POLITICAL CHALLENGES AND IMPERATIVES IN ACHIEVING RENEWABLE ENERGY SOLUTIONS FOR THIS DILEMMA AND REQUIREMENTS, PAKISTAN: A CASE STUDY

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Abstract:

Energy is the backbone of the social and financial result of any state. Pakistan has been enduring the lowest energy deficiency that has become a difficulty for the success of the state because of the usage of customary fuels instead of substitute fuels. The study explores the alternative potential machinery existing situation and outlook plan contextualizing Pakistan. The study focuses the clean energy sources, like hydroelectricity, geothermal, wind, biomass and solar, can relieve the energy issues of Pakistan. Besides, the data for this research has been got from the Ministry of Energy, National power policy Reports, Dam projects Reports, Government of Pakistan and United States Agency for International Development(USAID) Energy Funds Documents. This study also provides a thorough interpretation of energy needs in Pakistan, which might be beneficial for resolving the electricity quandary in Pakistan. In the end, the study proposes that green investments need to be put into practice and strengthened through guided civil expenditure, policy changes, and adjustments in tariff and regulation.

Keyword: *Energy, dilemma, gridlock, political, investment*

1. INTRODUCTION

This study examines the energy crisis in Pakistan which is a serious issue that affects both the country's economy and its citizens' daily lives. The study strives to figure out the root causes of the crisis include chronic losses, underinvestment, a shortage of natural gas, and fluctuations in the global price of oil. One-third of topneedthroughoutintensephases is because of the deficit in electricity supply. This shortage has resulted in widespread power outages in rural areas, where many people absenceof dependableapproach to electricity. The administration'sstrategy to upholdcommanddutiesunderneath the price of stock, as dogged by the National Electric Power Regulatory Authority (NEPRA), has required considerablesubsidizations from the financial plan(Coyle & Simmons, 2014). However, postponements in distributing these grants have directed todebts that have put the affluence of public and private cohortcorporations, fuel suppliers, refineries, and domestic oil and gas producers at risk. In this backdrop, the study highlights that the shortage of natural gas, which is Pakistan's largest primary fuel source after biofuels, has added to the crisis. The study investigates that this shortage has affected poor communities that rely on natural gas for cooking and heating. Variations in the internationalcost of oil have also augmented power productionprices and affected the country's budget. Indeed, the energy crisis in Pakistan is a complex issue that requires a multi-pronged approach to address. Some of the potential solutions include increasing security in the energy sphere, improving the efficiency of power generation, promoting renewable energy sources, reducing broadcast and deliverydamages, and reforming the tariff structure to decrease subsidies and ensure that tariffs replicate the accurateprice of supply(Awan & Khan, 2014).

The study also inspectsthose shortages of power and natural gas in Pakistan have significant economic costs, estimated at two percent of the Gross Domestic Product (GDP). These costs arise from lower output, exports, and employment, as well as from the additional costs that consumers experience in consuming alternate power bases. Mechanized and marketableobjects have connected their own generators, whereasfamily'susageholdup generators or battery-powered components, repeatedly at sophisticatedrates. However, small and medium-sized business initiatives and poor families often cannot utilize these high-cost alternatives and go exclusive ofenergy(Asif, 2012). The energy crisis was a significant issue in the 2013 nationwide elections, and the Pakistan Muslim League-Nawaz party brushed into supremacy partly because of pledges to tackle the energy difficulties that its precursors had flopped to tackle. However, the new administration's first year in office experienced only fractionalgrowth in concentrating the profoundphysicalconcernsconfronting the energy classification. Solving the energy crisis in Pakistan will require sustained effort, political will, and cooperation from all stakeholders. It will containsnowballingoutlay in the energy sector, decontaminating the proficiency of power generation, promoting renewable energy sources, decreasingdiffusion and supplycosts, and reforming the tariff structure to reduce subsidies and ensure that costs reflect the true cost of supply. The current energy crisis in Pakistan is a complex issue that has compounded by manifoldinfluences across numerousadministrations. Three key factors have funded to the crisis: a physical shortage of energy supply, a financial shortfall, and a governance crisis(Bint Faheem, 2016).

The supervision'sincapacity to executeprofitableregulationconsidered the authoritypredicament on government-owned efficacies and organizations, and their presentationendures to be under the heightsattained in addednations(Khan11, Begum, & Sher, 2012).. This has led to inefficiencies, corruption, and poor management, which have contributed to the energy crisis.The challenges facing Pakistan's energy sector are interrelated, and addressing them will require a comprehensive approach.(Masood & Shah, 2012).The deficit in power generation is because of a disappointment to acquire the securityconcentrations to enlarge and preserve power generation in course with the mountingultimatum. This scarcity of investing has also prohibited the segment from emergingnovel, inexpensive, and coalfoundations, such as coal or hydroelectric power, which would lessendependance on foreign fuel oil and fading natural gas stocks. The macroeconomic circumstances in Pakistan have also donated to the underperformance in Domestic savings havetumbled from their mid-2000smountaintop, and worldwide donor provision for reserves in Pakistan's power sector has degenerated because of radicalchaos, unpredictablefaithfulness to investment bonds, and fallingsafety. To converse these deteriorations, all shareholders, comprising the management, politicians, conveniences, undertakingdesigners, investors, and customers, requisite to addressing the encountersfronting the energy area.Pakistan needs to prioritize arresting the growth in consumption and investing in the future. (Rauf, Wang, Yuan, & Tan, 2015).

