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CENTRE FOR PEACE, SECURITY AND DEVELOPMENTAL STUDIES

# Energy Security Policy Proposal

June 2019

# Energy Security Policy Proposal

**A Sequel to National Seminar on Energy Security: Thinking Beyond the Norm**

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Center for Peace Security and Development Studies (CPSD) is an outreach of Dadabhoy higher educational pursuits – a nonprofit public policy organization based in Karachi and Islamabad. CPSD – an independent, nonpartisan, and multidimensional forum – conducts research on security, political, and economic issues of national and international importance.

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# ABOUT CPSD

The Centre for Peace, Security and Developmental Studies (CPSD), an outreach of Dadabhoy higher educational pursuits, is a nonprofit public policy organization based in Karachi and Islamabad. CPSD - an independent, non-partisan, and multidimensional forum - conducts research on security, political, and economic issues of national and international importance. CPSD promotes innovative ideas and is a platform of cutting-edge analysis for informed decision making.

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# ABBREVIATIONS

| | |
|---|---|
| AEDB | Alternative Energy Development Board |
| AJK | Azad Jammu and Kashmir |
| CASA-1000 | Central Asia South Asia 1000 Project |
| CGE | Canadian General Electric (Now GE Canada) |
| CHASNUPP | Chashma Nuclear Power Plant |
| CPEC | China Pakistan Economic Corridor |
| CPPA | Central Power Purchasing Agency |
| CNNC | China National Nuclear Corporation |
| CNG | Compressed Natural Gas |
| CZEC | China Zhongyuan Engineering Corporation |
| DISCOs | Distribution Companies |
| FATA | Federal Administrated Tribal Areas |
| FESCO | Faisalabad Electric Supply Company |
| GENCOs | Generation Companies |
| GOP | Government of Pakistan |
| HESCO | Hyderabad Electric Supply Company |
| HDIP | Hydrocarbon Development Institute of Pakistan |
| IMF | International Monetary Fund |
| IP | Iran-Pakistan Pipeline |
| IPPs | Independent Power Producers |
| KANUPP | Karachi Nuclear Power Plant |
| KE | Karachi Electric |
| KESC | Karachi Electric Supply Corporation |
| KfW | *Kreditanstalt für Wiederaufbau* (German Development Bank) |
| KPK | Khyber Pakhtunkhwa |
| MEPCO | Multan Electric Power Company |
| MOE | Ministry of Energy |
| MOF | Ministry of Finance |
| MSW | Municipal Solid Waste |
| LNG | Liquefied Natural Gas |
| LPG | Liquefied Petroleum Gas |
| NEA | National Energy Authority |

| | |
|---|---|
| NEECA | National Energy Efficiency and Conservation Authority |
| NEPRA | National Electric Power Regulatory Authority |
| NFEH | National Forum for Environment and Health |
| NPP | Nuclear Power Plants |
| NSG | Nuclear Suppliers Group |
| NTDC | National Transmission and Dispatch Company |
| O&M | Operation and Maintenance |
| PAEC | Pakistan Atomic Energy Commission |
| PCAT | Pakistan Council for Appropriate Technology |
| PCRET | Pakistan Council of Renewable Energy Technology |
| PEPCO | Pakistan Electric Power Company |
| PESCO | Peshawar Electric Supply Company |
| PMD | Pakistan Meteorological Department |
| PME | Protective Multiple Earthing |
| PPAF | Pakistan Poverty Alleviation Fund |
| PPIB | Private Power and Infrastructure Board |
| PPL | Pakistan Petroleum Limited |
| PSDP | Public Sector Development Program |
| QESCO | Quetta Electric Supply Company |
| RLNG | Re-gasified Liquid Natural Gas |
| SBI | Sindh Board of Investment |
| SEPCO | Sukkur Electric Power Company |
| SNGPL | Sui Northern Gas Pipelines Limited |
| SOEs | State Owned Enterprises |
| SOPs | Standard Operating Procedures |
| SSGCL | Sui Southern Gas Company Limited |
| TAPI | Turkmenistan Afghanistan Pakistan India Pipeline |
| UFG | Unaccounted For Gas |
| WAPDA | Water and Power Development Authority |

# Executive Summary

Pakistan has been dealing with a severe energy crisis for over 40 years. While the apparent issues seem to be frequent power outages, increasing gas load-shedding, and disrupted supply of transportation fuel, these are mere symptoms of a far more complex and costly issue. With energy as a fundamental element of national security, Pakistan's current experience can be best described as energy insecurity. From the geopolitical perspective, energy security is critical for national sovereignty. From the angle of geo-economics, heavy energy imports and volatility in the international market are a constant concern for the economic security of Pakistan.

The importance of energy security has been established in the world. The first chapter of this proposal presents an overview of energy security policies of three major powers: China, India, and the USA and compares them with the energy security of Pakistan. A closer view of Chinese, Indian, and American energy security policies reveals that the emerging and established powers of the World are making efforts to make their energy supply more reliable and cost-effective. In comparison, Pakistan does not recognize energy as an integral element of security and, hence, the energy crisis has not yet received the attention it deserves. The Chapter ends with highlighting the objective of the current document.

The second chapter presents the current and desirable contours of the energy security policy of Pakistan. The current contours of the energy security policy in Pakistan are based on ad hoc measures and reliance on conventional means of energy production. An analysis of different sources of energy supply in Pakistan showed huge dependence upon energy imports, with a very large share of oil and gas in the energy supply, lack of investment in exploration of indigenous reserves, delay in hydropower projects, and lack of attention to alternative and renewable energy resources. Hence, the desirable contours of energy security policy proposed herein are founded on three pillars: Optimizing and Efficiently Managing the Demand and Supply Structure of Energy Resources, Increasing Alternative Energy Share in the Supply Mix, and Securing Long-Term Commitment from Reliable External Resource Rich Suppliers.

The third chapter highlights the issues pertaining to the current energy governance structure in Pakistan. It explains that the current energy governance structure is fragmented. There is absence of a single policy document addressing all sectors in the energy industry. Instead, each institution follows its own policies creating a competitive policy structure instead of a complimentary one. Linked to this institutional complexity and policy inconsistency is poor financial governance in the energy sector. Circular debt, transmission and distribution losses, electricity and gas theft, and corruption are a constant threat to the economic sustainability of energy investments.

The solution to this poor energy governance issue lies in establishment of National Energy Authority (NEA) and a single energy ministry. The fourth chapter sheds lights on NEA, its composition, objectives, organizational structure, and operational framework. NEA is proposed to be a policy making institution connected to all entities in the energy sector, to ensure policy implementation, and to revise its policies according to shift in demand and supply. The role of energy ministry is to assist NEA in implementation of the energy security policy.

This last chapter of the document presents a clear policy statement and identifies goals that should be achieved through an energy security policy. Practical recommendations with respect to each policy goal are also provided. These policy goals and recommendations are for guidance of policy makers in Pakistan and should be given due attention.

# Chapter 01: INTRODUCTION

## Energy and Security

Security is a central prerequisite for survival of any state. In fact, the very idea of modern nation-states resides on the concept of a social contract for the provision of security in exchange for sacrifice of individual freedom. However, the contemporary notion of security, based on the writings of Barry Buzan, is much broader, inclusive, and human-centric.[1] Among the many dimensions of the post-modernist construct of security, energy security is one that that has been widely recognized in recent times. While the concept has been considered in theory only recently, access to inexpensive energy has been the quest of nations and societies since industrialization. This quest led European powers to scramble for energy resources in Asia and Africa through colonization.[2] Oil has not only fueled wars between states but has also led to intra-state conflict. Of late, non-state actors have also started sustaining themselves financially by trading oil in the black market.

While there is no universal understanding of energy security as a concept, the central idea is linked to how energy sufficiency provides political and economic security to the state. Through the course of this document, the term "energy security" refers to "energy supplies that are sustainable, continue without any hindrance, and avoid price volatility for end consumers." Hence, for the optimum level of synchronization of national and energy security, the state needs to be self-sufficient and self-reliant in ensuring energy supply. For achieving this objective, it is necessary for any state to design a formidable energy security policy. Pakistan can learn lessons from major countries like India, China, and USA on developing energy security policy, examining how each country's policy pays attention to the specific opportunities for and challenges to energy security objectives.

## Indian Energy Security Policy

The energy supply mix of India is quite diverse. However, the three key resources of Indian energy supply are oil, gas, and nuclear technology. Expansion and growth in these resources will decide the future Indian energy security. India is currently relying heavily on imports to meet its oil and gas requirements. Consequently, Indian energy policy is aimed at bridging the gap in oil production and consumption. For this purpose, the government is investing heavily in the upstream oil sector and trying to export its oil resources to other countries.

The main investments of Indian oil exploration sector are in Sudan and Russia. Although there is domination of public enterprises in the oil and gas sector, India is also engaging private sector companies in order to enhance its capability. Similarly, the government of India is investing heavily in the nuclear energy sector, eyeing the target of producing 50,000 MW of electricity through nuclear energy by the year 2050.

## Chinese Energy Security Policy

With the growing demand for reliance and consistent energy supply in the current era of advanced technology, China is also putting greater emphases on effective development of their energy security. Domestic energy resources fulfill about 90 percent of Chinese energy demands as China invests heavily on the exploration of indigenous resources such as oil and coal. Chinese energy security policy also has a growing focus on the development of renewable energy resources, particularly solar. One of the main

objectives of China's shift to renewable energy resources is to protect the environment from the emission of greenhouse gases. Under this policy, China is promoting the use of hybrid vehicles.

China has used its diplomatic channels wisely and effectively to avoid the disruption of safe and secure transportation of their imports from the other energy-rich regions. In the last few years, Chinese and Russian companies have culminated many partnerships for the development of each other's energy resources. With the growing turmoil in the Middle East, China has revised its energy security policy. It is now paying more attention to collaborating with states like Russia, India, and the United States instead of purchasing energy resources from the Middle East.

## United States' Energy Security Policy

Across the last few years, the United States has felt the need to modify its energy security policy, with additional focus on market compatibility and environmental sustainability as core objectives. Being a world power and among the top ten consumers of global energy supply, the US has a responsibility of not only making lives of its citizens better but also securing the rights of other countries affected by US exploitation of natural resources. Hence, the US government started taking initiatives for the reduction of greenhouse gas emission at the global level. In this context, the US' contribution was commendable in the culmination of Paris agreement in 2015. However, due to the change in the presidency after 2016 elections, the US backed out of the agreement.

Under the Obama administration, the US designed a three-pillared policy for effective energy security. The first pillar was resolving the growing environmental problems through the decarbonization of the economy. The second pillar was to gather substantial support for addressing the issue of greenhouse gases. This means that the US would support its allies for the development of sustainable energy systems, ensuring that its' allies were not dependent on any other energy exporting state to fulfill their energy requirements. This would have guaranteed consistency of the green energy initiative of the US extending to allied states as well as safeguarding US political and economic interests. The third pillar was to address energy liberalization so that a free and transparent market is developed for acquiring energy resources. The current administration, however, is not following this three-pillared approach. Taken together, the US energy security policy is not consistent and is dependent on the ideology of the Republican and Democratic parties.

## Energy Security Policy of Pakistan

Pakistan has been dealing with an energy crisis for almost half a century. Unfortunately, it has not been able to solve this crisis due to different agendas and policies of the multiple energy bodies and organizations in the country. Instead of complementing each other, there is usually a clash of ideas in these policies, which leads to a deadlock in decision -making, further aggravating the energy crisis. The national security policy of Pakistan does not recognize energy as an integral element of security and, hence, the energy crisis has not yet received the attention it deserves.

The energy crisis impedes the independent foreign policy of Pakistan. Since its allies and regional rivals have vital strategic energy needs of their own, more powerful states dictate their terms while Pakistan remains dependent upon foreign markets and events. The geo-strategic and geo-economic rivalry will fuel oil wars and energy politics. Impending competition over shipping lanes and oil pipelines may further worsen energy resource scarcity in Pakistan.

