

## **Topic: Energy crises:**

### **Introduction:**

Pakistan faces a myriad of internal and external challenges posing threats to its national security. In the modern era, all economic vistas are highly dependent on energy, hence energy security has become a vital factor that influences a state's economy, foreign policy and security policy. Pakistan's active participation in Belt and Road Initiatives has further accentuated the energy needs of Pakistan. Despite having diverse unexplored domestic energy resources, Pakistan relies heavily on foreign energy supplies which put huge burden on its fragile economy. Inadequate policy measures, global and domestic energy politics, short term planning, lack of political will and unsustainable energy mix are major grey areas in the energy security of Pakistan.

### **Pakistan's Energy Profile:**

Pakistan's energy mix has been a subject of change and development as the country seeks to address energy shortages, improve energy efficiency, and reduce its carbon footprint. The government has been actively pursuing energy diversification and cleaner energy sources to meet its growing energy demands while minimizing environmental impact. Pakistan has traditionally relied heavily on fossil fuels, particularly natural gas, and oil, for its energy needs. According to the Economic Survey of Pakistan 2022-23, the energy mix consists of 58.8 percent thermal, 25.8 percent hydel, and 8.6 percent nuclear power. Additionally, alternative power sources contribute 6.8 percent to the overall mix. Pakistan's primary energy supplies in the FY 2018-19, remained 83.81 Million Tons of Oil Equivalent (MTOE) with annual growth rate of -2.8%. As Figure 2 shows that oil and gas account for the larger share of 61% in energy mix. According to latest data available, in FY of 2017-18, out of total supplies of 86 MTOE energy, Pakistan indigenously produced 46 MTOE and imported 41 MTOE which is 54% and 46% respectively. Pakistan imported 91% oil (crude & refined products) 20% gas (LNG), 82% coal and 41% LPG to meet energy requirements. Moreover, Pakistan's total energy consumption in FY 2018-19 was 54.996 MTOE.<sup>9</sup> Pakistan's energy consumption is expected to grow by 70% in the next 10 years. Expected incremental power generation from indigenous Thar coal and renewables will only cater for 15-20% of energy demand. Remaining 80-85% incremental demand to be met through imports, resulting in additional impact of USD 6-8 billion on balance of payments.<sup>10</sup> Below Figure 4 and Figure 5 shows the Pakistan's energy consumption by source and sector. Figure-4: Pakistan's total Energy Consumption by Source (MTOE)

## Energy Situation and Challenges of Pakistan:

The energy security of Pakistan is at the mercy of imported fossil fuels. Pakistan relies mainly on oil and gas to meet its energy demand. The national energy system of Pakistan for various energy sources for the year 2018–2019

