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Policy**

**Report of Policy Lab on  
Bridging Gaps in  
National Security Policies and their  
Implementation in Pakistan**

پاکستان میں قومی سلامتی کی پالیسیوں  
کے اطلاق میں حائل رکاوٹوں کا خاتمہ

**Policy Analysis &  
Recommendations- Part-1 of 9  
Pakistan's  
Energy Security**

Examining sustainable and resilient  
energy policies to ensure national  
energy independence and efficiency.

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بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

إِنَّ اللَّهَ لَا يُغَيِّرُ مَا بِقَوْمٍ حَتَّى يُغَيِّرُوا مَا بِأَنْفُسِهِمْ

(سورة الرعد 13:11)

بے شک، اللہ کسی قوم کی حالت نہیں بدلتا جب تک وہ خود اپنی حالت کو نہ بدلے۔

Indeed, Allah does not change the condition of a people  
until they change what is in themselves.

(Surah Ar-Ra'd 13:11)

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ظَهَرَ الْفَسَادُ فِي الْبَرِّ وَالْبَحْرِ بِمَا كَسَبَتْ أَيْدِي  
النَّاسِ لِيُذِيقَهُمْ بَعْضَ الَّذِي عَمِلُوا لَعَلَّهُمْ يَرْجِعُونَ

(سورة الروم 30:41)

خشکی اور تری میں فساد ظاہر ہو گیا ہے، لوگوں کے اپنے ہاتھوں کے کیے ہوئے اعمال کی وجہ  
سے، تاکہ اللہ انہیں ان کے کچھ اعمال کا مزہ چکھائے، شاید کہ وہ باز آ جائیں۔

Corruption has appeared on land and sea because of  
what the hands of people have earned, so that  
He may let them taste part of what they have done,  
that perhaps they will return (to righteousness).

(Surah Ar-Rum 30:41)

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# Pakistan's Energy Security

Examining sustainable and resilient  
energy policies to ensure national  
energy independence and efficiency.

## Research Group

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## Preface

Public policy formulation and implementation are dynamic processes that require a comprehensive understanding of national security in all its dimensions. To equip policymakers, practitioners, and scholars with the necessary analytical tools to assess and refine policy strategies, a **Policy Simulation Lab on Analyzing & Evaluating Implementation Strategies for Pakistan's National Security Dimensions** was conceptualized, designed, and mentored by **Dr. Muqem Islam Soharwardy** in **November 2023**.

This **Policy simulation Lab** was a unique initiative aimed at critically assessing the effectiveness of policy implementation strategies across multiple domains of national security. It provided a structured environment where participants engaged in high-level problem-solving, scenario planning, and decision-making to address contemporary security challenges. The exercise was framed around a holistic approach to national security, moving beyond traditional defense mechanisms to include economic, environmental, cyber, and cultural security considerations.

The report of **Policy simulation Lab** presents the findings and recommendations of **nine Task Forces**, each dedicated to evaluating implementation strategies for a specific security dimension. These include:

1. **Energy Security** – Examining sustainable and resilient energy policies to ensure national energy independence and efficiency.
2. **Economic Security** – Identifying strategies to strengthen Pakistan's economic resilience, trade policies, and financial stability.
3. **Social Security** – Addressing social protection mechanisms, inequality, and welfare policies to promote social cohesion.
4. **Environmental Security** – Evaluating environmental policies to mitigate climate risks, resource depletion, and ecological threats.
5. **Military Security** – Reviewing the strategic defense framework, modernization efforts, and geopolitical considerations.
6. **Cybersecurity** – Assessing cybersecurity threats, digital infrastructure protection, and cyber policy frameworks.
7. **Health Security** – Developing robust public health policies to counter emerging health crises and pandemics.
8. **Food Security** – Ensuring sustainable agricultural policies, food distribution, and supply chain resilience.
9. **Cultural Security** – Analyzing policies to protect national identity, cultural heritage, and counter ideological extremism.

Each task force conducted an in-depth examination of current policy frameworks, identified key challenges, and proposed actionable strategies to enhance national security implementation. The insights gained from this simulation exercise offer valuable contributions to policy discourse and serve as a strategic guide for decision-makers.

This report is a testament to the collaborative efforts of participants, researchers, and policymakers who engaged in this exercise with commitment and intellectual rigor. It is our hope that the findings herein will serve as a valuable resource for shaping Pakistan's future national security policies in an increasingly complex global landscape.

It is hoped that this document will serve as a significant milestone in the design, implementation, and facilitation of policies, paving the way for broader economic and industrial transformation in Pakistan, انشاء الله .

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*December 15, 2023*

## **Executive Summary**

Energy security is a cornerstone of any nation's development, influencing not only economic stability but also social well-being and national security. It involves ensuring a reliable, affordable, and sustainable energy supply for all sectors of society. Pakistan, however, faces numerous challenges regarding its energy security, which have significantly impacted its economic development and its ability to provide reliable energy for its citizens.

### **Energy Crisis in Pakistan**

Pakistan's energy sector is beset by inefficiencies, a shortage of capacity, and a heavy reliance on imported fuels. Despite possessing a range of untapped energy resources such as hydropower, lignite coal, and vast solar and wind potential, Pakistan continues to rely on imported energy sources, primarily oil and liquefied natural gas (LNG). This dependence exacerbates the country's energy crisis, creating challenges for economic growth, exacerbating foreign exchange issues, and jeopardizing national security. The country's energy supply is also subject to geopolitical tensions and fluctuations in global energy prices, which add further unpredictability to Pakistan's energy landscape.

The energy demand-supply gap remains a persistent issue, with energy shortfalls leading to widespread power outages and rising energy prices. The lack of adequate policy measures, insufficient investment in energy infrastructure, and inefficient energy management strategies have hindered Pakistan's energy security. These challenges are compounded by the country's inability to fully utilize its domestic energy resources, despite their vast potential.

### **Role of Energy in National Development**

Energy is pivotal for achieving social well-being and economic progress. It is essential for the functioning of industries, transportation, healthcare, and education, and it is crucial for maintaining national security. Pakistan's inability to ensure an uninterrupted energy supply has far-reaching consequences for its socio-economic stability. The lack of energy access disproportionately affects low-income populations, who rely on affordable and consistent energy for survival and livelihood.

Furthermore, energy security is inextricably linked to environmental sustainability. With growing concerns about climate change and environmental degradation, it is essential for Pakistan to transition towards cleaner, renewable energy sources. The shift to renewable energy can not only mitigate the adverse environmental impact but also provide a more sustainable and self-reliant energy future.

### **Challenges and Key Issues**

One of the core challenges in Pakistan's energy sector is the heavy reliance on imported fuels, which drains foreign exchange reserves and leaves the country vulnerable to

external shocks. The import of refined oil, in particular, has become a major burden on Pakistan's economy, costing billions of dollars annually. Despite efforts to improve domestic production and reduce imports, the country continues to face a large gap between energy demand and supply. This has led to a situation where even small fluctuations in global energy prices significantly affect the country's balance of payments.

Natural gas, which contributes to a significant portion of Pakistan's energy mix, has also seen a decline in domestic production. As a result, the country has increasingly relied on LNG imports to meet its energy needs. However, this dependency on LNG imports has not only strained foreign reserves but also raised concerns about the future security of LNG supplies. Moreover, the country's energy mix remains overly reliant on fossil fuels, which are both environmentally damaging and increasingly expensive.

Pakistan's energy generation infrastructure also faces critical issues, including outdated technology, inadequate investment in upgrading power plants, and inefficient energy transmission and distribution systems. A large portion of the energy generated by Pakistan's independent power producers (IPPs) relies on imported fuels, which further exacerbates the dependence on foreign energy supplies.

### **Energy Potential and Strategic Position**

Despite these challenges, Pakistan holds significant untapped energy resources. The country is strategically located at the crossroads of major global energy markets, providing potential for energy trade and regional cooperation. Pakistan has vast hydropower potential, substantial lignite coal reserves, and promising solar and wind energy resources. However, the realization of these potentials has been hindered by political instability, a lack of long-term planning, and insufficient technological development.

Hydropower, for example, remains underutilized, with only a fraction of the country's potential being harnessed. The development of renewable energy sources such as solar and wind has also been slow, despite the country's favorable geographical conditions for these energy sources. As the global energy landscape shifts towards cleaner and more sustainable energy solutions, Pakistan needs to prioritize the development of these resources to achieve energy independence and sustainability.

### **Policy and Planning Recommendations**

To address the myriad challenges facing Pakistan's energy sector, there is a critical need for comprehensive and forward-looking policy reforms. Pakistan must adopt a more integrated approach to energy policy, which takes into account the full spectrum of energy security—economic, geopolitical, environmental, and technological factors.

A major shift towards renewable energy should be at the forefront of Pakistan's energy strategy. Investments in solar, wind, and hydropower are crucial to reducing dependence on imported fuels and mitigating the environmental impact of fossil fuel consumption. The government should incentivize private sector involvement in renewable energy projects and improve the regulatory framework to attract investment in these sectors.

Moreover, Pakistan must take immediate steps to modernize its energy infrastructure, focusing on the renovation and expansion of energy generation facilities, improving energy efficiency, and upgrading transmission and distribution networks. The development of a diversified energy mix, which includes both indigenous and renewable resources, can help reduce the vulnerability of the energy supply chain.

The country must also address the governance and political challenges that hinder the effective implementation of energy policies. Political will is essential for driving the necessary reforms and ensuring that long-term energy security becomes a national priority. A clear roadmap for energy development, backed by strong institutions, can ensure that Pakistan remains resilient to both domestic and external energy shocks.

The energy crisis in Pakistan is a critical issue that demands immediate and effective solutions. The country's energy sector faces significant challenges, including dependence on imported fuels, policy failures, circular debt, and an inefficient energy mix. These issues hinder economic growth and have led to widespread power outages and load shedding, directly affecting daily life and business operations. Addressing this crisis requires both short-term interventions and long-term strategies to improve efficiency, reduce costs, and ensure sustainability in the energy sector.

### **Key Challenges:**

- **Circular Debt:** A growing problem, escalating from Rs. 1,200 billion in 2018 to Rs. 2,491 billion in 2022. This has increased the cost of energy, leading to higher tariffs and inefficient sector functioning.
- **Dependency on Imported Fuels:** Reliance on imported LNG and oil has strained foreign reserves and contributed to rising energy prices.
- **Inefficient Energy Mix:** Fossil fuels dominate the energy mix, accounting for nearly three-fourths of the energy demand, with limited investment in renewable sources.

### **Short-Term Measures:**

1. **Revision of IPP Agreements:**
  - Adjust generation tariffs to reflect local currency components, reducing the financial strain caused by the fluctuation of the rupee-dollar exchange rate.
  - Replace the current take-or-pay contracts with more flexible take-and-pay contracts, where payments are tied to actual energy consumption.
2. **Comprehensive IPP Audits:**
  - Conduct thorough audits of Independent Power Producers (IPPs) to assess fuel consumption, profitability, and operational efficiency, ensuring that capacity payments are justified.
3. **Strengthening Distribution Companies (DISCOs):**
  - Address workforce shortages and technical inefficiencies in DISCOs, encourage public-private partnerships, and subdivide DISCOs to align with optimal distribution network coverage and population density.
  - Implement rural electrification through mini-grids powered by renewable energy sources, such as biomass and solar, to extend electricity to remote areas.



**4. Renewable Energy Projects:**

- Expand the use of utility-scale renewable energy sources like solar, wind, and biomass to reduce reliance on imported fuels and lower energy costs.

**Long-Term Measures:****1. Hybrid Renewable Energy Projects:**

- Integrate various renewable sources, including solar, nuclear, wind, biomass, and hydropower, to create stable, cost-effective energy solutions that can complement existing infrastructure.

**2. Energy Market Liberalization:**

- Relax government restrictions and encourage competition in the energy market. Privatization and the introduction of competitive trading can lead to improved efficiency, lower prices, and increased economic development.
- Liberalization has proven successful in countries like the UK, where market competition led to reduced prices for consumers and improved service delivery.

**3. Decentralized Planning for Distribution Utilities:**

- Enable distribution utilities to procure power on a competitive basis, improving efficiency and encouraging investment in technical infrastructure.

**4. Strategic Energy Mix Diversification:**

- Reduce dependence on fossil fuels by investing more heavily in renewable energy, ensuring a diverse and sustainable energy mix. This will reduce the strain on foreign exchange reserves and mitigate the impacts of volatile fuel prices.

**Conclusion:**

The energy crisis in Pakistan is a complex issue that requires a holistic approach involving immediate reforms and long-term strategic planning. By addressing inefficiencies in the energy sector, revising existing agreements, and fostering competition, Pakistan can begin to resolve its energy shortfall. The proposed measures, particularly those focused on renewable energy adoption, distribution network improvements, and market liberalization, will pave the way for a more sustainable, cost-effective, and reliable energy sector. These steps are crucial for Pakistan's economic growth and development, ensuring energy security and reducing the financial burden on consumers and the government.

