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Renewable Energy Resources Current Status and Barriers in their Adaptation for Pakistan

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ABSTRACT

Energy is the backbone of socio economic development of any country. It is observed from the recent decades, Pakistan is facing worst energy lag that has created deadlock for the prosperity of the country due to use of conventional fuels rather than alternative fuels. This concise study highlights the alternative energy technology current status and future scenario in context of Pakistan. The renewable energy resources such as hydro power, geothermal, biomass and solar can mitigate the energy disputes of Pakistan. Moreover, barriers in the deadlock of alternative energy development have been investigated in context of market, policy, technological and political terms. This study also presents a comprehensive understanding which might be helpful to resolve energy crisis in Pakistan.

Keyword: *Renewable energy, micro& peco plants, vitality, barriers, hydro power sites.*

INTRODUCTION

Energy is the spine of industrial economy and key gadget for development of a country. It is a universal fact that energy can neither be created nor be destroyed but can be converted from one form to another, e.g. hydro energy into mechanical which is further converted to electrical energy and solar energy into heat or electrical energy [1]. The primary energy resources are going to deplete day by day and cannot meet energy requirements anymore in context of whole world energy requirements or of a specific country. Public and political concerns to environmental issues and high energy demands leads the alteration of high price fuels to cheap and green fuels. To encounter the growing energy demands in optimum conditions necessitates the cardinal responsibility of the Governments. Energy resources occur in two forms either in renewable or exhaustible. These sources involve wind, biomass, solar energy and coal, fossil fuels respectively and occur in nature in limited amounts. That's why world cannot totally rely on these sources. The influence of bio energy on climate is comparatively better than the fossil fuels. Fossil fuels provide the same services as renewable fuels but national and international interests resist the use of fossil fuels because of their high price and environmental issues. It has been demonstrated that use of less installed capacity of power units and conventional fuels make any country unstable and energy deficient resulting a great danger to stability of national and international interests [2].

The energy sector of Pakistan is facing a lot of crisis due to use of conventional fuels which are more expensive than renewable energy resources. The use of furnace oil to produce electricity is a major practice in power production of Pakistan which is imparting a great burden on its economy. Being a developing country Pakistan has major dependency of energy requirements on fossil fuels. World has realized that proper use of energy is the key for achieving and stabilizing the sovereignty of a country. To deal with energy disputes there is a need of revolution from conventional primary fuels to alternative fuels Regarding world energy demands there is a huge need for the development of power generation [3]. Segmental energy production of the world through different energy resources is elaborated in Figure 1.

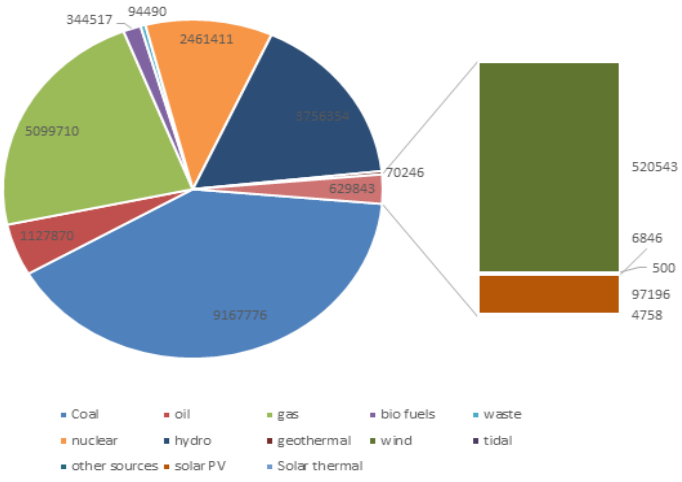

Figure 1: Segmental world energy supply [4].

To meet the energy lag between supply and demand established nations of the world are converting their energy supply from primary fuels to greener fuels. Many developments made in this concern as shown in Figure 2.

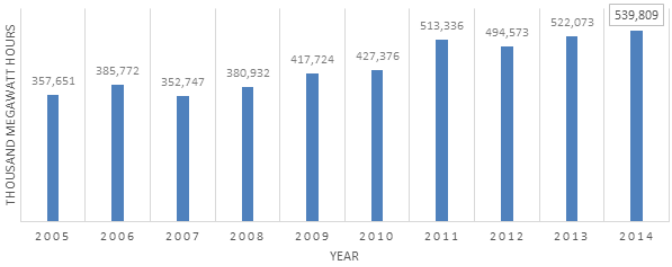

Figure 2: Net world generation of power from renewable source [5].

