Pakistan Power Investments: Cost & Planning Issues Syed Akhtar Ali PIDE On-Line Conference Pakistan's Energy Issues

- Our system of planning? Role of NEPRA, PC and Ministry?
- Tarif determination, IPPs and mounting losses?
- What is framework for this planning?
- Should IPP system be ended?
- What is the state of the surplus/deficit?
- How do we plan energy system better?
- How can energy prices be brought down?
- How do we move to renewables?

India-Pakistan Comparative Power

Profile

	INDIA	PAKISTAN
Peak Demand-MW	192000	25000
Installed Capacity-MW	370,000	36000
Electricity Coverage-%	99%	77%
Per Capita Consumption	1181 kWh	500-971 ? kWh
T&D losses-%	21	21
Solar Mission-Target	100,000 MW	13000 Solar,11000 Wind
Solar Capacity Existing	40000 MW	362 MW
Wind Power Capacity	37669 MW	1237 MW
Renewables Market Share	17% excl Hydro	4.4%

Power System Institutional Roles	
ССоЕ	Strategic Decisions
Minister of Energy	Sectoral Responsibility inc Fuel Sector
ECC	Pricing, Subsidies, CAPEX
Planning Commission	PC-1,third-party role
NEPRA	Tariff, oversight
SAPM	Coordination, Advice
Power Division	Control, establishment, Policies, Sectoral Planning, Coord
NTDC	Transmission, Power Planning
СРРА	Power Purchaser
NPPC-	Micro-planning ,scheduling and dispatch
IPP,GENCO,WAPDA,PAEC	Power Generation
DISCOs	Distribution
PPIB,AEDB	Project Facilitation, Tariff Proposals

Historical Annual Energy Generation (TWh) as of FY 2013-19 2013-14 2014-15 2015-16 2016-17 2017-18 2018-19

Chart 3-4: Historical Annual Energy Generation (GWh) from FY 2013-14 to FY 2018-19



Chart 3-5: Historical Peak Electricity Demand (MW) from FY 2013-14 to FY 2018-19

Peak Power Demand-MW

	Actual	Computed
2017-18	20500	26000
Projected-2019-20	22000	30,000
Actual-2019-20	19548	21732
Projected 2030	Low base 29000-39000	High Base 39000-49000
Peak Demand RoG %		3.8-4.3,4.9-5.3,6-6.3%
GDP RoG %		4.5,5.5,6.5 %
Source: NTDC IGCEP- 2047		

Comparative Power Demand Projections of various Studies-MW

	Peak Powe	r Demand- MW		GDP Growth%
Year	2020	2030	2040	
JICA-Base Case-2016	33913	57413	94980	8
JICA-High Case-2016	36314	69874	128377	9
NTDC IGCEP-47Low GDP-2020		39111	64538	4.5
NTDC -IGCEP47-Normal GDP		43820	83155	5.5
NTDC-IGCEP47- High GDP growth		48718	106517	6.5
Energy Security Plan-2008	72210	162590		10
SNC LAVALIN-2011-Low	42612	82457		
SNC LAVALIN-Normal	49824	107477		
SNC LVALIN-High	54998	128039		

Source: NTDC

Pakistan's energy development: the road ahead

Table 3.9: Energy security plan (Planning Commission) - 2030: electrical

	Nuclear	Hydel	Coal	Renew able	Oil	Gas	Total	Cumulative MW
Existing (2005)	400	6,460	160	180	6,400	5,940	19,540	
Addition								
2010		1.260	900	700	160	4,860	7,880	27,420
2015	900	7,570	3,000	800	300	7,550	20,120	47,540
2020	1,500	4,700	4,200	1,470	300	12,560	24,730	72,270
2025	2,000	5,600	5,400	2,700	300	22,490	38,490	110.760
2030	4,00	7,070	6,250	3,850	300	30,360	51.830	162.590
Total	8,800	32,660	19,910	9,700	7,760	83,760	162,590	

