

Trends in Electricity Generation 2006-07 to 2020-21



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Pakistan Bureau of Statistics

Ministry of Planning Development
& Special Initiatives

Government of Pakistan

July 2022

FOREWORD



Pakistan Bureau of Statistics (PBS) is responsible for collection, compilation and timely dissemination of reliable socio-economic statistical information. PBS publishes variety of data series and reports based on primary as well as secondary data sources. These indicators help policy makers, development planners and researchers to monitor their development plans for affective and efficient public service delivery and governance.

The task of preparation the report “**Trends in Electricity Generation**” has been taken up by the PBS team. Pursuantly, the report on trends in electricity generation has been produced for the years 2006-07 to 2020-21. This is the first report of its kind with a notion to make power generation information in visually presentable form and readily available for observing trends in the sector.

Requisite information is obtained from all electricity generating establishments in the country to ensure nationwide coverage of electricity generating units. The report on trends in electricity generation (2006-07 - 2020-21) is an important intervention to gauge Installed Capacity, Electricity Generation, Gross Value Added (GVA) and Capacity Utilization Rate of electricity sector which will be helpful for assessing performance of the sector.

I render thanks to WAPDA, Pakistan Atomic Energy Commission (PAEC), Central Power Purchasing Agency (CPPA), Independent Power Producers (IPPs) and all other stakeholders for their valuable support in providing data for compilation of this document.

Efforts have been made to compile this report as per requirements of policy makers, planners, researchers and other data users. It is hoped that the data users will find it very useful in tracing their objectives. Comments and suggestions for improvement of the report are welcomed and should be addressed to: emsection.pbs@gmail.com.

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PREFACE



Globally electric power generation is important to fulfill the growing need of the population. Electricity is produced through different generating systems such as nuclear, hydel, thermal, etc. Electricity is used in home appliances and industries need electricity for manufacturing various materials, equipment etc. Electricity is thus fundamental for socio-economic development of a country. There is a constantly increasing demand for electricity and users are always concerned about sustainability of current production and consumption patterns. Quality statistics on electricity generated and produced for consumption is therefore of paramount importance.

Electricity sector of Pakistan is diverse and has many players. The issues of capacity payment, local management and theft make sector vulnerable and give significant attention to the sector. Accurate and reliable data of the sector give fresh air to the stakeholder, policymaker and researches. The report establishes an effort to quench the thirst of the data user and sheds light on various important indicators of the sector. It accumulates all information on public and private establishments. The graphical visual representation makes lay man understand these statistics. The report is based on time series data from 2006-07 which will help researcher for understanding detailed analysis.

I owe special gratitude and appreciation to Dr. Bahrawar Jan, DDG (Industry), Syed. Abdul Qader Shah, Director, Mr. Mahmood Ahmad Qureshi, CSO (EM) and his team for the diligent efforts in compilation of the Trends in Electricity Report. Efforts have been made to make this report comprehensive informative and useful for administrators, researchers, policy makers, National Accounts and other stakeholders.

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Table of Contents

Chapter 1: Concepts and Data Sources	4
Chapter 2: Introduction	8
2.1 Historical Background	8
2.2 Pakistan's Energy Mix	9
2.3 Objectives	9
Chapter 3: Structure of Power Sector	11
Chapter 4: Main Indicators.....	15
4.1 Installed Capacity	15
4.1.1 Installed Capacity by type of Source.....	18
4.1.2 Installed Capacity by Province and Type of Source for the Year 2007 and 2021	21
4.2.1 Electricity Generation by type of Source	27
4.2.2 Electricity Generation by Province and type of Source	30
4.3 Gross Value Added (GVA) and Subsidy of Electricity Generation	31
4.4 Rate of Utilization.....	32
Chapter 5: Data Tables.....	39



List of Tables

Table 1: Share of Installed Capacity by type and region.....	2
Table 2: Electricity Generation by type and region	3
Table 4.1: Installed Capacity from 2006-07 to 2020-21	17
Table 4.2: Installed Capacity by type of Source from 2006-07 to2020-21	19
Table 4.3: Installed Capacity by Province and type of Source for the year 2006-07 and 2020-21.....	211
Table 4.4: Installed Capacity of Renewable, Nuclear and Thermal Power Plants	23
Table 4.5: Electricity Generation from 2006-07 to 2020-21	25
Table 4.6: Electricity Generation by type of Source.....	28
Table 4.7: Electricity Generation by Province and type of Source for the Year 2006-07 and 2020-21...30	
Table 4.8: Gross Value Added (GVA) and Subsidy of Electricity Generation from 2006-07 to2020-21 . 31	
Table 4.9: Capacity Utilization Rate by type of plants.....	33
Table 5.1: Installed Capacity (1947-48 to 2020-21).....	39
Table 5.2: Electricity Generation.....	41
Table 5.3: Electricity Generation from 2006-07 and 2020-21 by Province type of Plant.....	42
Table 5.4: Electricity Generation of 2020-21 by type of Establishment.....	45



List of Figures

Figure 1.1: Source of Electricity in Pakistan	6
Figure 3.1: Stakeholders of Power Sector	11
Figure 4.1: Chronologically Installed Capacity of Electricity.....	15
Figure 4.2: Public and Private Installed capacity of Electricity	16
Figure 4.3: Electricity Capacity Public vs Private	17
Figure 4.4: Electricity Installed Capacity by ownership and % change over previous year	18
Figure 4.5: Installed Capacity by type of Sources 2020-21 vs 2006-07	19
Figure 4.6: Installed Capacity by type of Sources from 2006-07 to 2020-21.....	20
Figure 4.7: Growth rate of Installed Capacity by type of Source (2020-21vs2006-07).....	20
Figure 4.8: Installed Capacity by Province (2020-21 and 2006-07)	21
Figure 4.9: Installed Capacity by type of Source and Province.....	22
Figure 4.10: Renewable Energy Mix (Installed Capacity),2021	24
Figure 4.11: Renewable Energy Mix, 2007	24
Figure 4.12: Electricity Generation (GWh) from2006-07 to 2020-21	25
Figure 4.13: Electricity Generation by the ownership (Public and Private) from 2006-07 to2020-21	26
Figure 4.14: Electricity Generation.....	27
Figure 4.15: Percentage growth of Electricity Generation by ownership.....	27
Figure 4.16: Electricity Generation (GWh) by type of sorces 2020-21 and 2006-07	28
Figure 4.17: Panel chart of Electricity Generation (GWh) and % Growth over the years.....	29
Figure 4.18: Comparison of Electricity Generation during 2006-07 vs 2020-21.....	30
Figure 4.19: Gross Value Added and Subsidy.....	32
Figure 4.20: Capacity Utilization Rate.....	33



List of Abbreviations & Acronyms

AAGR	Annual Average Growth Rate
AEDB	Alternate Energy Development Board
AJK	Azad Jammu & Kashmir
ARE	Alternate and Renewable Energy
CHASNUPP	Chashma Nuclear Power Plant
CPPA	Central Power Purchasing Agency
CPPs	Captive Power Producers
DISCO	Distribution Company
GENCO	Generation Company
GRI	Global Reporting Initiatives
GVA	Gross Value Added
GW	Giga Watt
HUBCO	Hub Power Company
IAEA	International Atomic Energy Agency
ICT	Islamabad Capital Territory
IPPs	Independent Power Producers
KANNUP	Karachi Nuclear Power Plant
KAPCO	Kot Addu Power Company
KE	K Electric
KP	Khyber Pakhtoonkhwa
MW	Mega Watt
NEPRA	National Electric Power Regularity Authority
NGO	Non-governmental Organization
NTDC	National Power Transmission and Despatch Company
PASMIC	Pakistan Steel Mills
PEPCO	Pakistan Electric Power Company
PPIB	Private Power Infrastructure Board
SPPs	Small Power Producers
WAPDA	Water and Power Development Authority



Major Indicators

Installed Capacity (MW)

	2006-07	2020-21
Total	19670	40606
Public	13479	25614
Private	6191	14992
By Province		
Punjab	7491	17247
Sindh	5316	11127
KP	3770	5951
Balochistan	2063	3722
AJK	1030	2331
By Source		
Thermal	12771	26600
Hydropower	6474	9912
Nuclear	425	1770
Wind	0	1242
Bagasse	0	527
Solar	0	555

Electricity Generation (GWh)

	2006-07	2020-21
Total	99895	143847
Public	56331	92894
Private	43565	50952
By Province		
Punjab	37470	59609
Sindh	26089	38241
KP	17498	19935
Balochistan	12646	14466
AJK	6192	11595
By Source		
Thermal	65713	89299
Hydropower	31887	38936
Nuclear	2284	11090
Wind	0	2900
Bagasse	11	711
Solar	0	911



Executive Summary

Electricity is considered to be life line of an economy as it is pivotal for industrial development that ultimately contributes to the socio-economic development of a country. Pakistan electricity market is evolved through different era and private sector entered in market in 1985. WAPDA is still a big player of this market. However, electricity generated by private sector from thermal and alternate energy sources eroded its monopoly over the time.

This report is an effort to understand the trends of this sector. This report will also provide data series from 2006-07 to 2020-21. Some salient features of the report are summarized as follows:

Installed Capacity

The overall installed capacity for the year 2020-21 stood at 40,606 MW. This shows a 0.98% growth over 40,211MW in 2019-20. Besides this, the installed capacity by type of source has also been computed where maximum installed capacity is of thermal having a share of 66% for the year 2020-21. Other sources, hydel, nuclear, wind, bagasse and solar have 25%, 4%, 3%, 1% and 1 % shares respectively. In Provinces, Punjab has maximum installed capacity i.e. 17,257 MW. Whereas, Sindh has second highest installed capacity of 11,345 MW followed by KP (5951MW), Balochistan (3722MW) and AJK (2331MW).

Table 1: Share of Installed Capacity by type and region

Unit: MW

Province/ Source	Nuclear	Hydel	Thermal	Bagasse	Solar	Wind	Total	%Share
Punjab	1330	1802	13316	373	436	0	17257	42.5
Sindh	440	0	9390	154	119	1242	11345	27.94
KP	0	5779	172	0	0		5951	14.66
Balochistan	0	0	3722	0	0	0	3722	9.16
AJK	0	2331	0	0	0	0	2331	5.74
Total	1770	9912	26600	527	555	1242	40606	100
%Share	4.36	24.41	65.51	1.29	1.37	3.06	100	

Electricity Generation

Total electricity generation in the country for the year 2020-21 has been recorded as 143,847 GWh. Punjab produced maximum generation of 59,609 GWh followed by Sindh with 38,241 GWh. Electricity generation by source and provincial break-up for the year 2020-21 is shown in following table.

Table 2: Electricity Generation by type and region

Unit: GWh

Province/ Source	Nuclear	Hydel	Thermal	Bagasse	Solar	Wind	Total
Punjab	9172	8025	41134	566	712	0	59609
Sindh	1918	0	33079	144	199	2900	38241
KP	0	19316	619	0	0	0	19935
Balochistan	0	0	14466	0	0	0	14466
AJK	0	11595	0	0	0	0	11595
Total	11090	38936	89299	711	911	2900	143847

Gross Value Added (GVA)

The Gross Value Added (GVA) of electricity generation for the year 2020-21 stood at Rs. 577,759 million. This shows 573% increase in fourteen years as Gross Value Added (GVA) for the year 2006-07 was recorded as Rs. 85,896 million. On the other hand, Gross Value Added (GVA) of 2020-21 amounting to Rs. 577,759 million has shown a decrease of 14.5% over the previous year 2019-20 which was Rs. 675,752 million. Similarly, subsidy paid by the government has shown 55% increase in 2020-21 over 2019-20.

Capacity Utilization Rate

Rate of utilization has been computed for the year 2020-21. According to the results, the average capacity utilization rate of Nuclear energy is very high with 72%, followed by Hydel (45%), thermal (38%), wind (27%), solar (19%) & Bagasse (15%).



Chapter 1

Concepts and Data Sources

This chapter sheds light on some basic definitions and concepts usually used in power sector at national and international level as per International Recommendations for Energy Statistics (IRES). The aim for including these concepts is for better understanding of the data users as well as for general public.

1.1 Definitions

- a) **Electricity:** The transfer of energy through the physical phenomena involving electric charges and their effects when at rest and in motion.
- b) **Fuel:** A fuel is defined as any substance burned as a source of heat or energy.
- c) **Electricity Establishment:** Any public or private entity which is engaged in generation, transmission and distribution of electricity.
- d) **Watt:** Watt is a unit of power. A watt is defined as the rate of doing one joule (J) of work in one second. Common units of power are multiple of the watt. These are as under:
 - One Watt (W) = 01 J/S
 - One Kilowatt (KW) = 10^3 J/S
 - One Megawatt (MW) = 10^6 J/S
 - One Giga watt (GW) = 10^9 J/S
- e) **Kilowatt Hours:** Kilowatt hour is a precise measure of energy and work. It is the work equivalent to 1000 watts (Joules per second) over one hour time.
 - Work = Power x Time
 - One Kilowatt hour (KWh) = 3.6×10^3 Joules
 - One Megawatt hour (MWh) = 3.6×10^6 Joules
 - One Giga watt hour (GWh) = 3.6×10^9 Joules



- f) **Installed Capacity:** The U.S. Energy Information Administration (EIA) refers to capacity as the maximum output of electricity that a generator can produce under ideal conditions. Capacity is generally measured in megawatts or kilowatts.
- g) **Generation:** Electricity generation refers to the amount of electricity that is produced over a specific period of time. This is usually measured in kilowatt-hours, megawatt-hours, or terawatt-hours (1 terawatt equals 1 million megawatts).
- h) **Gross Value Added in Electricity:** Gross value added (GVA) is an economic productivity metric that measures the contribution of a corporate subsidiary, company, or municipality to an economy, producer, sector, or region. GVA is the output of the country less the intermediate consumption, which is the difference between gross output and net output. GVA is important because it is used in the calculation of GDP, a key indicator of the state of a nation's total economy. It can also be used to see how much value is added (or lost) from a particular region, state, or province.
- i) **Rate of Utilization:** Rate of utilization is a measure for plant efficiency. It gives firsthand information regarding plant utilization. As electricity is generated from various sources, its rate of utilization also varies. Rate of utilization is obtained as actual production in a year by its capacity. NTDC and CPPA both use this indicator for merit list.
- j) **Alternative or renewable Energy:** Alternative or renewable energy means energy that is produced by alternative or renewable resources. Compared to the conventional these are replenished naturally and do not deplete when consumed and are non-polluting and environment friendly. It includes the following. a. Biomass (including but not limited to bagasse, agricultural waste, and other waste), b. Geothermal, Ocean /Tidal Wave energy, c. Solar (PV or Thermal, or any technology that uses heat and/or light of the sun to make electricity), d. Wind, e. Storage Technologies (Battery systems, Cells of all types, compressed gas, pumped storage), Biogas using any organic material (except fossil fuels), f. Energy from Waste (including but not limited to municipal solid waste, industrial waste, sewage, Refuse Derived Fuel), g. Hydrogen or Synthetic Gas etc.
- k) **Annual Average Growth Rate:** An indicator which measures the growth trend of a particular variable in the long run. It is calculated by the average of annual growth rates of a variable/series.



1.2 Data Sources

Data for this report was either collected directly from electricity establishment units or from Central Power Purchasing Agency (CPPA) datasheets. A frame of electricity generating establishments was developed by obtaining lists of electricity establishments from Private Power & Infrastructure Board (PPIB), National Electric Power Regulatory Authority (NEPRA) and Alternate Energy Development Board (AEDB). Over the course of time, the numbers of establishments have increased which are updated in the database. After establishment of Central Power Purchasing Agency (CPPA), PBS frame is updated by using the list of companies available on its website.

