ISBN 978-1-960740-68-7

ENERGY SYSTEMS ENGINEERING – MODELS AND METHODS

Review Based Book Chapter

RENEWABLE ENERGY RESOURCES: CASE STUDY FROM PAKISTAN, A GEOLOGICAL PERSPECTIVE

November 27, 2023
doi: 10.5281/zenodo.10252378

Scientific Knowledge Publisher (SciKnowPub), USA
info@sciknowpub.com

REVIEW BASED BOOK CHAPTER

RENEWABLE ENERGY RESOURCES: CASE STUDY FROM PAKISTAN, A GEOLOGICAL PERSPECTIVE

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Abstract

Globally growth prospects of the economy and increasing energy demand, there has been a skyrocket increase in Pakistan's energy demand, causing an increase in food and stock affluence, soaring inflation and tightening the economy of Pakistan. Pakistan's population is increasing day by day that posing a challenge to Pakistan's economy as it increases expenditures on health, education, and infrastructure. Moreover, we have limited conventional unexplored resources to tackle this problem. Not understanding its resource potential, had led Pakistan into a developing country in the world. As Pakistan has unique geology and different topography i.e., highlands, deep rivers, and deserts that would be used to produce conventional and alternative energy. We endeavor to find out the possible solution by studying different geological perspectives.

Keywords
Geothermal Energy, Power Generation, Sustainable Development, Energy Policy

Introduction

Pakistan is a country in South Asia (Figure 1). Since 2000, there is a paradigm shift in energy demand in Pakistan. Pakistan's acute energy crisis poses serious threats to Pakistan's economy [1]. In Pakistan two major components of the energy mix are oil and gas, sharing 65% of energy supplies in 2012 while coal reserves contribute 7% and nuclear reserves contribute 2% of energy as shown in (Figure 3).

It is calculated that the world consumes about 88 million barrels of oil per day [2]. The United States is one of the topmost countries that consume oil more than other countries (Figure 2). Pakistan is also included in the world's largest consumer of oil, and it has the world's 6th largest coal reserves. The biggest coal reserves are in the US, Russia, China, and India. In Thar, Sindh Province, about 184 billion tons of coal has been discovered over 9,000 sq. Km of area. The Punjab and Baluchistan provinces each contain further coal resources. Pakistan still heavily depends on imported oil and gas to meet its energy demands despite having ample coal resources. In Pakistan, the total resource potential is about 27 million barrels, and it produces 517,000 barrels per day. In Pakistan, 13 companies are involved in the production of crude oil.

Due to the massive demand for oil and gas in industries and for domestic purposes, the extraction rate is higher, causing the depletion of oil and gas resources. Results show that in Pakistan oil and gas production has been increasing over the year but it has not been enough to fulfill the demand of the public [3]. Many gas and oil fields have been dismissed because they are far from areas having accessibility and pipeline issues [4, 5].

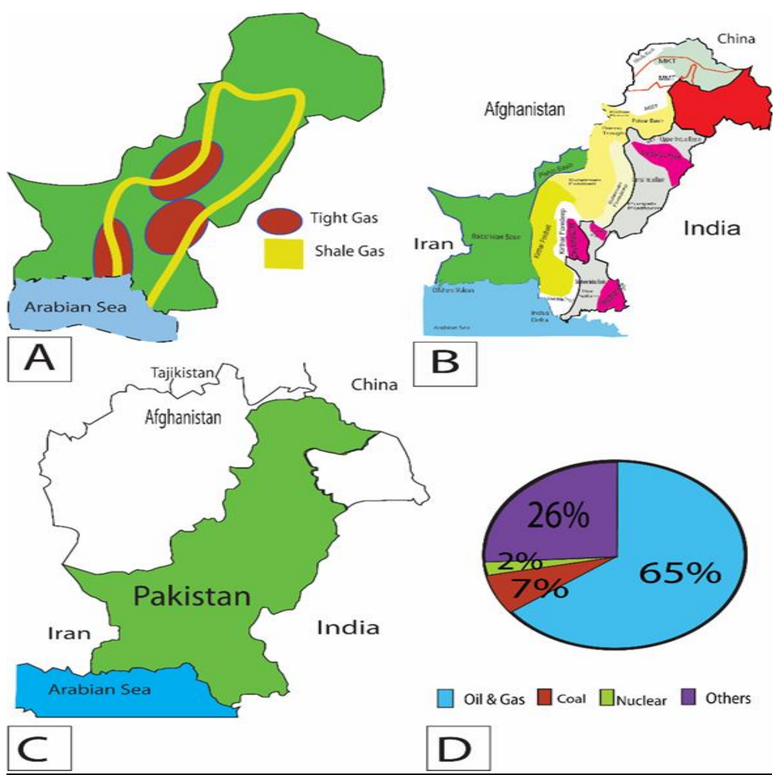

Figure 1: (a) Unconventional Resources Potential of Pakistan. (b) Sedimentary basins in Pakistan Major basins (Indus and Baluchistan) with minor basins (Peshawar Basin, Pishin Basin). (c) Location Map of Pakistan, with its neighboring country. (d) Energy mix of Pakistan, with predominance of oil, gas, coal, nuclear, others include, wind, solar and biomass energies

Nowadays, due to a shortage of resources, Pakistan is importing fuel to run the different fields. Similarly, due to the shortage of electricity, imported fuel vulnerability becomes hindrance to the evolution of the socio-economic development of Pakistan [4]. This framework causes significant increases in fuel prices that are highly impactful to the economical growth of Pakistan. An increase in fuel prices may also limit the development and growth of industrial zone that directly lessen the economical policy. Thus, the use of renewable energy resources is one of the remedies for the development of Pakistan.

