

194. Scope of renewable energy resources for fulfilling the energy gap in foreseeable future of Pakistan's power sector

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Abstract

This research paper provides consolidated argument for renewable energy resources being more significant as compare to conventional energy resources (oil & natural gas) in Pakistan's power sector for following important reasons: First is that, from statistical data regarding vast utilization of oil and natural gas resources of Pakistan for various purposes (industries, power plants, transport, domestic applications..) it is estimated that country's natural gas and oil reserves will become extinct in about 15-16 years, thus this estimated evidence compels to find such energy resources in the country that would be able to fill the gap of oil and natural gas resources in power sector of the country once they (oil and natural gas resources) are extinct. Second is that, Use of oil and natural gas resources in power plants is a source for generation of flue gases that are exhausted into atmosphere, these flue gases in the atmosphere significantly contribute to global warming which as of present has reached its peak value in Pakistan. The effects of global warming are devastating as it contributes in warming the planet significantly that is making life on earth unbearable. Thus to avoid any further increase in global warming of the country (Pakistan) use of oil and natural gas resources in power sector must be curtailed and adequate replacement in terms renewable energy sources (solar, wind, biomass and hydro) must be utilized in power sector of the country, because the use of renewable energy resources in power sector do not generate any harmful gases that can damage the planet. So basically this research paper shall provide a solid reason for utilizing the renewable energy resources in Pakistan's power sector as compare to near extinction conventional energy resources.

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1 Introduction

In this research paper statistical data for projected power demand on Pakistan's power system for years 2015-16 to 2029-30 along with statistical data for projected installed capacity of Pakistan's power system for years 2015-16 to 2029-30 are analyzed for determining the power demand and installed capacity gap for years 2015-16 to 2029-30.

Based on the analysis process projected power demand/installed capacity gaps for years 2015-16 to 2029-30 are focused and further analyzed in terms of constraints likes financial restrictions, conventional fuel resource shortage and no rehabilitation of existing power houses for determining projected power demand/supply gaps, and then based on the projected power demand/supply gaps for years 2015-16 to 2029-30 role of renewable energy resource power projects is defined for bridging the projected power demand/supply gaps in order to eliminate power crisis to some significant extent.

1.1 Analyzing future power crisis of Pakistan

As per national power system expansion plan the projected future power demand of Pakistan (KESC+PEPCO) for years 2015-16 to 2029-30 is evaluated by first determining the energy sales/energy demand (including the energy shed) for future years using regression analysis formula in which the important parameters used are historic energy sales/energy demand (including the energy shed for 2004-

15) for years 1970-2015 with 2015 taken as base year and projected growth of GDP, Population and category wise tariff rates ETC for years 2015-16 to 2029-30 and then projected Transmission/Distribution losses, projected auxiliary consumption and projected load factor are used to finally project the peak power demand on Pakistan’s power system for years 2015-16 to 2029-30. The data for projected peak power demand of Pakistan for years 2016-2030 under normal load forecast scenario is shown in Fig 1 and is detailed in appendix A.

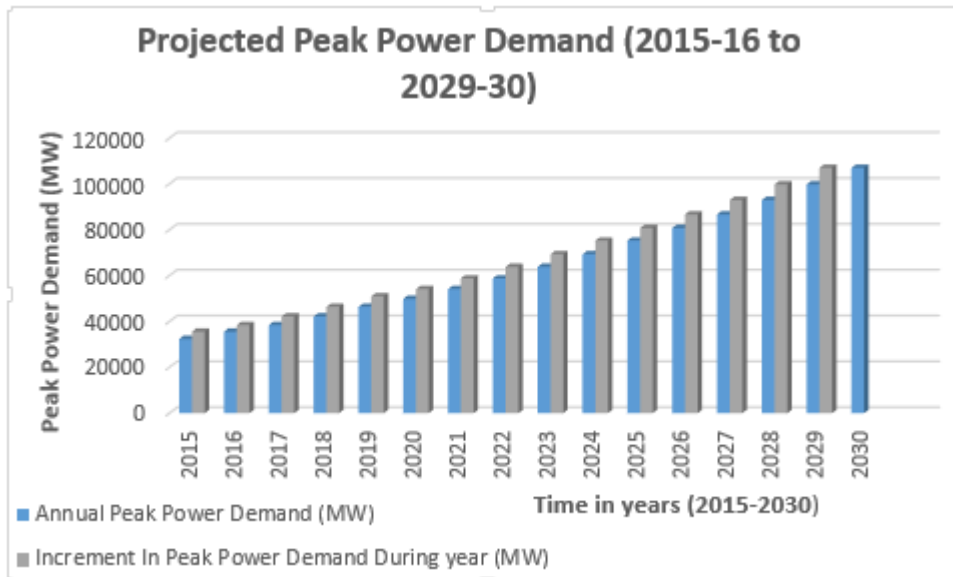


Fig 1

Similarly the projected installed generation capacity of Pakistan (PEPCO+KESC) for years 2015-16 to 2029-30 as per NTDC’s future power project list is shown in the fig 1.1 and is detailed in appendix B.