## ***Introduction***

Energy security is a complex and multifaceted concept that encompasses various dimensions, including economic, political, geopolitical, institutional, legal, and regulatory aspects within a country or region. The economic dimension of energy security considers the implications of reliance on energy imports in volatile markets, the diversification of energy sources, the utilization of domestic resources, and the circular flow of energy (Ahmad, 2014). Energy security is a crucial factor that significantly impacts a country's economy, foreign policy, and national security. It is considered the primary element of social well-being and plays a pivotal role in sustainable development. Striking a balance between energy supply and demand is of vital importance for any country in order to provide sustainable, clean, and affordable energy to consumers. With technological advancements, the dependence on energy for all economic sectors has increased, making the security of energy supply more crucial than ever (Khan, 2019).

Pakistan faces internal and external challenges that threaten its national security, and the demand-supply gap for energy has hindered its development pace in recent decades. Inadequate policy measures, global and domestic energy politics, short-term planning, lack of political will, and an inefficient energy mix are among the primary problems that contribute to Pakistan's energy shortfall (Baig, 2016). Pakistan's energy supply mix has always been dominated by both imported and indigenous fossil fuels. Almost three-fourths of the country's energy demand is met through gas and oil. Dependence on imported LNG and oil has exacerbated the situation by exerting pressure on foreign exchange reserves (Haider, 2019). If left unaddressed, this may aggravate the challenges further, such as the scarcity of indigenous resources, exponential hikes in imported fuel prices, and disruptions in future supply chain orders.

## ***Statement of the Problem***

Energy plays a pivotal role in social well-being and sustainable development. However, Pakistan's energy sector is beset by a host of issues and shortcomings, such as power outages, high prices, and shortages. Therefore, there is a need to analyze all the possible dimensions and challenges by critically examining the energy policies and their repercussions.

## ***Scope of the Study***

The scope of the study is to encompass a multidimensional approach to the issue, taking both national and global perspectives in order to analyze its impacts. This study will provide a comprehensive insight into the challenges posed by the existing policies and the lessons learned from developed and developing countries.

## ***Literature Review***

Energy security not only impacts a state's economy but also its environmental and national security. Energy is crucial to sustaining economic growth, and a continuous and reliable energy supply is necessary for technological advancement and societal progress. In the present era, energy security is influenced by various factors such as robustness, sovereignty, and resilience. In short, energy security is a linchpin, linking several sectors of the economy, governance, planning, international energy markets,

and diplomacy (Pasricha, 2017).

The contemporary challenge of ensuring energy security goes beyond merely safeguarding oil supplies, as it now encompasses a broader array of interconnected issues intertwined with energy policy dilemmas. This expanded perspective includes equitable access to modern energy resources and addressing the pressing concern of climate change (Cherp and Jewell, 2014). The concept of energy security has evolved to encompass these wider concerns, thereby introducing new dimensions like environmental impact, human security, international relations, foreign policy, energy efficiency, and capacity adequacy. Research efforts, both on a regional and country-specific scale, have explored a diverse range of dimensions and frameworks, rendering contemporary energy security a "multidimensional" concept (Yao and Chang, 2014). Additionally, it is imperative to consider the potential influence of "disruptive innovations" in shaping the future energy landscape (Proskuryakova, 2018).

In the case of Pakistan, it enjoys a strategic position because of its location at the crossroads of world energy resources. Despite having diverse untapped domestic energy resources such as hydropower, vast lignite coal deposits, hydrocarbons, and huge solar/wind potential, Pakistan relies heavily on foreign energy supplies. Owing to the increasing energy demand and fluctuating energy prices, the import bill is continuously surging, leading to a considerable burden on Pakistan's fragile economy (Hanif, 2017).

In a review of the existing literature on Pakistan's energy security, it becomes evident that most studies have predominantly examined Pakistan's energy situation qualitatively. These studies have focused on aspects such as policy evaluation, energy supply and demand dynamics, capacity planning for energy generation, and the composition of the primary energy mix (Aized, 2018). However, only a limited number of studies have ventured beyond qualitative assessments to provide a quantitative analysis that evaluates the "impact" of various factors on energy security, including government policy decisions and the persistent dependence on primary energy imports (Anwar, 2014).

Moreover, Pakistan is not self-sufficient in energy and depends largely on imports, making it vulnerable to external and internal energy shocks. Due to inadequate policy measures, global and domestic energy politics, short-term planning, lack of political will, and an unsustainable energy mix, Pakistan faces various energy-related challenges. These challenges have led to a limited utilization of the country's energy potentials and ultimately affected energy security dynamics and national security (Khudadad, 2021). As a result, Pakistan needs to develop a comprehensive and integrated energy policy that ensures energy security and sustainable development.

### ***Research Methodology***

The qualitative approach employed herein uses secondary data from newspapers, editorials, published research articles, and existing research on this subject.

### ***Situational Analysis***

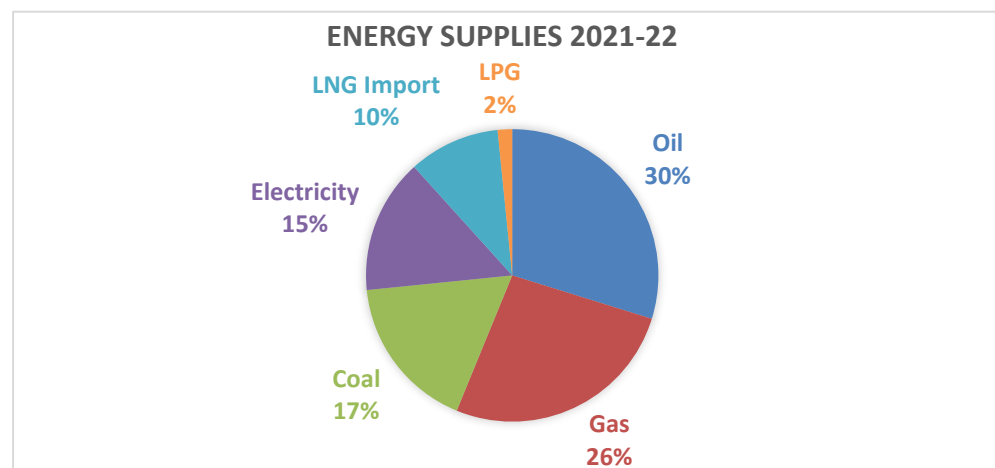
Pakistan has been grappling with a significant energy crisis over the past decade, which has had wide-ranging effects on its economy. This crisis is mainly due to a lack of increase in power generation capacity. Pakistan's energy generation relies on a mix of sources, including oil, natural gas (both natural gas and liquefied natural gas, LNG), coal, renewable energy (solar, wind, and hydro power), nuclear energy, and biomass. Importantly, the country heavily depends on imported fuels, such as oil and LNG, and is expected to continue this reliance for the next 10 to 15 years.

Pakistan continues to be a net importer of refined oil due to the limited capacity of its domestic refineries to process crude oil. Despite having a total refining capacity of 19 million tons, these refineries are not operating at full capacity due to a lack of upgrades and technical and financial constraints. In 2019, Pakistan only produced 4.3 million metric tons of crude oil, meeting just 20 percent of its petroleum needs. The remaining 80 percent is satisfied through imports of crude oil and refined petroleum products, costing the country \$15-\$16 billion annually. Pakistan presently operates five major oil refineries, primarily processing imported crude oil. In an effort to reduce this reliance on refined oil imports, Pakistan and Saudi Arabia agreed in October 2018 to construct a new refinery in Gwadar, Baluchistan.

Natural gas plays a significant role in Pakistan's energy supply, contributing 38 percent to the country's primary energy mix. However, domestic gas production has consistently remained at around 4 billion cubic feet per day (bcfd), while domestic demand is estimated to be in the range of 6-8 bcfd. Consequently, there exists a substantial gap between natural gas supply and demand. Pakistan's natural gas production reached its peak in 2012, and since then, it has been on the decline. Recent small discoveries of natural gas have struggled to offset this production decline. Pakistan is believed to have substantial shale gas reserves, and the government has offered incentives for the development of shale gas. However, there are challenges in developing these resources, including complex geography, environmental constraints, limitations on water resources, security issues, and low natural gas prices in Pakistan.

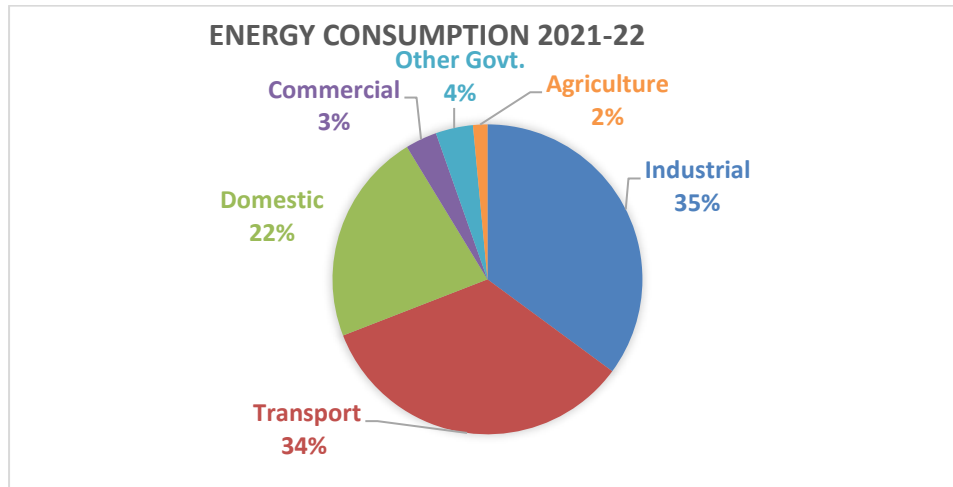
Due to the diminishing natural gas resources in existing fields, Pakistan began importing LNG in the fiscal year 2015 to meet the increasing domestic demand. The first regasification terminal, known as the Engro Elengy floating storage and regasification unit (FSRU), was commissioned in Port Qasim, Karachi, in 2015. The second LNG terminal commenced commercial operations in December 2017. As the demand for gas has risen, particularly in the private sector, including industries like power, cement, and textiles, the government has opened up the LNG sector to private

firms.  
These



companies can import LNG for their respective industries. In this context, a third LNG terminal is in progress, undergoing the necessary bureaucratic approvals.

(Source: Energy Year Book, 2021-22)



(Source: Energy Year Book, 2021-22)

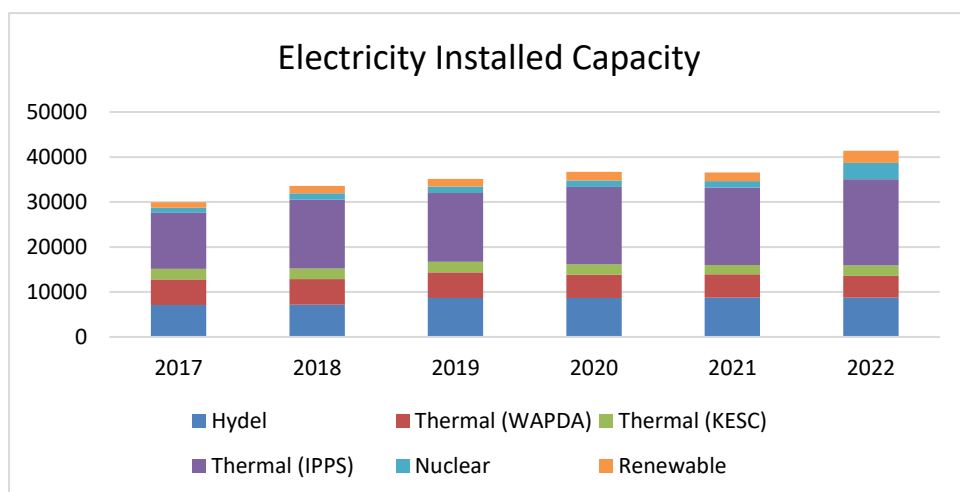
### Total Installed Capacity

Pakistan's total installed capacity as of June 2022 was 40,813 MW (excluding K-Electric). Of this, 33% is the share of renewable energy, which comprises hydro, solar, wind, and bagasse-based technologies, while 67% of the installed capacity is contributed by thermal projects, including local gas, local coal, imported coal, RFO, RLNG, and nuclear-based technologies. Currently, 78 independent power producers (IPPs) are operating in Pakistan, and they are based on imported fuel. Of these, 44% are based on natural gas, 30% on RFO, 21% on imported coal, 4% on local coal, and 1% on hydro.

Among Pakistan's installed capacity, the report indicates that 23,821 MW is thermal (GENCOs, IPPs, SPPs), 10,635 MW is hydroelectric, 1,838 MW is wind, 530 MW is solar, 369 MW is bagasse, and 3,620 MW is nuclear. The addition of the 1,145 MW K-3 nuclear power plant has significantly increased Pakistan's nuclear power generation capacity.