Overall, this paper debates about the factors that the energy crisis in Pakistan is a complex problem with multiple interrelated factors. A physical shortage of electricity supply, a financial shortfall in covering the cost of supply, and a governance crisis with weak management and regulatory frameworks all contribute to the problem. The lack of investment in the energy sector, due in part to macroeconomic conditions and declining donor support, has hindered the progress of new, cheaper, available fuel sources, compellingconstantdependance on imported petroleum oil and deteriorating natural gas capitals. The management'spreparation of puttingenergy tariffs beneath the expenses of stock and deliveringenormoussponsorships has created a burden on the national budget and sparked political controversy. Strategyactivities that were predictable to counterpartimprovements in the 1990s, such as affecting from an exchanged to modestundertaking for self-contained generation projects, not approved, and attempts to enforce commercial discipline and accountability, have been unsuccessful. Addressing these challenges will require contributions from all stakeholders, including the government, utilities, project developers and

financiers, and consumers, in reversing declines in savings and investment rates and investing in the future.

2. CONCEPTUAL FRAMEWORK

"We simply must balance our demand for energy with our rapidly shrinking resources. By acting now, we can control our future instead of letting the future control us" (Carter, 1977).

Access to energy services is essential for economic development and productivity, as it supports various sectors of the economy, such as transportation, homes, and service industries(Milne, 2022). Furthermore, efficient energy use improves resource efficiency, which is crucial for sustainable development. By exploiting energy possessions more competently, countries can lessen their carbon imprint and provide to justifying the influences of environment change(Vaughan, 2022).The energy sector also creates job opportunities, which can lead to increased incomes and improved living standards. This, in turn, can support economic growth and contribute to poverty reduction. Governments, international organizations, and other potential investors have a crucial role to play in promoting sustainable energy development(Chevalier, 2009). They can invest in renewable energy sources and promote policies and regulations that support sustainable energy use. This will not only promote economic growth but also ensure that the environment is protected for future generations.It is true that many developing countries view restrictions on carbon-intensive energy as a potential hindrance to their economic expansion goals. This is because industries that trustgreatly on fossil fuels, like oil and natural gas, are regularlyimportanthandlers of fiscal growth in these countries. However, it is important to note that continued reliance on carbon-intensive energy sources is not sustainable in the long term. It is essential for both industrial and developing countries to invest in mitigation programs that encourage the usage of clean energy sources, such as wind, lunar, and hydropower(Nakicenovic, Nakićenović, Grübler, McDonald, & McDonald, 1998). The linking between development and automation has been documentedinternationally since the Industrial Revolution, when the growth of industrial cities drove significant economic progress. Nevertheless, it is vital to distinguish that unchecked industrialization and urbanization can have adverseimpressions on both the environment and human health. Therefore, sustainable urbanization and industrialization must be a priority for both developed and developing countries alike, with a focus on promoting renewable energy, reducing waste and pollution, and protecting natural resources(Johansson, Patwardhan, Nakićenović, & Gomez-Echeverri, 2012).

United Nations(UN) forecasted the principal sources of universalheating and weathermodification to be fossil fuels, oil, natural gas, and coal energy usage. This is because these fossils fuels discharge greenhouse gases, such as carbon dioxide and methane, into the atmosphere, which dupe heat and add to global warming. Many nations, comprisingBeijing, New Delhi and East Asia nations, are looking forreplacements to fossil fuels, such as renewable energy sources like solar, wind, and hydroelectric power(Newton, 2013). Yet, monetaryevolution still trusts on the practice of fossil fuels in most states. This generates a multifacetedcondition where legislators must equalize the necessity for economic expansion with the basic to diminishGHG emission. It is important to recognize that inefficient fossil-fuel usage can have a negative impact on economic development. For example, reliance on expensive imported oil can drain a nation's finances and create economic instability. The costs of pollution and environmental damage caused by fossil-fuel usage can also have significant economic impacts, such as decreased productivity and health costs. Therefore, transitioning to more efficient and sustainable energy sources, such as renewable energy, can support economic development in the long run. Renewable energy can provide energy security, create new job opportunities, and reduce the costs associated with pollution and environmental damage(Bartlett, 1978). Governments can also incentivize renewable energy investment and innovation through policies such as tax credits, feed-in tariffs, and research and development funding. It is crucial to understand the complex relationship between economic development and energy usage, and to prioritize investments in sustainable and efficient energy sources to mitigate the negative impacts of fossil-fuel usage on both the environment and the economy. Uncontrolled economic expansion can lead to environmental hazards, as natural resources are not inexhaustible

and can deplete. Reducing energy intensity levels and increasing the use of low-carbon energy sources are critical for mitigating the negative impacts of fossil fuel usage in the environment. Academics, consultants, and policy-makers in industrializedcountries have realized the risks connected with mechanization, desertification, and other humanoidactions that can lead to environmental damage. It is important to balance economic progress with sustainability to ensure that economic growth is impossible to achieve at the expense of environmental degradation. Besides transitioning to low-carbon energy sources, there are other strategies that can reduce the negative environmental impacts of economic activities(Skea, Ekins, & Winskel, 2011). For example, sustainable production and consumption practices, including circular economy approaches, can reduce waste and resource consumption. It is important to recognize the interconnection between economic development and the environment, and to pursue strategies that promote both economic growth and environmental sustainability. This will require collaboration among various stakeholders, including governments, businesses, and individuals, to drive the change to a low-carbon, sustainable future(Goldthau & Tagliapietra, 2022).