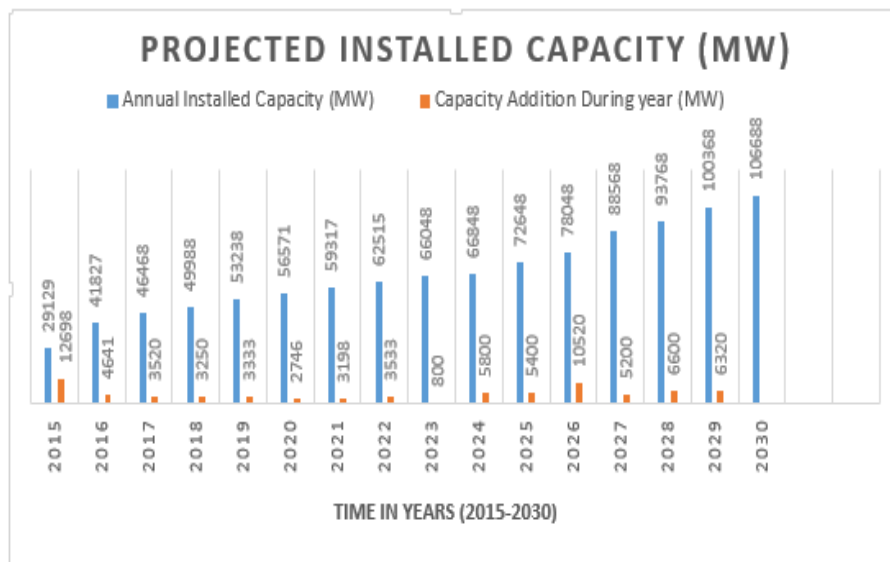


Fig 1.1

Then by comparing the projected peak demand and installed capacity of years 2015-16 to 2029-30 power demand/installed capacity gaps for years 2015-16 to 2029-30 are determined this is shown in fig 1.2 and is detailed in appendix C.