Government of Pakistan has taken many steps: rental power plants are engaged to enhance the energy production but still they cannot meet energy demands of Pakistan. In this modern world still 38% population of Pakistan is unaware of basic facilities of energy supply [6]. Every single fossil fuel is restricted and modest on a human scale. The routine assets are debilitating and making an extraordinary threat for physical steadiness and are essential for financial conduct. There must be moderation course of action as in projection of future years 2040-2050 vitality requests will be so high and just essential vitality cannot meet energy demands of a country [7]. At that time world has a great energy lag between supply and consumption as shown in Figure 3.

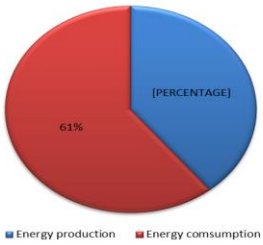

Figure 3: World Production VS Energy Consumption [4].

Government of Pakistan has made strategic collaboration with different countries such as United States of America, China and Russia to mitigate the energy requirements of Pakistan, different projects and have launched many pilot projects especially funded by US AID. Under the project initiated by the help of U.S.A nearly 900 MW is currently a part of energy cycle by restoration and upgrading of Tarbela Dam in KPK, Jamshoro Thermal Power Plant in Sindh and the Muzaffargharh Thermal Power Plant in Punjab and many other power plants in Pakistan [8]. Incorporation of renewable energy resources in energy mix of Pakistan is a stimulating duty of Government towards potential of low carbon energy system in the division of electricity.

1 Potential in Pakistan

A stable Pakistan both politically and economically is responsible for the progress of its demographic allied countries. According to NTDC annual growth rate is predicted 5-6% in coming years which demands a huge MW of electricity of about 32000 in Asia. Pakistan is a very rich country in case of renewable energy sources such as wind, hydro power, biomass and solar energy due to its demographic location in the world. Pakistan has an area of coastal lines mountains in Baluchistan and Sindh having a great potential of wind energy and also sunny areas like Baluchistan , Sindh and southern Punjab that receive a large amount of solar radiations which makes these regions perfect for the production of solar energy [9]. The peak areas of Pakistan have a great vicinity of hydro power micro and peco sites like Gilgit Baltistan. Northern areas of Pakistan also have a maximum number of geothermal sites.

Government of Pakistan is trying to enhance the use of renewable energy resources rather than use of conventional fuels. It is essential for Pakistan to codify a perfect energy policy to increase the share of renewable energy resources. Renewable energy resources are the best energy providers in remote areas such as villages of Pakistan to improve the living standards of the natives. Pakistan is generating electricity by using renewable energy resources from 2008 and production is progressively increasing year by year as shown in Figure 4.

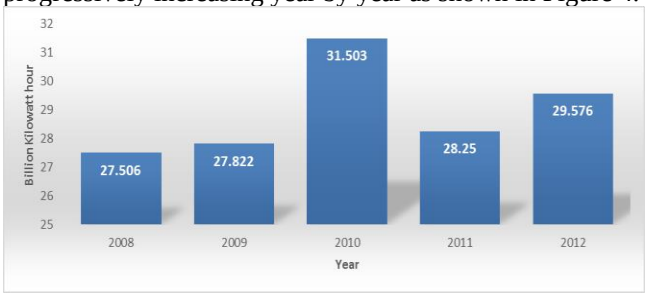

Figure 4: Total renewable electricity net generation for Pakistan [5].

Pakistan needs to replace resources energy from fossil fuels to renewable energy resources to meet the energy supply and demand. A survey of segmental consumption of energy depicts that primary energy production is not enough to meet energy gap between supply and demand. As Pakistan is deficient in energy so it has to spend millions of dollar to import the fuels like furnace oils and LPG [10].

2 Hydro Energy

Hydro energy is form of renewable energy which is produced from water which is abundantly present in nature in form of surface and ground water. The rivers, lakes and waterfalls are the illustrations of surface water while groundwater present in aquifers under the earth surface and pores of metamorphic rocks. Demography of Pakistan is very rich with mountain and plain areas which serve to catch and store the rain and make a way to use this natural source of water in an effective way [11]. Pakistan is meeting its major energy requirements of about 90% from hydro power plants during the last decades. There is great struggle known as “race to the top” for the hydro power and water management system. Pakistan is a land of 5 rivers and world famous and largest interlinked canal system having reasonable flow of water across Pakistan during the whole year. Pakistan has great potential for this type of renewable energy which has almost 303 hydropower sites on different canals all over Pakistan as shown in Figure 5.

