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Analyzing Pakistan's Energy Policy: Evaluating the Energy Mix and Climate Challenges

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Abstract

This paper investigates the intricate relationship between Pakistan's economic growth and its energy supply, highlighting the government's active pursuit of long-term and sustainable energy provision strategies. Despite efforts such as LNG importation and hydrocarbon infrastructure development, the nation's heavy reliance on non-renewable energy sources significantly contributes to global CO2 emissions, exacerbating climate challenges like glacier melt and rising temperatures. Addressing this, the research underscores the need for an integrated energy policy to ensure reliability, efficiency, and affordability. Drawing on quantitative data from HDIP and governmental policies, alongside international and local research papers, the study examines Pakistan's energy mix, sectoral utilization, organizational structures, and greenhouse gas emissions. Findings reveal a heavy reliance on hydrocarbons compared to regional counterparts, with untapped potential in renewable energy sources. Policy analysis highlights the importance of transitioning away from imported fuels while emphasizing reliable and affordable electricity provision. The study also sheds light on Pakistan's dominant energy consumption by the domestic sector, driven in part by imported fuels, posing economic challenges. Climate change implications, including CO2 emissions from imported coal usage, underscore the urgency of prioritizing indigenous and renewable resources. Recommendations include devising an integrated energy policy, promoting solar panel adoption, transitioning to indigenous coal, and exploring unconventional coal usage. Bridging the gap between policy statements and practical implementation is identified as crucial for sustainable energy and climate resilience in Pakistan.

Keywords: Economic Growth, Climate, Energy Policy, LNG, HDIP

The economic growth of the country is fully dependent over the supply of energy to all its avenues. Government of Pakistan is making efforts to increase its energy supply in long term and sustainable manner especially focusing on imports of LNG, development of hydrocarbon infrastructure and removal of constraints for smooth supply of electricity. On the other side, the main reason of increasing global temperature is due to emission of CO_2 resulted from burning of fossil fuels. The increasing temperature has caused melting of glaciers and warming the earth crust[1].

Statement of Problem

Pakistan primary energy mix is highly dependent over the non-renewable sources. The sector is disintegrated and regulated by different departments. Integration and formulation of Energy Policy to balance & ensure reliable, efficient and affordable energy is required.

Scope

This report aims to discuss the forms, types, sources and usage of energy in global perspective, energy mix and its importance in the country. The study will enlighten the sectoral energy utilization, administrative & organizational structure, types & causes of GHGs, comparative analysis of energy mix and conclusion & recommendations.

Methodology

This study has been conducted using quantitative energy mix data published by HDIP and referring the Government policies notified by Petroleum, Power Divisions and Climate Change. Local and international research papers available on internet have also been considered while concluding this study.

1. Energy

As per scientists, energy is defined as the ability to do work, it can be changed from one form to another. The primary sources of energy are categorized as renewable or non-renewable. These sources can be used to produce useful secondary energy sources such as electricity and hydrogen.

[1] National Climate Change Policy 2021

The sources of non-renewable energy are limited to the amounts that we can mine or extract from the earth which are Hydrocarbon liquids, Natural gas, Coal and Nuclear substances. The non-renewable are replenishable in the nature and comprised over Solar, Geothermal, Wind, Biomass, Hydropower. Types of energy are illustrated in figure-1.

