Crisis of Electrical Energy in Pakistan and Future guideline for Policy makers

Sifat Shah , M.K. L. Bhatti
COMSATS Institute of Information Technology, Abbottabad Pakistan
asifatshah@yahoo.com

***Abstract*— This paper analyses the problem of shortfall in the supply of electrical energy that is presently being faced by Pakistan. The root causes of the shortfall in supply are mentioned. A forecast for next 10-12 years has been made using empirical data and preliminary calculations. A brief review is given about the potential of Pakistan to produce electricity and energy sources it has. Importance of utilizing coal resources of Pakistan also discussed in it. Also potential of water resource for construction of hydro-electric power station is described with mentioning the importance of run of river power station. Short and long term solutions to overcome this crisis are also given. Importance of renewable energy sources such as solar and wind power is discussed in this article. This article provides a brief review of energy crisis in Pakistan and the main area to be focused to minimize shortfall of electricity in Pakistan.**

***Index Term*-- Energy Crisis, Renewable Energy, Energy Sources**

1. INTRODUCTION

Throughout the world electricity is the most widely used and desirable form of energy. It is a basic requirement for economic development and for an adequate standard of living. As a country's population grows and its economy expands its demand for electrical energy multiplies. If this demand is not met adequately a shortage in supply occurs. This shortage can assume crisis proportions.

Pakistan has been facing an unprecedented energy crisis since the last several years. The problem becomes severe during the summers. Large numbers of users have to be disconnected from the energy supply system to prevent overloading the generating stations (load shedding). On occasions the urban dwellers had to suffer load shedding of 8-10 hours everyday. During the same time rural consumers suffered it for up to 20 hours at a stretch. Almost two years ago the Chairman Water and Power Authority (WAPDA) admitted that his organization could not meet the current demand for electricity. It is surprising such a senior person took so long to discover this problem. The government talked about Pakistan's supposedly booming economy but failed to understand the need for meeting the energy needs of the boom. General Musharraf (R) (ex- President) after becoming Chief Executive used to talk about building dams especially Kalabagh Dam.Very few power plants have since been set up. The present energy crisis is totally due to lack of forecasting and planning.

A general block diagram of power system is presented in Fig. 1.

Any power system has 3 major parts:

1. Generation system
2. Transmission system
3. Distribution system

Generally speaking the major technical causes of the shortfall in the availability of electrical energy in Pakistan are:

- Insufficient installed generating capacity.
- Transmission system unable to transmit the greater load now imposed upon it.
- Grid Stations and related equipment unable to carry the load imposed.
- Distribution System was built to carry a smaller power and hence unable to cater to existing demands [Gelling at el 1988].

The major management-related causes of the crisis are:

- Management Information System (MIS) not fully utilized.
- Failure to forecast and plan for the future.
- Failure to set up new generating stations in time.
- No new Transmission/Distribution networks & grid stations setup.
- Unexpectedly rapid growth of load.

2. PRESENT SITUATION OF CRISES

Total generation of electricity by different sector in Pakistan is presented in Table 1.

Share of different kind of power generating plants in Pakistan is presented in Figure 2.

Historical peak demands of Pakistan from year 2002-2007 are presented in Table 2. A forecast of demand and generation for the years 2009-2020 is given in Table 3. A careful examination of the tables 2 and 3 clearly indicates that although Pakistan's installed generating capacity will increase, the shortfall will continue to exist [Federal Bureau of Statistics 1998]. The government must take steps to overcome this situation.

3.1 SHORT TERM SOLUTION

3.1.1 Line losses control

The methodology that will provide immediate relief is the conservation and judicious use of whatever little energy is being produced in the country. The current losses in the system are 24% of the total power generated. These include losses incurred during transmission and distribution as well as due to theft. Wasteful consumption such as businesses remaining open till

late at night and unnecessarily brightly lit also contribute to losses. By reducing these to 10 % we can save up to 300 MW of energy. The government should enforce shutting down businesses and forbidding excessive and unnecessary lighting during late hours. Zoning should be enforced in cities. Market zones can have their power switched off (load shedding) at scheduled hours. As a benefit of service WAPDA employees are allowed free use of electrical energy for their domestic use. This facility has been grossly misused [Federal Bureau of Statistics 2002]. It is recommended every WAPDA household be given a raise in salary and the free electricity facility be withdrawn.

3.1.2 Improving Power generating capacity

It is an unfortunate fact that WAPDA and IPPs thermal power plants are running at an average plant factor of about 50 percent. This means they are producing only 50% of their installed capacity. They are not being used to deliver their full power. Internationally it is quite usual to have thermal power plants operating at 75 to 80 percent plant factor. Operating the power stations at higher plant factors demands better maintenance procedures there. It is felt that operating the plants at a higher plant factor will cause them to deliver 20 to 30 %more energy to the system. This will alleviate the present shortage to a significant extent. Improving the power plant factor of the existing plant is far more economical then setting up new power plants.

