Paper No. 264

SELF GENERATION TO COMBAT POWER CRISIS

By

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ABSTRACT

Global energy game, appearing in the last 3 decades, has a particular context; while the resulting scenario in a country like Pakistan has taken its own shape. In Pakistan, the single largest emerging issue, has been the ghastly and acute crisis of power which unfortunately has been unintentionally or intentionally gravely mishandled. Alarm has been given on restoration of democracy, fighting terrorism, removing pollutions of all kinds, against which huge sums of foreign money has been spent, but very little has been said or done about the deplorable starving energy conditions in which people have been forced to get into. All governmental planning, mitigating actions, and privatization, have backfired. Technological solutions have not worked; because it is not the dearth of technology, it is the incompetence and wrongful doing on the part of earlier governments, which has brought people in the state in which they are now. The only way to reverse the power crisis is to let people produce their own power from whatever sources that are available to them, and to see that the money is not sucked out from them, and rather to divert some of it to improve the generating capacity of a community. It is in this direction, that the government effort and the foreign assistance programs should concentrate. Once the economic inflows and out flows from a system are controlled, the people will have improved generating capacities and they will themselves be able to take not only their own load but to support the government. Elimination of bottlenecks and putting people on self generation is a complex matter by itself. The quickest approach is building up systems for self generation through disbursement of technology and development of entrepreneurship. Participative mechanisms need to be formed in which an integral effort is done at the house holds, small communities, and industries while, need analyses, design development, development of tools and plant, management, micro-credits, and marketing functions are performed by professional bodies and volunteers in the respective fields after receiving suitable training. Although no efforts in the power field have been done on the above lines, positive efforts have been done on the above lines in the field of poverty alleviation. This paper describes the efforts being carried out by a number of persons including the author's team in this area.

The results of the pilot projects are very encouraging. The experience is expected to set the ball rolling. More people get into this kind of activity, better it will be and quicker will be the results. It is hoped that, soon after, a self growth path will be picked up by many, and expanded to national level. Ultimately, it is hoped that the back lash of poverty that reflects badly on the well being of people ends.

DETERIORATION OF POWER CONDITIONS

Pakistan's current total installed capacity of WAPDA and KESC amounts to 19,500 megawatts. Almost two third of this power comes from thermal power plants (fossil fuels), one third is generated by water and about 2% comes from nuclear power plants.

The demand for electricity in Pakistan during the winter months actually goes down and this winter has not been an exception. Throughout the month of December, the electricity consumption in Pakistan hovered around 11,000 MW, down from the peak levels of 17,500 MW seen in summer. This demand was well within the installed capacity of WAPDA & KESC yet they were only generating a meager one third (6500MW) of their maximum capacity during this period leaving a huge gap between supply and demand.

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From the failure to build new dams and the Government's inability to add even a single megawatt of new power to the grid during 9 years of its rule, it seems that the present crisis is a result of bad management and the lack of foresight.

The power crisis that the nation is facing is the cumulative effect of incompetence, and greed, on a massive scale. Since 1990, all the successive governments stressed the necessity for speed, so that the planning and execution of new projects should be completed before the shortages took on a pandemic form. Entrepreneurs were lined up to fund the start-ups and they came forward in droves. Deals were struck, kickbacks were negotiated and added to the project cost to be repaid along with the capital cost of the machinery. By none other than the consumers paid for the crafty work.

The oil companies have played a role to keep their considerable interests protected, by ensuring that the other options to generation of power be put on the back burner, then never to see the light of day.

The KESC and PEPCO owe more than Rs. 10b to the independent power producers (IPP) and paying them will help bring them into full operation and ease the crisis at least partially.

Pakistan Electric Power Company (PEPCO) blames independent power producers (IPPs) for the electricity crisis, as they have been able to give PEPCO only 3,800 MW on average out of 5,800 MW of confirmed capacity. Most of the IPPs are running fuel stocks below the required minimum of 21 days. IPPs complain that they are not being paid on time by PEPCO.

More strange incidences have been happening. On September 15, 2008, the Unit no. 5 of the Bin Qasim Power Plant, which normally generates 1185 megawatts tripped after developing some technical fault. The Plant could churn out only 560 megawatts with the suspension of electricity to the metropolis of Karachi.

The Korangi Thermal Power Plant which supplies 180 megawatts. Due to some unknown reasons dropped its production to 50 megawatts rather than its usual capacity of 180 megawatts.

Power transmission from Tarbela, Ghazi Barotha broke down on Sep 24, 2008, which caused black out to several cities and districts following another major power breakdown struck across Pakistan due to a fault in the national electricity transmission system.

There is no alternative but to resort to hours of load shedding. In June 2007, the power cuts in Pakistan lasted no more than 3 or 4 hours a day. This year, in extremely hot weather, Pakistanis have to endure without electricity for 8 to 10 hours a day. Industrial production is suffering, exports are down, jobs are being lost, and the national economy is in a downward spiral. By all indications, the power crisis in Pakistan is getting worse than ever.

If almost a third of the people of the world will live in power less conditions 30 years from now as the latest report of the UN Habitat projects, (1), how many more in Pakistan are already languishing in such horrid living conditions which are springing up all over the country?

Pakistan, which already faces this problem in a large dimension have to stand up and think.

ALTERNATIVE SOURCES OF POWER

Large hydro power generation projects involve a number of social, political and technical issues. Despite the government's intensive campaign, it has failed to remove the fears of Sindh

and NWFP on the issue of the Kalabagh Dam. Also, the construction of barrages and dams upstream on Indus has degraded the Indus delta. The promises of cheap hydro energy from large dams, if analyzed from a sustainable development prism, are not reliable because of two reasons; first, there is a vocal demand to include the social displacement and environmental degradation costs in the up-front capital costs of such projects.

Financing of such mega projects remains the most important aspect of this problem. Funding from international donors for such a project is difficult to receive, considering their commitment to facilitate investments in private thermal based power plants.

Second, even if the government arranges funding for such projects, the outlays involved in resettlement compensations are huge. For example, the government intends to spend Rs2.025 billion on the resettlement issues of the Kalabagh Dam by constructing 20 model and 27 extended villages.

Wind Source:
Near Islamabad, the wind speed is anywhere from 6.2 to 7.4 meters per second, while near Karachi, the range is between 6.2 and 6.9. There also exists a corridor between Gharo and Keti Bandar that carries regular wind of sufficient speed. The Alternative Energy Development Board (AEDB) was created in 2006 to pursue renewable energy. In Mirpur Sakro, 85 micro turbines have been installed to power 356 homes. In Kund Malir, 40 turbines have been installed, which power 111 homes. AEDB has also issued a letter of intent Makwind Power Private Ltd for the setting up of 50MW wind farm at Nooriabad in Sindh. An Indian company, Suzlon, has developed wind turbines, those start to turn at a speed as low as 3 meters per second. India now has the world's fourth largest number of wind turbines that have a capacity of 7,000 MW. The cost of wind power in India, however is between 2 and 2.5 cents per kilowatt hour while in Pakistan, the cost is 7 cents.

Solar Power:
Pakistan is an exceptionally sunny country. Impressed by advantages of solar power, National Institute of Silicon Technology (NIST), the Pakistan Council of Appropriate Technology (PCAT) and the Solar Energy Research Centre (SERC) and the Pakistan Council of Scientific and Industrial Research (PCSIR) were created to develop affordable means of solar power. Two decades after spending millions of rupees on the establishment, capital and operational cost on these institutes, NIST and the PCAT have been wound up and a new organization namely the Pakistan Council for Renewable Energy Technology (PCRET) has been established to further spend capital resources on failed and uncompleted projects of NIST and PACT. The directorate of renewable energy of the Ministry of Petroleum and Natural Resources has been closed after the failure of the project on solarization of some villages.

Small Hydro Electric Power:
However, small hydropower plants have emerged as a desirable option, especially for hilly terrains where natural and manageable waterfalls are abundantly available. Being environmentally benign and having a small gestation period, small hydro resources receive worldwide attention both in developed and developing countries to augment energy generation. Small hydro plants offer a wide range of benefits, especially for rural areas.

Development of small hydro power plants (SHP) around the world has increased substantially. There are over 420 small projects producing 1423 MW in India

Coal Power:
Pakistan has the fifth largest coal deposits in the world. The negative environmental effects of coal burning can be mitigated by making use of the latest clean coal technologies that limit noxious gas exhaust into the atmosphere.

Traditional Sources:
Traditional energy sources are firewood, animal dung, and bagasse (residue left-over from crushed sugar-cane) still make up more than half of all energy consumed in the rural areas.

INDIAN MODEL FOR RURAL POWER
India has embarked upon a Clean Development Mechanism (CDM) with a target to supply the 87,000 non-electrified rural villages in the first phase.

Participatory energy planning:
A participatory rural energy project involves project stakeholders—individuals or organizations who have an interest in developing an energy system or are significantly affected by its impacts—in all stages of the project. Communities play a key role in selecting, purchasing, operating and maintaining their own system. Communities have to attach energy system with greater goals of income generation, employment or basic infrastructure.

Decentralized energy planning:
Villages rely on energy sources that are locally available, rather than receiving electricity from a remote power plant. The use of local energy sources facilitates reliance on traditional ecological knowledge and reinforces the capacity of communities to manage their own energy supply.

The incumbent rural energy framework is centered on biomass, which is inherently decentralized in nature. Extending this paradigm from its current focus of household biomass combustion to an integrated energy supply model that includes community electricity generation would improve the quality of life of rural people and be more economical than extending the central electricity grid.

Nature of Projects: Six of these projects fit the rural energy model described above, as they are based on renewable energy technologies and could be implemented in a decentralized fashion using participatory methods:

- ☐ Small hydro power generation
- ☐ Biomass power generation
- ☐ Solar photovoltaic cells
- ☐ Improved cookstoves
- ☐ Residential solar cookers
- ☐ Residential biogas plants

The “ecosystems approach” has been adopted for rural energy promotes ecological conservation and rural development through the appropriate management of environmental and social resources. This methodology is based on a decentralized biomass model and incorporates local knowledge and conditions into the project design.

COMMUNITY POWER GENERATION EXPERIENCES IN PAKISTAN
In fact, Pakistan Council of Renewable Energy Technologies (PCRET) has implemented 290 micro-hydro power (MHP) schemes in FATA and the northern areas with a total capacity of

3.5MW, ranging from 3-50kW per plant, with the participation of local community. All of these plants are run-of-river type in the low (four meter) to medium (30 meter) head range.

Similarly, Aga Khan Rural Support Programme (AKRSP) has constructed 171 micro-hydel units providing electricity to around 17,000 households in the remote and isolated region of northern Pakistan, and currently provides 11,000 households with electricity in very remote locations.

Once the plant is installed, the local community takes the responsibility of operating it. These plants provide electricity mainly for domestic purposes. Local people have installed agro processing plants for flour grinding, rice husking, lathe, in the power house. Such units are run during the day time, directly from the turbine shaft. The electricity produced through micro hydropower in the country is in the range of 5-50 kW.

A major advantage of micro hydro is that it can be built locally at a considerably less cost. For instance, imported turbine sets generating up to 50 kW cost approximately Rs30,000-60,000 per kW, while the local manufacturers located in Taxila, Gujranwala, Lahore, Karachi offer facilities for turbine manufacturing at Rs10,000-15,000 per kW, with marginally reduced turbine efficiencies. The cross flow turbine used by PCRET and AKRSP is manufactured in local workshops.

EXAMPLES OF WHAT CAN BE PRODUCED WITHIN THE COMMUNITY

Micro Hydro power systems:

Not everyone is lucky enough to have a source of running water near their homes. But for those with river-side homes or live-on boats, small water generators (micro-hydro turbines) are the most reliable source of renewable energy available. One relatively small water turbine will produce power non-stop, as long as running water is available, no matter what the weather.

Micro Wind Power Generator:

A robust micro wind power generator is a tower mounted unit. It has low maintenance, and has automatic operation in adverse weather conditions. It can be favorably manufactured by many homeowners and professionals. It is particularly suitable for villages and remote stations. With only a few moving parts and heavy duty construction, it has no scheduled maintenance. It can either be battery charging and grid-connected. It is normally rated at 10 kW. The turbine is aligned into the wind by a tail assembly. The tail boom and and integrated rotor/alternator assembly attach to the mainframe assembly, which incorporates the yaw-axis slip-rings and the



Fig.-1: Immiscible Stream Power Generator

tower interface. The geometry of the mainframe creates the passive high wind speed protection. The mainframe offsets the rotor and yaw axes such that rotor thrust produces a furling moment about the yaw-axis. The weight and inclined pivot of the hinged tail provides a preset resistance to the rotor furling moment. Over speed control is initiated at a limited speed when rotor thrust overcomes the tail resistance and restoration is caused by gravity as the wind speed subsides. There is no shut-down wind speed. The turbine can be manually shut-down using a furling winch installed at the base of the tower.

Battery charging can be supplied with outputs of 48, 120 or 240 VDC. They are well suited for large rural homes, remote villages and facilities, eco-tourism resorts, and larger telecommunications sites.

Connection to the grid, can provide most of the electricity for an average total electric home at moderate wind sites. An inverter is added for grid connection.

Solar Photovoltaic Cell Modules:
Electricphotovoltaic modules are designed for both commercial and domestic applications and are suitable for grid connections. Polycrystalline PV modules can give desirably high power output. Cell strings are protected by sheets of ethylene vinyl acetate (EVA) and laminated between a weatherproof backing film and a highly transmittive, highly impact resistant, tempered glass and light can be effectively converted to electricity by using an anti-reflection coating.



Fig.-2: Wind Power Generator



Fig.-3: Photovoltaic Cells Module

Parabolic Solar Water Heater:
A simple or articulated parabolic water heater can raise sufficient temperatures that can greatly reduce the steam turbine effort. it can be assembled only with nut-bolts and other activities like forming a parabola at the site. The efficiency could be improved by 'enclosing' the boiler vessels. It can non-tracking which means that the geometry is such that it may not require constant viewing towards sun.



Fig.-4,5: Parabolic Solar Water Heaters

Garbage Power

Plasma arc garbage plants can burn any waste with minimal or no pretreatment; and they produce a stable waste form. The arc melter uses carbon electrodes to strike an arc in a bath of molten slag. The consumable carbon electrodes are continuously inserted into the chamber, eliminating the need to shut down for electrode replacement or maintenance. The high temperatures produced by the arc used to run steam turbines. Power plants run on garbage are functioning in a number of countries, such as Japan and China

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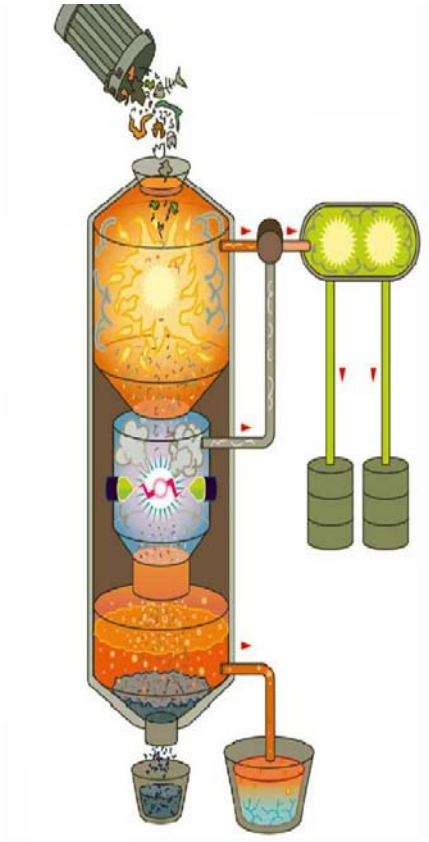


Fig.-6: Garbage Power Plant

PARTICIPATORY SELF GENERATING SYSTEM

Objective

The only way to provide power and improve living conditions on a mass scale, is to look at a locality as an economic system and to see what are the inflows and the out flows, and to divert some of them to be allocated to power generation there. This can be done only when their stocks are enhanced, and there is surplus to spend.

The power generation is not stand alone. It has to be integrated with the overall enhancement of the capital circulating within the community as described on Fig: 7, generating capacities of small businesses, workshops and households in poor areas through technology additions and entrepreneurship development, by establishing and running participative cell system.

