



# NATIONAL TRANSMISSION AND DISPATCH COMPANY



**Electricity Beyond Borders**

**SALIENT FEATURES**

**OF**

**POWER SYSTEM**

**IN**

**PAKISTAN**

# PAKISTAN POWER SECTOR

## Pre-Restructure Regime

### WAPDA/NTDC/PEPCO

- Responsible for development of water & power resources
- Power wing comprised of a vertically integrated utility responsible for generation, transmission & distribution of electrical energy

- Provided services in whole of Pakistan except Karachi

### **Karachi Electric Supply Company (KESC)**

- Vertically integrated utility responsible for generation, transmission & distribution of electrical energy
- Provides service in only district of Karachi

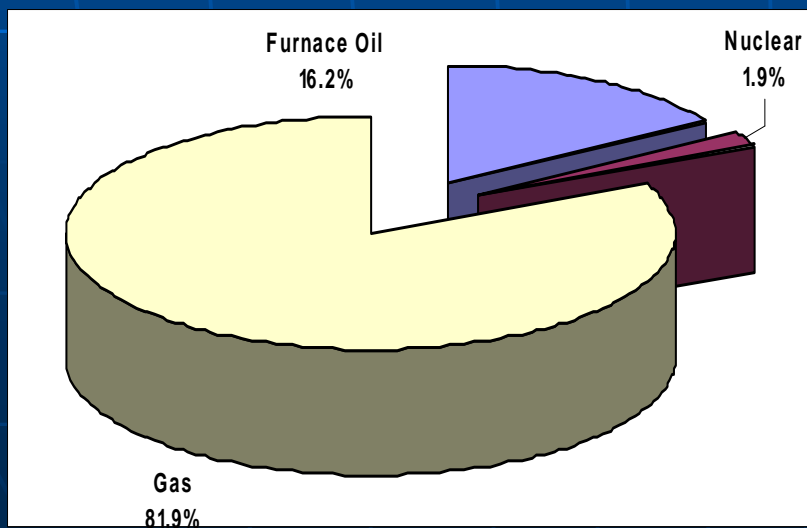
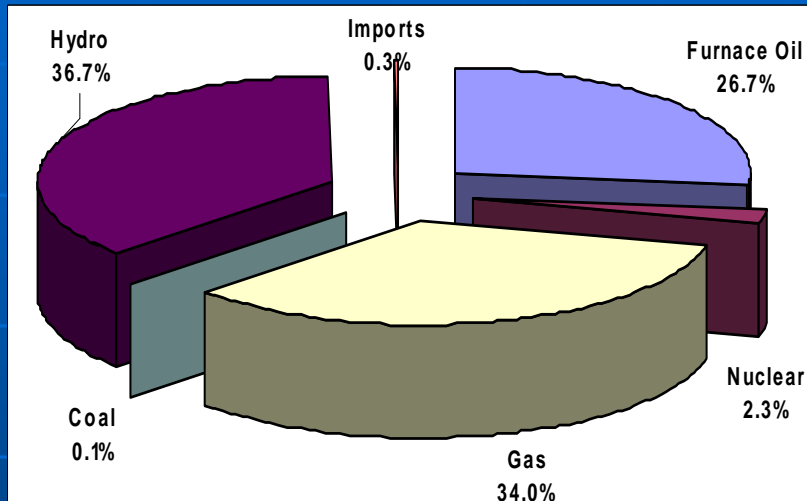
# INSTALLED CAPACITY (Breakup)

<b>NTDC System</b>	
<b>WAPDA Hydel</b>	<b>6444 MW</b>
<b>Thermal (GENCOs)</b>	<b>4500 MW</b>
<b>Nuclear (CHASHNUPP)</b>	<b>325 MW</b>
<b>IPPs</b>	<b>6097 MW</b>
<b>Sub Total (WAPDA System)</b>	<b>17366 MW</b>
<b>KESC System</b>	
<b>Thermal</b>	<b>1756 MW</b>
<b>Nuclear (KANUPP)</b>	<b>137 MW</b>
<b>IPPs</b>	<b>262 MW</b>
<b>Sub Total (KESC System)</b>	<b>2155 MW</b>
<b>Total Installed Capacity (Country)</b>	<b>19521 MW</b>

