



# Country Report on Energy Security & Power Crisis

JICA Training Course on "Energy Policy (A)"

By

**Arshad Maqsood Malik, Chief (Energy) Planning Commission**  
**Ashfaq Ahmad Sheikh, Dy Registrar Pakistan Engineering Council**



# Sequence of Presentation

- **Pakistan at Glance**
- **Energy Security**
  - **Situation Analysis**
  - **Energy Resource Potential**
  - **Energy Security Plan Objectives(2005-30)**
  - **Projected Supply Demand Analysis and to meet the gap**
  - **Achievements of Security Plan**
- **Power Shortages & Current Energy Situation**
  - **Existing Supply & Demand Situation**
  - **Generation Capability (hydel & thermal )and its Analysis**
  - **Circular Debt in Energy Sector**
- **Conclusion**

# Pakistan - Geographical Location



# Pakistan at a Glance

- Sixth most populous country- Estimated population in 2010 is over 169 million.
- It occupies a crossroads position between South Asia, Central Asia and the Middle East
- It has a 1,046 kilometres (650 mi) coastline along the Arabian Sea and Gulf of Oman in the south .
- Bordering Afghanistan and Iran in the west, India in the east and China in the northeast. Tajikistan also lies very close, separated by the narrow Wakhan Corridor .
- Semi-industrialized economy which mainly encompasses textiles, chemicals, food processing, agriculture and other industries

# Malam – Jaba, Swat



# Shigar Valley, Sakadu, Gilgit-Baltistan



# Noor Mahal Bawalpur-1872



# Rawal Dam - Islamabad





# Need For Energy Security

- Energy plays an important role in the national economy.
- Energy is the economic engine for growth.
- Sustainable, safe and secure energy supplies are essential.
- Energy supplies at affordable price

Access to low cost energy has become essential  
function of modern economics.

# Energy Security Threats

- Un-even distribution of energy supplies led to significant vulnerabilities.
- Political instability of several energy producing countries, manipulation of energy supply.
- Attacks on energy sources and supply infrastructures.
- Accidents and natural disasters.
- Limited supplies, un-even distribution and rising cost of energy.

# Energy Security Threats

Cont...

- Oligopoly or monopoly of suppliers, cartel of countries and single energy super power.
- Sabotage of energy resources and infrastructure through terrorism or warfare.
- New threats to energy security emerged in the form of increased pace of industrialization in the countries like China.