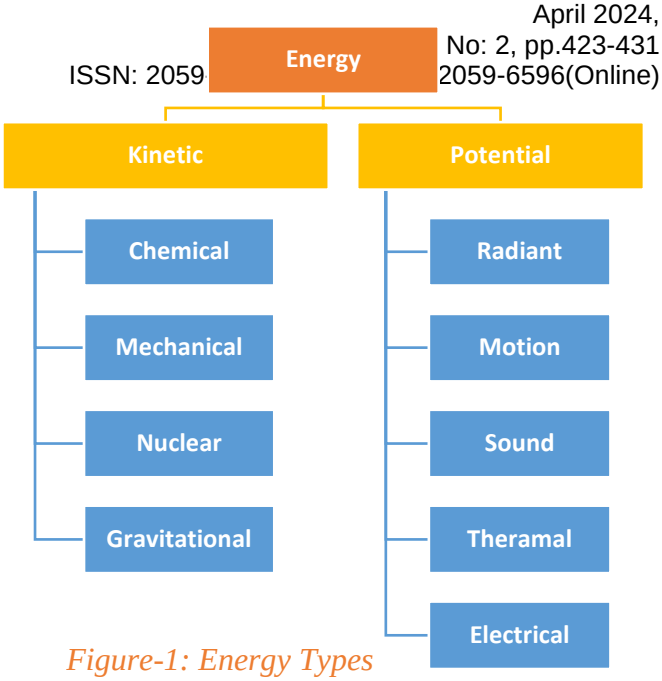


Figure-1: Energy Types

Energy Importance

In view of rising economic development in the world, energy demands have been raised manifolds. The foreign policy analysts are of view that the national security is directly linked with energy resources management which ensure food security and ultimately moves the wheels of economic development. The economic development of the country plays vital role in describing the foreign policy[2]. Accordingly, GoP has accorded 1st priority to "Affordable & Clean Energy" in its national SDGs[3]. Interdependence of food security on security of natural resources, and economic and political security is shown in Figure-2 [4].

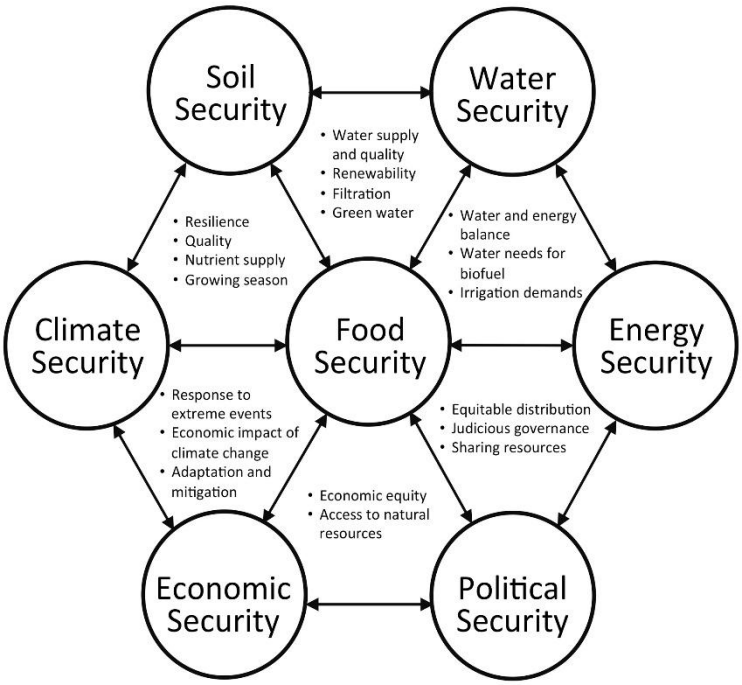


Figure-2: Interdependence of food, security & natural resource

Energy Mix

Regional Scenario

Pakistan's energy mix heavily depends on hydrocarbon as compared to regional

[2] Energy and National Security of Pakistan, NDU Journal, 2021
[3] (https://www.sdgpakistan.pk/web/sdgs, 2022)
[4] (https://flores.unu.edu/en/news/news/taking-hunger-out-of-the-poverty-equation-food-security-and-the-sdgs.html, 2021) accessed on October 29.2022

countries. The development of indigenous coal resources and utilization of imported coal play vital role in improving the country's future energy mix. The regional & neighboring countries China and India have focused on local resources of coal, hydro and renewable resources whereas, USA the largest hydrocarbon producer is paying attention to balance its energy mix (Table-1).Comparison of Energy Mix

Table-1 (In %)

Source	USA[5]	China[6]	India[7]	Pakistan
Oil	36	19	0.1	27.2
Gas	32	9	6.3	40.7
Coal	11	55	52.8	19
Hydro	2.28	8	11.7	9.2
Nuclear Electricity	8	2	1.7	2.6
Renewable Electricity	9.72	7	27.5	1.2

1.1.1. Renewable Resources of Pakistan

Despite the fact that Pakistan has strong potential of renewable energy sources but the country is far behind in its utilization. The wind survey data shown that vast area of 9,750 km^2 with a high wind speed at "Gharo-Corridor" can only produce 11,000 MW (Figure-3). Moreover, majority of the country's area receives solar radiation at an average of 08 hours per day. These radiation level have the potential to generate about 2,900,000 MW of solar power[8]. The country has been estimated hydropower generation capacity of around 42,000 MW, but only 16 %, has been exploited so far.

