Chapter 14

Energy

Energy is an important sector of the economy and plays a vital role in the country's economic development. Pakistan's economy has been confronted with energy side bottlenecks in the past, which had constrained its growth and development. The outgoing fiscal year 2017-18, has witnessed a 13 year high growth of 5.78 percent, due to wide ranging structural reforms undertaken by the present government to enhance productivity in all sectors of the economy. Since FY 2013-14, the share of Government in Fixed Investment (GFCF) has increased significantly especially in Electricity Generation and Distribution & Gas Distribution sector. During the period 2013 to 2018, thirty nine (39) projects with cumulative capacity of 12,230 MW have been added (Box-1). Further, due to significant improvement in the energy mix, the country's reliance on expensive oil has been reduced. The government has also played significant role to abridge severe energy-demand imbalance by importing Liquefied Natural Gas (LNG) in the shortest span in a competitive and transparent manner. The better energy supply has helped LSM and in turn manufacturing to both grow above 6 percent in FY 2017-18, which is an eleven year high.

Globally, major share of energy demand is contributed by the emerging economies, which are growing at a high rate and undergoing drastic demographic changes. In the developed countries, the increase in energy demand due to higher living standards, is offset by energy efficiency gains borne by the use of energy efficient technology and energy conserving infrastructure. Thus, global energy supply is seeing a shift towards renewable energy exploration. The developed countries are restructuring their energy systems to integrate renewable energy, with visible changes being made on the technological front through switching to low carbon technology in order to ensure energy efficiency and mitigate environmental hazards. China has recently introduced 'Energy Production and Consumption Revolution Strategy (2016-2030) encompassing a regulatory framework to lessen air pollution and prescribing market reforms in oil and gas sector. India's ambitious energy policy aims at attainment of energy security by setting targets for universal electrification, reduction in oil imports, increasing renewable energy generation capacity and Nationally Determined Contributions (NDCs) commitments under Paris Climate Agreement to lessen the emissions intensity of the economy by 2030 (World Energy Outlook, 2017). Pakistan has already framed its energy policy (National Power Policy – 2013) in setting medium and long term targets to build a power generation capacity that can meet Pakistan's energy needs in a sustainable manner.

Vision of the government: A broader picture

Being a developing economy, Pakistan energy requirements are increasing rapidly. The government is trying to ensure availability and security of sustainable supply of energy, oil and gas along with the development of natural resources and minerals. In power sector, per capita electricity consumption is considered one of the most important economic welfare indicator regarding availability of affordable energy. Pakistan is bestowed with enormous hydro and coal potential which, if carefully exploited, can ensure our future energy security on long term basis. Further, the expansion in generation capacity requires supporting expansion in the transmission infrastructure for evacuation of the power. The government has

encouraged local and foreign investment for setting up of power projects and related infrastructure including developing transmission lines. The Power Generation Policy-2015 was announced to offer enhanced incentives and simplified processing to encourage the local and international investors to participate in the development of power projects in Pakistan. The main objectives of the Policy are:

- Provide sufficient power generation capacity at the least cost
- Encourage and ensure exploitation of indigenous resources.
- Ensure that all stakeholders are looked after in the process; a win-win situation
- Be attuned to safeguarding the environment

China-Pakistan Economic Corridor (CPEC) is another major breakthrough in the development of the country's energy sector, under which financial outlay of around US $ 35 billion has been made for Energy sector projects including power generation and transmission projects to be implemented in IPP mode.

In case of natural gas, the gap between demand and supply was widening due to increase in gas demand and depletion of existing sources. The government has made efforts to exploit indigenous resources as well as import gas though transnational pipelines and LNG to mitigate the shortfall.

Indigenous crude oil meets only 15 percent of the country's total requirements, while 85 percent requirements are met through imports of crude oil and refined petroleum products. The indigenous and imported crude is refined by six major and two small refineries. The present government not only made concerted efforts for up gradation of existing refineries, but has also made addition of 6-depots with inland freight equalization margin. Further, to promote fuel efficiency, the government has introduced marketing of 92 RON Premier Motor Gasoline replacing the existing 87 RON PMG under the regulated environment.