The electricity sector of Pakistan is managed by both private and public sectors. Electricity is generated from various sources in the country. Pakistan Bureau of Statistics has been collecting electricity generation data on monthly basis from focal agencies and from establishments engaged in generation of electricity such as Nuclear, Hydel, Thermal and Alternate

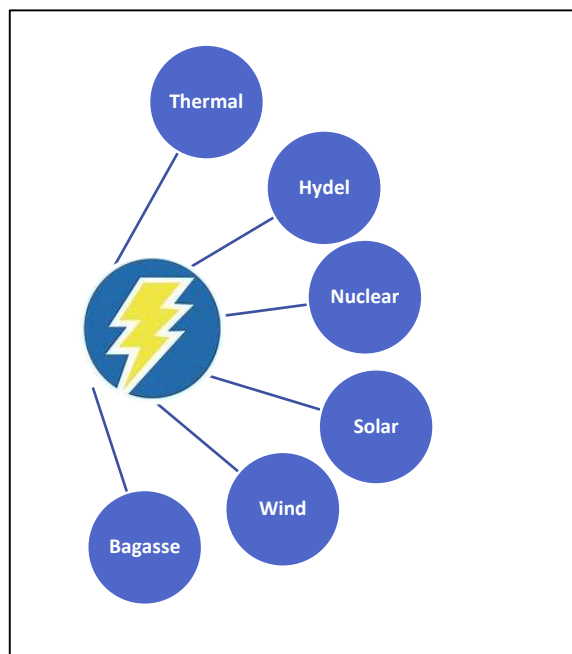


Figure 1.1: Source of Electricity in Pakistan

Energy Sources (Wind, Solar etc.) The sources of electricity in Pakistan are given in the figure 1.1.

1.3 Scope & Coverage

This report is based on annual data relating to all establishments engaged in generation of electricity through Hydel, Thermal, Nuclear and Alternate Energy Sources both in Public and Private sector in all Provinces of Pakistan including AJK for the years 2006-07 to 2020-21.



Chapter 2

Introduction

2.1 Historical Background

Electricity is considered to be lifeline of an economy as it is pivotal for the socio-economic development of a country. It is the engine and building block of economic growth in the country. It runs in each and every nook and corner of the country like blood in human body. Its transmission lines resemble the blood arteries in human body; its full time availability can boost the economic uplift of all Sectors. Regular supply of electricity is the prerequisite for industry to grow thereby enhancing indigenous production, consumption and exports. Due to its significance, clean and green energy/electricity has secured place in Sustainable Development Goals (SDGs).

After creation of Pakistan, the country has small power generation capacity. Rapid growth in industrialization during sixties coupled with government initiatives to enhance its generation capacity, huge water reservoirs had been constructed and the sector saw considerable growth. However, the growth was not sustainable. Over the period of time, Population and Industrialization growth along with failure for inclusion of new establishments in power sector led to power outage due to growing demand. This situation opens ground for private sector which was invited by the government to invest. Subsequently, HUBCO got first generation license in private sector. Thereafter, a large number of private power producers established new plants and contributed power generation to national grid.

At the time of independence, Pakistan's congenital power generation capacity was 69 MW only. Twelve years later, WAPDA was established in 1959. After one year in 1960 the installed capacity increased from 119 MW to 366 MW. Total generation was recorded as 781 GWh in 1960. Up till 1970, the power generation capacity rose from 636 MW to 1331 MW with installation of a number of Thermal and Hydel power units, in addition to the construction of Mangla Dam. During eighties, the system capacity rose to about 3,000 MW, owing to the construction of Tarbela Dam during 1976 and contribution in electricity generation by Pakistan Atomic Energy Commission (PAEC) as the first nuclear power reactor started working in 1972. By the end of 1990-91, Pakistan was able to produce about 7,000 MW of electricity. In



1997, National Electric Power Regulatory Authority (NEPRA) was created to introduce clear and prudent electricity regulation. Thus first independent power producer, i.e. Hub Power Station (HUBCO) was setup and since 1997 it added 2581 MW to total Thermal power generation capacity. To better manage power sector of Pakistan, another major development was made by establishing National Transmission and Dispatch Company (NTDC) in 1998. From 1990-91 to 2004-05, Pakistan's total installed power generation capacity increased to nearly threefold, from 7000 MW to 17500 MW with 64% share of thermal power units while share of hydro power was (33%) and Pakistan's nuclear power plants comprised a share of 3%. In 2007 installed capacity had reached 19,670 MW which now rose to 40,606 MW in 2020-21.

Box 1: Regional Comparison of Electricity Capacity

On the globe, Pakistan is situated in the Southern region of Asia. Other countries in the region are Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, and Sri Lanka. India is the largest country in the region that has electricity installed capacity of 459,200 MW during the year 2020-21 and Bangladesh has 21,395 MW during 2020-21. Sri Lanka, Afghanistan, Bhutan and Nepal stood at 4,263 MW, 641 MW, 2342MW and 1417MW in 2020 respectively. ¹Hence Pakistan has the 2nd largest installed electricity capacity of 40606 MW among the South Asian region.

Source:

i. India Economic Survey ii. Bangladesh Economic Survey iii. Central Bank of Sri Lanka

¹ https://www.irena.org/IRENADocuments/Statistical_Profiles/Asia/

2.2 Pakistan's Energy Mix

At the time of independence, Pakistan's energy mix primarily relied upon thermal electricity of around 58 MW whereas share of hydel was 11 MW. With the passage of time the share of thermal electricity increased due to ever increasing demand of electricity. By the end of seventies, the share of thermal was 61.33% whereas the share of hydel was 38.67%. In early eighties Nuclear Power Plant was installed and by 2008 the share of Thermal, Hydel and Nuclear in overall generation was 65%, 33% and 2% respectively. At present, the share of Thermal is 65.5%, Hydel 24.4% and Nuclear 4.4%. The alternate power plants contributes 5.7% in the overall energy mix including Wind (3.0%), Bagasse (1.3%) and Solar (1.4%).

2.3 Objectives

The main objective of this report is to present and analyze trend of variables related to electricity generation both at public and private sector electricity establishments. Key indicators covered in this



report are as under:

- (i) Installed Capacity by source and province
- (ii) Electricity generated by type and region
- (iii) Gross Value Added (GVA) of electricity generation
- (iv) Average capacity utilization rate

Chapter 3 of the report explains the structure of power sector of the country along with details of main actors in this field. Chapter 4 pertains to data on different variables and their trends as per objective of the report. Chapter 5 comprises of tables of all indicators of the report.

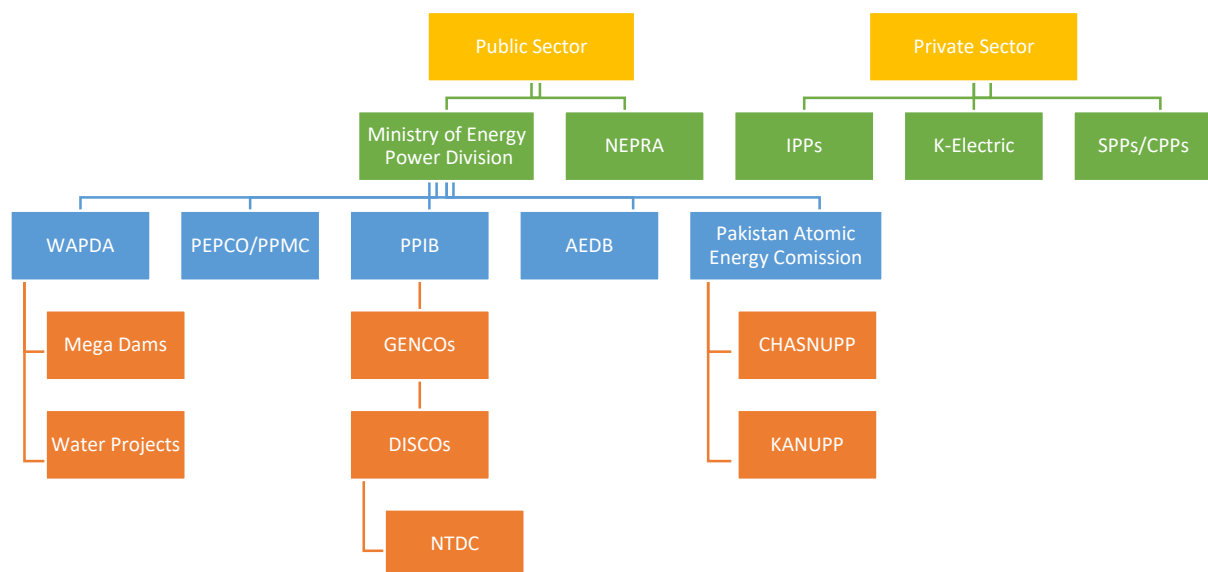


Chapter 3

Structure of Power Sector

Power Sector of Pakistan is the blend of public and private stakeholders. Power sector in the recent years proved to be Achilles heel. So many huge players in the area further intricate decision making and smooth functioning of the sector. Most important stakeholders of the sector are shown in Figure 3.1.

Figure 3.1: Stakeholders of Power Sector



The main public-sector actors in Pakistan’s electricity market are Ministry of Energy, WAPDA, NEPRA, and Pakistan Atomic Energy Commission the operator of the two nuclear power plants KANUPP (Karachi Nuclear Power Plant) and CHASNUPP (Chashma Nuclear Power Plant). Besides these, a number of



private Independent Power Producers (IPPs) have been established in the power generating sector since 1994.

The Ministry of Energy, Power Division is the federal level ministry created on 4th August 2017 after merging of the Ministry of Petroleum and Natural Resources with the Power Division of the Ministry of Water and Power (renamed as Ministry of Water Resources). The ministry has two divisions - petroleum and power. The Petroleum Division is headed by the Secretary Petroleum and the Power Division is headed by the Secretary Power. The main ministry/Division which deals with electricity is Power Division, Ministry of Energy.

The main stakeholder in public sector is WAPDA. After unbundling of Pakistan Water and Power Development Authority (WAPDA) in the year 2007, WAPDA's mandate is redefined as development of water and hydropower resources in an efficient manner. In line with its mandate, WAPDA is working hard to harness water and hydropower resources in the country. The utility part of WAPDA has been corporatized into independent companies as a result of restructuring of power wing in recent years. The shift from convergence to divergence has given birth to 13 entities to operate in different zones. These are National Transmissions and Dispatch Company (NTDC), four thermal power generation companies (GENCOs) and eight distribution companies (DISCOs).

National Electric Power Regulatory Authority (NEPRA), the regulator, proposes the price of the electricity for each distribution company i.e. a DISCO to the government after taking into account all major factors like the consumer mix, transmission losses, and operational cost as per tariff standards and procedure rules in vogue. However, the government finally decides the tariff of electricity, management, operation and maintenance to provide electricity to the consumers.

Alternative Energy Development Board (AEDB) is the sole representing agency of the Federal Government with the main objective to facilitate, promote and encourage development of Renewable Energy in Pakistan. In this context AEDB has recently launched Alternative and Renewable Energy Policy 2019.

CHASNUPP (Chashma Nuclear Power Plant) is the largest commercial nuclear power plant located in the vicinities of Chashma colony and Kundian in Punjab, Pakistan. The Nuclear Power plant is generating energy for industrial usage with four nuclear reactors with one being in planning phase in corporation with the China. CHASNUPP is supported by the International Atomic Energy Agency and Department of Energy of the United States.

KANUPP (Karachi Nuclear Power Plant), the power generation site is composed of three commercial nuclear power plants; K-1, K-2 and K-3. K-1 was operationalized in 1972 whereas K-2 was



operationalized on May 21, 2021 with a capacity of 1100 mega Watts. Work is underway for commissioning of K-3 unit with similar capacity and is expected to start operation in 2022. K-1 was commissioned with support from Canada whereas K-2 and K-3 have been supported by financing and investment provided by China and International Atomic Energy Agency (IAEA). The Nuclear Power Plant has a distinction of being first commercial nuclear plant in the Muslim world.

Besides these public offices, a large number of private power producers are also generating electricity and dispatching to national grid. IPPs (Independent Power Producers) are around 42 that contribute significantly in electricity generation of the country. In Pakistan, 41 thermal Independent Power Producers with a total installed capacity of 17642 MW and 8 hydro IPPs with a total installed capacity of 472 MW are operational.

K Electric (Karachi Electric Supply Company) is the only vertically integrated power utility in Pakistan that generates, transmits and distributes electricity to industrial, commercial, agricultural and residential consumers of Karachi (and its outskirts), a metropolis of 20 million people - Pakistan's largest city. KE was incorporated on September 1913 and privatized in 2005. KE secured a level 'A' rating from the Global Reporting Initiative (GRI) for its Integrated Sustainability Report for the year 2012. This makes K-Electric the first power utility in Pakistan to achieve the level 'A' rating for an integrated report.

In addition to these organizations, numbers of other players are also involved. Many enterprises, micro finance organizations and NGOs are actively participated in green and clean electricity generation by provision of Solar PVs at residential and commercial level. Net metering policy of the government also paves the way for harnessing the solar and wind potential in Pakistan. It will also ease the demand pressure of electricity.



Chapter 4

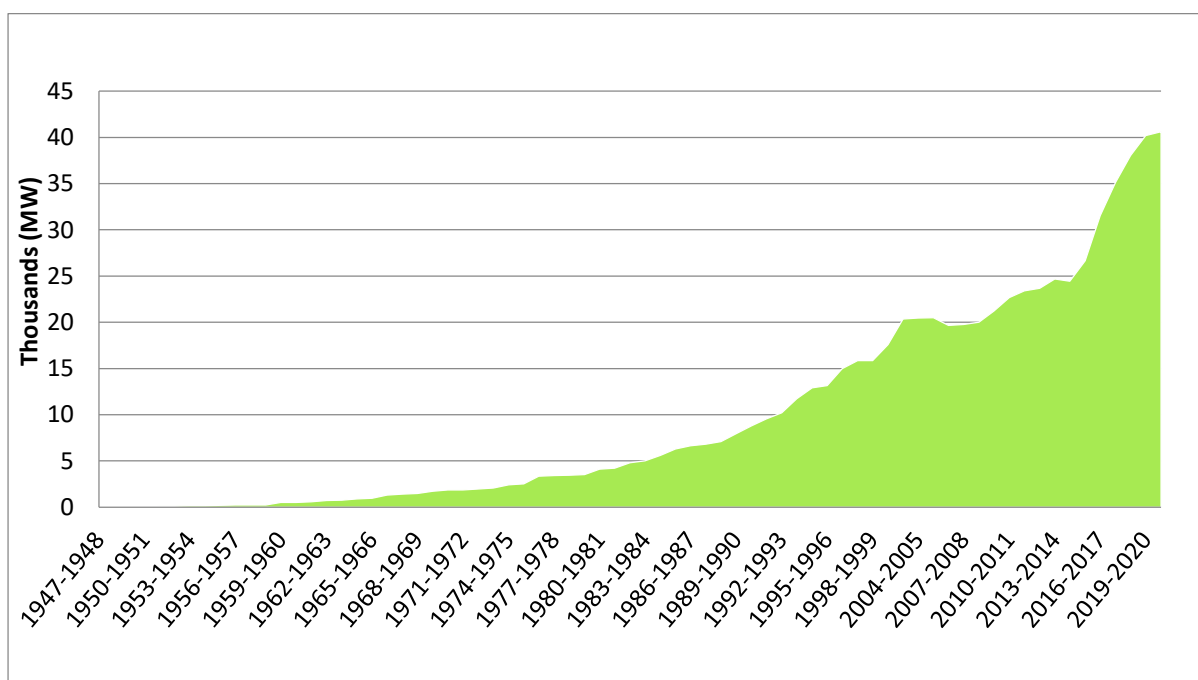
Main Indicators

4.1 Installed Capacity

Electricity sector in Pakistan is a continuously evolving due to ever increasing population and economic growth. Pakistan has not yet fully tapped the potential available in this sector due to resources and skill constraints. The Government has taken number of steps to bridge the gap between supply and demand of electricity, declaring the current decade as decade of dams, installation of solar parks etc. Various sources of electricity in Pakistan are Fossil fuels, Hydro, Nuclear and Alternate Energy Resources including Solar, Biomass and Wind etc.