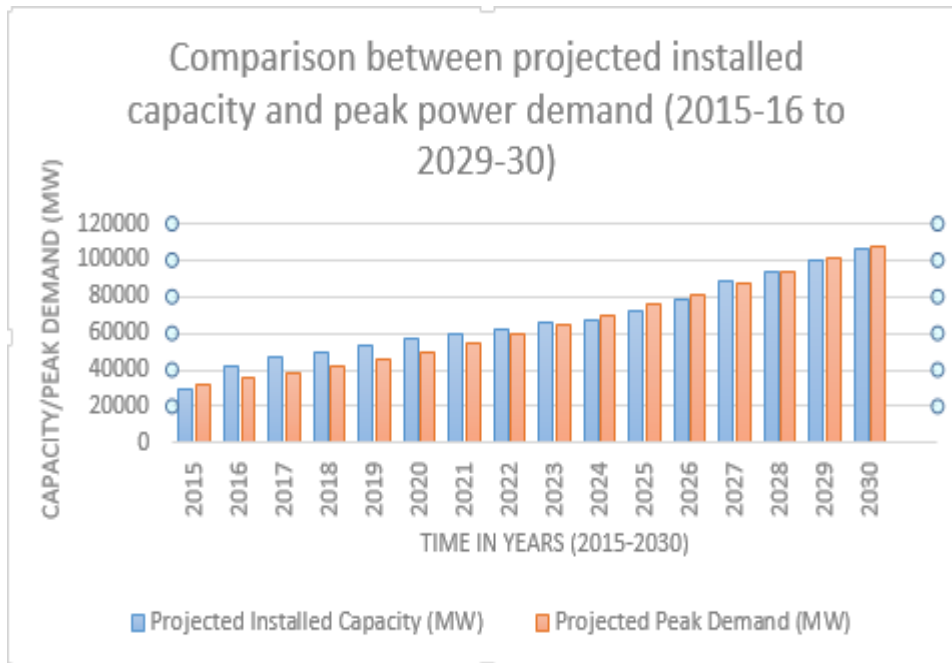


Fig 1.2

As indicated in fig. 1.2 from years 2015-16 to 2022-23 and year 2026-27 projected peak power demand on Pakistan’s power system shall be less than installed generation capacity by significant margin thus if it is assumed that actual generation capacity of country’s power system is equal to its installed capacity provided all the power houses are operating upto their rated capacity then Pakistan surprisingly shall not face any power crisis for those years from 2015-16 to 2022-23 and 2026-27 but unfortunately due to presence of constraints like shortage of fuel resources (import oil/gas) for thermal power stations (as per financial restrictions and natural gas allocation and management policy 2005) and hydro resources in winter for hydro power stations and no rehabilitation of existing power houses it is expected that actual generation capacity shall not be equal to installed capacity rather it is expected to be less than the power demand therefore by considering these factors it is expected that Pakistan shall face power crisis for years 2015-16 to 2022-23 and 2026-27. For the years 2023-24 to 2029-30 except 2026-27 projected peak demand on system is expected to be greater than installed generation capacity, thus even if actual generation capacity is assumed to be equal to installed capacity for years 2023-24 to 2029-30 except 2026-27 Pakistan is still expected to face power crisis and if factors like shortage of fuel resources for thermal/hydro power projects and no rehabilitation of existing power houses are considered then actual generation capacity is expected to be way below the power demand thus further consolidating the power crisis for years 2023-24 to 2029-30.

1.2 Conclusion (Role of renewable energy resources for eliminating future power crisis)

As discussed earlier in section 1.1 even though the projected installed capacity of Pakistan’s power system succeeds the power demand for years 2015-16 to 2022-23 and 2026-27 the country shall still be facing power crisis because of constraints already mentioned due to which conventional resource power stations shall be operating below their rated capacity and therefore actual generation capacity shall be lower than projected installed capacity and peak power demand thus widening the power demand/supply gap.

But in case of years 2023-24 to 2029-30 except 2026-27 power demand exceeds installed capacity thus country shall be facing severe power crisis even with actual generation capacity being equal to installed capacity and if factors like shortage of fuel resources for thermal/hydro power projects and no rehabilitation of existing power houses are considered then actual generation capacity is expected to be way below the power demand thus further increasing the severity of power crisis for years 2023-24 to 2029-30.

In order to reduce power demand/supply gap upto a significant margin for downgrading projected power

crisis of years 2015-16 to 2029-30 GOP must consider following steps:

- While considering shortage of conventional fuel resources and with renewable energy resources (wind+solar) available in abundant quantity within Pakistan, GOP shall put forward a mandate for construction of renewable energy resource (wind+solar) power projects on small scale along with rehabilitation of existing power houses for years 2015-16 to 2022-23 and 2026-27 for bridging demand/supply gap in order to reduce the power crisis upto some significant/tolerable extent.
- The above is true for years 2023-24 to 2029-30 except 2026-27 with one exception that is the renewable energy power projects must be constructed on massive scale because of power demand being greater than installed capacity for these years.

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2. Engr. Dr. Mohsin Tunio

References

- [1] EDF (Energy Demand Forecast) 2011-2035 NTDC.
- [2] NTDC Future Power Proect List 2011-2030.
- [3] NPSEP (national power system expansion plan) 2011-2030.

Appendix A Load forecast (PEPCO/ KESC/Self Generation) Normal

Load forecast for PEPCO+KESC+SELF GENERATION											
Year	Growth rate (%)	Energy sale (GWH)	Losses				Energy sent out (GWH)	Auxiliary Consumption (GWH)	Energy generation required	Load factor (%)	Peak demand (MW)
			Transmission (%)	Distribution (%)	Transmission (GWH)	Distribution (GWH)					
2014-15	-	162479	4.5	8334	12.5	22962	193775	7255	201030	71	32322
Future Projections											
2015-2016	9.7	178048	4.6	9140	11.9	23803	210991	7947	218938	70.4	35501
2016-2017	9.6	195045	4.5	9842	11.2	24253	229140	8582	237722	70.7	38383
2017-2018	9.5	213412	4.5	10681	10.5	24771	248864	9323	258187	70.6	41747
2018-2019	9.3	233173	4.5	11647	10.3	26537	271357	10165	281522	70.4	45649
2019-2020	9	254105	4.5	12695	10.3	28921	295721	11076	306797	70.3	49818
GR(2015-20)	9.4						8.8%		8.8%		9%
2020-2021	8.9	276619	4.5	13822	10.3	31488	321929	12057	333986	70.1	54388
2021-2022	8.6	300515	4.5	15017	10.3	34210	349742	13098	362840	70	59171
2022-2023	8.4	325787	4.5	16278	10.3	37084	379149	14200	393349	69.8	64330
2023-2024	8.1	352378	4.5	17600	10.3	40105	410083	15362	425445	69.7	69679