Pakistan has large indigenous coal reserves estimated at over 186 billion tons which are sufficient to meet the energy requirements of the country on long-term sustainable basis. There has been significant increase in import of coal due to commissioning of new coal based power plants at Sahiwal and Port Qasim. However, domestic production of coal is expected to increase in the coming years.

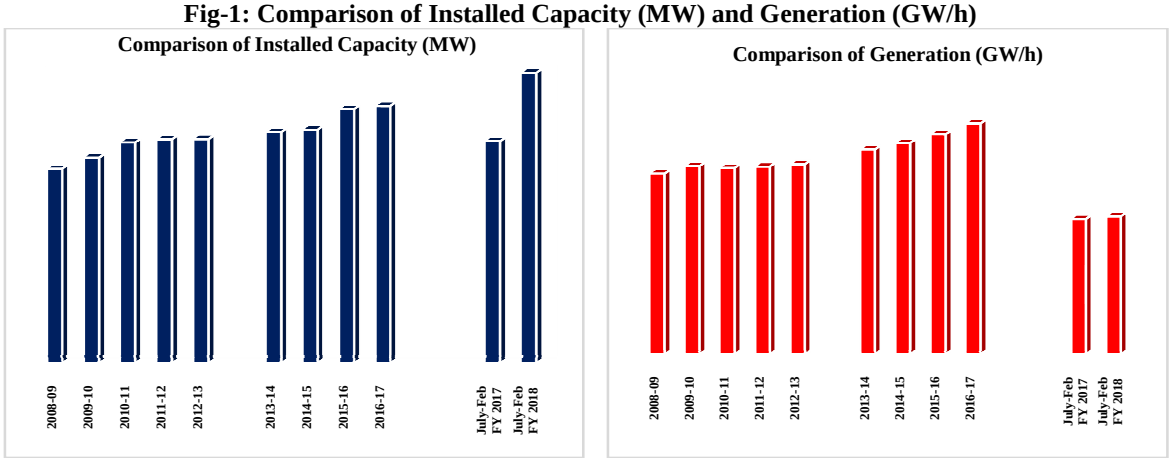
Overall, the energy situation during FY 2017-18 presents a promising picture. The gap between energy demand and energy supply has been brought down with additional production of cost effective energy mix. The government has been engaged in devising a holistic approach to cope up with the challenges of energy security, accessibility and affordability of energy. In compliance of Paris Climate Agreement to lessen the emissions intensity, Pakistan is gradually shifting to a decarburizations regime and focusing more on renewable energy sources.

Power Sector

With power shortages as a prime economic challenge five years earlier, the government accorded top priority to electricity generation. Firstly, payables of power sector entities against the Independent Power Producers (IPPs) and public sector power entities amounting Rs 480 billion were fully cleared in 2013, which added 1,700 MWs electricity to the national grid and eased load shedding considerably in the country. Secondly, the government has moved in the direction of providing targeted subsidy to power consumers (domestic up to 300 units) by moving towards better cost recovery leading to a financially stable power sector. Uptil Feb 2018, installed capacity of electricity reached 29,573 MW, which was 22,812 MW in 2012-13, thus, posting a growth of 30 percent. Although electricity generation varies due to availability of inputs and other constraints, the generation increased from 96,496 GW/h in 2012-13 to 117,326 GW/h in 2016-17 posting a growth of 22 percent, while, during July-Feb FY 2017-18, electricity generation remained 69,956 GW/h compared to 68,592 GW/h last year showing a growth of 2 percent. Figure-1

gives the comparison of installed capacity (MW) and generation (GW/h).