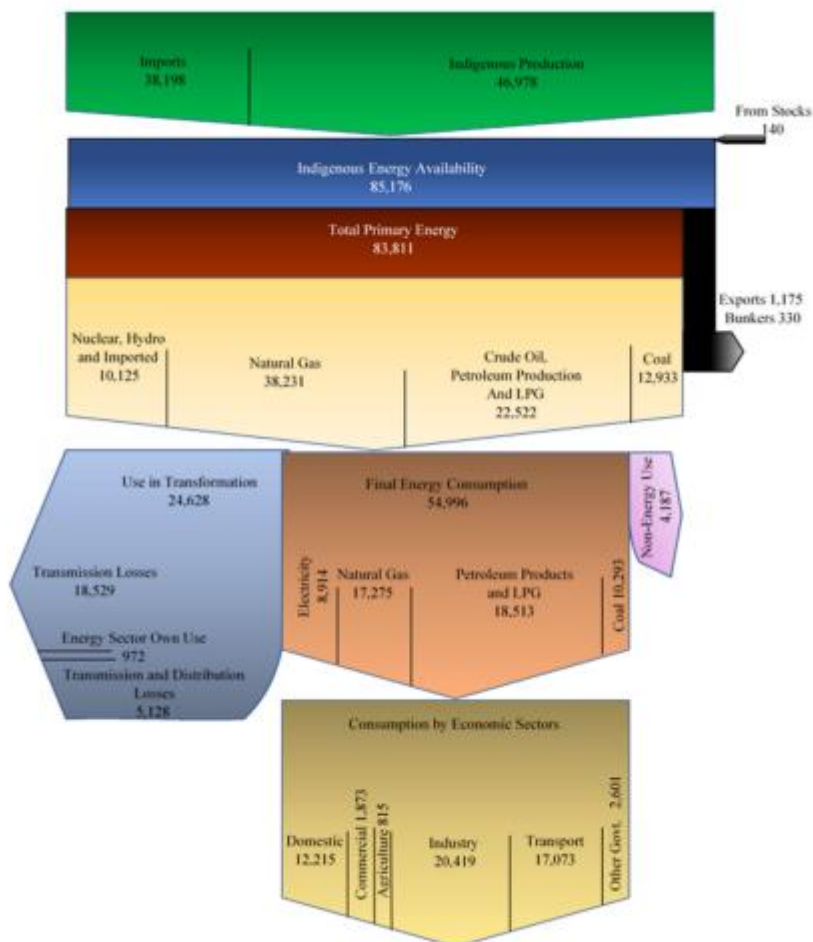


Figure 3. Flow chart of Pakistan's energy system [7].

It is evident from the above illustrations that indigenous energy availability is limited; therefore, the country must rely on imports. The share of different sources in primary commercial energy supply in the period from 2013–2014 to 2018–2019 has varied substantially. In 2013–2014, the oil share in the overall energy mix was 34.4%, which was reduced to 25.7% in 2018–2019. It is pertinent to note that the share of gas was also reduced from 46.3% in 2013–2014 to 35% in 2018–2019. However, the share of coal increased from 5.4% in 2013–2014 to 15.4% in 2018–2019. Another key variation in the overall share of the energy mix is related to hydro and nuclear resources, the share of which was reduced from 13.3% in 2013–2014 to 10.7% in 2018–2019. On the positive side, in 2018–2019, the overall energy mix included a renewable energy share of 1.3%, which minimal but expected to increase. With respect to energy consumption, the major consumers of primary commercial energy are the industrial, transport, and domestic sectors, as shown in Figure 4. Industrial energy consumption accounts 37.11% for the total, whereas the domestic sector consumes approximately 22% of primary energy. The commercial, agriculture, and other sectors consumed approximately 3%, 2%, and 5% of primary energy, respectively, in 2018–2019. The electricity generation mix according to source for 2018–2019 is shown in Figure 5; fossil fuels, hydropower, nuclear, and renewable

energy represent 67%, 21%, 8%, and 4% shares, respectively. Indigenous oil and gas resources are limited, and the country is heavily dependent on oil and gas imports. Given the present production rate, indigenous recoverable oil and gas reserves may be exhausted after 12 and 13 years, respectively. In the meantime, there is considerable potential of coal (185 billion tons) in the country; however, this resource has not been effectively employed due to somewhat inferior quality, economic restrictions, the site of the resources, and a lack of expertise and convenience in modern Energies 2023, 16, 423 6 of 27 coal conversion technologies. Approximately 85% of Pakistan’s oil demand is fulfilled by imports, with an expenditure of approximately USD 14.7 billion per annum [9]. The import of oil is a serious stress on the economy and has worsened economic conditions. The country’s energy demand is predicted to grow rapidly with economic growth, and it has been forecasted that the demand for primary commercial energy could increase at a rate of 4.3, 7.3, or 10.4% per annum depending on the situation. Therefore, the government of Pakistan (GOP) has planned to bridge the energy demand–supply gap by considering various alternative options. The options for import of regional gas have been controlled by the delicate local security situation, technical matters, and complications related to profitability and working measures, which are challenging in typical large-scale projects demanding intercountry contracts