Cell System

Cell System is a system of independently working individuals, who are interlinked with each other, through specific give and take mechanisms, and are geared towards the common broad objective, as regulated by a central coordinated unit.

Central Coordination Unit

Central Coordination Unit is a group of highly devoted resource persons whose function is to:

(i) train the trainers,
(ii) coordinate the activity,
(iii) to ensure quality, and
(iv) to disburse the Central Fund.

Individual Cell Units

1. Design Developers:

These are engineers and technologists, who develop plants and technology.

2. Factories:

The generators, gadgets, tools, and plants, will be manufactured by the factories, who agree to participate for these purposes.

3. Trainers:

The professional bodies raise trainers who go around in the communities to train people.

4. Creditors:

Credit is arranged from the creditors, so that the communities can get the machines, gadgets, tools, and plants made, as well obtain the raw materials and working capital.

5. Marketers:

The Marketers identify appropriate power generators, and market them.

CONCLUSION

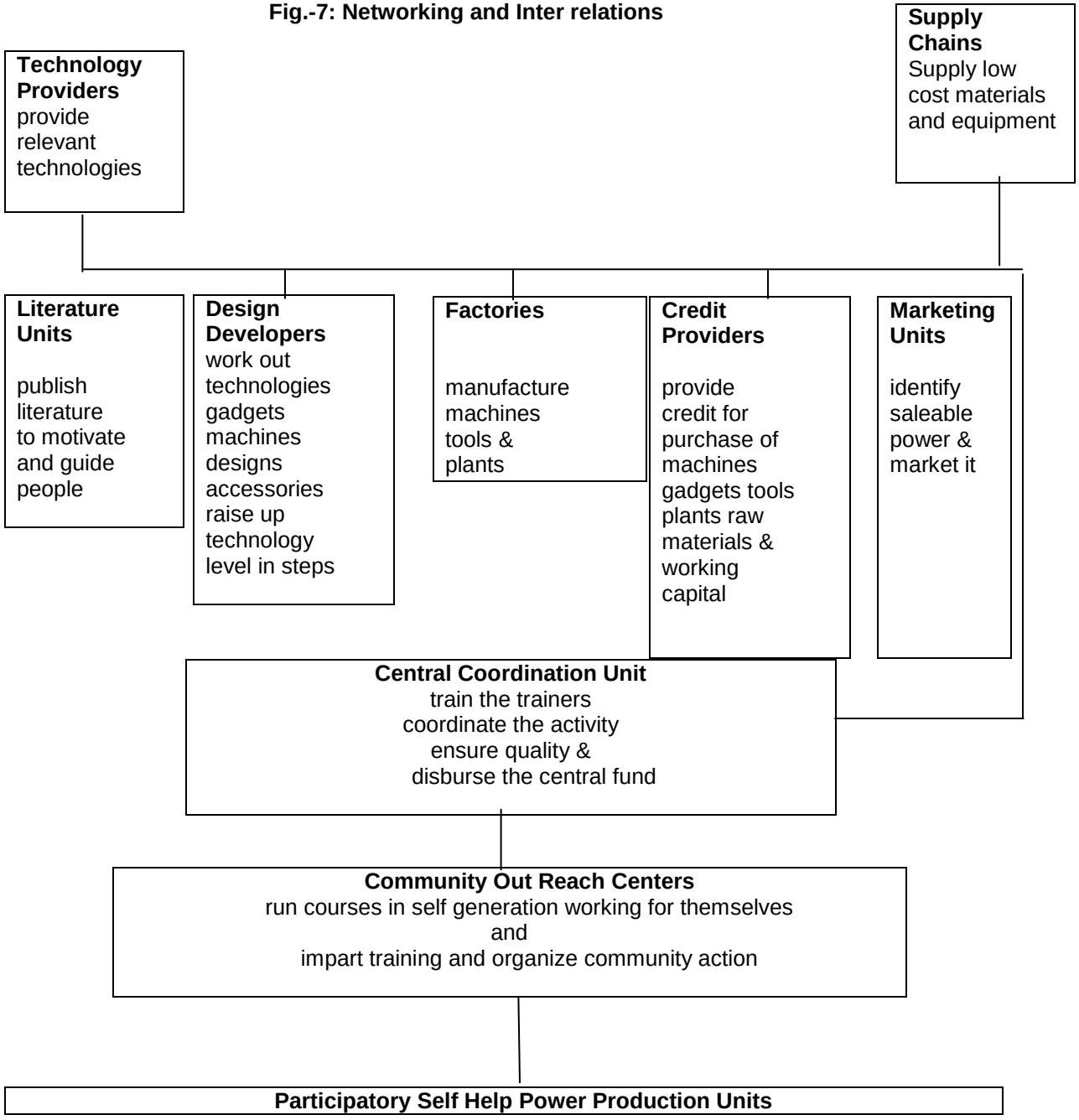
A severe issue, in Pakistan today are the ghastly devastating power conditions which unfortunately has been totally mismanaged. The only way to come out of this difficult situation is to resort to self generation within communities integrated with positive steps towards building of the earning capacities of the people. Participative mechanisms need to be formed in which the power production is done at the community level, with need marketing, design development, development of tools and plant, production management, micro-credits, and marketing functions. The experiences of the exercises conducted in limited areas are very encouraging. The effort is expected to set the ball rolling. More people get into this kind of activity, better it will be and quicker will be the results.

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Fig.-7: Networking and Inter relations



Paper No. 264

GENESIS OF POWER CRISES & ITS MANAGEMENT IN PAKISTAN PUBLIC PRIVATE PARTNERSHIP TO MITIGATE POWER CRISIS

By

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By

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ABSTRACT

It is now widely accepted that the 21st century needs a mix of public private partnership strategies. Developing societies need to inject private initiatives with doses of public action that encourage economic restructuring and technological advancement. A public private dialogue (PPD) will help in opening channels of communication between the government, the private sector, donors and other concerned parties. The concept of private public partnership is about how different stakeholders can use PPD to promote private sector development and reduce poverty.

To meet the ground requirements of the increasing population and to sustain the development in different projects, the need for improving management is recognized and these institutional changes are considered in compatible in Pakistan's environment. It is recognized that further and greater participation in different managements is of considerable value and needs to be persuade. In Pakistan people's participation to mitigate power crises can be achieved through a gradual and phased process.

1-INTRODUCTION

Energy is the lifeline of a nation. The economic engine and the wheels of industry, agriculture and business need energy to move forward. On the social aspect energy consumption per capita is a key indicator of the quality of life of the citizens and community. Pakistan economic, industrial and social growth has been greatly constrained due to an increasing gap in energy demand versus capacity. By involving public private partnership the energy crises in Pakistan can be mitigated to some extent.

The infrastructure sector in Pakistan comprises power, telecommunication, roads, ports, railways, air transport, water supply, waste management, information technology, and industrial estates. The public sector has remained the main provider of basic infrastructure. However, the large fiscal deficit has limited the Government's capacity to meet growing infrastructure requirements. Countries, such as Pakistan, that for a long time have financed infrastructure projects directly from fiscal budget allocations often lack the necessary institutional and regulatory capacity to facilitate private sector participation in infrastructure provision.

Infrastructure financing will have to rely more on private resources. The opportunities for developing and financing public private partnerships in Pakistan are considerable. There is proven demand for new projects in the **water, power, wastewater, solid waste, and transportation sectors.**

2-CONCEPT OF PUBLIC PRIVATE PARTNERSHIP

PPPs involves the investment of Private Capital to design, finance, construct, operate and maintain a project for Public use for specific term during which a private investment consortium is able to collect revenue from the users of the facility.

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Privatization represents a takeover of publicly owned entity. For the state the main attraction is that the Private sector can bear part of the financial burden of investing in infrastructure. Since the private sector is expected to be more efficient than the state in running certain concerns and is also likely to charge actual costs of services from customers, the burden of subsidies can be minimized. The other attraction is that state resources can be freed to provide funds in areas and sectors needed for the socio-economic uplift and stabilization of the less advantaged citizens. The state thus can retain to its core business of providing good governance enhancing knowledge and skills and providing basic needs for its citizens. For this, it is necessary to restructure the role of government so that operation can be separated from policy and independent regulatory authorities can be established.

The Government has set up the Infrastructure Project Development Facility (IPDF) under the auspices of the Ministry of Finance (MOF), to generate PPP projects with public sector institutions (line ministries, provincial Governments, local bodies, state owned enterprises etc.)

3-POLICY ON PUBLIC PRIVATE PARTNERSHIPS

The Government recognizes the importance of improving and expanding infrastructure services for sustaining economic and social development in its Medium Term Development Framework (2005-2010) (MTDF). Improved quality and service coverage in power and water supply, transport and logistics are vital for Pakistan's economy and the livelihood of its people. The Government estimates that less than 50% of the infrastructure investment needs can be covered by public funds under the MTDF. A combination of policy reforms, institutional support, incentives and financing modalities is required to encourage private-sector participation in financing, constructing and managing infrastructure projects.

Various governments around the world as a service delivery tool have adopted PPPs. Instead of the public sector procuring a capital asset and providing a public service, the private sector creates the asset through a business (usually designed, financed, built, maintained and operated by the private sector) and then delivers a service to a public sector entity/consumer, in return for payment that is linked to performance. PPPs permit the public sector to reduce their capital expenditure (and redirect to promote urgent social needs) PPPs allow each partner to concentrate on activities that best suit their skills.

The following sectors need to be focused by Public Private Projects.

i) **Small Scale Energy Projects** hydroelectric and captive power generation projects – other than those being facilitated by Private Power infrastructure Board (PPIB) and the Alternative Energy Development Board (AEDB).

ii) **Mass Urban Public Transport** including buses, and intra and inter-city rail.

iii) **Transport and logistics** including provincial and municipal roads, rail, seaports, airports, fishing harbors as well as warehousing, wholesale markets, slaughter houses and cold storage.

iv) **Municipal Services** including water supply and sanitation; solid waste management; low cost housing, and health/education facilities.

Although, PPPs will become an integral component of the Government's overall strategy for the provision of public services and public infrastructure across all sectors, this does not imply they are the preferred option for improving the efficiency of services delivery but that they enjoy equal status among a range of possible service delivery options available to the Government. Sector specific policies may be developed as necessary to provide more detailed guidance.

4-ROLE OF PPPs TO MITIGATE POWER CRISES IN PAKISTAN

Electricity is one of the important sources of energy. On the eve of independence in 1947, Pakistan inherited only 60 MW of power generation capabilities. In 1958, when WAPDA was formed, this capacity had increased to 119 MW. WAPDA was formed to accelerate the development of Water and Power resources of the country. It rose to 7,000 MW due to completion of mega projects i.e. Tarbela and Mangla, hydropower projects and thermal power projects at Guddu, Faisalabad Kotri, Muzaffar Garh and Ghazi Barotha (Hydro Power) etc. Total installed generation capacity in Pakistan is around 19,560 MW The distribution of hydel, and nuclear installed capacity in Pakistan produced by public and private sector as given in Table 1.

Table 1: Installed Power Generation Capacity of Pakistan

Sr. No.	Description	Capacity (MW)
1	WAPDA's Hydel Power Plants	6,463
2	WAPDA's Thermal Plants	4,834
3	IPP's Thermal Plants with WAPDA/KESC	6015
4	Nuclear Energy	462
5	KESC System including IPP's	1,756
6	Hydel Power Plants in Azad Kashmir	30
	Total	19,560

The power generation is highly capital-intensive investment. In Pakistan the equilibrium of demand and supply of power could not sustain due to increase in the pace of power demand in Pakistan. This resulted into severe load shedding and blackouts in the country. In order to bridge the power supply-demand gap, the government decided to mobilize private sector resources in the power sector.

The national demand for electricity has been raised and would keep on growing rapidly. Based on the present generation capacity, the hydel: thermal mix in the country is 33:67 which is almost the reverse of an ideal hydel-thermal mix, which should be 70:30 for overall economic development of Pakistan. Though induction of thermal generation through IPPs initially helps in overcoming load shading, it resulted in substandard increase in power tariff. Therefore, a sizeable injection of cheap hydropower through multipurpose storages is a viable option to keep the cost of electricity within the affordable limits of the consumers.

In Pakistan extensive private sector participation is envisaged in building additional power generation capacity of 7100 MW to meet the physical targets of power sector as given in Table-2.

Table 2: Core Projects to be commissioned during 2005-10

S.No.	Name of Project	Type	Capacity (MW)
	Public Sector		
1.	Allai Khawar	Hydel	121
2.	Khan Khawar	Hydel	72
3.	Dubair Khawar	Hydel	130

4.	Keyal Khawar	Hydel	130
5.	Jinnah Low Head	Hydel	96
6.	Golan Gol	Hydel	106
7.	Malakand Hydro	Hydel	81
8.	Pehur	Hydel	19
	Private Sector		
1.	New Bong Escape	Hydel	79
2.	Rajdhani	Hydel	132
3.	Gulpur	Hydel	60
4.	Small/Low Head	Hydel	50
5.	Matiltan	Hydel	84
6.	Kotli	Hydel	97
7.	Lakhra	Coal	450
8.	Thar Coal Chinese	Coal	300
9.	Dadabhoi	Coal	150
10.	Faisalabad	C.C.Gas	450
11.	Balloki	C.C. Gas	400
12.	Oil Based Power Plant	Oil	160
13.	Gas Based Power Plant	Gas	3100
14.	Renewable (Wind)		800
		Total	7100

5-OBJECTIVES

The Government's objectives in promoting PPPs are to provide:

- **More services**, as there is a huge backlog in basic services such as water and sanitation, solid waste management, transport and rural electricity. Not only do we need to catch up with the backlog, we need to start building infrastructure for future needs as well.

- **Better services,** as the quality of existing services is deteriorating due to lack of incentives and funding for infrastructure maintenance and up-gradation. The result is unclean water, unhygienic living conditions and inability to provide proper health care and education.

- **Affordable services,** as certain segments of the population cannot pay cost recovery tariffs, whereas the private service provider needs to recover costs in order to sustain operations. In such cases the Government will provide targeted (to low income consumers), explicit (not hidden as budget support) performance based (only provided once the service – such as 24 hour clean drinking water to the consumer's dwelling – is actually delivered).

- **Timely services,** as the Government do not have the capacity or the fiscal space to meet the immediate service demands of its citizens.

6-CONCLUSION

While Pakistan has demonstrated some pioneering experience with attracting private sector investment into the energy and telecommunications sectors, there has been very little progress

in the key urban and municipal infrastructure related to water, wastewater, solid waste management, urban transportation, and roads. The core impediments include:

- The policies at National, Provincial, and local Government levels do not fully support PPPs as a viable options for delivering services in urban and local services;
- The laws that allow Provincial and local governments to contract out the development and operation of urban and local services to qualified private sector firms are not clear and supportive;
- Lack of institutional capacity within Provincial and local government departments to successfully identify, analyze, structure, tender, evaluate, contract, and regulate PPPs;
- The application of technical models and toolkits lack in Provincial and local government officials to use when analyzing PPP projects, conducting public sector cost comparisons, preparing RFPs for qualified contractors, drafting PPP contracts, evaluating bids, and regulating tariffs and responding to disputes with PPPs;
- Limited funds to hire experienced and qualified specialist to conduct pre-feasibility studies and prepare PPP transactions for local infrastructure projects that Provincial and local Government officials have identified;
- The long-term local currency, fixed rate debt financing is quite insufficient in Pakistan's capital markets which is needed for the sustainable financing of local infrastructure investments; and
- Inadequate legal authority, human capacity and toolkits to regulate the post-transaction performance and the price-adjustment reviews for PPP infrastructure and utility sector investments.

7- RECOMMENDATIONS

- The training for human resource development to oversee and manage the process of PPP project preparation and development is directly needed;
- Exploitation of renewable energy resources available in the country i.e. wind energy, solar energy, bio-fuel energy etc.
- Adequate and effective participation of the Private Sector.
- Utilization of our own huge coal reservoirs of about 184 billion tons for generation of electricity.
- Injection of cheap hydropower through construction of multipurpose storages dams with the effective participation of private sector to meet with the energy and food crisis.
- Fast track projects in pipeline be commissioned according to schedule.
- Appropriate of conservation measures, load management and public awareness is required to be adopted to improve the critical situation of power.

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Paper No. 265

GENESIS OF THE POWER CRISES AND IT'S MANAGEMENT IN PAKISTAN!