In addition to geo-political and geo-economic challenges of energy security, the confidence of citizens in the Pakistani state is also faltering. Pakistan has been unable to meet the energy needs of people. The surge in oil and gas prices has stifled economic growth. Import of coal and gas to diversify the energy mix has further increased the import bill widening the current account deficit. Adding to the

woes of the economy is the power crisis, which is due to power evacuation bottlenecks, governance and managerial issues, electricity theft, and non-recovery of bills from consumers. All of these challenges lead to rising energy cost, which is one key issue for the economic security of Pakistan.

The crisis should not to be seen as an outcome of a lack of resources. Endowed with the world's largest reserves of coal and a largely unexplored area of petroleum energy resources, investment in the upstream sector can make Pakistan self-reliant in energy. Pakistan also has tremendous potential in renewable energy resources such as solar, wind, bio-energy, and hydel power. Unfortunately, such resources have been inadequately exploited. Pakistan's energy mix needs a greater share of renewables to offset relatively expensive imported fuel. Similarly, for energy imports, Pakistan is at the center of various pipeline routes. However, due to the absence of a defined security policy, the country has been unable to utilize this advantageous strategic position to its optimum potential.

The energy security policy proposal is, therefore, an answer to the current energy crisis in Pakistan. The proposal does not only pay attention to the economic and infrastructural challenges to the energy sector but also addresses the national security concerns linked to the absence of energy security policy. This policy proposal is the outcome of a well-designed inductive research methodology. The research began with a review of reports and research studies on energy security issues of Pakistan. It was followed by a roundtable discussion on alternative and renewable energy to see why the sector has failed to develop in the last decade despite high potential and low cost. Finally, a seminar was conducted with representation from key organizations in the sector like Water and Power Development Authority (WAPDA), Alternative Energy Development Board (AEDB), Pakistan Petroleum Limited (PPL), Pakistan Atomic Energy Commission (PAEC), and others. As a result, the policy document developed is an amalgamation of the key findings from analytical reports and research papers published on the energy crisis in Pakistan as well as the policy recommendations presented by the speakers in roundtable and seminar.

The document is composed of five chapters. In the first chapter, a brief background of the problem has been outlined to set the stage. The next chapter on contours of energy security policy provides details of the elements of the current energy supply structure of Pakistan, explains the issues in the energy supply mix, and presents three desirable contours of energy security policy. The third chapter is on the current energy governance structure of Pakistan. It explains three key concerns in the energy governance: institutional complexities, inconsistent policies, and poor financial governance. The fourth chapter provides solution to these three concerns in the form of NEA – a policy-making institution connected to all entities in the energy sector. The fifth and last chapter gives out the policy statement, policy goals, and recommendations with respect to each policy goal. The practical recommendations in this chapter are precise and tangible, with the intention that the policy makers would use this proposal as a blueprint for building the energy security policy of Pakistan.

# Chapter 02:

# CONTOURS OF ENERGY SECURITY POLICY: CURRENT AND DESIRABLE

## Introduction

Since energy is produced through multiple means, the most important feature of the security policy is to identify its contours – the elements on which to build the energy supply structure. This chapter presents the current contours of energy security in Pakistan and discusses the associated challenges. Based on an analysis of the challenges, recommendations for desirable contours of energy security policy are also shared. Briefly, the desirable contours of energy security policy proposed are based on three pillars:

- **Optimizing and Efficiently Managing the Demand and Supply Structure of Energy Resources**
- **Increasing Alternative Energy Share in the Supply Mix**
- **Securing Long-Term Commitment from Reliable External Suppliers**

## Current Energy Security Policy Contours

Pakistan's primary energy mix comprises natural gas, oil, hydropower, coal, nuclear, alternative energy sources and a small percentage of imported energy (See figure 2.1). Oil and natural gas account for the larger shares of the energy mix, 34.4 and 37.9 percent respectively. With little investment in the exploration of oil and gas reserves in the country, the growing energy demand has inevitably been met through imports.

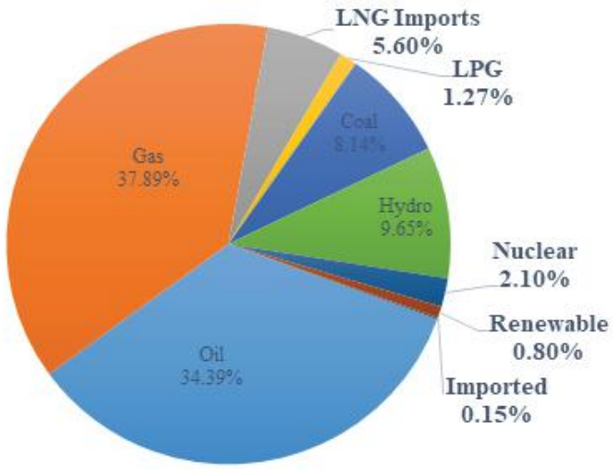


Figure 2.1: Current Energy Mix of Pakistan

Figure 2.2 gives an overview of the installed power plants in Pakistan. These include Independent Power Producers (IPPs), Utility power stations, and rental power plants of all key sectors. The majority of these power stations run through oil and gas resources. There are only a few hydroelectric, nuclear, solar, and wind power stations in the country despite high potential of these resources. A closer analysis of these sectors can reveal respective factors impeding their contribution to the energy supply in Pakistan.

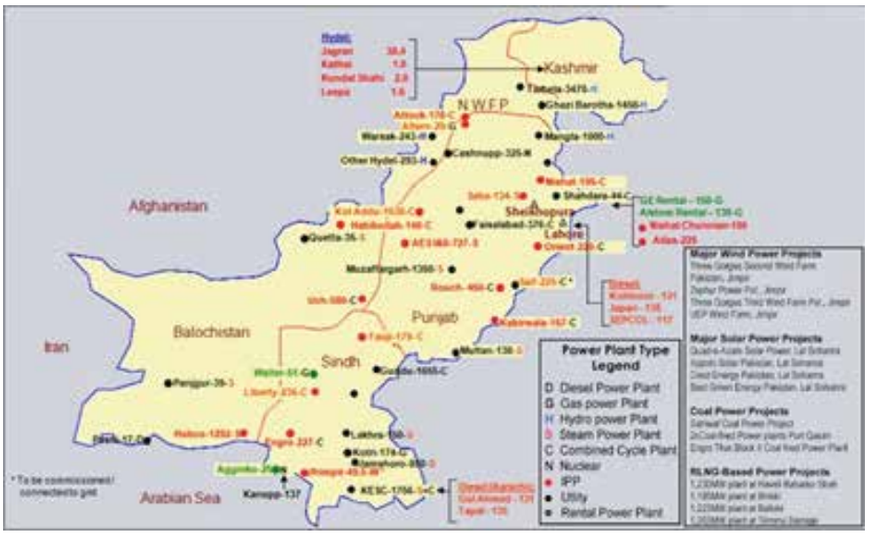


Figure 2.2: Installed Power Plants in Pakistan 2016-17

## *Oil and Gas*

Oil and gas are the main energy sources in the country. A combined energy supply of crude oil, Liquefied Natural Gas (LNG), Liquefied Petroleum Gas (LPG), and natural gas accounts for 79 percent of the energy supply, of which 34.4 percent is of oil and 37.9 percent is of gas.[4] However, majority of this supply is through imports as investment in the upstream oil and gas sector is limited despite high potential. As shown in Figure 2.3, only 10 percent of the sedimentary area has been explored till now and merely 1 percent is operational.

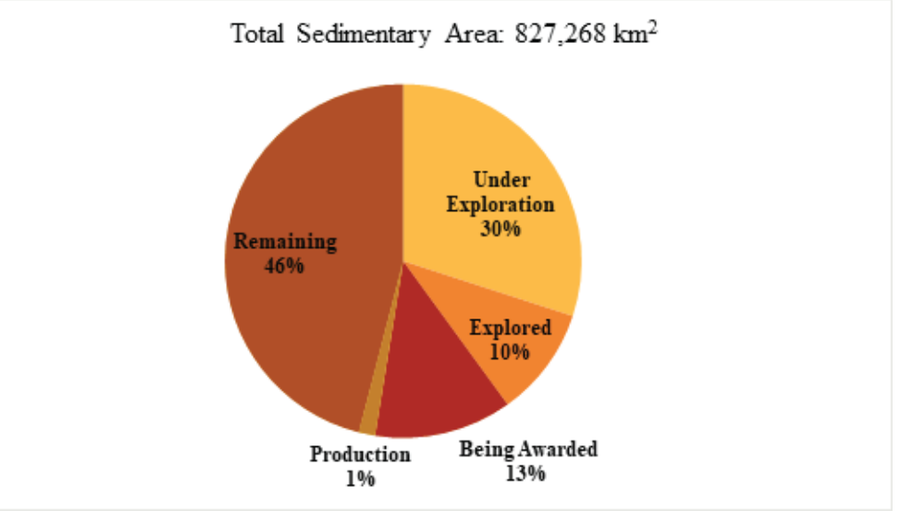


Figure 2.3: Hydrocarbon Potential in Pakistan

The new projects for exploration of oil and gas are not enough to meet the rise in demand. The annual growth of crude oil production in Pakistan was only 2.2 percent in FY 2016-2017 while the production of natural gas saw a decline of 0.4 percent. The exploration activities in the same year resulted in 15 more discoveries in the oil and gas sector. In total, Pakistan has discovered 67 associated and 221 non-associated gas fields. However, most of these were small and have already been depleted. The present supply of gas can be from 35 associated and 190 non-associated gas fields, still having recoverable gas reserves. The Sui field, which accounts for 25 percent of the supply, is on the decline. This decline curve will accelerate further in the coming year, resulting in a massive supply shortage. The shortfall in gas is expected to reach 3,999 bcfd by FY 2019-20 and the gap will reach 6,611 bcfd by FY

2029-30. non-associated gas fields. However, most of these were small and have already been depleted. The present supply of gas can be from 35 associated and 190 non-associated gas fields, still having recoverable gas reserves. The Sui field, which accounts for 25 percent of the supply, is on the decline. This decline curve will accelerate further in the coming year, resulting in a massive supply shortage. The shortfall in gas is expected to reach 3,999 bcfd by FY 2019-20 and the gap will reach 6,611 bcfd by FY 2029-30.[5]

Divided between Sui Southern Gas Company Limited (SSGCL) and Sui Northern Gas Pipelines Limited (SNGPL), the huge infrastructure of cross-country gas pipelines in the country is used by the government to supply natural gas to the end consumers. As of 30 June 2017, SSGCL & SNGPL's cumulative transmission network stood at 3,973 Km and 8,975 Km and distribution network at 45,521 Km and 110,217 Km respectively, with a combined consumer base of 8,575,760 consumers.

However, a large percentage of gas is lost before reaching the end consumers leading to the growing levels of unaccounted for gas (UFG)—the difference between the volume of metered gas at the point of dispatch and the volume of gas sold to consumers. Instead of investing for the maintenance of already constructed pipelines, the two companies have expanded their transmission network extensively. However, due to underground leakage, overhead leakage, and gas theft, this increase in transmission network is contributing to the rise in UFG. The cost of UFG is added in the retail tariff making consumers pay for corruption and mismanagement of gas companies.

In contrast, consumption is continuously rising. As shown in Figure 2.4, the consumption of crude oil has increased from 11.617 MTOE in 2011 to 17.904 MTOE in 2017, of LPG has increased from 0.444 MTOE to 1.209 MTOE, of LNG from 0.472 MTOE in 2014 to 4.455 MTOW in 2017 while the consumption of gas has slightly declined from 17.618 MTOE to 17.031 MTOE in 2017. The slight decline in the consumption of gas is mainly due to the shift of commercial sector to the imported LPG, as the indigenous supply of low-priced gas is seeing a decline. However, there is a significant rise in consumption of gas by domestic consumers owing to price differential vis-à-vis other competing fuels, i.e., LPG, firewood, and coal. On average, during the last five years, the gas companies connected more than 0.3 million consumers to the gas network annually.