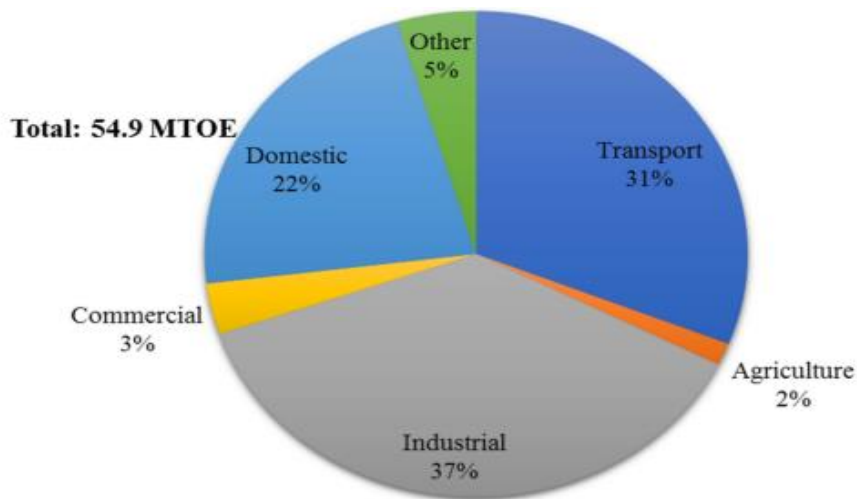


Figure 4. Primary energy consumption by sector [7].

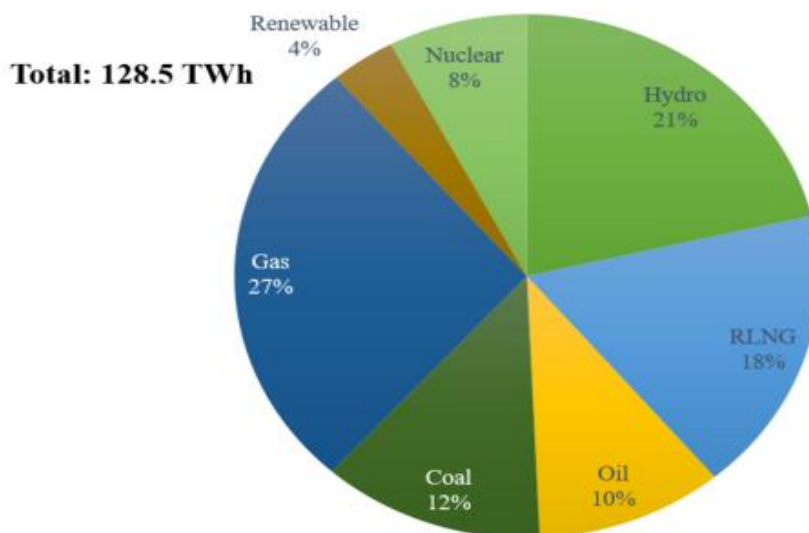


Figure 5. Electricity generation by source [8].

The country also suffers from an economic impediment known as circular debt. This issue in the energy sector has largely remained uncontrolled, even with unrelenting efforts of different governments. The reported debt of PKR 450 billion in 2013 had increased to PKR 2.3 trillion as of 31 December 2020, which is equivalent to 5.6% of the country's total GDP. The key reasons for circular debt in Pakistan are (i) the high cost of power generation affecting collection efficiency; (ii) pitfalls and delays in tariff determinations; (iii) high transmission losses, power theft, corruption, and revenue collection problems; (iv) government subsidies; and (v) high financial costs of government borrowing and expensive late-payment penalties on payables.