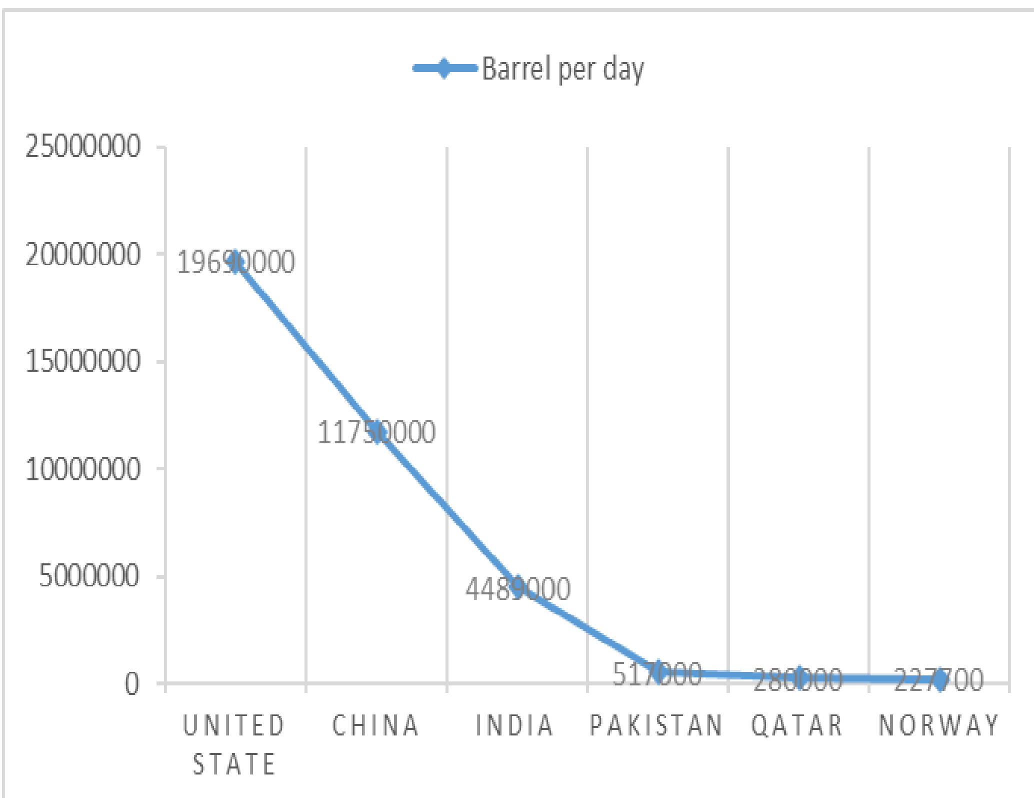

Figure 2: Oil consumption in different countries in 2022

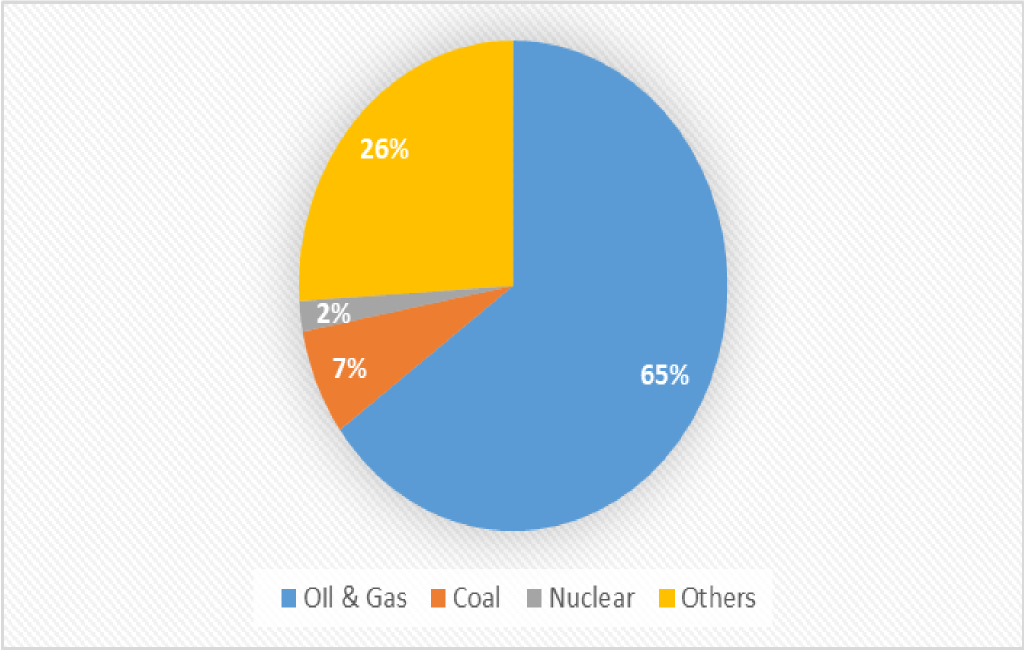

Figure 3: Energy Mix in Pakistan

Methods

We used a literature review, reports of the synthesis and already published data to compile and digitize our maps. These maps can help in planning new energy infrastructure in the country. With the help of published data, we draw a graph to show the production of oil and gas. We have tried to show different energy resource's contribution to Pakistan's energy demand with the help of a pie chart.

The basinal, structural and tectonic features were extracted from a single dataset. Google Earth and published maps pictures were analysed to produce these (courtesy of Google Earth). Various sets of maps were taken to capture the entire map perspective of the study region. Geo-referencing, fine corrections, colour balancing, and brightness matching improved the quality of the photos, making it easier to spot structures and lateral changes. Combining the red, green, and blue bands produced the final image. This procedure was found useful for extracting the features of interest for the study from the maps.