	2017	2018	2019	2020	2021	2022
Hydel	7129	7139	8639	8668	8723	8723
Thermal (WAPDA)	5688	5748	5748	5192	5192	4880
Thermal (KESC)	2295	2295	2295	2295	2085	2346
Thermal (IPPS)	12505	15304	15304	17195	17184	19081
Nuclear	1090	1430	1430	1430	1430	3630
Renewable	1237	1637	1698	1921	1921	2742
Total	29944	33553	35114	36701	36535	41402

(Source: Energy Year Book, 2021-22)



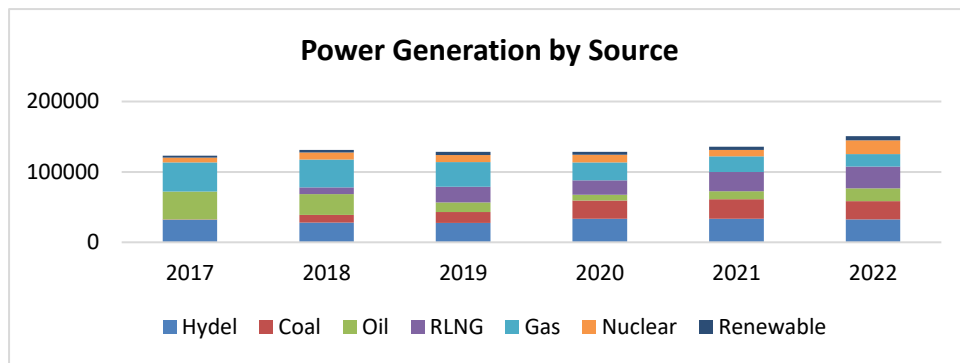
(Source: Energy Year Book, 2021-22)

### Total Generation

Pakistan's total electricity generation in FY2021-22 was 154,046.69 GWh (including K-Electric). The total generation in the CPPA-G area, which accounts for 93% of the country's total generation, included 35,546.28 GWh from hydro, 82,604.62 GWh from thermal sources (GENCOs, IPPs, SPPs), 18,247.77 GWh from nuclear, 6,195.66 GWh from renewables (wind, solar, and bagasse), and 514.36 GWh imported from Iran.

Source	2017	2018	2019	2020	2021	2022
Hydel	32183	27925	27339	33585	33548	32706
Coal	279	10911	15774	25857	27549	25906
Oil	39563	29501	13391	8242	11432	18219
RLNG	-	9768	22599	20545	27319	30643
Gas	41426	39435	34846	25475	22153	18024
Nuclear	6999	9880	9909	10815	9346	19174
Renewable	2668	3857	4682	4152	4323	6195
<b>Total</b>	<b>123118</b>	<b>131277</b>	<b>128540</b>	<b>128671</b>	<b>135670</b>	<b>150867</b>

(Source: Energy Year Book, 2021-22)



(Source: Energy Year Book, 2021-22)

### IPPs and Circular Debt

The energy mix in Pakistan changed significantly after the 1994 energy policy was implemented, opening doors for the private sector to venture into power generation. Prior to the policy, 60% of the energy mix came from hydroelectricity, and only 40% came from thermal capacity. However, in the years following the policy, the mix was reversed to 70% thermal capacity (based on imported fuel) and only 30% hydel generation. In the winter months, hydel generation was further reduced due to lower water flows in the rivers, causing the energy mix to reach as low as 20% hydel and 80% thermal capacity.

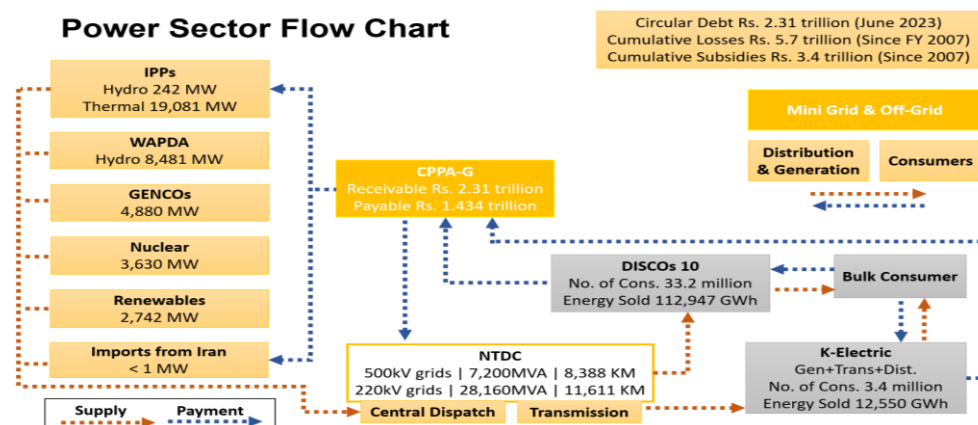
In 1994-95, the price of crude oil was \$10-15 per barrel, and the price of furnace oil was only Rs 2,540 per ton. As oil prices have risen significantly over the years and crossed \$100 per barrel from 2008 onwards, the cost of generating one unit at an Independent Power Producer (IPP) thermal plant has increased manifold to Rs 18 per KWh when produced on furnace oil and Rs 24 per unit when produced through diesel, while the average sale price of electricity in Pakistan is about Rs 9 per KWh. The 1994 energy policy in Pakistan had several significant flaws. One of the flaws was a curious decision to offer a fixed capacity price of 6.5 cents per kilowatt-hour (KWh), plus the actual cost of fuel as a pass-through item. This resulted in IPPs generating electricity at a cost greater than the average sale price of Rs 9 per KWh, leading to a subsidy that put strain on the country's resources. Another serious flaw was that the policy shifted the energy mix from hydroelectricity to thermal capacity fueled by imported oil. This created a permanent fault line in Pakistan's energy system and caused long hours of loadshedding. All of these factors contributed to generating the problem of circular debt.

Circular debt in Pakistan's power sector is a longstanding issue that has been present since 2006, when the government failed to increase tariffs in response to rising international oil prices. The circular debt has been exacerbated by technical inefficiencies, power theft, and a lack of balance between the receivables from the DISCOs (distribution companies) and the payables to the IPPs (independent power producers).

Tariff differential subsidies have been used to cover the gap between the cost of electricity and the notified tariff for consumers, which has led to increasing payables to the IPPs and a lack of funds for fuel procurement. The debt pile has continued to grow, reaching Rs 366 billion by 2010, despite the implementation of measures such as quarterly adjustments and pass-on criteria. The government has injected liquidity to clear the debt temporarily, but the underlying issues, such as inefficiencies in the

distribution companies and underutilization of capacity, remain unaddressed. The circular debt issue has persisted in Pakistan, and despite several efforts by the government to address the issue, it remains unresolved. One of the prominent factors contributing to the exponential rise of circular debt is an unsustainable and expensive mix of power generation. The circular debt has escalated in the past few years, increasing from Rs 1,200 billion in 2018 to Rs 2,491 billion in 2022. The rise in circular debt has led to load shedding, power outages, and a lack of investment in the power sector, hindering economic growth and development in the country. As a result, power tariff hikes are applied across all consumers to reduce the circular debt. However, these hikes have an adverse effect on the energy affordability of consumers, and the government has to provide an influx of subsidies to maintain energy affordability. The main factors that contribute to circular debt are the high generation cost, followed by technical losses and inadequate bill recoveries in the distribution sector. There is an uneven allocation of the cost of generation to customers. The transfer mechanism of these generation costs does not allow for the proper allocation of costs to customers. Moreover, if this is done properly, energy affordability may plunge. Additionally, the formula for the calculation of capacity payments is designed in favor of capacity payments to independent power producers, which contributes to the circular debt issue. Large power generation stations with a capacity of more than 1,000 MW contribute more to the circular debt problem.

Over view of Pakistan's Power sector:



## Critical Analysis and Evaluation of Existing Policies

**Coverage and Involvement of Stakeholders:** The development of the National Electricity Plan 2023-2027 has evolved through a mechanized and all-inclusive process for devising a sustainable long-term strategy for the power sector, thereby enabling the attainment of the policy goals. The document mentions the following stakeholders involved in the development of the National Electricity Plan 2023-2027:

- National stakeholders, including NEPRA, OGRA, NEECA, NTDCL, PPIB, AEDB, PITC, DISCOs, MoPDSI, MoC, MoCC, MoIP, MoST, PASS Division, EDB, NADRA, and NITB
- Sectoral & cross-sectoral entities/divisions
- Provincial Governments
- Consumer segments



- Academia & research bodies
- Policy think tanks
- Private sector
- Development finance institutions (DFIs)
- Local academia, including UET, LUMS, NUST, UET, and PIDE
- Esteemed international stakeholders, including IMF, World Bank, ADB, etc.

**Current Relevance:** The National Electricity Plan 2023-2027 is relevant because it serves as a blueprint or roadmap for Pakistan's power sector. The plan outlines a strategic architecture and action plan with clear timelines and tangible targets aimed at addressing the pressing challenges confronting Pakistan's power sector. These challenges include energy security, affordability, and environmental sustainability issues. The NE-Plan places paramount importance on social protection by ensuring the affordability of electricity, expanding electrification to even the most remote regions, and fostering economic stability through localization and self-sufficiency measures. It sets forth interventions in key areas such as network planning and operations, sustainable expansion and delivery of electricity services, and a financially viable power sector. The plan was developed with the collaboration and consultation of national and international stakeholders to ensure transparency and accountability in achieving its objectives. It is applicable for the control period from the date of its notification until FY-2027, and the government is expected to review the progress of the plan on a semi-annual basis.

**Realistic vs. Idealistic Objectives:** The National Electricity Plan 2023-2027 sets ambitious objectives, but they are not necessarily unrealistic or idealistic given the context of Pakistan's power sector. The objectives are based on the challenges and opportunities facing the sector and have been developed by taking into account the current and potential state of generation, transmission, and distribution, consumer load demands, fuel mix, financial viability of sector entities, and regulatory environment. The plan is also backed by a comprehensive action plan with clear timelines and tangible targets to support the achievement of the objectives. While some of the objectives may seem idealistic given the current state of the power sector in Pakistan, the plan's implementation over the next five years is expected to bring significant changes and improvements, such as enhanced electrification, expanded transmission and distribution infrastructure, increased use of renewable and distributed energy resources, and improved financial viability of the sector entities. Whether the objectives set by the plan are achievable in the given timeline will depend on various factors, including political will, resource availability, and external influences, among others. Nevertheless, the plan provides a much-needed clear direction for the power sector and is expected to make significant progress towards achieving the targets.

**Future-Oriented Aspects:** The National Electricity Plan 2023-2027 includes several future-oriented aspects focused on achieving greater sustainability, efficiency, and technological innovation in Pakistan's power sector.

**These aspects include:**

- From a diversification standpoint, the NE-Plan prioritizes integrated energy planning to expand both renewable and non-renewable energy generation, with an emphasis on meeting the target of a 65% clean energy mix for power generation by FY-2030.
- The plan also emphasizes energy efficiency and conservation on both the

supply and demand sides by introducing various incentive policies and schemes aimed at vigorously reducing the energy intensity in Pakistan's economy to meet sustainable transition goals.

- Localization of fuel and technology, promoting indigenous resources, and strategizing the production and use of emerging technologies like hydrogen and storage is critical for energy security and has been prioritized in the plan.
- The NE-Plan includes the institutionalization and integration of R&D frameworks across the sector with the aim of supporting the development of clean energy technology and digitalization. The plan aims to promote innovation initiatives and report annual updates.
- Institutional improvements and organizational restructuring of the power division, AEDB, and PPIB, among other entities, are to be carried out to improve their capacity to contribute effectively to the plan's implementation.
- The plan also highlights the importance of digital technologies such as a central information system and a central consumer service platform for the one-window facilitation of energy consumers, providing real-time data, and improving customer service delivery.

Overall, the NE-Plan emphasizes a sustainable transition in Pakistan's power sector, and its key initiatives prioritize energy security, market expansion, cost-effectiveness, and environmental sustainability. These aspects serve as the roadmap for Pakistan's power sector and will help ensure the country's future energy needs are met.

**Examination of Institutional Mechanisms for Implementation:** The National Electricity Plan 2023-2027 includes an implementation framework that defines institutional mechanisms for the plan's execution. The implementation plan has been designed to ensure sustainable and efficient execution of the plan.

The following are some of the institutional mechanisms listed in the plan to deliver the intended outcomes:

- The plan designates a 'Designated Entity' (DE) as the central authority for institutionalizing and monitoring the implementation of the NE-Plan. The DE will have to prepare reports periodically and will play a critical role in mobilizing resources, supervising the strategic and operational initiatives of the sectoral entities, and coordinating with relevant stakeholders.
- The designated entity will also be responsible for strategic risk management and implementation, including identifying, prioritizing, and monitoring strategic risks and the development of the risk assessment report.
- The plan outlines the involvement of power sector entities such as XW-DISCOs, NTDC, CPPA-G, AEDB, and PPIB, and their respective responsibilities for each initiative of the plan.
- The plan highlights the importance of monitoring and evaluation mechanisms to ensure compliance with the strategic directives, track progress of individual targets and directives, and gauge the performance of responsible entities. A total of 40 KPIs have been defined to track the strategic progress under the NE-Plan.
- The plan establishes regular reporting and updating mechanisms for the NE-Plan with semi-annual progress reports to be managed by the designated entity.

- ICT plans are to be developed and maintained for all entities to enable efficient tracking and integration of technological advancements in the sector.
- Institutional improvements and organizational restructuring of the power division, AEDB, and PPIB, among other entities, are to be carried out to improve their capacity to contribute effectively to the plan's implementation.