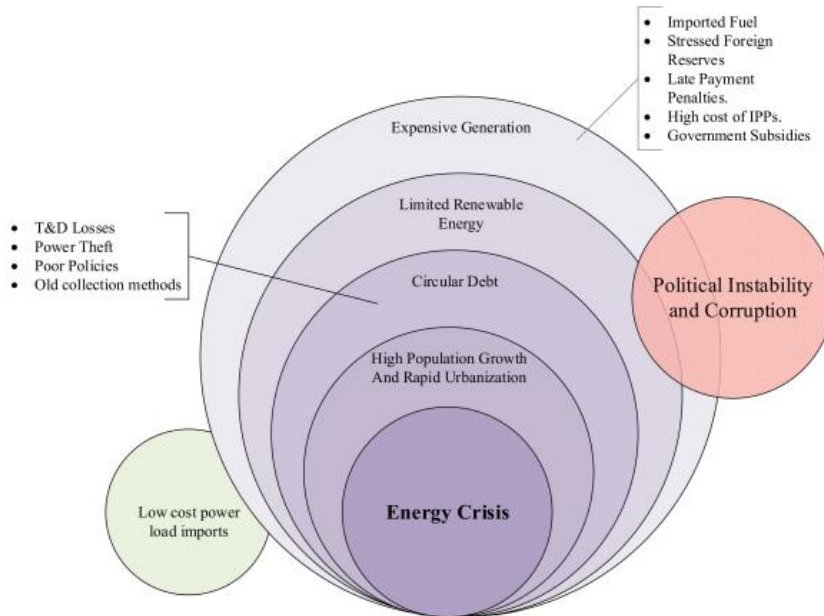


Figure 6. Energy crises in Pakistan.

The resolution of Pakistan's energy crises could be essentially achieved with effective energy planning by considering optimal diffusion of renewable energy resources and improving governance. This approach could help to overcome oil import expenses, contain climate change, and ensure energy security in the long run. If the country's energy crises are not tackled at both operating and strategic levels in the immediate future, Pakistan's energy crisis might become a national security threat.

### 3.ENERGY SECTOR OF PAKISTAN:

Problems in Energy sectors are majorly two, first load shedding and secondly expensive electricity generation.

#### 1. Load shedding in Pakistan:

The energy sector of Pakistan is facing severe loadshedding.

In the Summer 2023, the shortfall was well above the 7000 MW

Loadshedding in the urban centres varies from 4-5 hrs a day while in rural areas 10-12 hrs a day

In Summer 2022, the short fall was more than 10,000 MW while loadshedding in the urban center was around 8hrs a day. In rural areas around 16-18 hrs a day.

From 2007 till end of 2016, the shortfall varied from 5000 to 8000 MW

The loadshedding in the urban centres from 2006 to 2016 was around 8hrs a day.

In rural areas, more than 18hrs a day. In 2022-23, dangerous revival of energy.

## **2. Expensive electricity generation is the major problem of Pakistan:**

As the country generates the most expensive electricity in Asia and 3<sup>rd</sup> most expensive electricity generated in the World. (PM of Pakistan)

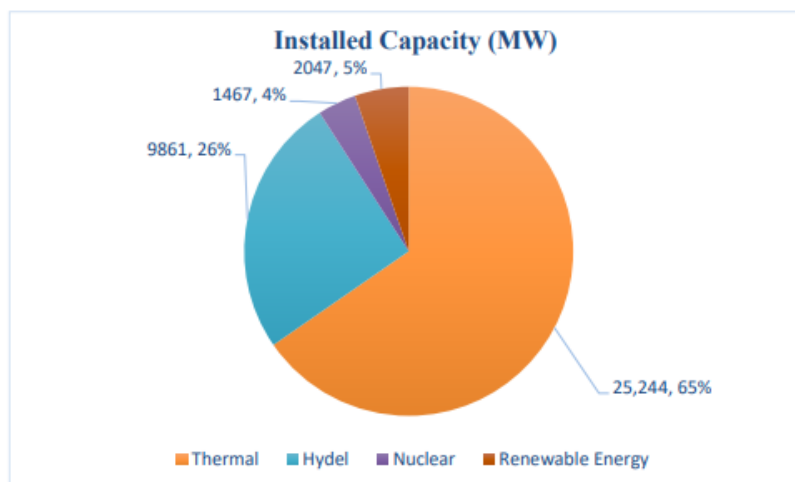
domestic unit charges vary from 24 to 65 PKRs. The price of per unit decided on the basis of SLABS being introduced by NEPRA. Below 100 units (1-100units) the cost is almost 28Pkr including all the taxes and other charges. From 100–300-unit slab price is 44 Pkr per unit including all the taxes and other charged. From 300-600 unit slab the cost is about 56 pkr per unit. Above 600 units the minimum price per unit is 72 pkr.

