

Report for 'Explore-a-Vision' Competition, GIKI-IEEE Olympiad 2009



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1. Abstract

Pakistan today faces a severe energy crisis with a shortfall that varies from 2000 to 5000 megawatts. Developing countries and emerging powers plan well in advance to not only ensure sufficient energy for the present but also for their future needs.

While alternative energy or 'greener' solutions are the talk of the hour – we in Pakistan need to understand the potential of utilizing our natural resources like coal and water for increased power generation apart from exploiting other sources like nuclear and tidal energy.

We, in this report, have tried to suggest a viable solution for today and plan for tomorrow to come out of the energy crisis at hand using all available resources.

2. Introduction

Pakistan's power generation has been marred by complex socio-political and economic issues over the past several years. We are a naturally blessed country, with immense potential if we choose to utilize water for power generation. We are already late. It is now time to move forward and explore other areas through which this crisis may be overcome.

In this report, we propose a comprehensive strategy discussing the use of the following power generation methods for Pakistan:

- a) Hydroelectric power
- b) Nuclear power
- c) Power generation based on Coal
- d) Green solutions for Pakistan (including solar, wind and tidal energy)

3. Power Generation Prospects

3.1 - Hydroelectric power:

Geographically, Pakistan has been blessed with river flows that are naturally supportive to electricity generation. Control and optimization of our water resources alone can contribute a great deal to our immediate power shortfall.

Currently, our hydroelectric power generation is from: Tarbela Dam (3000 MW), Mangla Dam (1000 MW), Warsak (245 MW) and Chashma (185 MW). We have had plans for more hydroelectric power generation stations in the pipeline for a long time but the actual implementation is always hindered and cornered by the socio-political conditions.

The development of the Kalabagh dam (3600 MW, with a gross storage capacity of 9.74 km³) and the Bhasha dam (4500 MW, with a storage capacity of 7.82 km³) would be a major breakthrough to containing our energy crisis.

Development in this sector requires time and patience. Pakistan, by 2015, should ideally have a hydroelectric power generation of 12000MW.

3.2 - Nuclear Energy

Today, Nuclear energy powers the world with approximately 15% of the total electricity produced. Pakistan, however, currently generates around 2.4% of its total electricity through its Nuclear power plants at Karachi and Chashma. The total generation capacity through nuclear power plants is roughly 425MW.

Development on an extension of the Chashma power plant, CHASNUPP-2, is in progress and is expected to be completed by the end of 2009. This will add another 325MW to Pakistan's energy-mix.

Nuclear energy has its share of advantages, for which Pakistan should put in concerted efforts to enhance nuclear power generation. It is a sustainable energy solution that also reduces carbon emission and suits Pakistan financially considering the fact that it will further reduce Pakistan's dependence on furnace oil and the costs associated with its imports. Handling of radioactive waste is the only major issue that arises, which may be a serious health hazard.

We believe Pakistan should enhance its power generation capabilities at Karachi (KANUPP) with a project similar to CHASNUPP-2 and to improve safety mechanisms at Karachi to make sure the reactor is allowed to operate to its full potential.

By the end of 2011, Pakistan should ideally have a Nuclear power generation capacity at around 1200MW.

3.3 - Coal Energy

Pakistan has one of the largest reserves of coal in the world. The Geological survey of Pakistan places Pakistan's coal reserves at '*Thar*' as the fourth largest in the world. Pakistan's total coal reserves stand at approximately **184,575** million tones out of which Punjab and Baluchistan have reserves of 235 and 217 million tones respectively. *Thar* coal has the rest.

Pakistan, at present, produces approximately **0.2%** of its total electricity through coal. **Compare this to a global average of 40%** electricity production through coal. India, our immediate neighbour, produces roughly 53% of its electricity through coal fired power plants. Pakistan's only coal fired power plant is at *Lakhra* with a power generation capacity of 30MW. It is indeed an alarming fact we need to wake up to and make most of what God has gifted to us.

Financially speaking, Pakistan also needs to cut down its dependency on oil and gas, to which coal is a fitting solution. Historically, the price of coal has generally been very stable as opposed to the price of oil and gas.

The coal mining sector, in general, is a neglected and underdeveloped area in Pakistan. The government needs to speed up and enhance the provision of basic infrastructure facilities, especially in the *Thar* region like roads, electricity, communication etc. to encourage investment in the exploration and development of coal projects.

With a consistent government policy, we can generate up to 5000MW of energy through coal.

4. Green solutions for Pakistan:

Renewable and greener sources of energy are being deployed throughout the world to minimize carbon emission and to lower costs associated with power generation. Let us discuss the options available to us in Pakistan.