**Design of Implementation Strategies:** The National Electricity Plan 2023-2027 has incorporated several measures to ensure robust and effective implementation strategies. Here are some of the key points regarding the design of the implementation strategies for the NE-Plan:

- Responsibility for implementing the targets and directives of the plan has been assigned to specific Responsible Entities.
- A monitoring and evaluation mechanism has been deployed to track the progress of individual targets and directives and to gauge the performance of the Responsible Entities.
- A multi-tier reporting hierarchy has been devised to assess progress towards achieving the overall objectives of the NE-Plan and to outline specific actions for informed decision-making.
- To ensure sustainable implementation of the NE-Plan, a robust implementation framework has been devised, which provides for monitoring, evaluation, and reporting mechanisms.
- The plan includes a web-based Monitoring & Evaluation System (M&ES), which has been developed and deployed to enable effective monitoring and evaluation of the plan's strategic directives. This web-based platform allows every Responsible Entity to update its compliance status for all the assigned strategic directives.
- Dedicated user interfaces have been created for each Responsible Entity to provide input into the overall system performance monitoring dashboard of the plan in real-time.
- Roles and responsibilities of various entities in the NE-Plan are also outlined to provide a clear definition of the designated functions, organizational restructuring, necessary training, and human resource capacity building.

Overall, the National Electricity Plan 2023-2027 emphasizes a structured and practical approach to the implementation of the plan's objectives. It provides a monitoring and evaluation framework along with a well-defined Responsible Entity structure to undertake monitoring and reporting activities, aiding in efficient implementation.

**Assessment of Impact:** The National Electricity Plan 2023-2027 emphasizes assessing the impact of various initiatives through ex-ante and ex-post assessments. A few key points related to the assessment of the impact of the plan are:

- A comprehensive Monitoring and Evaluation System (M&ES) has been developed and deployed to measure the progress of individual strategic directives, project implementation progress, and economic and environmental sustainability issues associated with the NE-Plan.
- The impact assessment of the NE-Plan involves both ex-ante and ex-post

evaluations. It involves the establishment of an MRV (monitoring, reporting, and verification) system, which has been integrated within each priority area and further aligned with the implementation framework of the NE-Plan. Ex-ante assessments will be performed for all projects, initiatives, and programs before their implementation, and ex-post assessments will be conducted after their implementation.

- MoCC, in collaboration with relevant entities, shall regularly assess the shadow costs of carbon emissions and develop a roadmap for the development of the integrated assessment model to inform the cross-sectoral policy decisions in an integrated manner.
- These assessments will support the identification of critical success factors and best practices, as well as areas that require improvement. Through these mechanisms, the NE-Plan aims to ensure that the desired outcomes are achieved effectively and efficiently while also taking into account the economic and environmental sustainability of the initiatives.

#### ***ADMINISTRATIVE & HUMAN RESOURCES ISSUES PERTAINING TO IMPLEMENTATION IN PAKISTAN POWER SECTOR***

The Pakistan Power Sector is facing a number of administrative and human resources issues that are hindering its effective implementation. These issues include:

- **Lack of coordination among different stakeholders:** The power sector in Pakistan is fragmented, with different government agencies and private companies involved in generation, transmission, and distribution. This lack of coordination among stakeholders can lead to delays and inefficiencies in implementation.
- **Corruption:** Corruption is a major problem in the Pakistan Power Sector, and it can lead to delays, cost overruns, and poor-quality work.
- **Shortage of skilled personnel:** The power sector in Pakistan is facing a shortage of skilled personnel, both at the managerial and technical levels. This shortage is making it difficult to implement new projects and to maintain the existing infrastructure.
- **Weak institutional capacity:** Many of the institutions involved in the power sector in Pakistan have weak institutional capacity. This makes it difficult for them to effectively implement projects and manage the sector.
- **Political interference:** The power sector in Pakistan is often subject to political interference. This can lead to delays in decision-making and suboptimal decisions being made.

These administrative and human resources issues are making it difficult to implement new projects in the power sector and to improve the efficiency and reliability of the existing infrastructure. As a result, Pakistan is facing a number of power shortages, which are hindering economic growth and development.

## **6. STAKEHOLDER ANALYSIS**

The main stakeholders in Pakistan's power sector are as follows:

1. **Government-controlled power generation companies:** High interest due to

their role in producing electricity to meet national demand and generating revenue for the government. High power, as the government controls these companies directly. Their role includes planning, constructing, and operating power plants.

2. **National Electric Power Regulatory Authority:** Moderate interest as the regulator of the power sector, responsible for creating a competitive environment and regulating tariffs. High power, as NEPRA has the authority to approve or deny applications made by companies for power generation, transmission, and distribution.
3. **Independent Power Producers:** High interest in generating electricity, selling it to power distribution companies, and making a profit. Moderate power, as they make important contributions to the power sector but must follow rules established by the government.
4. **National Transmission and Dispatch Company:** Moderate interest in transmitting electricity from the generation companies to DISCOs, managing the national grid, and making sure power is available when and where it is needed most. Moderate power, as they perform a critical function in the power value chain.
5. **Distribution Companies:** High interest in distributing electricity to end consumers and collecting payments from them. Low power, as they have little say in the regulations that govern the power sector.
6. **Commercial and Industrial Consumers:** High interest in accessing reliable and affordable power for their businesses. Low power, as they have little say in the regulations of the power sector.
7. **Residential Consumers:** High interest in accessing reliable and affordable power for their household needs. Low power, as they have little say in the regulations of the power sector.
8. **Renewable Energy Companies:** High interest in producing electricity through renewable sources, creating jobs, and reducing the reliance on fossil fuels. Low power, as they are a relatively new industry in Pakistan.

Overall, it can be concluded that the government-owned power companies and NEPRA possess the most power in the power sector, with the other stakeholders having relatively less power.

## 7. LEGAL FRAMEWORK/INSTRUMENT

- **National Security Policy of Pakistan (2022-2027)**

### **Energy Security**

Pakistan faces challenges in its energy sector. One of the major challenges is the external imbalance, which results in consistently higher foreign exchange outflows than inflows. To address this challenge, Pakistan aims to primarily focus on export growth, export-oriented foreign direct investment, and improving the ease of doing business. Pakistan's energy sector has contributed to low economic output, increased production costs, and has put an increased burden on the government's funds in the form of subsidies and capacity payments. Circular debt is a critical challenge in the energy sector. Pakistan also aims to increase the share of installed capacity through renewable sources of energy to 30% by 2030. Additionally, prioritizing investments in hydropower projects, the country's share of clean energy should reach 60% by 2030.

To achieve energy security, the national security policy objectives include:

- Reforming Pakistan's energy sector by promoting sustainable, eco-friendly energy development at competitive rates that are proportional to the demand for energy in a growing Pakistan.
- Moving towards a market-based energy sector, improving energy storage, and securing dependable international access to energy sources to meet future demand while prioritizing indigenous energy resource development.
- **National Electric Power Regulatory Authority (NEPRA) Act, 1997:**

NEPRA is the regulatory body responsible for regulating the generation, transmission, and distribution of electric power. It determines tariff rates and ensures compliance with the Electric Power Act 1997 and NEPRA rules made under Section 47 of the Act.

- **National Electric Policy, 2021:**

The National Electricity Plan 2021 includes an implementation framework that defines institutional mechanisms for the plan's execution.

- **National Electric Policy, 2023:**

The National Electricity Plan 2021 includes an implementation framework that defines institutional mechanisms for the plan's execution. The implementation plan has been designed to ensure sustainable and efficient execution of the plan.

- **Electric Power Policy, 2015:**

This policy provides a framework for the development of the power sector in Pakistan. It outlines objectives such as increasing generation capacity, improving efficiency, and promoting renewable energy sources.

- **Power Generation Policy, 2002:**

This policy aimed to attract private investment in the power generation sector. It introduced mechanisms for the establishment of Independent Power Producers (IPPs) and encouraged the use of various energy sources, including coal and renewable energy. The subject policy covers:

- Private sector projects
- Public sector projects
- Public-private partnership projects
- Projects developed by the public sector and then divested

- **Renewable Energy Policy, 2019:**

Pakistan has made efforts to promote renewable energy sources, and this policy outlines the government's strategy for the development of renewable energy projects, including wind, solar, and biomass.

- **Provincial Regulations:**

In addition to federal regulations, provinces in Pakistan also have their own regulatory authorities and policies related to energy. These provincial authorities play a role in the implementation and regulation of energy projects within their jurisdictions.

## ***GAP ANALYSIS***

### **7.1 Gap Analysis of National Electricity Policy, 2021**

The National Electricity Policy 2021 of Pakistan is a comprehensive document that aims to address the challenges and opportunities facing the country's electricity sector. The policy is aligned with the Sustainable Development Goals and sets ambitious targets for increasing renewable energy generation, improving energy efficiency, and reducing greenhouse gas emissions.

However, there are a number of gaps between the NEP 2021's stated goals and the current reality of the Pakistani electricity sector. Some of the key gaps include:

- **Implementation:** The NEP 2021 is a comprehensive document, but its implementation will require significant political will, financial resources, and technical expertise. It is important to develop a clear and realistic implementation plan for the

policy, with specific timelines and milestones.

- **Capacity building:** The NEP 2021 calls for a number of new initiatives and reforms, but many of these will require new skills and capabilities from the government and private sector. It is important to invest in capacity building to ensure that the policy is implemented effectively.

- **Coordination:** The NEP 2021 is a cross-cutting policy that will require coordination between different ministries, departments, and agencies. It is important to establish a clear institutional framework for coordinating the implementation of the policy.

In addition to these general gaps, there are also a number of specific gaps in relation to the NEP 2021's targets and goals. For example, the policy calls for a 30% share of renewable energy in the generation mix by 2030. However, the current share of renewable energy is only around 5%. This means that significant investment and policy support will be needed to achieve the NEP 2021's target.

Another gap is in relation to the NEP 2021's target of reducing energy consumption by 15% by 2030. This target is ambitious, and it will require a concerted effort from the government, private sector, and households to achieve it.

### What needs to be done

The following recommendations can help to address the gaps in the NEP 2021:

- **Develop a clear and realistic implementation plan:** The government should develop a clear and realistic implementation plan for the NEP 2021, with specific timelines and milestones. The plan should identify the resources required to implement the policy, and it should be regularly reviewed and updated.
- **Invest in capacity building:** The government should invest in capacity building to ensure that the NEP 2021 is implemented effectively. This could include training programs for government officials, private sector stakeholders, and other relevant actors.

- **Establish a clear institutional framework for coordination:**

The government should establish a clear institutional framework for coordinating the implementation of the NEP 2021. This could involve establishing a dedicated NEP 2021 implementation unit or task force.

- **Provide financial incentives and support for renewable energy development:** The government should provide financial incentives and support for the development of renewable energy projects. This could include tax breaks, subsidies, and other forms of support.

- **Implement energy efficiency standards and programs:** The government should implement energy efficiency standards and programs to reduce energy consumption. This could include raising energy efficiency standards for buildings and appliances, and providing subsidies for energy-efficient appliances and technologies.

## 7.2 Gap Analysis of National Energy Policy, 2023

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The National Energy Efficiency and Conservation Policy 2023 (NEECP 2023) of Pakistan is a comprehensive policy that aims to improve energy efficiency and conservation across all sectors of the economy. The policy sets ambitious targets for reducing energy consumption and greenhouse gas emissions, and it outlines a number of measures to achieve these targets.

However, there are a number of gaps between the NEECP 2023's stated goals and the current reality of the Pakistani energy sector. Some of the key gaps include:

- **Implementation:** The NEECP 2023 is a comprehensive document, but its implementation will require significant political will, financial resources, and technical expertise. It is important to develop a clear and realistic implementation plan for the policy, with specific timelines and milestones.
- **Awareness and capacity:** There is a lack of awareness and capacity for energy efficiency and conservation across all sectors of the Pakistani economy. It is important to raise awareness of the benefits of energy efficiency and conservation, and to build capacity for implementing energy efficiency measures.
- **Enforcement:** The NEECP 2023 outlines a number of mandatory and voluntary energy efficiency measures. However, there is a lack of capacity and resources to enforce these measures. It is important to develop and implement effective enforcement mechanisms to ensure that the NEECP 2023's targets are met.

In addition to these general gaps, there are also a number of specific gaps in relation to the NEECP 2023's targets and goals. For example, the policy calls for a 10% reduction in energy consumption by 2030. However, the current rate of energy efficiency improvement is only around 1%. This means that significant additional efforts will be needed to achieve the NEECP 2023's target. Another gap is in relation to the NEECP 2023's target of increasing the share of renewable energy in the generation mix to 30% by 2030. This target is ambitious, and it will require significant investment and policy support to achieve it.

### What needs to be done

The following recommendations can help to address the gaps in the NEECP 2023:

- **Develop a clear and realistic implementation plan:** The government should develop a clear and realistic implementation plan for the NEECP 2023, with specific timelines and milestones. The plan should identify the resources required to implement the policy, and it should be regularly reviewed and updated.
- **Raise awareness and build capacity:** The government should raise awareness of the benefits of energy efficiency and conservation, and build capacity for implementing energy efficiency measures. This could be done through public awareness campaigns, training programs, and other initiatives.
- **Develop and implement effective enforcement mechanisms:** The government should develop and implement effective enforcement mechanisms to ensure that the NEECP 2023's mandatory energy efficiency measures are complied with. This could involve establishing a dedicated energy efficiency enforcement unit, and developing and implementing clear penalties for non-compliance.
- **Provide financial incentives and support for energy efficiency and renewable energy:** The government should provide financial incentives and support for energy efficiency and renewable energy projects. This could include tax breaks, subsidies, and other forms of support.

- **Promote energy efficiency and renewable energy through public procurement:** The government should promote energy efficiency and renewable energy through its public procurement policies. This could involve giving preference to energy-efficient products and services in public procurement tenders.