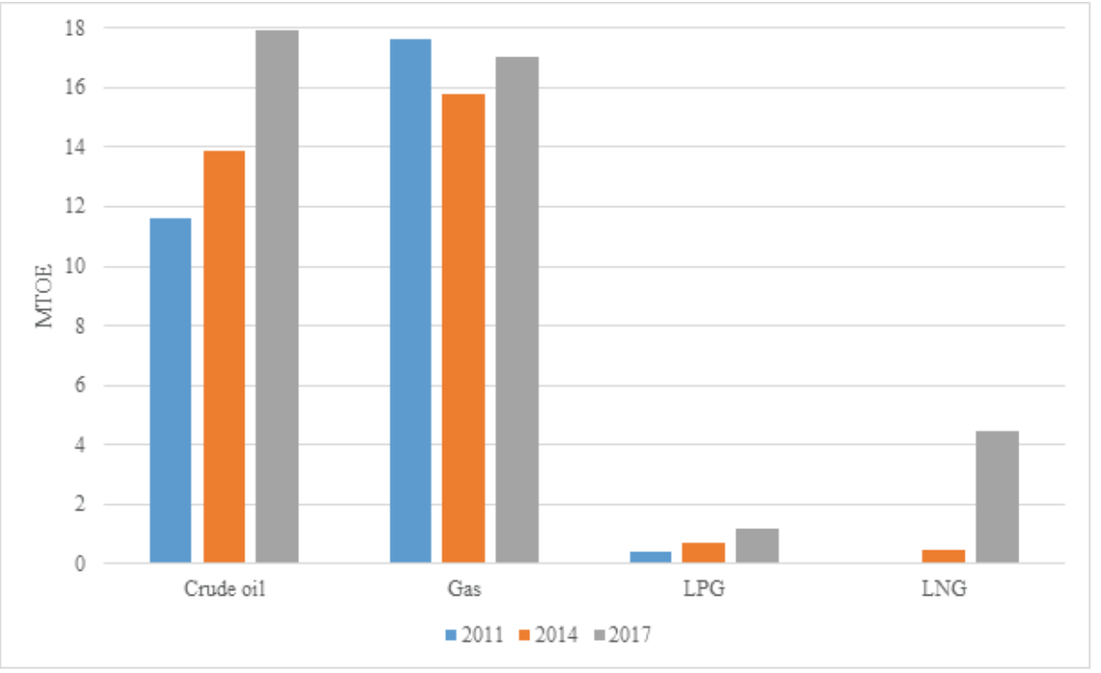


Figure 2.4: Consumption of Hydrocarbon Development

To meet this growing demand, Pakistan is heavily relying on imports. According to 2016 estimates of Hydrocarbon Development Institute of Pakistan, Pakistan imported 8.7 million tons of crude oil, 15.1 million tons of petroleum products and 4.5 million tons of LNG. While the total import bill declined by 2.29 percent in the first quarter of 2018-19, the energy import bill grew by around 15 percent to $7.6 billion, which is one-fourth of the total import bill. The import bill for LNG soared by 146.77 percent during July-August 2018 while that of LPG plunged 30.15 percent. [6] A major rise in the import bill is also contributed by increase of LNG and coal imports in the country.

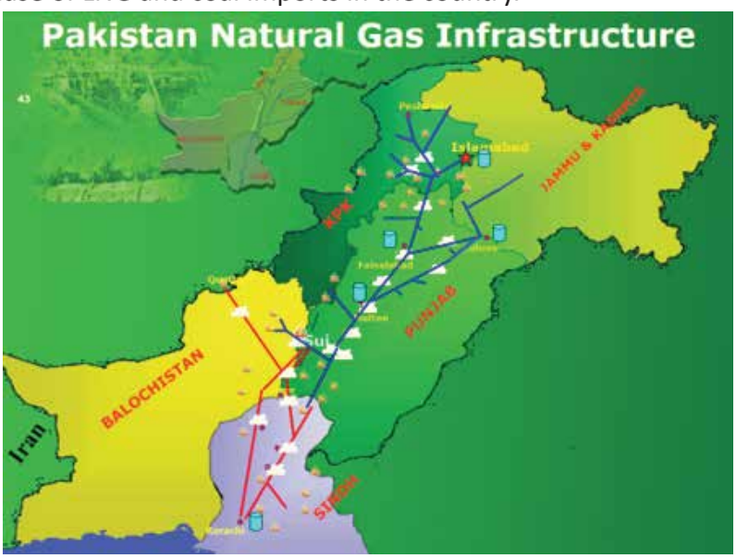


Figure 2.5: Pakistan's Natural Gas Infrastructure

Under Gas Allocation and Management Policy 2013, the first priority is given to domestic and commercial users, second priority to the power sector, third is assigned to industrial and fertilizer sector, fourth to cement sector and fifth to Compressed Natural Gas (CNG) sector. The gas tariff system also supports domestic consumer, supplying the gas at much cheaper rates.

## *Hydropower*

Hydropower has traditionally been the most prominent source of energy in Pakistan. Despite this, the existing installed capacity remains far below the country's economically and technically viable potential, including the significant potential for development of small-scale (1-50 megawatt [MW]) run-of-river hydropower projects. As per 2010 estimates, the total installed capacity of hydropower resources was 6,720 MW[7] which is only 11 percent of the total hydropower potential of Pakistan. The total proved hydropower potential of Pakistan is 60,000 MW.[8]

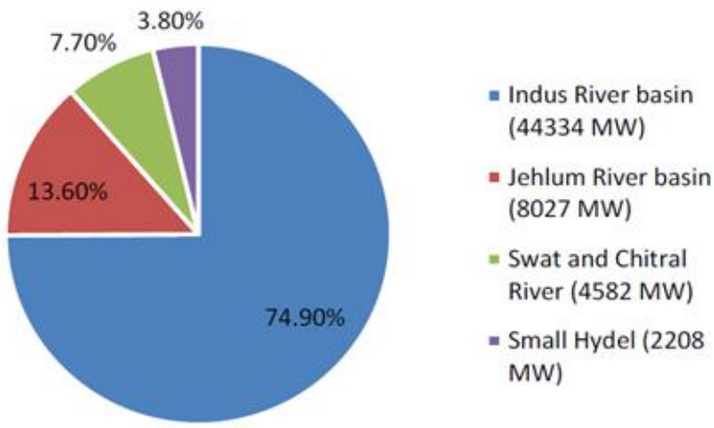


Figure 2.6: Distribution of hydropower potential in Pakistan[9]

Figure 2.6 presents a categorization of hydropower potential in terms of available basins, rivers, and small hydel potential sites available in the country. The Indus River Basin contributes almost 75 percent of all hydropower potential in Pakistan. From Table 2.1, it can be inferred that several feasibility studies and engineering design works have been carried out to explore the hydropower potential in Pakistan.

| S. No | Name of Project | Installed Capacity (MW) |
|---|---|---|
| 1 | Neelum Jhelum – AJK | 969 |
| 2 | DiamarBasha - Diamar/Kohistan | 4500 |
| 3 | Bunji – Astore | 7100 |
| 4 | Dasu – Kohistan | 4320 |
| 5 | Tarbela4th Extension-Swabi | 1400 |
| 6 | Munda-Muhamend Agency | 740 |
| 7 | Lower Spat-GahKohistan | 496 |
| 8 | Lower Palas Valley Kohistan | 665 |
| 9 | Patan | 2800 |
| 10 | Thakot | 2800 |
| 11 | KheyalKhawar –KPK | 122 |
| 12 | Golen Gol Project-KPK | 106 |
| 13 | Tarbela.5th Extension Swabi | 500 |
| 14 | Akhori Dam- Punjab | 600 |
| 15 | Yulbu dam | 2800 |
| 16 | Shyok (Yugo) Project | 520 |
| 17 | Skardu Dam Project | 1600 |
| 18 | Tungus Hydropower Project | 2200 |
| 19 | Dudhnial Hydropower Project | 960 |
| 20 | Suki-Kinari Hydropower Project | 840 |
| 21 | KundalShahi Hydropower Project | 700 |
| 22 | Rajdhani Hydropower | 132 |
| 23 | Mahl Hydropower Project | 600 |
| 24 | Kala Bagh Dam | 3800 |
| | | Total: 41270 |

Table 2.1: Large Scale Hydropower projects of Pakistan[10]

As environmental scientists are concerned about the impact of large hydropower projects on local fishery and riverine ecosystems, small hydropower development provides the best alternative solution having no carbon emission and negligible environmental footprints. The limit of small hydropower varies in the world. In China, the limit for small hydropower is 25 MW.[11] In other countries, small hydropower varies between 500 kW and 50 MW. In Pakistan, there are several small hydropower plants now in operation. Table 2.2 indicates the current small-scale hydropower potential of Pakistan at 868 MW.

| Region/Regions | Responsible Stakeholder | No. of Projects | Installed Capacity(MW) |
|---|---|---|---|
| Punjab | Government of Punjab | 10 | 142 |
| Punjab | AEDB Pakistan | 30 | 240 |
| Punjab | Government of Pakistan | 5 | 24 |
| Gilgit Baltistan | Government of Pakistan | 2 | 30 |
| Khyber Pakhtunkhwa | AEDB Pakistan | 22 | 92 |
| Punjab, KPK, AJ&K, Sindh | AEDB Pakistan | 25 | 284 |
| Khyber Pakhtunkhwa | Government of Pakistan | 3 | 56 |
| | | | Total 868 |

Table 2.2: Small-scale hydel power projects of Pakistan that are under implementation process[12]

## *Coal*

Pakistan is a coal-rich country, with 185.5 billion tons of coal deposits. The potential to generate energy from indigenous coal reserves in Pakistan is about 1540 MTOE. Unfortunately, coal has not been used for power generation for more than three decades due to lack of infrastructure, insufficient financing, and absence of modern coal mining technical expertise. According to the BP Statistical Review of World Energy, coal production in Pakistan was only 1.8 million ton in 2017.[13] Every year Pakistan is importing four to five million tons of coal to meet the needs of different sectors like steel, cement, and power generation.[14]

In Sindh, Thar has 175,506 million tons of lignite coal reserves still untapped, making it amongst the seventh largest lignite coal deposits of the world. Under China Pakistan Economic Corridor (CPEC) investment, the country has started using this coal for generation of electricity and the first unit of 330 MW power plant has been energized on March 19, 2019. However, lignite is considered as the worst quality of coal and this is a major impediment to the use of this coal for energy production.

The quality of coal in other provinces is classified as more environmentally friendly. In Baluchistan, the total coal reserves are about 217 million tons, of which 32 million tons are considered mineable. Baluchistan coal is classified as sub-bituminous to bituminous and the heating value ranges from 9,637 to 15,499 Btu/lb. It has low ash and high sulfur and is considered suitable for power generation. In Punjab, the total coal resources are estimated at 235 million tons, of which 33 million tons are mineable. Punjab coal is classified as sub-bituminous and the heating value ranges from 9,472 to 15,801 Btu/lb. It is also more suitable than Thar coal for coal-fired power plants. Similarly, although the coal reserves in Khyber Pakhtunkhwa (KPK) are not yet fully explored, they are believed to be of sub-bituminous quality, with heating value ranges from 9,386 to 14,217 Btu/lb. The total coal resources of Azad Jammu and Kashmir (AJK) are estimated at 0.06 million tons, classified as sub-bituminous, with the heating value ranges from 7,336 to 12,338 Btu/lb.[15]

Previous government introduced a new power policy aimed at increasing electricity production and decided to set up many new power projects. Out of all the projects announced since 2013, two are running on coal and two using Re-gasified Liquefied Natural Gas (RLNG) have already started producing electricity.[16] There are several coal-fired plants under construction and it is estimated that by 2030, there will be a substantial increase in power generation from coal up to 3930 MW.