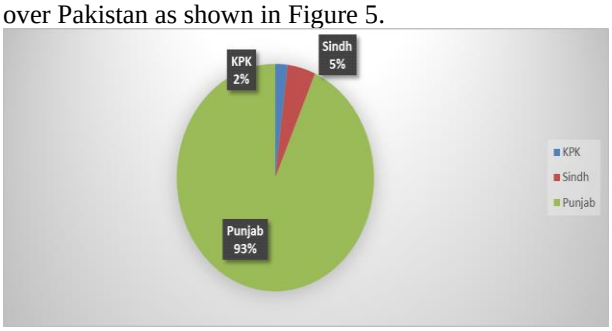

Figure 5: Hydro Power sites in Pakistan [12].

Pakistan has made a great development in hydro power energy system from day of independence to till now. Many projects and agencies have been launched which ensure the stable and continuous supply of energy system. NEPRA and WAPDA are the main governing regulatory authorities of Pakistan energy system. WAPDA owns 54% shares of power generation capacity to fulfill 88% customer's energy demands. Hydropower is also known as eco-friendly, non-consumptive, reliable and low cast energy production process which imparts a great potential for the stable economy of Pakistan. Pakistan is blessed with approximately 41722 MW of hydro power having a great potential in Northern areas of Pakistan and land of 5 rivers Punjab which serves the main storage of water [13]. As Pakistan has huge lag between energy supply and demand so country has to meet its requirements from greener fuels. The small scale hydropower plants at micro and peco levels which do not need any storage of water are very useful for people to meet the basic needs of energy. Many micro and peco level hydro power plants are being planted in Northern areas of Pakistan to standardize the native people [14].

Pakistan Water and Power Development Authority has started many small "run of the river projects" in Northern areas of Pakistan as compliance to large power projects like extension of Tarbeela and Mangla Dam. Tangir power generation station located in Gilgit is one of micro level project to provide basic facilities of energy to the people of Northern areas. At that time different old and new hydropower plants like Tarbeela, Mangla, Warsak and Gomal zomal Hydro power project respectively are contributing in energy mix of Pakistan as shown in Figure 6.

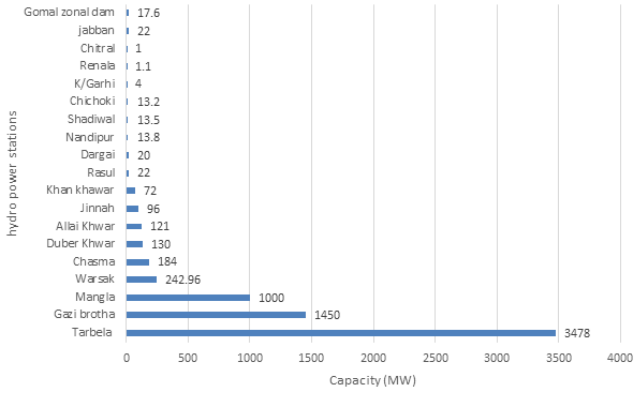

Figure 6: Capacity (MW) of Hydro power plants in Pakistan [15].

In recent years, Pakistan Army has also started small level hydro power plants without any Government support, in Northern areas of Pakistan. Four micro and peco level hydro power plants are installed in KPK on Bara River to standardize natives. Furthermore, Pakistan army has completed many projects in Baluchistan to meet the living standards of natives [16]. Private power & infrastructure board (PPIB) is a famous private power provider for energy mix of Pakistan. PPIB is focusing on the energy production from alternative sources and serves as "One Window Facilitator". The main responsibility of PPIB is to establish policies and to facilitate the investors in private power energy mix. The first hydro IPP is recently commissioned in AJK Pakistan having capacity of 84MW. Many hydropower projects are under evaluation stage like Rajdani hydropower project in AJK and Neckeherdim hydro power project in Chitral [17]. The Government of Punjab has imitated many projects and issued LOIs to number of investors for energy mix of Pakistan. AEDB has evaluated 25 hydro sites across Pakistan and hydropower plant of capacity 284.1 MW is recently completed. Huge investment done for the development of hydro power project across the Pakistan is shown in Figure 7.

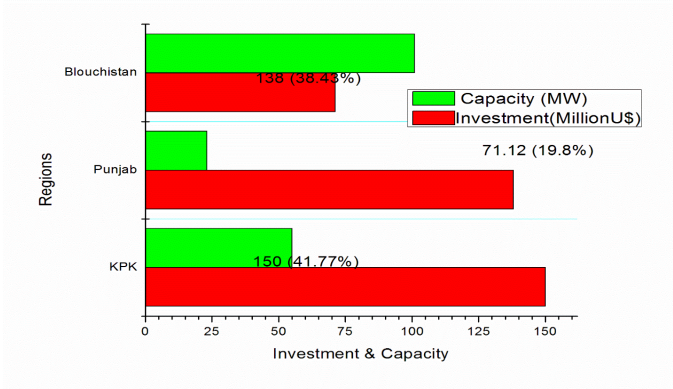

Figure 7: Investment in different Provinces of Pakistan [9].