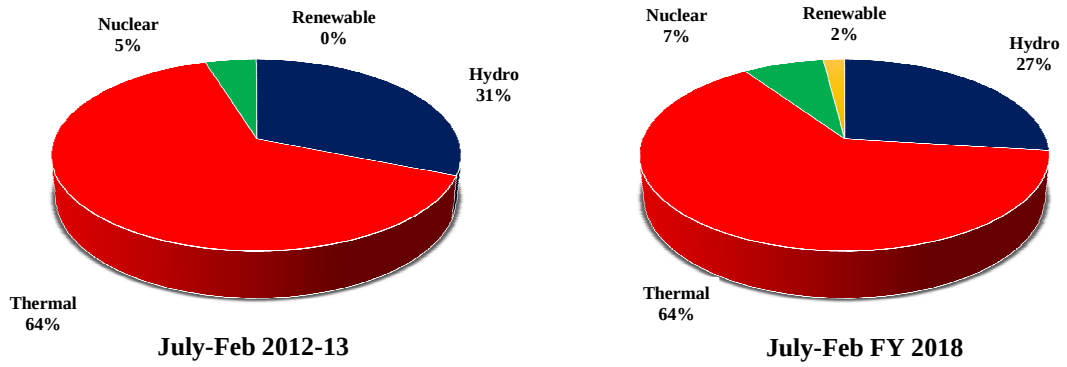
Fig-1: Comparison of Installed Capacity (MW) and Generation (GW/h)



Source: Ministry of Energy (Power Division)

With regards to share of different sources of electricity generation, it can be observed that share of hydro in electricity generation has decreased over the last five years. Lower availability of water is the main reason for reduced generation from hydel power plants. The indent as conveyed by Indus River System Authority (IRSA) to National Power Control Center (NPCC) varies from 10,000 to 200,000 CFS (cubic feet per second). This huge variation spans the entire year and correspondingly affects the hydel share in national energy mix. During winter 2017-18, the indent of Mangla was also declared at zero CFS, a historic low from the nominal minimum of 5000 CFS for Mangla. Further, considerably decreased rainfall along with minimal snowfall during winters resulted in consequent decrease in the downstream flows of water in major rivers. The impact is intensified in summer season. As substitute, the government showed commitment for electricity generation capacity though renewable energy sources. Presently, renewables constitute only two percent in electricity generation, though it is expected that they will increase in coming years. The comparison of share of different sources in electricity generation is given below in Fig-2.

Fig-2: Share in Electricity Generation



Source: Ministry of Energy (Power Division)

In terms of cost of electricity generation (Rs / Kwh), coal is considered to be one of the cheapest source. During FY 2018, import of coal has substantially increased comparative to last year due to commissioning of new coal based power plants at Sahiwal and Port Qasim. Gas is another cheaper source. The government started import of LNG in first quarter of year 2015, as it is an economical and efficient fuel as compared to other petroleum products. At present, the regasification capacity of the two existing Floating Storage Regasification Units

(FSRU) to re-gassify LNG is 1200 MMCFD. During July-Feb FY 2018, 63 percent of the RLNG (401 MMCFD) was supplied to various power plants (Bhikki, Haveli Bahadur Shah, Balloki, Halmore, Orient, Rousch, KAPCO, Saif and Sapphire) while, the remaining was supplied to fertilizer plants, industrial and transport sector.

In term of efficiency, significant improvements have been seen in recovery of dues as well as meaningful decline in transmission and distribution losses. Over the last five years, on average recovery remained above 90 percent. During July-March FY 2017-18, recovery remained 89.5 percent mainly due to only 24 percent recovery from Quetta Electric Supply Company (QESCO). In terms of transmission and distribution losses, the government was successful in consistently bringing down transmission and distribution losses. During July-March FY 2017-18, the transmission and distribution losses have decreased to 16.8 percent regardless of some anomalies. Peshawar Electric Supply Company (PESCO) recorded 37 percent transmission and distribution losses, followed by Sukkur Electric Power Company (SEPCO), Hyderabad Electric Supply Company (HESCO) and Quetta Electric Supply Company (QESCO) in which transmission and distribution losses remained 35, 29 and 22 percent, respectively