However, a major concern with regards to these coal-fired plants, as well as thermal and gas-fired plants, is the environmental pollution they can cause. Even after successful mining, the power costs and environmental damage of burning Thar lignite in coal-fired plants would be prohibitive. Coal pollutes the environment like no other fuel does. According to some studies, a 30 percent increase in greenhouse gas emissions from electricity production has already been witnessed in Pakistan between 1990 and 2012.[17] With the introduction of coal-fired power plants, the environment will become even more polluted as greenhouse gas emission is expected to rise even further.

## *Nuclear*

According to statistics published by National Electric Power Regulatory Authority (NEPRA),[18] if all power plants in Pakistan could operate, at the combined average capacity factors of Nuclear Power Plants (NPPs), there would have been no load shedding in the country. NPPs provide energy security through low fuel cost, low cost of on-site storage and hence, low foreign exchange requirement for fuel production, operations and maintenance. A refueled nuclear plant can keep working for one to two years. Nuclear energy is also an economical source of energy. After loan repayment, all NPPs are producing electricity at less than Rs 7 per unit, which is very low in comparison to LNG, Hydro, Wind and Solar and even lower than the average per-unit cost of power plants using local natural gas.

Despite these known benefits, the share of nuclear energy in the energy supply mix of Pakistan is only 3.9 percent. Since the 1960s, nuclear energy has been the major plank of Pakistan energy program. However, the international community has created multiple problems for Pakistan in the names of embargoes and other financial sanctions. The plant provided 137 MW to the national grid. However, the supplier pulled out of the contract for supplying spare parts and fuels in 1976. PAEC started to operate the program indigenously in 1980.

Pakistan has prioritized nuclear energy to meet its energy needs but it has always faced obstructions from the international community. The experience of interacting with nuclear technology providers resulted in a delay of two decades since Pakistan started constructed its second nuclear power plant in Chashma with the help of China National Nuclear Corporation (CNNC). The plant supplies 300 MW of electricity to the national grid. Similarly, Chashma Nuclear Power Plant 2 (CHASNUPP-2), CHASNUPP-3, and CHASNUPP-4 supplied electricity worth 300, 315, and 313 MW respectively.

| Reactor Unit | Type Capacity [MW(e)] | Net Supplier | Status | Reactor | Construction Date | Commercial Date | UCF for 2017 |
|---|---|---|---|---|---|---|---|
| CHASNUPP-1 | PWR | 300 | Operational | CNNC | 1993-08-01 | 2000-09-15 | 82.5 |
| CHASNUPP-2 | PWR | 300 | Operational | CNNC | 2005-12-28 | 2011-05-18 | 97.6 |
| CHASNUPP-3 | PWR | 315 | Operational | CNNC | 2011-05-28 | 2016-12-01 | 94.1 |
| CHASNUPP-4 | PWR | 313 | Operational | CNNC | 2011-12-18 | 2017-09-19 | 95.2 |
| KANUPP-1 | PHWR | 90 | Operational | CGE | 1966-08-01 | 1972-12-07 | 45.7 |
| KANUPP-2 | PWR | 1014 | Under Construction | CZEC | 2015-08-20 | 2020-07-31 | |
| KANUPP-3 | PWR | 1014 | Under Construction | CZEC | 2016-05-31 | | |

Table 2.3 Nuclear power projects of Pakistan

Currently, Pakistan is constructing two nuclear power plants based on Pressurized Water Reactor (PWR) design that will provide 2200 MW electricity to the national grid. An overview of the operational and under-construction nuclear plants is provided in Table 2.3 above. It is clear that the country is seeing a growth in the share of nuclear energy supply in the coming years. By 2030, it is estimated that Pakistan is going to produce 8800 MW of electricity and, by the year 2050, electricity production is going to be 40,000 MW.

Even though Nuclear Energy is a viable means to produce electricity around the world, there are certain limitations for Pakistan, which are mentioned below:

1. The financial resources of Pakistan, similar to other developing countries, are very limited. Although, nuclear power is competitive compared to other electricity generation options, it is a very capital-intensive technology. Nuclear Power Development requires high initial investments, huge industrial infrastructure and skilled labor for its development.

2. Site evaluation and technical design studies take a much longer time for nuclear power plants compared to fossil fuel based power plants.

3. Pakistan is not a signatory to the nuclear non-proliferation treaty, so it is not eligible to purchase nuclear reactors from states that are members of the Nuclear Suppliers Group (NSG). However, Pakistan's crippling energy sector demands a nuclear energy to envisage a target of 8,800 MW of electricity by 2030.

4. There are also environmental consequences of nuclear power plant disaster. The Fukushima

Daiichi nuclear power plant incident of March 2011 showed that a nuclear and radiological release in case of a natural calamity could have serious human, financial, and environmental consequences. More than 100,000 people had to be evacuated in the aftermath of the earthquake and tsunami that wrecked the Fukushima nuclear power plant.

## *Alternative Energy Resources*

While the world is experimenting with a wide variety of alternative energy resources, the sector is mainly comprised of solar, wind and biomass resources in Pakistan.

### *i. Solar Energy:*

Pakistan has great potential to generate electricity through solar energy (Fig 2.7) as it lies on the Sun Belt. With a sharp reduction globally, the price of solar electricity has been reported as approximately 2.5 cents per MW recently. However, such price reductions have not yet been achieved in Pakistan. Further, there are technical limits on development of the resource currently due to intermittency and unavailability of low cost energy storage technologies.

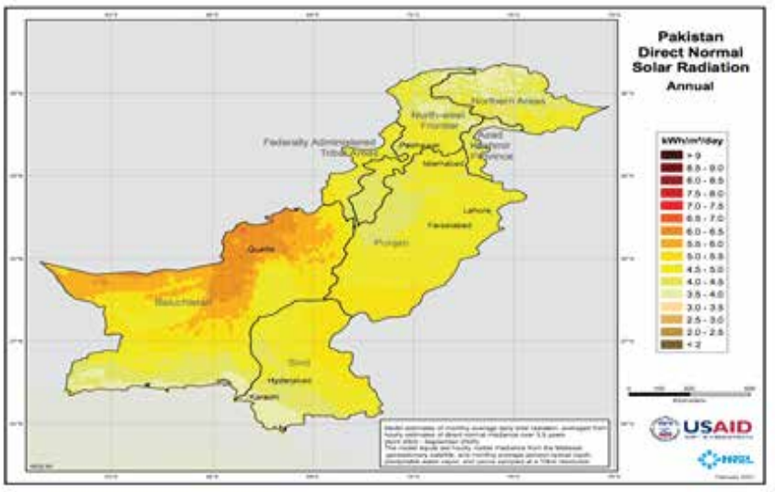


Figure 2.7: Solar Potential in the Pakistan

To overcome the energy crisis in the country, German Development Bank (KfW) and Pakistan Poverty Alleviation Fund (PPAF) set up Solar Energy Mini-Grids Projects in the villages of Khyber Pakhtunkhwa. Mini-Grid Systems with total capacity of 500 kW were initiated in remote areas of Karak, Swabi, and Lakki Marwat districts of KPK in 2013 and these projects have been completed as of July 2018. The mini-grid solar systems, installed in villages of Karak and Swabi districts, have a total capacity of 196kW and 185kW and jointly provide electricity from indigenous and clean energy resource to about 434 households within these districts. Around 24 Solar mini-grid systems have also been completed in the remote villages of Lakki Marwat, with a total capacity of 119 kW.[19]

Quaid-e-Azam Solar Power was established by the Government of the Punjab in 2013, which started commercial operations in 2015. The company has been established in Bahawalpur, for development of renewable energy projects, particularly solar energy projects. It is the first ever utility scale solar power plant of Pakistan. In December 2015, it was revealed that the solar park is producing only 18 MW of electricity instead of the 100 MW that was promised by the provincial government. According to Arshad Abbasi, energy expert, Bahawalpur's climate is not suitable for this solar project. The temperature rises above 45 degrees Celsius, which does not produce the required amount of electricity. He added that the solar plant is an expensive project for Pakistan and the focus should have

been on installing solar panels on wasteland with more focus on hydropower, like India.[20] The situation has gradually become worse and in May 2018, Chief Justice of Pakistan took legal notice of Quaid-e-Azam Solar Power Plant.

At present, several private companies are setting up solar power plants in Pakistan. By 2030, additional solar power generation will reach 2639 MW. This power will supplement the National Grid at peak load hours and will cost about Rs. 5.5 per KWh.[21]

***ii. Wind Energy***

NEPRA reported that the country produced 141.6 GWh of wind energy in September 2017, which is 0.46 percent point higher than 82.63 GWh produced in December 2016. According to the National Forum for Environment and Health (NFEH), wind turbines in Gharo-Jhimpir, achieved installed capacity of 788.5MW of wind-based power from 15 projects that have entered the operational phase in 2017.

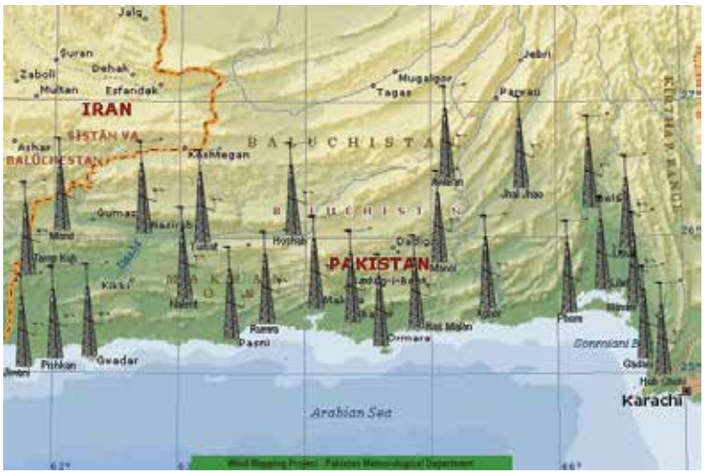


Figure 2.8: Potential Wind Power Project in Pakistan's Coastline

***iii. Biogas***

Biogas is the cheapest form of renewable energy. Domestic biogas plants gained government's attention as alternative energy in 1974. Pakistan Council for Appropriate Technology (PCAT) developed 21 biogas plants based on fixed dome Chinese type technology. These plants did not work as expected due to leakage of gas from the hairline cracks developed in the domes / gasholder. Thus, this design was not successful. In 1979, moveable gasholder, (an Indian design), was adopted with certain modifications and 10 biogas plants were installed in Districts Mirpur, Kotali, and Rawalakot in collaboration with Local Government and Rural Development. These plants worked satisfactorily. The following year 100 biogas plants were installed throughout the country under a Public Sector Development Program (PSDP) project successfully. In 1986, Directorate General of New and Renewable Energy Resources installed about 4000 biogas plants under a PSDP project. Unfortunately, due to lack of technical guidance and poor field experience, the project could not be implemented properly.[22] Over the years, several plants were installed frequently for the promotion of biogas energy.

## Desirable Energy Security Policy Contours

### *Optimizing and Efficiently Managing the Demand and Supply Structure of Energy Resources*

The widening demand supply gap in energy is the core issue of energy crisis in Pakistan. With the government seeking economic growth, the demand is expected to rise even further. Hence, the first

desirable contour of the energy security policy is to optimize and efficiently manage the demand and supply structure. This requires:

1. Reduction in demand through efficient consumption;
2. Increase in supply through investment in indigenous resources;
3. Reduction of transmission and distribution losses.