Source: Planning Commission of Pakistan / Economic survey of Pakistan 2008

Indicators of Planning Problems

- NTDC IGCEP does not include Bhasha Dam, while WAPDA signs contract for Bhasha
- PC Electricity Security Plan -2005 allocates Gas Power Plant Capacity 83760 MW as opposed to 162,590 MW total Capacity in 2030.
- There was no Gas Supply potential nor imports no LNG in 2005
- Lack of Resource knowledge and Consensus

Demand Supply Planning

	Demand	Supply
Estimation	Academia, Economist	Power Planners
Variables	GDP, Prices, CPI etc	Cost, Efficiency, Capacity
Parameters	Growth rate, Elasticity	Cost Functions,RoI
		Locations etc



IGCEP-Indicated Generation Plan

	Unit	Low	Normal	High	
GDP RoG	%	4.5	5.5	6.5	
Demand MW- RoG	%	3.8-4.3	4.9-5.3	6-6.3	
Generation- 2020-21	GWh	159,003	162,472	165,662	
Peak Demand	MW	28143	28,755	29,320	
Generation- 2024-25	GWh	185,203?	188,792	200,096	
Peak Demand	MW	32076	34,209	36,257	
Generation 2029- 30	GWh	212418	237,990	264,595	
Peak Demand	MW	39111	43,820	48,717	
Capacity 2020-21	MW		36,000		
Capacity 2024-25	MW				
Capacity-2029-30	MW		78,762		

Total Installed Capacity under IGCEP by 2030

				Thermal				
			Import	/Gas/RL	Nuclea			
	Hydro	Thar	ed coal	NG	r	Solar	Wind	Total
Existing capacity-2019	8713	330	3960		1467	430	1048	36000
Comm. Capacity addition-2030	5154	3270	1620	1263	3300	373	899	20300
Candidata Canadity 2020	2620	2474		4000		12000	0000	20005
Candidate Capacity-2030	2630	21/4		4868		12000	8332	30685
Subtotal Canacity addition	7784	5774	1620	6139		12773	10279	45891
Subtotal capacity addition	//04	3774	IULU	0100		12,73	10275	43031
Retirement								7629
Bhasha	4500							
Total	20997	5774	5580	24567	4767	12773	10279	78762

Source: NTDC, NEPRA, Author's Estimates

Indicative Generation Capacity Additions (Committed + Candidate Projects) as of April 2020

L	egend											
Hydro			Riali-II									
Solar			7 Lawi 69								Cand. OCOT 1,129	
Wind			Siddique			Cand.Local Coul					Canel, Wind	
Nuclea	ır		330 Shanghal Beetrie unit 1	Wind-2	Cand. Wind Midland	1514 Canit. Solar	1				1,000 Cand. Wind Midland	Cand. Wind North
Import	ed Coal		660	548	300	1,500					263	200
Local	Coal		TEL	Jamshoro-1	Cand. Wind North	Blue star			Hatim		Cand. Solar	Cand, Wind South
RLNG			330	660	200				20		1,500	1,000
Bagas	se		Thal Nova	Birginson-3	Cand. Wind South	Cand. Wind South	Cand, Wind South	Cand. Wind South	Cand. Wind South		Tradest III	Cand, Wind Midland
			330	581	1,000	1,000	922	673	301		1,686	300
Gas	Gas		Lucky	Sharighal Electric and H	Cand. Solar	Cand. Wind Midland	Cand. Solar	Rialli 3	Canid. Solar		Dubair Kalay	Cand. Solar
Bar to	differentiate C	Committed	660	660	1,500	300	1,500		1,500		66	1,500
from C	andidate proj	ects	Solar-1	Solar-2		Cand. Wind		Cand. Solar	Oracle-1	South	Dhandher	Cand. OCGT
		Zorlu 100	Etithard 74	Gwadar 300	CASA 1000		Dasu-1 2,160	1,500		Cand. Solar 1,500	Neral Dubair 46	Oracle-2 660
	Existing System as	Hyd-1	Wind-1	Karot	Kinari	1410	Keyal	Itarpo	Azad Pattan	Cand, OCGT	Rajdhani 132	Mahl
	of 31st Dec 2019	Trimmu	82	KI	Matiltan	Jamahoro-H	Mohmand	CV	Kohala		and a second second	
		1263	1100	1100	84	660	800	1,100	1,124			
Year	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Commited MW	0	1,441	3,933	4,841	1,968	2,070	3,088	1,135	1,824	0	0	0
Candidate MW	0	0	0	0	3,000	4,406	2,422	2,176	2,481	3,861	5,878	6,461
Total MW	0	1,441	3,933	4,841	4,968	6,476	5,510	3,311	4,305	3,861	5,878	6,461
								Total	Capacity	y (MW)	50,	985