# Situation Analysis

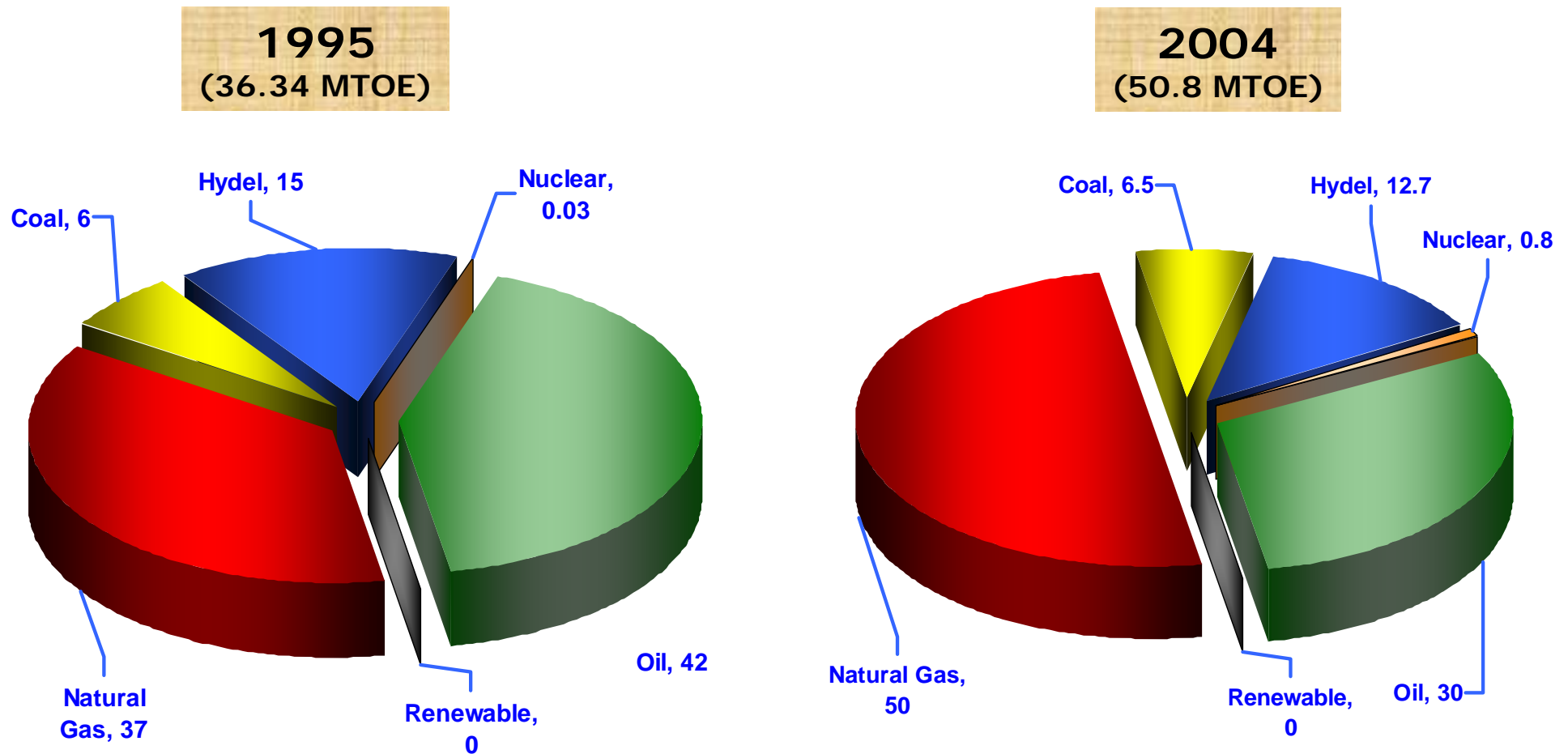
- Pakistan lacks integrated national energy security plan up till 2005.
- Low per capita energy consumption with only 14 million British Thermal Unit (MMBTU) as compared to 92 MMBTU for Malaysia and 514 MMBTU for Japan.
- Per capita energy consumption is a key development indicators of “quality of life” of the population.
- Demand suppression strategy has been used which has perpetuated unavailability of energy.
- Unavailability of sustained and affordable energy to industry which has suppressed economic growth and created declining tendency for industrial investment in Pakistan.

# Energy Policies

- Presently seven policies related to energy sector are in place or being updated.
  - Liquefied Natural Gas(LNG) Policy-2006
  - Liquefied Petroleum Gas (LPG)-2006
  - Natural Gas Allocation & Management Police-2005
  - Petroleum Policy -2009
  - Policy for Power Generation Projects-2002
  - Pakistan Renewable Development Policy-2006
  - National Policy for Coal Development-2010(Inprogress)