A key concern with regard to efficient management of supply structure is to build a balanced energy supply mix. The desirable energy supply mix presented in Figure 2.9 is an outcome of the analysis of the potential of each sector. The proposed energy mix can generate a gross installed capacity of 118,268 MW of power by the year 2030 in which indigenous energy resources of Pakistan as a whole represent 80.7 percent. The share of oil and gas in the proposed supply structure is reduced to only 11.8 percent with the total gross installed capacity less than 14000 MW.

A major source of energy supply in the proposed structure is hydropower, having about 40 percent share in the energy supply. This is mainly due to the high potential of hydropower in the country. However, a large number of approved projects in the hydel sector are suffering due to political issues. Pakistan has the potential of producing 63,351 MW annually from hydropower projects. The country has not yet been able to utilize this potential for power generation due to lack of political will, failure in resolving conflict among different interests groups, and shortage of foreign investment in the hydel power sector. Timely and unwavering completion of the ongoing power projects is a necessity to fill the demand and supply gap.

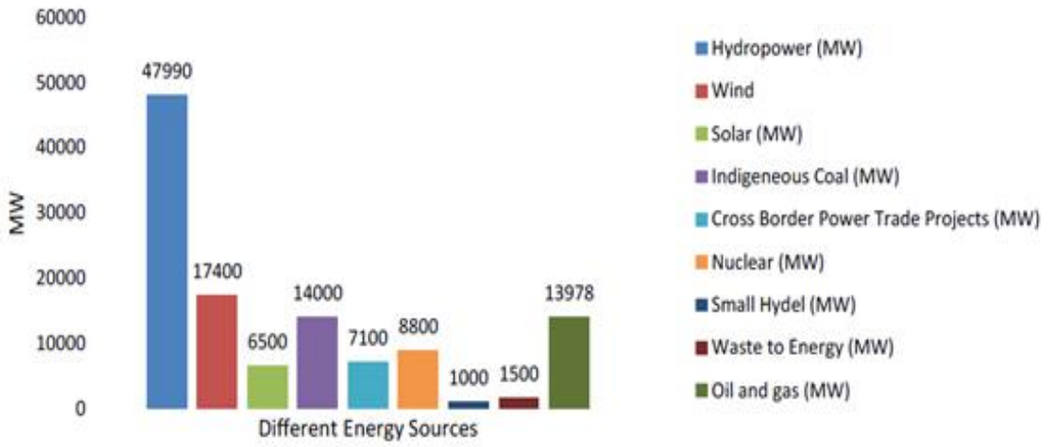


Figure 2.9: Projected gross installed capacity of different energy sources for proposed mix

As environmental scientists are also concerned about the hydropower development and their impact on local fishery and riverine ecosystems, small hydropower development provides the best alternative solution having no carbon emissions and negligible environmental footprint. A telemetry system was installed for real time monitoring of water quantity, which is a global technology for flood warning and hydropower management. The system is dysfunctional for last many years, allowing theft of water and inability of government to empirically justify the construction of new dams. The government needs to ensure that these telemetry installations are functional and operated under single authority of NEA.

## *Increasing Alternative Energy Share in the Supply Mix*

At present the share of alternative energy in the supply mix is less than 5 percent. In the proposed supply mix, shown in Figure 2.9, a diversified approach has been proposed with increase in the share of solar, wind, biomass, and nuclear resources of energy. There is also a constant need to invest in

research and development within the sector, encouraging innovative clean energy solution through new alternative resources.

The proposed energy security policy recommends up to 15 percent share of wind energy in the supply structure. The coastal belt of Sindh has huge potential for the development of wind energy projects. The 'wind corridor' of Sindh stretching from Keti Bandar to Gharo, is capable of producing 50,000 MW of electricity. Wind energy corridor of Gharo which is 60 km wide and 180 km long, stretching up to Hyderabad, has an average speed of 10 m/sec. With so much potential, it can play a vital role in ensuring all-round development and growth of economy of the country. As per Pakistan Meteorological Department (PMD), potential energy supply areas in Sindh cover 9700 sq.km. The gross wind power potential of this area is 43000 MW and the exploitable electric power generation potential of this area is estimated to be about 11000MW. Some good sites for wind turbines have also been identified in Khyber Pakhtunkhwa and Baluchistan.

Nuclear energy is close to 5 percent of energy supply in the proposed structure. Based on experience gained since 2005 and the outstanding performance of NPPs in the country as well as the cooperation extended by the Chinese government for supply of 1000 MW NPPs, a self-sustaining Nuclear Power Vision 2050 was approved by the National Command Authority in 2011. The future energy security policy can use this Nuclear Power Vision for cost efficient and environmentally security supply of electricity through nuclear power projects.

At the rural level, where energy demand is limited, the supply can be met through innovative means. In particular, the potential of biogas and bio-waste for production of energy is very high in the rural areas of Pakistan. About 81 million ton biomass production has a huge potential to produce enough bio-energy by using different technologies like combustion, gasification, pyrolysis and trans-esterification process. Similarly, readily available dung from 72 million animals like cows and buffalos and poultry droppings from 785 million poultry birds can produce considerable biogas to produce heat and electricity. The cattle and dairy population of Pakistan is around 67,294,000 and animal manure generation is around 368,434,650 metric tons. This is a very good proposition for Pakistan to generate biogas from animal manure as Pakistan has the potential to produce electrical energy equivalent to 23,654 GWh. Solid waste in 9 major urban centers is around 7.12 million tons per annum which is increasing by 2.5 percent per year due to rapid increase in population and high rate of industrialization. The average calorific value of Municipal Solid Waste (MSW) in Pakistan is 6.89 MJ/kg, which implies power generation potential of around 13,900 GWh per annum.

Similarly, while the potential of solar energy is high in Pakistan the sector still needs much investment and subsidization from the government. Current efficiency level of solar modules at 18 percent is sufficient to produce 0.320 to 0.400 MWh of electricity per $m^2$/year . With huge availability of sunlight, Sindh and Balochistan have great potential to utilize solar energy for not only agriculture purpose but also for households. Sindh has tremendous potential to produce 0.320 to 0.400 MWh of electricity per year, with average 5.5-6 KWh per day and about 1800-2200 kWh per year radiation from sun. In Pakistan, the sunshine duration of 8-8.5 hours a day is estimated to generate enough energy to electrify 40,000 villages.[24]

## *Securing Long-Term Commitment from Reliable External Resource Rich Suppliers*

Despite no dearth of resources to explore in Pakistan, the country cannot be fully self-sufficient and has to import energy products. However, the current energy import structure is not very reliable with majority of energy import from the politically volatile Middle East. For a more secure supply, the country needs to secure long-term commitments from several external suppliers. Sourcing energy from multiple countries allows a more consistent supply.

To meet the future energy demand, Pakistan needs to complete existing energy trade projects and initiate new projects. Pakistan cannot afford to overlook national interest and succumb to external pressure. Iran-Pakistan gas pipeline is a prime example with Pakistan delaying the construction for past many years. As Iran has already laid down the pipeline on its territory, the delays in the project not only affect relationship with the neighboring state, but have serious economic implications too.

Similarly, Turkmenistan Afghanistan Pakistan India (TAPI) pipeline is important to meet the growing gas demand of the country. Undeniably, the gas pipeline is one of the biggest energy projects in the region that started from Turkmenistan will pass through Afghanistan to Pakistan and India. The construction of the Turkmenistan section of the pipeline has been completed and Pakistan needs to initiate negotiations with Afghanistan for starting the construction.

Pakistan has recently also started paying attention to the resource rich suppliers in the region. Pakistan and Russia have signed many agreements related to the energy sector, including construction of North-South Gas Pipeline, import of LNG from Russia, installation of air mix plant and establishing a 600MW combined cycle power plant. Pakistan and Azerbaijan have also signed deals related to supply of electricity, import of crude and refined oil products as well as LNG and LPG.

The Central Asia South Asia (CASA-1000) project is designed to boost electricity trade between the Central Asian countries i.e. Tajikistan and Kyrgyz Republic and the South Asian countries i.e. Afghanistan and Pakistan. This project should be given prioritized attention by the government. In addition, with the help of China, Pakistan is working on the KANUPP-2 and KANUPP-3 reactor units, initiated in August 2015 and May 2016, with commercial operations scheduled for 2021 and 2022, respectively.

# Chapter 03:

# CURRENT ENERGY GOVERNANCE

Lack of governance is not the reason behind the energy crisis in Pakistan. Instead, an oversized government is the real challenge: multiple federal and provincial ministries devising policies and making decisions; several regulatory bodies deciding pricing mechanisms; and innumerable public and private organizations working for generation, transmission, and distribution of power. The search for energy governance structure in Pakistan reveals that there is no uniformity in decision-making and organizational objectives. At present, Ministry of Energy has two freestanding divisions – Power and Petroleum. Hydroelectric power generation comes under Ministry of Water Resources. PAEC works as an independent entity. The financial decisions with regard to energy pricing and regulation are through Ministry of Finance while Ministry of Planning, Development, and Reform conducts research for energy policy initiatives.

Consequently, Pakistan does not have a single energy policy document. Instead, each institution has come up with its own policy document like Petroleum Policy, Power Policy, Renewable Energy Policy, Energy Conservation and Efficiency Policy, and Environment Policy. Instead of complementing each other, these policies are competing and contradicting – each serving the vested interests of particular sector or organization it belongs to. For instance, the Power Policy of 1994 provided impetus to the thermal and nuclear power plant generation and reduced the hydropower and thermal generation proportion to 1:4. In the following year, Hydropower Policy 1995 attempted to revive the hydropower share in energy resources.[25]

Given these fragmented and inconsistent policy, the energy sector of Pakistan has witnessed a continuous steep decline and deterioration. The prevailing dichotomies in Pakistan's power governance have generated various debates, which only emphasize that all the unbundled power policies must be integrated into a single energy policy. However, the absence of coordinated effort among stakeholders in the energy and power sector is retarding the development of the proposed single energy policy document. This chapter gives an overview of the operational, financial, and policy governance system in the energy sector of Pakistan, outlining the lack of vision and direction.

## Institutional Complexities in the Energy Sector

The prevailing structure of Pakistan's energy sector institutions present a complex and chaotic picture, where several entities are engaged with different but interrelated functions and areas of jurisdiction. In the early days of independence, Pakistan's power sector was almost non-existent. By 1960, the installed power capacity of the country was only 366MW. However, in just two decades the installed capacity rose to 1323MW by 1970 and 2685MW by 1980 with average annual growth of 12.1 percent.[27] This was clearly the result of a cohesive institutional structure of the government with a singular authority making all key decisions on production, imports, distribution, and transmission of energy. The problem of energy governance surfaced only after 1980s because of defragmentation of policymaking authorities and establishment of new public and private entities.

In the first few years of independence, there was no dedicated ministry for energy and power. Ayub Khan introduced the first separate ministry for the energy sector in 1960 with the title of Ministry of Work and Water Resources, later renamed as Ministry of Works, Housing, and Water Resources in the

same year. On 23 April 1960, the Ministry was abolished and a new Ministry of Fuel Power and Natural Resources was created, to expand the scope beyond hydel power generation. In 1962, the cabinet expanded this under the new constitution into a much larger Ministry of Industries and Natural Resources. The first democratically elected cabinet under Prime Minister Z.A. Bhutto finally separated the Ministry of Fuel, Power and Natural Resources from the Ministry of Industry in an attempt to ensure focused energy policy making. However, after the 1977 election, ZA Bhutto divided the ministry in two: Ministry of Water and Power; and Ministry of Petroleum and Natural Resources. The division remained till 2017 when the Ministry of Petroleum and Natural Resources was merged with the Power division of the Ministry of Water and Power to create Ministry of Energy. It was argued that this merger was important to integrate the energy sector, yet the two divisions of power and petroleum under this ministry are working under separate federal ministers and there is no notable coordination between the two. Instead of systemizing the decision making in the energy sector, this decision has created more confusion over the division of authority between the two divisions. Also, the ministry of Water Resources is working separately, remaining responsible for hydroelectric power projects.