4.1 - Solar Energy:

Pakistan is amongst those countries which receive a high level of solar radiation. Studies have shown that on average our country receives 19MW per square meter of solar energy.

Solar energy is not too expensive and its best use, for now, is in domestic applications such as water heating and for UPS (Uninterrupted Power Supply) systems. It is also beneficial for providing electricity to rural areas and far off villages where it is not feasible to connect them directly to the national grid.

Although it is not an absolute solution to the energy crisis we face today, it is a good source of alternative energy for reducing domestic dependence on the national grid. This will not only lower electricity bills, it will also release some load off the national grid.

4.2 - Wind Energy:



Wind energy is another environment friendly alternative source of energy. Pakistan has some 'wind-swept' corridors that are essential for generating power through wind energy. Extensive research and analysis of wind speeds, directions and corridors is important before investing in this sector.

The Government of Pakistan has set the 'Alternative Energy Development' board a target of generating 700MW of electricity through wind energy by the end of 2010 and around 9700MW by the end of 2030.

Independent Power Producers have set up wind farms on a small scale, possibly to assess the potential of wind energy in Pakistan, which is believed to be immense.

Pakistan's first major wind power plant deal has been signed by the Hyderabad electric supply company with a Turkish firm. The wind-farm will provide HESCO with 6MW electricity, powering almost 6900 homes.

We believe if the AEDB is able to achieve its target by producing 700MW of electricity through wind energy; it will be a trend setting breakthrough for Pakistan's energy woes.

4.3 - Tidal Energy:

Tidal energy is a form of hydropower that exploits the movement of water caused by tidal currents or the rise and fall in sea levels due to tides. Tidal energy is a relatively unexplored area in Pakistan.

As a first step, we need a thorough survey of the coastal areas of Pakistan to identify the best locations for setting up power plants for tidal power generation. We also need to encourage research and development activities in this area to exploit tidal energy.

From available data, the known natural advantages that Pakistan has for tidal energy development include a 170km creek system of the Indus delta, 2-5 meter high tides at Korangi creek and over 5 meters at Sir Creek.

The infrastructure setup for tidal power plants is expensive and improvements are still needed in the system for a cost effective solution to cater to Pakistan's requirements.

5. Transmission Losses

Transmission losses and a poor distribution system also account for Pakistan's energy crisis. The government and its responsible departments need to take firm action to control power theft and to improve the distribution system in general. The US department Energy (DoE) reports transmission losses of up to 30% in Pakistan.

Aging and overloading of the transmission system and power theft account for Pakistan's transmission problems. This issue must be addressed proactively by the government of Pakistan.

6. Conclusion & Recommendations

Vision 2010:

Based on our analysis of various power generation techniques, we suggest:

- Development of hydro-electric power plants and large water reservoirs should begin immediately.
- Wind power generation should reach 500MW and ideally 700MW (the goal that has been set for the AEDB by the Government of Pakistan).
- Domestic applications of solar power should be publicized and encouraged.
- Utilizing financial resources effectively to make sure Independent Power Producers and power plants based on oil operate to their maximum capacity.
- Immediate steps should be taken to reduce to transmission losses and power theft.

Vision 2015:

Based on our analysis of various power generation techniques, we suggest:

- Development of hydro-electric power plants and large water reservoirs should generate around 12000MW, almost doubling the current generation capacity.
- Wind power generation should reach 1200MW. This speed of development in the wind energy sector will require a very serious effort from the government agencies, a firm resolve to enhance development and production capacity. Independent power production in this sector must be encouraged and supported.
- 30% of Pakistan's 'unpowered' rural areas should have electricity for basic use based on solar and wind resources.
- Nuclear power generation by the year 2015 should reach 1500MW.
- Coal resources should be put to effective use and rapid development of infrastructure and power plants should make sure Pakistan is able to generate up to 5000MW of electricity by the year 2015.
- Pakistan's total generation capacity should increase, with 19700MW of electricity coming only from the hydro-electric, coal, nuclear and wind power plants that have been discussed in this document.
- Dependence on oil/gas based power plants can be greatly reduced by increasing reliance on the methods mentioned here.

7. References

[1] Wikipedia.org

<http://www.wikipedia.org>

[2] Presentation on Tidal Energy by Majida Islam,

<http://www.slideshare.net/ieeepkhi/tidal-energy-by-majida-islam-presentation>

[3] Geological Survey of Pakistan

<http://www.gsp.gov.pk>

[4] US Department of Energy,

<http://www.eia.doe.gov/emeu/cabs/Pakistan/Electricity.html>

[5] ADB, Technical Assistance to the Govt. of Pakistan (on Transmission losses)

www.adb.org/Documents/TARs/PAK/tar-pak-37192.pdf