### *SWOT ANALYSIS OF INSTITUTIONS*

#### **SWOT Analysis of NEPRA**

##### **Strengths**

- **Independent regulator:** NEPRA is an independent regulator, which means it is not subject to government interference. This gives NEPRA the freedom to make decisions that are in the best interests of consumers and the gas sector.
- **Strong technical expertise:** NEPRA has a strong team of technical experts with a deep understanding of the gas sector. This expertise is essential for NEPRA to effectively regulate the sector and promote competition.
- **Comprehensive regulatory framework:** NEPRA has a comprehensive regulatory framework in place that covers all aspects of the gas sector. This framework provides NEPRA with the authority and tools it needs to regulate the sector effectively.
- **Good track record of implementing reforms:** NEPRA has a good track record of implementing reforms in the gas sector. For example, NEPRA has helped to reduce gas theft and improve the efficiency of the gas transmission and distribution system.

##### **Weaknesses**

- **Lack of resources:** NEPRA lacks the resources and capacity to effectively monitor and enforce the regulatory framework. This is due to a number of factors, including limited funding and staff shortages.
- **Politicization of the regulatory process:** The regulatory process in Pakistan is often politicized, which can undermine NEPRA's independence and its ability to make impartial decisions.
- **Lack of transparency and accountability:** NEPRA needs to improve its transparency and accountability practices. This includes providing better public access to information and being more responsive to public feedback.
- **Weak enforcement of consumer protection measures:** NEPRA needs to do more to enforce consumer protection measures. This includes investigating complaints from consumers and taking action against gas companies that violate consumer rights.

##### **Opportunities**

- **Growing demand for gas:** The demand for gas in Pakistan is growing rapidly. This presents an opportunity for NEPRA to promote the development of new gas resources and improve the efficiency of the gas transmission and distribution system.
- **Opportunities to promote renewable energy and energy efficiency:** NEPRA can play a role in promoting the development of renewable energy and energy efficiency in Pakistan. This would help to reduce Pakistan's reliance on imported gas and improve energy security.
- **Support from international donors and development partners:** NEPRA can benefit from the support of international donors and development partners. This support can help NEPRA improve its capacity and implement reforms in the gas sector.

##### **Threats**

- **Fiscal constraints:** NEPRA faces fiscal constraints, which could limit its ability

to implement reforms and improve its capacity.

- **Political instability:** Political instability in Pakistan could undermine NEPRA's independence and ability to make impartial decisions.
- **Corruption:** Corruption is a major problem in Pakistan, which could undermine NEPRA's ability to regulate the gas sector effectively.
- **Competition from other energy sources:** The competition from other energy sources, such as electricity and renewables, could reduce the demand for gas in Pakistan. This could have a negative impact on the gas sector and NEPRA's role in regulating it.

### SWOT Analysis of Private Power and Infrastructure Board

#### Strengths

- **Experience in promoting private sector investment in the power and infrastructure sectors:** PPIB has a long track record of promoting private sector investment in the power and infrastructure sectors in Pakistan. This experience gives PPIB a strong understanding of the needs of investors and the challenges of developing new projects.
- **Comprehensive range of services:** PPIB offers a comprehensive range of services to investors, including project development, financing, and risk management. This allows PPIB to provide a one-stop shop for investors, which can simplify the process of developing and implementing new projects.
- **Strong relationships with government and other stakeholders:** PPIB has strong relationships with government and other stakeholders in the power and infrastructure sectors. This gives PPIB the ability to navigate complex bureaucratic processes and secure the necessary approvals for new projects.
- **Financial resources:** PPIB has access to financial resources from the government and other sources. This allows PPIB to provide financial assistance to investors, which can reduce the risk of new projects and make them more attractive to investors.

#### Weaknesses

- **Bureaucratic processes:** The bureaucratic processes involved in developing and implementing new power and infrastructure projects in Pakistan can be complex and time-consuming. PPIB can sometimes be slow to respond to investor requests and to make decisions on new projects.
- **Limited capacity:** PPIB has limited capacity to manage a large number of projects simultaneously. This can lead to delays in the development and implementation of new projects.
- **Lack of transparency:** PPIB could improve its transparency practices. This includes providing more information to the public about the projects it is supporting and the criteria it uses to select projects.
- **Political interference:** PPIB is sometimes subject to political interference, which can undermine its ability to make impartial decisions and promote the development of sustainable and competitive power and infrastructure projects.

#### Opportunities

- **Growing demand for power and infrastructure in Pakistan:** The demand for power and infrastructure in Pakistan is growing rapidly. This presents an opportunity for PPIB to attract more investment and to develop more new projects.
- **Government support for private sector investment:** The government of

Pakistan is supportive of private sector investment in the power and infrastructure sectors. This support can help PPIB to attract more investors and to develop more new projects.

- **New technologies:** New technologies, such as renewable energy and energy efficiency, can help to reduce the cost of power and infrastructure development. PPIB can play a role in promoting the adoption of these new technologies in Pakistan.
- **Regional cooperation:** Pakistan can cooperate with other countries in the region to develop power and infrastructure projects. This cooperation can help to reduce the cost of projects and to share expertise.

#### **Threats**

- **Economic slowdown:** An economic slowdown in Pakistan could reduce the demand for power and infrastructure projects. This could have a negative impact on PPIB's ability to attract investment and to develop new projects.
- **Political instability:** Political instability in Pakistan could undermine investor confidence and make it difficult for PPIB to attract investment.
- **Corruption:** Corruption is a major problem in Pakistan, which could undermine PPIB's ability to manage projects effectively and ensure value for money.
- **Competition from other countries:** Pakistan faces competition from other countries in the region to attract investment in the power and infrastructure sectors. PPIB needs to be competitive in order to attract investors.

**Overall,** PPIB has a number of strengths that it can build on to improve its performance. However, PPIB also faces a number of challenges, such as bureaucratic processes, limited capacity, and political interference. PPIB needs to address these challenges in order to become a more effective facilitator of private sector investment in the power and infrastructure sectors in Pakistan.

#### **SWOT Analysis of WAPDA**

##### **Strengths**

- WAPDA is a vertically integrated utility with a strong track record of providing reliable electricity supply to Pakistan.
- WAPDA has a large and experienced workforce.
- WAPDA has a diversified generation mix, including hydropower, nuclear power, and thermal power.
- WAPDA has a large transmission and distribution network.

##### **Weaknesses**

- WAPDA is a highly bureaucratic organization with slow decision-making processes.
- WAPDA's transmission and distribution network is inefficient and outdated.
- WAPDA's power plants are aging and in need of refurbishment.
- WAPDA has a high level of non-technical losses.

##### **Opportunities**

- The growing demand for electricity in Pakistan presents a significant opportunity for WAPDA to expand its generation and transmission capacity.
- The transition to renewable energy presents another opportunity for WAPDA to develop and implement new technologies.
- WAPDA can improve its efficiency and reduce its costs by implementing reforms such as unbundling and privatization.

##### **Threats**

- The rapidly changing electricity sector poses a challenge for WAPDA to keep up with the latest trends and technologies.

- The government's interference in WAPDA's affairs can undermine its efficiency and effectiveness.
- The lack of resources can make it difficult for WAPDA to maintain and upgrade its infrastructure.

### **SWOT Analysis of All DISCOs of Pakistan**

#### **Strengths**

- **Monopoly power:** DISCOs have a monopoly on the distribution of electricity in their respective areas of operation. This gives them a significant advantage in terms of market share and pricing power.
- **Large customer base:** DISCOs in Pakistan have a combined customer base of over 30 million. This gives them a large and diversified revenue stream.
- **Government support:** DISCOs are regulated and supported by the government. This gives them access to financial resources and other benefits.

#### **Weaknesses**

- **High transmission and distribution losses:** T&D losses in Pakistan are among the highest in the world. This is a major financial burden for DISCOs and their customers.
- **Inefficient operations:** DISCOs in Pakistan are generally inefficient and poorly managed. This leads to high costs and poor customer service.
- **High tariffs:** DISCOs in Pakistan charge relatively high tariffs to their customers. This is due to a number of factors, including high T&D losses, inefficient operations, and government subsidies.

### Opportunities

- **Growing demand for electricity:** Demand for electricity in Pakistan is growing rapidly due to population growth and economic development. This presents a significant opportunity for DISCOs to grow their businesses.
- **Investment in new technologies:** DISCOs can invest in new technologies to improve their efficiency and reduce their costs. This would make them more competitive and profitable.
- **Government reforms:** The government is considering a number of reforms to the power sector, including the privatization of DISCOs. This could lead to improved efficiency and customer service.

### Threats

- **Economic downturn:** An economic downturn could lead to reduced demand for electricity and lower revenue for DISCOs.
- **Government subsidies:** The government currently provides significant subsidies to DISCOs. If these subsidies are reduced or eliminated, it would have a negative impact on the financial performance of DISCOs.
- **Competition from renewable energy:** Renewable energy sources, such as solar and wind power, are becoming increasingly competitive. This could pose a threat to DISCOs in the long term.

**Overall,** the SWOT analysis of DISCOs in Pakistan presents a mixed picture. On the one hand, DISCOs have a number of strengths, including monopoly power, a large customer base, and government support. On the other hand, DISCOs also have a number of weaknesses, including high T&D losses, inefficient operations, and high tariffs. To capitalize on their strengths and mitigate their weaknesses, DISCOs in Pakistan need to focus on improving their efficiency and reducing their costs. They also need to invest in new technologies to improve their customer service. Additionally, the government needs to provide DISCOs with the necessary support to help them improve their performance.

### FINANCIAL ANALYSIS OF THE ENERGY SECTOR

Year	Revenue (PKR trillion)	Expenditure (PKR trillion)	Profit/Loss (PKR trillion)	Investment (PKR trillion)
FY2018	2.3	2.8	-0.5	0.5
FY2019	2.6	3.4	-0.8	0.6
FY2020	3	4.2	-1.2	0.7
FY2021	3.3	4.9	-1.6	0.8
FY2022	3.5	4.1	-0.6	1

(Source: Pakistan Economic Survey, 2022-23)

These figures show that the revenue of the energy sector has increased from PKR 2.3 trillion in FY2018 to PKR 3.5 trillion in FY2023. However, the expenditure of the sector has also increased from PKR 2.8 trillion in FY2018 to PKR 4.1 trillion in FY2023. This has resulted in the sector incurring losses in all but one of the past five years.

Investment in the energy sector has increased from PKR 0.5 trillion in FY2018 to PKR 1.0 trillion in FY2023. This is a positive sign, as it shows that the government and the private sector are committed to developing the energy sector.

## ECONOMIC ANALYSIS

The energy sector is a vital component of the Pakistani economy, accounting for around 5% of GDP and 60% of total energy consumption. The sector is dominated by fossil fuels, with oil and gas accounting for over 80% of the total energy supply. This reliance on imported fossil fuels makes Pakistan vulnerable to price shocks and supply disruptions.

The energy sector in Pakistan has grown significantly in recent years. The sector's revenue increased from PKR 2.3 trillion in FY2018 to PKR 3.5 trillion in FY2023, while its expenditure increased from PKR 2.8 trillion to PKR 4.1 trillion over the same period. This growth has been driven by a number of factors, including:

- **Increased energy demand:** Pakistan's energy demand has been growing at an average rate of 5% per year in recent years. This growth is due to a number of factors, including population growth, economic growth, and urbanization.
- **Increased investment in the energy sector:** The government of Pakistan has increased its investment in the energy sector in recent years. This investment has been used to develop new power generation capacity, improve transmission and distribution infrastructure, and expand access to energy.
- **Increase in energy prices:** The government of Pakistan has increased energy prices in recent years in order to reduce subsidies and make the energy sector more financially sustainable.

## ISSUES / CHALLENGES

- **Heavy reliance on foreign energy supplies, putting a considerable burden on Pakistan's fragile economy:** Pakistan has diverse unexplored domestic energy resources, yet it continues to rely heavily on imports of oil, gas, and other energy supplies, which creates a massive burden on the Pakistani economy. This heavy dependence on foreign energy sources makes the economy vulnerable to fluctuations in global energy markets.
- **Inadequate policy measures, lack of a comprehensive energy policy, and short-term planning:** Pakistan lacks a comprehensive energy policy that can provide a framework for sound decision-making in the energy sector. The absence of long-term planning also creates uncertainty and a lack of direction in the country's energy sector, leading to suboptimal usage of resources and investment in wrong areas.
- **Global and domestic energy politics, including geopolitical concerns, competing interests, and constraints related to regional and international energy security:** Energy is increasingly becoming a strategic commodity, and global and regional energy politics play a critical role in shaping energy security policies and decisions. This creates competition and constraints in the energy sector, especially in conflict regions, where energy is often used as a geopolitical tool.
- **An unsustainable energy mix with excessive reliance on fossil fuels, thereby neglecting the development of renewable energy resources:** Pakistan needs a diversified energy mix that includes efficient use of domestic energy resources and sustainable development of renewable energy sources. Unfortunately, Pakistan has an unsustainable energy mix that overemphasizes the use of fossil fuels at the expense of renewable sources, leading to negative environmental impacts and instability in supply chains.