Box-1: List of Power Plants Started during Present Government

										Total
2014	Plant Names	GENCO II - Guddu CC	Wind others	Laraib						
	Fuel Type									
	Installed Capacity (MW)	**747**	**106**	**84**						**937**
2015	Plant Names	RYK Mill Limited	FWEL-I	Quaid-e-Azam	Nandipur					
	Fuel Type	(Bagasse)	(Wind)	(Solar)	(Thermal)					
	Installed Capacity (MW)	**30**	**50**	**100**	**425**					**605**
	Plant Names	Sapphire	Chiniot Power limited							
	Fuel Type	(Wind)	(Bagasse)							
	Installed Capacity (MW)	**53**	**63**							**115**
2016	Plant Names	Apolo	Best Green	Crest Energy	Metro	Younis				
	Fuel Type	(Solar)	(Solar)	(Solar)	(Wind)	(Wind)				
	Installed Capacity (MW)	**100**	**100**	**100**	**50**	**50**				**400**
	Plant Names	Tapal	Master	Gul Ahmad	Tenaga	Chasnupp C-3				
	Fuel Type	(Wind)	(Wind)	(Wind)	(Wind)	(Nuclear)				
	Installed Capacity (MW)	**30**	**50**	**50**	**50**	**340**				**519**
2017	Plant Names	Fatima Energy	Hamza Sugar	Sachal	Dawood Hydro China	Bhikki	Haveli Bahadar Shah	Sahiwal		
	Fuel Type	(Bagasse)	(Bagasse)	(Wind)	(Wind)	(RLNG)	(RLNG)	(Coal)		
	Installed Capacity (MW)	**99**	**15**	**50**	**50**	**1,156**	**1,207**	**1,243**		**3,820**
	Plant Names	RASHMA Power	Gulf Power	Balloki	Patrind	Chasnupp C-4	United Energy	Port Qasim	Thal industries	
	Fuel Type	(RFO)	(RFO)	(RLNG)	(Hydel)'	(Nuclear)	(Wind)	(Coal)	Baggase	
	Installed Capacity (MW)	**97**	**84**	**1,198**	**147**	**340**	**99**	**1,320**	**20**	**3,305**
2018	Plant Names	Artistic	Jhimpir	Hawa	Tarbela T-4 Unit-17	Neelum Jehlum				
	Fuel Type	(Wind)	(Wind)	(Wind)	(Hydel)'	Hydel				
	Installed Capacity (MW)	**50**	**50**	**50**	**1,410**	**969**				**2,529**
Grand Total (MW)										**12,230**

Renewable Energy

Pakistan is blessed with large potential of wind and solar resources that can be used for power generation. The government has decided to develop new wind and solar power projects through competitive bidding instead of upfront tariffs and plans to carry out competitive bidding for approximately 1200 MW wind and 600 MW solar power capacity in 2018 (calendar year). Over the last five years, eighteen (18) wind power projects of 937.27 MW cumulative capacity have achieved commercial operation and are supplying electricity to the national grid, while six (06)

solar power projects of 418 MW capacity have been made operational. For power generation from bagasse cogeneration, six (06) sugar mills having a cumulative capacity of 201.1 MW are operational.

Comparison of the performance in power sector is given below:

Table 1: Power Sector Performance Comparison

			2009-2013	2014-2018
Capacity		MW	22,812 as on June 2013	29,573 as on Feb 2018
Generation		MW	20,850	28,171
Transmission		MVA	33,370	49,128
Distribution		MVA	33,751	44,096
Number of New Project		No	17	39
PPIB	Investment	US $ Million	2,635	7,103
	Capacity Addition	MW	2,530	4,954
AEDB	Investment	US $ Million	227	2,868
	Capacity Addition	MW	106	1,462
Transmission and Distribution Losses	Maximum	%	19.6% in FY 2010	18.7% in FY 2014
	Minimum		18.9% in FY 2013	17.9% in FY 2017
	Average		19.4%	18.3%
Recovery	Maximum	%	89.6% in FY 2013	94.5% in FY 2016
	Minimum		85.2% in FY 2010	89.1% in FY 2014
	Average		85.6%	91.2%

Source: Ministry of Energy (Power Division)

National Electric Power Regulatory Authority (NEPRA)

The National Electric Power Regulatory Authority (NEPRA) responsible for regulating electric power services and safeguarding the interests of investors and consumers has handled 4,371 complaints during July-March FY 2017-18. Thirty one (31) Generation Licenses with installed capacity of 2,469.63 MW were issued. Likewise, generation tariffs were determined for five projects based on Nuclear, RLNG, Coal and Bagasse. The upfront tariff for Captive Power Plans on Residual Fuel Oil (RFO), Coal and Gas was determined by NEPRA for short term utilization of the available generation capacity.