There is a mounting body of research that examines the connection between energy usage, carbon dioxide emissions, and economic development. The shift towards renewable energy sources is not only an environmental necessity but also an economic opportunity(Manieniyan, Thambidurai, & Selvakumar, 2009). The development and deployment of renewable energy technologies can create jobs, stimulate local economies, and reduce energy costs over the long term. Understanding the link between energy usage, CO2 emissions, and economic development is essential for developing effective energy policies and promoting sustainable development. By investing in alternative energy sources and adopting more efficient energy technologies, nations can reduce their environmental impact while fostering economic growth. Reducing greenhouse gas emissions from burning fossil fuels is essential to addressing climate change(Wicks, 2009). The closure of coal-fired power plants because of renewable energy may lead to a decrease in coal demand and prices, making coal more attractive to other energy users, such as developing countries that have limited access to cleaner energy sources. Whereas the association between energy consumption and monetarydevelopment is multifarious and fluctuatescontingent on numerousaspects, such as the level of technological advancement, resource availability, and energy efficiency, there is a consensus among experts that there is a positive correlation between the two. Energy consumption is a crucial driver of economic growth as it fuels industrial production, transportation, and modern infrastructure. Economic growth creates a demand for energy, which further stimulates the energy sector's development(Herzog, Lipman, & Kammen, 2001).

Keeping in view the aforementioned existing literature, this study talks on energy crisis in Pakistan. The governance structure of the power sector has poses severe challenges in Pakistan. The government controls several power generation and distribution companies, which have historically been subject to political interference in decision-making and have struggled to operate. These companies are also indebted, because of nonpayment of electricity bills by consumers, including government entities, and the inability of the companies to collect these dues. The government has tried to address these issues through various measures, such as restructuring the power sector, introducing performance-based contracts, and promoting private sector participation in the sector. The study explores that why progress has been slow and uneven, and many of the problems persist. Corruption and lack of transparency in the sector also pose significant challenges, affecting both the allocation of resources and the effectiveness of governance mechanisms(Shaikh, Ji, & Fan, 2015). Addressing these governance issues requires sustained effort from the government, civil society, and other stakeholders, including the media and the private sector.To address the answers the key questions of this research study are following: -What is the current energy situation in Pakistan? Another vital aspect of this study is to decipher the major sources of energy, and to comprehend the challenges associated with them.Furthermore, the study addresses that what are the environmental effects of Pakistan's current energy mix? What are the existing policies, regulations, and incentives related to renewable energy in Pakistan? How effective are they in

fostering renewable energy adoption? What are the barriers and challenges in implementing renewable energy projects in Pakistan? What we can learn from these projects in terms of their impact, scalability, and sustainability? What is the economic viability of renewable energy in Pakistan? How does it compare to conventional energy sources in terms of cost-effectiveness and long-term financial sustainability? What are the potential strategies and recommendations for policymakers, stakeholders, and investors to promote renewable energy deployment in Pakistan?Besides, this research has applied quantitative and qualitative research methodologies. First, this research has been conducted a comprehensive literature review to gather existing knowledge and concepts related to the energy situation in Pakistan and renewable energy solutions. This helped to understand the current state of research, identify research gaps, and refine the research objectives. Then relevant data has gathered to analyze the energy dilemma and requirements in Pakistan. The primary data has gathered through surveys or focus groups and other relevant stakeholders to understand their perspectives on energy requirements and renewable energy solutions. Qualitative analysis involved thematic analysis of content analysis of documents to identify key themes, patterns, and insights. It is a case study of existing renewable energy projects in Pakistan to understand their impact, challenges, and lessons learned. This can involve analyzing project documents, financial reports, and interviewing with project stakeholders. Using these research methodologies, the study has gained an all-encompassing comprehension of the energy predicament and demands in Pakistan and suggest useful renewable energy solutions.

3. CURRENT SITUATION OF ENERGY RESOURCES IN PAKISTAN

There is a strong connection between economic development, energy consumption, and industrial growth. The desire for fast economic progress in developing nations has led to an expansion of production, which has increased energy consumption. However, this increased energy consumption has also resulted in the emission of greenhouse gases that are damaging to the ecosystem and human well-being. Notwithstanding this, encouraging economic development through increased energy consumption is still beneficial. This suggests that any decrease in energy use could affect economic progress(Kessides, 2013). However, the passage also acknowledges that increased energy consumption can have negative effects on economic development under certain circumstances. For instance, there may be a necessity to changeproduction towards parts with lesser energy supplies or to reserve energy to subdivisions with volumebounds and inadequacies that necessitate energy cutback. In such cases, double-way causality shows that the connection between energy consumption and economic development is complex and requires careful consideration. While increased energy consumption is necessary for economic development(Hali, Yong, & Kamran, 2017). The mountinganxieties over energy safety, large-scaleheating, geopolitical battles, and latest nuclear tragedies, and in what way these have commandedrespectiveadministrations to reflectnoteworthystrategies for energy exchange and ladders to protect energy. Attaining an equilibrium between fiscaldevelopment and green sustainability is critical, as these two issues are tangled(Valasai et al., 2017). Governments must appraise the probabilities for achievement and the inspiration of energy changeoverstrategies on economic maturity. They must also contemplate the possibleoutsidesurprises to the energy marketplace and their impression on economic progress. Although fuel switch is one mode to encourageworkableelaboration in energy strategy, attaining a poise between economic progress and conservation sustainability necessitatescautiousassessment of the impression of energy replacementprocedures on economic progress, possibleexteriorastonishments to the energy marketplace, and the inclusivedependance on coal(Shah & Solangi, 2019).