# ELECTRICITY GENERATION

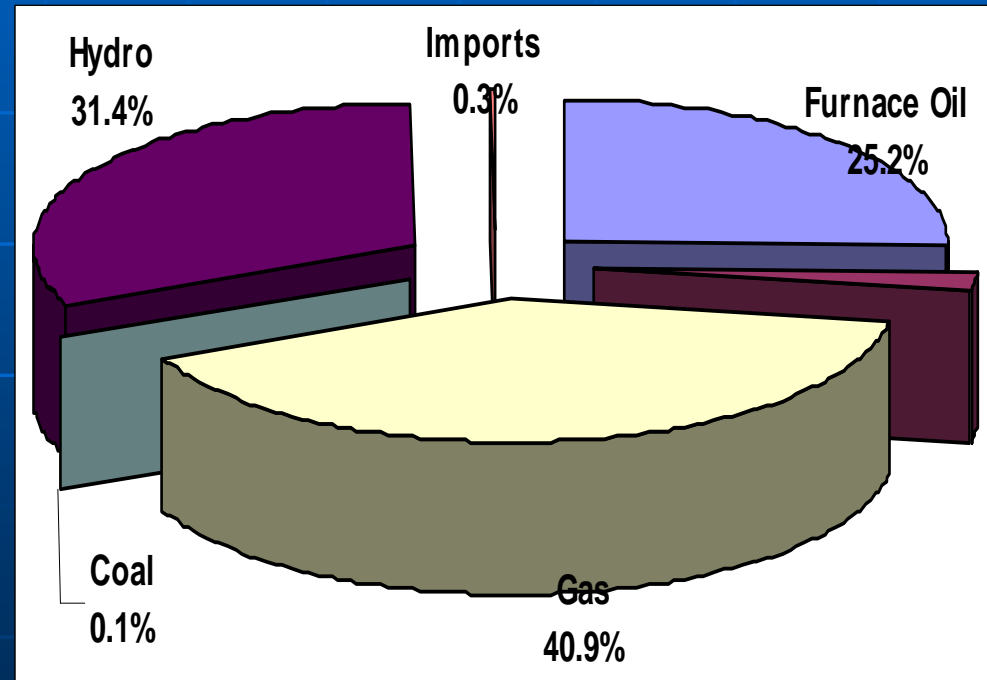
Source-Wise break up (Year 2006-07)