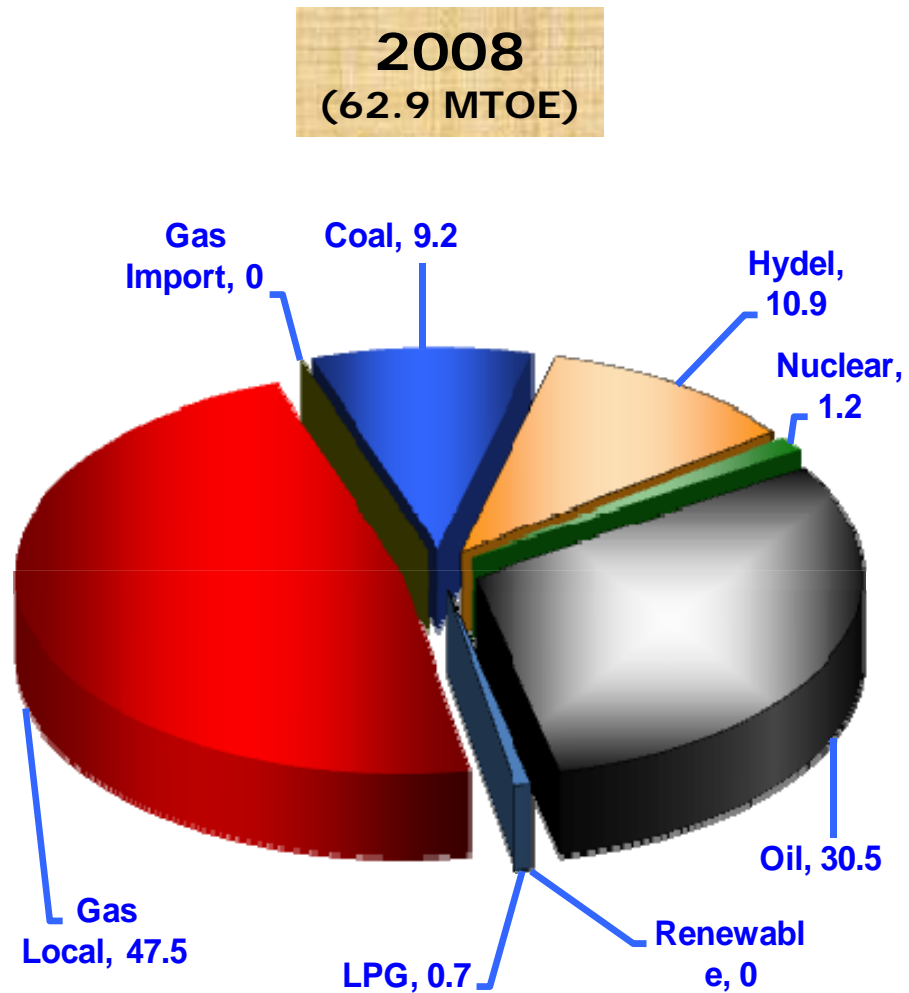
To meet 21<sup>st</sup> Century challenges, an Integrated Energy Policy is essential.