4. ENERGY RESOURCES IN PAKISTAN

Pakistan is a nation with a burgeoning population, which demands a growing need for its energy resources. The country has been dealing with an energy issue for many years, causing power outages, load shedding, and a detrimental impact on the economy. To fathom the energy potentiality of Pakistan, it is necessary to examine the current energy resources in the country. Oil

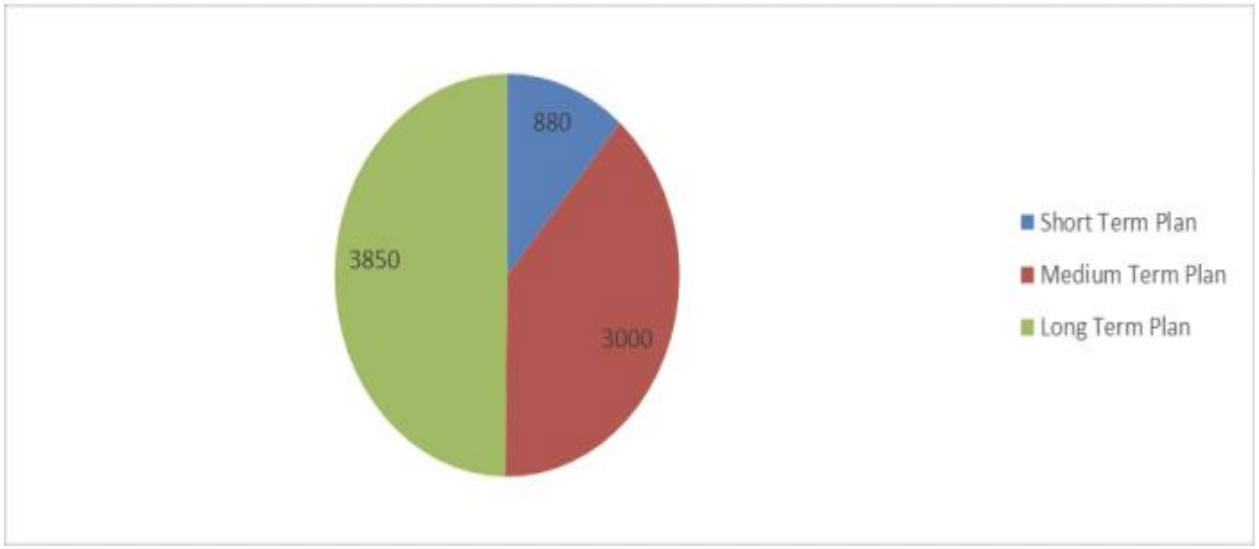
and gas are two of the primary energy sources in Pakistan, with the country yielding around 89,000 barrels of crude oil per day and 4,000 million cubic feet of natural gas per day. Most of this development is in the province of Sindh, in the districts of Ghotki, Sukkur, and Sanghar. Despite being a major player in the global oil and gas industry, Pakistan still relies on imports to satisfy its energy requirements(Malik, 2012). Pakistan has substantial amounts of coal reserves in the Thar Desert region of Sindh. The projected coal supply in this area is around 175 billion tons, making it one of the most substantial coal supplies in the world. The country is still in the initial stages of exploiting its coal resources, with most of its coal being used for power generation(Malkani & Mahmood, 2017).

Hydropower is another significant source of energy in Pakistan, with the nation having a total prospective hydropower capacity of around 60,000 megawatts. Just a small part of this potential has been achieved, with Pakistan generating around 7,000 megawatts of hydropower at present. The primary origins of hydropower in the nation are the Indus River and its branches. Pakistan has remarkable wind and solar energy capability, in the southern province of Sindh and the southwestern province of Baluchistan. The country has already established multiple wind and solar energy schemes, with the potential to generate up to 60,000 megawatts of wind and solar energy. Pakistan is one of the handful of countries in the world with a nuclear energy program, with the nation working three nuclear power plants and planning to build more in the future. The nuclear power plants in Pakistan generate around 1,400 megawatts of electricity, which is around 5% of the nation's overall energy blend(U. K. Mirza, Ahmad, Majeed, & Harijan, 2008). Pakistan's dependence on oil attained 43.5% in FY-1998 and FY-2001 regarding the energy blend. Oil dependency for the FY-2018 declined to 31,2%. Hydro projected to hit 13.1% in FY-1998, and it documented as 7.7% in the fiscal year 2017-2018. Although the decreasing amount of oil symbolizes a welcome note as the national budget turns out lighter, the decreased amount of hydro reveals the lack of enthusiasm and the neglect of consecutive administrations to carry out such demanding undertakings. In the complete energy mix in FY-2006, Pakistan's gas reliance attained a record high of 50.4%. Whereas the reliance on gas for the FY-2018 decreased to 34.6%. This decrease in vigor blend segment is caused by decreasing natural gas resources and limited gas utilization in the transportation sector and LNG adoption since 2015. The amount of LNG brought in augmented by 0.7% in 2015 to 8.7% in 2018, which shows a massive boost in the energy balance of the fuel. For the last two decades, the percentage of coal has been at a single digit. In FY-2018, however, coal participation in the energy blend was high by 12.7%. in FY2015, the renewable power proportion was noted to grow to 1.1% FY-2018 from 0.3%. In addition, the nuclear power contribution in FY-2018 increased to 2.7% compared to 0.2% in FY-1997. Government applied the Integrated Energy Strategy to create such a historic divergence for each energy supply in the country's energy mix. The expansive energy approach would not only study energy requirements and potential supply sources but also form long-term policy choices established on facts(U. S. Ahmad, Usman, Hussain, Jahanger, & Abrar, 2022).