By

Engr Tahir Basharat Cheema

GENESIS OF THE POWER CRISES AND IT'S MANAGEMENT IN PAKISTAN !

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Pakistan, at present, is facing a severe power crises – considered to be the worst of the four such crises it has faced since 1974-75 onwards. Incidentally, the present crisis which is carrying on since the last twenty-four months is even greater than the one faced by the country during the eighties which gave birth to the concept of the IPPs etc.and which in a way changed the whole complexion of the power sector once and for all. Actually, it used to be only shortage of power during the earlier three crisis periods, while this time around it is energy shortage for twenty-four hours and that too of the highest order. The continuing negatives of the situation have now engulfed the national economy in a stifling embrace. Industrial productivity has gone down and the situation portends badly for exports and the ensuing balance of payments. Although, serious thoughts have been given by the Government for amelioration of the current problem and hopefully the power deficits of today would be contained by 2009-2010, but still the stranglehold of today may have far reaching implications for all of us. As a consequence, the instant study would strive to unlock the mysteries and the genesis of the crises and also detail out both the supply side and demand side measures in the offing as management of the crises.

Power sector, as a rule, has always been finance intensive. It is large investments that make the sector move-over to the next generation of technologies – incidentally a must for any standard system. On the other hand, the returns are also large and many an investment has been returned to investors within the year. The experts are of the opinion that without new investments and heavy outlays on operation and maintenance of power systems, the sector will simply stagnate. Besides, it is of utmost importance that new and needed technologies must be inducted as a necessary tool from time to time. Actually, the transaction from one step to the next should be visible for all. Apt example would be the communications sector and its entry into the 3-G technologies since long. Unfortunately, the Pakistani Power Sector comprising of the twelve PEPCO managed companies in the public domain and the KESC in the private hands is seen to have stagnated. This is also the reason for continuing trite operations and the difference seen between the sector under study and the communications sector leading the way in Pakistan. Once in a while, the pundits do try to compare both these sectors, but are unable to draw conclusions.

A little insight into the Pakistani power sector reveals that it was firstly dealt with a severe blow in the late 1980s and mid 1990s when the so-called WB led reform process was taken-up through vertical de-bundling of WAPDA's Power Wing and the lackluster corporatization of the same. The sad process in fact has been the start of the decay and a major cause of the present crises. It has then been neglected over the years and in fact has been deprived of badly needed investment during the last 15 years – actually, the last one decade has been debilitating. The solely legislated Water & Power Development Authority (WAPDA) set-up under the WAPDA Act of 1958 had been relegated to the back-burner, while new entities headed mainly by generalists had been tasked to come-up to the expectations and power requirements of the people. The Private Power & Infrastructure Board (PPIB), Alternate Energy Development Board (AEDB) and such like small and nearly non-professional bodies can be quoted in this context. Strangely, infrastructure building was delegated to the private sector through these bodies leaving WAPDA all dressed up with no way to go. The later had just the

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gigantic Tarbela to speak about, which it had completed way back in 1976. Taking no chances, the GoP's one page notification of 1987 sealed Wapda's fate to the effect that all new thermal power would only be set-up by the private sector under the auspices of the so-called one window facilitator known as the PPIB – thus in a de-facto manner denying the Country any chance of enjoying the fruits of competition between the public and the private sector – a necessity in order to contain the run-away profiteering of the private sector and to also ensure supremacy of the auditability and accountability of the public sector. This step alone led to the debacle of today and the tainted proposals of the private sector and the delays in acceptance of the same by NEPRA. WAPDA could work on hydel projects, including those coming under the ambit of hydro generation, and nothing else. As consensus could not be reached by the federating units of Pakistan in this regard, atrophy set and one fine morning it transpired that time had left the once glorious edifice unable to do anything. Instead of correcting the rot, WAPDA was declared beyond local repairs and we saw sprouting-up of new organizations (surely baptized in order to arrange employment for the favourites) with stupendous agendas to fulfill. That one such organization viz the Sind Coal Authority (SCA) is still groping in the dark while another Board (TCEB) is being built is a story needing separate space to dilate upon. However, as the prerequisites to creation of new public sector entities have been conveniently ignored most of the times, the various stakeholders need to sit together and reconsider things – otherwise very soon the things would further rot.

Coming back to the past investment in the power sector, we see that the only worthwhile outlays were under the heading of IPPs, when over USD 6.5 billion were invested on[1] arranging for 5728 MW of power during the period 1994–1996 (evident in shape of shining but tainted power stations seen during 1996–1999). It is also a fact that instead of arranging power on the as and when required basis, the whole chunk of nearly 6000 MW of power came on bar in a very short span of 24 months or so. This led to issues of handling the surpluses against the earlier shortages – specially when the IPPs had ostensibly come into being without even a tacit approval of acceptance from WAPDA and its management, which had never planned to handle such a huge chunk of power and that too at higher rates (also not backed-up by compatible tariff increase etc) . As WAPDA was by then under soldierly control, the poor Khakis were at the greatest of loss to utilize the newly inducted generation. They tried to sell-off some of the huge surplus (according to them un-sellable) to India, but couldn't get past the first of the posts. Additionally, they also had to bite the dust by accepting all and sundry of the IPPs as pure and pristine to the core, not withstanding some squeaks from the NAB (surely a sick person whoever coined the acronym). This management was also responsible for convincing the then President that the actual issue was the sale of surplus power and not any shortage around the corner (probably, one of the reasons for the tardy progress afterwards).

In hindsight, we see that the issue of corruption in IPPs was wrongly tackled during 1997–2001. Instead of being able to catch hold of the corrupt, arrange matters so that there would not be repeats etc and to thereafter use the shade and space created by 5728 MW of power and in the process start projects enabling production of cheap power by 2005–06, the last decade was wasted by simply crying foul and that WAPDA's (non-professional) management could not sell the excess IPP power – that the IPP rates and surpluses were the greatest of negatives to contend with is indeed the truth. However, the experts then and even now consider non-introduction of innovative tariffs and other such solutions to ameliorate the assail of the whole new concept and the inability of the concerned then to have arranged for a better deal as it happened in Bangla Desh, as poor management. All this, besides leading to the crises being faced now, also acted as a means to scare private investment (specially foreign investment)

away from the country. That seemingly the negatives seen in the IPPs set-up under the 1994 Power Policy are still evident in the current IPPs is again a wonder to reckon with.

The situation would have not been that problematic and grim, had the Pakistani power customer contained itself to the normal load growth of 2-3% year instead of breaking all barriers and reaching a whooping figure of nearly 14% during 2006-07 (**Table-I**). This unprecedented load growth according to experts was spurned on account of the consumption led growth adopted by the then government against the development / production led structures. The situation was compounded by easy availability of the hitherto unknown consumer finance. So much was the hype that even grade-IV employees of the government ended up with more than one consumer loan and access to home appliances acquired on installments. Unfortunately, because of all this Pakistan became a importing nation, a dumping ground for energy in-efficient goods, a country which changed its life style in quantum terms and the ensuing consumption avarice that burdened the economy beyond relief. The details of seven type of home appliances added to the power system during 2005-06 and 2006-07 are available with this paper as **Table-II** & **III**. Perusal of the data leads us to the conclusion that all of a sudden the Pakistani living standards artificially improved and up to 40 million appliances may have been added to the power system in the last five years alone. As this affluence was not backed by real economy, the country was hit by a double whammy.

[2] [3]

Table-I
HISTORICAL PEAK DEMAND / GROWTH RATE (2002-2008)

Year	WAPDA		KESC		COUNTRY	
	Demand MW	Growth Rate	Demand MW	Growth Rate	Demand MW	Growth Rate
2001-02	10,109	4.02%	1,885	1.34%	11,875	3.59%
2002-03	10,481	3.68%	1,973	4.67%	12,330	3.11%
2003-04	11,078	5.70%	2,073	5.07%	13,021	6.35%
2004-05	12,035	8.64%	2,197	5.98%	14,091	8.22%
2005-06	13,212	9.78%	2,223	1.18%	15,282	8.45%
2006-07	15,138	14.58%	2,349	5.67%	17,314	13.33%
2007-08	16,838	11.23%	2,443	4.00%	19,090	10.26%

Table-II
DETAILS OF HOME APPLIANCES ADDED TO POWER SYSTEM (LOCALLY MANUFACTURED/IMPORTED) 2005-2006

Sr No	Appliance	Numbers	Percentage		Power requirements MW	Expected growth then in sales for 2006-2007. over the figure of 2005-2006.
			Local	Imported		
1.	Refrigerators	1,100,000	90%	10%	110	15%
2.	Deep Freezers	200,000	100%	-	60	15%
3.	Air Conditioners	500,000	60%	40%	1000	20%
4.	Microwaves Ovens	400,000	50%	50%	800	15%
5.	TVs	1,200,000	85%	15%	120	15%
6.	Washing	600,000	94%	6%	180	10-15%

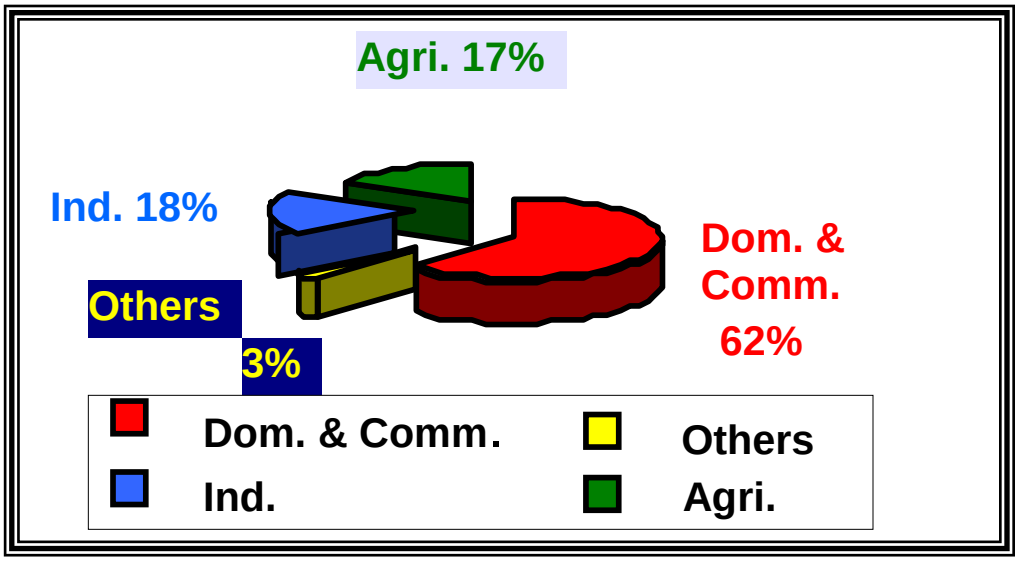
	Machines					
7.	Fans	3,500,000	100%	-	280	15%
Total		**7,500,000**			**2550**	

Table-III
DETAILS OF HOME APPLIANCES ADDED TO POWER SYSTEM
(LOCALLY MANUFACTURED/IMPORTED) 2006-2007

Sr No	Appliance	Numbers	Percentage		Power requirements MW	Expected growth then in sales for 2006-2007. over the figure of 2005-2006.
			Local	Imported		
1.	Refrigerators	12,50,000	90%	10%	125	10% - 15%
2.	Deep Freezers	2,50,000	100%	-	75	25%
3.	Air Conditioners	7,50,000	60%	40%	1500	50%
4.	Microwaves Ovens	5,50,000	50%	50%	1100	35%
5.	TVs	12,00,000	85%	15%	120	-
6.	Washing Machines	7,00,000 to 8,50,000	94%	6%	210 to 250	15% to 30%
7.	Fans	50,00,000	100%	-	400	45%
Total		**98.0 to 99.5 lacs**				**3530 to 3570**

Further study revealed that the power consumption in the country was totally skewed towards wasteful use. 62% growth was evident in the domestic and commercial sectors alone, while 18% and 17% of the total growth was seen in the industrial and the agricultural sectors respectively. In other words, growth in power usage for the industrial sector was only one forth of the increase in usage in the domestic and the commercial sectors. The pie chart depicting the power consumption patterns is available with this paper as **Table-IV**.

Table-IV
LOAD GROWTH AS %AGE OF VARIOUS SECTORS !



Not to be left here and as a logical sequel, we see the situation aggravating with the country currently experiencing power shortages of 5000 MW in the summers. To explain the matter, it is seen that no worthwhile investments were being made in the sector (in other words no generation was added the earlier tally – rather 450 MW of old plants were retired in 2001 – 03), while demand was growing at 14% per year and it was considered enough to once in a while require both PPIB and the AEDB to speed up the things on paper. We would also see a few press items telling us about the fast incoming thousands of mega-wattage of power and the hundreds of LOIs issued by the PPIB and the AEDB. During this period, the situation became bad to worse due to the poor hydrological conditions of the calendar years 2007 and 2008, lesser supply of gas and the constrictions in fuel oil supplies and lastly on account of financial constraints due to huge receivables of the power utilities and high cost of production compared with the sale rate. With this, we saw load shedding firstly in 2002-03 and thence regularly from 2005-06 till date. The yearly / monthly supply and demand position for 2001–02 till today is available with this paper as **Table-V** & **Table-VI** [5]. It would, however be in the fitness of the things to explain that the public forgets the past quickly and the load shedding of 2006 – though tangible, was easily swept under the carpet to be followed by another such shortage in 2007 and so on.

Table-V
LOAD SHEDING A PERENIAL PHENOMINA

YEAR	WAPDA/PEPCO SYSTEM		
	Supply	Computed Peak Demand*	Surplus/ Shortfall
2001-02	10894	10459	435
2002-03	10958	11044	-86
2003-04	11834	11598	236
2004-05	12792	12595	197
2005-06	12600	13847	-1247
2006-07	13292	15838	-2546
2007-08	12442	17398	-4956

*** Figures include load shedding and export to KESC**

Table-VI
MONTH-WISE DEMAND & SUPPLY POSITION (MW) 2007–2008

MONTH	PEAK DEMAND *	CORRESPONDING SUPPLY	SURPLUS/DEFICIT
Sep-07	16056	13644	-2412
Oct-07	13737	14092	355
Nov-07	12401	11590	-811
Dec-07	12154	9679	-2475
Jan-08	12255	9104	-3151
Feb-08	12123	10122	-2001
Mar-08	13682	9845	-3837
Apr-08	15124	11568	-3556
May-08	16649	11195	-5454
Jun-08	17398	12442	-4956

Jul-08	17715	12822	-4893
Aug-08	17272	12751	-4521
Sep-08	17852	13637	-4215
Oct-08	14231	10174	-4057
Nov-08	11098	10057	-1042
Dec – 08	11069	9188	-1881

What is the way out? How can the situation be managed. According to experts, we would have to undertake both supply side and demand side measures as soon as possible. The supply side measures would include installation of rental power plants in private sector (able to join in six to nine months against three years for a traditional thermal power plant), expeditious installation of IPPs already contracted by the PPIB and struck-up in the myriad in-competencies of that organization, (at least it was so then), installation of new power plants in public sector, induction of fast-track generation capacity by PPIB, rehabilitation of GENCOs existing plants and utilization of redundant capacity of captive power plants. The public sector would have to re-position itself and come into competition with the private investors to ensure affordability of power tariff etc. The demand side measures include reduction of demand through energy conservation and load management, as a MW saved is, in fact, better than a MW generated. For this too massive awareness campaign has to be funded and more so, because the cost to the nation for non-supply of electricity is up to ten time of the cost of one unit of power.