Geological Setting

If we see the geology of Pakistan, has very complex provinces, topography and elevation differences that are very unique [6], this unique geology setting helps harness energy from renewable energy like solar, wind etc. to control the existing problem. Since 2003, the advancement and use of renewable energy resources have become a major venture [7]. The power policy that was given in 2002 supports the usage of alternative energy resources. The purpose of this policy is to develop roughly 500MW of Renewable Energy generation [8]. CPEC incrimination and integration of renewable technologies, Pakistan has supplement potential of reliable, accessible and affordable energy resources i.e., hydro-power energy, wind energy, solar energy etc. [9]. Such resources play important role in the development of sustainable energy for the country, the production of energy for the future and also involved in the reduction of climate change [10]. Pakistan should make sure that its energy production meets the need of the country not only to finance economical policy but also to nourish geographic and worldwide economic lethargy.

Sedimentary Basins of Pakistan

Pakistan is a geologically complex region. It has two main sedimentary basins i.e., Indus basin (upper, central southern and lower) and Baluchistan Basin as shown in (Figure. 1B).

Kakar-Khorasan is a smaller basin, also called the Pishin Basin. There are other ten smaller basins in Pakistan [11]. In Northern most of Pakistan, Upper Indus Basin (UIB) is located and it is geologically complex area, mainly oil-producing [12-17]. Moreover, it is further divided into Potwar and Kohat Sub-Basin [18]. Rocks from Precambrian to recent are present in upper Indus Basin [19-23]. Central Indus Basin has unconventional plays and is mostly gas producing area in Pakistan. Southern Indus Basin is oil and gas-prone area and has unconventional resources. Tight gas and shale gas are present in this region. The coal present in the Lower Indus Basin has the capability of being a coal bed methane reservoir [24]. The Offshore Makran Basin is thought to be a great hydrate capacity. Baluchistan Basin has both conventional and unconventional resources. It has a hydrate methane reservoir near the Makran coast [25]. Besides Baluchistan Basin is enriched with a lot of mineral deposits [26].

Explored and Unexplored Basins

In Pakistan exploration of basins has been occurring for the last few years. We have already explored the low-hanging fruit now we have to move towards deeper exploration of the areas and basins that are unexplored yet.

Explored Basin

In Kohat- Potwar and Hazara Basins [20], an already large extension of exploration has been occurring that's why resources are limited there.

Unexplored Basins

These are basins that we have not explored yet the north of MBT there is not much drilling occurring due to some technical issues, now it's our task to resolve these issues and explored these basins' resources. Some of the unexplored basins are given below and their stratigraphy is shown in (Figure 4).

Offshore Makran

It mostly consists of deformed flysch (panjgur sandstone) of the Miocene age. The oldest rock is reported are cretaceous marl which was deposited deep ocean floor. Offshore Makran is an active margin [27].

The most enhancing feature that is sustainable for the generation of hydrocarbon in Makran region is the presence of numerous gas seeps occurring as spectacle mud volcanoes and as a bubbling gas and turbid water offshore [28].

The total organic content is very lean to moderate in these rocks, a large volume of mudstone is deposited in the slope and outer shelf environment incorporating a significant amount of organic matter [29]. The middle Eocene Panjgur Formation is an ideal form reservoir, porosity ranges from 10 to 25 %. It also consists of severally reverse faulted structures. The reason that we haven't drilled here much is due to overpressure zone [13], the sedimentary rate is too high so no diagenesis that's why we should use advanced techniques of exploration.

Punjab Platform

The easternmost part of the Central Indus Basin is the Punjab Platform. It acts as a large monocline gently dipping towards the Suleiman Depression. The Punjab Platform is away from the collision zone thaswhy having no surface outcrop. It is a tectonically stable area having extensive coal deposits [30].

Punjab Platform has an extensive coal deposit, valuable oil and gas fields, the potential for geothermal energy and a vast groundwater reservoirs [31].

Gas Reserves are mostly present in Mesozoic sandstone of Punjab Platform [32]. In Punjab Platform there is no presence of source rock and has no structural understanding (horst and graben).

Indus offshore

The Indus Offshore has a very limited exploration history, only 15 wells are drilled within the last 50 years. In this basin, only Pakcan -1 well has produced sub-commercial gas from the Miocene.

Indus offshore has no source rock, so we should to use 3D seismic methods for more drilling.

Bannu Basin

Bannu Basin is present in the western part of the Potwar Plateau [33]. There are potential traps present in Bannu Basin, it mostly consists of Quaternary Sandy and alluvium deposits [34]. First, exploratory well was drilled in 1886 (Kundal Seep) having no structural understanding and security issues so drilling is huge challenge here. Jurassic age of Datta and Shinwari formations acted as a reservoir rock and Chichali Formation as a source rock.