In commercial (markets, industry, agriculture), it varies from 48 to 90+ PKRs per unit cost. Slabs are also varying the prices per unit. The prices got almost more than 3 times in the last two years. The cost of domestic unit of slab 300-600 unit, 18pkr in 2022, now the price rises more than 56 Pkr.

## **Pakistan’s Energy Resources;**

As of June 30, 2020, total installed power generation capacity in Pakistan stands at 38,719 MW, of which 35,735 MW is connected with National Transmission & Despatch Company (NTDC) system whereas 2,984 MW is connected with K-Electric Limited (KEL) system.<sup>11</sup> The distribution of installed capacity by source as shown in fig

**Figure-6: Pakistan’s Total Installed Power Generation Capacity (as of 30th June 2020)**



Source: National Electric Power Regulatory Authority, 2020.

### **a) Oil and Gas**

Oil and gas are the main energy sources of Pakistan. According to latest report, in FY 2018-19, a combined energy supply of crude oil, refined petroleum products, LNG,

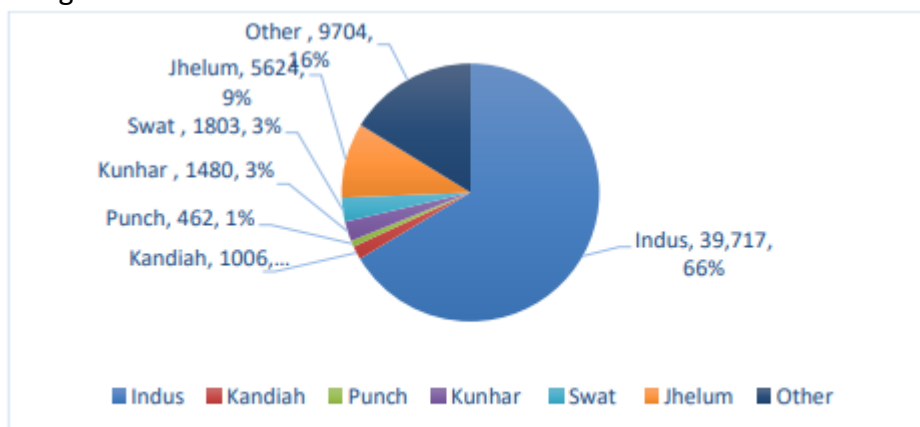
LPG, and natural gas accounts for 76 percent of the energy supply, of which 25.7 percent is of oil, 45.6 percent is of gas including LNG and 1.1 percent is of LPG. Bulk of this, is imported as indigenous exploration and production is still underdeveloped despite huge potential. 12 As per FY-2018 estimates, the Annual Compound Growth Rate (ACGR) of gas and oil in Pakistan was only 5.1 percent while the production of natural gas saw a decline of 0.8 percent in the same period.13 In total, Pakistan has 254 oil fields, 70 associated and 240 non-associated gas fields. However, most of these are small and are depleting. The Sui field, which accounts for 25 percent of the supply, is on the decline. The shortfall in gas is expected to reach 6,611 Bcf/D by FY 2029-30. 14 In contrast, consumption is continuously rising. This gap between demand and indigenous supply is going to deepen further as local gas reserves are fast depleting while consumption is on the increase.