# Pakistan Primary Energy Mix (%age)



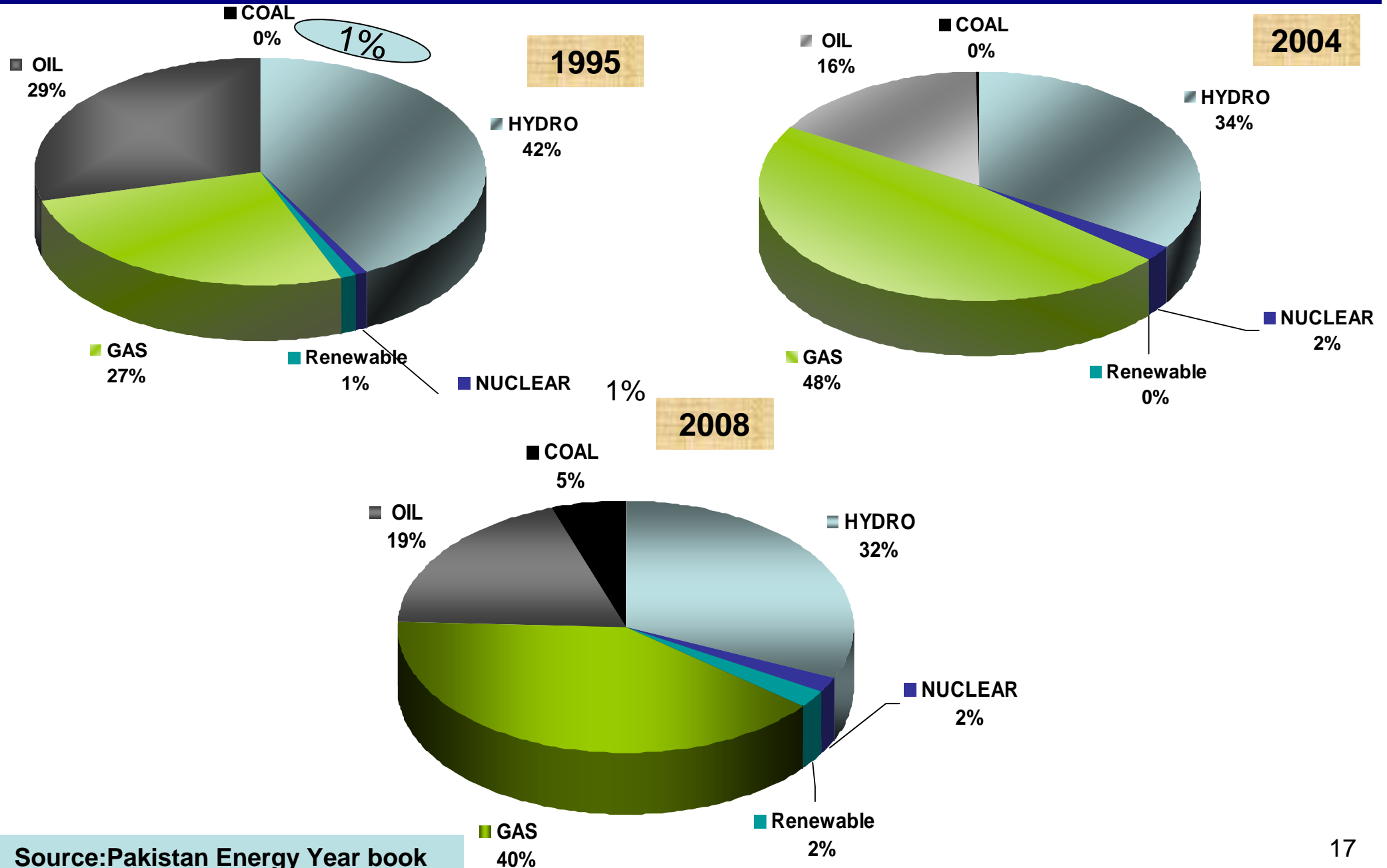
Source: Pakistan Energy Year book

# Pakistan Primary Energy Mix (%age)



Source: Pakistan Energy Year book

# Energy Mix in Power Generation (%age)



Source: Pakistan Energy Year book



# Energy Security Plan Objectives (2005-30)

- Maximum utilization of indigenous resources (coal, gas, hydel, nuclear and renewable) to meet the growing demand on a sustained and affordable basis thereby providing energy security, sovereignty and sustainability.
- Promotion of R&D for improvement in energy efficiency and conservation and development of energy efficient appliances.
- Improve quality of consumer services and creating competitive environment to solicit maximum private sector participation.

# Energy Security Plan Objectives

Cont...

- To improve the strategic oil reserves from 20 days to 45 days.
- Integrated coal mining & power generation and coal gasification to increase the indigenous coal share in the energy mix i.e. upto 20% in 25 years plan and lay the foundation for future share to go up to 50%.
- Reduce dependence on imported oil through accelerated exploitation of indigenous resources.
- Resort to import of natural gas and LNG through multiple sources on best possible terms if indigenous resources fall short to maintain GDP growth.

# Energy Security Plan Objectives

Cont...

- Maximize indigenization of design and manufacturing of Power Market Equipment (PME) to minimize capital cost and O&M expenses.
- Facilitate establishment of refineries and petrochemical industry based on coal, gas and oil.
- Promotion of nuclear and renewable/alternate energy sources (wind, solar) to have 10% share in energy mix in 25 years.
- Promote human resource development to ensure availability of required manpower to achieve Plan objectives.

# Ultimate Energy Resource Potential Estimates

## Hydrocarbon

Resource Category	Ultimate/Proved estimates	Level Of Production	Level Of Consumption (2009)
Oil (barrels)	27bill*/300 mill (1.1%)	22.6 M.Barrels (7.5%)	80.0 M. barrels
Natural Gas (Cubic meters)	8.0*/0.8 TCM (10%)	113 MCMD (0.01%)	113 MCMD
Coal (Tones)	185/3.3 billion tons (1.8%)	3.3 M. Tons (0.1%)	6.1 M. Tons

### Power (Hydel)

56,721 MW  
(Identified  
Potential)

6,459 MW (12%)  
(29,853 GWh)  
(Installed capacity)

83,755 GWh  
(Total Electricity  
Generation)

### Power (Wind)

43,000 MW  
(Identified Potential)

(First 50 MW in-  
progress)