5. PROSPECTIVE IN PAKISTAN AND SUBSTITUTE RENEWABLE ENERGY RESOURCES

i. Wind energy

The progress and usage of clean energy reserves have been a colossal effort since 2003. The Pakistani administration has established a genuine committee to organize undertakings in the region(U. K. Mirza, Ahmad, Majeed, & Harijan, 2007). The results of the workability research scrutinized by Alternative Energy Development Board Pakistan (AEDB), and it was revealed that a massivezone of 9750 km with a robust wind swiftness was identified and called as "Gharo-Corridor"(Khahro et al., 2014). The region has a huge capability to generate nearbyfifty-thousand MW of energy. Other economic activities limited the use of twenty-five percent of the range, along a manufacture capacity of eleven thousand MW(J. Iqbal & Khan, 2017). People noted remarkable wind velocities in the seasideshare of Baluchistan, exclusively in Swat and some of the Northern ranges. It has evaluated that forty-two spots exist there, seven have a poweraspectchanging from ten to eighteen percent and are perfect for advantage wind turbines(Baloch, Kaloi, & Memon, 2016).

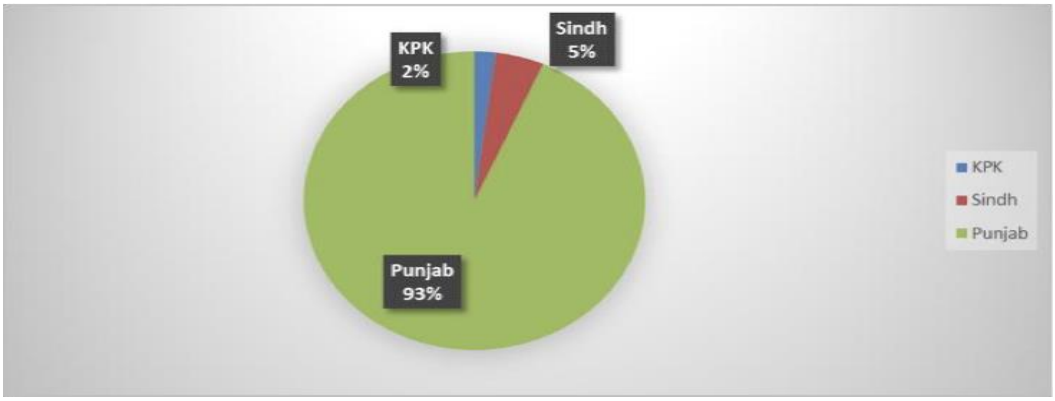


Source: Ministry of Energy, Government of Pakistan, Policy Brief, 2018

A secure Pakistan can handle the progress of its people and adjacent countries(J. Iqbal & Khan, 2017). As shown by NTDC, it relied on the yearly development rate upon to be 5-6% in the following years, causing a colossal MW of electricity of around 32000 in Asia. In this context, Pakistan is a wealthy land regarding renewable energy suppliers such as wind, hydropower, biomass and solar energy because of its geographic position in the world(I. A. Mirza & Khalil, 2011).

ii. **Hydro Energy**

It is a type of energy which is generated from water available in the environment as rivers and lakes. The streams, ponds and cascades are examples of water on the surface, while groundwater exists in aquifers underground and in the pores of metamorphic minerals(Asif, 2009). The structure of the population of Pakistan is manifold, with both alpine and flatlands regions that can trap and preserve rain and permit the use of this natural water source. Pakistan is meeting its significant energy needs of 90% from hydropower facilities in the last decades. There is extensive effort called “race to the top” for the hydropower and water regulation(U. K. Mirza, Ahmad, Majeed, et al., 2008). It has created a variety of schemes and bodies which guarantee the reliable and perpetual supply of energy system. NEPRA and WAPDA are the chief regulating agencies of the Pakistan energy system. WAPDA holds fifty four percent of energy productionbulk to accomplisheighty-eight percent client's energy requirements. Hydropower is a green, non-consuming, dependable and affordable energy production procedure that offers an immense opportunity to Pakistan's robust economy(Uddin et al., 2019).



Source: Hydropower site in Pakistan, Ministry of Energy Affairs, 2019.