## WAPDA (82225 GWh)



## WAPDA + KESC

96725 GWh

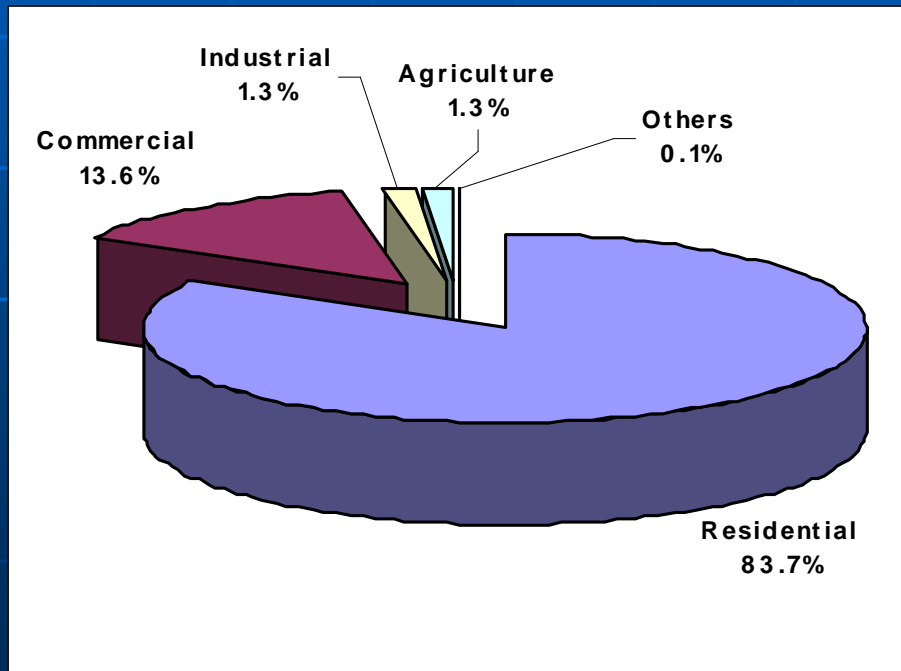


## KESC (14500 GWh)

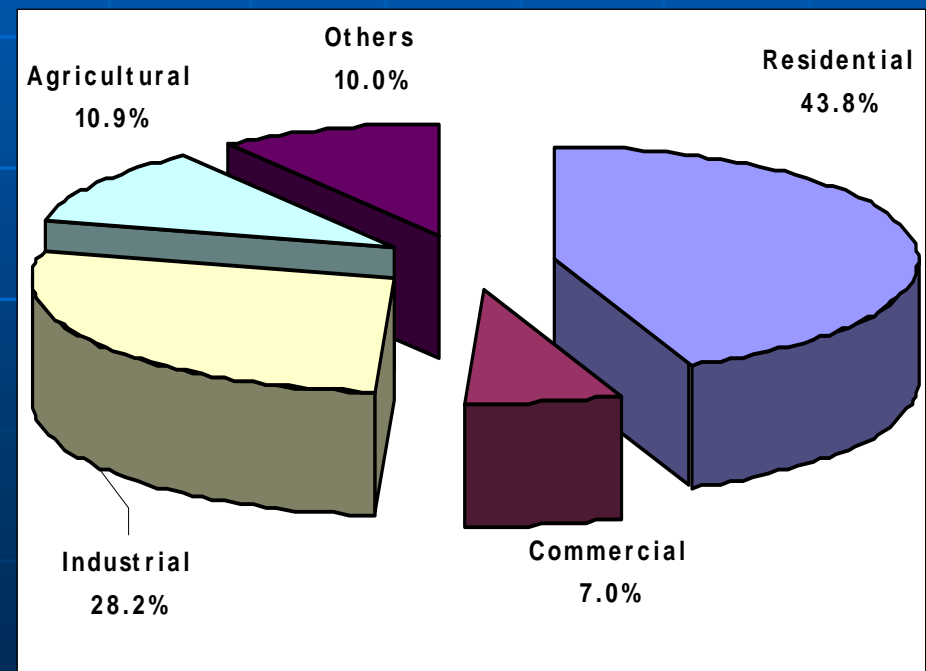
# Consumers Profile & Consumption Pattern

## Consumers Profile

Total 18.9 Million



## Consumption Pattern



# TRANSMISSION SYSTEM

Voltage	Sub Stations				Transmission Lines (circuit km)	
	WAPDA		KESC		WAPDA	KESC
	No.	MVA	No.	MVA		
500 kV	11	14132	-	-	4743	-
220 kV	26	12350	6	2500	7488	276
132 kV	467	21132	40	3459	32437	604
66/33 kV	195	2712	6	215	7552	219
<b>Total</b>	<b>699</b>	<b>50326</b>	<b>52</b>	<b>6174</b>	<b>52220</b>	<b>1099</b>

# EXISTING GENERATING CAPACITY

Type of Generation	Installed Capacity (MW)	Derated/ Dependable Capacity (MW)	Availability (MW)	
			Summer	Winter
<b>WAPDA Hydro</b>	<b>6444</b>	<b>6444</b>	<b>6250</b>	<b>2300*</b>
<b>GENCOs + Rental</b>	<b>4825</b>	<b>4023</b>	<b>2780</b>	<b>3620**</b>
<b>IPPs (incl Nuclear)</b>	<b>6097</b>	<b>5511</b>	<b>4950</b>	<b>5180*</b> *
<b>Total</b>	<b>17366</b>	<b>15978</b>	<b>13980</b>	<b>11100</b>

\* Hydro availability based on 5 years average

\*\* Excludes 10% Forced Outages for GENCOs & 6.0% for IPPs



# Historical Demand (2002 – 2007)

YEAR	WAPDA <sup>+</sup>		KESC		COUNTRY**	
	MW	G.R.	MW	G.R.	MW	G.R.
2001-02	10109	4.02%	1885	1.34%	11875	3.59%
2002-03	10481	3.68%	1885	0.00%	12244	3.11%
2003-04	11078	5.70%	2073	9.97%	13021	6.35%
2004-05	12035	8.64%	2197	5.98%	14091	8.22%
2005-06	13212	9.78%	2223	1.18%	15282	8.45%
2006-07	15138*	14.6%	2349	5.7%	17314	13.33%

+ WAPDA computed demand; excludes export to KESC

\* Excludes 700 MW export to KESC

\*\* Assuming 1% diversity between WAPDA & KESC Power Demands

## Actual surplus/deficit (MW)

<b>2006-07</b>	<b>Demand</b>	<b>Capability</b>	<b>Surplus/ deficit</b>
<b>July</b>	<b>14238</b>	<b>13543</b>	<b>-707</b>
<b>Aug.</b>	<b>14013</b>	<b>13616</b>	<b>-397</b>
<b>Sept.</b>	<b>13976</b>	<b>12947</b>	<b>-1029</b>
<b>Oct</b>	<b>13717</b>	<b>13971</b>	<b>254</b>
<b>Nov.</b>	<b>12073</b>	<b>12537</b>	<b>464</b>
<b>Dec</b>	<b>11743</b>	<b>10897</b>	<b>-846</b>
<b>Jan</b>	<b>12093</b>	<b>11039</b>	<b>-1054</b>
<b>Feb</b>	<b>11590</b>	<b>12552</b>	<b>962</b>
<b>March</b>	<b>12311</b>	<b>1171</b>	<b>-1140</b>
<b>April</b>	<b>13843</b>	<b>13002</b>	<b>-841</b>
<b>May</b>	<b>14650</b>	<b>13567</b>	<b>-1083</b>
<b>June</b>	<b>15838</b>	<b>13292</b>	<b>-2546</b>