The present government has taken up provision of new generation very seriously with six rental power plants totaling 1002 MW planned for Faisalabad, Guddu, Sialkot, Multan and Quetta planned to start producing power by June 2009 (**Table-VII**). Similarly, an addition of 502 MW of hydro power to the system is seen by 2011 (**Table-VIII**). So as to further improve upon the ante, 22 IPPs with a grand total of 4608 MW are on the anvil for joining in by June 2012 (**Tables-IX).**[6]

Table-VII
POWER GENERATION ADDITION RENTAL PLANTS

Sr No	Name of Project	Fuel	Capacity (MW)	Expected COD
1.	Rental Power Plant, Faisalabad	Oil	150	Mar 2009
2.	Rental Power Plant, Guddu	Gas	110	Mar 2009
3.	Rental Power Plant, Sahuwala, Sialkot	Oil	150	Mar 2009
4.	Rental Power Plant, Multan	Oil	192	Apr 2009
5.	Rental Power Plant, Satiana Road, Faisalabad	Oil	200	May 2009
6.	Rental Power Plant, Sheikh Manda, Quetta	Oil	200	Jun 2009
Total			**1002**	

Table-VIII
POWER GENERATION ADDITION WAPDA HYDRO PROJECTS

Sr No	Name of Project	Type	Capacity (MW)	Expected COD
1.	Khan Khwar	Hydro	72	Sep 2009
2.	Jinnah Hydro	Hydro	96	Feb 2010
3.	Allai Khwar	Hydro	121	Sep 2010
4.	Duber Khwar	Hydro	130	Oct 2010

5.	Kurram Tangi	Hydro	83	Sep 2011
Total			**502**	

Table-IX
POWER GENERATION ADDITION IPP PROJECTS

A.

Sr No	Name of Project	Fuel	Capacity (MW)	Expected COD
1.	Attock Power Project	Oil	165	Jan 2009
2.	Atlas Shirazi Project	Oil	225	Mar 2009
3.	Orient Thermal C.C.(Balloki)	Dual	225	Apr 2009
4.	Muridke Power Project	Dual	225	Jul 2009
5.	Fauji Mari Power Project	Gas	202	Sep 2009

B.

Sr No	Name of Project	Fuel	Capacity (MW)	Expected COD
6.	Engro Power Project	Gas	227	Dec 2009
7.	Sahiwal Power Project	Gas	225	Feb 2010
8.	HUBCO Narowal	Oil	225	Mar 2010
9.	Associated Technical Project	Oil	200	Jun 2010
10.	Nishat Chunian Project	Oil	200	Dec 2010
11.	Japan Expansion Project	Oil	101	Dec 2010
12.	Green Power Project	Gas	205	Dec 2010
13.	Bhikki Power Project	Dual	225	Dec 2010
14.	Liberty Power	Oil	200	Dec 2010
15.	PIE AmPower Project	Oil	390	Dec 2010
16.	Star Thermal Project	Gas	134	Feb 2011
17.	Bestway	Oil	200	Mar 2011
18.	Gulistan Project	Oil	200	Jun 2011
19.	New Bong Escape HPP	Hydel	84	Dec 2011
20.	UCH-2 ICB Power Project	Gas	450	Dec 2011
21.	Shahkot Power Project	Oil	200	Dec 2011
22.	Kotli HPP	Hydel	100	Jun 2012
Total			**4608**	

As power demand is growing at a fast pace viz 10.26% annually, which may be down from the high 14% of last financial year but still remains amongst the highest in the world, the government has further decided to take-up fast track projects through the PPIB. This concept is borrowed from the business plans conjured by leaders in power generation for Africa, which requires availability of power quickly and for small periods of use and does not possess an integrated power system like Pakistan. It is also in fashion for huge construction and other development projects which require quick power for limited time periods. These totaling 1366 MW include Walters Rental Project Karachi, Karkey Rental Project Karachi, Cavalier Energy Project Port Qasim (OC) Karachi, Progas Energy Limited Port Qasim (OC) Karachi, Ruba Energy Project (CC) Karachi and Progas Energy Ltd Port Qasim (CC) Karachi (**Table-X**).

Table-X
POWER GENERATION ADDITION PPIB FAST TRACK PROJECTS

Sr No	Name of Project	Fuel	Capacity (MW)	Expected COD
1.	Walters Rental Project, Karachi	RFO/HSD	205	Feb 2009
2.	Karkey Rental Project, Karach	RFO	232	Feb 2009

3.	Cavalier Energy Project, Port Qasim (OC)	LPG/HSD	156	Aug 2009
4.	Progas Energy Limited, Port Qasim (OC)	LPG	210	Aug 2009
5.	Ruba Energy Project (OC)	RFO	107	Dec 2009
6.	Cavalier Energy Project, Port Qasim (CC)	LPG/HSD	314	Apr 2010
7.	Ruba Energy Project (CC)	RFO	47	Dec 2010
8.	Progas Energy Limited, Port Qasim (CC)	LPG	95	Dec 2010
Total			**1366**	

In order to ensure that all possible facets of power generation are tapped, Pakistan Electric Power Company (PEPCO) mainly and to some extent the KESC have also added captive power to their generation capabilities. This has beefed up the present supplies by about 250 MW of badly needed power, while a potential of 1500 MW remains to be tapped. However, further additions will depend upon the provision of high pressure boilers along with corresponding turbines and generators at the various sugar mills of Pakistan[7] (**Table-XI**). It would also need the enactment of a law / policy allowing special benefits for such additions / investments – specially when the private sector has to be incentivized before it under takes any new venture.

Table-XI
MEASURES TO MITIGATE SHORTAGES
Supply Side Measures - Captive Power MW

Sr No	ITEM	Textile Mills	Sugar Mills	Total
1.	Connected and supplying power	127	14	131
2.	Contracted/Pipeline	31	57	88
3.	Potential	185	167	352
Total		**343**	**238**	**581**
Potential (if high pressure boilers alongwith corresponding turbines & generators are installed)			**1000 MW**	

However, in order to mitigate the present power shortages, PEPCO and KESC seriously need to take up demand side management and conservation, massive public awareness campaign through electronic and print media, closure of shopping centers / plazas after sunset, staggering of industrial holidays, interaction with industries for reduction of load during peak hours especially steel furnaces, induction of energy saver lamps(CFLs) to replace incandescent bulbs and tube lights, loss reduction by DISCOs through implementation of ELR Projects and by administrative measures, other conservation measures, switching of bill boards and alternate street light points and switching of unnecessary lights and appliances at peak hours voluntarily by the general public. All in all, the power utilities would have to take up the DSMs and specially conservation activity on a pro-active manner. These, incidentally are the only solution till new generation comes up and for the days to come when no one could think of wasting power. This is the way through which the country can breath at least while it awaits new generation.

Unfortunately, the above supply side measures though auguring well for the country, also contain certain inherent risks. These include the undue dependence of new generation on imported oil, the logistics nightmare in the making for feeding the tens of small IPPs/new plants, the likelihood of tariff increase in the immediate future, the possibility of break-downs in the

small size IPPs and danger to the power system as a whole because the scheme of things does not cater for many a contingency. As a consequence, the following is suggested to be taken up as a necessary requirement. It would be to the effect that WAPDA be fully re-positioned and then utilized for development of both water and power projects (being the only legislated body for the purpose) and this should be by giving it the original autonomous status. PPIB and AEDB be then merged with WAPDA and the later can thereafter arrange PPPs / JVs – both national and international. WAPDA can put up new generation through bridge finance and then arrange for subsequent disinvestment / IPOs. The IPP size should be extended to a minimum of 2000 MW for economy of scale etc. Incidentally, our neighbouring India facing an equally daunting challenge to contain it's runaway power deficits has upped the IPP ante to mega-projects of 4000 MW and above. In their case, the investors have to arrange for their own fuel viz cheap coal and gas with the infra-structure being built by the government / public sector. On the other hand, all newly created entities then need to be disbanded with the Thar Coal generation being handed over to WAPDA, while mining of the coal may be tackled by the Sindh Mines & Minerals Department and the PMDC – incidentally, the later is also dressed up with no where to go. Experts consider this as the only option, in case Pakistan wishes to utilize its own vast coal reserves of 184 billion tons. It is also considered that after the SOS has been heard and the present Supply and DSMs are taken up, we need to revert back to the earlier system of implementing planning strategies put forth by the Planning Commission of Pakistan on the five yearly planned basis. Additionally, the National Power Plan of 1995 needs to be updated and then followed as the bible for all new power additions.

As indigenization of fuel for power generation is of prime importance – also a part of any good energy security plan, the Country would have to work on conversion of existing generation from oil and gas to local coal. Alternate sources of fuel viz. wind and sun on the basis of an integrated energy plan would also have to be taken in to quick consideration. As this needs separate space, it is being left for a separate article.

In the end, it would be appropriated to suggest and also state that the above supply side measures are basically of immediate and short term nature that have to be necessarily followed by the medium and the long term projects, which basically would comprise of the two hydel projects underway viz the 970 MW Neelum Jehlum HPP and the 4500 MW Diamer – Basha HPP, the host of others in the pipe line, the Nuclear power plants being undertaken by the PAEC and possible gas and electricity imports from Iran (IPI), Turkmanistan (TAPI) and Iran (1100 MW of gas power) etc, notwithstanding the possibility of eventual blackmail as undertaken by Russia currently or by local LPG producers. Alternate energy through wind, bio-mass, solar and coal would also be supplementing the power acquisitions during the medium and long terms. As the potential of such power is phenomenal, the future should be bright provided we remain on the right track and that detractors of alternate energy too remain at bay.

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Paper No. 266

NATURAL GAS TRANSMISSION & DISTRIBUTION INFRASTRUCTURE DEVELOPMENT IN PAKISTAN & ITS ROLE IN POWER GENERATION

By

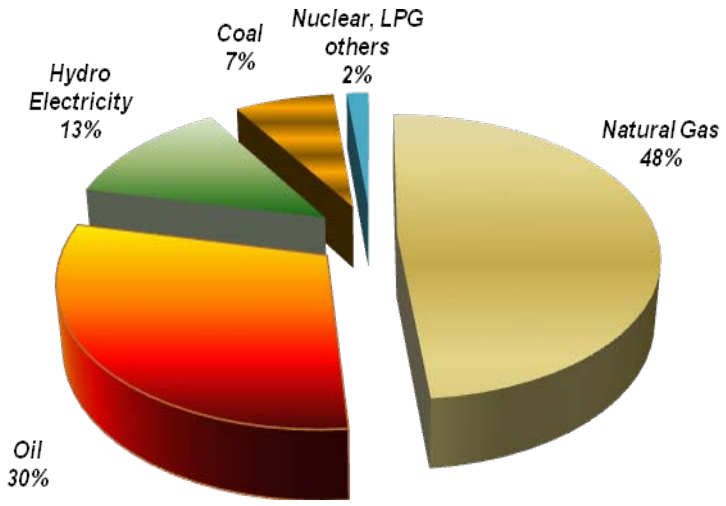
A. Rashid Lone

NATURAL GAS TRANSMISSION & DISTRIBUTION INFRASTRUCTURE DEVELOPMENT IN PAKISTAN & ITS ROLE IN POWER GENERATION

By

A. Rashid Lone*

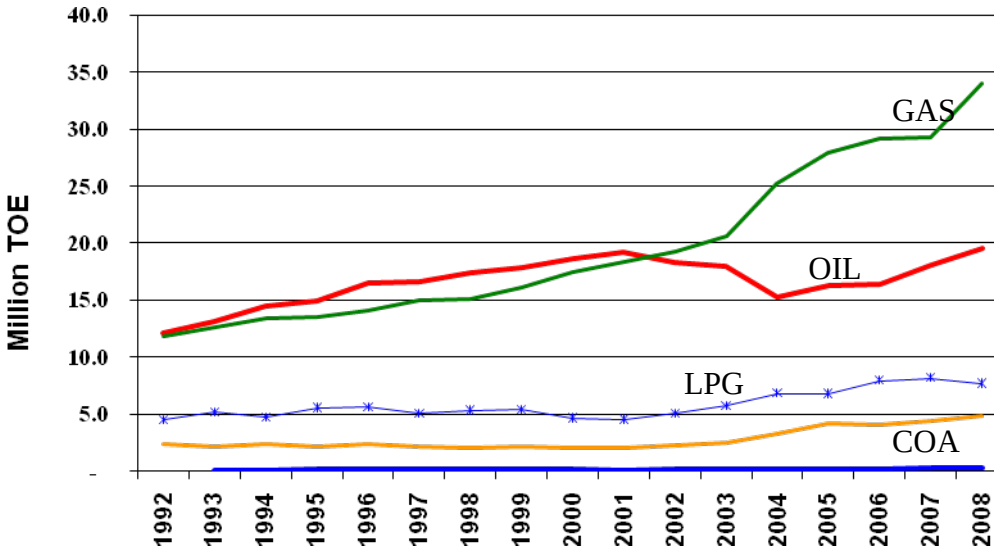
Pakistan is a country, blessed by diversified natural resources. Coal, Oil, Gas, Minerals, Stones and a number of other categories of ores are scattered in the wildernesses of Province Baluchistan, in the mountains of Province NWFP, in the planes of Province Punjab and in the rich basin of Indus. The country started from oil and coal as pre-dominant energy sources and soon switched to Hydral Power after construction of huge Hydral Power Projects and then after the discovery of Natural gas, the table was turned around. Today the natural gas claims one half of the share of energy market of the country and the economy seems to be revolving around it. The agriculture based economy of the country relies on availability of indigenously synthesized fertilizers manufactured from Natural gas, the turbines of power houses burn natural gas to run the wheel of industry, General Industry of the country fires this flexible fuel for boilers and heaters, the stove of common man is dependent on this gas and also the car of a mediocre person needs its fueling as CNG. In all these sectors these Natural Gas is serving the nation and bearing the major load of economy.



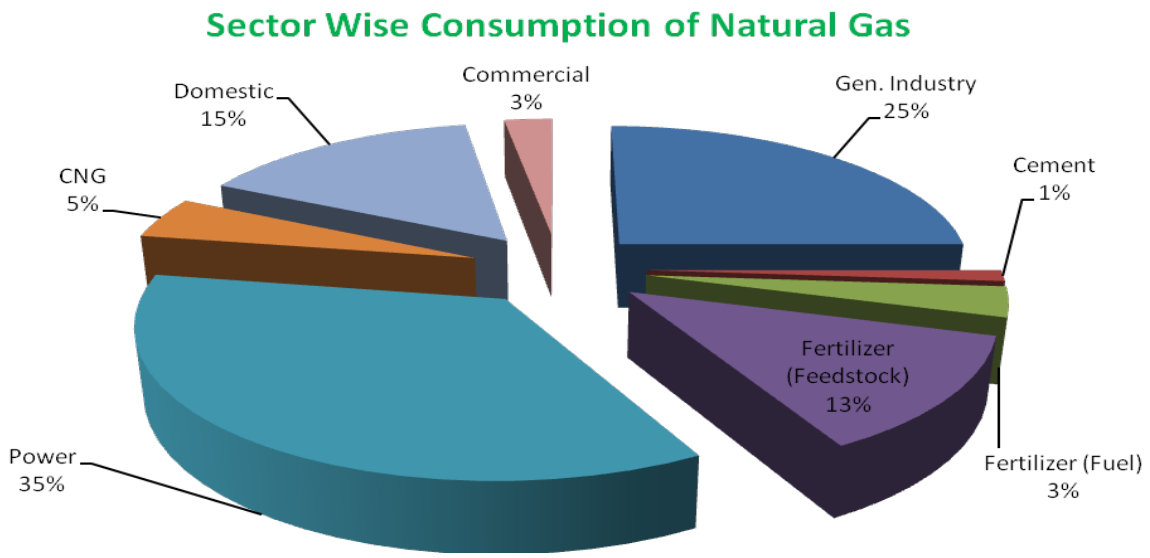
PAKISTAN ENERGY SUPPLY MIX 2007

The study of the energy supply mix of the country from 1992 to 2007 clearly indicates that the shift is towards the Natural Gas due to ease of combustion and cheaper price as compared to other domestic / industrial fuels.

