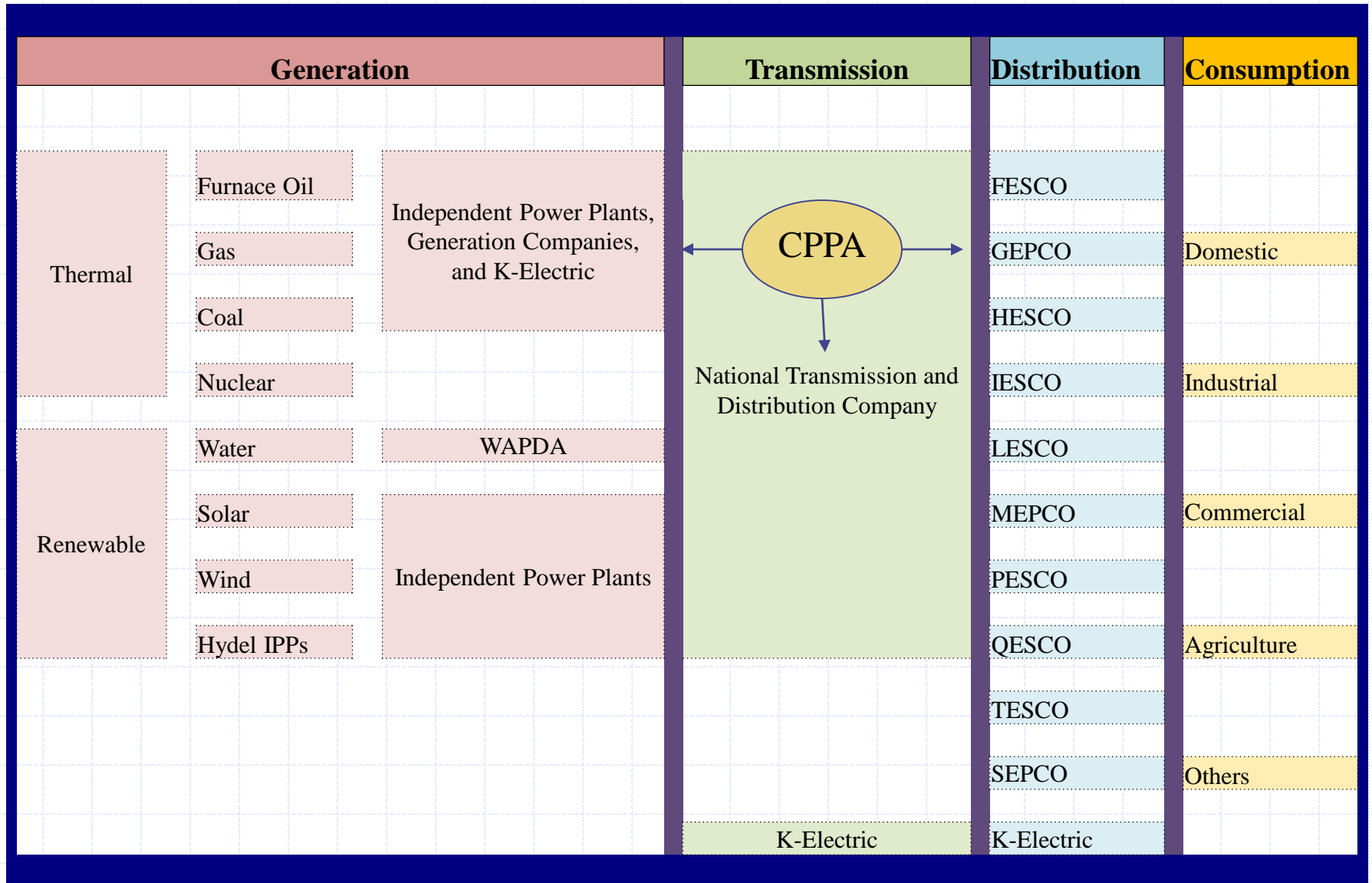


Power Generation

Power Chain
Capacity & Generation Mix
Hydel & Coal Power Projects
Bagasse Based Production
Risk Bubble
Sector Outlook