3 Solar Energy

Energy that we extract from the sun is termed as solar energy. On the basis of distribution, capturing and conversion, solar technology can be broadly divided as active solar and passive solar. Solar energy is a form of renewable energy that is used by the world to obtain energy that is inexpensive and pollution free.

Pakistan is located on a sunny belt with almost 300 days of sunshine per year and almost about 3000-3300 hours of sunshine per year [18]. Pakistan has a huge potential of solar energy and its conditions are ideal for the use of solar applications. Approximately 90% of the villages in remote areas of Pakistan are using electricity due to different reasons like: they are not in the grid or there are no transmission lines. 38% of the country has no access to grid stations through transmission lines [19]. The best solution to this problem is the use of solar energy. By developing small solar farms we can provide them cheap electricity and also help in improving their living standards. Solar panel technology is rapidly growing in Pakistan, some solar panels are installed domestically as shown in Figure 8.

Figure 8: Solar panels install domestically in Pakistan.

Government of Pakistan needs to take some steps to provide cheap solar energy to the people of remote areas. Most parts of Pakistan, especially southern Punjab, Sindh and Baluchistan are best for its use and application. According to the federal bureau of Pakistan statistics, in the start of 1980s almost 440

KW of solar energy systems are installed across Pakistan but due to the unavailability of technical staff and equipment's they do not meet the specific requirement. Government has installed 20 different solar water pumps in Baluchistan. The best applications of solar energy can be carried out in Sindh and Baluchistan because they are rich in sunlight. Moreover in the interior areas of Sindh and Baluchistan there is a lack of energy distribution system so solar energy is the best solution to those areas which are off the grid. In 2004-2005, AEDB lightened 601 houses in rural areas of Pakistan by solar PV system. They want to electrified 400 houses more [20]. 49 villages in Thar parker Sindh has been installed with 3000 solar home systems. In 2011, almost 30 GW of new solar PV capacity is added worldwide. Major portion of PV capacity is grid connected. While almost 2 % of PV capacity is off grid globally and the developing countries is showing huge interest in off grid PV capacity systems. Almost 54.77 MW of solar PV systems has been imported by private companies in last 7 years. The grid connected and off grid connected solar PV system can produce $3.525x10^6$ and 455.3 GWH of electricity annually in Pakistan [19].

On May 29, 2012, first on-grid solar power plant was inaugurated in Islamabad with the cooperation of Japan International Cooperation Agency (JICA) under cool earth partnership. Photovoltaic solar systems are installed and the entire setup can produce almost 356.16 kW of electricity [21]. In 2015 Pepsi Pakistan in collaboration with liter to light Pakistan used solar panel to provide electricity to Jalozai IDP camp that is 35 Km from Peshawar with a population of 36000.In April 2015, two MOU are signed between china and Pakistan for the production of solar energy. In May 2015,100 MW of solar power project is inaugurated in Quaid-e-Azam Solar Park Bahawalpur [22]. Solar radiations received by the provincial capitals of Pakistan is shown in Figure 9.

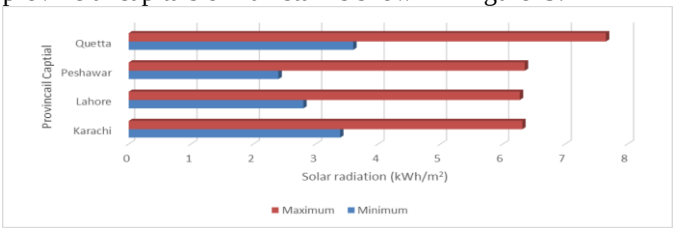

Figure 9: Solar radiations receive by provincial capital of Pakistan [20].

4 Geothermal Energy

The persistent vitality flux spilling out of the center of the earth towards its surface is the wellspring of this geothermal energy [23]. There are 21 nations on the planet that have started converting geothermal energy to mechanical. The power by such procedure delivers zero carbon discharges. The emission of carbon dioxide from various power plants is shown in Figure 10.