1.1.2. Energy Mix

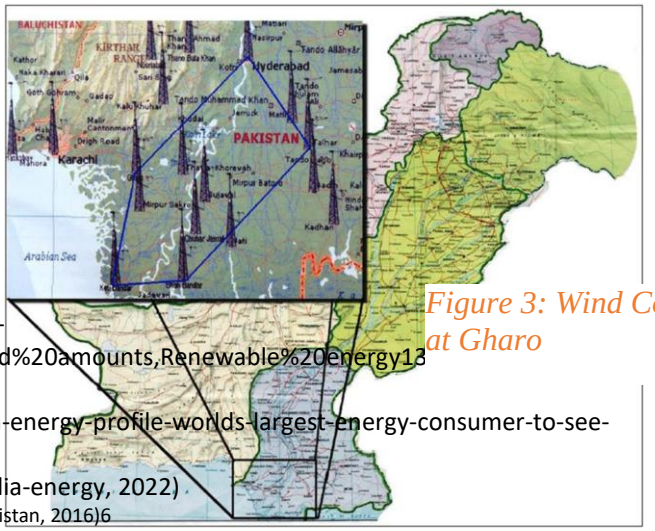


Figure 3: Wind Corridor at Gharo

[5] (https://www.eia.gov/energyexplained/us-energy-facts/#:~:text=The%20percentage%20shares%20and%20amounts,Renewable%20energy13 2021)accessed on October 29, 2022
[6] (https://www.eurasiareview.com/06092022-china-energy-profile-worlds-largest-energy-consumer-to-see-increase-in-demand-analysis/, 2022)
[7] (https://trade.gov/country-commercial-guides/india-energy, 2022)
[8] (Renewable Energy Deployment to Combat Energy Crisis in Pakistan, 2016)6

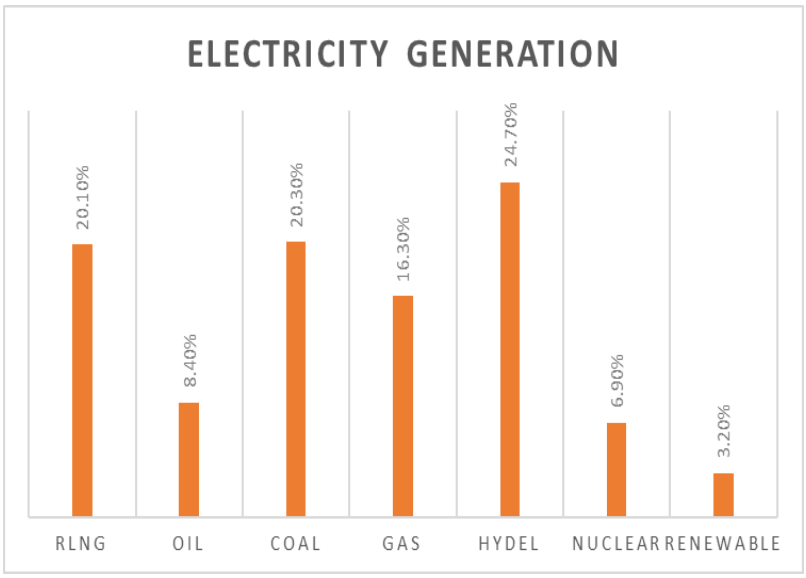
Hydrocarbon remained the major contributor in the primary energy supplies with 67.9% followed by coal 19%, whereas, renewable electricity accounted only 1.2%. Half of energy is imported. The utilization of energy lead by industrial sector with 40.08% and followed by the transport 29.88%, domestic consumption accounted 20.98% and agriculture remained at lowest consumer with 1.41%. Data of last five years of energy supplies is tabulated in the following Table-2 and electricity generation by source is illustrated in Figure-4.