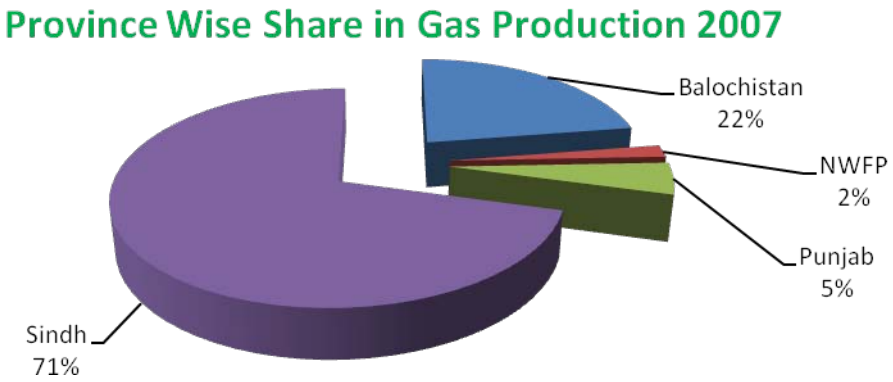
*Managing Director Sui Northern Gas Pipelines Ltd. PAKISTAN



The country offers huge oil and gas potential and vast relatively unexplored acreage, with historical exploration success ratio of 1:3.4. Natural gas was first discovered in 1952 at Sui in Balochistan province which proved the most significant and the largest gas reservoir. After successful exploration and extraction, it was brought to service in 1955. This major discovery at Sui followed a number of medium and small size gas fields in other part of the country. A normalized estimate of Natural gas reserves of Pakistan at 900 BTU/Cu.ft. is around 28.18 Trillion Cubic Feet (TCF) while the natural gas production during the year 2006-2007 was around 3.873 Billion CFT/Day. This consumption pattern of this Gas in different sectors of economy is as under:



All the four provinces have their contribution in the production of Natural Gas for the country. The province wise breakup of the production of Natural gas for the year 2006-07 is as under:

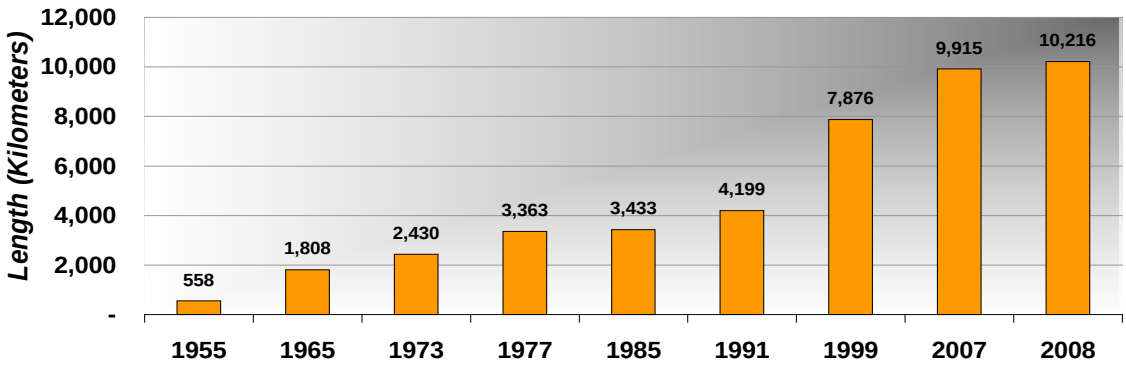


In 1964 an average daily sale of Natural Gas in Pakistan was around 47 MMCFD Day which presently goes as high as 3800 MMCFD. While fully recognizing the dynamics of the rapidly changing global energy scenario, the country has put strenuous efforts to establish and technological empowerment of a strong infrastructure for upstream as well as for downstream activities. Presently country has more than 10200 Kms. of Transmission Pipelines of diameters upto 36 inch and being operated at pressures as high as 1260 Psi bringing gas from far flung gas sources to the consumption centers. And further trough a distribution network of around 90,000 Kms., this gas is being served to more than Five Million valued customers.

	SNGPL	SSGCL	TOTAL
Transmission (Kms)	**7,016**	**3,200**	**10,216**

Distribution (Kms)	**59,951**	**29,832**	**89,783**
Compression (HP)	**185,000**	**62,900**	**247,900**
Towns Connected (Nos.)	**1,297**	**1,127**	**2,424**
Number of Consumers (Millions)	**3.19**	**1.90**	**5.09**

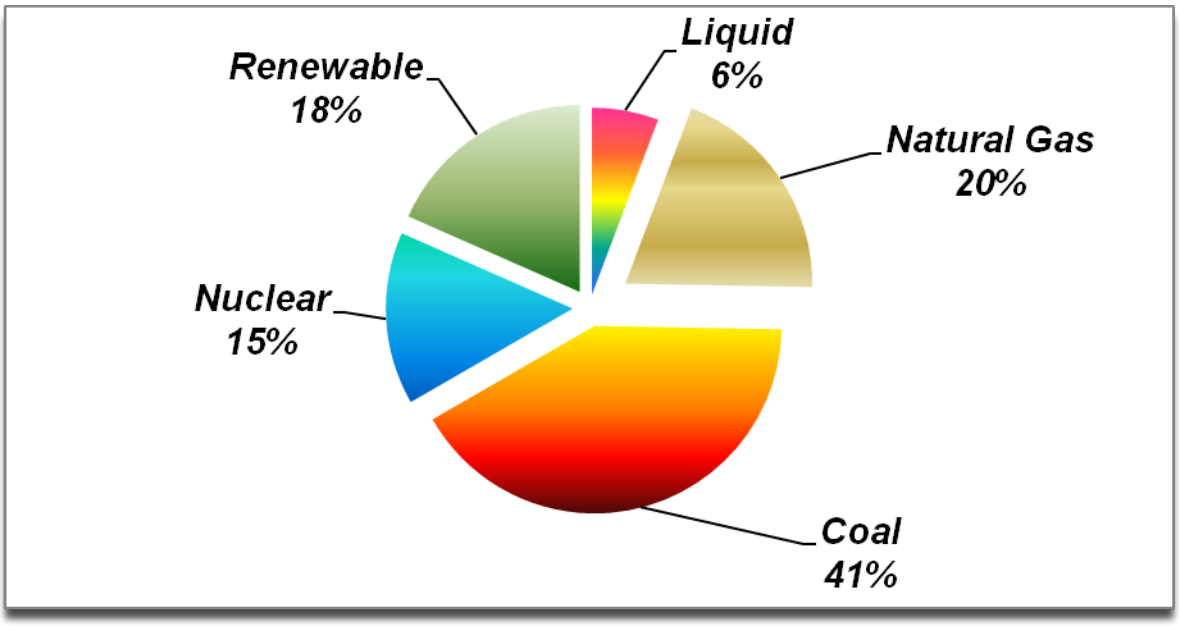
The Transmission and Distribution Networks have faced phenomenal growth in last few years owing towards rapid increase in the customers of gas.



TR

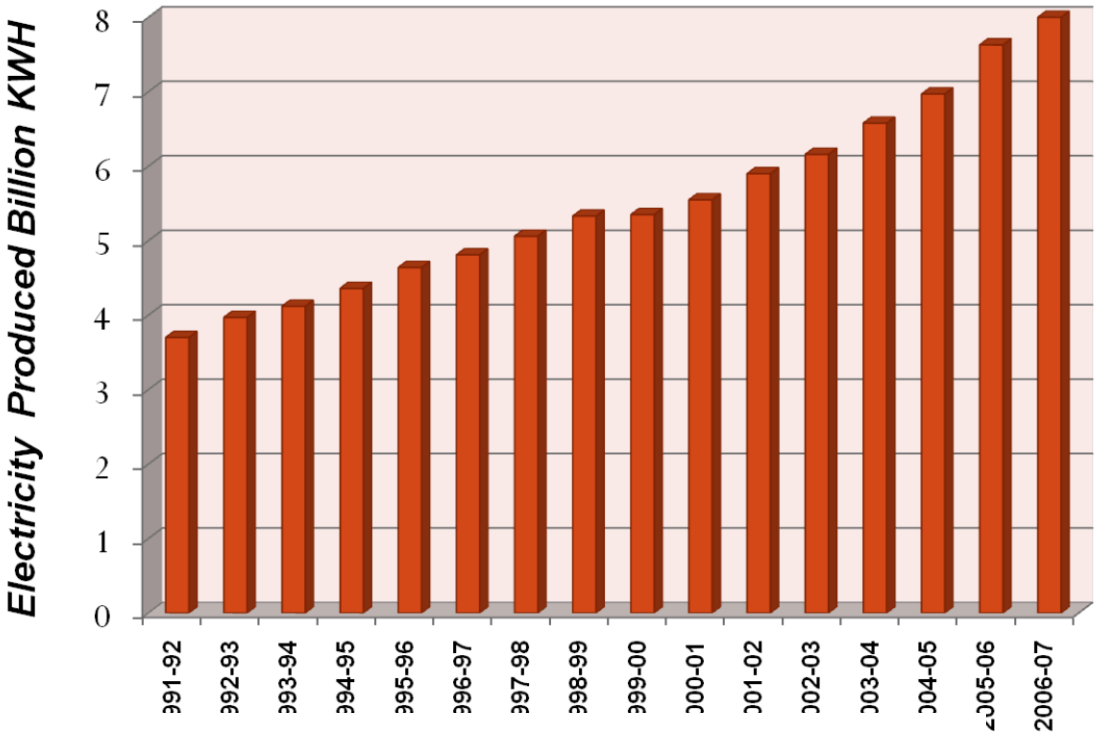
ANSMISSION NETWORK GROWTH 1955 TO 2008

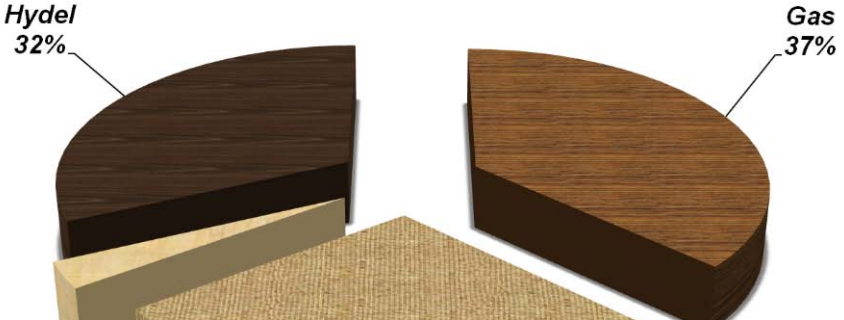
In the year 2007, the total Power generated of the world was around 17.3 Trillion Kilowatthours however an annual increase of 2.6% is expected in the coming years. The world power requirement is estimated to be around 33.3 Trillion Kilowatthours by the year 2030. No doubt the electricity is the fastest growing form of energy in the world while for generation of this electricity, the fastest growing fuel is Natural Gas. Internationally around 41% power is being generated by Coal.



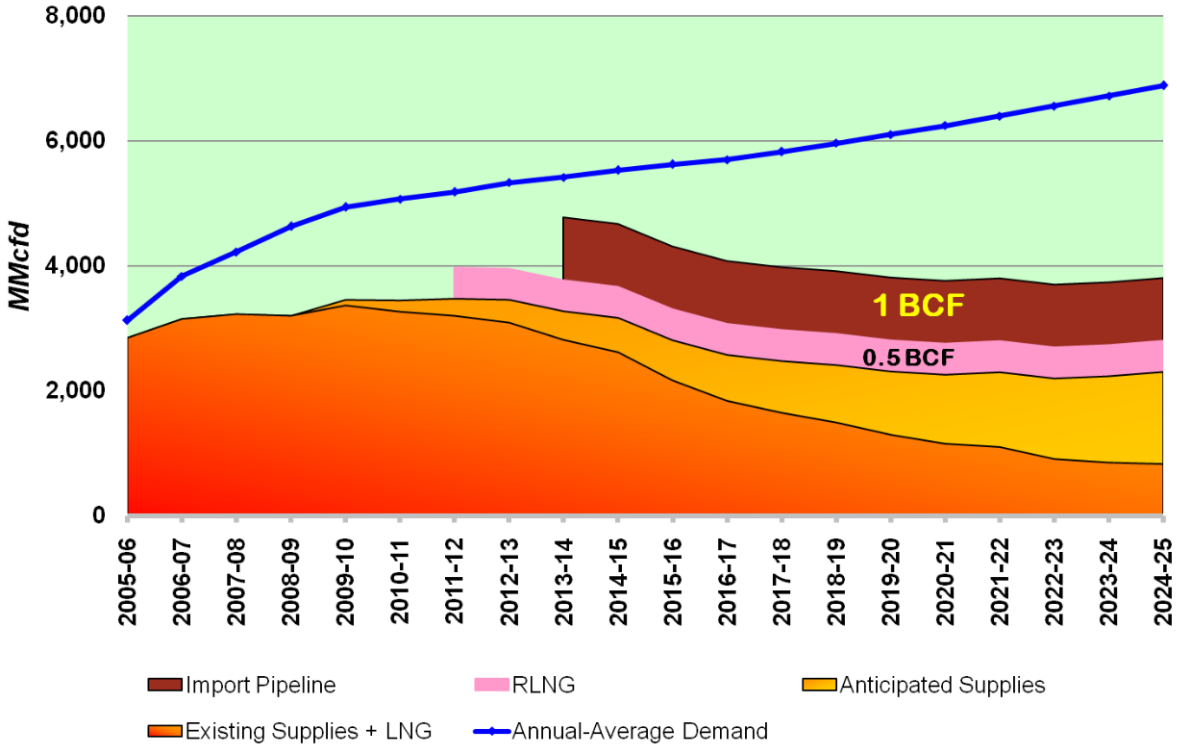
SHARE OF DIFFERENT FUELS IN POWER GENERATION (WORLD-WIDE, 2007)

However Natural Gas is becoming the fuel of choice for Power Generation due to its availability, Environment friendly nature and high efficiency of latest gas turbine based combined cycle equipments. The Power Generation is also increasing in Pakistan and it has almost doubled from 1992 to 2007.





A projection of total gas inputs, demand and committed sales of M/S. SNGPL has been shown in following graph:



Pakistan's Gas Demand and Supply Projections indicate a widening gap of approximately 1700 MMCFD by the year 2010. Any commitments of additional gas supplies to industries, power or fertilizer plants on a long term basis are therefore not possible, without confirmation of additional sources of gas supply. This may be possible through an import gas pipeline which shall take at least 4 to 6 years to supply gas. To cover this gap an alternate is the LNG import option which by current assessment will be able to provide gas by the year 2010/11 for which the planning of 3.5 million tons per annum (MTPA i.e. around 500 MMCFD) LNG import project with a re-gasification facility to be located in the vicinity of Karachi, the port city of Pakistan is under way. Government of Pakistan has already issued LNG policy in 2006 and has offered several incentives for LNG import through this policy.

Besides LNG project, the gas import projects are also moving forward but at a slower pace. The geographical, technical, economical and political factors are shaping the projects and

hindering the progress. However Pakistan has an excellent potential for foreign investment in any Gas import related project, as the country has a consistent increasing demand for gas and the utilization of existing gas infrastructure to distribute this gas shall maximize the profits.

CONCLUSION.

Pakistan has dependable and extremely efficient gas Transmission and Distribution networks belonging to two gas companies operating in the country. However, in order to meet the shortfall of gas for power generation and other industrial usage, it is imperative that gas should be imported on fast track basis either through Iran-Pakistan-India (IPI)/Turkmenistan-Afghanistan-Pakistan (TAP) or LNG. There is an urgent need for improvement in exploration activities and for increase in indigenous gas production.

References:

1. Pakistan Energy Year Book – 2007
2. Annual Report M/S. Sui Northern Gas Pipelines Ltd. - 2007
3. Annual Report M/S. Sui Southern Gas Company Ltd. – 2007
4. Data from Sales & Transmission Department M/S. Sui Northern Gas Pipelines Ltd. Till June, 2008
5. Data from M/S. Sui Southern Gas Company Ltd. Till June, 2008

Paper No. 267

BARRIERS IN RENEWABLE ENERGY DEPLOYMENT IN PAKISTAN

By

Syed Tahawar Hussain

By

Syed Tahawar Hussain

Overview (Brief history, current installed capacity, potential)

Pakistan is blessed with abundantly available and inexhaustible Renewable Energy (RE) resources, which if tapped effectively can play a considerable role in ensuring Energy Security and Energy Independence of the country. Sporadic efforts and initiatives have been undertaken by the Government in the past leading to lackluster results due to non-commitment, improper and disjointed planning and lack of focused, integrated efforts on part of the stakeholders involved.

Realizing the need to integrate the efforts for promotion and development of Alternative Renewable Energy (ARE), the Government of Pakistan established the Alternative Energy Development Board (AEDB) as an autonomous and the apex national organization in April 2005 with the mandate to undertake development of medium and long term national plans and policies, promotional and dissemination activities in the field of Renewable Energy Technologies; and to facilitate power generation through alternative or renewable energy resources by acting as a one window facility for establishing, promoting and facilitating alternative or renewable energy projects based on wind, solar, micro-hydel, fuel cells, tidal, ocean, bio gas, bio mass etc.