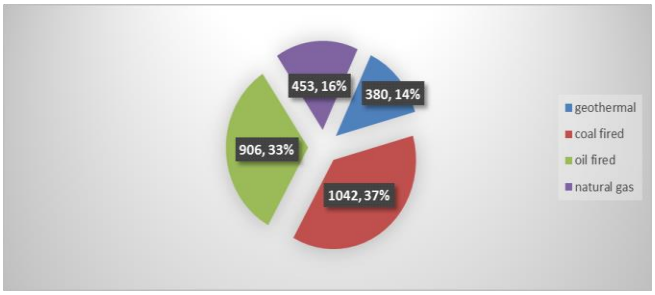

Figure 10 : CO_2 emission from Power plant [24].

In geothermal power projects water is used to absorb heat from hot rocks and this heat is converted into electricity by moving turbine generators on the surface of earth. High-temperature, highly permeability and fluid-filled rock in the earth's upper crust are typical conditions for exploiting geothermal reservoirs especially in the areas of young volcanic rocks and nearby. A typical geothermal reservoir is considered to be a commercial reservoir if temperature ranges 240–320°C [25].

The collision of the Indian plate with the European plate originates geothermal activity in Pakistan whereby the main mantle thrust and the main Karakoram thrust have been produced [26]. Northern areas have hot springs in the Gilgit, Hunza, and Yasin valleys. The highest surface temperature recorded in the Hunza valley is 210°C and introductory studies indicate higher subsurface temperatures. Beneath the Indian plate, Arabian plate sub ducted and brings about the appearance of the Chagai volcanic arc where quaternary volcanic are found with evidence of recent diastrophism [23]. The third geothermal zone reaches out from North East to South East of the nation as a slender belt along the Indus bowl edge, down to Karachi. A vast amassing of geothermal appearances happens in Dadu District of the Sindh territory. The geothermal reservoirs locations are shown in Figure *11*.

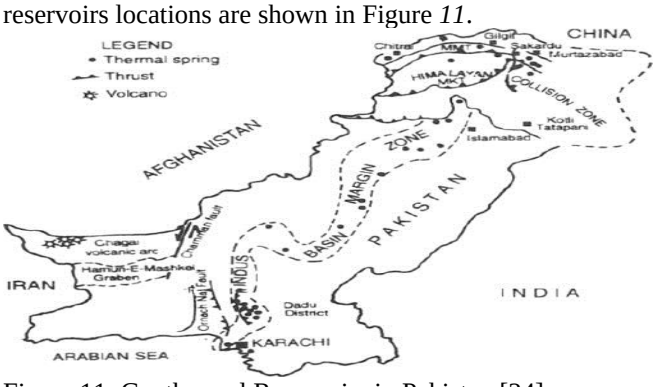

Figure 11: Geothermal Reservoirs in Pakistan [24].

4.1 Northern Geothermal Zone

This zone is found in Northern areas of Pakistan. It reaches out from 340 40′ to 370 04′ N and 720 30′ to 770 50′ E. It is encompassed in the North by Afghanistan and China and in the East by Jammu and Kashmir. The territory has steep geography and U-molded valleys. A portion of the most astounding crests like K-2 (8,611 m), Gashabrem (6,068 m), and Rakaposhi are the huge tectonic highlights of the zone. The principle water wellspring of the zone is the Indus River, with the Shigar, Shiyok and Yasin streams as its tributaries. The geothermal framework here is the consequence of the crash of the Indian and Eurasian plates. Hot springs are scattered and its temperature ranges up to 91°C [27]. There are two famous

thermal springs, one is near Turboto das and the other is located 3 km near Darkot pass in Gilgit region [26]. A spot called Garam Chashma has truly various warm springs situated with the subsurface temperature ranges from 85 to 252°C, taking into account silica and Na-K geo thermometers respectively [23].

4.2 Chagai Volcanic Zone

This volcanic zone is situated in Baluchistan region. This zone is contained in restricted belt that amplifies eastwards and truncates against the Chaman change flaw. This structure is formed as an after effect of subduction of the Arabian plate underneath the European plate and is liable to be the vital geothermal framework. Because of this subduction, a channel has been formed south of Makran and a volcanic bend has been developed. The procedure of subduction has additionally framed Koh-e-Sultan fountain of liquid magma and other volcanic cones in the Chagai range. The water from the hot springs of the Koh-e-Sultan territory has been collected and examined. Its temperature ranges from 1,500 to 1,700°C [23].