3.2 MEDIUM TERM SOLUTIONS

The policy makers of Pakistan talk about making dams and setting up nuclear power plants but do not understand the importance and benefits of alternate energy (renewable source of energy) sources such as solar, windmill energy, etc. These are cheap and quick methods for producing electricity. Pakistan is very blessed because abundant solar energy is available. Similarly wind energy is readily available in the coastal areas and throughout the winter months in Baluchistan. These energy sources if tapped can be of great help in reducing the current demand supply gap.

3.2.1 Wind Energy

America, Canada and China have invested large sums of money into research and development in order to obtain maximum energy from wind. Wind power is now the fastest-growing energy source worldwide [US Department of Energy 2002]. Total worldwide production of electrical energy from wind is around 30000MW. Germany, with over 12,000 megawatts of wind power at the end of 2002, leads the world in generating capacity. Spain and the United States, at 4,800 and 4,700 megawatts, are second and third. Many predict that, with the development of more efficient wind turbines, wind energy will provide an increasingly large proportion of electrical production in the U.S. Tiny Denmark is fourth with 2,900 megawatts, and India is fifth with 1,700 megawatts. Although a score of countries now generate electricity from wind, a second wave of major players is coming onto the field, including the United Kingdom, France, Italy, Brazil, and China. However, land clearing for vast "wind farms" may cause concern to environmentalists.

3.2.2 Solar Energy

Pakistan has high potential of renewable energy sources. A very large part of the rural population does not have the facility of electricity because they are either too remote or it is found too expensive to connect their villages to the national grid station. Pakistan being in the sunny belt is ideally located to take advantage of solar energy. This energy sources is widely distributed and abundantly available in the country. During last 15 years Pakistan has shown quite encouraging progress in the use of photovoltaic cells. Currently electrical power derived from solar energy is being used is being used in some public parks. These include Khalid bin Waleed Park in Peshawar and the Race Course Park in Rawalpindi. The Public Health department has installed solar water pump for drinking purposes in some parts of the country. Both public and private sector are playing their role in up grading of photovoltaic system in the country. If this technology is used in large scale commercial production of electricity the problem of energy shortage can be substantially reduced.

3.3 LONG TERM SOLUTION

3.3.1 Coal Potential in Pakistan

Pakistan has the 5th largest coal reserve in the World, amounting to approximately 185.175 billion tones. Thar has largest reserve in the country that is approximately 75.5 billion tones. Pakistan can generate more than 100,000 MW of electricity for next 30 years if it uses all coal available to it. At present Pakistan generates only 0.79% of its total electricity from coal [WAPDA Annual report 2007-08]. Coal contributes approximately 39% of the total global primary energy demand. Share of coal in total electricity produced in different countries is

PAKISTAN	0.79%
USA	56%
UK	58%
China	81%

3.3.2 Hydro-electric power potential

Pakistan has a huge potential to produce electric power from hydro-electric power plants. In table 5 presents a view of electric power generation with power plants whose feasibility study has been completed or is under process. Construction of all these plants gives almost 55,000 MW. This easily meets the electrical energy requirement of Pakistan for next 20-25 years.

From the table 4, 5 we can see that hydro-electric power has a great potential. Some details of these projects are given in table 4,5.These plants can give low cost electricity. As they are run of river plants, they can be easily installed with minimum cost and in short time.

CONCLUSIONS

The policy makers of Pakistan do talk about making dams and setting up nuclear power plants but do not understand the

importance and benefits of alternate energy (**renewable source of energy**) sources such as solar, windmill Tidal, Wave, and Geothermal energy, etc. They are cheap and quick methods for producing electricity. Pakistan is a very blessed country because solar energy is available in most cities all year round. Similarly wind energy is readily available in the coastal areas and in interior Baluchistan during winter. These energy sources if tapped can be of great help in reducing the current demand supply gap. The possibility of using coal and hydro-electric run of river plants must also be considered seriously for the long term.