February 2017

Power Chain



Capacity – Dependable

Capacity Source		Dependable Generation Capacity (MW)								
		Jun-16	Mix		Jun-15	Mix		Jun-14	Mix	
			%	%		%	%		%	%
Thermal	IPPs	7,992	33.7%	64.1%	7,939	34.1%	65.1%	7,939	37.2%	63.9%
	GENCOs	4,676	19.7%		4,669	20.1%		3,160	14.8%	
	K-Electric	2,247	9.5%		2,247	9.7%		2,247	10.5%	
	Others (CPPs/SPPs)	282	1.2%		285	1.2%		285	1.3%	
Hydel	WAPDA	6,902	29.1%	30.0%	6,902	29.7%	30.6%	6,755	31.6%	32.6%
	IPPs	213	0.9%		213	0.9%		213	1.0%	
Nuclear	Two Nuclear plants	615	2.6%	2.6%	615	2.6%	2.6%	615	2.9%	2.9%
Wind	IPPs	254	1.1%	1.1%	205	0.9%	0.9%	106	0.5%	0.5%
Solar	IPPs	400	1.7%	1.7%	100	0.4%	0.4%	-		
Bagasse	IPPs	139	0.6%	0.6%	76	0.3%	0.3%	26	0.1%	0.1%
Total		23,720	100%	100%	23,251	100%	100%	21,346	100%	100%

Generation (Actual)



	FY16	FY15	FY14	FY13	FY12	FY11
Generation (GWh)	112,362	105,420	103,857	102,989	98,664	100,582
Growth (%)	6.6%	1.5%	0.8%	4.4%	-1.9%	0.8%
Capacity Factor (Utilization)	54%	52%	56%	50%	48%	49%

- ◆ Thermal – the largest source of electricity generation
- ◆ Addition of Wind, Solar and Bagasse based IPPs
- ◆ Moderate rise in thermal & hydel resources

Future Capacity

- ◆ To meet energy needs of the country government has taken various steps to increase generation capacity.
- ◆ In next two years generation capacity is expected to increase by ~12,332MW
- ◆ Long term Hydel electricity projects and thermal projects will add ~22,056MW beyond 2020

Future Capacity - MWs							
Year	Thermal		Hydel		Alternative IPPs	Nuclear (Govt.)	Total
	IPPs RLNG	IPPs Coal	WAPDA	IPPs			
CY17	2,400	2,507	106	147	807	680	6,647
CY18	1,200	1,303	2,501	102	579	-	5,685
CY19	-	595	310	-	710	-	1,615
CY20 & Beyond	-	4,688	8,070	5,098	-	4,200	22,056
Total	3,600	9,093	10,987	5,347	2,096	4,880	36,003

Demand and Supply during Peak Hours

- ◆ Supply deficient country
- ◆ As per NEPRA's state of industry report, Pakistan would be electricity surplus by FY19

	Generation Capability (MW)	Demand during Peak Hours (MW)	Surplus / (Deficit) (MW)
	Actual		
FY10	12,751	18,467	(5,716)
FY11	13,193	18,521	(5,328)
FY12	12,320	18,940	(6,620)
FY13	14,600	18,827	(4,227)
FY14	16,170	20,576	(4,406)
FY15	16,500	21,701	(5,201)
	Projected		
FY16	17,551	22,457	(4,906)
FY17	20,641	23,816	(3,175)
FY18	25,077	25,140	(63)
FY19	29,171	26,439	2,732
FY20	31,216	27,725	3,491

Generation Mix (Fuel) and Cost

Source	FY16			FY15			FY14		
	Generation (%)	Energy Cost (%)	Cost/Unit (PKR/KWh)	Generation (%)	Energy Cost (%)	Cost/Unit (PKR/KWh)	Generation (%)	Energy Cost (%)	Cost/Unit (PKR/KWh)
Gas	32.1%	37.5%	5.2	27.4%	21.9%	5.0	23.0%	15.8%	5.4
RFO	31.1%	55.0%	7.9	32.0%	66.4%	13.0	38.3%	76.9%	15.6
Hydel	30.5%	0.9%	0.1	30.9%	0.5%	0.1	31.0%	0.3%	0.1
Nuclear	3.4%	0.9%	1.2	4.7%	0.9%	1.2	4.2%	0.7%	1.3
HSD	1.3%	3.7%	13.0	2.8%	7.8%	17.7	1.6%	4.5%	22.3
Bagasse	0.5%	0.6%	5.8	0.2%	0.2%	6.2	0.0%	0.0%	-
Import	0.4%	1.0%	10.5	0.4%	0.7%	10.0	0.4%	0.5%	9.3
Mixed	0.2%	0.4%	7.1	1.0%	1.5%	8.9	1.1%	1.3%	9.3
Solar	0.2%	0.0%	0.0						
Wind	0.2%	0.0%	0.0	0.4%	0.0%	0.0	0.3%	0.0%	0.0
Coal	0.1%	0.1%	4.5	0.1%	0.1%	4.6	0.1%	0.1%	4.2
Gross NTDC + K-Electric	100.0%	100%	4.5	100%	100%	6.3	100%	100%	7.8