# Supply-Demand Position Peak Load Day Of Year 2006-07

During the year 2006-07, the maximum computed demand was experienced on June 11, 2007 and the power supply/demand position at peak time of the day was as follows:

Hydro	5325 MW
GENCOs Thermal	2656 MW
IPPs	5203 MW
Rental	108 MW
Recorded Peak Demand	13292 MW
Load Management	2546 MW
<b>Total Computed Peak Demand</b>	<b>15838 MW</b>
Export to KESC	700 MW
WAPDA Demand without KESC export	15138 MW

# LOAD FORECAST

Year	Projected at GOP Medium Term Development Framework (MTDF) load forecast growth rates	
	MW	G.R
2006-07*	15138 *	
2007-08	16273	7.5%
2008-09	17624	8.3%
2009-10	19193	8.9%
<i>A.C.G.R. (2006-2010)</i>		8.2%
2010-11	20920	9.0%
2011-12	22970	9.8%
2012-13	25175	9.6%
2013-14	27340	8.6%
2014-15	29582	8.2%
<i>ACGR. (2010-2015)</i>		9.1%

# LOAD FORECAST

Year	Projected at GOP Medium Term Development Framework (MTDF) load forecast growth rates	
	MW	G.R
2015-16	31801	7.5%
2016-17	34090	7.2%
2017-18	36545	7.2%
2018-19	39176	7.2%
2019-20	42075	7.4%
ACGR. (2015-2025)		7.3%
2020-21	45273	7.6%
2021-22	48850	7.9%
2022-23	52855	8.2%
2023-24	57295	8.4%
2024-25	62165	8.5%
ACGR. (2020-2025)		8.1%

\* Actual on 11th June, 2007.

# Summary of future Generation Plan (2007-08 to 2011-12)

Year	Thermal			Hydro		Total MW
	Public Sector	IPPs*	Nuclear	Public Sector	IPPs	
2007-08				81		81
2008-09	300	1179		323		1802
2009-10	250	1693		96		2039
2010-11		194	325	83	184	786
2011-12		3675		106	417	4198

\*IPPs which are likely to be implemented

# **SUMMARY OF POWER BALANCES (MW)**

## **WITHOUT SUPPLY & DEMAND SIDE MEASURES**

**Based on Load Demand of 11<sup>th</sup> June-07 projected at GOP MTD Load Forecast Growth Rates**

<b>Year</b>	<b>Jul</b>	<b>Aug</b>	<b>Sep</b>	<b>Oct</b>	<b>Nov</b>	<b>Dec</b>	<b>Jan</b>	<b>Feb</b>	<b>Mar</b>	<b>Apr</b>	<b>May</b>	<b>Jun</b>
<b>2007-08</b>					<b>-2176</b>	<b>-2553</b>	<b>-3049</b>	<b>-2414</b>	<b>-2408</b>	<b>-2453</b>	<b>-2736</b>	<b>-2941</b>
<b>2008-09</b>	<b>-3370</b>	<b>-3332</b>	<b>-3428</b>	<b>-3209</b>	<b>-3177</b>	<b>-3171</b>	<b>-3971</b>	<b>-3301</b>	<b>-3316</b>	<b>-3334</b>	<b>-3293</b>	<b>-3250</b>
<b>2009-10</b>	<b>-3108</b>	<b>-2935</b>	<b>-2533</b>	<b>-1474</b>	<b>-1400</b>	<b>-1448</b>	<b>-1990</b>	<b>-1530</b>	<b>-1399</b>	<b>-1400</b>	<b>-1437</b>	<b>-1459</b>
<b>2010-11</b>	<b>916</b>	<b>940</b>	<b>889</b>	<b>922</b>	<b>943</b>	<b>949</b>	<b>929</b>	<b>961</b>	<b>917</b>	<b>982</b>	<b>885</b>	<b>925</b>
<b>2011-12</b>	<b>908</b>	<b>924</b>	<b>846</b>	<b>926</b>	<b>871</b>	<b>926</b>	<b>936</b>	<b>910</b>	<b>904</b>	<b>913</b>	<b>840</b>	<b>896</b>