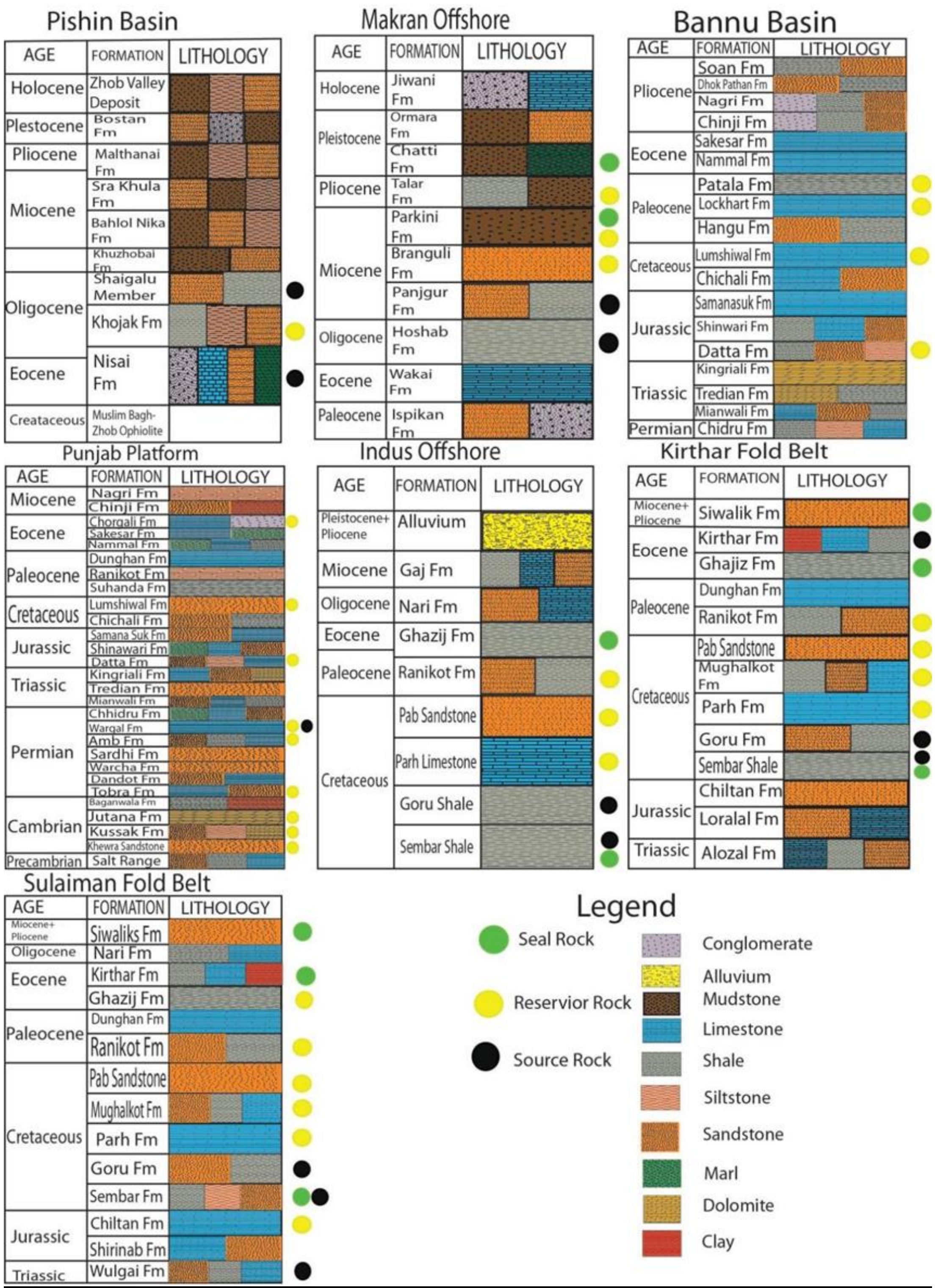

Figure 4: Stratigraphy of Pakistan Unexplored basins and petroleum plays are also marked in each basin

Pishin Basin

Pishin Basin is also called Kakar-Khorasan Basin. It is considered to be a recent basin. As less exploration is done here, very fewer datasets are available. We need to do more seismic surveys here.

Kirthar, Suleiman Fold and Belt

In Kirthar, Suleiman fold and belt there is a problem of thickness of sedimentary package that's the reason not much exploration occurs here. However, Mari, Khairpur and Mazarani were wells drilled in Kirthar Fordeep, now we have to explore the Kirthar Foldbelt. The western margin of Kirthar fold belt has an association with hydrothermal activities which lead to the formation of extensive economical mineral deposits. We can also place turbines along the foldbelt to get better energy production.

Gas Hydrates in Offshore Region

Gas hydrates have been found in Pakistan's Offshore area, specifically in the Indus Delta and along the Makran Coast. It is thought that these gas hydrates could be a significant source of natural gas. Gas hydrates have been found in shallow areas in the Indus Delta region, with an estimated 100 TCF in reserves (trillion cubic feet). Similar to this, deepwater locations around the Makran Coast have seen the discovery of gas hydrates, with estimated reserves of about 50 TCF. The potential of gas hydrates as an energy source in Pakistan is currently being further evaluated through a number of research and exploratory programs. Yet before it can become a practical source of energy, considerable technological and financial difficulties must be taken into consideration for commercial manufacturing of gas hydrates.

Renewable Energy Resources

Getting energy from natural resources is the best alternative. Renewable energy resources are considered to be the best alternative to getting energy without causing any harmful effects [35]. Some of the renewable energy resources are discussed here and also shown their presence in Pakistan (Figure 5).

Wind Energy

Wind energy is one of the sustainable and major sources of renewable energy and has a smaller impact on climate change and the environment than fossil fuels. Wind turbines are mostly used to generate electricity from wind [36]. Pakistan has many wind corridors, that are run on wind energy and approximately all have an average speed of 7.8 m/s.

National renewable energy Laboratories and Pakistan's Metrological department did wind speed surveys in Baluchistan and Sindh provinces at different locations [37]. Besides this, in the coastal part of Baluchistan like Gwadar, Ormara, have remarkable amount of wind speed is also identified [38].

Solar Energy

Pakistan is positioned between 62 degrees and 72 degrees east of longitude and 24 degrees and 37 degrees north of latitude. This distinctive topographical orientation and weather conditions are favorable for the implementation of solar energy [39]. Solar is effective for manufacturing of favorable amount of energy, without instigating conflicting results on the environment [40]. Usually, for capturing solar energy and converting solar radiation into electricity, photovoltaic cells are used It is used for numerous purposes in metropolitan areas and other areas [41].