Figure 7-1: IGCEP 2047: Generation Sequence (2020-30)



Cost of Generation& Tariff

Typical COGE

- Fossil : 8 USc per kWh-Rs 12.00
- Solar & Wind: 4 USc per kWh-Rs .6.00
- Hydro : 8 Usc
- Nuclear : 10 Usc-secret ?
- CAPEX typical: 1 million USD/MW
- Typically 40% higher than elsewhere

	N 222312522222	NEO	EPR	CPR	Avg. Rate		
Description		Proj. FY 2019-20					
· · · ·	SR. SR.	BRW hs	2000/021-03240	Rs. / kWh	-		
1	GENCO:	7.1	6.9	4.1	11.0		
2	IPPs- RFO	1.2	18.9	49.9	68.8		
з	IPPs- RLNG + KAPCO + Muz.Gach	26.2	13.4	5.7	19.1		
4	IPPE-GAS	7.8	4.5	3.5	8,0		
5	COAL PLANTS	27.5	7.6	8.2	15.9		
6	NUCLEAR	9,2	1.3	7,8	9.1		
17	WAPDA HYDEL	29.0	0.1	4.0	4.1		
8	Other Hydels (NG, T.Ext)	10.3	0.3	5.9	6.2		
9	Wind	3.1		25.6	25.6		
10	Solar	0.6		29.8	29.8		
11	Bagasse	1.3	7.6	6.4	14.0		
12	Tavanir Iran	0.5	7.1		7.1		
13	SPPs	0.5	11.7	(area)	11.7		
	FY 2019-20 (Projected)	124.3	5.7	6.8	12.5		

Comparative Solar & Wind Power Tariff

Foundation-1 Wind

	Western			
	Wind	Access Solar	Reference	Actual March 20
O & M Local		0.449	0.3953	0.5295
O &M Foreign		0.449	1.5324	2.5947
Insurance	0.1651	0.2081	0.7833	0.7833
RoE	1.2754	1.7964	3.9165	6.054
RoEDC	0.1149	0.0798	0.7893	1.3592
Loan Repayment	2.3546	2.3216	5.794	4.0842
Interest	0.9436	0.1749	7.1186	9.2726
Total	5.6828	6.2343	15.9146	23.8942
exchange rate-USD)		100.5	155.35
KIBOR			9.63	13.49
LIBOR			0.33	1.91

Source:NEPRA

Comparative Fuel and O&M Cost Coal Power Plants-March 2020

	Fuel	0&M	Total
	Rs/kWh		
Port Qasim CPP	5.4197	0.1627	5.5824
Sahiwal CPP	8.196	0.1798	8.3758
China Hub CPP	5.0688	0.4972	5.566
Engro Thar Lignite PP	2.0715	1.0673	3.1388
Sahiwal Transport Cost	2.7767		
Sahiwal Net Fuel Cost excl Transport	5.4193		

Source: NTDC

Plants				OceanIntion	
	Capacity	CAPEX	unit CAPEX	COGE.Level	Completion
	MW	MnUSD	MNUSD/MW	Usc/kWh	year
CPEC-NEPRA upfront Tariff	1320	1463	1.45	9.16/8.36	2018
Jamshoro Coal Power Plant-ADB	1320	1181	0.895	6.2361	2020
Hassayan-UAE-USC	2400			4.501	2021
Egypt-Shangai-Dongfeng	6000		0.733(EPC)	5.4	2022
Malaysia-Manjung-USC	1000	1200	1.2	5.695	2015
Malaysia-Tanjung-4	1000	100	1.1	5.695	2016
Kudgi SSTP-USC-India	2400	2300	0.9		2017
Khargon-USC-India	1300	1500	1.1		2019