4.3 Dadu & Karachi Zone

The parallel edges of branches of Kirthar ranges run parallel between the limits of Karachi and Dadu Districts. In the zone of Dadu, there is a huge gathering of hot springs where the normal surface temperature is 40°C [23]. Mangopir territory Karachi, the surface temperature of the springs is 48°C. In the south, this zone extends in the middle of Karachi and Badin and methodologies pretty much with the same width up to east of Sibi and west of Bahawalpur. The zone demonstrates three primary geothermal odd gatherings of geothermal angle irregularities having higher estimations of 4 and/or 4.5 8C/100 m. The southern high geothermal angle irregularities in the middle of Karachi and Badin are derived to be connected with blamed fragments of the Thar fossil-fizzled crack. Reports are exhibited on the warm slopes increment from east (2.36 8C/100 m) to west (4.3 8C/100 m) in the Badin Hyderabad territory in view of the base opening temperatures of a portion of the wells that backings the present study [28]. A development which has great potential is the direct use of the heat from shallow ground two or more meters deep which the earth maintains a constant temperature of about 10–16°C .

5 Biomass

Biomass is the fourth largest energy source after oil, coal and natural gas and it is one of the most suitable renewable energy option [29]. About 1.5 billion people use it as major energy source. Biomass energy has similar properties as fossil fuels so it can be stored, renewed and transferred [30]. Sources for biomass are generally categorized into four groups.

1. Virgin wood (fuel wood, forestry residue etc.)
2. Energy crops (Hydroponics, Jatropha, Castor seed, Jojoba etc.)
3. Agriculture residue (animal litter, straw and husk, bagasse, animal slurry and farmyard manure)
4. Industrial wastes (woody waste, pulp and paper waste, sewage sludge and textile waste etc.)

Pakistan has agro-livestock based economy and produces large biomass including sugar cane bagasse animal dung, poultry litter, wheat straw, rise husk, cotton linter, sewage sludge, textile wastes and energy crops. Table 1 shows the major crops provisional production and area used, for 2013-14 [31].

Table 1: The crops cultivation in Pakistan and potential source for biomass

Crops	Area (thousand hectors)	Production (thousand tons)
Wheat	9039	25285.6
Mize	1116.6	4527.2
Rice	2789.2	6798.1
Sugar cane	1172.5	66469
Cotton*	2805.7	12769

*Cotton production in thousand bales of 375 lbs. each.

Electricity, biogas, biodiesel and ethanol can be produced from these biomasses. Pakistan is the 5th largest producer of sugar cane in the world and has averagely, produced 10 million tons of bagasse every year. The strength of livestock in Pakistan in 2009-10 was 159 million animals with the annual growth rate of 4% as mentioned in Table 2 [32].

Table 2: The strength of livestock in Pakistan and potential source for biogas

Specie	No. (Millions)
Buffalos	30.9
Cattles	34.3
Goats	59.9
Sheep	27.8
Camels	1.0
Equines	4.5

Pakistan has immense sources for biomass which can be utilized to produce thermal energy, electricity and fuels for power generation. The methods that can be employed are direct combustion, gasification and liquidation but the selection of method depends on the type of biomass [30]. The theoretical potential of biomass to produce power is calculated for sugar cane bagasse, cotton linter, municipal solid waste and animal dung depending on the availability and quality of biomass for 2007-11. The detail of power generation from biomass is shown in the **Error! Reference source not found.**.

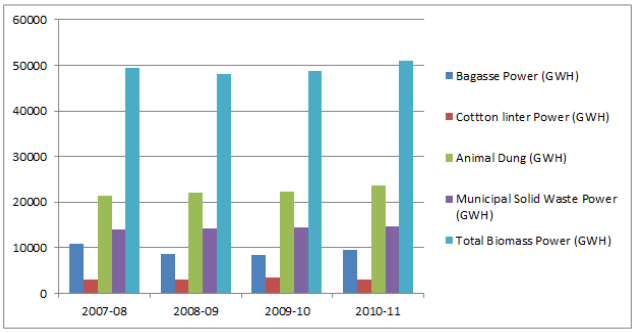

Figure 12: Power generation estimation from biomass in Pakistan [33].

Government of Pakistan established an autonomous body named Alternative Energy Development Board in 2010 to assist and facilitate the private sector for the development and generation of alternative or renewable energy [34]. The board has issued letter of intents to following different private companies for setting up biomass to energy power plants of different capacity as shown in Table 3.

Table 3: Letter of Intents issued to the companies [35].