2024-2025	7.9	380272	4.5	18981	10.3	43267	442520	16583	459104	69.5	75408
GR(20 20-25)	8.4						8.4%		8.4%		8.6%
2025-2026	7.5	409273	4.5	20411	10.3	46547	476231	17856	494087	69.3	81389
2026-2027	7.3	439480	4.5	21892	10.4	49955	511327	19184	530511	69.2	87515
2027-2028	7	470636	4.5	23410	10.4	53458	547504	20558	568062	69	93981
2028-2029	6.7	502784	4.5	24966	10.4	57058	584808	21981	606789	68.9	100534
2029-2030	6.4	535950	4.5	26559	10.4	60755	623264	23453	646717	68.7	107461

Appendix B/C NTDC Future Generation Projects/Comparison of Installed Capacity with Peak demand

Year	Name of Future projects	Type	Capacity (MW)	Expected COD	Annual Capacity Added (MW)	Total installed Capacity after Addition (MW)	Peak demand (MW)
2014-15	Golan Gol HPP	WAPDA	106	Jul 2014			
	Integrated coal Sondha, Sindh	IPP	405	Aug 2014			
	TPS Quetta EXT CC	GENCO	200	Sept 2014			
	TPS Sukkur EXT CC	GENCO	120	Oct 2014			
	TPS Shahdara EXT CC	GENCO	200	Oct 2014			
	China Intl W&E Corp Sindh	IPP	50	Oct 2014			
	HOM Energy Jhimpir Sindh	IPP	50	Dec 2014		3495	29129
	Dawood Power Ghara Sindh	Rental	-200	Dec 2014			
		IPP	97	Dec 2014			
		IPP	147	Dec 2014			
		IPP	50	Feb 2015			
	Rental satiana RD	GENCO	400	Mar 2015			
	Fais..abad Punj	Rental	-62	Apr 2015			
	Kotli HPP AJK	IPP	132	Jun 2015			
	Patrind HPP Mansehra	IPP	50	Jun 2015			
	KPK	GENCO	700	Jun 2015			
	Zephyr power Ghara Sindh	GENCO	1000	Jun 2015			
	NGPS Multan EXT Punjab						
	Gulf PP Gujranwala Punjab						
	Rajdhani AJK						
Metro power CO Jhimpir Sindh							
TPS Muzaffar garh EXT							
Imported Coal PP Karachi							
2015-16	Karkey project Karachi	Rental	-232	Jul 2015			
	Karot HPP Kotli AJK	IPP	720	Aug 2015			
	TPS Jamshoro Sindh	GENCO	1050	Aug 2015			
	Coal fired PP Sibi Baluchistan	GENCO	100	Aug 2015			
		GENCO	350	Aug 2015			
	SPS Faisalabad Punjab	GENCO	1000	Sep 2015			
	CC Dadu Sindh	IPP	50	Aug 2015			
	Master wind PP Jhimpir Sindh	IPP	50	Sep 2015			
		IPP	1200	Sep 2015		12698	41827
	Gul ahmed Wind PP Sindh	IPP	1200	Sep 2015			35501
		Rental	-51	Oct 2015			
	AES Coal PP Gadani	WAPDA	969	Oct 2015			
	Baluchistan	GENCO	350	Nov 2015			
	Candidate Imported Coal	Rental	-201	Dec 2015			
		IPP	215	Dec 2015			
Walters Naudero Sindh	IPP	157	Dec 2015				