**b) Coal:**

Pakistan is a coal-rich country, with total 7775.5 million tonnes of measured reserves. Out of measured reserves, it is currently producing 4.3 million tonnes of coal. The average consumption is almost 17.9 million tonnes.15 This huge potential has not been harvested for decades due to insufficient financing, underdeveloped infrastructure and lack of modern technical expertise. However, there are other more serious concerns as well; the quality of coal especially in the Thar is not very economical for power production. In addition, the environmental pollution that it is going to cost will further deteriorate the already threatened safety levels as coal pollutes the environment like no other fuel does. Figure 7 shows the year wise statistics of coal production, consumption and import.

**c) Hydropower:**

Hydropower has traditionally been the prominent source of energy in Pakistan. Pakistan has total of 60,000 MW (approx.) of hydropower potential. 16 Distribution of this exploitable potential of different water resources in Pakistan17 is given below in Figure.



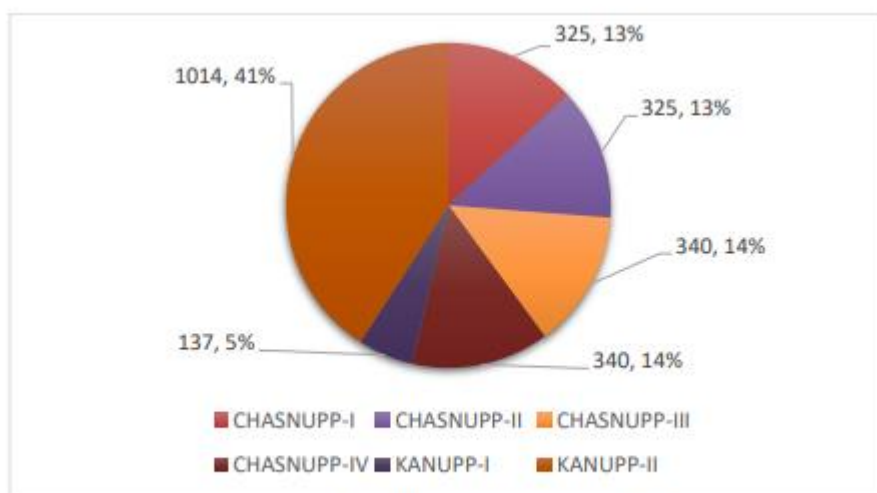
Source: Ministry of Water and Power, Government of Pakistan.

As of June 2020, Pakistan has been able to exploit only 11 percent of total hydropower potential so far. Pakistan has total 9,861 MW of hydropower generation installed capacity which is connected with Pakistan Electric Power Company (PEPCO) / NTDC, developed by Water and Power Development Authority (WAPDA) and Independent Power Producers (IPPs).18 Currently, hydropower is contributing around 25 percent to total installed power generation capacity in the country. However, the

existing installed capacity remains far below the country's economically and technically viable potential, including the significant potential for development of small-scale run-of-river hydropower projects. The share of hydel & thermal power generation was 65% to 35% during the years 1960-70 which has almost gone reverse in the power system due to non-construction of any mega hydel project. The imbalance between hydel and thermal has increased the demand of imported fuels and severely affecting country's foreign exchange. The high tariff rates of IPPs are consuming major share of revenue and have also caused immense increase in overall electricity tariff rates.<sup>19</sup> The construction of hydropower projects remain neglected due to lack of political will and politicization of different hydropower projects. Controversy over Kalabagh dam halted development on other hydropower projects as well. Presently, as table 1 shows, around 30,428.07 MW (approx.)<sup>20</sup> of hydropower projects are at different stages of development under the China Pakistan Economic Corridor (CPEC) and non CPEC domains that are likely to be completed by 2025-30.

#### **D) Nuclear Power:**

Nuclear power is competitive compared to other electricity generation options, but requires high initial investments, huge industrial infrastructure and sophisticated technical expertise for its development and operation. Pakistan started developing nuclear energy in 1960s and currently producing 1,467 MW plus 1,014 MW from Karachi Nuclear Power Plant-II (KANUPP-II) making total of 2,481 MW of nuclear energy; contributing around 6 percent to total installed power generation capacity in the country. <sup>21</sup> Karachi Nuclear Power Plant – III (KANUPP-III) with capacity of 1,014 MW is under construction and will be operational in 2022.<sup>22</sup> However, Pakistan is targeting 8,800 MW of tangible nuclear power generation capacity by 2030.<sup>23</sup> The Figure 9 below shows the current installed capacity of nuclear power plants in Pakistan



Source: National Electric Power Regulatory Authority, 2020.