Company Name	Capacity (MW)	Conversion	Location
Limen Energia Pvt. Limited	12	Agricultural wastes to power generation	Jhang, Punjab
SSJD Bioenergy Generation License	12	Agricultural wastes to power generation	Mirpurkhas, Sindh
Pak ethanol Pvt. Limited	09	Spent wash of distillery to biogas	Matli, Sindh
Biomass Power Generation Limited	12	Biomass to power generation	Faisalabad, Punjab
Greensure Environmental Solutions Pvt. Limited	12	Municipal waste to power generation	Mardan, KPK

The board has also realized the importance of alternative fuel, biodiesel production and has outlined a National Biodiesel Program. By this program, the board has developed an advisory committee of the relevant stakeholders. The Government of Pakistan assigned a task to the board to raise the share of biodiesel up to 10% by volume of total consumption of diesel in the country till 2025. For this target to achieve a commercial biodiesel refinery has been established in Karachi by Eco-friendly fuels Pvt. Limited, with coordination of AEDB. This refinery has capacity to produce 18000 tons per annum. Similarly the cultivation of Jatropha has increased from 2 acres in 2005 to more than 700 acres in 2010 [36].

6 **Wind Energy**

Wind power is one of the renewable assets having no use of fuel. Numerous developed nations are currently delivering vitality from wind and its establishment becoming extensively every year comprehensively. With expanding of populace step by step distinctive nations are currently angering to supplant its routine vitality assets to renewable vitality assets to take care of the obliged vitality demand. Furthermore, wind vitality can give the top level input of renewable assets. Its worldwide commitment in couple of years before was 282.275 GW which is the Figure of aggregate introduced limit universally and establishment developing with normal of right around 44.609 GW every year. China is using wind asset 75.324 GW and as per a study in most recent couple of years the limit of wind power in USA, Germany was 59.882 GW and 31 GW individually. When we discuss Pakistan it is on 44th position in the utilization of wind force [37]. Pakistan has the ability to deliver wind control 70 to 80 GW out of which 50 GW potential is in Sindh having normal wind speed 7 ms^{-1} and 20-30 GW in different ranges of Pakistan including Baluchistan and Punjab. Numerous activities of wind force began from 2010 by Alternative Energy Development Board and Ministry of Water and power Pakistan [38]. Around there, Pakistan has less specialized skills for the advancement of wind energy. However, numerous exploration activities are under assessment in diverse colleges of Pakistan and around 30 wind plants have been introduced for pumping water. Pakistan meteorological division specify the distinctive regions that are suitable for wind power installation and numerous different ranges are being assessed. Coastal ranges of Pakistan are most suitable as recorded wind speed varies from 5-6 to 11.43 ms-1 and its esteem gets to be greatest in the mid of the year June [37]. PMD (Pakistan metrological department) surveyed numerous urban areas of Northern zones of Pakistan and that there is a great deal of potential accessible roughly 10-20% limit impact at 50 meter stature for wind control. It will be ideal to cover the limit of those ranges where national conveyance framework did not approach. In order to mitigate the deadlock of energy and to enhance wind power contribution to energy mix of Pakistan three stage plan was designed known as short term (2005-2010), medium(2011-2020) and long terms plans (Up to 2020) .The segmental production plan is shown in Figure 12.

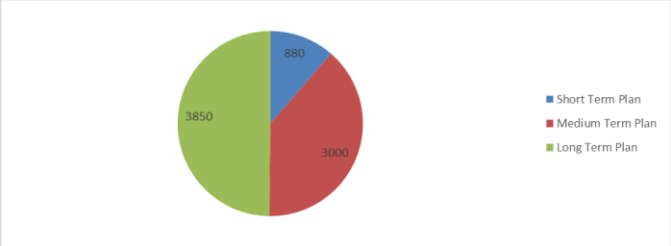

Figure 12: Wind energy production (MW) plans [9].

According to reports of NREL and USAID Pakistan has absolute capability of 346000 MW and to be exact which is getable is 120000 MW [39]. Thousands of mini plants are in operational condition in different areas of Pakistan producing 1000-3000 watts. Many projects have been completed under the custody of Alternative energy board is shown in Table 3.

Table 3 : Project capacity of companies working in Pakistan [40]

Project Capacity (MW)	Company
49.5	New Park Energy Ltd
50	Tenaga Generasi Ltd.
50	Foundation Wind Energy -II Pvt. Ltd (Formerly: Green Power (Pvt. Ltd)

50	FFC Energy Ltd.
50	Yunus Energy Ltd (Formerly: Lucky Energy Ltd)
50	Metro Power Co. (Pvt. Ltd)
50	Gul Ahmed Energy Ltd
56.4	Zorlu Enerji Pakistan Ltd

Various upgrades have been made especially in waterfront domains of Pakistan from 2000 to till now. Provincially bank subsidized first wind force venture was inaugurated by president of Pakistan having limit of 50MW in Jampir. 56.4 MW ZORLU Energy wind Project was started by AEDB around the same period [40].