# Pakistan's Hydropower Potential

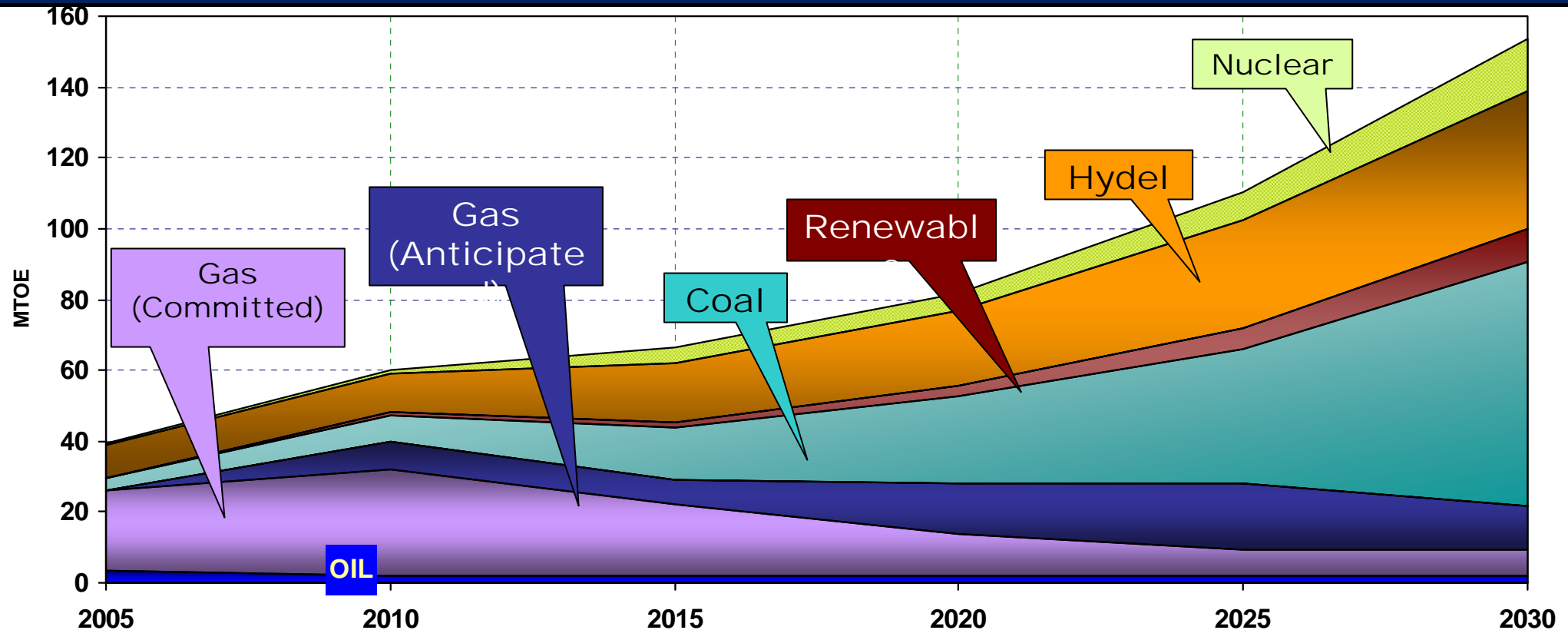
Sr. No.	River/ Tributary	Power (MW)
1.	Indus River	37780
2.	Tributaries of Indus (Northern Areas) & NWFP	6006
	Sub Total (1+2)	43786
3.	Jhelum River	3143
4.	Kunhar River	1435
5.	Neelum River & its Tributaries	1844
6.	Poonch River	397
	Sub Total (3+4+5+6)	6819
7.	Swat River & its Tributaries	2371
8.	Chitral River & its Tributaries	2282
	Sub Total (7+8)	4653
9.	Schemes below 50 MW on Tributaries	1055
10.	Schemes below 50 MW on Canals	408
	Sub Total (9+10)	1463
<b>TOTAL</b>		<b>56721</b>

## Wind Energy Survey - Potential

- Based on the survey, potential areas for installing wind power farms have been identified.
- These areas having coverage of 9700 sq. km in Sindh have a gross wind power potential of 43,000 MW.  
(Gross Potential of the Area corresponding to 25% capacity Factor =  $9749 \times 4.5 = 43871$  MW)
- Keeping in view the area utilization constrains etc. the exploitable electric power potential of this area is about 11,000 MW. Exploitable potential (25% of the Area) = 11000 MW
- Northern Areas Survey is still under progress
- Solar Energy Potential is huge which is still to be tapped