- ◆ Reliance on RFO generation gradually declining
- ◆ HSD – most expensive source of generation
- ◆ Hydel – cheapest source of generation
- ◆ Reduced cost / unit owing to lower international oil prices

Generation Mix (Entity) and Cost

Source	FY16			FY15			FY14		
	Generation (%)	Energy Cost (%)	Cost/Unit (PKR/KWh)	Generation (%)	Energy Cost (%)	Cost/Unit (PKR/KWh)	Generation (%)	Energy Cost (%)	Cost/Unit (PKR/KWh)
IPPs	40.6%	62.0%	6.8	42.4%	67.6%	10.0	42.1%	65.7%	12.2
WAPDA (Hydel)	29.5%	0.6%	0.1	29.9%	0.5%	0.1	30.0%	0.3%	0.1
GENCOs	15.2%	22.7%	6.7	11.2%	19.8%	11.1	12.4%	23.4%	14.7
K-Electric	8.3%	11.9%	6.1	8.8%	9.1%	6.4	8.4%	7.9%	7.4
Two Nuclear plants	3.4%	0.9%	1.2	4.7%	0.9%	1.2	4.2%	0.7%	1.3
Others (CPPs/SPPs)	1.2%	0.6%	2.4	1.0%	1.4%	8.9	1.2%	1.4%	9.4
Hydel IPPs	1.0%	0.2%	1.1	1.0%	0.1%	0.4	1.0%	0.0%	0.4
Wind\ IPPs	0.2%	0.0%	0.0	0.5%	0.0%	0.0	0.3%	0.0%	0.0
Mainly from Iran	0.4%	1.0%	10.6	0.4%	0.7%	10.0	0.4%	0.5%	9.3
Solar	0.0%	0.0%	0.7	0.0%	0.0%	-	0.0%	0.0%	-
Bagasse	0.1%	0.1%	6.5	0.0%	0.0%	-	0.0%	0.0%	-
Gross NTDC + K-Electric	100%	100%	4.5	100%	100%	6.3	100%	100%	7.8

- ◆ IPPs continue to contribute significant share in generation followed by WAPDA
- ◆ GENCOs inefficient source

Hydel Electricity Generation

- ◆ Potential of ~40,000 MW of hydel electricity generation
- ◆ Installed capacity – 7,116 MW
- ◆ Most (97%) of the installed hydro power capacity is owned by Pakistan Water and Power Development Authority (WAPDA) while only 3% is owned by private sector
- ◆ Currently contributing 31% to the total national capacity
- ◆ KPK government - PEDO is in the process of constructing 350 micro dams which will generate ~3000MW.
- ◆ 105MW electricity is produced under PEDO.

Hydel Electricity Generation

- ◆ Tarbela – the largest source of hydel electricity generation
- ◆ Nominal addition in the capacity of WAPDA in recent years

WAPDA Installed Capacity (MW)					
Sr. #	Project	share	June-16	June-15	June-14
1	Tarbela	50%	3,478	3,478	3,478
2	Ghazi Barotha	21%	1,450	1,450	1,450
3	Mangla	14%	1,000	1,000	1,000
4	Warsak	4%	243	243	243
5	Chashma	3%	184	184	184
6	Dubair Khwar	2%	130	130	130
7	Allai Khawar	2%	121	121	121
8	Jinnah	1%	96	96	96
9	Khan Khawar	1%	72	72	72
10	Rasul	0%	22	22	22
11	Jabban	0%	22	22	22
12	Dargai	0%	20	20	20
13	Gomal Zam	0%	17	17	17
14	Nandipur	0%	14	14	14
15	Shadiwal	0%	14	14	14
16	Chichoki	0%	13	13	13
17	Kurram Garhi	0%	4	4	4
18	Renala	0%	1	1	1
19	Chitral (Hydel)	0%	1	1	1
Total		100%	6,902	6,902	6,902