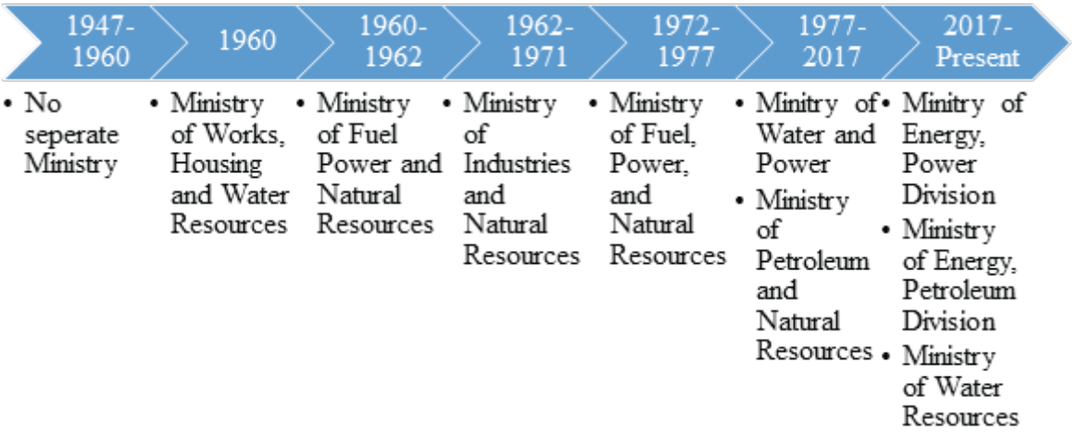


Figure 3.1: Fragmentation of Energy Authority in Pakistan

A similar shift from simple and integrated structure to a complex and overlapped arrangement can be observed in the enterprises working under these ministries (See Figure 3.2). When Pakistan came into being, Karachi was the industrial hub and was in dire need of energy supply. Hence, Karachi Electric Supply Corporation (KESC) was granted the license to generate, transmit and distribute power in the city and its premises.[28] KESC was a private limited company, producing and supplying electricity to Karachi since 1913. In 1952, the company operated through diesel and steam power. There was just one diesel unit having installed capacity of only 6MW and two steam units with installed capacity of 23.5MW.[29] After its nationalization, another 30MW steam engine was installed to deal with the increasing demand caused by refugees' arrival in the city.

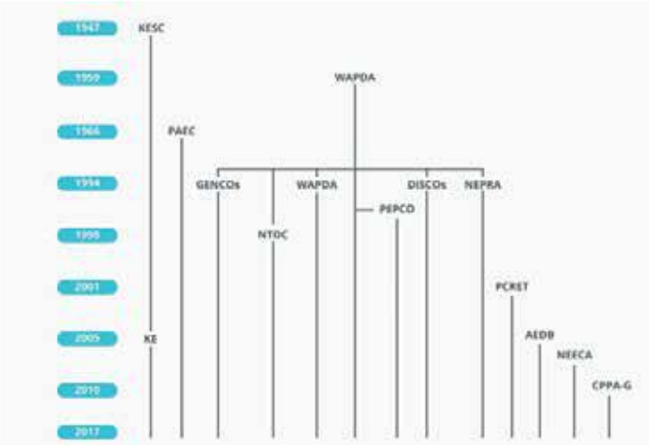


Figure 3.2: Institutional expansion in the energy sector of Pakistan

As the industrial sector started progressing gradually, the government realized the growing electricity demand and started planning for proper energy governance for the entire country. The first national institution in the energy sector WAPDA is the main energy authority responsible for generation, transmission and distribution of power throughout the country along with issues related to water management such as irrigation, drainage, and flood control etc. With the establishment of WAPDA in 1959, the power generation capacity of Pakistan increased to 119MW.[30]

The establishment of WAPDA was the start of a major flaw in Pakistan's energy governance – predisposition to one particular sector. Under WAPDA, the government remained focused on hydel power projects only. As new sources of energy supply were introduced in the country, the government established separate entities instead of expanding the role of WAPDA. For instance, in 1966, the government of Pakistan started working on atomic energy and PAEC was established as an independent organization for this purpose.

The functioning of these two integrated organizations (WAPDA and KESC) remained satisfactory up till 1970s. There was an addition of over 1300 MW of electricity to the national grid through new hydel projects mainly Mangla and Tarbela Dam. However, as time passed, the financial and technical inefficiencies of both organizations exposed their inability to generate sufficient funds for maintenance and expansion of power infrastructure to meet consumer needs. Massive degradation in governance led to heavy losses in WAPDA and KESC which necessitated the need for restructuring. It was realized that power generation and transmission capacity expansion and efficiency could only be achieved with the institutional reforms and the involvement of the private sector.

Electricity reforms in Pakistan started with entry of IPPs under the plan for restructuring and privatization of WAPDA. Private Power and Infrastructure Board (PPIB) was established in 1994 to promote and facilitate private sector in establishing power projects and related infrastructure. In addition to IPPs, the government started planning to disintegrate the vertically integrated authorities and form a separate authority to regulate the restructured power market. Consequently, in 1997, WAPDA was disintegrated through formation of four Generation Companies (GENCOs) and eight Distribution Companies (DISCOs). NEPRA was established as an independent regulatory body reporting directly to the Minister of Water and Power. Main responsibilities assigned to NEPRA were:

- Issuing license for electric power generation, distribution and transmission;
- Establishing and enforcing Standard Operating Procedures (SOPs) for power projects;
- Undertaking investment and power addition programs of utility companies;
- Determining tariff for power generation, distribution, and transmission.

In addition to vertical and horizontal breakup of WAPDA into several companies, a new entity: Pakistan Electric Power Company (PEPCO) was established within WAPDA to enhance the process of reform. PEPCO oversaw control of the affairs of the newly established GENCOs and DISCOs to prepare those companies for privatization. The deadline for privatization of the firm was set at 2006, after which PEPCO was supposed to get dissolved. However, PEPCO remained functional till 2012, due to its inability to complete the assigned task. Finally, under the pressure of development partners, the government dissolved PEPCO in April 2012.

The second structural transformation occurred in 1998 when distribution sector was further split into ten DISCOs and establishment of the National Transmission and Dispatch Company (NTDC) for electricity transmission. To provide technical support to the power sector, Pakistan Council of Renewable Energy Technology (PCRET) was developed in 2001, AEDB was developed in 2005 and National Energy Efficiency and Conservation Authority (NEECA) was established in 2016. These new entities operated under government control however, they had independent jurisdiction and organizational autonomy. To reduce the burden of NTDC, another subsidiary namely Central Power

Purchasing Agency (CPPA-G) was developed in 2015. The purpose of CPPA-G was to manage financial matters involved in sale and purchase of electricity amongst the generators and distributors.

The third structural transformation was privatization of State Owned Enterprises (SOEs), initiated in 2005. Under this transformation, KESC was privatized as Karachi Electric (KE) and was allowed to function for the city of Karachi and adjoining areas independently with its own electricity generation, transmission, and distribution network. However, the problem of energy shortage is getting worse with each new reform. Through studies examining the possible cause of failure of energy reforms in improving efficiency of the power sector, it has been established that weak institutional arrangement is one of the major causes for reform failure. With absence of a single authority to connect different stakeholders under one policy, the regulator, firms, consumers, and government entities have information constraints. These constraints increase uncertainty amongst the stakeholders while encouraging opportunistic behavior among some stakeholders, such as politicians and utility employees, who influence the reform process and outcomes according to their personal interest. The only solution to this issue is establishment of an authority that brings institutional reforms according to defined national objectives.

## Paradoxes of Energy Policy Framework

The energy policy structure in Pakistan comprises several sub-policies. Up until now, different political governments in their respective periods have introduced six energy policies. In addition to these power policies, there are separate policies for thermal, nuclear, hydel, and alternative energy sectors. Although these policies have been introduced with a promise to devise a better course of action for structural transformation, design and implementation issues are paramount and affect all of them. An overview of these policies also reveals abrupt shifts in policy initiatives by every new government.

Till the 1970s, the government of Pakistan had a Five Year Plan strategy, where policy was revised after every five years to ensure gradual advancement instead of implementing a drastic change. The system was successful in keeping a consistent and long-term energy strategy and there was notable progress in the energy supply industry. However, under Bhutto regime, there was a policy shift with adoption of a short-term strategy to cater growing energy demand. With industrialization and increase in population, the consumption of energy was increasing and with fear of losing popularity among masses, the government opted for short-term policies.

Instead of understanding the root cause of the problem, the governments after 1970s resorted to political point scoring by blaming previous governments for the impending energy crisis. The policy reforms adopted by governments in 1990s and 2000s were under pressure from foreign funding agencies and, hence, lacked the vision and will to deal with challenge of energy crisis.

The first energy policy was presented in 1994 which introduced lucrative terms and conditions for privatization of power generation sector. Private investors were granted full autonomy to propose plant site, technology, and type of fuel. Under long-term power purchase agreements, NTDC was compelled to purchase power from IPPs on priority basis instead of purchasing power from public power generators. Various unnecessary guarantees were also provided which included confirmed availability of fuel and foreign exchange as well as sovereign guarantee to free investors from any liability in case of default. Moreover, under this policy, private generators were exempted from sales tax and income tax. This policy also provided the legal grounds to the development of single buyer model in the country.

With the change in government in 1995, another policy was introduced that emphasized the utilization of hydro potential for electricity generation. Various incentives were offered to foreign investors which included 30 percent investment from GOP and exemption of sales and income tax. However, due to

disturbed political situation in the country, this policy failed to attract foreign investment. No addition of installed capacity was made under this policy.

In 1998, the newly elected government introduced a subsequent policy, with even more incentives for attracting private investments. The major incentive offered to private power houses was to conduct pre-feasibility surveys of desired projects. Under this policy, foreign investors were also allowed to issue corporate bonds and shares for meeting their financial obligations.

In 2002, a new energy policy was introduced by military government which included a number of provisions for performance enhancement of the sector. For the first time, GOP permitted public–private partnership energy projects. The new policy discontinued the practice of bulk tariff and introduced competitive bidding mechanism for power purchase. Two-part tariff model, which consisted of fixed charge and capacity charge, was also made part of this policy. This policy also introduced flexibility to launch power projects after passing through one window qualifying operations. Due to these incentives, a number of investors rushed in to get the benefits and, as a result, almost 2500 MW was added in installed capacity. After many years, the government was finally able to upgrade this policy in 2008. Hence, the energy policy 2008 was continuation of energy policy 2002, which included renewable energy sources. A large number of incentives were offered to renewable energy projects which included exemption of taxes on import of equipment.

Energy Policy 2013 also offered number of flexibilities for renewable energy projects while introducing upfront tariff model for these projects. This policy also contained provisions for gradual shifting from expensive thermal generation to indigenous and environmental friendly fuels. However, the government immediately signed agreements for purchase of LPG from Qatar and increased the imports of oil and coal to meet the energy demand. The policy clearly lacks implementation as the growth of alternative energy sector is not sufficient to replace thermal generation in the near future.

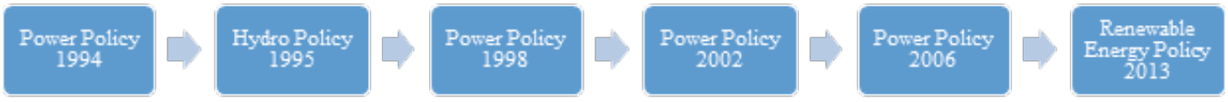


Figure 3.3. Pakistan Power Policies Timeline

## Issues in Financial Governance of Energy Sector

Attached to the institutional complexity and policy contradiction is the problem of poor financial governance in the energy sector of Pakistan. Due to absence of any decision making authority to oversee long-term feasibility of projects and compare the financial cost of proposed projects by different public and private organizations, decisions are usually made through lobbying and nepotism.