Figure 4.1 shows the electricity installed capacity in Pakistan over the period of 1947-48 to 2020-21. Detailed data on installed capacity can be seen in Chapter 5, Table1.

Figure 4.1: Chronologically Installed capacity of Electricity in Pakistan (000 MW)

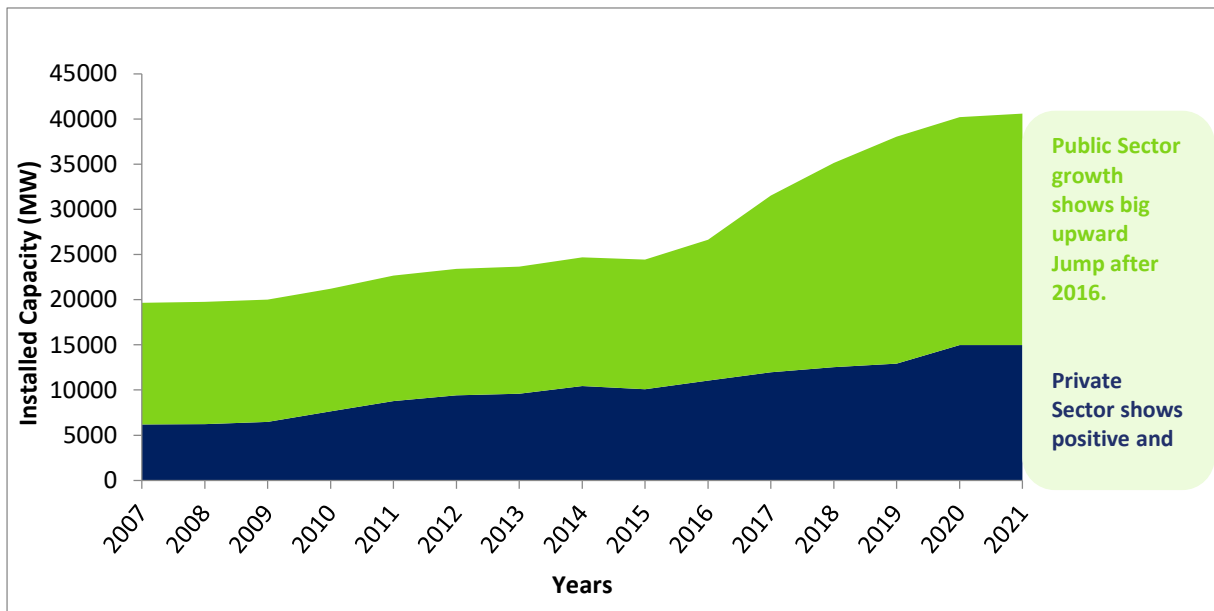




As of June 30th, 2021, the total installed capacity of all the electricity generating establishments (Thermal, Nuclear, Hydel and Alternate Sources) stood at 40,606 MW. This indicates a slight increase of 0.98% over the installed capacity of 40,211 MW during the previous year. However, major increase in the installed capacity can be observed during 2016 and 2017. Since the creation of Pakistan, installed capacity has increased with an average annual growth rate (AAGR) of slightly above 10%.

Figure 4.2 shows a positive trend over time regarding Installed capacity. It also indicates that from 2016, the market shows exponential growth which reached 40606 MW in 2021. Pakistan's electricity generating capacity almost doubled during the last decade. From 2007 to 2021, the installed capacity increased with an average annual growth of about 5%. However during the last six years, a visible increase of 9% can be observed in the average annual growth.

Figure 4.2: Public and Private Installed Capacity of Electricity



Installed capacity of electricity along with percentage changes from 2006-07 to 2020-21 are given in Table 4.1 with Public and Private breakup. Figure 4.2 clearly depicts that there is a big jump and increase in electricity generating capacity after 2016 in respect of Public Sector. The Private sector shows 6.7% AAGR from 2006-07 to 2020-21 whereas Public sector portrays only 4.9% during the same period of time.

Table 4.1: Installed Capacity from 2006-07 to 2020-21 (MW)

Year (On 30th June)	Private Sector	% Change	Public Sector	%Change	Total Installed Capacity	% Change
2007	6191		13479		19670	---
2008	6214	0.37	13560	0.6	19774	0.53
2009	6460	3.96	13560	0	20020	1.24
2010	7645	18.34	13578	0.13	21223	6.01
2011	8771	14.73	13903	2.39	22674	6.84
2012	9426	7.47	13975	0.52	23401	3.21
2013	9602	1.87	14071	0.67	23673	1.16
2014	10456	8.89	14231	1.14	24687	4.28
2015	10087	-3.53	14361	0.91	24448	-0.97
2016	11048	9.53	15603	8.65	26651	9.01
2017	11964	8.29	19573	25.44	31537	18.33
2018	12525	4.69	22613	15.53	35138	11.42
2019	12936	3.28	25119	11.08	38055	8.30
2020	14974	15.75	25237	0.47	40211	5.67
2021	14992	0.12	25614	1.49	40606	0.98

Figure 4.3 shows comparison of total electricity capacity during the year 2006-07 and 2020-21. The overall increase in generating capacity during the period is more than 106% i.e more than double. Further, the Public sector share was 69% in 2007 which has been reduced to 63% in 2021. Similarly, share of Private Sector in total electricity capacity increased from 31% to 37% during the same period of time. It shows that private players in the sector are increasing gradually over the time.

Figure 4.3: Electricity Capacity Public vs Private

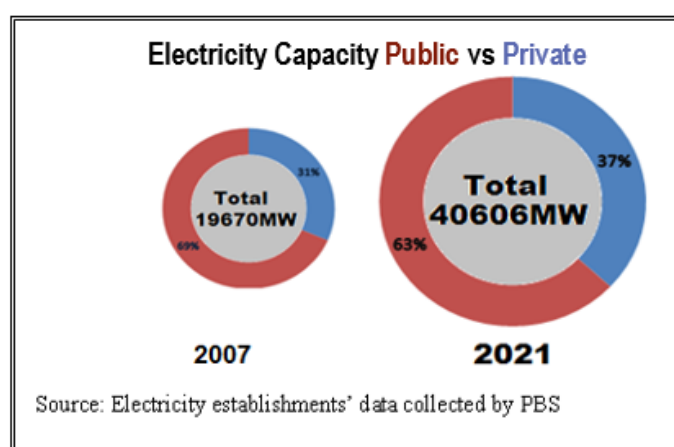
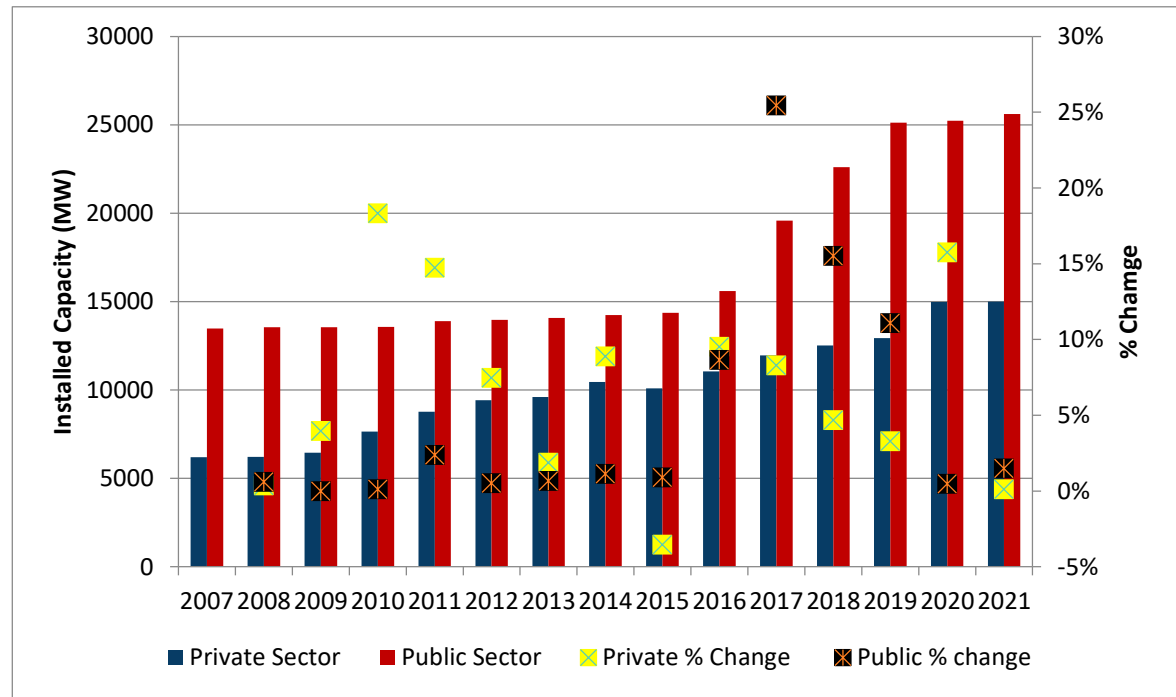




Figure 4.4 shows the electricity installed capacity by the ownership i.e Public owned and Private owned establishments. It is evident that Public sector is dominated in the market whereas Private sector has also increased its share gradually over time. Till 2015 the annual increase in electricity capacity by the Public sector is almost negligible. However significant increase (25%) is observed during 2017. The Private sector has shown maximum increase in 2010, 2011 and 2020.

Figure 4.4: Electricity Installed Capacity by ownership and % change over previous year



4.1.1 Installed Capacity by type of Source

Various types of sources such as Thermal (based on Coal, Natural Gas, Oil), Nuclear, Hydropower, Wind, Bagasse and Solar operate for generation of electricity and their installed capacity is presented in Table 4.2. The share of installed capacity of Hydel contracted from 33% to 24% from 2007 to 2021 but in absolute terms its installed capacity increased from 6474 MW in 2007 to 9912 MW in 2021. All other sources also expanded their share from 2007 to 2021 i.e. Nuclear 2.16% to 4.36%, Thermal 64.9% to 65.5%, Bagasse 0 to 1.3% Solar 0 to 1.37% and Wind 0 to 3.06%. However Thermal is still leading source of energy in Pakistan. The share of Thermal reached at maximum during 2018 (69.70% of the total capacity). Figure 4.5 below summarizes the share of different sources in overall installed capacity of the country.

Figure 4.6: Installed Capacity by type of Sources 2020-21 vs 2006-07

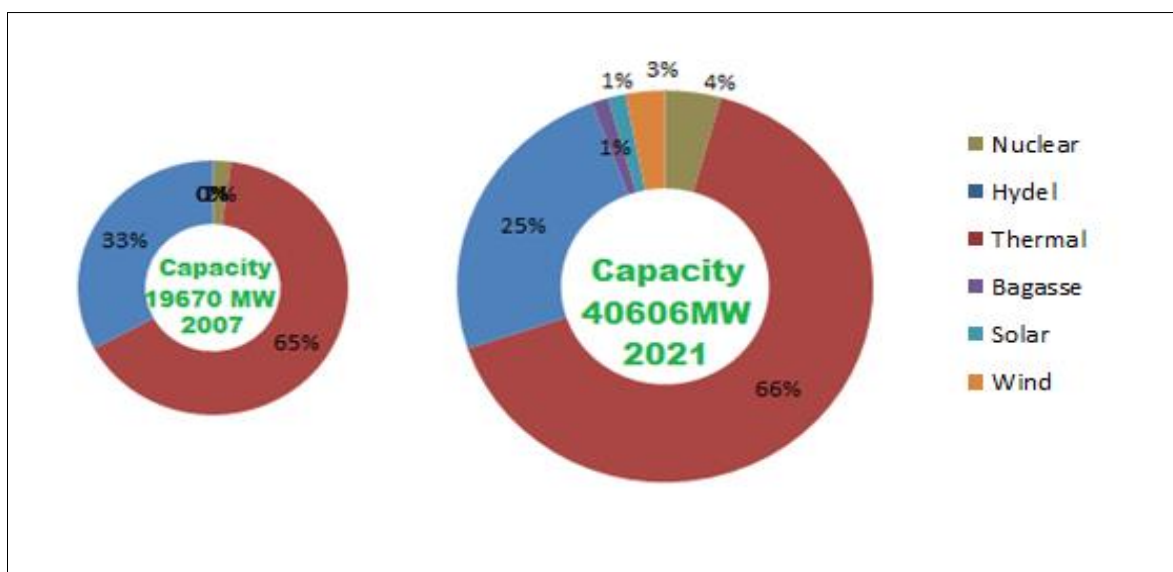


Table 4.2: Installed Capacity by type of Source from 2006-07 to 2020-21 (MW)

Year	Nuclear	% share	Hydel	% share	Thermal	% share	Bagasse	% share	Solar	% share	Wind	% share	Total
2007	425	2.16	6474	32.91	12771	64.9	0	0	0	0	0	0	19670
2008	425	2.15	6555	33.15	12794	64.7	0	0	0	0	0	0	19774
2009	425	2.12	6555	32.74	13040	65.1	0	0	0	0	0	0	20020
2010	425	2.00	6573	30.97	14217	67.0	8	0.04	0	0	0	0	21223
2011	750	3.31	6573	28.99	15343	67.7	8	0.04	0	0	0	0	22674
2012	750	3.20	6645	28.40	15942	68.1	8	0.03	0	0	56	0.24	23401
2013	750	3.17	6825	28.83	15920	67.2	72	0.30	0	0	106	0.45	23673
2014	750	3.04	6985	28.29	16713	67.7	133	0.54	0	0	106	0.43	24687
2015	750	3.07	7115	29.10	16170	66.1	157	0.64	0	0	256	1.05	24448
2016	750	2.81	7115	26.70	17827	66.9	219	0.82	400	1.50	340	1.28	26651
2017	1090	3.46	7115	22.56	21684	68.76	456	1.45	400	1.27	792	2.51	31537
2018	1430	4.07	7270	20.69	24491	69.70	469	1.33	436	1.24	1042	2.97	35138
2019	1430	3.76	9757	25.64	24594	64.63	527	1.38	505	1.33	1242	3.26	38055
2020	1430	3.56	9858	24.52	26599	66.15	527	1.31	555	1.38	1242	3.09	40211
2021	1770	4.36	9912	24.41	26600	65.51	527	1.30	555	1.37	1242	3.06	40606