IPPs Installed Capacity (MW)					
Sr. #	Project	share	June-16	June-15	June-14
1	Laraib Energy	39%	84	84	84
2	Malakand - III	38%	81	81	81
3	Jagran AJ&K	14%	30	30	30
4	Pehur	8%	18	18	18
5	Garam Chashma	0%	1	1	1
Total		100%	214	214	214

Upcoming Hydel Projects

WAPDA Projects under construction

Sr. #	Project	Location	Capacity (MW)	Expected Completion
1	Golen Gol	Golen Gol River, Chitral, KPK	106	2017
2	Neelum Jhelum	Neelum River, AJ&K	969	2018
3	Tarbela 4th Extension	Indus River, Tarbela, KPK	1,410	2018
4	Keyal Khwar	Indus River, Kohistan, KPK	122	2018
5	Mangla Dam upgradation	Jhelum River, Punjab	310	2019
6	Dasu I	Indus River, Kohistan, KPK	2,160	2021
7	Tarbela 5th Extension	Indus River, Tarbela, KPK	1,410	2021
8	Diamer Basha	Indus River, Chilas, KPK	4,500	2024
Total			10,987	

Upcoming IPPs

Sr. #	Project	Location	Capacity (MW)	Expected Completion
1	Patrind	Kunhar River, AJ&K	147	2017
2	Gulpur Hydropower Project	Poonch River/Gulpur AJ&K	102	2019
3	Karot	Jhelum River, Rawalpindi	720	2021
4	Sehra Hydropower Project	Poonch River AJ&K	130	2021
5	Suki Kinari Hydropower (Pvt.)	Kunhar River, KPK	870	2022
6	Kohala Hydropower	Jhelum River. Kohala AJ&K	1,100	2023
7	Azad Pattan	Jhelum River, KPK	640	2024
8	Chakothi Hattian	Jhelum River, AJ&K	500	2024
9	Kaigah Hydropower Project	Kaigah Indus River KPK	548	2024
10	Mahl HydroPower	Jhelum River	590	2024
Total			5,347	

Coal Power Projects

- ◆ Pakistan is producing only 0.1% of its electricity from coal. However, worldwide 46% of electricity is produced from coal
- ◆ Pakistan has total coal reserves of 185 billion tonnes. The Thar coalfield in Sindh has 175 billion tonnes of coal
- ◆ To cater the energy needs of the country the government is pursuing coal power projects in the country
- ◆ Plants are being installed both on imported and local coal basis
- ◆ NEPRA has issued different tariff for local coal and imported coal
- ◆ Tariff is also dependent on size and capacity of the plant

Upcoming Coal Based Power Plants

Location	Company	Capacity	Coal	Expected Completion
Sahiwal	Huaneng Shandong Ruyi (Pakistan) Energy (Pvt) Limited	1,320	Imported	2017
Port Qasim	Sinohydro Resources Limited	1,320	Imported	2017
Thar	Thal Energy Limited	330	Thar	2018
Thar	Thal Nova Power (Pvt.) Limited	330	Thar	2018
Thar	Engro Power Gen Thar Limited	660	Thar	2019
Port Qasim	Grange Power Limited	163	Imported	2019
HUB	Hub Power Company Limited	1,320	Imported	2020
Port Qasim	Siddiqsons Limited	350	Thar	2020
Thar	Shanghai electric	1,320	Thar	2020
Port Qasim	Lucky Electric Power Company Ltd.	660	Thar	2020
Thar	Oracle Coal Fiels	1,320	Thar	2021
		9,093		

Pakistan | Bagasse Production & Upcoming IPPs

- ◆ Pakistan being the fifth largest sugarcane producer in the world has the potential to generate more than 2,000 MW electricity through Co-Generation.
- ◆ Pakistan total bagasse production for 2015: ~16 mln tonnes
- ◆ Expected bagasse requirement for upcoming IPPs: ~1.9 mln tonnes

Electricity Production by Bagasse (MWh)

	Capacity MW	2015			2016									Total
		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	
JDW-I	26	9,129	5,677	14,435	13,830	13,647	14,471	17,449	14,996	17,067	17,806	17,399	16,428	163,205
JDW-II	26	-	4,749	15,199	13,981	13,634	16,509	17,056	10,921	17,000	17,487	17,118	13,864	157,518
RYK	24	-		12,190	13,406	12,501	12,491	9,550	9,468	6,962	9,085	6,415	193	92,261
CPL	62	19,656	8,061	13,894	18,200	21,801	30,761	25,224	26,134	25,125	24,460	29,823	11,729	235,212
Total	139	28,785	18,487	55,718	59,417	61,583	74,232	69,279	61,519	66,154	68,838	70,755	42,213	648,195