For the direct conversion of solar rays into electricity, Photovoltaic cells are very beneficial. Solar thermal mechanization is efficient for capturing solar energy in a solar collector from the sun, warm the water and convert into steam for the inception of electricity [42]. Many researchers have widely investigated solar energy anticipation in Pakistan. Akhtar et al. [41], examine coverage of solar radiation data in 58 different locations, the results come from these data show that over 95% of the area in Pakistan encounters solar radiation. Similarly, Akhtar et al. [41] apply various methods to evaluate and categorized direct and indirect solar radiation in different areas. Naseer et al. [87] administered the survey in different countries to estimate wind speed and solar radiation intensity. ABED has been evaluated that about 2.334 million MW of solar radiation potential is present in Pakistan [43].

Chief Minister of Punjab, Pakistan launched the "UJAALA" scheme, where 30W Photovoltaic panels were disseminated throughout the country to university students. Another project launched by the government is Quaid e Azam solar park. The objective of this project is to generate 200MW of electricity by 2015. After 2020, photovoltaic electricity production was established [44]. According to World Bank, Pakistan would meet current electricity demand just by exploiting 00.71 percent of solar photovoltaic energy [45].

Solar Thermal system

Solar water heating mechanization is extensively used in Pakistan. According to Han et al [75], besides the usage of natural gas or conventional resources, harnessing solar water heating technology would meet the need of Pakistan's energy demand and also be significantly beneficial for economic growth, and social and environmental sustainability [46]. Moreover, solar water heaters are also used for various commercial and industrial purposes like laundering, homes, etc. [47]. Furthermore, the government should consider this technology and promote massive investment to meet the power of energy in rural areas like Baluchistan, and Cholistan areas, where grid connectivity is not reachable.

Solar Water Distillation

Solar distillation is an advance and environmentally friendly mechanics that are used to eliminate the NaCl and other heavy alloys from water that is used in daily life purposes [48]. This mechanization desalinizes the brackish water /or seawater by using different techniques. This technology makes seawater drinkable by using solar distillation techniques. It is an eco-friendly and cost-effective technology; hence it is much more favorable for rural areas by providing portable water by removing salt from seawater [49]. This makes it prospective technology to use in various areas of Pakistan where drinkable water is limited or has no fresh water like in Cholistan or the Thar Desert region.

Biomass

Biomass is generally extracted from plants, animals, or any agricultural waste like wood residue, energy crops, etc. [50]. It is exploited for many objectives, mainly for electricity in bucolic areas. Biomass is categorized into four major types

(I) Husk

(II) Metropolitan solid waste

(III) Animal debris

(IV) Plants remnant

Nevertheless, plants and animal residue are the major sources of biomass proffering. Each year, nearly a billion tons of biomass is generated from these resources, which have the potential to produce a feasible amount of energy without releasing harmful gases that affect the environment. Pakistan has the potential to generate 20,707MW of bioelectricity from biomass [51]. In areas where rice is grown, rice husk, a byproduct of rice milling, is commonly accessible. It is a fuel source for many industrial operations and has a high energy content. It is true that employing rice husk as a feed-stock in industry can help Pakistan, especially in rural regions, satisfy its energy needs. Pakistan is a large producer of rice, and rice husk, a byproduct of rice milling, is typically burned in open fields, contributing to air pollution, smog and the release of greenhouse gases. In addition to lowering greenhouse gas emissions, the use of rice husk as a fuel for industrial activities like power generation can also provide a cheap and sustainable source of energy. Also, it may open up new business prospects for farmers and rural enterprises. In Pakistan, a number of rice mills have already begun using rice husk as a fuel source to meet their energy needs. To lessen dependency on fossil fuels, there is still a big opportunity to increase the use of rice husk in other industries, such as the manufacture of cement. Hence accessibility of biomass is highly substantial from agricultural residue, livestock sources, and animal debris [52].

Bio-ethanol and Bio-diesel

Pakistan has substantial capability to generate bio-fuels such as bio-ethanol and bio-diesel. The production of these fuels will be helpful to lessen the oil demand and for the sustainability of economic growth [53]. Pakistan Sugar mills association is the organization that is accountable for the production of biofuel in the country. To maximize bioethanol production, sugars millers provide inducement and materials such as pesticides, and humus to sugarcane growers to increase crop proffering, to enhance bio-ethanol production [54]. In 2007, Pakistan has only limited mills (6 out of 80) that have the aptitude to convert raw molasses. Castor oil is beneficial to produce biodiesel, as in ambient temperature conditions. It is soluble in alcohol [55]. It is an inaugural source in Pakistan that is beneficial for biodiesel production and ultimately will not only provide sustainable economic growth but also be beneficial to meet the need of energy demand.

Unconventional Resources are Practically Possible or Impossible

Unconventional resources are generally not extracted directly or used specialized techniques to obtain fuel from deposits [56]. Although unconventional oil is difficult to extract now researchers use different techniques to extract it [57]. Pakistan is in the top 10 countries, having a big resource of shale oil and gas. About 105 TCF of shale reserves are present in Pakistan. Central Indus Basin has unconventional plays and is mostly gas producing area in Pakistan. The Southern Indus Basin is an oil and gas-prone area and has unconventional resources [58]. Tight gas and shale gas are present in this region. The coal present in the Lower Indus Basin has the capability of a coal bed methane reservoir. In the lower Indus Basin, Guru and pub formation is acting as a tight gas reservoir [59]. Shale is one unconventional resource but the problem is the huge investment required to extract it. Its reserve is mostly found in the densely populated region (Figure 1A). Shale gas production requires technological advancement and superfluous water. The elicitation of shale gas from a deposit can be done by hydraulic fracturing or by horizontal drilling [60].