- **Inefficient and outdated energy infrastructure and transmission systems leading to T&D losses:** Pakistan's energy infrastructure and related transmission system are outdated and inefficient, resulting in significant losses in transmission and distribution. This issue affects energy security by compromising the country's ability to deliver energy reliably and efficiently.
- **Governance issues such as inefficient and inconsistent regulation, overlapping jurisdiction of various energy bodies, political influence, and corruption on pricing and tariffs:** Governance issues in the energy sector are also a significant challenge in Pakistan. Inadequate regulatory structures, overlapping authorities, and political interference in pricing and tariffs negatively impact energy security in Pakistan.
- **Lack of diversified and decentralized energy production and distribution systems, which may lead to instability of energy supplies at the local and national levels:** Pakistan needs to diversify its energy production and distribution systems, enabling it to generate energy at local levels as well. The current centralized system leads to vulnerabilities to energy supply interruption and insecurity.



### **Theft**

Electricity theft, non-recovery/non-payment, and technical losses are three different terms that are often used interchangeably. However, there are important distinctions between them. Electricity theft is the deliberate and unauthorized use of electricity without paying for it. Non-recovery/non-payment refers to the failure of customers to pay their electricity bills. Technical losses are energy losses that occur during the generation, transmission, and distribution of electricity.

Addressing electricity theft requires strong enforcement and deterrent measures. This includes cracking down on illegal connections and imposing penalties on those who are caught stealing electricity. Non-recovery/non-payment can be addressed through improved billing mechanisms and payment facilitation. This could involve making it easier for customers to pay their bills online or through mobile phone apps. Technical losses can be reduced through system upgrades and maintenance. This includes investing in new equipment and repairing existing infrastructure.

In FY 2021-22, DISCOs (distribution companies) in Pakistan reported overall losses of 17.13%, which exceeded NEPRA's (National Electric Power Regulatory Authority) target of 13.41%. This resulted in a financial loss of Rs. 520 billion. The recovery ratio of DISCOs in FY 2021-22 was 90.51%. This means that 9.49% of electricity bills were not paid on time.

Technological solutions such as smart AMI meters and upgrading the distribution system can help to prevent electricity theft. Smart AMI meters can track electricity consumption in real time and identify any unauthorized usage. Upgrading the distribution system can help to reduce technical losses. In addition to technological solutions, enhanced enforcement, cost-benefit realignment, and institutionalization within DISCOs are also suggested solutions to control electricity theft. Enhanced enforcement involves cracking down on illegal connections and imposing penalties on those who are caught stealing electricity. Cost-benefit realignment involves restructuring DISCOs in a way that makes them more efficient and profitable. Institutionalization involves strengthening the internal controls and governance structures within DISCOs. The Pakistani government is currently carrying out a campaign against power theft. Since the start of the campaign, 19,415 people have been arrested and Rs. 14 billion has been recovered. The campaign has been most successful in Mardan, where the rate of power theft has decreased from 43% to 13%. However, the government is facing challenges in implementing the campaign in Balochistan, due to resistance from local communities. The government is committed to continuing the campaign against power theft in order to improve the country's energy security and reduce costs.

### **TECHNOLOGICAL CHALLENGES**

- The power sector in Pakistan faces a number of technological challenges that impede its ability to provide reliable and affordable electricity to its citizens. Some of the key challenges include:
- Outdated and inefficient power plants that are unable to generate electricity at maximum capacity.
- Inadequate transmission and distribution infrastructure, which results in high transmission losses and frequent power outages.

- Limited use of renewable energy sources, such as solar and wind power, due to high upfront costs and lack of government incentives.

### **COMPARATIVE ANALYSIS OF DEVELOPING COUNTRIES**

#### **Comparative Analysis of Morocco**

Morocco's energy mix is changing rapidly, with a growing emphasis on renewable energy. In 2021, renewable energy accounted for 38% of Morocco's electricity generation, up from 17% in 2011. The country has set ambitious goals to increase the share of renewable energy in its electricity generation to 52% by 2030 and 80% by 2050. Solar energy is the largest source of renewable energy in Morocco, accounting for 23% of electricity generation in 2021. Wind energy is the second largest source of renewable energy, accounting for 15% of electricity generation in 2021. Hydropower is also a significant source of renewable energy in Morocco, accounting for 10% of electricity generation in 2021. Morocco is also investing in other renewable energy sources, such as geothermal energy and biomass energy. In 2021, geothermal energy accounted for 0.2% of electricity generation in Morocco, and biomass energy accounted for 0.1% of electricity generation.

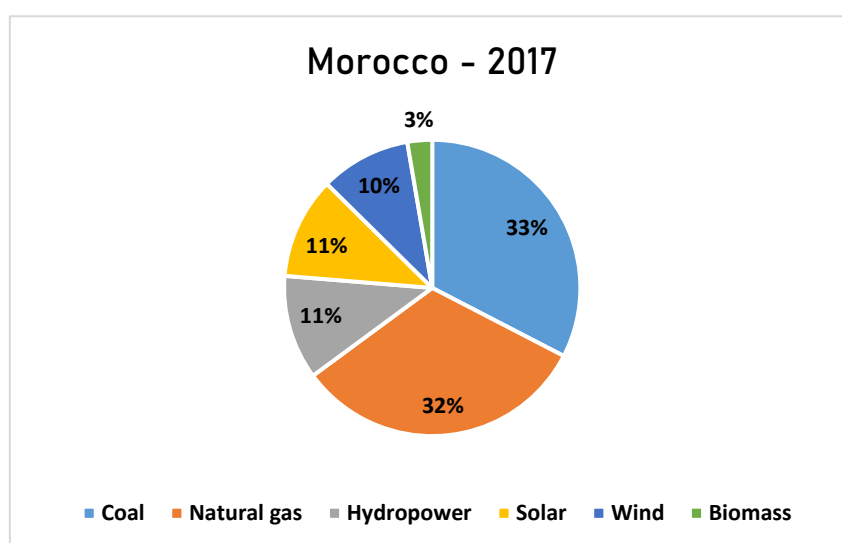
Fossil fuels still play a significant role in Morocco's energy mix, accounting for 62% of electricity generation in 2021. Coal is the largest source of fossil fuels in Morocco, accounting for 33% of electricity generation in 2021. Natural gas is the second largest source of fossil fuels in Morocco, accounting for 29% of electricity generation in 2021. Morocco is also working to reduce its dependence on imported fossil fuels. In 2021, Morocco imported 90% of its oil and 70% of its natural gas. The country is investing in domestic oil and gas production, as well as renewable energy, in order to reduce its dependence on imports.

Overall, Morocco's energy mix is changing rapidly, with a growing emphasis on renewable energy. The country is well-positioned to achieve its ambitious goals of increasing the share of renewable energy in its electricity generation to 52% by 2030 and 80% by 2050.

### Energy mix 2017

Morocco's energy mix in 2017 was as follows:

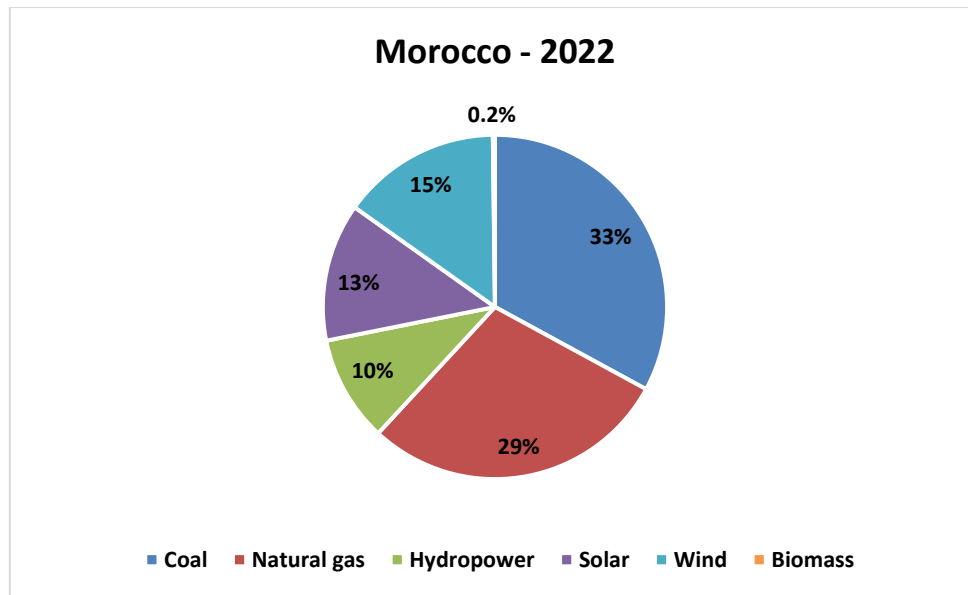
<b>Coal</b>	<b>33%</b>
<b>Natural gas</b>	32%
<b>Hydropower</b>	11%
<b>Solar</b>	11%
<b>Wind</b>	10%
<b>Biomass</b>	3%



In 2017, Morocco's total primary energy consumption (TPER) was 101.6 million tonnes of oil equivalent (TOE). The country's net energy imports were 92.9 million TOE, accounting for 91.5% of its TPER.

### Energy mix 2022

<b>Coal</b>	<b>33%</b>
<b>Natural gas</b>	29%
<b>Hydropower</b>	10%
<b>Solar</b>	13%
<b>Wind</b>	15%
<b>Biomass</b>	0%



In 2022, Morocco's TPER was 109.4 million TOE. The country's net energy imports were 97.9 million TOE, accounting for 89.9% of its TPER. Morocco is on track to achieve its ambitious goals for renewable energy development. The country has a number of large-scale renewable energy projects underway and is also promoting the development of small-scale renewable energy projects.

### Energy Policy in Morocco

Morocco's energy policy is focused on developing a sustainable and secure energy supply through a diversified energy mix. The country has ambitious goals to increase the share of renewable energy in its electricity generation to 52% by 2030 and 80% by 2050. Morocco's energy policy is based on the following four pillars:

- **Energy security:** Morocco is committed to ensuring a secure and reliable energy supply for its citizens and businesses. This includes reducing the country's dependence on imported fossil fuels and increasing the use of domestic energy resources.
- **Energy efficiency:** Morocco is working to improve energy efficiency in all sectors of the economy. This includes promoting energy-efficient appliances and technologies, and improving energy management practices.
- **Renewable energy:** Morocco is investing heavily in renewable energy sources, such as solar, wind, and hydropower. The country has a number of large-scale renewable energy projects underway and is also promoting the development of small-scale renewable energy projects.
- **Access to energy:** Morocco is committed to ensuring that all citizens have access to affordable and reliable energy. This includes expanding the electricity grid to rural areas and providing subsidies to low-income households.

It is supported by a number of different initiatives, including:

- **The National Energy Strategy (NES):** The NES is a comprehensive plan for developing Morocco's energy sector. It sets out the country's goals for energy security, energy efficiency, renewable energy, and access to energy.

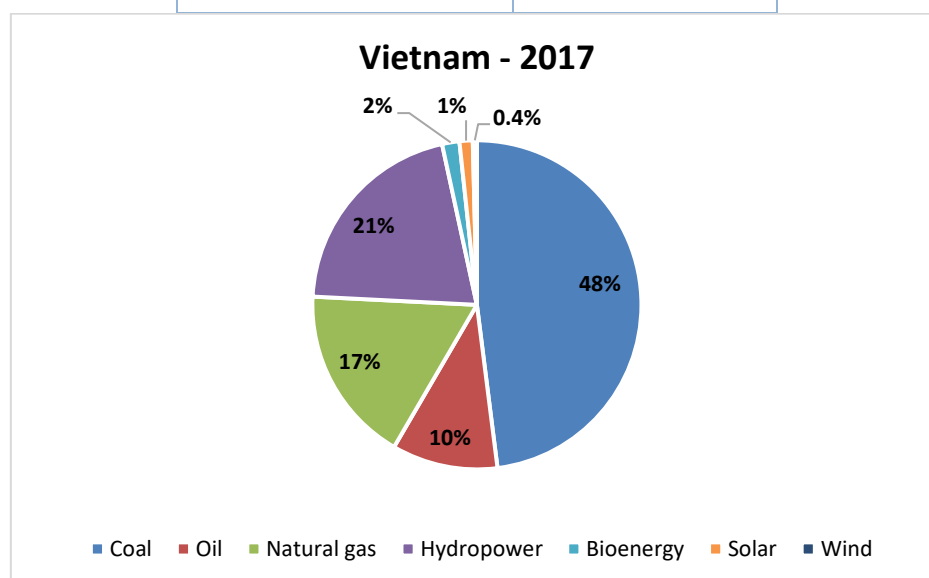
- **The Renewable Energy Law:** The Renewable Energy Law, passed in 2015, provides a number of incentives for the development of renewable energy projects.
- **The National Energy Efficiency Program:** The National Energy Efficiency Program, launched in 2016, aims to reduce energy consumption in Morocco by 20% by 2030.
- **The Access to Energy Program:** The Access to Energy Program, launched in 2017, aims to provide electricity access to all Moroccans by 2025.

### Comparative Analysis of Vietnam

Vietnam has made significant progress in diversifying its energy mix and developing renewable energy sources in recent years. The share of renewable energy in Vietnam's electricity generation increased from 24.2% in 2017 to 30.3% in 2022. This is due in part to the government's supportive policies for renewable energy development, such as feed-in tariffs and net metering. Vietnam still relies on fossil fuels and is working to address this issue by diversifying its energy mix, improving energy efficiency, and developing renewable energy sources. The country has set ambitious goals to increase the share of renewable energy in its electricity generation to 30% by 2030 and 45% by 2045. Vietnam is a rapidly growing economy, and its energy demand is expected to continue to grow in the coming years.