Pakistan is fortunate with around 41722 MW of hydro power partaking a wonderful opportunity in the northern parts of Pakistan and the terrestrial of fivewaterways Punjab, which helps the primary source of water. The mini hydropower shrubs at small and average scales which do not necessitate

any space of water are very beneficial for individuals to satisfy the fundamental requisites of energy(Qadir, Abujubbeh, Mariam, Fahrioglu, & Batunlu, 2019).

iii. Solar Energy

This type of energy is taken from sunshine and heat it is known as solar energy. Based on delivery, seizing, and transformation, solar machinery can be distributed into vigorous solar and reflexive solar. Solar energy is a sustainable energy that is employed by the international society to gain energy that is costly and pollutant-free(U. K. Mirza, Maroto-Valer, & Ahmad, 2003). Pakistan is in a sunny region with 300 days of brilliant light every year and 3000-3300 hours of sunlight. Pakistan has a marvelousprospective of solar energy and its situations are superlative for the consumption of solar uses. Ninety percent of the towns in far-flung regions of Pakistan are not using electricity because of various reasons, such as they are not in the system or there are no transmission lines. The state does not have access to web points through transmission lines almost 38%. The most effective resolution to this conundrum is the use of solar energy(Jaffery et al., 2014). By constructing small solar power stations government couldsupply reasonable electricity and also contribute to enhancing their living standards. The government is constructing small solar power stations in Pakistan.

Source: (Author's own observation)Solar Panels install domestically in Pakistan

In the rural zones of Sindh and Baluchistan, there is a nonexistence of energy supply network, so solar energy solves those places which are off the network. In 2004-2005, AEDB illuminated 601 houses in distant areas of Pakistan by solar PV system. Government of Pakistan desired to electrify 400 additional houses(Soomro et al., 2019). It has supplied 49 settlements in Thar parker Sindh with 3000 solar home units. In 2011, they incorporated close to 30 GW of fresh solar PV potential worldwide. Almost 2% of PV volume is off grid and the developing countries are expressing strong fascination with off grid PV energy systems. Individual corporations have brought in from abroad almost 54.77 MW of solar PV networks in the last seven years(Akhtar, Hashmi, Ahmad, & Raza, 2018).

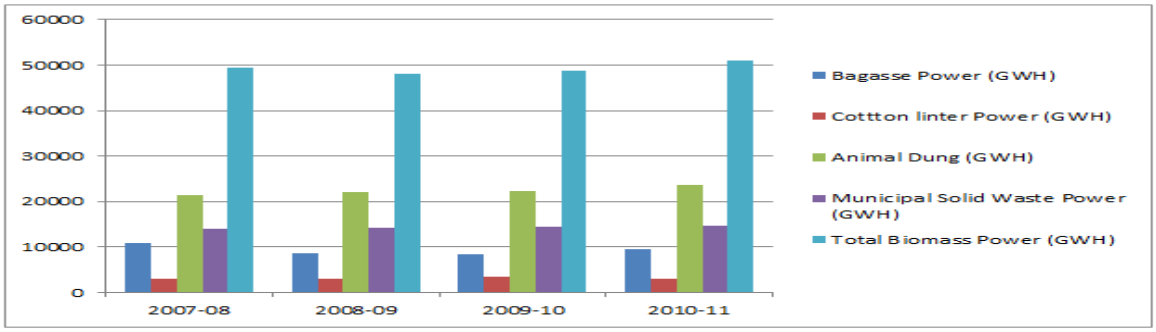
iv. Geothermal Energy

The continuous energy flow streaming out of the core of the earth towards its outer layer is the origin of this geothermal energy. Twenty-one states around the world have transformed geothermal energy into mechanical. The energy from such a technique produces no carbon discharges. In geothermal power ventures, water is harnessed to take in heat from boiling rocks, and this heat is changed over into energy by turning turbine generators on the exterior of the earth(Gondal, Masood, & Amjad, 2017). High-heat, permeable and liquid-filled stones in the earth's top shell are necessary for tapping geothermal storage tanks in the regions of juvenile igneous rocks and close by. Government could consider an average geothermal source to be a moneymaking source if the heat is between 24 and 20°C. The Indian plate's encounter with the European plate leads to geothermal activity in Pakistan with the primary crustal thrust and the major Karakoram thrust(Zaigham, Nayyar, & Hisamuddin, 2009). Northern domains have searing springs in the Gilgit, Hunza, and Yasin valleys. The chief external heat registered in the Hunza Valley is 210°C and initial research suggests even higher internal heat levels. Underneath the Indian plate, the Arabian plate falls and results in the Chagai volcanic arc showing up with proof of recent diastrophism and

quaternary volcanic activity. The third geothermal area extends from North East to South East of the nation as a thin strip along the Indus bowl border, down to Karachi. A great deal of geothermal activities take place in the Dadu District of the Sindh area. This region is in the northern parts of Pakistan(Abbas, Bazmi, Bhutto, & Zahedi, 2014). It ranges from 340 40′ to 370 04′ N and 720 30′ to 770 50′ E. Afghanistan and China surround it in the North and in the East by Jammu and Kashmir. This region has dramatic terrain and U-shaped hollows. A part of the most impressive peaks like K-2 (8,611 m), Gasherbrum (6,068 m), and Rakaposhi are the eminent geologic features of the area. The primary water source of the area is the Indus River, with the Shigar, Shiyok, and Yasin rivers as its offshoots. The geothermal structure here results from the collision of the Indian and Eurasian plates. It spread out blazing springs and its temperature fluctuates up to 91°C. There are two renowned thermal springs, one is near Turboto das and the other is situated 3 km near the Darkot crossing in Gilgit region(I. Ahmad & Rashid, 2010).