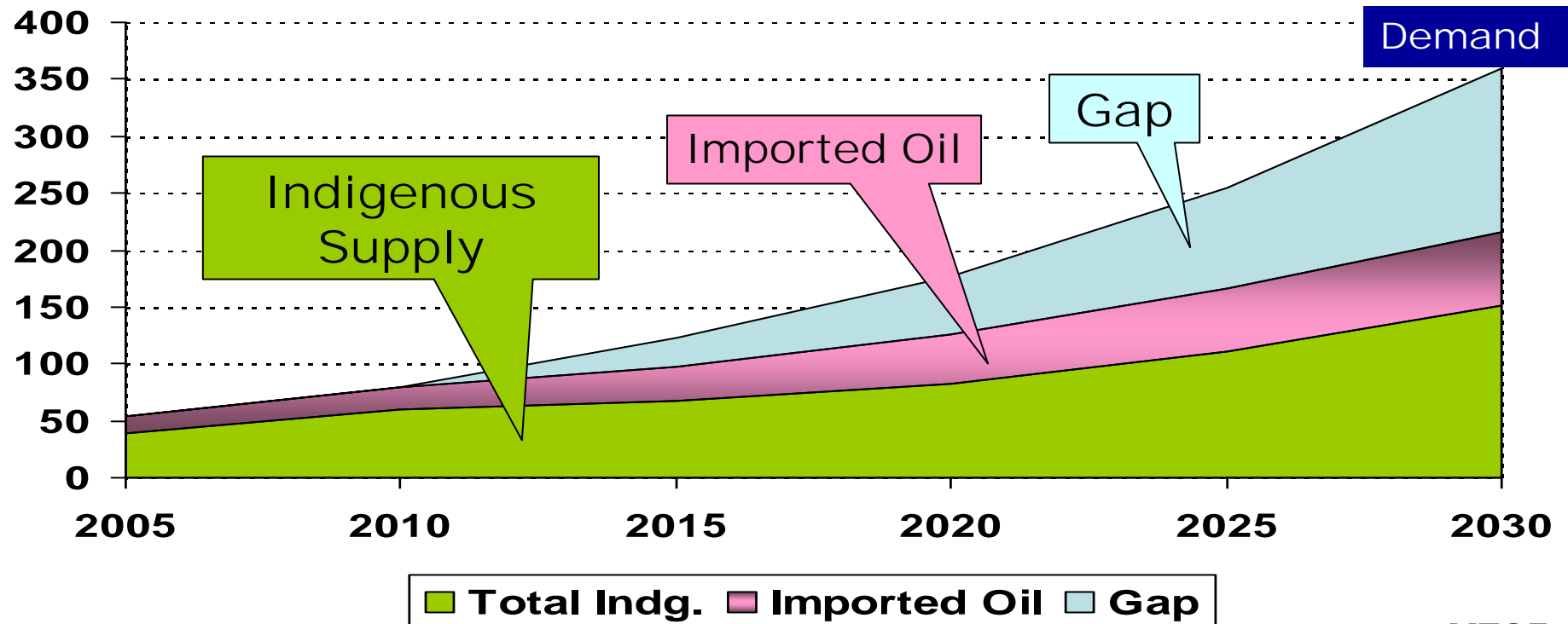
# INDIGENOUS SUPPLY PROJECTIONS

MTOE



	2005	2010	2015	2020	2025	2030
OIL	3.62	2.20	2.18	2.20	2.20	2.20 (1.4%)
GAS (Committed)	22.30	29.93	20.22	11.81	7.29	7.29 (4.7%)
GAS (Anticipated)	1.00	7.85	6.68	13.82	18.34	12.35 (8.0%)
COAL	2.30	7.40	14.81	24.77	38.28	68.65 (44.6%)
RENEWABLE	0.00	0.84	1.60	3.00	5.58	9.25 (6.0%)
HYDEL	9.24	11.03	16.40	21.44	30.5	38.93 (25.3%)
NUCLEAR	0.73	0.69	4.81	4.81	8.24	15.11 (9.8%)
<b>TOTAL</b>	<b>39.29</b>	<b>59.94</b>	<b>66.70</b>	<b>81.85</b>	<b>110.43</b>	<b>153.78 (100%)</b>

