.

- In Punjab cultivation of sugar cane should be restricted to Riverine area's totalling 4 Million acres. Water requirement would be for

only 2-3 months. As the roots go down these can use residual moisture.

- WATER LOSSES IN IRRIGATIOIN
- 15% main canal
- 8% Branches
- 30 % water courses
- 30% at farmland due to non precision land levelling. Lining canals is not advisable where ground water is sweet because it will reduce recharging.
- Lining for Sindh's irrigation system is essential.
- Sindh has 14 main canals from three barrages.
- The efficiency of unlined canals is 75%- Lining brings it up to 90-95 %.
- Provide dedicated feeders for Irrigation tube wells or separate village supply from tube well supply lines.
- Precision land levelling for tube well irrigated areas. The irrigation cost of tube well water is very high. Therefore in order to save water precision land levelling in these areas is very important. Additionally tube well irrigation can be efficiently applied at night only if the fields are precision land levelled. This way, instead of providing electric power for tube wells during day when it is a time of peak demand throughout the country, the tube wells can be operated at night when demand is not at peak.

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