NEPRA allowed one percent capital cost of the project reduced by US$ 150,000/annum (subject to 3 percent indexation for each year after the first year from COD) as security cost in respect of each CPEC power projects in accordance with the approved payment mechanism and is being treated as pass-through item.

NEPRA granted permission to K-Electric for procurement of 11 – 14 MW power from Lotte Chemicals Pakistan Limited (LCPL) and approved the tariff for LCPL for sale of surplus power to K-Electric on take and pay basis. The purchase of gas power from LCPL shall be beneficial for the consumers and shall not have any negative impact on the existing tariff of K-Electric.

Fuel Cost Adjustment allowed by NEPRA to DISCOs for the period July-Feb FY 2017-18 is as follows:

Table 2: Fuel Cost Adjustment

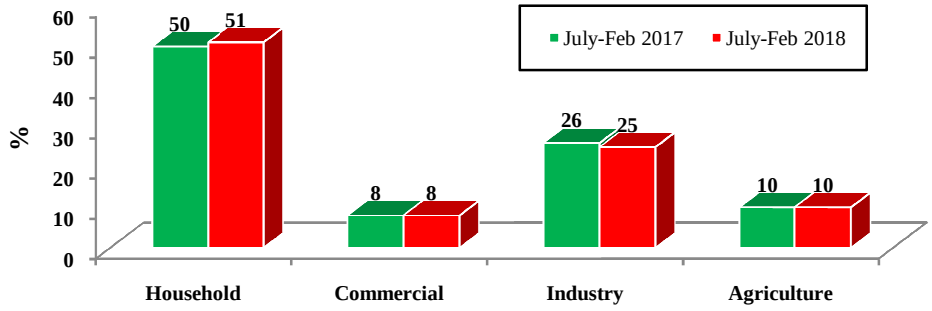
Months	July	August	September	October	November	December	January	February
FCA (Rs/kWh) (Decreae)	(1.7094)	(1.8198)	(2.1941)	(2.2548)	(3.1143)	(2.9844)	(3.2421)	(2.2866)

Source: NEPRA

Electricity Consumption

Over the last one year, there has been no significant change in the consumption pattern of electricity, although the share of households in electricity consumption has increased marginally to 51 percent. This has been offset by a one percent decline in share of industry in electricity consumption. The comparison between consumption patterns of electricity during July-Feb FY 2018 with corresponding period last year is shown below in Figure-3:

Fig 3: Share in Electricty Consumption (%)



Source: HDIP, Ministry of Energy (Power Division

Nuclear Energy

The Pakistan Atomic Energy Commission (PAEC) is tasked with generating electricity though nuclear power. Presently, there are five nuclear power plants operating on two sites in the country, one unit namely, Karachi Nuclear power plant (KANUPP) at Karachi and four units of Chashma Nuclear power plants (C-1, C-2, C-3, C-4) at Chashma (Mainwali). The gross capacity of these five nuclear power plants is 1,430 MW that supplied about 5,811 million units of electricity to the national grid during the first eight months of FY 2017-18.

KANUPP, the oldest of the nuclear power plants, has now completed 46 years of safe and successful operation. C-4 was formally inaugurated by the Honorable Prime Minister on 8th September, 2017. All operating units at Chashma are amongst the best performers in the country in terms of endurance and availability. Some performance parameters of these operating plants are presented in the following table:

Table 3: PAEC's Performance Parameters

Plant	Capacity (MW)		Electricity sent to Grid (Million KWH)	
	Gross	Net	1st July 2017 to 28th Feb,2018	Lifetime upto 28th Feb, 2018
KANUPP	100	90	211	14,261
C-1	325	300	1,708	34,903
C-2	325	300	1,461	15,122
C-3	340	315	1,752	3,329
C-4	340	315	890	892
Total	**1,430**	**1,320**	**6,022**	**67,615**

Source: PAEC

Two more nuclear power plants at Karachi, Karachi Nuclear power plants units-2 & unit-3 (K-2 and K-3) are under construction. The First concrete pour of K-2 and K-3 was performed on 20th August, 2015 and 31st May, 2016, respectively.