Government planners allocate fuel supplies and set prices instead of the market. Because the market plays a limited role in penalizing underperformance and rewarding efficiency, energy suppliers, especially public ones, face little pressure to control costs and maximize outputs. In addition, hefty losses of electricity in distribution, along with poor recovery of overdue electricity bills, have given rise to alarming levels of debt in the sector and prompted repeated government bailouts given the title of “circular debt.”

Circular debt is the amount of cash shortfall within the CPPA-G that it cannot pay to power supply companies. This shortfall is the result of difference between the actual cost of providing electricity in relation to revenues realized by DISCOs from sales to customers plus subsidies. Also insufficient payments are made by the DISCOs to CPPA out of realized revenue as priority is given to DISCOs own cash flow needs. This revenue shortfall cascades through the entire energy supply chain, from

velectricity generators to fuel suppliers, refiners, and producers; resulting in a shortage of fuel supply to the public sector thermal GENCOs, a reduction in power generated by IPPs, and an increases in load shedding. [33]

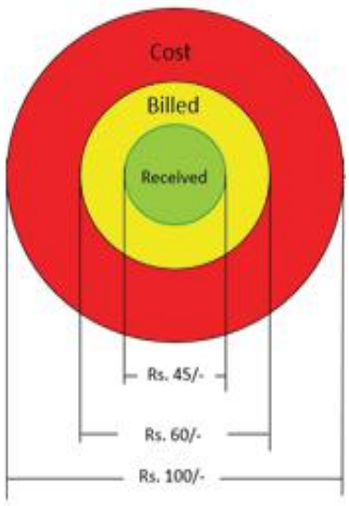


Figure 3.4: Circular Debt Example

The problem of circular debt first occurred in 2006 when electricity prices were not allowed to rise in line with the steep rise in the international oil prices. The problem aggravated in 2010 as power outages increased to an alarming level. Increases in oil prices as well as government inability to answer the root causes of circular debt caused Pakistan's oil refineries to operate at only 45 percent of their capacity at the end of 2010.

On January 2, 2019 it was reported that the energy sector's circular debt had reached Rs 1362 billion mark, of which Rs 755 billion is of the Power Holding Company Limited and Rs 607 billion of Standby Term Finance Facility loans. Circular debt generally arises out of high electricity losses, due to poor supply-demand management, theft of electricity, costly input and the rising recurring costs. As per estimates of a World Bank report, the circular debt crisis annually cost about 2.6 percent of GDP, with over 700,000 job losses and $5.8 billion damage to Pakistan's economy.[35]

Although there are many contributing factors to circular debt, few of them are poor governance, electricity subsidies, import dependence, poor bill recovery rate, and inequality in the distribution system. Poor governance is at the heart of the issue of circular debt. The key players are federal and provincial governments, both playing havoc with the national grid system. Governance needs to improve at all levels, i.e. government, corporate, and regulatory.

In majority cases, various private and public sectors are defaulters and have to pay huge electricity bills as well as other payments. Since a long time, multibillion rupees of DISCOs' bills have been outstanding against various power consumers. In May 2018 Rs 96.9 billion default was reported by audit officials on the system of Peshawar Electric Supply Company (PESCO), Rs 80.3 billion on Quetta Electric Supply Company (QESCO), Rs 32 billion on Federal Administrated Tribal Areas (FATA), Rs 8.43 billion on Multan Electric Power Company (MEPCO), Rs 6.16 billion on Hyderabad Electric Supply Company (HESCO), and Rs 2.68 billion default is on the system of Sukkur Electric Power Company SEPCO.[36]

The system of electricity subsidies like free electricity to WAPDA and other public organizations' employees is also one of the major sources of circular debt. Instead of adopting a reimbursement method to pay off the electricity bills and defining a maximum limit on free electricity, the government chose an open system enabling corruption and wastage. Hence, circular debt is the outcome of the inability of the DISCOs to pass on the cost of electricity to customers and likewise the inability of the

government to pay the tariff differential subsidy (difference between the applied tariff and the determined tariff) in a timely manner. Increased dependence on imported fuel is also creates circular debt in the energy sector. Higher amount of import leads to depletion of Federal reserves, which further pushes the government to take loans from International Monetary Fund (IMF) and World Bank.

Another factor for the rise in circular debt is a lack of focus on the transmission and distribution aspect of power supply. The losses in the transmission and distribution system have remained there for a long time. According to WAPDA officials, the previous government was able to increase the installed generation capacity in Pakistan to approximately 28,000 MW but the transmission and distribution capacity is stalled at approximately 22,000 MW. However, the figures by NEPRA are lower than this. According to 2016 estimates from NEPRA, the generation capacity is about 20,121 MW and the total demand during peak hours stands at nearly 25,754 MW; this leads to a deficit of about 5,633MW.[37] The capacity of all units like primary transmission lines, secondary transmission lines, grid stations, distribution lines, distribution transformers has failed to keep pace with the increase in generation capacity.[38]

To make matters worse, under-pricing of gas has created a fiscal burden and has undermined the performance of utilities. Pakistan has a two-tier gas market. Imported LNG is broadly charged at the full cost to consumers, but domestic gas was priced at roughly 36 percent of the international benchmark. Under-pricing contributes to fuel shortages, not only because it encourages wasteful energy consumption but also because it reduces suppliers' interest in upstream exploration and production. Numerous large gas-based power generation projects have been abandoned because of the government's unwillingness to raise tariffs to allow cost recovery with reasonable returns. The shortage of gas for power generation was made up through expensive imported oil, increasing both electricity costs and trade bills.

# Chapter 04:

# PROPOSED ENERGY GOVERNANCE STRUCTURE – NATIONAL ENERGY AUTHORITY (NEA)

Keeping in view the institutional complexities, policy paradoxes and poor financial governance, described in previous chapter, this chapter proposes a solution to the energy governance problem – National Energy Authority (NEA). Only through a single authority overseeing all institutions in the energy industry, the government of Pakistan can come up with a clear long-term, consistent, and rationale policy for the energy security of Pakistan. The chapter provides details of organizational and functional structure of the proposed authority, its composition, and objectives. This Authority will have the ability to coordinate the efforts of all the sectors, relating to drafting and implementation of a single energy policy. NEA should also oversee the regulation of energy market, ensuring a single regulatory body define tariff for all sub-sectors within the energy and power sector.

The idea of Integrated Energy Planning and Governance is not new. In 2009, the Government of Pakistan developed an Integrated Energy Plan. In 2011, Ministry of Planning and Development, in collaboration with Asian Development Bank developed a policy framework with the title Pakistan's Integrated Energy Model. This model endorsed development of a structure that ensures collaboration among institutions working in the energy sector. The political party in power included the agenda of integrating the energy sector in its manifesto

While there has been talk of integration in the energy sector, a clear picture of how this integration should be implemented has not yet been provided. This Energy Security Policy Proposal has been developed as an action plan, a clear model for the establishment of NEA, describing its organizational chart, functional framework, composition and objective. The proposed NEA should be established under National Security Agenda, to give it clear authority to make innovative changes in the energy governance structure. NEA offers a solution in recognition to the energy security threats to Pakistan and is proposed to oversee and monitor the Ministry of Energy and secure the country from economic and strategic cost of energy mismanagement.

## NEA Composition

Since human resource management lies at the center of successful operation of any organization, it is imperative to define a strategy for this purpose. The proposed strategy for NEA human resource management should begin with selection of people from the energy industry who are technically skilled and professionally experienced. It is critical for the success of NEA to seek positive attitude, original approach, understanding of energy market, and clarity of services to be provided. With timely and effective execution of duties assigned to individuals, NEA can yield positive results for the energy security of Pakistan.

Human resources for NEA should comprise professionals from state, private and public sectors including experts from E&P sector, upstream, midstream and downstream oil and gas sector, natural gas transmission and distribution companies, other thermal energy sectors like LNG, LPG, CNG and Shale oil and gas, hydropower and nuclear power generation authorities, as well as alternative and

renewable energy.

## Objectives of NEA

The core objective of NEA is to document a single policy for the entire energy and power industry, outlining procedures for generation, imports, transmission, and distribution of power to the end consumers. Linked to this core objective are subsequent key objectives:

- NEA should ensure availability of sufficient energy on sustainable basis and at affordable prices through devising a comprehensive strategy.

- NEA must end Pakistan's dependence on imported fuels and should revise the supply mix with larger share of indigenous resources (coal, gas, hydel nuclear oil and renewable). This is critical to meet the growing demand on a sustained and affordable basis thereby providing energy security, sovereignty, and sustainability.

- If indigenous resources fall short, NEA must resort to import of natural gas and LNG that should not be from one particular region or country only. NEA should develop an energy import strategy giving preference to cost-effective and reliable sources.

- A major flaw in the current institutional structure is lack of information sharing among different organizations. Each enterprise conducts its own research for data collection, while Planning Commission conducts separate research with collaboration of international bodies. NEA should oversee all R&D projects in the energy sector to maintain coherence.

- NEA should work for improvement in energy efficiency, conservation of energy, and development of energy efficient appliances. To achieve this, it is imperative for the authority to define a minimum threshold for energy efficiency of appliances and ensure that appliances below that efficiency level are not sold in the market.

- While multiple efforts have been made in the past for privatization of the energy sector, they failed mainly due to absence of an authority. NEA has to work for creating competitive environment to solicit maximum private sector participation.

- Monitoring the functioning of companies involved with distribution of energy is a critical role of NEA and it should work with them to improve quality of consumer services.
- NEA should maximize indigenization of design and manufacturing of Protective Multiple Earthing (PME) to minimize capital cost and Operation and Maintenance (O&M) expenses

- NEA has to give special attention to the refining sector and should work with the ministry to implement a minimum standard for refineries. All present refineries are obligated to upgrade and meet that standard in a timeline given by NEA.

## NEA Organizational Structure

The proposed NEA would serve as a cohesive authority over all organizations working in their respective sectors. The policymaking authority will ensure there is a single policy document that addresses issues in oil and gas, coal, hydel, nuclear and alternative sources of energy. A single energy ministry, on the other hand, will ensure that the policy prepared by NEA gets executed while the departments working under the energy ministry will implement the policy directions provided to them. Based on this hierarchical structure, the authority will be transferred in a pyramidal structure, as shown in figure 4.1.