TABLE I
Total capacity of electric power generation of Pakistan in 2009

Public sector	MW	%
WAPDA	6444	33
GENCOs	4834	25
PAEC	462	2
Sub-total	11740	60
Private sector		
IPPs	6185	31
KESC	1756	9
Sub-total	7941	40
G. total	19681	100

TABLE II
Historical peak demand 2002-2007

Year	WAPDA		KESC		Country	
	MW	Growth rate	MW	Growth rate	MW	Growth Rate
2001-02	10109	40.02%	1885	1.34%	11875	3.59%
2002-03	10481	3.68%	1973	4.67%	12330	3.11%
2003-04	11078	5.70%	2073	5.07%	13021	6.35%
2004-05	12035	8.46%	2197	5.98%	14091	8.22%
2005-06	13212	9.78%	2223	1.18%	15282	8.45%
2006-07	15138	14.6%	2349	5.67%	17314	13.33%
2007-08	16484	8.9%	2673	13.85%	18983	9.7%

TABLE III
Forecast Supply and demand position from 2009-2020 in MW

		Short term			Medium term					Long term			
	Years	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
A	Existing Generation												
	Hydel	6444	6444	6444	6444	6444	6444	6444	6444	6444	6444	6444	6444
	Gen.Cos	3580	3580	3580	3580	3580	3580	3580	3580	3580	3580	3580	3580
	IPPs	5541	5541	5541	5541	5541	5541	5541	5541	5541	5541	5541	5541
	Rental	285	285	285	285	285	285	285	285	285	285	285	285
	SPPs	70	70	70	70	70	70	70	70	70	70	70	70
	Total A	15920	15920	15920	15920	15920	15920	15920	15920	15920	15920	15920	15920
B	Committed Under process generation	2466	5501	7806	7806	7556	7256	7256	7256	7256	7256	7256	7256
c	Total A+B	18386	21421	23726	23726	23476	23176	23176	23176	23176	23176	23176	23176
d	0.8×C	14709	17137	18981	18981	18781	18541	18541	18541	18541	18541	18541	18541
e	Demand summer peak	22500	24474	26520	28683	30944	33394	36217	40648	43864	46689	50152	54319
f	deficit of generation	7791	7237	7539	10702	12273	14853	17676	22107	25323	28148	31611	35738

TABLE IV
Pakistan's Total Power Potential

Station/Projects	Capacity (MW)
Hydro-electric power Stations in Operation	6596
Under Implementations	1965
Chasnupp- 2	300
Feasibility Study Completed i. Run Of River ii. Multipurpose	1780 8840
Feasibility Studies in Hand	10331
Projects Feasibility Studies are to be Carried Out	25000
Total	54711

TABLE V
Run of river projects with their feasibility status

Name of Project	Capacity (MW)	Feasibility Status
Basho	28	Completed
Harpo	28	"
Phandar	80	"
Doyian	425	"
Naltar	32	"
Kohala	600	"
Gulpur	100	"
Kotli	100	"
Daral Khwar	35	"
Bunji	5400	In Hand
Dasu	3700	"
Gabral	105	"
Keyel Khwar	130	"
Lawi	65	"
Spat Gah Lower scheme	545	"
Chor Nullah Lower scheme	386	"
Total	10331	

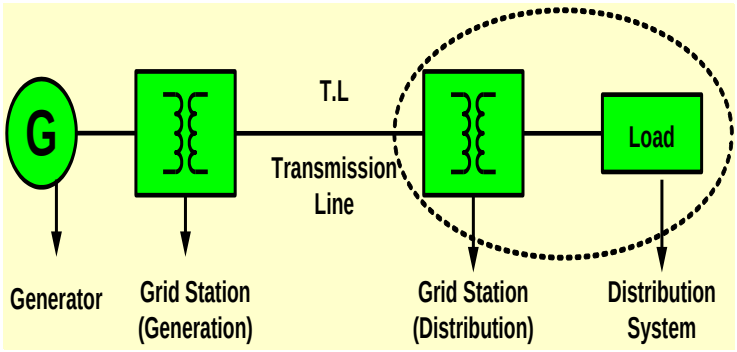

Fig. 1. Block diagram of power system

Fig. 2. Power generation in Pakistan by different sectors

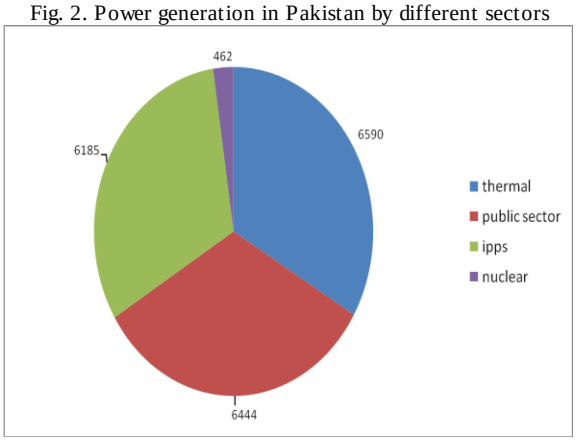

Fig. 3. Power generation in last few years by WAPDA and KESC

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