7 Barriers

To accomplish sustainable progress in any area of the world for the human endeavors one has to take many steps under attention. There are large numbers of barriers for the development of alternative technologies cited in literature. These may include market, technical, social acceptance and political regulatory barriers. Some of these are specific to region and market while other are technological.

(i)Transmission access

Renewable energy providers have access to the basic utilities and their access to transmission line is restricted by high pricing. Many of alternative energy providers are away from the final consumers a need a third party which can make policies for easy access of vendor to final consumer.

(ii) Technical expertise

Pakistan is a developing country and facing technology lag. Renewable energy resources demands continuous R&D for favorable energy production in case of competitive environment with existing fuels. A policy must be developed to handover the renewable energy projects to efficient R&D organization at institutional level.

(iii) Capital investment

Investment is a major barrier in the development of any project. As alternative energy providers are remote from urbanization, they require high investment in case of installation, site management and to resolve other political issues. In context of Pakistan there is negligible trend of financial aid from banks to the energy provider.

(iv) Restriction on installation and construction

Some of projects of alternative energy are facing social and environmental safety restrictions in installation process like high roof solar heaters, large heights of wind turbines and combustion of biomass[41].Policy must be executed to allocate the safe environment and lands for these projects.

(v) Lack of Institutional coordination

Pakistan is facing inter institutional coordination lag. Governing bodies are not coordinating with sub institutions in efficient way. There must be one governing body to ensure the coordination b/w major and sub institutions [42].

(vi) Public awareness

Market imperfection and lack in public awareness is a significant hurdle for the development of renewable technologies indicating poor image of alternative technology as compared to conventional technology in context of cost and other benefits. Social and electronic media are the primary sources of information, seminars and other beneficial activities must be focused for public awareness[43].

(vii) Resource assessment

Unavailability of resources in easy way is an important barrier for the deadlock of alternative energy technology development. In Pakistan lag occurs in provision of data on accessible databases. Monitoring policies and agencies must be governed in order to update the resource management data such as existing capacities, weather data and geographic statistics.

(viii) Market failure

Numerous business barriers adds to productivity hole of renewable technologies, these may include lost motivators and unpriced expenses[44].In Pakistan there is great risk of market failure which is creating a continuous deadlock for the adaptation of alternative energy resources Some other important barriers are contextualized in the following **Error! Reference source not found.**.

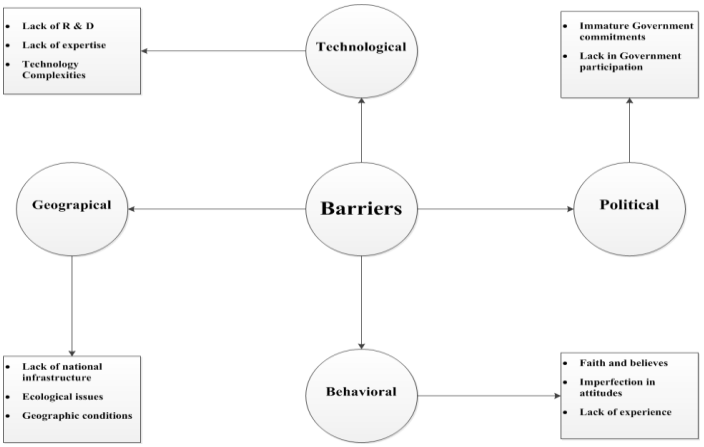

Figure 14: Barriers graphical representation [43].

8 CONCLUSION:

In the last two decades, energy situation in Pakistan is becoming worst year by year. In current scenario there is a need of governing bodies which can formulate polices to integrate renewable technologies for the energy mix of Pakistan. NEPRA, AEDB and PCRET are the operational governing bodies for the alternative energy mix of Pakistan but these organizations need perfection in institutional coordination. Pakistan has 3300 hours of day light per year which provides a huge potential for energy. This energy must be utilized in efficient way through mature polices. Local manufacturing of solar panels can lead this technology to peak level. Hydro energy is very cheap of all kinds of energy sources and its portion in national energy mix should be increased to control the power tariff. Micro and peco hydro energy projects have been started in KPK and such projects should be expanded to Punjab and other provinces. Biomass is produced in millions of tons every year in Pakistan and this is the most suitable and cost effective material to generate energy in terms of biogas and biodiesel and ethanol. Government of Pakistan should focus on solar, wind and biomass energy for short term solution to energy crisis, while geothermal energy should be as medium

term solution and hydro energy should be considered for long term solution of energy crisis.

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