Primary Energy Mix – 2020-21

Table – 2 (In %)

Source	Financial Year				
	2016-17	2017-18	2018-19	2019-20	2020-21
Oil	34.4	31.2	25.7	22.6	25.9
Gas	37.9	34.6	35	3.1	29.3
LNG Import	5.6	8.7	10.6	10.3	11.4
LPG	1.3	1.2	1.1	1.3	1.3
Coal	8.1	12.7	15.4	18.2	19
Hydro	9.7	7.7	7.8	9.9	9.2
Nuclear	2.1	2.7	2.8	3.2	2.6
Renewable	0.8	1.1	1.3	1.2	1.2
Imp. Electricity	0.1	0.2	0.1	0.2	0.1

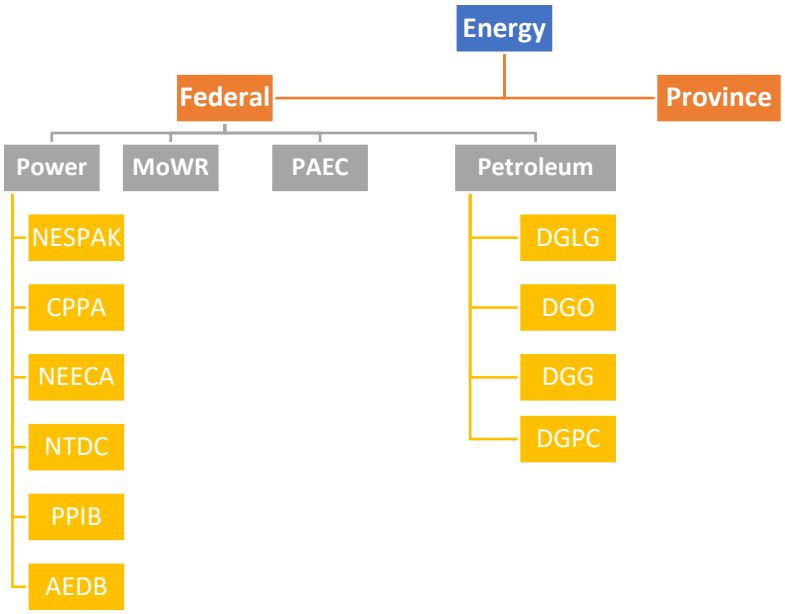
Figure-4: Electricity generation by source



1.1.3. Administrative Structure

The energy sector of Pakistan is governed the through Ministry of Energy consisting over two Divisions i.e., Petroleum and Power. Petroleum Division is responsible to handle all matters relating to hydrocarbon. Power Division is entrusted with the responsibilities for development of power resources and electric utilities. Ministry of Water Resource has the

mandate to develop hydro resources of the country[9]. A Federal Agency, PAEC is charged with the peaceful uses of atomic energy interalia for nuclear power generation. NEPRA and ORGRA have been assigned role of regulatory bodies for tariff determination of electricity and petroleum products respectively. Article 157 of the Constitution allows Provincial Governments to construct power houses, grid stations, lay transmission lines, determine the tariff for distribution of electricity within the province[10].



1.1.4. Energy Mix & Climate Change Policies

Existing Public policies in the country in respect of energy supplies and climate change at federal government level are tabulated as follow (Table-3):

Sr. No.	Sector Policy Description	Remarks
1.	Petroleum Policy 2012 Natural Gas Allocation and Management Policy 2005 Liquified Natural Gas Policy 2011 LPG Production and Distribution Policy 2016	Dealing all matter related to exploration and production of oil & gas sector
2.	National Electricity Policy 2021 Alternative & Renewable Energy Policy 2019 National Policy for Power Co-Generation by Sugar Industry	Pertains to power generation
3.	National Water Policy	River system
4.	National Climate Change Policy 2021	Climate
5.	Nuclear substances	Strategic resources