PAEC is planning to intensify its activities to meet the nuclear electricity generation target of 8,800 MW by the year 2030. Construction of K-2/K-3 is the first major step in this regard and the PAEC is planning to develop additional sites to house more nuclear power plants in future with the sites identified throughout the

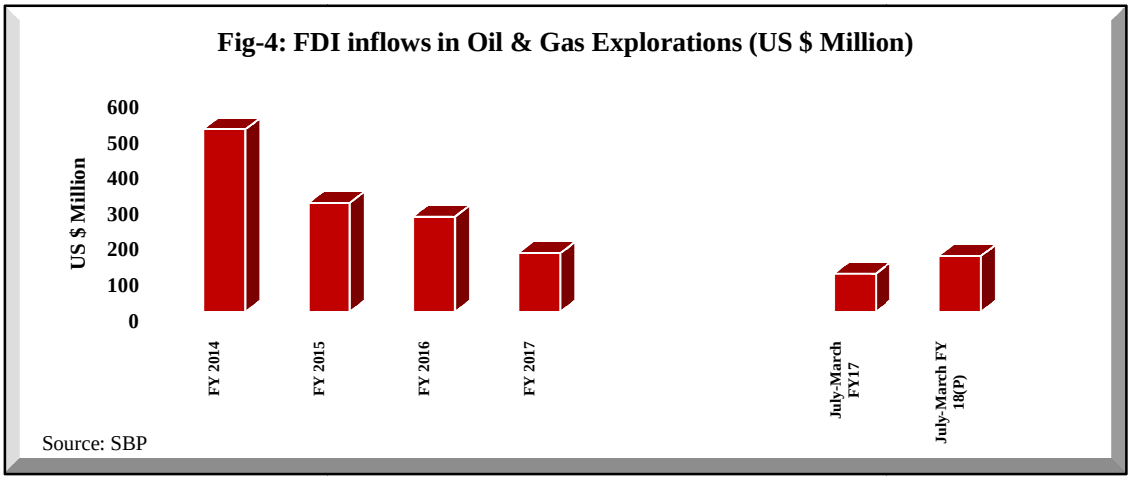
country being investigated and acquired for development.

In order to ensure the continuous availability of requisite manpower for its nuclear power programme, PAEC has put in place a dedicated nuclear technology human resource development infrastructure. The infrastructure is based on Institutes imparting training and education in all relevant disciplines and at all levels, from technical training to academic programmes.

Oil sector:

The annual consumption of petroleum products in the country was around 26 million tons during FY 2016-17. During July-Feb FY 2017-18, 60.4 million barrels of crude oil was imported, while 21.8 million barrels was locally extracted. The indigenous crude oil meets only 15 percent of the country's total requirements, while 85 percent requirements are met through imports in the shape of crude oil and refined petroleum products. The indigenous and imported crude is refined by six major and two small refineries.

Fig-4: FDI inflows in Oil & Gas Explorations (US $ Million)



Source: SBP

The government is making efforts to bring improvement in existing refineries as well as attracting foreign investment in this sector. Some of the main achievements are:

- Recently, Byco Oil Pakistan Limited (Byco) has established an Oil Refinery at Hub, Balochistan with refinery capacity of 120,000 Barrel Per Day (5 million tons/annum) at cost of US$ 400 million. Byco has also installed Single Buoy Mooring (SBM) facilities for transportation of imported Crude Oil and petroleum products from ships to the storages tanks. The capacity of said facility is 12 M. tons per annum.
- Attock Refinery Limited (ARL) has started producing Euro-II (0.05 percent Sulphur HSD) Further, the refinery has also installed isomerization plant and enhanced the production of Motor Gasoline.
- Pakistan Refinery Limited (PRL) has also installed isomerization plant in 2016 and since then has doubled its production of Motor Gasoline.
- Pak Arab Refinery Limited (PARCO) is implementing PARCO Coastal Refinery project at Khalifa Point, near Hub, Balochistan, which is a state of the art refinery having capacity of 250,000 barrels per day (over 11 Million tons per annum). Estimated cost of the project is over US$ 5 billion. On the directive of the Prime Minister, 1811 acres land has been allocated for the establishment of PARCO Coastal Refinery. PARCO is working on a detailed feasibility study of the project which is expected to be finalized by the end June, 2017 and the project is expected to be completed by end of 2023.
- Due to lesser availability of Gas to CNG stations and use of Motor Gasoline in generators, the demand of MS has