	Neelum Jhelum HPP	IPP	120	Dec 2015			
	Lakhra Coal PP Sindh	IPP	1200	Feb 2016			
	Reshma PP	GENCO	1200	Mar 2016			
	Asrit Kedam HPP Swat	IPP	1000	Apr 2016			
	KPK	WAPDA	33	Apr 2016			
	Madyan HPP Swat KPK	WAPDA	80	May 2016			
	Taunsa HPP	WAPDA	28	May 2016			
	Engro Coal PP Thar	IPP	50	Jun 2016			
	Coal Fired PP Thar	WAPDA	960	Jun 2016			
	Imported Power Iran	GENCO	100	Jun 2016			
	Harpo HPP	IPP	1000	Jun 2016			
	Phandar HPP						
	Basho HPP						
	Wind Eagle Jhimpir						
	Sindh 1						
	Tarbella 4 th extension						
	Coal fired PP Khuzdar						
	CASA 1000 MW import						
	Tajikistan						
	Kohala HPP	IPP	1100	Jul 2016			
	Azad Pattan AJK	IPP	222	Aug 2016			
	CHASHNUPP-III	PAEC	340	Sep 2016			
	Punjab	WAPDA	122	Oct 2016			
	Keyal Khwar HPP	IPP	500	Dec 2016			
	Chakothi HPP AJK	IPP	197	Dec 2016			
	Kalam asrit HPP Swat	IPP	101	Dec 2016	4641	46468	38383
	KPK	IPP	127	Dec 2016			
	Gabral Kalam HPP swat	IPP	130	Dec 2016			
2016-17	KPK	IPP	102	Dec 2016			
	Shogosin HPP KPK	IPP	50	Mar 2017			
	Sehra HPP KPK	WAPDA	740	mar 2017			
	Shushgai Zhendholi	WAPDA	70	Apr 2017			
	HPP KPK	IPP	840	Jun 2017			
	Wind Eagle Jhimpir						
	Sindh II						
	Munda Dam HPP						
	Lawi HPP						
	Suki Kinari HPP						
	CHASHNUPP-IV	PAEC	340	Jul 2017			
	Punjab	IPP	548	Dec 2017			
	Kaigah HPP	IPP	1300	Mar 2018	3520	49988	41747
2017-18	Coal Fired PP Thar	GENCO	1300	Mar 2018			
	Coal Fired PP Thar	WAPDA	32	Jun 2018			
	Trappi HPP						
2018-19	Basha HPP	WAPDA	2250	Sep 2018	3250	53238	45649
	Nuclear PP	PAEC	1000	Jun 2019			
2019-20	Nuclear PP	PAEC	1000	Jul 2019	3333	56571	49818
	Bunji HPP	WAPDA	2333	Sep 2019			
2020-21	Basha HPP	WAPDA	2250	Sep 2020	2746	59317	54388
	Lower Spatgah HPP	WAPDA	496	May 2021			
2021-22	Bunji HPP	WAPDA	2333	Apr 2022			
	Candidate Wind PP	IPP	200	Jun 2022	3198	62515	59171
	Palas Velley HPP	WAPDA	665	Jun 2022			
2022-23	Candidate wind PP	IPP	200	Dec 2022			
	Bunji HPP	WAPDA	2333	May 2023	3533	66048	64330
	Nuclear PP	PAEC	1000	Jun 2023			
2023-24	Akhori HPP	WAPDA	600	Aug 2023	800	66848	69679
	Candidate wind PP	IPP	200	Dec 2023			
2024-25	Pattan HPP	WAPDA	2800	Mar 2025	5800	72648	75408
	Thakot HPP	WAPDA	2800	Jun 2025			
	Candidate wind PP	PAEC	200	Jun 2025			
	Nuclear PP	PAEC	1000	Jul 2025			
	Dhudhnial HPP	WAPDA	800	Dec 2025			
2025-26	Candidate Wind PP	IPP	200	Dec 2025	5400	78048	81389
	Coal Fired PP Thar	GENCO	2400	Feb 2016			
	Nuclear PP	PAEC	1000	Jun 2016			
2026-27	Coal fired PP Thar	GENCO	6000	Aug 2026			
	Candidate wind PP	IPP	200	Dec 2026	10520	88568	87515
	Dasu HPP	WAPDA	4320	Apr 2027			
	Yulbo HPP	WAPDA	2800	Aug 2027			
	Candidate wind PP	IPP	200	Mar 2028			
2027-28	Coal Fired PP	GENCO	1200	Nov 2027	5200	93768	93981
	Nuclear PP	PAEC	1000	Jun 2028			
	Nuclear PP	PAEC	1000	Jun 2029			

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2028-29	Candidate Wind PP	IPP	200	Jun 2029	6600	100368	100534
	Sindh	GENCO	5400	Jun 2029			
	Coal Fired PP Thar						
	Tungus HPP	WAPDA	2200	Oct 2029			
	Skardu HPP	WAPDA	1600	Nov 2029			
	Yugo HPP	WAPDA	520	Dec 2029			
2029-30	Candidate Wind PP	IPP	200	Jan 2030	6320	106688	107461
	Sindh	PAEC	1800	Mar 2030			
	Coal Fired PP Thar						