Figure 4.6: Installed Capacity by type of Sources from 2006-07 to 2020-21

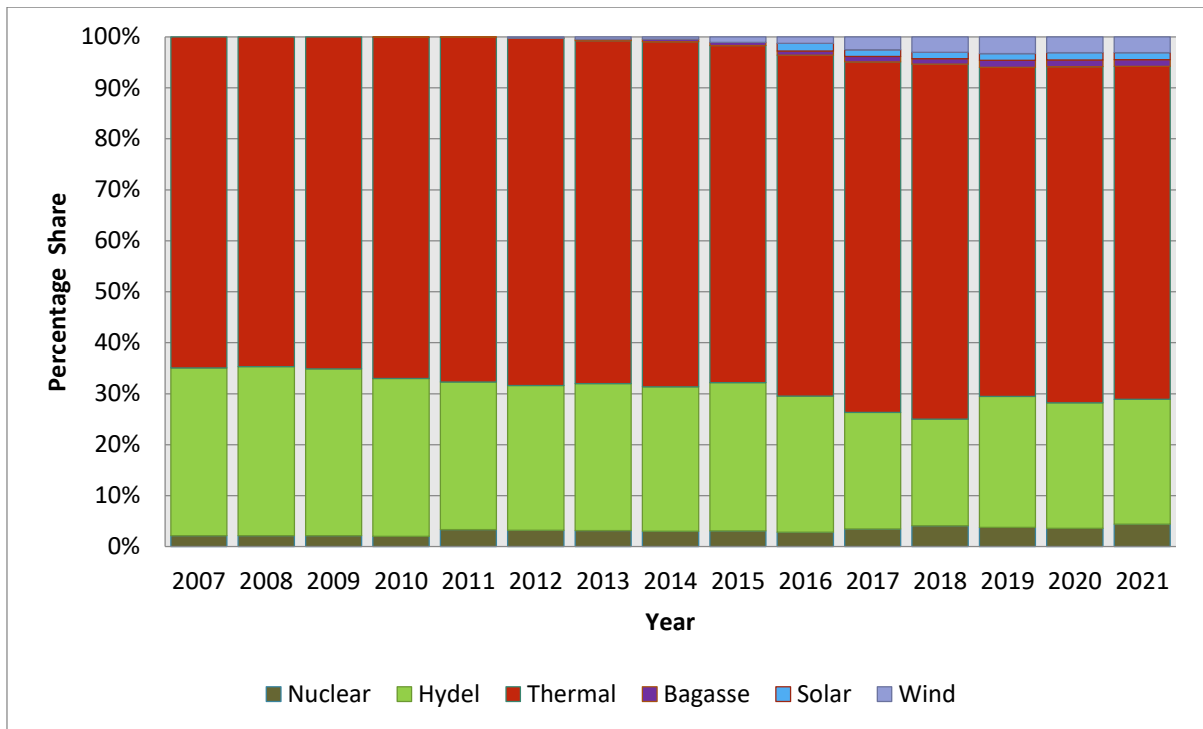
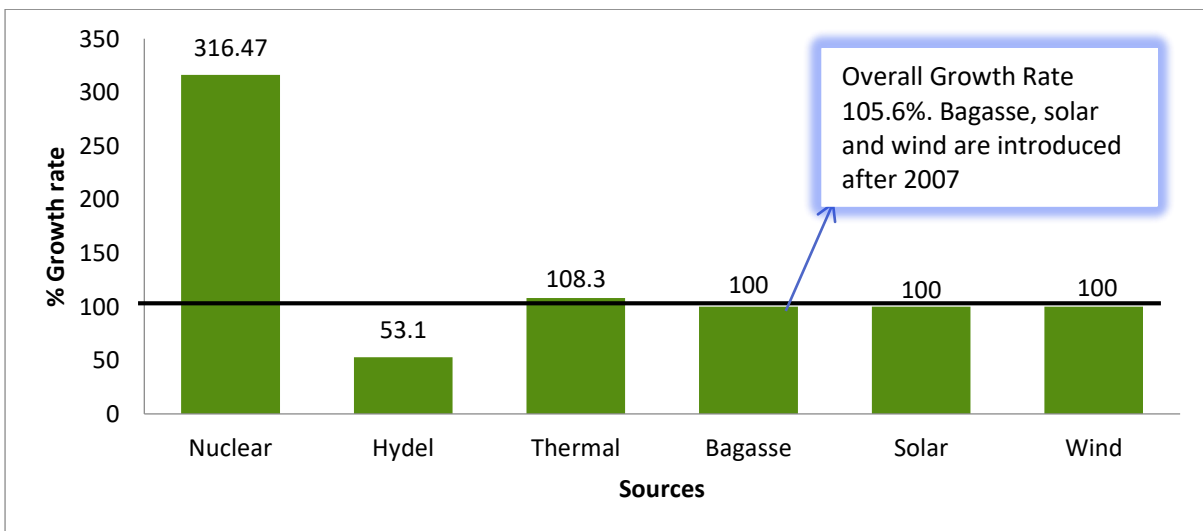


Figure 4.6 shows percentage share by type of source to the total installed capacity during the particular year. It also reveals that alternate energy resources sector has expanded after 2010.

Figure 4.7: Growth rate of Installed Capacity by type of Source (2020-21 vs 2006-07)



Above Figure 4.7 shows source wise growth rate of installed capacity for the year 2021 against 2007. During the period Nuclear plant based capacity of electricity increased by 316%. Thermal growth rate is 107% whereas growth rate of Hydel based electricity capacity increased by 53%. Shifting of capacity to other sources such as Bagasse, Wind and Solar based plants in the system is also evident. The overall growth rate by all type of plant is 105.6% during 2021 over 2007.

Table 4.3: Installed Capacity by Province and Type of Source for the year 2006-07 and 2020-21 (MW)

Plant/State	Year	Punjab	Sindh	KP	Balochistan	AJK	Total
Nuclear	2007	325	100	0	0	0	425
	2021	1330	440	0	0	0	1770
	% Growth	309.23	340	0	0	0	316.47
Hydel	2007	1698	0	3746	0	1030	6474
	2021	1802	0	5779	0	2331	9912
	% Growth	6.12	0	54.27	0	126.31	53.1
Thermal	2007	5468	5216	24	2063	0	12771
	2021	13316	9390	172	3722	0	26600
	% Growth	143.53	80.02	616.67	80.42	0	108.28
Bagasse	2007	0	0	0	0	0	0
	2021	373	154	0	0	0	527
	% Growth	100	100	0	0	0	100
Wind	2007	0	0	0	0	0	0
	2021	0	1242	0	0	0	1242
	% Growth	0	100	0	0	0	100
Solar	2007	0	0	0	0	0	0
	2021	436	119	0	0	0	555
	% Growth	100	100	0	0	0	100
Overall	2007	7491	5316	3770	2063	1030	19670
	2021	17257	11345	5951	3722	2331	40606
	% Growth	130.37	113.41	57.85	80.42	126.31	106.43

4.1.2 Installed Capacity by Province and Type of Source for the Year 2007 and 2021

Installed capacity by province and type of source for the years 2007 and 2021 has been discussed in the section. During 2021 Punjab stood first with installed capacity of 17,247 MW, Sindh placed at second highest installed capacity of 11,127 MW, KP, Baluchistan and AJK with installed capacities of 5,951 MW, 3,722 MW and 2,331 MW respectively. Details of installed capacity along with growth for the year 2021 over 2007 is given in Table 4.3.

Figure 4.8: Installed Capacity by Province (2020-21 and 2006-07)

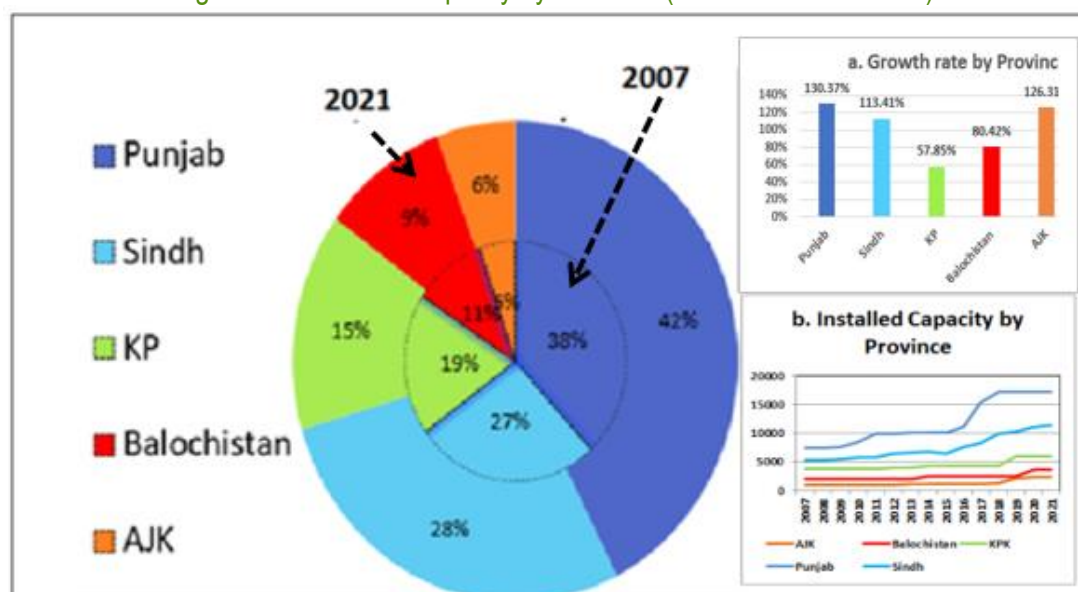




Figure 4.8 shows comparison of installed capacity by province for the year 2007 and 2021. The internal pie represents data for the year 2007 whereas outer pie depicts data for the year 2021. Figure 4.8 reveals that Punjab, AJK and Sindh increased their share of installed capacity whereas KP and Balochistan contracted their share in total installed capacity from 2007 to 2021. In absolute terms, installed capacity of all provinces enhanced from 2007 to 2021. Figure 4.8 (a) shows a growth of above 100% in Punjab, AJK and Sindh whereas other provinces also show positive growth during the period under reference. Figure 4.8 (b) shows Province wise trends of installed capacity from 2007 to 2021. Punjab and Sindh show increasing trend after 2015-2016 whereas trends in KP, Balochistan and AJK show a jump after 2018-2019. The AAGRs for Sindh, Punjab, KP, Balochistan and AJK are 6%, 7%, 4%, 5% and 7% respectively. Province wise electricity capacity by type of source by province is given in Figure 4.9.

Figure 4.9: Installed Capacity by type of Source and Province

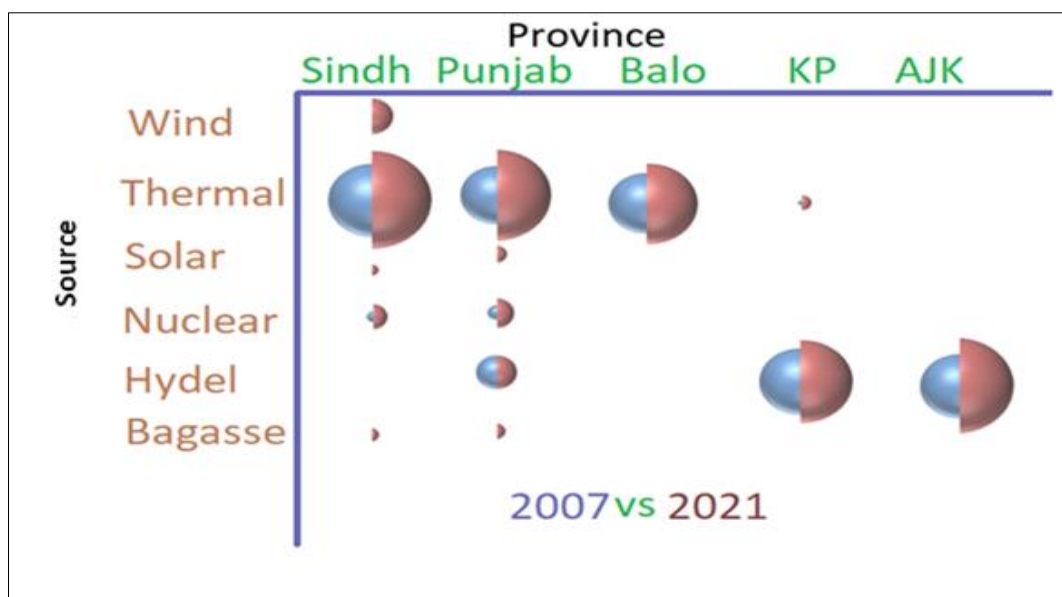


Figure 4.9 shows comparison of Province wise installed capacity (MW) by type of source. Each bubble size shows volume of installed capacity by type of plant in respective year. The blue bubble represents year 2007 and red bubble represents year 2021. The absence of bubble means that the province does not have installed capacity of this particular source. Hydel power plants do not exist in Sindh and Balochistan. Provinces tapped electricity by other kind of plants. Wind, Solar and Bagasse plants were not installed in 2007 but in 2021, these sources contributed a handsome amount of electricity in the system. Punjab province mainly relies on Thermal, Nuclear and Hydel electricity. Wind energy has still not been installed in the province despite a huge wind corridor available in northern Punjab. In Balochistan electricity generation is solely based on Thermal whereas AJK is based on Hydel only. Khyber Pakhtunkhwa has only two type of sources thermal and hydel. Thermal portion is very small whereas hydel has a large contribution.



4.1.3 Renewable installed capacity in the country

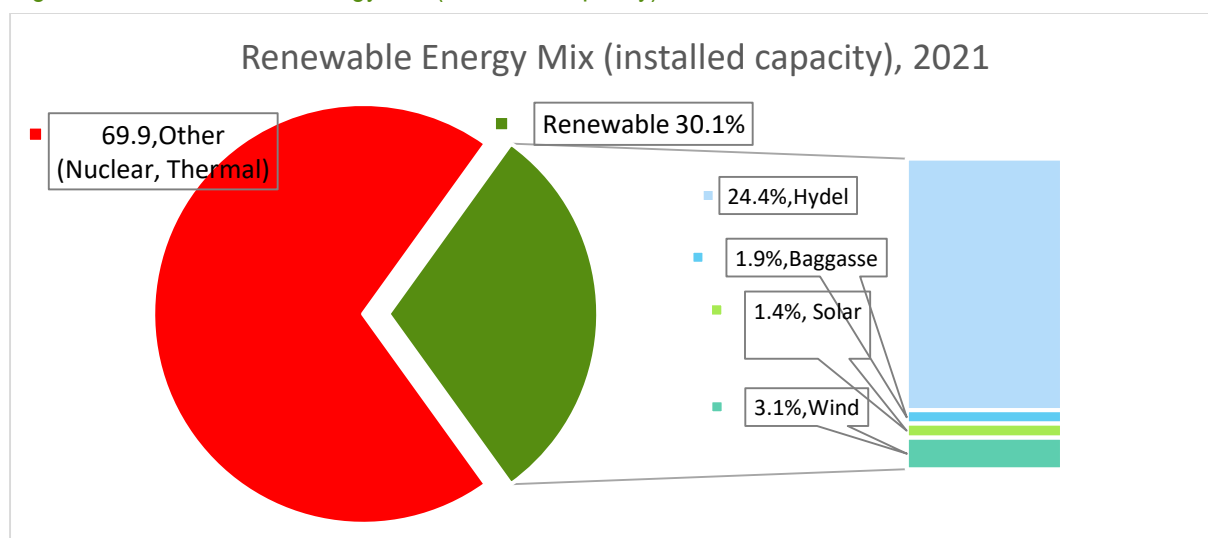
The country broadly relied on thermal generation of electricity as evident from Figure 4.9. Due to environmental concerns, world discourages production from these sources which pave the way for green energy. With the adoption of Sustainable Development Goals (SDGs) in 2015, the focus was shifted to affordable and clean energy under goal 7. Various targets were substantially set to increase share of renewable energy in the global energy mix. The targets can be achieved through enhancing electricity generation capacity through alternate and renewable energy sources. Pakistan has also adopted new Alternate and Renewable Energy (ARE) policy 2019 with the aim to create a conducive environment for the sustainable growth of ARE Sector in Pakistan. This section highlights the Renewable energy installed capacity of the country. Renewable energy sources comprise of Hydel, Wind, Solar, Bagasse, Geothermal, Tidal Wave etc. In subsequent paragraphs renewable sources installed in the country will be discussed along with their trends.

Pakistan is mainly using Hydel, Wind, Solar and Bagasse as renewable sources, Plans are also under way to tap other potential areas as Pakistan has abundant resources for green energy. Table 4.4 below differentiates renewable and other (Thermal and Nuclear) energy mix installed capacity in the country.