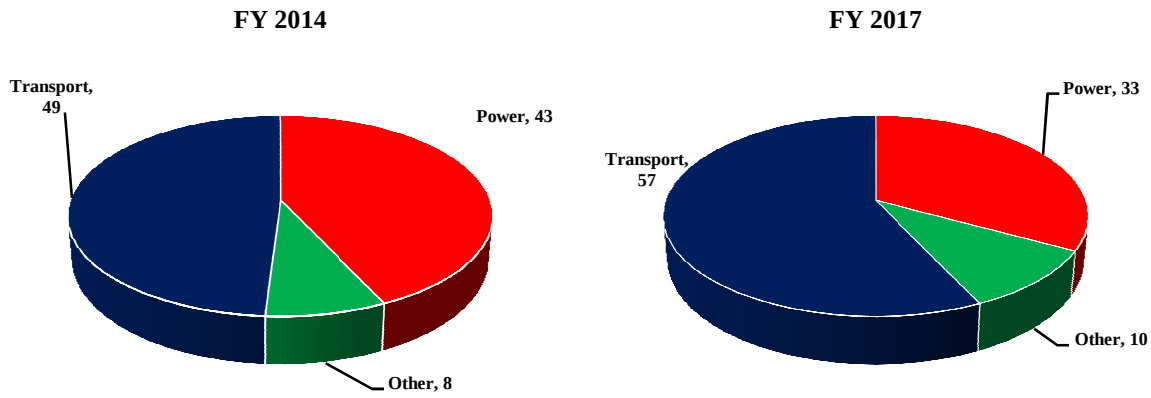
increased up to 25 percent during last 5 years, necessitating the opening of abandoned oil depots to overcome the shortages. Accordingly, six (6) abandoned depots have been opened included in the Inland Freight Equalization Margin (IFEM) due to which the storage capacity of HSD, MS, SKO and LDO has been enhanced.

- In order to promote fuel efficiency, the government has introduced marketing of 92 RON Premier Motor Gasoline replacing the existing 87 RON PMG under the regulated environment. Further, the marketing of 95/97 PMG has also been allowed under deregulated environment. Oil Marketing Companies (OMCs) have been allowed to import entire High Speed Diesel (HSD) as per Euro-II specification (0.05 percent Sulphur content) since start of 2017. However, from September 2017, OMCs have been allowed to import and market diesel conforming to Euro-IV & V specifications in a deregulated environment.

All of the above mentioned measures have led to a small hike in local crude oil extraction. During July-Feb FY 2017-18, 21.8 million barrels of crude oil was locally extracted compared to 21.5 million barrels in the corresponding period last year.

Total oil consumption during July-Feb FY 2018 at 16. 5 million tons, was marginally lower than consumption recorded during the same period last year (16.7 million tons). Since FY 2014, there has been a considerable change in share of components in oil consumption.

Fig-5: Oil Consumption by major components



Source: HDIP

The share of power in oil consumption has significantly declined while share of transport has increased. This is taking place as the newer installed power plants are moving toward cheaper fuels, whereas, increase share of transport is mainly due to decline in domestic prices of petrol and higher imports of used cars. During July-Feb FY 2017-18, share of transport in oil consumption increased further to 64.4 percent compared to 57.2 percent during the same period last year. However, share of power decreased to 26.4 percent from 33.2 percent during the period under discussion.