AEDB has been assigned the following targets by the Government of Pakistan:

- Development of wind and solar energy to ensure that at least 5% of total power generation capacity is met through these resources by 2030 (i.e. 9700 MW).
- Alternative Energy Development Board to ensure the installation of 700 MW of wind energy at Keti Bandar and Gharo, Sindh through the private sector.
- Solar products like solar lights, solar fans, solar cooker, solar geyser, etc. must be developed through private sector on top priority.
- Laws and taxes designed to encourage self energy generation by domestic sector like use of solar heating, solar geyser etc.
- Provision of electricity to remote, off-grid villages through Renewable Energy Sources, e.g. solar, wind, biomass etc. 7,874 such villages in Balochistan and Sindh have been identified initially.
- Replacement of 5% of total annual diesel consumption with Biodiesel by the year 2015, and 10% by the year 2025.

Current installed capacity of ARE in the country (excluding large hydro projects above 50 MW capacity) is roughly around 25 MW only.

Potential for various ARE technologies in the country vary from significant to phenomenal, which is as follows:

- Wind: 346,000 MW
- Solar: 2.9 Million MW
- Small Hydel: 2,000 MW
- Bagasse Cogeneration: 1,800 MW
- Waste to Power: 500 MW

*Director, Alternative Energy Development Board Government of Pakistan

In addition, potential for other ARE technologies such as Geothermal, Wave Energy, Tidal Energy, Biomass etc. also exists but is yet to be determined. In this regard the following activities have been completed:

- National Renewable Energy Laboratories (USA) under the USAID assistance program in 2007 has carried out the wind resource study of Pakistan and developed a meso scale map showing the wind speed potential available at 50m altitude. NREL study has also indicated the wind corridor in the south of Pakistan as already been discovered by PMD. The NREL wind resource map of Pakistan has given a great boost to the wind power development activities in the wind corridor regions. Now this potential area has become the focal point for the development of wind energy in the near future.

- Wind mapping of Gharo-Kaiti Bandar wind corridor has been conducted. Solar Map of Pakistan has also been completed by NERL/USAID.

- A Feasibility Study conducted by SNV of Netherlands indicates the potential of 5 Million Biogas units for domestic use; one of the largest in the region.

- Estimated potential for electricity generation through Biomass / Waste to Power (including Bagasse cogeneration) also exceeds 2000 MW.

Table 1: Renewable Energy Generation in Pakistan

Sr. No.	Technology	Province	Village Name	District	Number of Houses	Year of Commissioning	Generation (MWh/Year)	Capacity (kW)
1	Solar Energy	Punjab	Narian	Rawalpindi	53	2005/2006	80.59	27.60
			Khorian	Rawalpindi	57			
			Basti Bugha	D.G Khan	100			
			Lakhi Bair	D.G Khan	135			
		Sindh	Pinpario	Chachro	100	2005/2006	50.22	17.20
			Bharomal	Chachro	115			
		N.W.F.P	Shnow Garri	Kohat	100	2005/2006	51.39	17.60
			Janak	Kohat	120			
		Balochistan	Takht	Kalat	100	2005/2006	51.63	17.68
			Killa Mama Macherzai	Killa Saifullah				
			Allah Baksh Bazar Dandar	Turbat	121			

Sr. No.	Technology	Province	Village Name	District	Number of Houses	Year of Commissioning	Generation (MWh/year)	Capacity (kW)
2	Micro Wind Turbines	Sindh	Goth Gul Muhammad Khaskheli	Mirpur Sakro	12	2006	91.10	52
			Goth Jumo Khan Khaskheli	Mirpur Sakro	60			
			Goth Ismail Khaskheli 1	Mirpur Sakro	5			
			Goth Ismail Mahpar	Mirpur Sakro	8			
			Goth Mohd Hasan	Mirpur Sakro	14			

			Khaskheli					
			Goth Allah Dino Mahpar	Mirpur Sakro	14			
			Hot Khan	Gharo	10			
			Goth Sher Muhammad Hamaiti	Gujjo	48			
			Goth Daandaari	Ghorabari	250			
			Goth Lukman	Ghorabari	20			
			Goth Sammo	Ghorabari	19			
			Goth Ali Hasan Paareri	Ghorabari	120			
		Balochistan	Goth Meer Isa	Lasbela	3	2006	13.14	7.50
			Goth Ramzan	Lasbela	15			
			Goth Haji Sher Muhammad	Lasbela	35			
			Goth Yaaqoob	Lasbela	18			
			Goth Mir Abdullah	Lasbela	8			
				Lasbela	32			
	Micro Wind Turbine Installed by K.H.FARMA Ltd	Sindh (Karachi)					262.80	150
3	Rural Electrification Programme	Sindh		Tharparker	3,000	2008/09	244.46	167.44
4	Micro/Mini Hydel	Punjab	-		-		-	80
5	Biomass (Bagasse to Energy)	N.W.F.P	-	D.I.Khan	-	2008	94,608	27,000
6	Biomass (Anaerobic Digestion)	Punjab	-	Multan	-	2007	56,064	8,000
	Total						**151,517.33**	**35,537.02**

Source: AEDB / Pakistan Energy Year Book 2008

1. Global Renewable Energy Status

Table 2: Global Renewable Energy Status

Selected Indicators	2005	2006	2007
Investment in new renewable capacity (annual)	$40 billion	$55 billion	$71 billion
Renewables power capacity (existing, excl. large hydro)	182	207	240 GW
Renewables power capacity (existing, incl. large hydro)	930	970	1,010 GW
Wind power capacity (existing)	59	74	95 GW
Grid-connected solar PV capacity (existing)	3.5	5.1	7.8 GW
Solar PV production (annual)	1.8	2.5	3.8 GW
Solar hot water capacity (existing)	88	105	128 GWth
Ethanol production (annual)	33	39	46 billion liters

Biodiesel production (annual)	3.9	6	8 billion liters

Source: Renewables 2007 Global Status Report, REN 21

1.1 Global Market Trends

- Renewable power capacity of about 240 GW in 2007 (ex. large hydro) represents almost 6% of total global power capacity (~4,300 GW) and the share is increasing.
- Over 70 countries now have wind power, and many developing countries have joined the trend recently, including Brazil, Egypt, Iran, Mexico, Morocco, and South Africa, all with added capacity in 2006.
- Offshore wind power grew significantly in 2006-2007, with several projects in the 100-300 MW range underway in Europe and the United States.
- Solar PV market growth is centered in Germany, Japan, Spain, Italy, South Korea, California, and New Jersey, but with the market now broadening to more countries and states (such as France).
- Rooftop solar collectors provide hot water to over 50 million households worldwide, most in China. China now represents 75% of global annual additions of solar hot water.
- Geothermal heat pumps are a rapidly growing market, with over 2 million heat pumps used in over 30 countries, mostly in Europe and the U.S.
- Biomass-fueled heating still provides five times as much heat worldwide than solar and geothermal combined, and continues to grow in northern Europe.
- The U.S. has become the dominant ethanol producer (corn-based), although Brazil has started an ambitious program to increase production by 50% by 2009 (sugar-based).
- Ethanol provided > 40 percent of all (non-diesel) motor vehicle fuel in Brazil in 2005.
- Biodiesel production has increased at 20-100% annual rates in recent years, particularly in Germany, France, Italy, Poland, and the United States.
- Almost half of world biodiesel production continued to be in Germany.
- The first group of commercial-scale solar thermal power plants since the 1980s started operation in 2006-2007, including in Nevada (USA) and Spain. Many more plants are now planned.

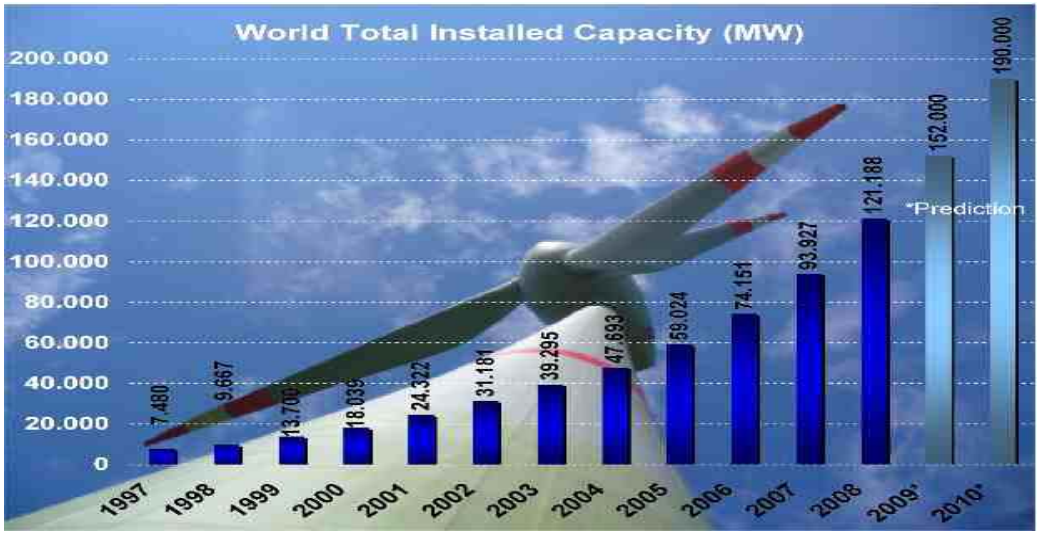


Table 3: Global Wind Installed Capacity, 2008

Position 2008	Country	Total Capacity installed end	Added Capacity 2008	Growth Rate 2008

		2008		
		(MW)	(MW)	(%)
1	USA	**25,170**	8,351.2	49.7
2	Germany	**23,902.8**	1,655.4	7.4
3	Spain	**16,740.3**	1,595.2	10.5
4	China	**12,210**	6,298	106.5
5	India	**9,587**	1,737	22.1
6	Italy	**3,736**	1,009.9	37
7	France	**3,404**	949	38.7
8	United Kingdom	**3,287.9**	898.9	37.6
9	Denmark	**3,160**	35	1.1
10	Portugal	**2,862**	732	34.4
11	Canada	**2,369**	523	28.3
12	Netherlands	**2,225**	478	27.4
13	Japan	**1,880**	352	23
14	Australia	**1,494**	676.7	82.8
15	Ireland	**1,244.7**	439.7	54.6
16	Sweden	**1,066.9**	235.9	28.4
17	Austria	**994.9**	13.4	1.4
18	Greece	**989.7**	116.5	13.3
19	Poland	**472**	196	71
20	Norway	**428**	95.1	28.5
21	Eygpt	**390**	80	25.8
22	Belgium	**383.6**	96.7	33.7
23	Chinese Taipeh	**358.2**	78.3	28
24	Brazil	**338.5**	91.5	37
25	Turkey	**333.4**	126.6	61.2
26	New Zealand	**325.3**	3.5	1.1
27	Korea (South)	**278**	85.9	44.7
28	Bulgaria	**157.5**	100.6	176.7
29	Czech Republic	**150**	34	29.3
30	Finland	**140**	30	27.3
31	Hungary	**127**	62	95.4
32	Morrocco	**125.2**	0.0	0.0
33	Ukraine	**90**	1	1.1
34	Mexico	**85**	0	0
35	Iran	**82**	15.5	23.3
36	Estonia	**78.3**	19.7	33.6
37	Costa Rica	**74**	0	0
38	Lithuania	**54.4**	2.1	4
39	Luxembourg	**35.3**	0	0
40	Latvia	**30**	2.6	9.5
41	Argentina	**29.8**	0	0
42	Philippines	**25.2**	0	0
43	South Africa	**21.8**	5.2	31.4
44	Jamaica	**20.7**	0	0
45	Guadeloupe	**20.5**	0	0
46	Uruguay	**20.5**	19.9	3,308.3
47	Chile	**20.1**	0	0
48	Tunisia	**20**	0	0

49	Colombia	**19.5**	0	0
50	Croatia	**18.2**	1	5.8
51	Russia	**16.5**	0	0
52	Switzerland	**13.8**	2.2	19.2
53	Guyana	**13.5**	0	0
54	Curacao	**12**	0	0
55	Romania	**7.8**	0	0
56	Israel	**6**	0	0
57	**Pakistan**	**6**	**6**	**New**
58	Slovakia	**5.1**	0.1	2.8
59	Faroe Islands	**4.1**	0	0
60	Ecuador	**4**	0.9	30.7
61	Cuba	**7.2**	5.1	242.9
62	Cape Verde	**2.8**	0	0
63	Mongolia	**2.4**	2.4	New
64	Nigeria	**2.2**	0	0
65	Jordan	**2**	0	0
66	Indonesia	**1.2**	0.2	20
67	Martinique	**1.1**	0	0
68	Belarus	**1.1**	0	0
69	Eritrea	**0.8**	0	0
70	Peru	**0.7**	0	0
71	Kazakhstan	**0.5**	0	0
72	Namibia	**0.5**	0	0
73	Netherlands Antilles	**0.3**	0	0
74	Syria	**0.3**	0	0
75	North Korea	**0.2**	0.2	2010
76	Bolivia	**0.01**	0	0
	Total	**121,187.9**	27,261.1	

Source: World Wind Energy Report 2008, WWEA

2. Policy Highlights (A brief description of successive policies relevant to the industry)

The ARE sector had been largely ignored prior to the establishment of AEDB. Upon its inception, one of the tasks undertaken by AEDB was the formulation of country's first ever Renewable Energy Policy. As a result, the Policy for Development of Renewable Energy for Power Generation was approved by the Federal Government and issued in December 2006. Salient features of the Renewable Energy Policy 2006 are as follows:

- It invites investment from the private sector for following categories of proposals:
  a. Independent power projects, or IPPs (for sale of power to the grid only)
  b. Captive cum grid spillover power projects. (i.e., for self-use and sale to utility)
  c. Captive power projects (i.e., for self or dedicated use)
  d. Isolated grid power projects (i.e., small, stand-alone)
- Except for Category (a) above, these projects will not require any LOI, LOS, or IA from the Government.
- Electricity purchase by NTDC / CPPA from qualifying renewable energy-based generation projects has been made mandatory.

- It permits an investor to generate electricity based on renewable resources at one location and receive an equivalent amount for own use elsewhere on the grid at the investor's own cost of generation plus transmission charges (wheeling).
- It allows net metering and billing so that a producer can sell surplus electricity at one time and receive electricity from the grid at another time and settle accounts on net basis. This will directly benefit the economics of small scale, dispersed generation and optimize capacity utilization of installed systems.
- It de-licences and deregulates small scale power production through renewable resources (up to 5 MW for hydro and 1 MW for net metered sales) to reduce the transaction costs for such investments. This will be particularly beneficial for micro, mini and small hydro as well as solar-based electricity production.
- It lays down simplified and transparent principles of tariff determination.
- It insulates the investor from resource variability risk, which is allocated to the power purchaser.
- It facilitates projects to obtain carbon credits for avoided greenhouse gas emissions, helping improve financial returns and reducing per unit costs for the purchaser.

3. Demand/ Supply Scenario (Current vs Projected, graphs and tables can be included)

Current installed capacity of the country stands at 19,522 MW. There exists a shortfall of 6,000 MW today. The energy demand over the next five years is expected to grow at a rate of 7.4 percent per annum. In order to meet additional power generation requirement of 143,310 MW during 2005-2030, an investment of $ 150 billion would be required.

Renewable Energy, however, can effectively complement the conventional energy resources for meeting the demand / supply gap. Given the right kind of support, over 10,000 MW can be added to the national installed capacity through Renewable Energy resources by the year 2030.

4. Projects in pipeline at this time (Magnitude of projects and required investment, brief description, expected period of commissioning)

Several projects in different RE technologies, which include wind power projects, micro / mini hydel, bio mass / bio gas, waste-to-energy and solar, are currently in the pipeline. A detail of these projects is presented in Table-1 below:

Table 4: Renewable Energy Projects in Pipeline, Pakistan

Renewable Energy Projects In Pipeline						
	Name of Project	**Technology**	**Capacity (MW)**	**Expected Commissioning Year**	**Estimated Cost (Million $)**	**Implementation by**
	Zorlu Enerji Pakistan Ltd.	Wind	50	2009	121	Private sector
	Green Power Pvt. Ltd.	Wind	50	2010	135	Private sector
	Arabian Sea Pvt. Ltd.	Wind	50	2011	161.3	Private sector
	Dawood Power Ltd.	Wind	50	2011	133	Private sector
	Beacon Energy Ltd.	Wind	50	2011	135	Private sector
	Clean Energy Development	Bio Mass	25	2010	-	Private sector

Wind Power Projects

The wind power projects mentioned in the Table-1 are being developed in the Gharo and Jhimpir areas of Thatta District. Construction work is already in progress on one of these projects being pursued by M/s Zorlu Enerji Pakistan Ltd. and the first phase of the project of 06 MW will be completed by March 2009.