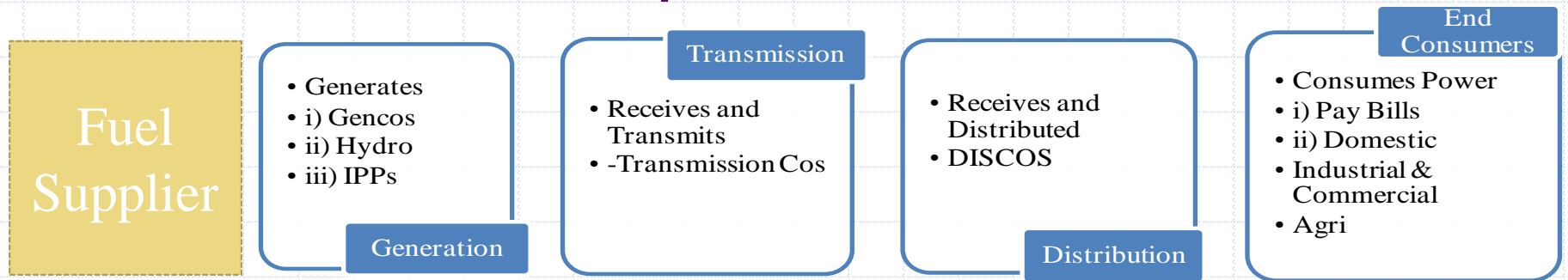
Pakistan | Upcoming Bagasse Based Projects

Company	Location	Capacity (MW)	Milestone
Hamza Sugar Mill Limited	Khanpur, District Rahim Yar Khan, Punjab	15	LoS issued
Alliance Sugar Mills Limited	Rasheedabad, Ubauro, District Ghotki, Sindh	19	LoI issued
Layyah Sugar Mills Limited	Karoor Road, District Layyah, Punjab	41	LoI issued
Safina Sugar Mills Limited	Sargodha Road, Lalian, District Chiniot, Punjab	20	LoI issued
Almoiz Industries Limited	Adda Hameed Kot, District Mianwali, Punjab	36	LoI issued
Etihad Power Generation Limited	Mouza Karamabad, District Rahim Yar Khan, Punjab	67	LoI issued
Shahtaj Sugar Mills Limited	Mandi Bahauddin, Punjab	15	LoI issued
Chanar Energy Limited	District Faisalabad	22	LoI issued
Total		235	
Generation (On season 5.5 months)		930,600,000	KWh
Bagasse Consumption for Upcoming Plants		1,861,200	Tonnes

Bagasse Upfront Tariff

Tariff Components	1-10 years (PKR/KWh)	11-30 years (PKR/KWh)
Fuel Cost	5.98	5.98
Variable O&M Local	0.12	0.12
Variable O&M Foreign	0.34	0.34
Fixed O&M Local	0.32	0.32
Insurance	0.22	0.22
Working Capital	0.17	0.17
Debt Service	3.90	
Return on Equity	1.03	1.03
Total	12.09	8.19

Risk Bubble | Where to find it?



Circular Debt | Build up over the years

Receivables (PKR bln)							
	Sep-16	Jun-16	Mar-16	Dec-15	Sep-15	Jun-15	Jun-14
PSO	191	180	173	165	174	181	175
OGDCL	114	111	127	123	129	121	101
PPL	57	57	57	57	57	59	50
Attock Petroleum & Shell	10	9	5	5	9	9	16
Total	371	357	362	350	312	370	342

Sector Outlook

Challenges

Circular Debt

Expensive and unsustainable fuel mix

Tariff subsidies pressure on fiscal reserve

Supply deficit: Low capacity; High T&D losses

GENCOs: Inefficient; Expensive; Weak governance

Developments

High foreign investment (CPEC: 19 projects; 15,425MW; \$33.8bln)

Power subsidies reduced in FY17 budget (PKR 118bln; FY16: PKR 171bln) – positive step to curtail circular debt

3600 MW RLNG based Power Plants to start generating electricity in FY18

Four Nuclear Power plants are under construction and will add ~3500 MW

NEPRA has been placed under Ministry of Water & Power as part of new regulations

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