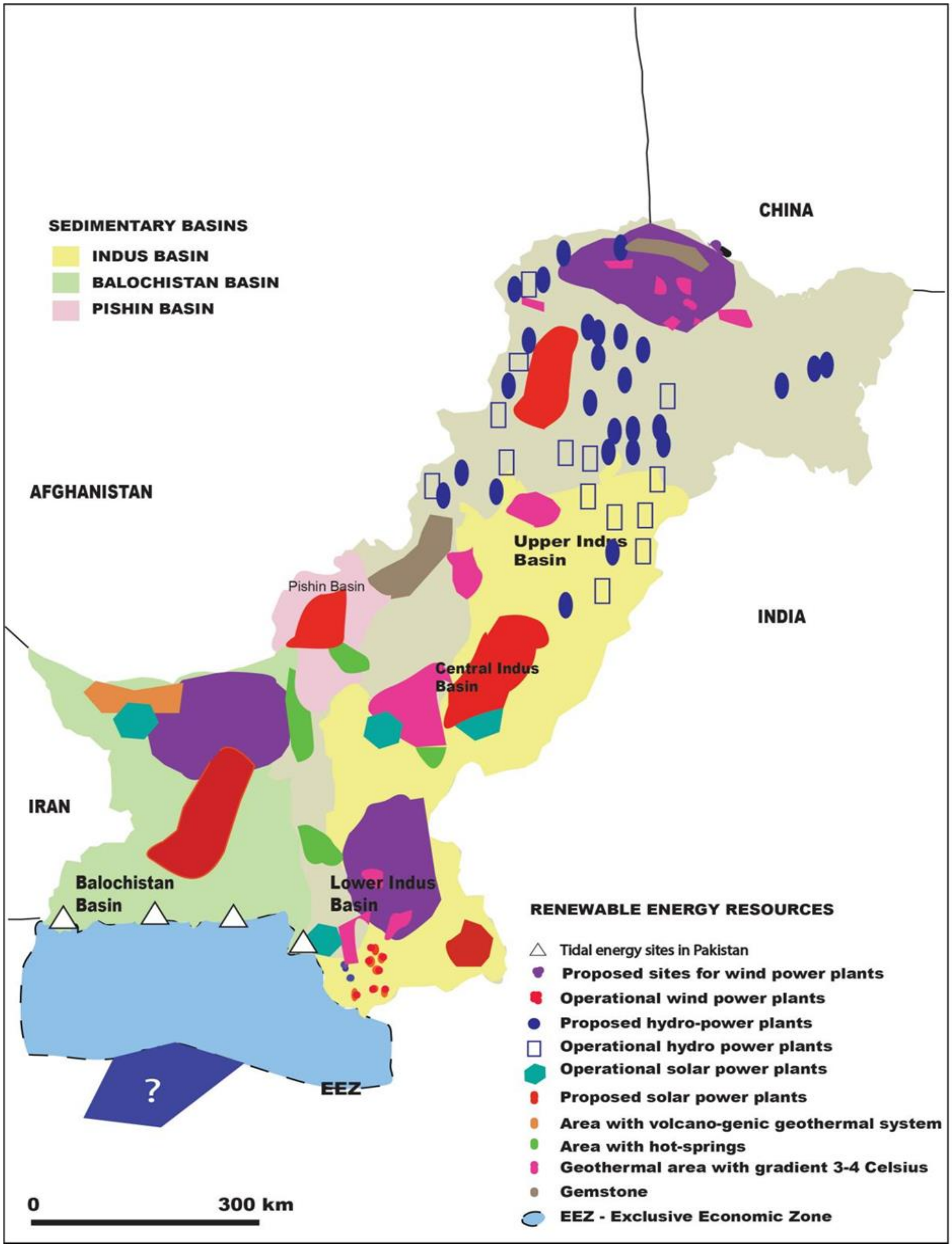

Figure 5: Map showing the renewable energy resources in Pakistan

Coal and Its Use for Energy Generation

Before the independence of Pakistan presence of coal deposits are known, but in 1980, its economical worth is accentuated, when huge reserves of coal were identified in different areas of Sindh Province [61]. Subsequently, this extensive discovery of coal. Pakistan become the 6th largest coal reserves nation in the world [61, 62]. In Pakistan, coal contributes only one percent of electric power generation.

Coal that has been discovered from Sonda and Sindh fields has exceedingly moisture, Sulphur and ash content. Larger reserves of coal are extensively present in different parts of Pakistan, like Punjab, Baluchistan, and Sindh [63]. In Thar, about 175 BT of coal has been discovered over 9,000 sq. km of area. In the Salt Range total coal field reserves are present at about 213 sq. km of area. The highest extraction has been taken from the Duki area, as it has one of the highest-quality coal in Pakistan [64].

In December 2021, about 7.523 tons of coal production was recorded in Pakistan (Figure 6).