V. Biomass

Pakistan has plentiful reserves for biomass, which can generate thermal energy, electricity and fuels for power production(U. K. Mirza, Ahmad, & Majeed, 2008). The type of biomass determines which combustion, gasification or liquidation method used to generate thermal energy, electricity and fuels for power production(Saghir et al., 2019). The probable power production of biomass is determined for sugar cane bagasse, cotton linter, municipal firm waste and animal dung based on the availability and quality of biomass for 2007-2011(T. Iqbal et al., 2018). The committee has also recognized the alternative energy, biodiesel development and has established a National Biodiesel Program. Through this initiative, the board has established an advisory committee comprising the relevant parties. Pakistan gave the board a duty to increase biodiesel up to 10% by measure of total utilization of diesel in the nation till 2025. To accomplish this aim, Eco-amicable fuels Pvt has created a publicity biodiesel processor in Karachi. Limited, with collaboration of AEDB. This manufacturing unit has the potential to create 18000 tons per annum. The expansion of Jatropha has grown from 2 acres in 2005 to over 700 acres in 2010(Shah & Solangi, 2019).

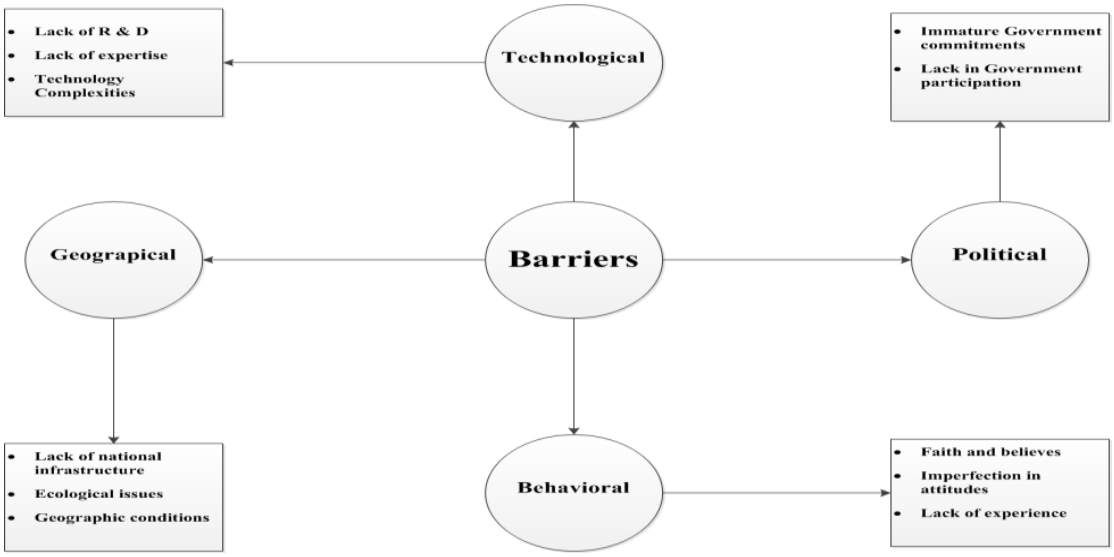


Source: Pakistan Energy Year Book 2021

6. CHALLENGES FOR ALTERNATIVE ENERGY RESOURCES

Different technologies could involve market, technical, public approval and political limits. Diverse regions and industries take different actions in order to impede the different technologies, with some impediments being more advanced than others(Bint Faheem, 2016). Renewable drivesuppliers have entry to the chiefefficacies and their connection to the broadcastconnection is limited by high costs. Several renewable energy donors are far away from the other users and require a third party to establish rules for easy access of the supplier to the final user. Pakistan is a under developed nation and confronting technology shortfall(Hassan & Kamal, 2016). Renewable energy sources require ongoing research and development for successful energy production compared to current fuels. A law must delegate the renewable energy ventures to capable at an administrative level. Financing is a key hindrance to the development of any scheme. As alternative energy sources are separate from growth, they cause considerable outlay in terms of setup, location control and to talk other governmental concerns. Taking Pakistan into consideration, banks provide very little help

to the energy supplier. A few of enterprises of alternative energy are struggling with social and ecological regulations in the setup procedure such as outstandingtop solar warmers, pinnacles of wind turbines and scorching of biomass(Valasai et al., 2017).



Author's own Analysis

Stakeholders must implement policies to assign the secure ecosystem and regions for these ventures. Pakistan is experiencing a lack of interinstitutional coordination. Regulatory agencies are not collaborating with subordinate organizations(Shahbaz, 2015). There must be one governing body to guarantee the collaboration between principal and sub institutions. Market inadequacy and absence of public knowledge is a major hindrance for the renewable technologies, exhibiting an inadequate representation of alternative technology associated to traditional skill in terms of expenditure and other advantages(Shaikh et al., 2015).