Solar Photovoltaic Projects

Under Rural Electrification Program (REP) AEDB is providing solar photovoltaic systems to households in 300 un-electrified villages of Baluchistan and 100 un-electrified villages of Sindh with an envisaged expenditure of Rs. 1167.73 millions. More than 3000 households in Sindh have already been provided with the solar photovoltaic systems.

Bio Mass / Bio Gas Projects

M/s Clean Energy Development Ltd of New Zealand is actively working on the development of a 25 MW biomass project at Landhi, Karachi. The pilot phase of the project (250 kW) has been initiated and the full scale plant of 25 MW will be completed by 2010.

5. Challenges facing the sector (policy issues, technical challenges)

POLICY ISSUES

- The efforts of the government have not met with success mainly due to a lack of integrated planning and implementation mechanism. Unfocussed efforts with duplication of activities by various agencies which is uncoordinated combined with limited resources and constraints leads to confusion and attainment of targets is not possible. There is a proliferation of Government agencies often duplicating functions. These agencies under various Ministries are not empowered sufficiently to develop ARE resources, and are working with limited resources and constraints. Lack of coordination and cohesion among the agencies responsible for developing the ARE sector is preventing from achieving a critical mass concentration of these technologies. Scant, peripheral and parallel activities by various agencies also cause confusion among the Donor Agencies. The provincial governments do not have a proper 'buy-in' and do not support the process.

- Another key issue responsible for hindering the growth of ARE sector in the country is the general lack of capacity in the public sector, which coupled with the already burdensome approval process for RE IPPs, is slowing down tangible progress for setting up RE projects in the country. It is important to understand that building capacity is as important as adding Mega Watts to the grid. The challenge faced today is to make the different Government of Pakistan players coalesce around the development and implementation of a national RE strategy in a complimentary way.

- One of the most critical factors responsible for preventing the realization of RE projects, especially Wind Power Projects is that of **tariff.** More often than not, wind IPPs has found the tariff determined by NEPRA to be unworkable and unacceptable. The leading wind IPPs of the country, i.e., Zorlu Enerji, Green Power Pvt. Ltd. and Dawood Power Pvt. Ltd., all have gone through the cumbersome process of filing multiple tariff petitions with NEPRA due to the fact that the offered tariff was always considerably less than the one petitioned for. Green Power has so far gone through this process three times and still hasn't been awarded a tariff of its liking. This leads to inevitable delays in the project as the IPPs are unable to firm up their turbine supply and EPC agreements and the window of opportunity is lost; not to mention the direct and indirect additions to the project cost as filing of each tariff petition costs in excess of Rs. 2.5 Million and the turbine prices in the international market have been experiencing a continuous upward trend for the past three years. The biggest reason that not a single wind power project has come on-ground to date is that of tariff disputes with NEPRA; thus compounding the current prevailing energy crisis.

TECHNICAL CHALLENGES

- Renewable Energy projects are going to be a first in the history of country's power sector. Due to their unique nature and intermittent resource variability, they also pose technical challenges. The Government entities in the power sector are only experienced in dealing with thermal and large hydro projects, and are therefore not technically equipped to handle RE projects. One of the main reasons for delays in developing a standard Energy Purchase Agreement for wind projects was lack of experience and capacity for understanding and handling the technical aspects of wind energy generation and dispatch issues.

- The currently enforced Grid Codes do not cater for Renewable Energy projects. Modification of these Grid Codes to successfully incorporate wind energy projects is proving to be a major technical issue and challenge. The issue needs to be addressed at the earliest possible to inject wind energy to the national grid without any further delays.

- The NPCC which is the agency responsible for managing and controlling the national grid, also lacks the experience to manage dispatch of wind energy to the grid.

6. 'Immediate Problems Immediate Solutions'

- Focused and integrated approach by the Government to develop the RE Sector is required without any further delays. This can be achieved by strengthening the AEDB as an institution, both in terms of its legal mandate and financial resources. Another practical and extremely useful approach can be to establish a separate ministry for Alternative Renewable Energy, along the similar lines as adopted by India and various other countries around the world which have served them really well. In this way, integrated efforts can be undertaken by the Government by displaying the necessary resolve and political will for development and promotion of RE.

- Renewable Energy around the world has flourished mainly due to the reason that it got unflinching support of the Governments in the form of binding targets, legislations and attractive incentives for private sector investment. Among them, the concept adopted universally with great success is that of Feed-in Tariffs and this mechanism should be adopted in Pakistan without any further delay. Feed-in Tariff not only takes into account the private cost of the project, but also accounts for the externalities arising due to social costs had it been a business-as-usual scenario using conventional energy resources. The approach adopted in Pakistan so far for such RE projects is on "cost-plus" basis. The cost-plus computation requires a case-by-case determination of the applicable tariff for every single producer. This approach is typically favoured by NEPRA in order to help reduce the risk faced by the developers who want to undertake such projects, since it guarantees a return-on-equity (ROE) of at least 15 %.

While this method reduces some of the risks to the developer, it also eliminates any additional incentive to develop these types of projects. For instance, the ROE assured is the same regardless the type of power generation project under consideration (i.e., renewable or conventional). This can lead to quite curious situations, such as that the upfront tariff allowed by NEPRA for conventional generation using reciprocating engines burning diesel oil is 25% higher than the upfront tariff for generation using wind, regardless of the benefits that the latter brings to the environment or in terms of fuel independence.

Additionally, available international evidence shows that feed-in tariffs are the best incentive mechanism for developing RE capacity, as can be observed in the cases of Europe and some BRIC (Brazil, Russia, India and China) countries.

- The few initial wind power projects may be exempted from the Grid Codes currently in vogue in the country so as to ensure their immediate despatch of energy. In addition, the Grid Codes should be revised to cater for off-take of wind energy based on the best international practices instead of re-inventing the wheel all over again.

- The Gharo – Keti Bandar Wind Corridor may be declared a perennial wind corridor by the Government, dedicated to the development of wind energy projects. This will help in making these projects bankable as it would be easier for financial institutions to finance these projects without any fear of land lease for the project being revoked by the Government of Sindh at any stage during the project life.

Mid term and Long Term Problems and Mid Term and Long Term Solutions

The issues addressed above are also generally applicable for the mid term as well as the long term. However the biggest challenge will be for the Government to continue its resolve to support the initiatives undertaken already and during the short term to make this sector a viable and sustainable option for Pakistan. This may include the following:

- Capacity and capability building of the public sector institutions involved with the development of RE sector, i.e., AEDB, NTDC, NEPRA, CPPA, NPCC etc.

- Development of an enabling environment for Renewable Energy technologies by introducing and implementing plans and policies that offer enough incentives to sustain the sector in the medium term and enable the RE technologies to become competitive with the conventional technologies on a level-playing field in the long term.

- Introduction and implementation of the feed-in tariff mechanism at least for the medium term.

- Introduction of binding targets and legislations for use of RE technologies, both for utilities and consumers.

- Incentives to manufacturers for indigenization of RE technologies, as it will help in not only considerably reduce the projects' cost in future but will also have a very positive impact on the overall economy of the country.

- Strengthening of the Alternative Energy Fund (AEF), which has been recently established with an objective to develop the RE sector and to promote PPPs as well as to assist the private sector for developing RE projects that have certain risk perceptions associated with them due to not having any past precedence in the country.

7. Investment requirement for the next 15 years to carry out major projects. How will the capital requirement be met?

On –grid RE projects in the country are mainly being established on the IPP model. However pilot projects are planned to be undertaken by the public sector to provide a certain level of comfort to the private sector for investing in such projects of mega scale. In addition, RE projects are also being undertaken by the Government to improve the livelihood of the impoverished inhabitants of remote, off-grid areas with a view of social development and meeting the Millennium Development Goals.

To meet the projected targets in the next 15 years, an investment of USD 500 Billion will be required for wind energy projects alone. USD 250 Million may be required for Rural Electrification Programme.

This capital requirement may be met from various sources, including Government funding, e.g. PSDP, international donor agencies (who are already supporting such initiatives in Pakistan, e.g. ADB, UNDP/GEF, USAID, EC, World Bank etc.), and the private sector which may be the biggest driver for investment in the RE sector. However it is estimated that a support of USD 1-2 Billion dollars during the mid term will enable the sector to become self-sustainable in the long term.

8. Opportunities for improving efficiency (production, transmission)

Renewable Energy technologies, by default, are the most energy efficient options available. Implementation of RE technologies will result in considerably improving the efficiency of the country's power sector.

In addition, one of the biggest advantages of utilizing RE technologies is the reduction of T&D losses in the grid. This is achieved either by having the electricity generating source right next to the point of consumption or relieving the grid of the amount of power that is otherwise generated by an RE application.

Hence using RE options provides excellent opportunities for considerably improving both the production and transmission efficiencies of the overall grid system.

9. Opportunities for technological enhancement

Promotion of RE technologies in the country can also open the floodgates to technological advancement of Pakistan in this area. Indigenization and transfer of such technologies can bring about a revolution in the engineering and industrial sector of the country. Another advantage that can be gained out of this technological advancement is the strategic location of the country. Pakistan has the potential of becoming a hub for exporting the RE technologies and equipment to the countries in the region.

10. Biodiesel

Oil imports of Pakistan continue to rise, presenting a serious cause of concern for the Government due to rising and unstable crude oil prices. Pakistan consumes 8 Million tons of Diesel annually out of which 4 Million tons is imported. Diesel is consumed by the industrial, transportation and agriculture sectors, which make up for 75% of the country's annual energy use at 26.280 MTOE. 10% of country's annual Diesel consumption replaced with Biodiesel will result in estimated savings in excess of US $ 1 Billion per annum.

The ECC of the Federal Cabinet approved the Policy Recommendations for Use of Biodiesel as an Alternative Fuel in February 2008, which has set the indicative target of Gradual introduction of Biodiesel fuel blends with petroleum diesel so as to achieve a minimum share of 5% by volume of the total Diesel consumption in the country by the year 2015 and 10% by 2025.

Pace of development of Biodiesel sector in Pakistan is such that events may overtake policy leading to Government losing control over the production of Biodiesel which can either destabilize this sector or stint its growth before the sector gets the opportunity to mature and become viable. Integrated and focused efforts are required on government's part as multiple stakeholders are involved from the public sector including AEDB, Ministry of Food, Agriculture & Livestock, Ministry of Petroleum & Natural Resources, PSO, OGRA as well as the provincial governments. These stakeholders need to realize the gravity of the situation and address all the critical issues associated with the sustainability of the National Biodiesel Programme spearheaded by AEDB. Immediate decisions are required in order to effectively address these issues and formulate a National Biofuels Policy in the soonest possible time span.

10.1 Issues & Recommendations

- Any act or policy formulated in haste without first catering to all the relevant issues and plugging the techno-economic gaps in this largely untested sector, will only lead to disastrous results. This is one area where the government needs to tread very carefully as a false start can derail this fledgling sector, adverse effects of which will be felt on the economy for a very long time; a situation Pakistan cannot afford given the current energy crisis.

- Only non-edible oil feedstock may be allowed for Biodiesel production as a policy decision. However another important issue that can't be ignored is the quality of the Biodiesel thus produced and its conformance to international standards. Inferior quality Biodiesel produced from a certain feedstock will only serve to damage the National Biodiesel Programme. Hence it is imperative to carefully evaluate the pros and cons associated with a certain type of feedstock before it is given priority or preference over other available feedstock for production of Biodiesel.

- Aggressive R&D is being conducted globally to identify next-generation Biodiesel feedstock options to diversify Biodiesel production resources, otherwise known as lignocelluloses. The technology will allow Biodiesel to be produced from any plant material, there would be no conflict between the need for food and the need for fuel. It will also significantly lower the Biodiesel production cost. R&D efforts in this regard need strong and continuous support & commitment from the Government to ensure the viability and sustainability of the National Biodiesel Programme.

- As already mandated by the ECC, AEDB is to spearhead the National Biodiesel Programme and ensure that the targets determined by ECC are met with successfully. However there already is a duplication of efforts as evidenced by the Committees formed under the President ZTBL and Adviser to the PM on Finance for Biofuels, which also include Biodiesel in their TORs. The government needs to empower and strengthen the agency mandated with this responsibility accordingly so as to enable it to formulate and come up with the necessary Policy and Regulatory framework by involving all the stakeholders

11. Recommendations and Conclusions:

Today's global quest for energy is impacted by the following realities:

- Depleting Fossil Fuel Reserves
- Geo-political Issues
- Volatile Oil Prices
- Environment Concerns

Collectively, these issues have dictated a global shift in strategy which has led to a growing trend for utilization of clean Alternative Renewable Energy (ARE) technologies world-wide. In addition, issue of Social Responsibility in the form of binding agreements for CO_2 emission reductions has put an obligation on countries around the world for adoption of ARE technologies. This had forced both the developed and developing nations of the world to show resolve for promoting ARE technologies by setting firm mid and long term targets for replacement of conventional energy based generation systems to RE based generation systems. Pakistan is also obligated to show its resolve to the world in this regard by establishing itself as a responsible and serious nation committed to the cause of protecting the environment degradation. Hence it is imperative for Government of Pakistan to support and develop the ARE sector.

This can be achieved by adopting the following recommendations:

- Fixed 'Feed-In Tariffs' for a five year period be introduced that are competitive with the world and not based on a "cost-plus basis." This would give the RE sector a 'jump-start' and enable investors to 'fast-track' the project. It would have a multiplier effect for job generation and boost the engineering industry in the country.
  - Setting of firm targets for RE deployment over the short, mid and long terms taking into account that there are no recurring fuel costs and after the first ten years of a project life the tariff will drop significantly as the capital cost is paid off..
  - Wind mapping to cover the whole of Pakistan to be comprehensively carried out.
  - Enactment of legislations for mandatory use of RE technologies. For promotion of RE technologies, high profile targets in government buildings should be initiated to develop success stories.
  - Provincial, city and local governments should be given monetary incentives to introduce RE technologies in various projects.
  - Removal of policy and regulatory barriers.
  - Formulation of favorable policy and regulatory framework for deployment of RE technologies including feed-in tariffs and obligating the utilities to meet a certain percentage of their electricity demand with RE technologies. Similarly, power distribution set-ups (DISCO's) should be 'incentivised' to utilize RE sources.
  - Smart Grids be developed with reversible meters to allow utility companies to purchase surplus power generated by consumers.
  - Institutional strengthening of AEDB. A review should be carried out to create an independent Ministry of Renewable Energy for focused efforts for growth of all RE activities.
  - Financial support of the RE sector by strengthening the Alternative Energy Fund (AEF) and provision of an estimated USD 1-2 Billion till the year 2016, beyond which AEDB and the RE sector should be able to sustain itself.
  - City governments should be encouraged to produce bio-energy through anaerobic digesters to produce power.

The investment potential for the RE sector of the country from short to medium term is over USD 16 Billion Dollars, which if supported through Government resolve and initiative can help in turning around the energy sector of the country; not to mention an overall strengthening of the country's economy and its projection around the world as a responsible, modern and committed nation. RE deployment has to be supported by the Government as a strategic option.

Paper No. 268

RENEWABLE ENERGIES-AN ULTIMATE SOLUTION TO OVERCOME POWER CRISES OF PAKISTAN

By

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I. Energy Rational

Demand for electricity grows with the growth of economy and if the growth on the supply side is not maintained at the same pace, a crisis is always in the making which has already emerged in Pakistan during the last two years. Non-availability of natural resources for expansion of power sector has widened the gap between demand and supply. At the growth rate prevailing in Pakistan, power shortage was likely to appear in 2006, which practically happened and forced utilities load shedding. The typical shortfall is 4000-5000 MW, which could be the major cause of stagnant growth in all sectors. If any of the pipeline projects is not implemented in near future, there will be enormous pressure on the electrical infrastructure of the country.