#### **Major Causes of Energy Crisis in Pakistan:**

##### **a) Governance Structure:**

Currently there are numerous agencies working under two different ministries for energy development, transmission and regulation with their own terms of



reference, policies and strategies without any efficient system of coordination. Since June 2017, two regulatory authorities have been put under control of two different ministries i.e., NEPRA under Water and Power Division and Oil and Gas Regulation Authority (OGRA) under Petroleum and Natural Resource Division. These regulatory authorities are working in highly centralised manner under considerable political influence on pricing and tariffs.

**b) Policy Issues:**

Absence of an energy policy to provide guidance for improved monitoring, evaluation, and decision making by the government for the secure supply of energy accentuates lack of integration in energy policymaking and implementation as there are separate bodies for policy making, planning, developing a legal and regulatory framework for each fuel mix.

**c) Heavy Reliance on Imported Fossil Fuel:**

Heavy reliance on imported fossil fuels particularly oil and LNG has been the trend in our energy profile. Oil and LNG worth \$824.872 million, 24 were imported in FY 2020-21 which is nearly 15% of the entire import bill.

**d) Depletion of Indigenous Gas:**

Share of indigenous natural gas has reduced from 43% of energy mix in 2014 to 34% in 2019 as Pakistan's depleting reserves are sufficient only to sustain current levels of gas consumption of (17.2 MTOE) for the next only 25 years.<sup>26</sup> Indigenous supplies are expected to decline by approximately 50% in the next 10 years, which will have to be covered through LNG imports in addition to catering for incremental demand growth.

**e) Shale Gas Exploration**

According to a report published by US Energy Information Administration (EIA), Pakistan has estimated fresh recoverable shale gas reserves of 105 Trillion Cubic Feet (Tcf) and more than nine billion barrels of oil in Pakistan.<sup>27</sup> Shale gas had seen tremendous developments in a couple of other countries.

**f) Independent Power Producers**

(IPPs) Issue Introduction of IPPs in energy sector had considerable implications on power sector that raised the prices of power and shifted Pakistan energy mix in favour of oil and gas. In addition, the inexpedient agreements with IPPs allowing them to set high tariffs and inessential guarantees also aided to the power crisis in Pakistan.

**g) Transmission and Distribution Losses**

Pakistan ranks 14 out of 131 countries of world in T&D losses. T&D loss of one percent can incur deficit of approximately twenty billion rupees over national treasury.<sup>28</sup> These T&D losses are both technical and non- technical/commercial, both arising mainly due to poor administration and poor governance.

**Way Forward:**

Pakistan despite its relevance to the energy security of the region and beyond, has not been able to solve this crisis due to different roles and policies of the multiple energy bodies and organizations in the country. The current situation demands strict implementation of the following steps to achieve energy security in Pakistan.



### **a) Improving Energy Governance by Establishment of National Energy Authority**

There is a need to establish a single National Energy Authority (NEA) to oversee all institutions in the energy sector. NEA must have the power to coordinate the efforts of all the sectors, relating to drafting and implementation of a single energy policy.

### **b) Energy Security Policy**

Pakistan has to come up with a clear long-term, consistent, and rationale policy for the energy security of Pakistan; therefore, a centralised comprehensive policy to address existing energy sector issues, is required to be formulated. There are following recommended key policy goals.

**1) Realistic and Objective Oriented Approach in Formulating Policy.** Policy making should be realistic based on actual potential and affordability. Tendency to make false promises by political parties be curbed. Objectives and goals of policy should be attainable and practicable.