Vietnam's energy mix in 2017 was as follows:

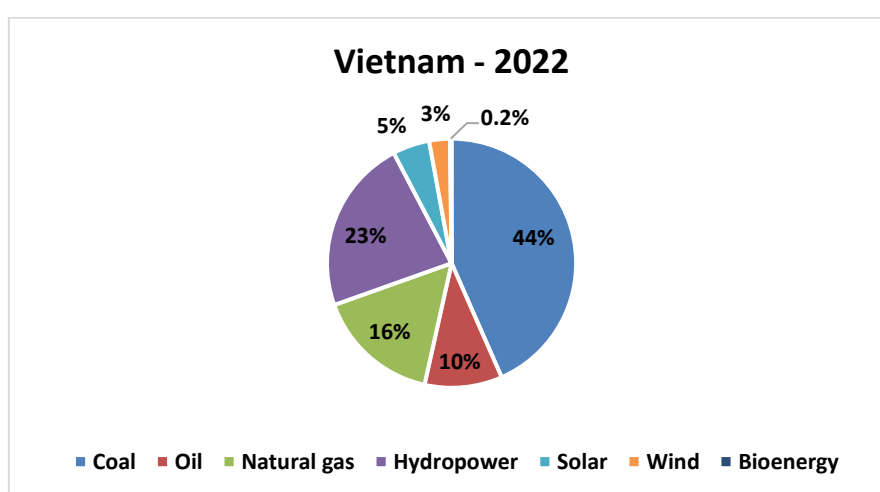
<b>Coal</b>	<b>48%</b>
<b>Oil</b>	10%
<b>Natural gas</b>	17%
<b>Hydropower</b>	21%
<b>Bioenergy</b>	2%
<b>Solar</b>	1%
<b>Wind</b>	0%



In 2017, Vietnam's TPER was 187.1 million TOE. The country's net energy imports were 63.3 million TOE, accounting for 33.9% of its TPER.

Vietnam's energy mix in 2022 was as follows:

Coal	44%
Oil	10%
Natural gas	16%
Hydropower	23%
Solar	5%
Wind	3%
Bioenergy	0%



In 2022, Vietnam's TPER was 222.6 million TOE. The country's net energy imports were 79.8 million TOE, accounting for 35.8% of its TPER. Vietnam is on track to achieve its ambitious goals for renewable energy development. The country has a number of large-scale renewable energy projects underway and is also promoting the development of small-scale renewable energy projects. Vietnam, along with a coalition of international partners including the United Kingdom, the United States, the European Union, and Japan, announced a \$15.5 billion Just Energy Transition Partnership in December 2022. The partnership aims to accelerate the reduction of carbon emissions and increase the uptake of renewable energy in Vietnam. The plan calls for Vietnam to reach peak emissions in 2030 and net-zero emissions by 2050.

The Vietnamese government has implemented a number of policies to support the development of the energy sector, including:

- **Diversifying the energy mix:** The government is committed to reducing Vietnam's reliance on imported fossil fuels and increasing the share of renewable energy in its energy mix. It has set ambitious goals to increase the share of renewable energy in its electricity generation to 30% by 2030 and 45% by 2045.
- **Improving energy efficiency:** The government is also working to improve energy

efficiency in all sectors of the economy. It has implemented a number of policies, such as energy efficiency standards for appliances and buildings, and financial incentives for energy efficiency upgrades.

- **Developing renewable energy sources:** The government is actively promoting the development of renewable energy sources, such as solar, wind, and hydropower. It has implemented a number of policies, such as feed-in tariffs and net metering, to make renewable energy more attractive to investors.
- **Reforming the energy sector:** The government is also reforming the energy sector to make it more efficient and competitive. It has privatized a number of state-owned energy companies and introduced new regulations to promote competition in the sector.

The following are some specific examples of policies that the Vietnamese government has implemented to support the energy sector:

- **The Electricity Law (2017):** This law provides a framework for the development of the electricity sector, including the promotion of renewable energy and energy efficiency.
- **The National Energy Efficiency Program (2019-2025):** This program aims to reduce energy consumption in Vietnam by 10% by 2025.
- **The Renewable Energy Law (2017):** This law provides a number of incentives for the development of renewable energy projects, such as feed-in tariffs and net metering.
- **The Power Purchase Agreement (PPA) Template:** This template was issued by the Vietnamese government in 2019 to facilitate the negotiation of PPAs between renewable energy developers and electricity utilities.
- **The National Climate Change Strategy:** This strategy, which was issued in 2011, outlines the government's plans to address climate change, including the development of renewable energy and energy efficiency.

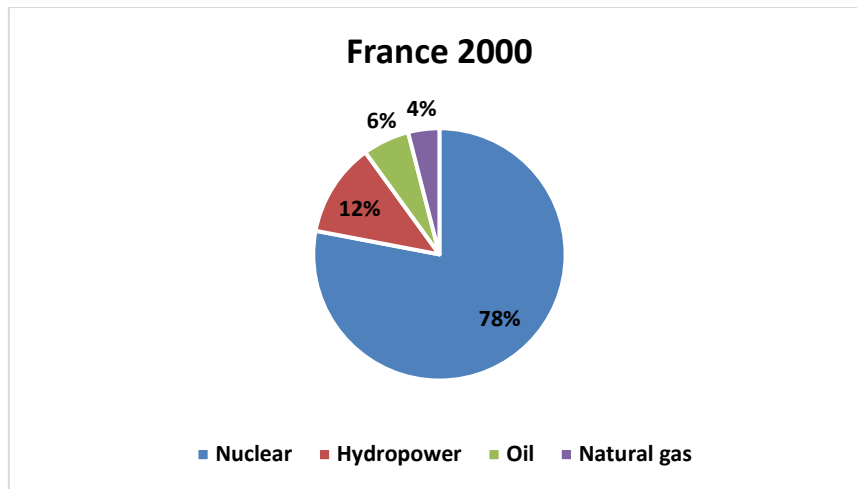
## COMPARATIVE ANALYSIS OF DEVELOPED COUNTRIES

### Comparative Analysis of France

France's efforts to improve energy efficiency and promote renewable energy are paying off. France's primary energy consumption has fallen by 17% since 1990, and its greenhouse gas emissions have fallen by 27% over the same period. France is on track to achieve its ambitious targets for energy conservation and energy efficiency. In 2000, nuclear power was the dominant source of electricity generation in France, accounting for 78% of the total. Hydropower was the second largest source of electricity generation, accounting for 12% of the total. Fossil fuels accounted for the remaining 10% of electricity generation, with oil accounting for 6% and natural gas accounting for 4%. Renewables (other than hydropower) accounted for a negligible share of electricity generation in France in 2000, at less than 0.

The energy mix of France in 2000 was as follows:

<b>Nuclear</b>	<b>78.0%</b>
<b>Hydropower</b>	<b>12.0%</b>
<b>Oil</b>	<b>6.0%</b>
<b>Natural gas</b>	<b>4.0%</b>



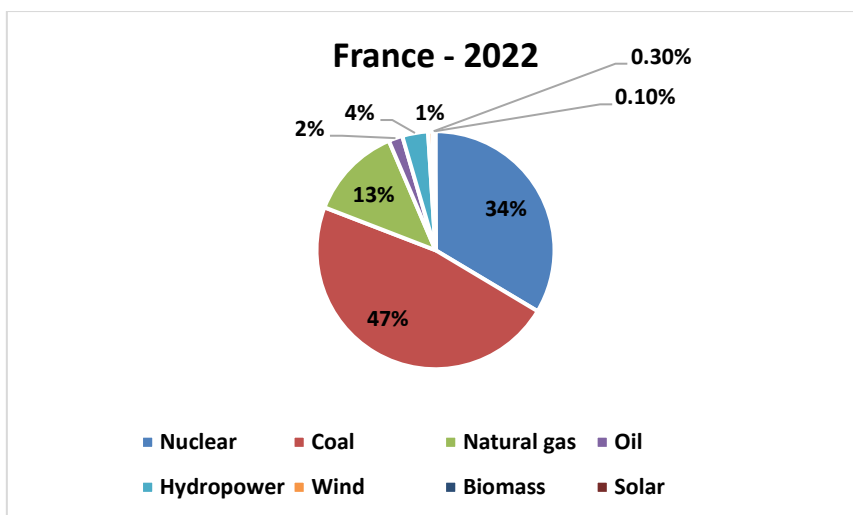
Total energy consumption in France in 2000 was 225.7 million tonnes of oil equivalent (Mtoe).

Since 2000, France has made significant progress in increasing the share of renewables in its energy mix. In 2022, renewables accounted for 24.2% of France's electricity generation, up from less than 0.1% in 2000. This increase has been driven by the development of solar and wind power, which accounted for 10.4% and 8.2% of France's electricity generation in 2022, respectively. Nuclear power remains the dominant source of electricity generation in France, accounting for 69.7% of the total in 2022. However, the share of nuclear power in France's electricity mix is declining as the government transitions to a cleaner energy future. France is targeting a 100% renewable energy mix by 2050. To achieve this goal, the government is investing heavily in the development of renewable energy and is also working to improve energy efficiency and reduce energy consumption.

The energy mix of France in 2022 was as follows:

<b>Nuclear</b>	<b>69.7%</b>
<b>Hydropower</b>	11.0%
<b>Oil</b>	6.7%
<b>Natural gas</b>	12.6%
<b>Solar</b>	10.4%
<b>Wind</b>	8.2%
<b>Biomass</b>	4.4%
<b>Geothermal</b>	1.2%





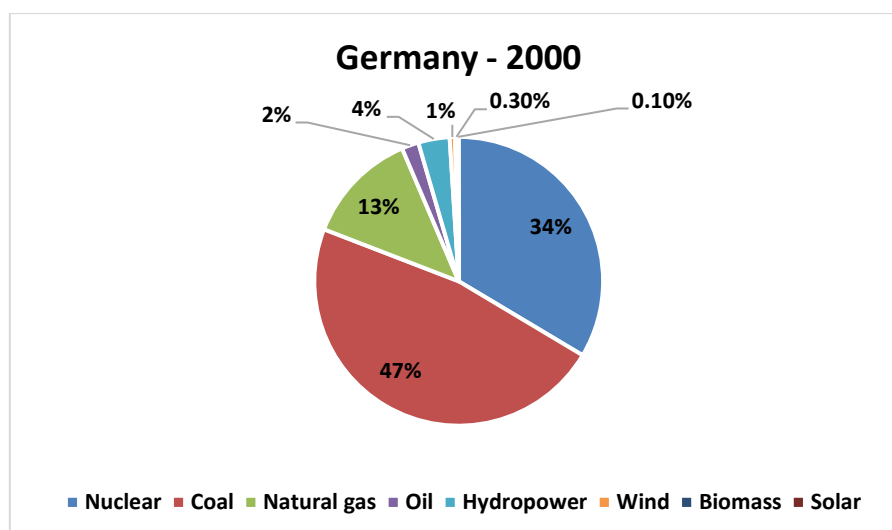
France is also moving towards energy conservation in a number of ways, including:

- **Improving energy efficiency in buildings:** France's Energy Transition Law (2015) sets a target of reducing energy consumption in buildings by 50% by 2050. The government has implemented several policies to achieve this goal, such as energy efficiency standards for new and existing buildings, energy audits for businesses, and financial incentives for energy efficiency upgrades.
- **Promoting energy efficiency in industry:** France's National Energy Efficiency Action Plan (2019-2025) sets a target of reducing energy consumption in industry by 40% by 2030. The government has implemented several policies to achieve this goal, such as energy audits for businesses, financial incentives for energy efficiency upgrades, and tax breaks for businesses that invest in energy-efficient technologies.
- **Supporting the development of renewable energy:** France has a target of increasing the share of renewable energy in its energy mix to 40% by 2030 and 100% by 2050. The government has implemented several policies to achieve this goal, such as feed-in tariffs, renewable energy auctions, and financial incentives for the development of renewable energy projects.
- **Raising public awareness about energy conservation:** The French government conducts public awareness campaigns to educate the public about the importance of energy conservation and how to save energy.

In addition to these national policies, there are also several regional and local policies and initiatives in place to promote energy conservation in France. For example, many cities and towns have energy savings programs that offer residents and businesses incentives to improve their energy efficiency.