Table 4.4: Installed Capacity of Renewable, Nuclear and Thermal Power Plants (MW)

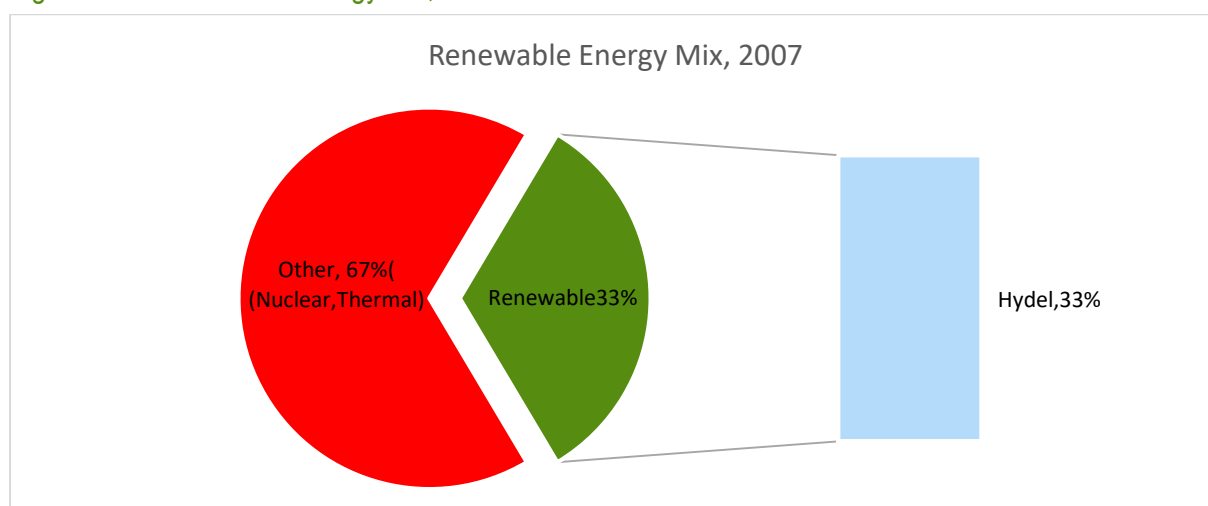
Year	Nuclear	Thermal	Renewable	Total	% Change
2006-07	425	12771	6474	19670	---
2007-08	425	12794	6555	19774	0.53
2008-09	425	13040	6555	20020	1.24
2009-10	425	14217	6581	21223	6.01
2010-11	750	15343	6581	22674	6.84
2011-12	750	15942	6709	23401	3.21
2012-13	750	15920	7003	23673	1.16
2013-14	750	16713	7224	24687	4.28
2014-15	750	16170	7528	24448	-0.97
2015-16	750	17827	8074	26651	9.01
2016-17	1090	21684	8763	31537	18.33
2017-18	1430	24491	9217	35138	11.42
2018-19	1430	24594	12031	38055	8.3
2019-20	1430	26599	12182	40211	5.67
2020-21	1770	26600	12236	40606	0.98

Figure 4.10: Renewable Energy Mix (Installed Capacity), 2021



The Figure 4.10 shows renewable energy mix in the total installed capacity during the year 2021. The bar of Pie shows that the share of renewable energy in the overall installed capacity is 30.1%. The bar further explains that out of 30.1% hydel is 24.4%, Wind comprises 3,1%, Solar 1.4% and Baggasse 1.3%. Figure 4.11 below shows share of renewable energy in overall energy mix during 2007. It is evident that during 2007 only hydel power plants contributed 33% and all other sources were not explored at that time.

Figure 4.11: Renewable Energy Mix, 2007



4.2. Electricity Generation

Pakistan Bureau of Statistics has been collecting data on electricity generation on monthly basis from source agencies as well as from establishments engaged in generation of electricity through Nuclear, Hydel, Thermal and Alternate Energy Sources such as Wind, Solar etc. A summary of electricity generation data for fiscal years 2006-07 to 2020-21 is given in Table 4.5. The data on electricity



generation has been collected from public undertakings (WAPDA, KANUPP, CHASNUPP) and private undertakings including KAPCO & HUBCO etc.

Table 4.5: Electricity Generation from 2006-07 to 2020-21 (GWh)

Year	Private	% Change	Public	% Change	Total	% Change
2006-07	43565		56331		99896	
2007-08	45234	3.8	52916	-6.1	98150	-1.7
2008-09	45130	-0.2	50036	-5.4	95166	-3.04
2009-10	48792	8.1	51578	3.1	100370	5.5
2010-11	51605	5.8	50168	-2.7	101773	1.4
2011-12	51447	-0.3	48043	-4.2	99490	-2.2
2012-13	51063	-0.7	49333	2.9	100396	0.9
2013-14	56059	9.8	51652	4.7	107711	7.3
2014-15	58587	4.5	51108	-1.1	109695	1.8
2015-16	60900	3.9	54192	6.03	115092	4.9
2016-17	62817	3.1	60374	11.4	123191	7.04
2017-18	61571	-1.9	73813	22.3	135384	9.9
2018-19	47483	-22.9	88360	19.7	135843	0.3
2019-20	45098	-5.02	89358	1.1	134456	-1.02
2020-21	50952	12.9	92894	3.96	143847	6.98

The Figure 4.12 shows a positive trend of electricity generation from 2006-07 to 2020-21. The overall increase is 44% from 99895 GWh in 2006-07 to 143704 GWh in 2020-21. The Annual Average Growth Rate (AAGR) is about 2.7% during the period 2006-07-2020-21. The maximum increase of 10% is observed in 2017-18 over 2016-17. The electricity generation for the year 2020-21 has shown an increase of 6.9 % over the previous year.



Figure 4.12: Electricity Generation (GWh) from 2006-07 to 2020-21

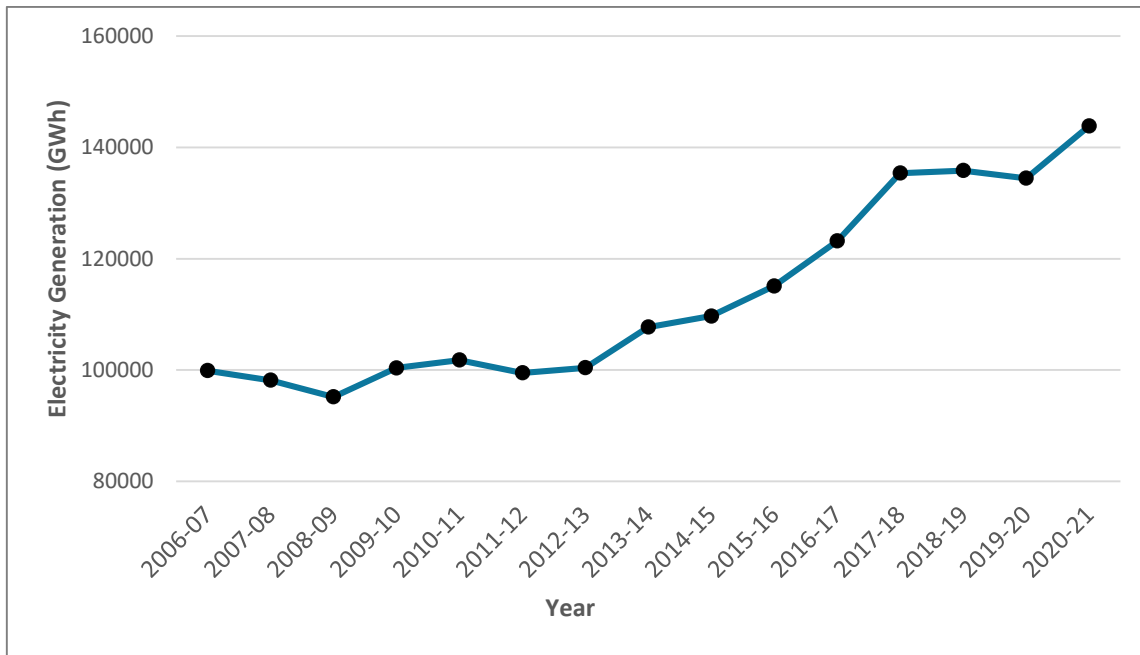


Figure 4.13 shows the overall electricity generation in the country by the type of ownership. The share in generation by the Public sector was 56% in 2006-07 which has increased to 65% in 2020-21. Similarly, the share of Private sector decreased from 44% in 2006-07 to 35% in 2020-21. The data shows that from 2009-10 to 2015-16 the market share by both the sector was around 50%. Thereafter share of Public sector becomes dominated over Private sector.

Figure 4.13: Electricity Generation by ownership (Public and Private) from 2006-07 to 2020-21

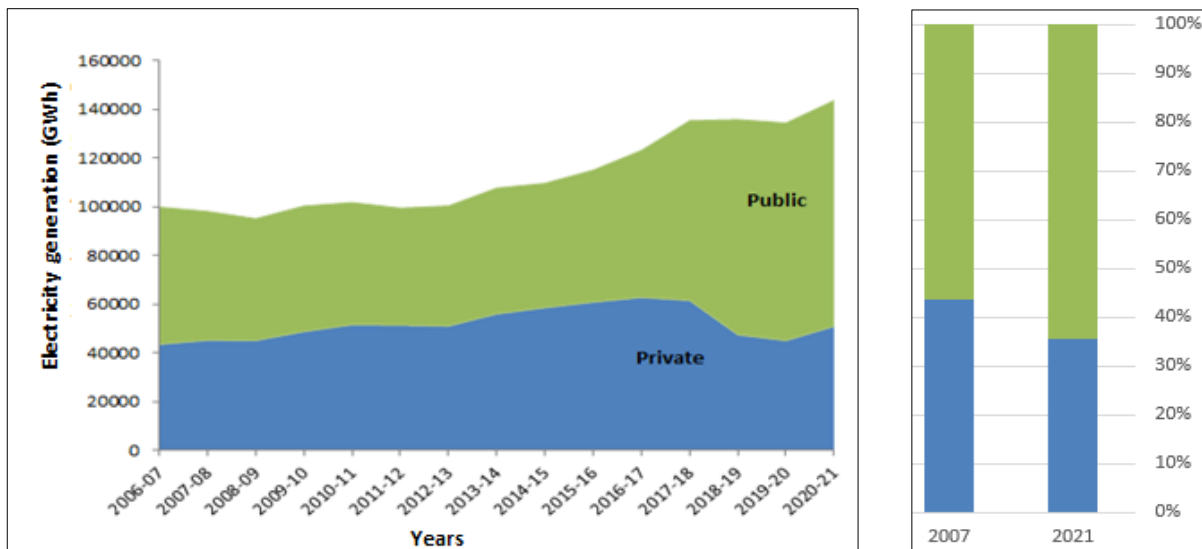


Figure 4.14 represents the trend of electricity generation by the Public and Private sector in the country. Prior to 2010-11, Public Sector power plants were generating more electricity than private sector.



Thereafter private sector produced more electricity but after 2016-17 public sector rebound and reached its maximum of 92894 GWh of electricity generation.

Figure 4.14: Electricity Generation

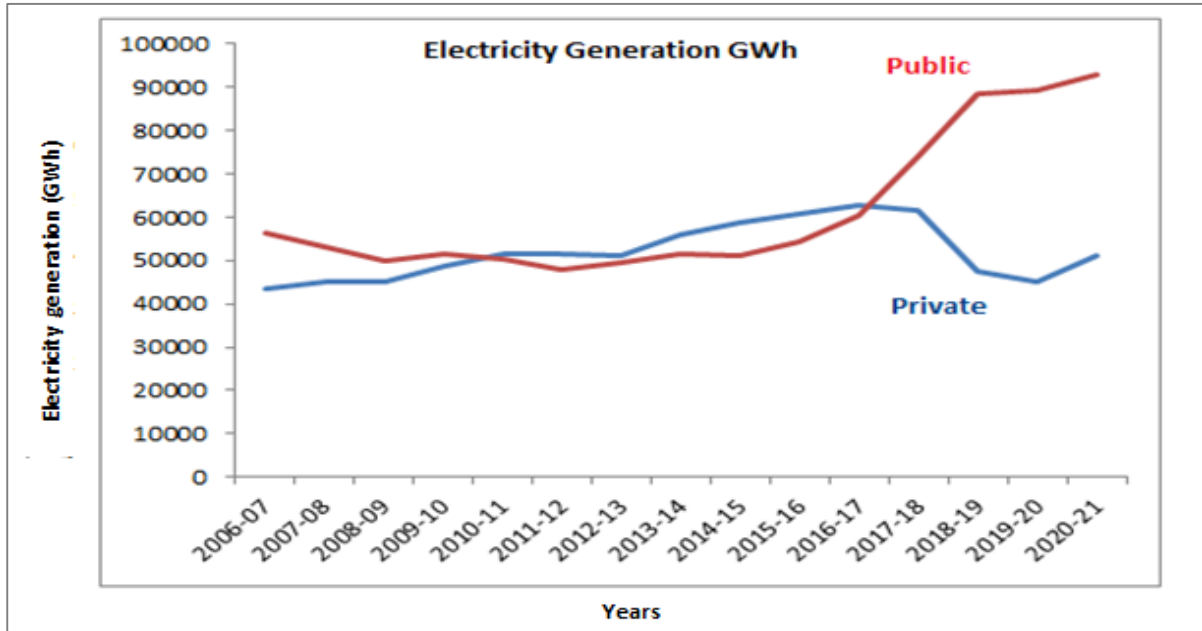
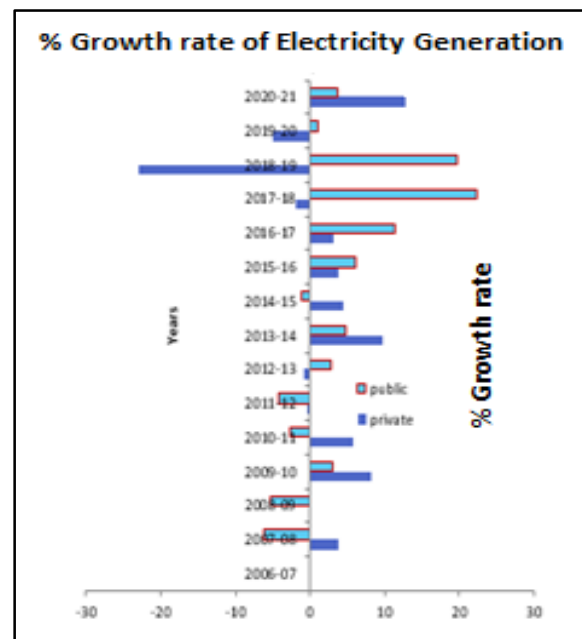


Figure 4.15 represents year over year growth of electricity generation in the country by the Public and Private sector. The Private sector observed maximum change in 2018-19 of about 23% dipped over previous year. The Public sector shows positive growth from 2015-16 onwards with maximum growth of slightly above 22% during 2017-18. The annual average growth rate (AAGR) electricity generation for Public Sector plants is 4% whereas for Private Sector it is 1.5%.