Cost Issues

- NEPRA Parameters-Interest rates Margins, O&M etc
- CAPEX Determination and Jacking-zero Equity
- Over Capacity and Capacity underUtilization-40%
- Undue Escalations
- Seasonal Difference in Demand
- Energy not Utilised due to T&D Issues
- T&D losses and Theft
- Cross Subsidy

New Contributors to Circular Debt

- LIBOR and KIBOR increase quadrupling from less than 0.5 % to over 2%;has come down now
- Exchange Rate Devaluation-continues to be there
- Combined Effect 50% increase in debt servicing &RoI in Rupee Terms
- 70% rise in Capacity Payments(Ra 1.045 Tn in 2021 to Rs 1.7 Tn in 2025) from by 2025;will demand increase by that margin?

T& D losses-Theft

- More than 20%-adds 4-6 Rs to Tariff
- Poverty-consumer and Inspector
- Same in India and Bangladesh and L.A.
- Used to be 30% in the beginning in the U.S.A
- Some technical solutions-smart meters @ consumer or D.T.
- 35 million meters,5 -7 billion USD,7-10 years
- Can be reduced to half ;with difficulty; reduction of 2-3 Rs in Tariff of Rs 20 or so;all cost elements have to come down

WAPDA EX-DISCO Distribution Cost-2017-18

	Losses	Unit Sales Price	Unit PPP	UDM+
	%	Rs/kWh	Rs/kWh	Losses
IESCO	8.65	14.9310	10.3137	4.6173
LESCO	11.76	16.1184	11.0484	5.0700
FESCO	10.24	17.3533	11.5019	5.8515
GEPCO	10.03	14.6595	11.3413	3.3182
MEPCO	15	17.7994	11.9779	5.8215
PESCO	31.95	21.6532	14.4073	7.2459
HESCO	22.59	23.8361	18.9790	4.8571
QESCO	17.5	17.2489	12.2872	4.9617
SEPCO	29.75	20.8638	13.8385	7.0252
TESCO	12.47	14.5167	12.3767	2.1400
Total	15.53	17.3565	11.8634	5.4931

Source: NEPRA Annual DISCO Determination Annual-2017-18Revenue Requirement

Oil vs Power Sectors

	Oil	Power
Sovereign Guarantees	none	yes
Purchase Guarantees	none	yes
Price Assurance	International Prices	yes
Protection	5%	40-100%
Take or Pay	none	yes

Why Coal still ?

- Imported Coal & LNG-short term solutions
- Thar Coal-late starter; will remain unfullfilled dream; no future beyond 2030
- India started Thar in 1970s;Europe Lignite 1950s
- Only 5000 MW ? In IGCEP 2030
- Water Issues
- High cost of local Thar coal-twice the cost elsewhere

Renewable Energy-Solar & Wind

- More Solar than Wind-available everywhere
- Distributed generation; no transmission
- More at consumer premises
- Cheaper than Fossil-4 Usc or less vs 8-10 Usc
- However, Problems at Utility level; weak grids
- Storage required; expensive; another 10 years
- 10 % share possible to-date;5-7000 MW in 2020-30
- IGCEP provides for higher share but may not be achieved due to slower demand and other priorities, Bhasha-4500 MW

Renewable Strategy

- District based generation
- Rural Electrification: 1-2 MW per location-Balochistan
- Consumer based roof top:1-5 kW
- Average District Demand=200 MW x 100=20,000 MW
- Avg. District Demand 2030 =300-400 MWx100=30-40000 MW
- Karachi: 4000 MW LHR: 3000 MW
- 25% Market Share possible thru Distributed generation; grid-based options undesirable

Solution

- EPC based competition
- Tariff based auctions
- Electricity Market
- Privatization
- Organizational & Governance Reforms
- Regulatory Reforms

Strategy: Distributed REN

Generation

- No more fossil power plants
- No more centralized generation
- There is enough base-load capacity
- After committed projects, only REN projects to be added
- Distributed generation, preferably, after 2025
- It would be at-least half cheaper