The German energy mix in 2000 was as follows:

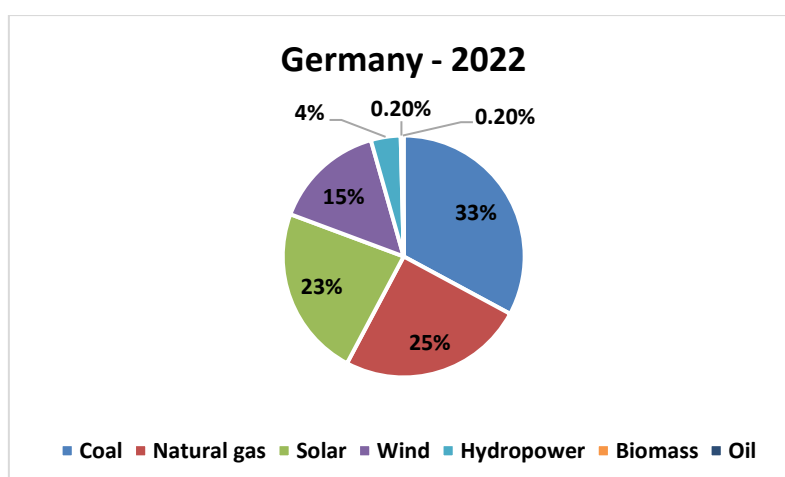
<b>Nuclear</b>	<b>34%</b>
<b>Coal</b>	<b>47%</b>
<b>Natural gas</b>	<b>13%</b>
<b>Oil</b>	<b>2%</b>
<b>Hydropower</b>	<b>4%</b>
<b>Wind</b>	<b>1%</b>
<b>Biomass</b>	<b>0%</b>
<b>Solar</b>	<b>0%</b>



By 2022, this share had increased to 42%, with solar and wind power becoming the two largest sources of renewable energy.

Germany's energy mix in 2022

Coal	33%
Natural gas	25%
Solar	23%
Wind	15%
Hydropower	4%
Biomass	0.20%
Oil	0.20%



This transformation has been driven by a number of factors, including government policies, technological innovation, and public support.

### Government policies

The German government has played a key role in supporting the development of renewable energy. In 2000, the government introduced the Renewable Energy Act (EEG), which provides feed-in tariffs for renewable energy producers. This guaranteed price for renewable energy has made it more attractive for investors to invest in renewable energy projects. The government has also set ambitious targets for increasing the share of renewable energy in the electricity mix. In 2011, the government set a target of 80% renewable energy by 2050. In 2021, the government increased this target to 100% renewable energy by 2035. Germany's energy mix has changed significantly in recent years, with a shift away from fossil fuels and towards renewable energy sources. In 2022, renewable energy accounted for 42% of Germany's electricity generation, up from 7% in 2000. The largest source of renewable energy in Germany is solar, followed by wind and hydropower.

Germany has a number of policies in place to support the development of renewable energy, including:

- **Feed-in tariffs:** Feed-in tariffs guarantee renewable energy producers a fixed price for their electricity, which helps make renewable energy more competitive with fossil fuels.
- **Renewable energy targets:** Germany has ambitious targets for increasing the share of renewable energy in its electricity generation to 80% by 2050.
- **Public investment in research and development:** The German government invests heavily in research and development to develop new renewable energy technologies.
- **Subsidies and tax breaks:** The German government provides subsidies and tax breaks to businesses and consumers who invest in renewable energy.

Germany has also implemented a number of policies to reduce energy consumption and improve energy efficiency. These policies include:

- **Energy efficiency standards:** Germany has energy efficiency standards for appliances, buildings, and vehicles.
- **Energy audits:** Businesses and organizations are required to have regular energy audits, which help identify ways to reduce energy consumption.
- **Public education and outreach:** The German government educates the public about the importance of energy efficiency and renewable energy, and how to save energy.

Germany's energy policies have been successful in reducing energy consumption and greenhouse gas emissions. Germany's primary energy consumption has fallen by 15% since 1990, and its greenhouse gas emissions have fallen by 30% over the same period. Germany is on track to achieve its ambitious targets for renewable energy and energy efficiency.

## *Conclusion*

### **Conclusion 1:**

In conclusion, the energy crisis in Pakistan is a multifaceted challenge that

encompasses issues of affordability, sustainability, and governance. The power sector's heavy reliance on imported and expensive fuels, coupled with policy lapses and a lack of competitive dynamics, has led to the exponential growth of circular debt. To address this crisis, Pakistan must embark on a comprehensive and multifaceted strategy. It should learn lessons from its past mistakes and the energy transitions of different developed and developing countries in order to streamline the issues in Pakistan's power sector.

### **Conclusion 2:**

In conclusion, it is evident that Pakistan is facing significant challenges in its energy sector, which have hindered its development pace in recent decades. Inadequate policy measures, global and domestic energy politics, short-term planning, lack of political will, and an inefficient energy mix are among the primary problems that contribute to Pakistan's energy shortfall. Dependency on imported fuel has exacerbated the situation by exerting pressure on foreign exchange reserves. The circular debt has escalated in the past few years, increasing from Rs. 1,200 billion in 2018 to Rs. 2,491 billion in 2022. The rise in circular debt has led to load shedding, power outages, and a lack of investment in the power sector, hindering economic growth and development in the country. This situation warrants an urgent plan.

### **Conclusion 3:**

In conclusion, one of the key problems Pakistan faces is the circular debt, which has escalated in the past few years and led to load shedding, power outages, and a lack of investment in the power sector. The inefficiency in the energy mix also compounds the problem, as Pakistan's energy supply mix has generally been dominated by imported and indigenous fossil fuels, particularly gas and oil, which account for almost three-fourths of the country's energy demand. The dependence on imported LNG and oil has exacerbated the situation by exerting pressure on foreign exchange reserves, which may lead to a scarcity of indigenous resources, an exponential hike in imported fuel prices, and disruption in the future supply chain. To address the energy shortfall and improve the efficiency and reliability of the existing infrastructure, a timely strategy and work plan are needed.

## ***Recommendations***

### **Short-Term Measures: Revisions in IPP Agreements and Enhancements in Utility Companies**

#### **i. Revisions and Adjustment of Generation Tariffs for Independent Power Producers (IPPs)**

The government's assurances to mitigate the investment risks of IPPs necessitate capacity payments, which are influenced by fluctuations in the rupee-dollar exchange rate. These guarantees are exerting an undue strain on the national treasury due to a disparity between consumer payments and the actual energy costs, with a focus on ensuring affordability for consumers. The capacity component of the tariff primarily relies on costs denominated in dollars, subject to quarterly indexing. To gauge the reasonableness of excessive capacity

payments concerning available capacity, it is essential to assess the profitability of IPPs. This evaluation should prompt necessary modifications to generation policies, with the aim of transitioning capacity payments to local currency components.

## **ii. Emphasis on Dual Contracts**

Presently, all power purchase agreements are structured as take-or-pay contracts, mandating capacity payments regardless of actual capacity utilization. A more prudent approach would involve new contracts designed to accommodate capacity charges for the initial years, allowing for the recovery of investments and full debt servicing. Subsequently, the transition to take-and-pay contracts could be considered, incorporating both capacity and energy charges, but only for the actual energy consumed.

## **iii. Comprehensive IPP Audit**

Addressing the circular debt issue necessitates a thorough audit of all IPPs, encompassing a cross-check of establishment costs, actual fuel consumption, heat rates, Operations & Maintenance (O&M) components of tariffs, Interest During Construction (IDC), and Net Annual Plant Capacity (NAPC) factors. These factors significantly impact the payments made to IPPs, but during installation, they are often not accounted for in audits or assessments.

## **iv. Improvements in Distribution Companies (DISCOs)**

DISCOs are entrusted with the operation, maintenance, supply, distribution, construction, and expansion of the distribution grid network within their respective areas of jurisdiction. Notably, there is a shortage of workforce and technical resources in almost every DISCO relative to their service areas and populations. DISCOs face challenges in addressing technical inefficiencies, inadequate bill recoveries, and power theft. To enhance distribution network improvements, it is advisable to deregulate the administrative and operational activities of DISCOs and encourage public-private partnerships. This approach would divide the workload among multiple entities, fostering competitiveness in business and expediting operational management and improvements in power markets. The responsibility for transmission and wired infrastructure would remain with DISCOs.

## **v. Subdivision of DISCOs into Sub-Units**

Currently, Pakistan operates ten DISCOs, consisting of five distribution companies in Punjab (namely, IESCO, LESCO, FESCO, MEPCO, and GEPCO), three in Sindh (SEPCO, HESCO, and the privately owned KE), two in Khyber Pakhtunkhwa (PESCO and TESCO), and one in Baluchistan (QESCO). To align more effectively with the number of electricity consumers and the jurisdictional areas of provinces, it is recommended to subdivide these DISCOs based on optimal distribution network coverage and population density. This division into smaller sub-units would alleviate the capacity constraints of DISCOs, promoting electrification and improving efficiency by reducing Transmission and Distribution (T&D) losses. Moreover, by addressing issues like non-recoveries in divided areas or among consumers, this subdivision would enhance the performance of DISCOs, particularly in regions such as Khyber

Pakhtunkhwa, where T&D losses are substantial.

#### **vi. Rural Electrification via Mini-Grids**

Rural electrification in remote areas poses a significant challenge for DISCOs due to low population density beyond the reach of the existing grid. An effective solution is the implementation of mini-grids powered by renewable sources, particularly biomass and solar hybrid power plants. Pakistan's abundant agricultural resources make it ideal for biomass fuel generation, while the favorable environmental conditions support the establishment of solar plants, particularly micro and mini-grids, in areas lacking grid connectivity. This approach is particularly relevant to northern regions of Pakistan with underdeveloped distribution grid infrastructure, presenting opportunities for micro-hydropower stations. Renewable Energy Supply Companies (RESCOs) can play a pivotal role in increasing the share of alternative energy sources, aligning with the Alternative and Renewable Energy Policy of 2019 while supplying cost-effective energy to the grid. The capacity obligations can be minimized through competitive energy trading, emphasizing flexibility and ease of doing business to encourage investment, construction, and other operations.

#### **vii. Utility-Scale Renewable Energy Projects**

At the utility scale, embracing competitive bidding and hybrid power plants presents viable avenues to enhance renewable energy adoption while keeping costs to a minimum. Currently, renewable energy, including solar, wind, and biomass, constitutes a mere 5.47% of the total installed capacity, despite the vast untapped potential for renewable energy projects in the country. The prevalence of imported fuel-based generation tariffs in conventional power plants significantly raises the average energy costs, surpassing revenue recovery and exacerbating the issue of circular debt. In response, the expansion of renewable power generation is crucial. At the utility scale, the adoption of renewable energy is advantageous for reducing average energy prices, as there is no fuel component involved. The maturity of solar, wind, and biomass technologies has led to cost reductions in energy generation. Compared to conventional power generation, global trends indicate a significant decrease in energy tariffs over the lifetime of renewable projects, which can have a substantial impact on reducing average tariffs. Additionally, competitive bidding and hybrid settlements can lower capacity payments for renewable plants.

### **Long-Term Measures**

#### **i. Hybrid Renewable Energy Projects**

The scalability and specific site requirements pose challenges in developing renewable energy projects. Furthermore, renewable sources exhibit intermittency and variability in power output. Addressing these issues, hybrid renewable energy plants offer several advantages. Solar photovoltaics, with minimal site constraints, enable the integration of solar technologies with wind farms, biomass, hydropower, and tidal energy. Such integration enhances grid stability and optimizes capital costs, potentially leading to lower energy prices.

#### **ii. Energy Market Liberalization**

The liberalization of the energy market involves the relaxation of government restrictions, opening the sector to increased competition and the inclusion of business entities in commercializing operations. Privatization and competitive trading are key principles for liberalizing the power sector. Capacity payments are a significant factor contributing to circular debt, and market liberalization can potentially reduce government-guaranteed obligations. Through market liberalization, where power plant capacities can be traded similarly to energy, the presence of multiple buyers can enhance competitive trading. Furthermore, energy market liberalization has the potential to increase employment levels, improve business efficiency, stimulate economic development, and boost GDP growth, ultimately benefiting consumers. The impact of market liberalization on these key areas should be carefully assessed to understand the advantages it brings, particularly in improving operational efficiency and system effectiveness. The power sector is burdened by technical inefficiencies within the distribution network, which state-owned DISCOs are ill-equipped to rectify. The introduction of much-needed competition is imperative, with private entities striving to enhance the technical infrastructure to increase profitability. Furthermore, decentralized planning should be a primary focus for distribution utilities, enabling them to procure power on a competitive basis. International best practices, such as the UK's energy market liberalization in the 1980s through privatization, have shown benefits to consumers in terms of lower prices due to increased competition among rival energy firms. This liberalization has proven compelling because competitive markets foster price competition rather than relying on a single monopoly, thus eliminating the need for government guarantees against investment risks.

### iii. Capacity Building for Indigenous Resources

Many of the existing issues stem from a heavy reliance on foreign markets for resources, operations and maintenance (O&M), installations, fuel, and consultancies. This not only strains foreign reserves but also makes payments susceptible to currency fluctuations. The escalation of payments can be mitigated by promoting indigenous resources.

#### Logical Framework Matrix:

Target	Establish a high-level steering committee to coordinate and oversee the power sector.
KPIs	Number of meetings held by the steering committee
Means of Verification	Minutes of meetings
Executing Agency	Ministry of Energy (Power Division)
Financing	Government of Pakistan
Timeframe	Three years
Assumption	All major stakeholders in the power sector are willing to participate in meetings and work together.



Strategy	Tackle corruption and mismanagement
Target	Strengthen the oversight of the power sector by the government and anti-corruption agencies
KPIs	Number of cases of corruption and mismanagement investigated and prosecuted
Means of Verification	Reports from the National Accountability Bureau (NAB) and other anti-corruption agencies
Executing Agency	NAB and other anti-corruption agencies
Financing	Government of Pakistan
Timeframe	Three years
Assumption	NAB and other anti-corruption agencies are effective in investigating and prosecuting cases of corruption and mismanagement in the power sector.

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