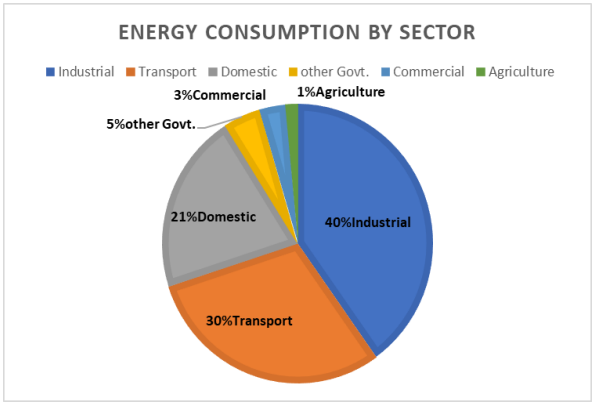
[9] Rules of Business - 1973
[10] Constitution of Islamic Republic of Pakistan

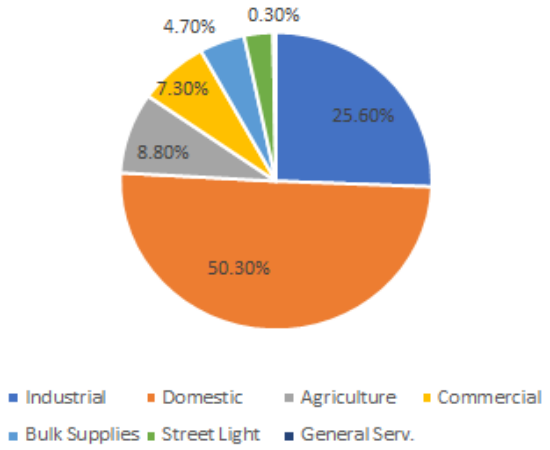
6.	Coal Sector	Provincial subject

The National Electricity Policy – 2021 emphasize over the provision of reliable, secure, efficient and affordable electricity. The imported fuel will be gradually reduced and attention will be paid to local resources comprising coal, gas etc. to reduce greenhouse gas emissions.

1.1.5. Energy Consumption

Pakistan used almost 21.30% of its thermal fuels in power generation and, in the same year, the domestic sector consumed 50.3% of the final electric besides direct consumption of 21.52% of the thermal fuels. Pakistan is feeding its domestic demand primarily through imported fuels, which is not economically sustainable[11]. Primary energy and electricity consumption by sector is shown in Figure-5.





Climate Change

Climate change refers to change of weather patterns due to emission of greenhouse gases which trap the heat from releasing in to the upper atmosphere. Climate change is key challenge of 21st century. Among the GHG, CO_2 is considered as a major contributor to global warming produced through burning of fossil fuels. Besides CO_2, other gases involve CH_4, N_2O and others. Increase in the earth temperature is resulting extreme weather and related events, such as glacier melting, sea-level rise, flood, wildfires, severe droughts etc.

11 Energy Security in Pakistan: A Quantitative Approach to (ADBInstitute, 2019)A Sustainable Energy Policy - 2019

Major contributors of GHGs are China, USA, India, EU etc. As per US Environment Protection Agency data, share of different gases in total GHGs mare as under[12]:

Gas	Share (%)
CO_2 [due to fossil fuel & industrial process]	65
CO_2 [deforestation and other land use]	11
CH_4 [agriculture & waste]	16
N_2O [fertilizer use in agriculture]	6
Fluorinated gases [industrial & refrigeration]	2

Pakistan is CO2 emissions is increasing gradually where emission from coal witnessed highest growth during recent preceding years. Major reason is use of imported coal for power generation which contributes nearly quarter to the total CO2 emissions

Conclusion

Government is endeavoring to import LNG through long term contracts and electricity generation on imported coal to meet the energy demands which is increasing pressure on foreign exchange. Whereas, presence of massive potential of renewable resources and indigenous coal resources are not fully considered for robust development. Number of policies statements are present for development of alternative energy resources and utilization of available resources. There is gap in between guidelines and practical approach.

Recommendation

Looking forward, the country needs to increase the share of alternative energy sources. After going through the literature, following recommendations are proposed:

1. Devise energy policy integrating all sources with targeted contribution
2. Domestic sector consumed half of electricity therefore, mechanism for provision of solar panels is proposed
3. Conversion of imported coal power plant to indigenous coal
4. Introduce non-conventional use of local coal i.e., conversion into gas/liquid

[12] (https://www.epa.gov/ghgemissions/global-greenhouse-gas-emissions-data, 2022)

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