Figure 4.15: Percentage growth of Electricity Generation by ownership



4.2.1 Electricity Generation by type of Source

The overall generation of electricity is the mixture of electricity generated by various power plants installed throughout the country. Each power generator produced electricity on the basis of its installed capacity and its efficiency is measured by the concept of rate of utilization which will be reviewed in subsequent

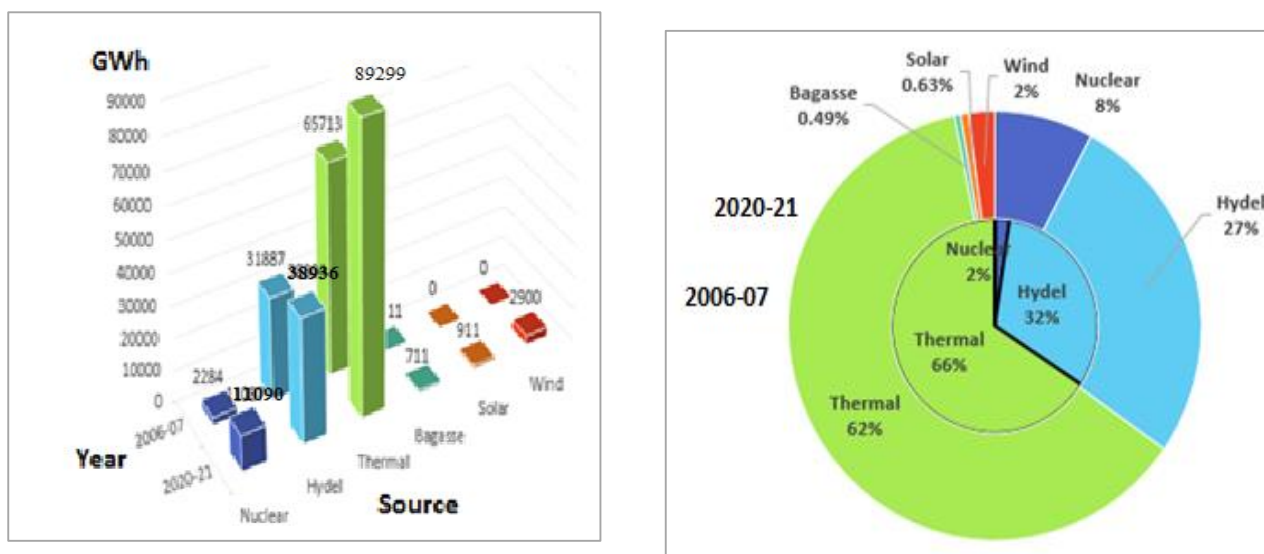


sections. Table 4.6 presents the data on electricity generated by type of sources from the years 2006-07 to 2020-21.

Table 4.6: Electricity Generation by type of Source (GWh)

Year	Nuclear	Hydel	Thermal	Bagasse	Solar	Wind	Grand Total
2006-07	2284	31887	65713	11	0	0	99895
2007-08	3077	28704	66355	15	0	0	98151
2008-09	1618	28180	65345	23	0	0	95166
2009-10	2894	28521	68918	36	0	0	100369
2010-11	3418	32135	66167	53	0	0	101773
2011-12	5265	28906	65297	16	0	6	99490
2012-13	4553	30397	65415	25	0	6	100396
2013-14	5090	32210	70049	96	0	265	107710
2014-15	5804	32867	70123	441	0	460	109695
2015-16	4602	34573	74287	632	207	791	115092
2016-17	6867	32132	81107	1011	654	1421	123192
2017-18	9849	27729	93948	1020	714	2124	135384
2018-19	9134	32359	89426	920	772	3232	135843
2019-20	9898	38700	81539	571	858	2891	134457
2020-21	11090	38936	89299	711	911	2900	143847

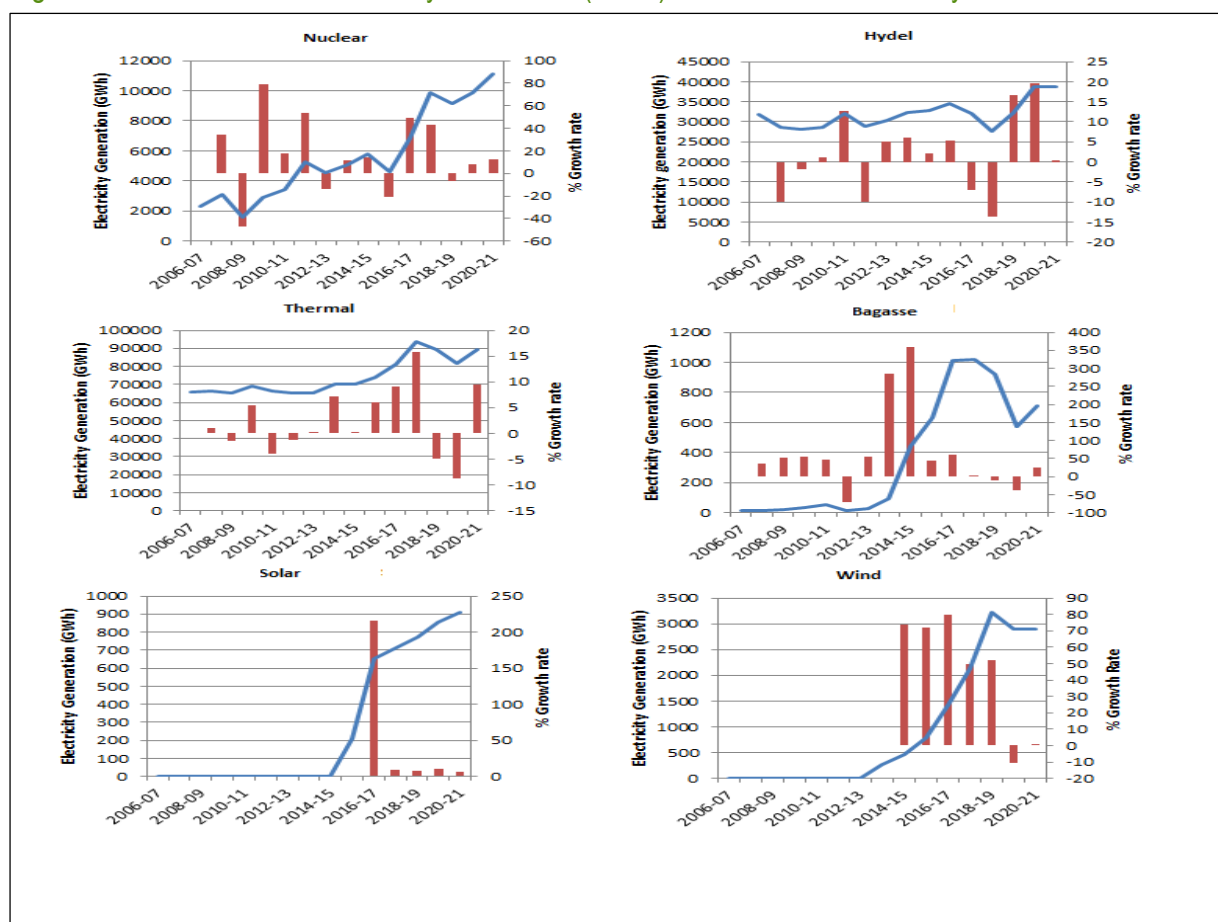
Figure 4.16: Electricity Generation (GWh) by type of Sources 2020-21 and 2006-07





During the years from 2006-07 to 2020-21, the electricity generated through Nuclear plants increased from 2284 to 11087 GWh showing 385% growth, Hydel shown 22%, Thermal 36% and all other alternate sources which were not existed in 2006-07 generated 4522 GWh electricity in 2020-21. The Pie chart in the Figure 4.16 shows the comparison of electricity generation in 2006-07 and 2020-21. Outer pie for 2020-21 shows that the thermal has maximum share of 62% while Hydel, Nuclear, Bagasse, Wind and Solar constitute share of 27%, 8%, 0.49%, 2% and 0.6% respectively. The inner pie for 2006-07 shows that electricity was generated by only three type of plants, Thermal 66%, Hydel 32% and Nuclear with share of 2%.

Figure 4.17: Panel chart of Electricity Generation (GWh) and % Growth over the years



The Panel Chart (Figure 4.17) shows the electricity generation by various type of plants. The bars under each component show the year over year growth rate in generation of electricity. All type of plants show positive trend over the period of time. Hydel, Thermal, Bagasse and Solar have shown smaller growth whereas Wind and Nuclear have shown considerably higher growth over the years. The Annual Average Growth Rates of electricity generation by Nuclear, Hydel, Thermal, Bagasse, Solar and Wind are 17%, 2%, 2%, 65%, 42% and 331% respectively.

4.2.2 Electricity Generation by Province and type of Source

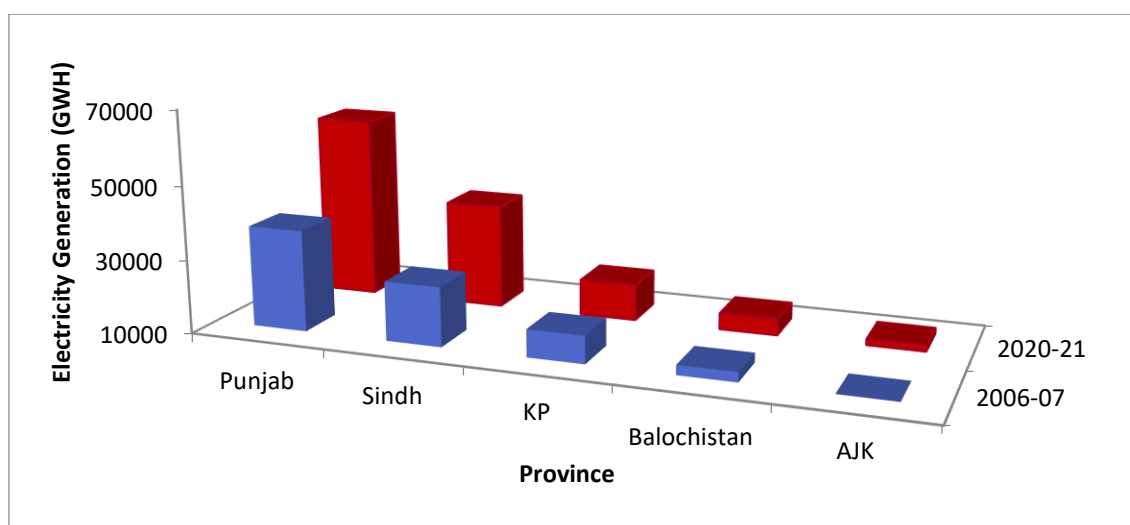
Electricity generation data by province for the years 2006-07 and 2020-21 is given in Table 4.7. During the year 2020-21, Punjab produced maximum electricity of 59609 GWh, followed by Sindh which generated 38241 GWh. KP was third with 19803 GWh, whereas Balochistan and AJK generated electricity of 14466 GWh and 11595 GWh, respectively. The electricity generated by type of source in the four provinces is also compiled for the year 2020-21 and 2006-07 and presented in Table 4.7.

Table 4.7: Electricity Generation by Province and type of Source for the Year 2006-07 and 2020-21 (GWh)

Source\State		Punjab	Sindh	KP	Balochistan	AJK	Total
Nuclear	2006-07	2099	186	0	0	0	2284
	2020-21	9172	1918	0	0	0	11090
	% Growth	336.83	340	0	0	0	676.83
Hydel	2006-07	8290	0	17405	0	6192	31887
	2020-21	8025	0	19316	0	11595	38936
	% Growth	-3.2	0	10.22	0	87.26	7.02
Thermal	2006-07	27070	25903	93	12646	0	65713
	2020-21	41134	33079	619	14466	0	89299
	% Growth	51.92	27.7	565.59	14.39	0	659.6
Bagasse	2006-07	11	0	0	0	0	11
	2020-21	566	144	0	0	0	711
	% Growth	5045.45	100	0	0	0	5145.45
Wind	2006-07	0	0	0	0	0	0
	2020-21	0	2900	0	0	0	2900
	% Growth	0	100	0	0	0	100
Solar	2006-07	0	0	0	0	0	0
	2020-21	712	199	0	0	0	911
	% Growth	100	100	0	0	0	200
Overall	2006-07	37470	26089	17498	12646	6192	99895
	2020-21	59609	38241	19935	14466	11595	143847
	% Growth	59.08	46.58	13.93	14.39	87.26	43.98

Figure 4.18 shows that Punjab is leading in both 2006-07 and 2020-21. Maximum production in Punjab is recorded for Thermal. Similarly, Sindh is sole producer of Wind energy where most of plants are established in Gharo and Jimphir Thatta.

Figure 4.18: Comparison of Electricity Generation during 2006-07 vs 2020-21



4.3 Gross Value Added (GVA) and Subsidy of Electricity Generation

Gross Value Added (GVA) is the contribution of any sector towards the national income which is measured in the form of GDP. GVA of electricity generation along with growth rate is given in the Table 4.8. The GVA for the year 2006-07 was estimated to be Rs. 85,896 million which increased to Rs. 577,759 million in 2020-21 showing 573% increase in Fifteen years

Table 4.8: Gross Value Added (GVA) and Subsidy of Electricity Generation

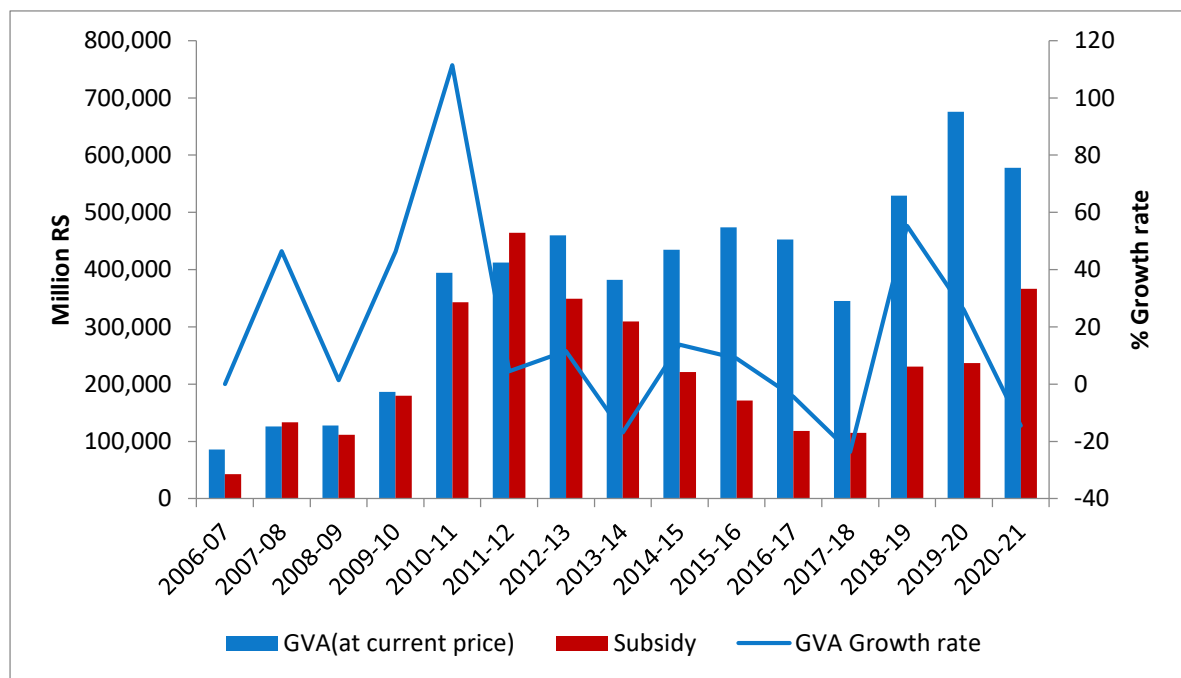
Unit: Million Rs.

Year	GVA (at current price)	Subsidy	GVA Growth rate
2006-07	85,896	42,617	---
2007-08	125,756	133,254	46.4
2008-09	127,515	111,640	1.4
2009-10	186,540	179,526	46.3
2010-11	394,396	343,144	111.4
2011-12	412,215	464,256	4.5
2012-13	459,680	349,287	11.5
2013-14	382,078	309,417	-16.9
2014-15	434,822	221,000	13.8
2015-16	474,120	171,205	9
2016-17	452,570	118,000	-4.5
2017-18	345,434	114,976	-23.7
2018-19	529,167	230,400	55.3
2019-20	675,752	236,500	26
2020-21	577,759	366,350	-14.5



In Figure 4.19 shows Gross Value Added (GVA) of electricity generation and subsidy paid by the government. The solid line depicts annual growth rate of GVA. A significant increase in GVA is observed during the year 2010-11 which is more than 110% growth. Overall Gross Value added is showing a significant growth over time. For these fifteen years, the Annual Average Growth Rate (AAGR) is 19% on annual basis. On the other hand, GVA of 2020-21 has shown 14.5% decrease over the GVA of previous year 2019-20.