*Above figures take into account 700 MW power export to KESC upto June 2011, 160 MW demand of BPC Tawarqi Steel from Jan. 2009 and Capacity Improvement due to Rehabilitation of GENCO's Plants. These figures correspond to Peak demand.*

## HYDROPOWER PROJECTS READY FOR IMPLEMENTATION (PUBLIC SECTOR)

PROJECT	LOCATION	LIVE STORAGE (MAF)	CAPACITY (MW)	ENERGY (GWh)	Estimated Cost (\$ in Billion)	YEAR OF COMPLETION
<b>Diamer Basha Dam</b>	<b>NWFP/NA</b>	<b>6.3</b>	<b>4500</b>	<b>16700</b>	<b>8.5</b>	<b>2015-16</b>
<b>Kala Bagh</b>	<b>Punjab</b>	<b>6.1</b>	<b>3600</b>	<b>14400</b>	<b>6.1</b>	<b>2015-16</b>
<b>Munda</b>	<b>NWFP</b>	<b>0.7</b>	<b>660</b>	<b>2699</b>	<b>1.05</b>	<b>2012-13</b>
<b>Akhori</b>	<b>Punjab</b>	<b>7.0</b>	<b>600</b>	<b>2189</b>	<b>4.4</b>	<b>2016-17</b>
<b>Kurram Tangi</b>	<b>NWFP</b>	<b>0.6</b>	<b>83</b>	<b>383</b>	<b>0.32</b>	<b>2010-11</b>
<b>Total:</b>		<b>20.7</b>	<b>9443</b>	<b>36371</b>	<b>20.37</b>	<b>2016-17</b>



**INTER CONNECTION  
WITH  
NEIGHBOURING  
COUNTRIES**

# Regional Geographical Map



# Import of Power from Iran

- **Agreement signed in Nov 2002**
- **Voltage of inter connection**
  - **Jachigur (Iran) - Mand (Pakistan) : 132 kV**
  - **Taftan 20 kV**
  - **Mushkhel 20 kV**
- **Maximum Power Demand**
  - **For Mand 30 MW**
  - **For Taftan/Mushkhel 1 MW**
- **Price**
  - **Price of electricity per kWh US\$ 0.03**
  - **(for 3 years)**
  - **Min monthly invoicing US\$ 210,000**

# PAKISTAN POWER SECTOR FUTURE PERSPECTIVE

- **System Expansion commensurate with increasing demand**
- **Exploit Maximum Hydro Potential**
  - Large Hydro on Indus & Tributaries (15000 MW)
  - Hydro on other Rivers ( 6000 MW)
  - Small Hydro Schemes on Canals ( 600 MW)
- **Exploit Maximum Indigenous Coal Potential**
  - Coal in the South (6000-8000 MW)
- **Enhance Gas Based Power Generation**
- **Exploit Renewable Energy Resources**
- **Expansion of EHV Transmission System to transport power from hydro & coal resources to the load centres**

# Regional Energy Cooperation

- Pakistan supports every initiative for regional cooperation in Energy Sector
- Pakistan supports establishment of a regional grid of South Asian Countries so as to maximize the utilization of available resources
- Pakistan respects cooperation which is beneficial to all the participating countries

# Reforms-Objective of Reforms

- To provide:
  - Maximum safety (equipment/staff)
  - Maximum security, stability and reliability
  - Stable voltage and frequency
  - Minimum cost
- To attract investment without sovereign guarantees
- Introduce competition and privatization
- Free trade of electricity between cross border countries
- Exchange program/knowledge

# Interconnection Possibilities

Central Asian Countries	Interconnection Already Exists
South Asian Countries	Need to be Connected

## Note:

The Interconnection feasibility is possible both synchronous and asynchronous due to same voltage level and frequency.

Detail study/feasibility need to be performed.

# Legal and regulatory Framework

The following need to be done:

- Compatible Grid Code for interconnected countries.
- Reliability assurance
  - Electrical reliability
  - Political reliability
- Risk factor analysis
- Financing



# ISSUES

- Principal Agreement between all countries.
- Formulation of legal and regulated Authority compatible with the Regulatory framework of each country.
- Pricing regime acceptable to all.
- Reliability assurance
- IFIs initiative.
- portioning/Sectioning of transmission Line domain.
- Selection of voltage (AC or DC)
- Defining road map.
- Deciding quantum of energy to be traded, direction of flow (one way or two way) and seasonal load pattern.

**THANK YOU**