Gas sector:

Natural Gas is a clean, safe, efficient and environment friendly fuel. Its indigenous supplies contribute about 38 percent in total primary energy supply mix of the country. Pakistan has an extensive gas network of over 12,829 km Transmission, 132,065 km Distribution and 34,631 Services gas pipelines to cater the requirement of more than 8.9 Million consumers across the country. The government is pursuing its policies for enhancing indigenous gas production as well as importing gas to meet the increasing demand of energy in the country. During July-Feb FY 2017-18, average natural gas consumption was about 3,837 Million Cubic Feet per day (MMCFD) including 632 MMCFD volume of RLNG, compared to 3,205 Million Cubic Feet

per day (MMCFD) last year. The power sector continues to remain the largest consumer of gas, followed by the domestic sector. The sector wise breakup is given in Table 4 below:

Table-4: Average sector wise natural gas consumption (mmcfd) during July-Feb FY 2018

Sector	Gas Consumption in MMCFD	RLNG	Total
Power	936	401	1,337
Domestic	860	-	860
Commercial	88	-	88
Transport (CNG)	138	53	191
Fertilizer	613	7	620
General Industry	570	171	741
Total	3,205	632	3,837

Source:- Ministry of Energy (Petroleum Division)

During July-Feb FY 2017-18, the two Gas utility companies (SNGPL & SSGCL) have laid 328 Km Gas Transmission network, 8,861 Km Distribution and 1,216 Km Services lines and connected 231 villages/towns to the gas network. During the period under discussion, the gas utility companies have invested Rs 1,351 Million on Transmission Projects, Rs 10,202 Million on Distribution Projects and Rs 11,198 Million on other projects bringing total investment to about Rs 22,751 Million. Additional gas connections of 428,282 were provided across the country additional including 426,721 Domestic, 1,519 Commercial and 42 Industrial.

Government of Pakistan had initially encouraged use of Compressed Natural Gas (CNG) as an alternate fuel for automobiles in order to control environmental degradation, reduce foreign exchange expenditure on import of liquid fuel and generate employment. Pursuant to government's investor friendly initiatives, Pakistan has become the world leading CNG user country. Currently, more than 3,416 CNG stations have CNG marketing licenses in the country. However, in view of the mushroom growth of CNG stations in the country vis-à-vis depletion of natural gas reserves, there has been a ban on establishing of new CNG stations since 2008. However, for sustainable growth of this sector, the present government has approved provision of RLNG to this sector with fiscal incentives of GIDC at the rate of zero and Sales Tax at the rate of five percent.

Coal

Pakistan has fairly large indigenous coal resources (over 186 billion tons) which are sufficient to meet the energy requirements of the country on long-term sustainable basis. Domestic production of coal is expected to increase in the coming years on start of mining activity at Thar coalfield. Presently, indigenous coal production is mostly consumed by brick kilns and a small quantity is utilized by Khanote Power Plant and cement factories. Imported coal is used by power plants, cement manufacturing units, Pakistan Steel and other industries etc. Import of coal has substantially increased comparative to preceding year (FY 2016-17) due to commissioning of new coal based power plants at Sahiwal & Port Qasim. Key statistics of coal sector over the last 2 years are given in Table 5:

Table-5:- Performance of Coal

FiscalYear	Domestic Coal Production		Coal Import		Total Supply	
	Metric Tons	TOE	Metric Tons	TOE	Metric Tons	TOE
2016-17	4,164,926	1,863,388	7,020,844	4,619,013	11,185,770	6,482,401
2017-18 (July-Dec)	2,286,144	1,022,821	5,497,275	3,616,657	7,783,419	4,639,478

Source: Ministry of Energy (Petroleum Division) Directorate General Mineral

Conclusion

Over the last five years, the government has successfully removed energy side bottlenecks, due to which the economy had been stuck in a low growth trap and has now attained a high growth trajectory driven by increased activity in agriculture, industrial and services sector. The past five years have witnessed a record increase in the country's installed generation capacity through commissioning of energy related projects. The government will continue to diversify energy supply to meet energy needs in a sustainable and affordable manner. The government is engaged in developing a 5-year National Electricity Plan that would provide a road map for future power generation projects, pricing issues and set high standards for power consumers.