Figure 4.19: GVA and Subsidy Contribution of Electricity Generation to GDP



Government of Pakistan has paid subsidy to DISCOs and K-electric due to high fuel cost for controlling prices of electricity generation. It has many other implications but purpose is to reduce unit price for the end users. The subsidy paid by the government has shown 55% increase in 2020-21 over subsidy paid in 2019-20.

4.4 Rate of Utilization

The rate of utilization is an important factor used for measuring the efficiency of the electricity sector. Rate of utilization is computed for the year 2020-21. Figure 4.20 shows that the average capacity utilization rate for Nuclear is very high (72%), followed by Hydel (45%), Thermal (38%), Wind (27%), Solar (19%) & Bagasse (15%). Table 4.9 provides capacity utilization rate by type of plants.

Figure 4.20: Capacity Utilization Rate

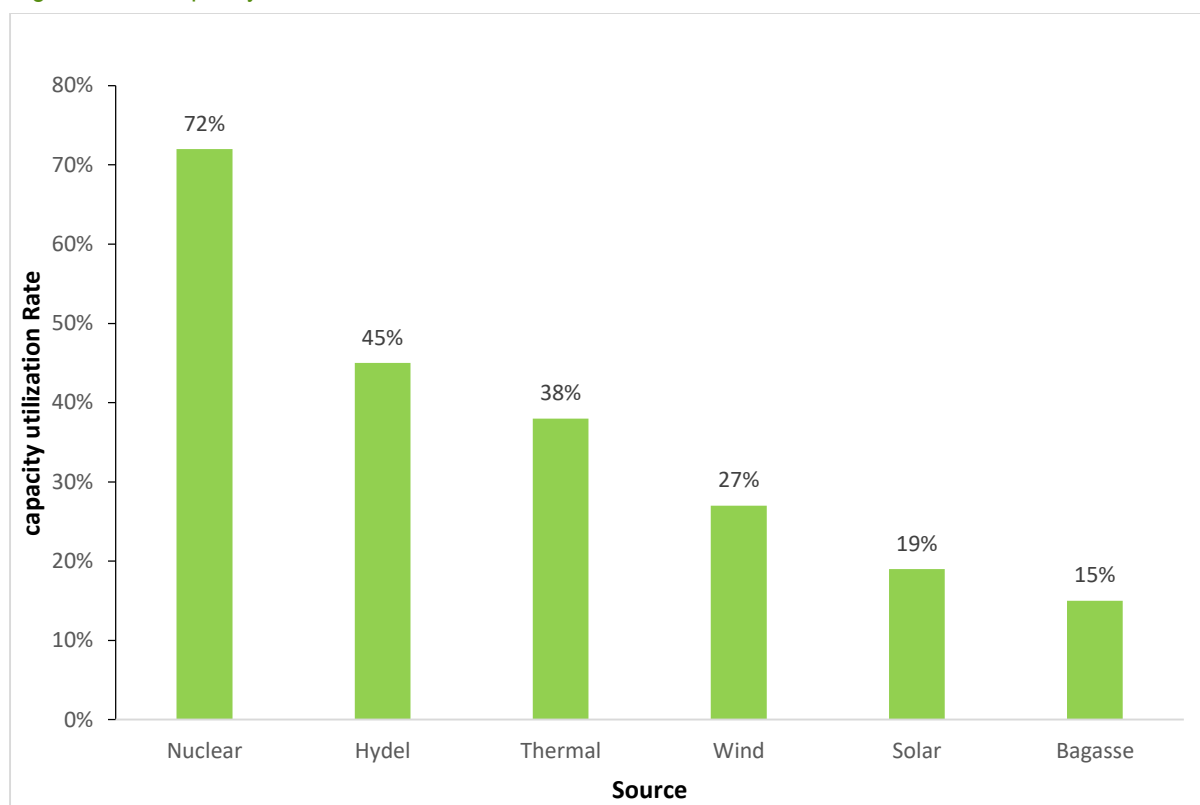


Table 4.9: Capacity Utilization Rate by type of plant (2020-21 over 2019-20)

Name of Establishment	Province/ State	Installed Capacity	Generation (2019-20)	Capacity Utilization Rate	Generation (2020-21)	Capacity Utilization Rate	Change
Nuclear							
Kanupp-I	Sindh	100	193131	22	219029	25	3
Kanupp-II	Sindh	....	0	0	1698919	57	57
Chasnupp - I	Punjab	325	2044630	72	2244332	79	7
Chasnupp -II	Punjab	325	2636129	93	2067983	73	-20
Chasnupp -III	Punjab	340	2322858	78	2403623	81	3
Chasnupp -IV	Punjab	340	2701293	91	2456153	82	-9
Nuclear Total		1430	9898041	79	11090039	72	-7
Hydel							
Tarbela	KP	3478	11857690	39	12565738	41	2
Tarbela Extension-4th	Punjab	1410	5485663	44	3550595	29	-15
Ghazi Barotha	AJK	1450	6482214	51	6810917	54	3
Mangla	KP	1000	4589327	52	5313831	61	9
Warsak	Punjab	243	1095462	51	1064986	50	-1
Chasma	KP	184	747163	46	772321	48	2



Name of Establishment	Province/ State	Installed Capacity	Generation (2019-20)	Capacity Utilization Rate	Generation (2020-21)	Capacity Utilization Rate	Change
Duber Khwar Hydro Project	KP	130	609395	54	640783	56	2
Golen Gol (GGHP)	KP	108	86131	9	82403	9	0
Allia Khwar Hydro Project	Punjab	121	469476	44	439086	41	-3
Jinnah	KP	96	176585	21	235015	28	7
Khan Khwar Hydro Project	Punjab	72	273875	43	231193	37	-6
Rasul	KP	22	34043	18	76804	40	22
Dargai	KP	20	98421	56	108725	62	6
New Jabban	KP	22	137671	71	134458	70	-1
Gomal Zam	Punjab	17	54416	37	62094	42	5
Nandipur	Punjab	14	33821	28	32524	27	-1
Shadiwal	Punjab	14	13685	11	31901	26	15
Chichoki	KP	13	29544	26	27445	24	-2
Kurram Garhi	Punjab	4	15111	43	19712	56	13
Renala	KP	1	2034	23	1963	22	-1
Chitral	KP	1	3044	35	2652	30	-5
Daral Khwar	Punjab	--	---	0	91845	28	28
Neelum Jhelum	AJK	969	4842301	57	4787155	56	-1
Head Marala	AJK	8	32160	46	36593	52	6
Jagran	KP	30	86255	33	113229	43	10
Laraib	AJK	84	384433	52	465186	63	11
Mira Power	AJK	101	34333	4	256883	29	25
Malakand-III	KP	81	408526	58	321666	45	-13
Pehur Hydro Power	KP	18	50592	32	0	0	-32
Star Hydro	AJK	147	566248	44	624453	48	4
Ranolia	KP	.....	0	0	33822	23	23
Hydral Total		9858	38699619	45	38935978	45	0
Thermal							
TPS JAMSHORO	Sindh	880	217815	3	202093	3	0
GTPS KOTRI	Sindh	174	0	0	0	0	0
TPS GUDDU(1-4)	Sindh	640	1605407	29	1562132	28	-1
TPS GUDDU(5-16)	Sindh	1762	4316353	28	3262758	21	-7
TPS QUETTA	Balochistan	35	0	0	0	0	0
TPS M GARH	Punjab	1350	305166	3	302805	3	0
SPS FAISALABAD	Punjab	132	0	0	0	0	0
GTPS FAISALABAD	Punjab	244	0	0	0	0	0

Name of Establishment	Province/ State	Installed Capacity	Generation (2019-20)	Capacity Utilization Rate	Generation (2020-21)	Capacity Utilization Rate	Change
NGPS MULTAN	Punjab	195	0	0	0	0	0
GTPS Shahdra	Punjab	59	0	0	0	0	0
CCPP Nandipur	Punjab	425	1476328	40	1481980	40	0
FBC LAKHRA	Sindh	50	0	0	0	0	0
TPS PASNI	Balochistan	17	0	0	0	0	0
GTPS PANJGUR	Balochistan	39	0	0	0	0	0
AES Lal Pir	Punjab	350	186319	6	620783	20	14
AES Pak. Gen.	Punjab	350	149760	5	445543	15	10
Agar Textile	Sindh	15	44448	34	19236	15	-19
Altern Power	Punjab	27	3728	2	12403	5	3
Anoud Power	Sindh	24	59520	28	12500	6	-22
Anoud Textile	Sindh	12	315	0	279	0	0
Atlas Power	Punjab	219	259327	14	517082	27	13
Attock Gen Limited	Punjab	165	320957	22	384031	27	5
Cherat Cement Company	KP	30	0	0	0	0	0
Balloki	Punjab	1320	5911839	51	6032812	52	1
Bestway Cement Chakwal	Punjab	16	49293	35	0	0	-35
China Hub	Balochistan	1220	6136196	57	7923409	74	17
Coal Power	Punjab	1320	6167188	53	7342700	64	11
Dadu Energy	Sindh	20	0	0	0	0	0
Davis Energy Pvt	Punjab	13	27	0	0	0	0
engro powrgen	Punjab	217	700741	37	648503	34	-3
Engro powergen Thar	Sindh	660	4280220	74	3909298	68	-6
FKPCL	Punjab	157	346317	25	389955	28	3
FFBL	Sindh	118	412914	40	1000366	62	22
Foundation Power	Sindh	185	777297	48	452881	44	-4
Gadoon Textile Mills	KP	54	182093	38	201818	43	5
Garam Chasma	KP	.....	0	0	38	0	0
Gul Ahmed	Sindh	136	496139	42	673228	57	15
Gulf Power	Punjab	62	0	0	0	0	0
Habibullah Power	Balochistan	129	108372	10	0	0	-10
Halmore Power	Punjab	225	347695	18	509793	26	8
Hawali Bahadur Shah	Punjab	1230	7050339	65	7682346	71	6
Hi-Tech	Punjab	15	2654	2	8789	7	5
HUBCO	Balochistan	1292	32379	0	112919	1	1



Name of Establishment	Province/ State	Installed Capacity	Generation (2019-20)	Capacity Utilization Rate	Generation (2020-21)	Capacity Utilization Rate	Change
HUBCO Narowal	Punjab	214	338091	18	496058	26	8
ICI Pakistan	Punjab	14	16783	14	0	0	-14
International Industries	Sindh	4	61867	177	52540	26	-151
International Steel	Punjab	19	0	0	0	0	0
Japan Pawor	Punjab	135	0	0	0	0	0
KAPCO	Punjab	1600	3476674	25	3562244	25	0
K Electric	Sindh	2295	9664653	48	10191546	51	3
Kohinoor Energy	Punjab	131	363856	32	337072	29	-3
Kumhar Wala power	Punjab	15	12029	9	9841	7	-2
Liberty Power Tech	Punjab	196	458538	27	606656	35	8
Lotte Powergen	Sindh	48	0	0	60992	15	15
Lucky Cement Karachi	Sindh	116	60250	6	155024	15	9
Lucky Cement Pezo	KP	87	388855	51	417507	55	4
Nishat Chunian Ltd.	Punjab	200	351227	20	537568	31	11
Nishat Power	Punjab	202	277457	16	523403	30	14
Omni Power	Sindh	13	0	0	0	0	0
Orient company	Punjab	229	338001	17	597917	30	13
PASMIC	Sindh	110	0	0	0	0	0
Port Qasim	Sindh	1320	8969740	78	8372375	72	-6
Quaid-e-Azam Thermal Power	Punjab	1180	5192498	50	7118804	69	19
Resham	Punjab	97	2066	0	0	0	0
Roush Power	Punjab	450	217526	6	284358	7	1
Saba Power	Punjab	134	50838	4	121653	10	6
Saif Power Limited	Punjab	210	476279	26	639403	35	9
Sapphire electric company	Punjab	212	296760	16	568042	31	15
Shikarpur Power	Sindh	13	0	0	0	0	0
Sitara Energy Ltd	Punjab	88	57193	7	0	0	-7
SNPC	Punjab	152	0	0	759910	57	57
Southern power	Sindh	135	722878	61	0	0	-61
Tapal Power	Sindh	126	626766	57	736790	67	10
Thatta Power	Sindh	46	39419	10	23591	6	-4
TNB Liberty Power	Sindh	235	896746	44	983334	48	4
UCH Power I	Balochistan	586	4087333	80	4090541	80	0
UCH Power II	Balochistan	404	2148017	61	2339368	66	5
Thermal Total		26599	81539486	35	89299017	38	3

Name of Establishment	Province/ State	Installed Capacity	Generation (2019-20)	Capacity Utilization Rate	Generation (2020-21)	Capacity Utilization Rate	Change
Bagasse							
Al Abbas Sugar Mill	Sindh	8	0	0	0	0	0
Al Moiz Sugar Mill	Punjab	36	15098	5	29832	9	4
Al Noor Sugar Mill	Sindh	37	0	0	0	0	0
Bandhi Sugar Mill	Sindh	12	4485	4	0	0	-4
Chamber Sugar Mill	Sindh	5	255	1	0	0	-1
Chanaar Power	Punjab	22	77657	40	160558	30	-10
Chiniot Power	Punjab	62	22336	4	38263	20	16
Faran Sugar Mill	Sindh	13	0	0	0	0	0
Fatima Sugar Mill	Punjab	120	0	0	0	0	0
Habib Sugar Mill	Sindh	13	866	1	0	0	-1
Hamza Sugar Mill	Punjab	15	45029	34	39987	30	-4
Indus Sugar Mill	Punjab	11	0	0	0	0	0
JDW-II	Punjab	27	161880	68	177172	75	7
JDW-III	Sindh	27	129207	55	144435	61	6
Layyah Sugar Mill	Punjab	41	36788	10	46369	13	3
Mehran Sugar Mill	Sindh	14	15	0	0	0	0
Noon Sugar Mill	Punjab	15	0	0	0	0	0
Sanghar Sugar Mill	Sindh	13	3249	3	0	0	-3
Tando Allah Yar Sugar Mill	Sindh	12	3237	3	0	0	-3
RYK	Punjab	24	71035	34	73940	35	1
Bagasse Total		527	571137	12	710556	15	3
Solar							
AJ Soalr	Punjab	18	18028	11	18496	12	1
Appolo Solar	Punjab	100	163025	19	164909	19	0
Oursun	Sindh	50	88218	20	90872	21	1
Best Green	Punjab	100	162921	19	164250	19	0
Crest Energy	Punjab	100	165314	19	166967	19	0
Gharo Solar	Sindh	50	64679	15	108626	25	10
Harappa Solar	Punjab	18	30686	19	31448	20	1
Sukkar IBA Uni. Plant	Punjab	19	0	0	0	0	0
Quaid-e-Azam Solar Power	Punjab	100	164994	19	165566	19	0
Solar Total		555	857865	18	911134	19	1
Wind							
AEP Wind	Sindh	50	132160	30	166065	38	8



Name of Establishment	Province/ State	Installed Capacity	Generation (2019-20)	Capacity Utilization Rate	Generation (2020-21)	Capacity Utilization Rate	Change
Dawood Wind Power	Sindh	50	121140	28	101590	23	-5
FFCL Wind Energy	Sindh	50	118401	27	90890	21	-6
Foundation Power-I	Sindh	50	239193	55	123221	28	-27
Foundation Power-II	Sindh	50	0	0	73178	17	17
Gul Ahmed Wind	Sindh	50	91145	21	110374	25	4
Hawwa	Sindh	50	115453	26	140960	32	6
Jhampir	Sindh	50	119175	27	143905	33	6
Master	Sindh	53	95271	21	110135	24	3
Metro Wind	Sindh	50	154689	35	120120	27	-8
Sachal Wind Power	Sindh	50	142361	33	107775	25	-8
Sapphir Wind	Sindh	53	89698	19	104006	22	3
Tapal Wind	Sindh	31	64762	24	74700	28	4
Tenaga Generasi	Sindh	50	125774	29	104085	24	-5
TGT Wind	Sindh	50	135627	31	99143	23	-8
TGS Wind	Sindh	50	95183	22	112533	26	4
Tricon Boston-A	Sindh	50	92770	21	108434	25	4
Tricon Boston-B	Sindh	50	124951	29	149898	34	5
Tricon Boston-C	Sindh	50	117644	27	144138	33	6
Three Gorges	Sindh	50	117513	27	143545	33	6
UEPL	Sindh	99	187135	22	203617	23	1
Yunus Energy Limited	Sindh	50	89861	21	108852	25	4
Zephyr Wind	Sindh	50	177050	40	149068	34	-6
Zorlu Energi	Sindh	56	143551	29	109652	22	-7
Wind Total		1242	2890507	27	2899884	27	0



Chapter 5

Data Tables

This chapter contains the following detailed Data Tables. Monthly data tables for electricity generation are also available which can be obtained by request.