7. DIRE CONSEQUENCES OF ENERGY CHAOS ON ECONOMY

The requirement for energy regarding supply in this contemporary period is on the rise. Certain multiple perspectives and ideas may associate energy with economic expansion. Energy is considered the basis of every financial system and assumes a substantial role in a country's socio-economic expansion. Unless energy would be adequate, there will be no industrial expansion, which is crucial to running factories and production units, for business and leftover usage, and transport, etc. An inadequate energy supply will impede development and prevent the growth phase. In brief, energy is required to tackle the energy crisis and resource industries, such as farming production, joblessness, destitution, lower GDP, and higher inflation(Kessides, 2013). Regrettably, Pakistan has had to face the most dreadful energy crisis throughout its existence. Pakistan, like several other growing countries, is among the energy-intensive developing nations. Just like in many countries without oil production, they complete their fuel needs with large amounts of oil imports. Pakistan's structure for energy is not prepared and showed to be mishandled. No significant energy production plans have been taken despite population increase, economic advancement, and escalating requirement over the last few years(Goldthau & Tagliapietra, 2022).

The situation has declined because of antiquated infrastructure, robbery of electricity and transmission losses. The present political, financial and energy problems have hindered Pakistan's growth, financial, industrial, and commercial undertakings. The prolonged shutdown of the industry would cause joblessness and blockage. In other countries, the government motivates the industry with many rewards for increasing production, exports, and competitiveness in the international market(Sohail, Majeed, Shaikh, & Andlib, 2022). But the vast majority of businesses in Pakistan do

not have contentment and they are also troubled by hefty taxation and expensive energy sources, with continual effects which lead to the loss in outputs of the textile sector, in textiles whose exports are restricted to a quite lower scale, and which are shut down or move towards the neighboring countries(Raza et al., 2022).

8. FUTURISTIC OUTLOOK

We can only solve the distinct difficulties facing the power and energy sector with the involvement of all participants. Electricity clients should know, and accept, the genuine cost of energy(Raza et al., 2022).Among the other SDGs, SDGs number seven focuses on "affordable and clean energy for all." Pakistan is facing a severe energy crisis(Ur Rehman, Cai, Fazal, Walasai, & Mirjat, 2017). That is leading towards slow economic growth, political instability and overall affecting the human development in the region. SDG 7 having four dimensions to "ensure access to affordable, reliable, sustainable and modern energy for all" is a challenge opposing every country, that touches everyone Almost 2.7 billion people in the world rely on traditional methods of costly energy generation, which is harmful to the environment and for our future generation, causing drastic changes to our climate system, which is affecting almost every continent of the world. There are some alternative ways of energy generations by using which we can save environmental pollution, climate change, global warming, and the huge amount of money that we spent on our traditional ways of energy generation. Pakistan is still depending on the energy sources like oil, coal and gas which are limited, rare, harming the environment and are costly(Rehman & Deyuan, 2018).

The broadcasting and intellectual groups must concentrate on conversations, investigations, and solutions. The wealthy and influential must discontinuemeddling in the practicalities' determinations to decreaserobbery and default. Enhancing the electrical resource can merely be accomplished in the long run, and all efforts should be created to preventidealisticexpectations. Projects to create new power cannot become expensive sources of supply, as has happened with past endeavors to transfer production to foreign fuel oil. Pakistan can decrease this danger by assessing those projects to most economical standards and competitive drive. Some investment encouragements may need to be provided. They need to limit these projects to the initial set to gain savings(Zubair & Aman, 2010).

9. CONCLUSION:

This paper has examined thatenergy conditions in Pakistan have been deteriorating. Therefore, in the existingcondition, there is a requirement for supervisory entities that can craft regulations to include renewable solutions for the energy concoction. NEPRA, AEDBand PCRET are the operative controlling forces. Government have started micro and Peco-hydro energy initiatives in KPK. Government should widen such initiatives to Punjab and other provinces. The study has discovered that biomass is generated each year in abundance.

The study in this paper has highlighted the measures regarding solar photovoltaic energy production, which have been seen as a necessary substitute for energy for the upcoming decades. Those in higher position need to comprehend that, in the future, reliance on solar photovoltaic energy may be essential in tackling the socio-economic troubles which Pakistan is experiencing today. Solar photovoltaic power is associated with the constant improvement of lifestyles for individual citizens, as well as communities in a broad sense through the constant delivery of electric power to both remote areas and to developed areas of the country without raising the greenhouse gases levels in the atmosphere(Irfan et al., 2019). This method decreases the sending and delivery losses of the country. Even in schools, implementing solar photovoltaic electric power seems to be essential in eliminating hindrances and improving scholastic performance.

There is a dire need to explore the substitutes for these resources. Governments throughout the world are shifting from the energy generation sources of oil, coal, and gas towards much cheaper and environment friendly sources like solar power, wind energy, Mini hydro- power plants, etc. Pakistan still is far behind from achieving the renewable, affordable, clean and environment friendly energy generation methods. If Pakistan wants to achieve the target of the SDG7 before the year 2030, Pakistan needs some effective policies and practical implementations. Government

must educate people about policy initiatives that increase reliance on solar energy. It is vital for policy makers and people of Pakistan to cope with the challenges of the energy crisis in Pakistan to bring foreign investment at home and to enhance industrialization. Because without energy effectiveness, Pakistan could not meet with its current gloomy economic crisis.

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