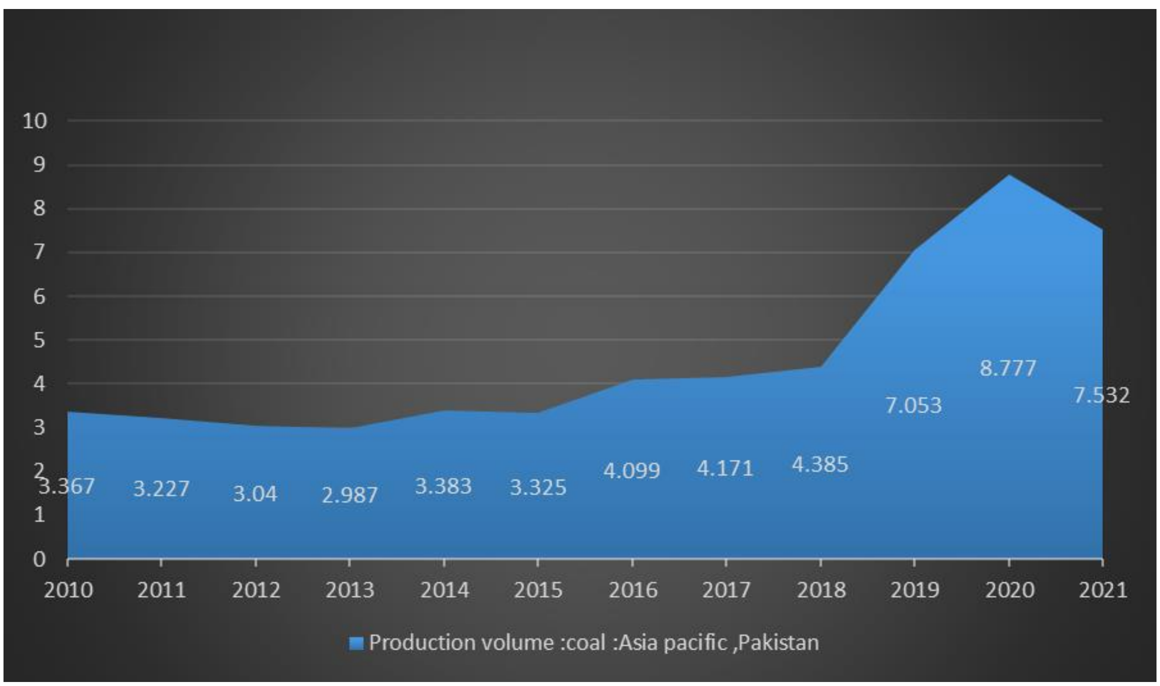

Figure 6: Production of coal in Pakistan since 2010

The coal is mostly used in Brick Kilns Industries and other factories such as textile and cement Pakistan is harnessing coal power plants that are part of CPEC (China -Pakistan Economic Corridor) for the generation of electricity [65].

Hydroelectricity is the Cheapest Form of Energy in Pakistan

Water is a major constituent of life, necessary for survival, moreover, it is also used for energy generation. Hydropower is associated with the generation of energy by dropping water from a height [66]. The kinetic energy of water is transferred into mechanical energy by a hydropower turbine by dropping the water from a highly elevated area and then used for the generation of electricity. The electricity production is directly linked to the height from where the water dropped. The higher the elevation, the higher will be the rate of generation of electricity and vice versa [67].

Higher demand for electricity and low supply lead to cause serious threats to our economy as shown in (Figure 7) thus, hydropower plays a vital role in the generation of the total energy mix in several countries of the world. In Norway, about 95% of energy generation comes from hydropower plants. Moreover, Canada generates 70%, Brazil 88%, and Australia produces about 65% of its energy from hydropower [68].

In Pakistan major rivers such as Ravi, Jhelum etc. falling into the Indus River can also contribute a part to the generation of electricity. More than 91 percent of fresh water is consumed for irrigation purposes in Pakistan, but its production per acre is less than in other countries. Pakistan has a capacity of 13-million-acre feet for the storage of its annual river flow [69].

Seawater reverse osmosis technology based on renewable energy. It is cost-effective and eco-friendly technology that is used in Pakistan for water supply for irrigation purposes [70]. According to the water policy, the main purpose is the production of electricity and to enhance water holding capability from hydropower by building dams by 2030 [71].

Building large dams are beneficial for economic growth and for the storage of water in the country, especially in developing countries but the building of new dams needs large investments and it's a time taking process [72]. Moreover, it also leads to a financial crisis, as more cost is required for purchasing equipment, and machinery. Besides this, the Indus River water policy conflict also exists which is a major hindrance to the development of hydropower projects.

Thus, besides constructing new dams, enhancing the capacity of the existing dam should be a more feasible option. This technology is much more feasible as it requires very little investment and time, and also increases the generation of electricity [73]. The extension of the Tarbela Dam is the best example for enhancing the generation of electricity from the existing dam by enhancing the storage capacity of the dam.

The Government of Pakistan is putting all its consideration to increase the generation of energy by developing new power plants and by enhancing the water storage capacity area [74]. Its shows that more generation of electricity and energy will lead to an increase in economic growth, also beneficial for the environment, and social sustainability.