Table 5.1: Installed Capacity (1947-48 to 2020-21)

Table 5.2: Electricity Generation (1947-48 to 2020-21)

Table 5.3: Electricity Generation from 2006-07 and 2020-21 by type of Source and Province

Table 5.4: Electricity Generation of 2020-21 by Establishment

Table 5.1: Installed Capacity (1947-48 to 2020-21)

(MW)

Year	Installed Capacity	% Change	Year	Installed Capacity	% Change
1947-48	69		1984-85	5615	12.08
1948-49	74	7.25	1985-86	6298	12.16
1949-50	87	17.57	1986-87	6653	5.64
1950-51	106	21.84	1987-88	6811	2.37
1951-52	130	22.64	1988-89	7104	4.3
1952-53	144	10.77	1989-90	7949	11.89
1953-54	164	13.89	1990-91	8776	10.4
1954-55	168	2.43	1991-92	9534	8.64
1955-56	207	23.21	1992-93	10192	6.9
1956-57	216	4.35	1993-94	11721	15
1957-58	229	6.02	1994-95	12894	10.01
1958-59	241	5.24	1995-96	13154	2.02
1959-60	493	104.56	1996-97	14983	13.9
1960-61	521	5.68	1997-98	15860	5.85
1961-62	584	12.09	1998-99	15860	0
1962-63	726	24.32	1999-00	17564	0.7
1963-64	742	2.2	2000-01	17689	1.6
1964-65	899	21.16	2001-02	17974	0.0
1965-66	948	5.45	2002-03	17974	13.3
1966-67	1311	38.29	2003-04	20360	0.5
1967-68	1411	7.63	2004-05	20456	0.47
1968-69	1470	4.18	2005-06	20495	0.19
1969-70	1725	17.34	2006-07	19670	-4.02
1970-71	1857	7.65	2007-08	19774	0.53
1971-72	1862	0.27	2008-09	20020	1.24
1972-73	1972	5.91	2009-10	21223	6.01
1973-74	2072	5.07	2010-11	22674	6.84
1974-75	2430	17.28	2011-12	23401	3.21
1975-76	2528	4.03	2012-13	23673	1.16
1976-77	3334	31.88	2013-14	24687	4.28
1977-78	3417	2.49	2014-15	24448	-0.97
1978-79	3467	1.46	2015-16	26651	9.01
1979-80	3518	1.47	2016-17	31537	18.33
1980-81	4105	16.69	2017-18	35138	11.42
1981-82	4205	2.43	2018-19	38055	8.3
1982-83	4798	14.1	2019-20	40211	5.67
1983-84	5010	4.42	2020-21	40606	0.98

Table 5.2: Electricity Generation (1947-48 to 2020-21)

(GWh)

Year	Electricity Generation	% Change	Year	Electricity Generation	% Change
1947-48	118		1984-85	23003	5.5
1948-49	115	-2.5	1985-86	25589	11.2
1949-50	156	35.7	1986-87	28703	12.5
1950-51	206	32.1	1987-88	33091	15.3
1951-52	282	36.9	1988-89	34562	4.4
1952-53	385	36.5	1989-90	37660	9
1953-54	469	21.8	1990-91	41918	11.3
1954-55	594	26.7	1991-92	45876	9.4
1955-56	726	22.2	1992-93	48912	6.6
1956-57	830	14.4	1993-94	51474	5.2
1957-58	1066	28.4	1994-95	54530	5.9
1958-59	1126	5.6	1995-96	57732	5.9
1959-60	1047	-7	1996-97	59894	3.7
1960-61	1298	24	1997-98	62915	5.1
1961-62	1692	30.4	1998-99	65402	4
1962-63	2171	28.3	1999-00	66562	1.8
1963-64	2712	24.9	2000-01	68117	2.3
1964-65	3179	17.2	2001-02	72405	6.3
1965-66	3698	16.3	2002-03	75682	4.5
1966-67	3925	6.1	2003-04	83607	10.5
1967-68	4677	19.2	2004-05	88379	5.7
1968-69	5518	18	2005-06	96478	9.2
1969-70	6380	15.6	2006-07	99895	3.5
1970-71	7202	12.9	2007-08	98151	-1.7
1971-72	7572	5.1	2008-09	95166	-3.04
1972-73	8377	10.6	2009-10	100369	5.5
1973-74	9064	8.2	2010-11	101773	1.4
1974-75	9941	9.7	2011-12	99490	-2.2
1975-76	10319	3.8	2012-13	100396	0.9
1976-77	10877	5.4	2013-14	107710	7.3
1977-78	12375	13.8	2014-15	109695	1.8
1978-79	14174	14.5	2015-16	115092	4.9
1979-80	14974	5.6	2016-17	123192	7.03
1980-81	16062	7.3	2017-18	135384	10
1981-82	17688	10.1	2018-19	135843	0.3
1982-83	92697	424.1	2019-20	134457	-1.02
1983-84	21873	-76.4	2020-21	143847	6.9

Table 5.3: Electricity Generation from 2006-07 and 2020-21 by type of Plant

(GWh)

Plant/ Province	AJK	Balochistan	KPK	Punjab	Sindh	Total
Baggase						
2006-07				11	0	11
2007-08				15	0	15
2008-09				23	0	23
2009-10				13	23	36
2010-11				10	43	53
2011-12				16	0	16
2012-13				25	0	25
2013-14				57	39	96
2014-15				246	194	440
2015-16				425	207	632
2016-17				795	216	1011
2017-18				790	229	1019
2018-19				715	205	920
2019-20				430	141	571
2020-21				566	144	710
Hydel						
2006-07	6192		17405	8290		31887
2007-08	4828		16182	7693		28703
2008-09	4924		15491	7765		28180
2009-10	4907		15558	8056		28521
2010-11	6088		17482	8566		32136
2011-12	4856		15735	83115		103706
2012-13	4979		16752	8666		30397
2013-14	6388		17311	8510		32209
2014-15	7077		17751	8038		32866
2015-16	7520		18934	8118		34572
2016-17	5912		17949	8271		32132
2017-18	4864		15656	7209		27729
2018-19	8735		15965	7638		32338
2019-20	10503		20645	7551		38699
2020-21	11595		19316	8025		38936
Nuclear						
2006-07				2099	186	2285
2007-08				2653	424	3077
2008-09				1142	475	1617
2009-10				2257	637	2894
2010-11				3197	221	3418
2011-12				4751	514	5265
2012-13				3947	606	4553
2013-14				4762	328	5090
2014-15				5400	404	5804
2015-16				4173	430	4603

Plant/ Province	AJK	Balochistan	KPK	Punjab	Sindh	Total
2016-17				6376	491	6867
2017-18				9430	419	9849
2018-19				9006	128	9134
2019-20				9705	193	9898
2020-21				9172	1918	11090
Solar						
2006-07				0		0
2007-08				0		0
2008-09				0		0
2009-10				0		0
2010-11				0		0
2011-12				0		0
2012-13				0		0
2013-14				0		0
2014-15				0		0
2015-16				207		207
2016-17				654		654
2017-18				714		714
2018-19				715	58	773
2019-20				705	153	858
2020-21				712	199	911
Thermal						
2006-07		12646	93	27070	25903	65712
2007-08		13105	100	27214	25936	66355
2008-09		14252	99	26863	24131	65345
2009-10		14242	80	29846	24750	68918
2010-11		13703	40	29403	23020	66166
2011-12		13182	33	29687	22396	65298
2012-13		12649	28	29437	23301	65415
2013-14		13230	543	33862	22415	70050
2014-15		14813	578	31113	23618	70122
2015-16		15093	572	34125	24497	74287
2016-17		14823	610	36460	29213	81106
2017-18		13176	644	48440	31688	93948
2018-19		8706	581	45038	35100	89425
2019-20		12512	571	34503	33953	81539
2020-21		14466	619	41134	33079	89299
Wind						
2006-07					0	0
2007-08					0	0
2008-09					0	0
2009-10					0	0
2010-11					0	0
2011-12					6	6
2012-13					6	6

Plant/ Province	AJK	Balochistan	KPK	Punjab	Sindh	Total
2013-14					265	265
2014-15					461	461
2015-16					791	791
2016-17					1422	1422
2017-18					2124	2124
2018-19					3232	3232
2019-20					2891	2891
2020-21					2900	2900

Table 5.4: Electricity Generation of 2020-21 by Establishment

(GWh)

Name of Establishment	AJK	Balochistan	KPK	Punjab	Sindh	Total
International Steel						
AEP Wind					166	166
AES Lal Pir				621		621
AES Pak. Gen.				446		446
Agar Textile					19	19
AGGREKO						
Aj Solar				18		18
AKHP			439			439
Al Abbas sugar mill						
Al Moiz Industries				30		30
Al Noor Sugar Mills						
Altern Power				12		12
Anoud Power					13	13
Anoud Textile						
Atlas Power				517		517
Attock Gen Limited				384		384
Balloki-I				5980		5980
Balloki-II				53		53
Bandhi Sugar Mill						
Best Green				164		164
Bestway Cement Chakwal						
CCPP Nandipur				1482		1482
Chamber Sugar Mill						
Chanaar Energy				38		38
CHASMA				772		772
Chasnupp - I				2244		2244
Chasnupp -II				2068		2068
Chasnupp -III				2404		2404
Chasnupp -IV				2456		2456
Cherat Cement Company						
CHICHOKI				27		27
China Hub Power		7923				7923
Chiniot Power				161		161
CHITRAL			3			3
Coal Fire				7343		7343
Crest Energy				167		167
Dadu Energy						
Daral Khwar			92			92
DARGAI			109			109
Davis Energy Pvt						
Dawood Wind Power					102	102
DHA Cogen						
DKHP			641			641
engro Powergen Thar					3909	3909
engro powergen Unit-1					649	649
engro powergen Unit-2						
Faran Sugar Mill						
Fatima Sugar Mill						

Name of Establishment	AJK	Balochistan	KPK	Punjab	Sindh	Total
FBC LAKHRA						
FFCL Wind Energy					91	91
FKPCL				390		390
Foundation Power					1000	1000
Foundation Wind Power					123	123
Foundation Wind Power-II					73	73
FPCL/FFBL					453	453
Gadoon Textile Mills			202			202
Garam Chasma						
Gharo Solar					109	109
GHAZI BAROTHA				6811		6811
GOLEN GOL			82			82
GOMAL ZAM			62			62
GTPS FAISALABAD						
GTPS KOTRI						
GTPS PANJGUR						
GTPS SHAHDRA						
Gul Ahmed					673	673
Gul Ahmed Wind					110	110
Gulf Power						
Habib Sugar Mill						
Habibullah Power						
Halmore Power Unit-1				472		472
Halmore Power Unit-2				38		38
Hamza sugar mill				40		40
Harappa Solar (Pvt)Ltd				31		31
Havali Bahadar Shah-I				7682		7682
Havali Bahadar Shah-II						
Hawwa					141	141
Head Marala				37		37
Hi-Tech				9		9
HUBCO		113				113
HUBCO Narowal plant				496		496
ICI Pakistan						
Indus Sugar Mill						
International Industries					53	53
JABBAN			134			134
Jagran	113					113
Japan power						
JDW - II				177		177
JDW- III					144	144
Jhampir					144	144
JINNAH				235		235
Kanupp					219	219
Kanupp-II					1699	1699
KAPCO				3562		3562
KE(Formerly KESCL)					10192	10192
K-GARHI			20			20
KKHP			231			231
Kohinoor Energy				337		337

Name of Establishment	AJK	Balochistan	KPK	Punjab	Sindh	Total
Kumhar wala power				10		10
Laraib	465					465
Layyah Sugar Mill				46		46
Liberty Power Tech				607		607
Lotte Powergen					61	61
Lucky Cement Pezo			418			418
Lucky Cement Karachi					155	155
Malakand-III			322			322
MANGLA	5314					5314
Master					110	110
Mehran Sugar Mill						
Metro					120	120
Mira	257					257
NANDIPUR				33		33
Neelum Jhelum	4787					4787
NGPS MULTAN						
Nishat Chunian Ltd.				538		538
Nishat Power				523		523
Noon Sugar Mill						
Omni Power						
Opollo Solar				165		165
Orient Power company Unit-1					541	
Orient Power company Unit-2					57	
Oursun					91	91
PASMIC						
Pehur Hydro Power						
Port Qasim					8372	8372
Quaid-e-Azam Solar Power				166		166
Quaid-e-Azam Thermal Power Pvt. Ltd Unit-1						7110
Quaid-e-Azam Thermal Power Pvt. Ltd Unit-2						9
Ranolia	34					34
RASUL				77		77
RENALA				2		2
Reshman						
Roush Power				284		284
RYK				74		74
Saba Power				122		122
Sachal Wind Power					108	108
Saif Power Limited Unit-1				613		613
Saif Power Limited Unit-2				26		26
Sanghar Sugar Mill						
Sapphir Wind					104	104
Sapphire electric company Unit-1					452	
Sapphire electric company Unit-2					116	
SHADIWAL				32		32
Shikarpur Power						
Sitara Energy Ltd						
SNPC					760	760
Southern Electric						
SPS FAISALABAD						

Name of Establishment	AJK	Balochistan	KPK	Punjab	Sindh	Total
Star Hydro	624					624
Sukkur IBA Uni. plant						
Tando Allah Yar Sugar Mill						
Tapal Power					737	737
Tapal Wind					75	75
TARBELA			12566			12566
TARBELA- 4TH			3551			3551
Tenaga Generasi					104	104
TGS Wind					108	108
TGT Wind					113	113
Thatta Power					24	24
Three Gorges					99	99
TNB Liberty Power					983	983
TPS GUDDU(1-4)					1562	1562
TPS GUDDU(5-16)					3263	3263
TPS JAMSHORO					202	202
TPS M GARH				303		303
TPS PASNI						
TPS QUETTA						
Tricon Bostan-A					150	150
Tricon Bostan-B					144	144
Tricon Bostan-C					144	144
UCH Power I		4091				4091
UCH Power II		2339				2339
UEPL Wind					204	204
WARSAK			1065			1065
Yunus Energy Limited					109	109
ZEPHYR Wind					149	149
Zorlu Energi					110	110
Total	11595	14466	19935	59609	38241	143847



Genesis of the Report

The report on trends in electricity generation (2006-07 - 2020-21) owes to dedicated and tireless efforts of the following staff of Energy & Mining Section, Pakistan Bureau of Statistics (PBS).

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