**2) Achieving Robustness, Resilience and Sovereignty.** Main policy goal for ensuring the energy security of Pakistan should concentrate on robustness, resilience and upholding sovereignty focusing on reduction in imports and more reliance on exploiting local resources.

**3) Ensuring Efficient Energy Consumption Policy.** To reduce the demand and supply gap, the policy is to focus on both increasing supply and decreasing consumption by minimizing distribution losses and other wastages.

#### **c) Formulation of Integrated Energy Policy:**

Integrated energy planning is to be followed with four key considerations.

**1) Minimize Burden on Balance of Payments.** Indigenisation is to be pursued ensuring national energy security. For instance, Thar coal may also be explored for its potential of conversion into other energy forms for use in other industries.

**2) Maximize Storage Based Hydro Projects.** Under-development hydropower projects should be completed without any further delay. Other multiple projects with over 25,000 MW that are at feasibility / engineering stage with WAPDA should be expedited.

**3) Exploit Solar/Wind Potential.** Best use of solar is at small scale is at small scale domestic application whereas wind potential should be harnessed through large scale wind farms. Local solar assembling and manufacturing industries need to be encouraged and developed.

**4) Exploit Local Hydrocarbon Resources.** Adequate incentives should be provided in the policy framework for expeditious development of shale gas/oil potential. Unexplored areas where 3D seismic surveys have been completed must be opened for gas and oil exploration.

#### **d) Ensure Competitive Tariffs:**

**1) Natural Gas Tariff.** Captive power plants receive selective advantage in terms of gas allocation and pricing. In current power surplus situation, captive power plants must move to national grid. Gas pricing to captive

power plants must also ensure levelized cost of power generation at par with new RLNG based power plants.

**2) Power Sector Tariff.** Reduction in T&D losses from 20% to 10% in the next 5 years can reduce the consumer tariffs by around 1-1.5 cents/kwh. DISCOs should be allowed recovery of capital investment for investment in replacement/upgradation of technology required for reducing T&D losses.

**e) Energy Efficiency and Conservation:**

**1) Hybrid / Electric Vehicles.** Hybrid & electrical vehicles should be promoted/incentivized in the new Auto Policy including installation of battery charging stations.

**2) LED Lightening.** LED bulbs are approximately 50-80% more efficient than other alternates. Import duties and sales tax on LED bulbs should be removed and industry be incentivised for local manufacturing.

**3) Building Codes and Commercial Shopping Centres.** There is a need of creating awareness about energy conservation and using day light hours. Pakistan can save up to 1,100 megawatts of energy if its industries and households – the two main energy consuming sectors try to change their behaviour about energy conservation.

**f) Revising Independent Power Producers: (IPPs) System**

**1) Energy efficiency Tests of IPPs.** To analyse efficiency of installed IPPs, energy efficiency tests of every IPP be conducted at priority. IPPs to enhance their production and those with less efficiency may be decommissioned.

**g) Use of Modern Technologies:**

Recently, Pakistan faced a countrywide blackout due to sudden decrease in frequency in transmission system.<sup>32</sup> Pakistan still operates outdated power grids and transmission systems. There is a need to utilise the latest technologies in the energy sector i.e., automation, efficient management, fault eradication, artificial intelligence, smart computers, latest research and development tools to avoid undesired power cuts and T&D losses.

**Conclusion:**

Energy security can be achieved through political will, robustness and resilience. Pakistan needs to have the right methodology and structure to go about the energy security. Also needs to have the right energy mix and reduced dependence on fossil fuels. There is a dire need to exploit indigenous resources whether they are hydel, renewable, nuclear or coal to bring energy sufficiency and reduce the cost of imported energy. The over utilisation of expensive imported resources has already deteriorated the energy situation and has seriously impacted our economy. The diversification of the energy mix and utilisation of indigenous resources is key option with Pakistan to ensure its energy security. At the same time, environmental concerns should be kept at the forefront in dealing with the energy crisis and options for greener and sustainable energy should get the priority to ensure a cleaner environment for the local population.