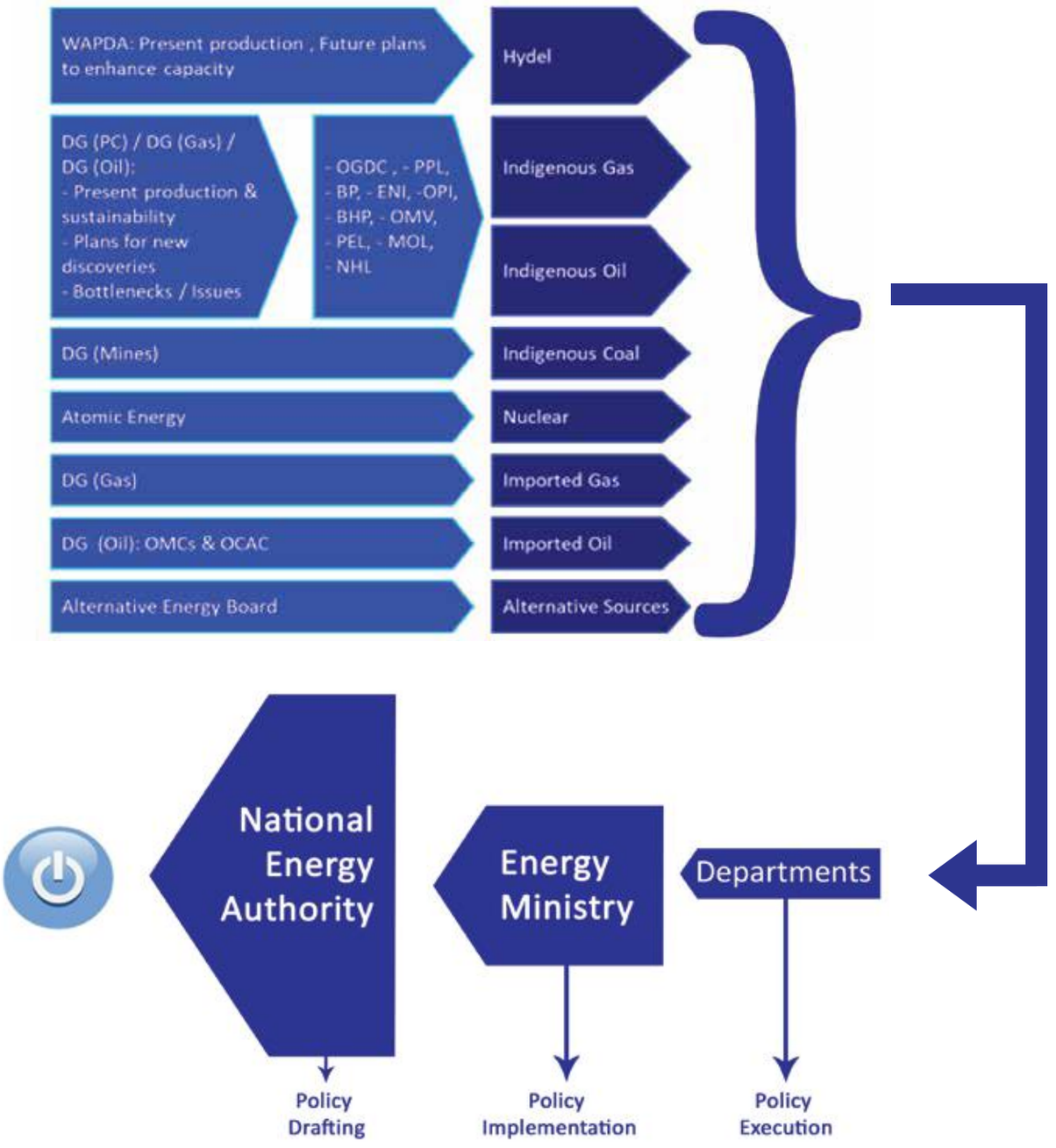


Figure 4.1: Energy Authority Hierarchy

All enterprises working without a clear authority are proposed to work as departments under energy ministry. The division of departments and details of current organization's position in the future organization structure under NEA is shown in figure 4.1. This structure is more coherent and systematic and allows information flow from enterprises to authority, allowing more informed and integrated policy making.

## NEA Operational Framework

To achieve the objectives outlined above, the energy authority will function alongside a single energy ministry. While the job of energy authority is to develop the energy policy, the ministry will ensure implementation of the developed policy.

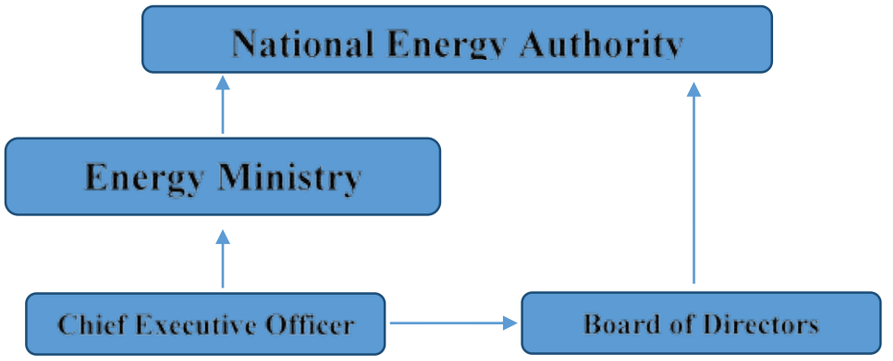


Figure 4.2: Collaborative Operational Network among NEA, Energy Ministry and Organizations

Figure 4.2 presents a framework to ensure a collaborative operational network among NEA, Energy Ministry and enterprises working under both. The Chief Executive Officers of all key organizations in the energy sector will report directly to the Energy Ministry with regards implementation of policies. Energy Ministry will then report updates on implementation to the NEA so it can revise policies accordingly. Simultaneously, each organization will have an independent board of directors which will make decisions in light of the policy provided by NEA. They will coordinate with NEA on issues related to internal policy decisions. Since NEA will be responsible for research and development, NEA will provide them necessary data required for any decision making. To ensure transparency a parallel operational link will be built between the CEOs of specific organizations and the energy ministry, which will ensure that the policy decisions are not clashing with any clause of energy security policy and the ministry will remain updated on it through the CEO.

# Chapter 05:

# ENERGY SECURITY POLICY STATEMENT AND GOALS

## Policy Statement

Energy Security Policy of Pakistan is proposed with the aim to provide guidance for improved monitoring, evaluation, and decision making by the government for the secure supply of energy. The policy proposal is based on the analysis of key issues in the current contours of the energy security policy and the flaws in the energy security governance. The policy provides solution to these problems by giving out a desirable energy security framework and by proposing an integrated energy governance structure in the form of NEA. Recognizing energy as a key element of national security of Pakistan, the current policy proposal can only be effective if adopted as a singular policy document for all institutions in the energy sector. Such an integrated, consistent, and sustainable policy structure is critical for securing Pakistan from the financial losses in the energy sector and for tackling the energy crisis.

## Policy Goals and Recommendations

Keeping the aim of the Energy Security Policy in consideration, the policy proposal had identified five key policy goals:

### *1. Achieving Energy Self-Sufficiency*

While it is not possible for any state to be completely self-sufficient, the main policy goal for ensuring the energy security of Pakistan is to revise the energy import strategy and decrease the energy supply reliance on it. In this regard, the Energy Security Policy urges the government to develop a new integrated energy trade policy, taking into account the potential suppliers in the region. Instead of importing energy from political volatile region of Middle East, the policy recommends Pakistan to become part of the multilateral energy trade agreements like TAPI and CASA-1000. If the US lifts its sanctions on Iran, the Iran-Pakistan (IP) pipeline agreement should be given precedence over other energy investments to save the country from $1.2 billion compensation to Iran.

The government should also focus on building local technology and human resource for the energy sector. New courses on energy needs should be introduced in universities. The institutions working in the energy sector should be encouraged to invest in research and development and the government ought to provide incentives for new innovation in the energy technology.

### *2. Ensuring Efficient Energy Consumption*

To reduce the energy demand and supply gap, the policy recommends focusing on both increasing supply and decreasing consumption. The second policy goals is to make energy consumption more efficient and in accordance to the supply goals provided below. The key policy requirements for efficient energy consumption include:efficient energy consumption include:

- Drafting a policy outlining the minimum efficiency standards for market product and ensuring its implementation through banning all products below that standard.

- Encouraging domestic users to use alternative and renewable energy resources while using coal, hydropower and oil and gas fired plants for industrial and commercial users.

- Developing a competing fuel structure for transport sector introducing electric and hybrid cars.

## *3. Goals for Future Energy Mix*

The proposed plan intends to generate a gross installed capacity of 118,268 MW of power by the year 2030 with 80.7 percent of energy mix produced through indigenous energy resources. The goals for future energy mix require increasing efficiency in the following ways:

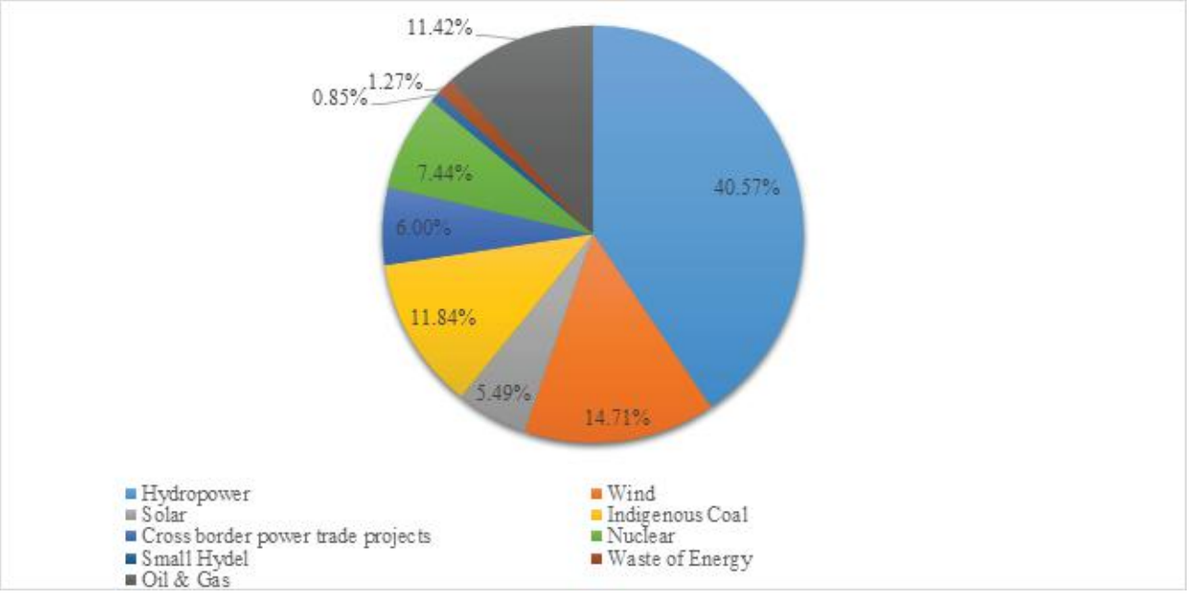


Figure 5.1: Energy Supply Mix as per Policy Goal

- Increasing hydropower share in the energy mix from 9.65 percent to 40.57 percent. To achieve this goal, the government needs to resolve political issues surrounding the pending dam projects.

- Starting new small hydropower projects that would constitute only 0.85 percent share to the national energy supply but can be a direct source of electricity to local population in electricity-deprived northern areas.

- Reducing the share of petroleum resources to only 11.8 percent and ensuring that majority of this share is filled through exploration of indigenous petroleum reserves.

- Increasing use of the indigenous coal reserves, however keeping the share of coal limited to 11.84 percent due to environmental concerns associated with coal-fired plants.

- Increasing the share of renewable resources like wind, solar and bio-waste in the energy supply mix at least up to 22 percent.

- Building more nuclear power plants and increasing nuclear energy share from 2 percent to 7.4 percent.

## *4. Goals for Alternative and Renewable Energy Supply*

As described above, the goal for alternative and renewable energy supply is to increase its combined share up to 22 percent. The respective share and policy goals for solar, wind and bio-waste energy are:

- Conducting a nation-wide survey on sustainability, economic security and reliability of renewable energy resources in Pakistan;
- Increasing share of solar energy supply up to 5 percent through building mini-grid solar power plants in areas with higher and longer solar radiation;
- Increasing share of wind energy supply to 15 percent by building new wind turbines along the coastal belt of Sindh and Balochistan to power small industrial projects in this area;
- Using agricultural, animal, and human waste in the rural areas to produce biofuels and bioenergy to meet energy requirements for agriculture development in the region;
- Building hybrid energy plants integrating renewable resources with conventional resources;
- Developing subsidies to promote private-sector investment for solar, wind and bio-waste plants for electrification of rural areas.

## *5. Integrating Decision Making and Policy Implementation*

While there have been multiple energy policies implemented in the past, the current policy proposal endorses integrated planning and implementation through:

- Recognition of energy security policy as part of national security plan
- Establishment of NEA as a single policy making institution
- Merging Petroleum and Power Division of Ministry of Energy and Ministry of Water Resources into a singular Ministry of Energy having responsibility to implement the policy formulated by NEA

In addition, the government must ensure that the policy developed by NEA is comprehensive, long-term, and irreversible. All stakeholders must be on board during the process of policy formulation to ensure its timely implementation.

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