The thermal sources induce exorbitant import bills and deployment of FOREX reserves in case of oil whereas gas reserves are diminishing. The hydal and coal projects have political concerns and long gestation periods before they can start generating.

In order to rescue the situation, Renewable Energies deserve a strong pursuance for both on grid and off grid applications. The on grid applications will take the pressure off from national grid and the off grid applications will add productivity in the areas which are deprived of electricity access even in current era.

II. Solutions for Pakistan:

- Off Grid / Micro Generation
- On Grid Power Generation

Within the broad scope of above, following concrete opportunities can be exploited:

1. Solar Water Pumps
2. Solar Home Solutions (Rural)
3. Outdoor Lights (Solar / LEDs)
4. Solar PV
5. Solar Water Heating Solutions
6. Wind Power Projects
7. Solar Thermal Power Projects
8. Bio Diesel Projects
9. Micro / Mini Hydal

1. Solar Water Pumps:

Pakistan has remained an agricultural based economy for ages. The sector still has a lot to add in the economy mix. The diversified climate, fertile lands and good canal systems make all contribute to keep on improving this sector.

Water pumping is conventionally done through large tube wells, which are operated on WAPDA Electricity or Diesel Generating Sets.

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The concept of Solar Water Pumping will support *drip irrigation*, a much appreciated practice almost globally. This is because it is not only an efficient irrigation system consuming optimum water quantities, it also requires relatively less delivery and distribution infrastructure. Rather, its basic principle is to have more scattered pumping units at designated places from where, the further distribution is easier. *Solar water pumps having the limitation of flow rate fits well in this concept*. It is partly offset by the fact that sun is available throughout the year and it even keeps pumping during off season. *The water pumped during off seasons can be stored to meet the demands of peak season*.

Keeping all the above in view, the solar water pumps can be installed and used effectively. The capacity calculation needs to be determined on the basis of annual delivery capacity as sun is available throughout the year to operate the pump. An appropriate storage is to be prepared/utilized, which will keep storing the water during off seasons. This approach will enable to select low delivery pumps, which will deliver less on a daily basis but meet the overall requirement on an annual basis.

It is also necessary to analyze the distribution requirement. There should be scattered pumping units with a relatively small network of distribution streams with each unit. This will also regenerate the un-utilized or virgin lands, which are waiting for supply of irrigation water from canals or tube wells.

In order to implement the program at the country or province wide scale, a real-time feasibility can be undertaken to study the land utilization and water table in different areas followed by a pilot project. The exercise will ultimately determine the exact locations and size of solar water pumps along with the distribution network, which will be sufficient to meet the requirement of those particular areas.

2. Solar Home Solutions (Rural):

According to a survey, far flung areas which are located more than 20 Km away from existing national grid are financially not viable for provision of electricity through conventional means. There are as much as 4,000 such villages, where people are still deprived of electricity.

In such areas, micro level energy solution can be provided to the households and the standard of living can be improved.

A detailed feasibility study needs to be carried out in parallel for pilot projects of rural Electrification. Solar Electrification in rural areas will not only provide electricity to the communities but also help to improve their standards of living. Proper implementation plan and awareness campaigns for rural communities also need to be planned along with the installation of solar home systems

3. Outdoor Lights (Solar / LEDs):

In the present circumstances, the cost of electricity will be a mere consideration in near future and the focus will be to have whatever can be made available. Considering street lights in particular; they cause certain hurdles during installation, operation and maintenance. These include grid connectivity, transmission line, internal cabling and transformers etc. Setting up the infrastructure causes wastage of time and money and introduces a lot of administrative constraints.

As mega watt scale power generation is required to feed the national grid, Government is rightly taking steps to achieve that. Wind power projects will contribute in the coming years. As a short / medium term plan, solar photovoltaic lighting solutions can straight away take over some grid load in urban areas and cities, where outdoor public and community lights such as on streets, roads, parks, billboards, public places etc have a handsome share. Similarly, the far off and scattered applications are also a win – win situation for solar solutions.

This is economically and even financially viable when the overall cost of developing the project including allied accessories at the back end to energize the systems and the O & M are considered all together. The financial implications of capital cost of conventional lights, grid connectivity including transmission line, inter connect cabling, transformers, distribution boxes, fuse circuits, the civil works and labor, the daily tariff, the operation and maintenance, the cost and over heads of repairs and replacements including manpower and equipment are all together analyzed. The use of solar technology to contribute in power sector, being an environment friendly and non depleting energy resource remains above everything.

The real benefits of Solar Lights are realized when LEDs (Light Emitting Diodes) are used. LED's are very low in charge consumption, thus requiring low powered solar panels and low capacity battery banks. A low power LED light powered by a low power panel charging a low capacity battery can produce much more light than equivalent conventional light.

Even in cases where grid infrastructure is available, LEDs contain a lot of potential to be used as Energy Efficient Lights saving 75% electricity as compared to conventional lights.

A system on solar lights has a typical payback period of 5-6 years, whereas a system on LED lights powered by WAPDA electricity has a typical payback period of 2-3 years.

4. Solar Water Heating Solutions:

This is a need of the hour solution in the market in view of depleting gas reserves in Pakistan, low pressures of gas & load shedding during winters and increasing gas tariffs. The solution is based on a collector, which can operate in cold climates to heat the water in a thermally insulated tank. The solar system is modular in terms of interface and it can be used as an independent unit or a pre-heater or a hybrid with gas geyser.

In any of the configuration, it contributes in saving the gas consumption resulting in cost savings for the consumer (reduced gas bill) and also safeguards this rapidly depleting resource at national level. Burning of natural gas also results in GHG emissions, which another advantage to the solar system use.

Like all Renewable Energy Technologies, the solar water heaters have high CAPEX and low/negligible OPEX with a very attractive payback period of *2-3 years*.

The solar collector is based on evacuated glass tubes. The size and number of tubes depend on the heating requirement. The tubes are directly attached with the storage tank. The principal of operation is same as of gas heater. The piping is also on the similar techniques. In order to utilize max solar potential, special measures are required to keep the piping network insulated. Moreover, the system needs resident time for water to stay in the tank during sunshine in order to achieve the desired temperature.

The system has an inbuilt optional feature of electric hybrid.

The system can be installed in three (03) configurations according to the user's suitability:

- **Independent Unit:** It operates in the same configuration and principle as of conventional gas geyser except that heat source is sun.

- **Pre-Heating / Dual Source Heating:** The inlet water of a conventional gas geyser is pre-heated through a solar system to reduce the operation of its burner and thus reduce gas consumption.

- **Hybrid Unit:** The system can be made hybrid in two ways. Either to use electric heating coil in the tank of solar water heater. The coil will operate under certain temperature conditions when performance of solar collector is down. The other way is to use a conventional gas geyser and a solar water heater, both connected with the main piping network. Any one of the two can operate through flow control valves.

5. Wind Power Projects:

Wind Power projects are already underway in coastal areas of Pakistan. However, there is very little practical implementation.

Pakistan has a considerable potential of wind energy in the coastal belt of Sindh, Balochistan and as well as in central Punjab and northern areas. The Wind Data of selected areas has been collected by Pakistan Metrological Department and analyzed by AEDB. As per the collected data, the coastal belt of Pakistan is blessed with a God gifted wind corridor that is 60 km wide (Gharo ~ Keti Bandar) and 180 km long (up to Hyderabad). This corridor has the exploitable potential of 50,000 MW of electricity generation through wind energy. AEDB has made a wind resource study to setup the benchmark wind speed values at different levels from Gharo and Jhimpir regions at present.

Most of the remote villages in the south can be electrified through micro wind turbines. It is estimated that more than 5000 villages can be electrified through wind energy in Sindh, Balochistan and Northern areas.

With the efforts of AEDB, aggressive lobbying for investment has been done with national and international investors to make them realize the potentials of renewable particularly the wind energy. Till date, 93 LOIs have been issued for 4650 MW wind power generation. Land has been allocated to 20-25 investors, who are now working on the feasibility of their proposed projects. There have been delays due to slow implementation of policy but a few projects are now really on the way to enter in implementation stage.

6. Solar Thermal Power Projects:

Solar thermal energy has been in use for several decades. Solar thermal technology is basically concentrating the sun light to a single point to generate a lot of heat which is utilized to generate electricity. The power generation by solar thermal technology was introduced several years ago and it has proven itself most viable future technology for large scale power generation through alternate means.

Pakistan being in the Sun Belt is ideally located to take advantage of solar energy technologies. This energy source is widely distributed and abundantly available in the country. The mean global radiation falling on horizontal surface is about **200-250 watt per sq.m** in a day. This amounts to about **2500-3000 sun shine hours** and **1.9 - 2.3 MWh per sq.met** in a year. It has an average daily global irradiance of 19 to 20 MJ/sq.met per day with annual mean sunshine duration of 8 to 8.5 hours (6-7hrs in cold and 10-12 hrs in hot season) and these values are among the highest in the world. For daily global radiation up to 23MJ/m2, 24 (80%) consecutive

days are available in this area for solar energy. Such conditions are ideal for solar thermal applications.

To summarize, the sun shines for 250-300 days per years in Pakistan with an average sun shine hours of 8-10 per day. This gives huge amount of energy to be used for electricity generation by solar thermal power plants.

A quick idea for the potential of solar energy in Pakistan can be obtained from the satellite map of solar radiation released by National Renewable Energy Lab (NREL) of USA

Solar Energy can be used for heating, cooling and cooking purposes with very simple-to-use technologies. In Pakistan, except some isolated examples, there is no mass scale implementation of these simple technologies. Solar cookers in northern areas can greatly help in saving forests. Solar water heaters in cities can save valuable natural gas. There are many individuals making effort in this field but we have to integrate them for focused efforts and better results.

7. Solar PV Power Projects:

Solar PV can be used on mass scale is the lighting, indoor and outdoor. Indoor lighting meant for offices and homes for which solar PV modules can be coupled with LED lights which require very little electrical energy for the same luminosity and at the same time have very long life.

Alternatively, we can use energy saver bulbs. Outdoor lights mainly comprise street lights as discussed earlier. It is the time when private business groups should plan and implement a phased change-over of conventional lights with solar PV and LED lights for streets and parks; we can start with alternate light poles, if not all. Housing societies like DHA, Bahria Town, and the townships of industrial units must also come forward to launch such projects. These projects will trigger and encourage/promote local mass production of solar PV modules and LED lights, which will result in low cost of such systems.

8. Bio Diesel Projects:

Bio Diesel has a lot of potential through various means. It is a renewable fuel, produced from local resources, which will never deplete and avoids dependence on conventional oil thus reducing import bill in foreign exchange.

The project of bio diesel needs studies on land / soil conditions, the production options and the supply chain network. The most difficult part is considered to be the supply chain mechanism. However, it is a known technology across the world and its introduction in Pakistan can be made practical.

Biodiesel policy has been approved by Government of Pakistan but practical implementation is still lacking, Feasibility on bio diesel resources, its mass production, and supply chain mechanism can be carried out to implement the program in Pakistan.

In parallel, pilot phase projects can be initiated to create social adaption of technology. In this regard oil marketing companies can take the initiative by making biodiesel blends (B5, B10, B20) with conventional oil in order to develop supply chain mechanism and identify the barriers.

9. Micro / Mini Hydal:

Mountain Regions of Pakistan receive high rainfalls and are rich in water resources. Most of the large rivers originate in these mountain ranges. There is abundance of perennial streams,

waterfalls and canals, which can be successfully exploited to generate electricity and mechanical power by using mini and micro hydro power plants.

The need is to explore potential of hydroelectric power in Pakistan that has been estimated to be nearly 40,000 MW, whereas only 16% of the total potential has so far been exploited.

Micro hydropower technology has various positive attributes not usually associated with large hydropower plants. One is that due to their size, Micro hydropower technology scheme permits local involvement in the full range of activities from initiation and implementation to operation, maintenance and management. It is predicted to improve the quality of life of the people of far-flung rural areas by providing them with clean, renewable and carbon free source of energy. Moreover establishment of small-scale industrial units on Micro hydropower technology plants may help in the uplift of socio-economic conditions of the remote areas.

III ISSUES AND CHALLENGES

1. Human Acceptance and Mindset

Lack of awareness toward renewable energy technologies is one cause leading to social rigidity toward adapting these technologies. There is a need to understand that to promote renewable energy is not the problem or responsibility of an individual suffering from routine power outages cuts but a shared responsibility to lower the dependence of country on non renewable resources which are continuously depleting and also to adapt healthier environment friendly renewable technologies.

With this mindset, strife and struggle expanding the RE sector is a priority of all policy makers across the world; and Pakistan is surely in the same queue. A lot has been envisaged on the potential and viability of RE technologies and the decision makers have now managed to decide towards adaptation. As the RE Program enters into the planning and pre-implementation phase in Pakistan, the stage has reached where the implementation is stuck; rather slowed down because of many factors.

It is also time to understand the challenges that why investors from private sector have not been able to implement RE technologies. One reason is that our policy makers did not foresee the changing technology needs and are still skeptical about it. Second, for every new technology there is an incubation period. One has to follow a learning curve to gain confidence about a new technology, whether it is the investor or the regulator.

2. Financial Viability

Whenever one speaks about these renewable energy sources in Pakistan, they are often taken as very expensive, un-reliable technologies. The need is to change the approach and realize as to why the world markets of these technologies are exploding? Although it is a fact that conventional resources are ideal but depletion of these resources lead us to serious power crises we are facing today. In this scenario, philosophies of renewable energy need to be understood.

For example a thermal power plant starting the tariff with 16 cents will reach to 25 cents in in 20th year. On the contrary a wind power plant, if started with 12 cents per kWh will drastically decrease to around 3-4 cents per kWh in the later part of its service.

The same is true for other technologies with different starting points on the tariff ladder.

As renewable energy technologies are getting better transaction in the world (many US states now mandate nearly 10-20% of all energy to be derived from renewable sources), prices per

KWH are coming down. Wind energy is now almost competitive with natural gas derived electricity, and solar is not that far away as well.

The futuristic approach reveals that RE options will sustain forever and these must be inducted in our system.

3. RE Philosophy

The RE technologies have their own psychology and suitable scenario. These have their own usage phenomenon and the benefits can be realized by developing a complete understanding and capability. The technical viability of RE technologies is often challenged due to lack of awareness and misconception circulating about RE. As said earlier that conventional resources are ideal but non reliable, non environment friendly and are depleting continuously. On the other hand Renewable technologies are life long, reliable and environmental friendly solution. Therefore it is pointless to compare renewable resources with conventional resources and consider them impracticable.

For example if a solar system fails due to non availability of sun, it doesn't mean that the technology is not technically viable. The solar power system is designed to provide a fixed daily KWh of energy. Once installed, the system can only provide that amount of energy every day against which it is designed and that too is subject to availability of sun shine. It cannot be unlimited unlike WAPDA; where subscriber can use as much as desired and pay the bill accordingly. Similarly a solar water heating system is designed for a fixed water volume which can be heated to a certain temperature in one sunny day. Same is with wind. The usage scenario needs to tailored with built in / default philosophy of RE instead of going for a total refusal.

IV Recommendations:

- Legislation for Solar Water Heaters on all Government Buildings
- Legislation for 5% of all Public Buildings to become Green Buildings
- Legislation for mandatory Solar Billboards
- Feasibility Study for Bio Diesel, Solar Thermal and Solar PV
- The wind power projects need to be expedited by minimizing the lengthy legal procedures during development.
- Pilot Projects of LED Lights, Solar Pumps, Rural Electrification and Micro / Mini Hydal
- A Vocational Training Institute for RE/EM/HRD is mandatory for successful induction and operation
- Establishment of regulatory and incentive frameworks (feed-in tariff, etc) for all renewable energy sources
- Develop strategy and action plan for local RE manufacturing and for other renewable.

V. Way Forward:

The challenges to understand the dynamics of RE based power planning, system integration designs of an RE power project, technical and financial, due diligence of RE projects, the optimum utilization of renewable energy, long term financial benefits and a lot more issues against while the RE program is battling recently, which is otherwise recognized as *real future of energy*.

However, it is quite an understandable phase which occurs quite often while adapting a new technology/methodology. Most of the challenges have the solutions, which will off course streamline everything – **the picture is turning round and the other Side is very bright**.