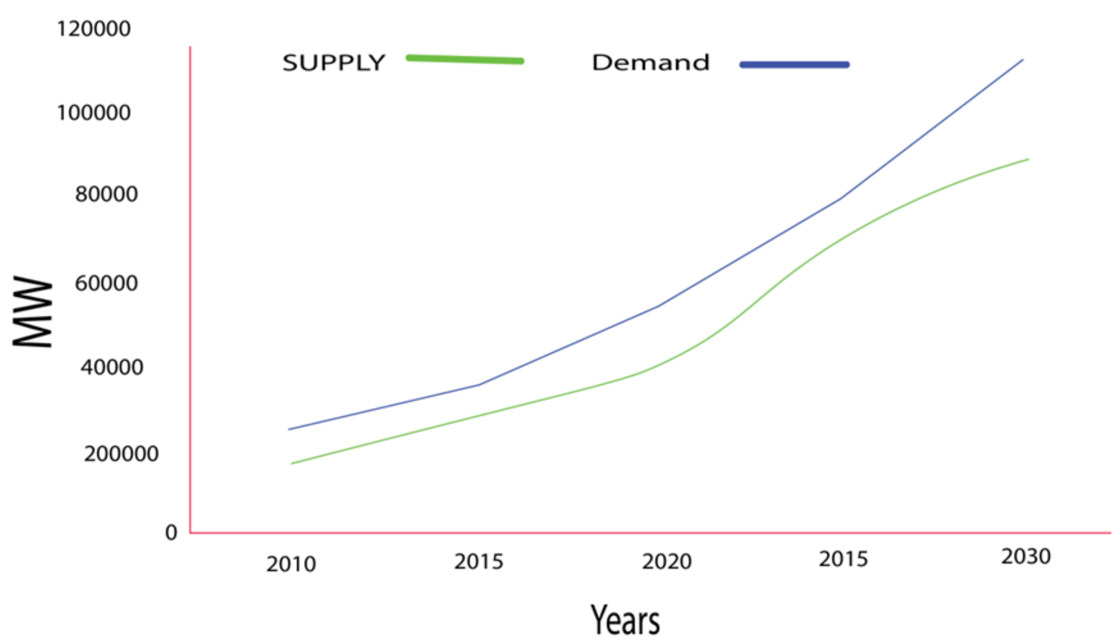

Figure 7: Electricity demand and supply in Pakistan over the years

Rainwater Harvesting and Making Larger Dams under Cities like Lahore

In the urban area and rural areas, water and roads are the lifelines that are important for the development and sustainability of socioeconomic conditions. According to UN-HABITAT utilizing the rainwater harvesting technique is helpful for sustainability, and helps to tackle the shortage of water [75]. Harnessing the rainwater harvesting technique is significantly helpful to urbanizing half of the population by 2025 by providing water in those areas where water is not available [76].

The biggest provocation in the world is water scarcity, especially in developing countries like Pakistan. Pakistan's population is increasing day by day which poses a challenge to Pakistan's economy as its increase's expenditures on health, and education infrastructure and we have limited conventional resources to tackle this problem.

Due to the increase in Pakistan's population, the availability of fresh water is decreasing [77]. Thus, to store the rainwater and reuse it, rain water harvesting technique is used.

Rainwater Storage Sites

In Lahore, the groundwater aquifer is only the source of water supply. Currently, at 2900 acre-feet of area, about 1800 tube wells are installed. The rate of extraction of water per day from these tubes is 3500 AF [78]. Due to increasing population and increasing water demand, extraction of groundwater has been increased, that's why grounder water resources are depleting day by day. Therefore, using rainwater for the artificial recharge of groundwater is one of the valuable options for the augmentation of groundwater resources in Lahore.

The concept of rainwater harvesting technique is not new, in many parts of the world (Australia, Brazil, China, Greece, India, Bangladesh, Iran, Pakistan, Indonesia, Hawaii, Kenya, Thailand, Germany, Guatemala, Ireland, Jordan, Namibia, Singapore, Malaysia, South Africa, Spain, Sweden, UK, USA, Taiwan, and Zambia) [79].

In Malaysia, Rain Water Harvesting technique is also used because of water availability issues. The rainwater harvesting technique was applied to a pilot project at Gaddafi stadium to avoid the mixing of water and for the generation of artificial recharge of groundwater [80].

Geothermal Energy

Geothermal reservoirs are naturally occurring reservoirs that have hydrothermal resources [81]. These reservoirs are present underground with a greater depth Geothermal energy comes out to the surface in the form of volcanoes, fumaroles, hot springs, and geysers. Mostly along tectonic plate boundaries, geothermal resources are present [82]. Ring of Fire is considered to be one of the most active geothermal areas. The tectonic framework of Pakistan suggests that it has a considerable number of exploitable sources of geothermal energy as several fumaroles, and hot springs are present in Pakistan areas [83]. In Pakistan, geothermal resources are used for various purposes such as healing and physical therapy, cooking, space heating etc. [84].

Geo Pressurized System

In an impermeable bed, normal heat flow is trapped in it. These are present at a specific depth, mostly ranging from 6,000 km and having a temperature of less than 93 or more than 150 [85]. In Pakistan geo pressurized systems are present in Indus Basin and Potwar Basin. The Suleiman and Kirthar areas are have geothermal zones [86]. The Kharan area which is almost parallel to Chagi Volcanic Arc is associated with magmatic zones [87].

Discussion

Pakistan's oil and gas production has been increasing over the year but it has not been enough to fulfill the demand of the public. Many oil and gas fields have been dismissed because they are far from areas having accessibility and pipeline issues. Now, if we see the geology of Pakistan, it has very complex geological provinces, topography and elevation differences that are very unique so, this unique geology setting helps harness energy from renewable energy like solar wind etc. We have large reserves of coal having a low quality that can be used for coal bed methane by burning in the subsurface for generating energy for generating electricity. Moreover, offshore we have in Makran has huge potential for methane hydrates and having pressure in the subsurface can use for providing adequate energy. We have mud volcanoes for the generation of steam and substitution for the generation of heat and electricity. Area of Baluchistan, where the winter temperature is very low, use wood for heat production so, by using these renewable energies we can save the environment. Deserts like Thar, Cholistan and Thal are promising for solar energy and have an immense supply of silica and quartz that are used in Industry. Similarly, it's time to explore more basins, by using advanced techniques. In the end, we can say that by providing proper infrastructure, railway tracks and road connectivity to those areas that are sparsely far from each other can be used for energy resources.

Conclusions

1. Pakistan is being targeted to run out of energy resources, leading to a low economical stage. However, a major hindrance in the development of Pakistan is importing energy resources rather than untapping their indigenous ones.

2. Our venture to evaluate different energy reserves, Moreover, to less dependent on importation from other countries. It seems to be tough until rigorous measures would be taken to meet the need of energy demand in Pakistan.

3. Some geological initiatives, such as seismic durveys, drilling can enhance the production of energy resources.

4. Moreover, Pakistan is a developing country, and for the high demand of Industrial and machinery sectors, alternative energy resources i.e., renewable energy is one of the remedies to meet the need.

Author Contributions
SHA developed the concept, writing, editing; KZ and RUF collected the dataset, illustrations, AH helped in the ARCGIS digitization; AW, NS and YB worked in reviewing, paraphrasing and proof-reading of this book chapter.

Acknowledgments
The authors would like to thank the University of Sargodha for providing facilities for lab facilities and digitization of maps and illustrations.

Conflicts of Interest
The author declares no conflict of interest.

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