# ENERGY SUPPLY DEMAND GAP



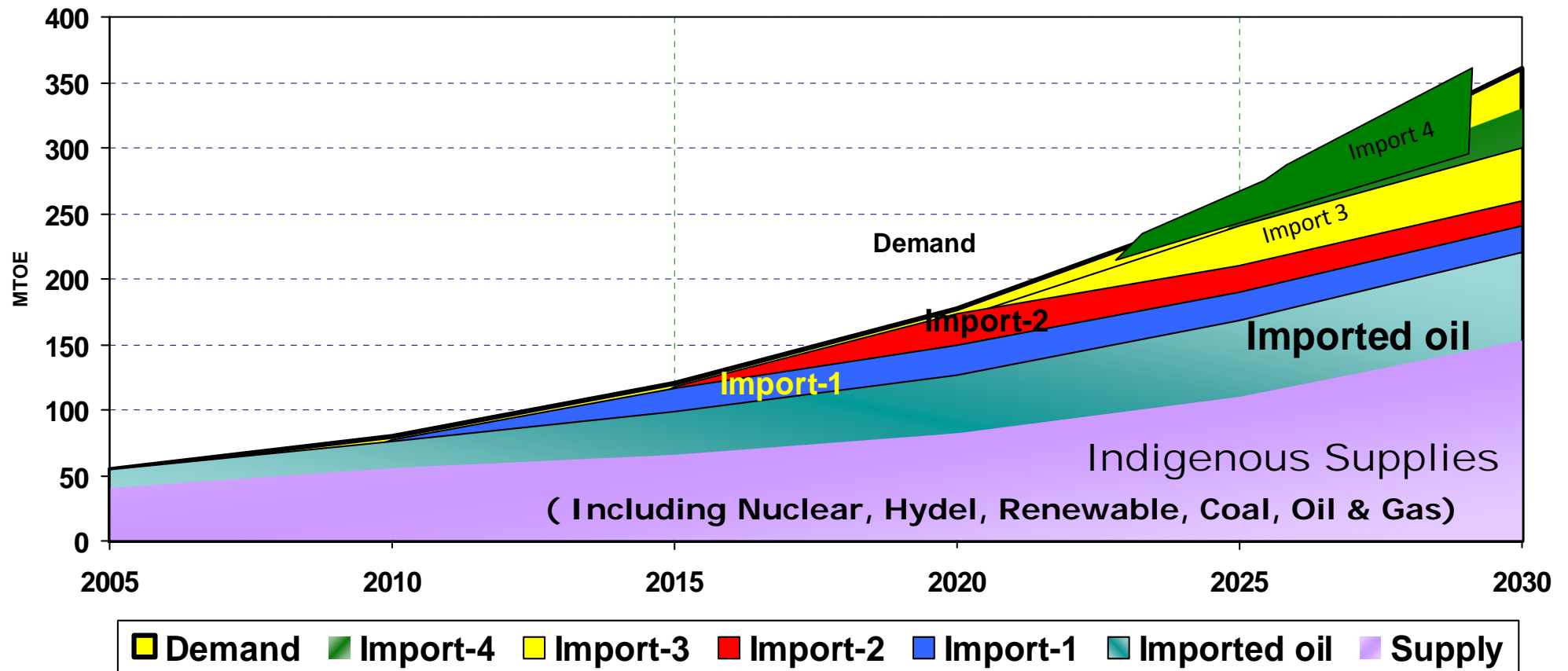
	MTOE					
	2005	2010	2015	2020	2025	2030
INDIGENOUS SUPPLIES	39.38	59.94	66.70	81.85	110.43	153.79
IMPORTED OIL	14.66	18.80	30.33	43.27	55.73	63.55
IMPORTED COAL	1.00	2.00	2.00	2.00	2.00	2.00
<b>GRAND TOTAL</b>	<b>54.04</b>	<b>80.74</b>	<b>99.03</b>	<b>127.12</b>	<b>168.16</b>	<b>219.34</b>
<b>DEMAND</b>	<b>53.78</b>	<b>79.55</b>	<b>122.96</b>	<b>176.63</b>	<b>255.37</b>	<b>361.47</b>
<b>GAP</b>	<b>0.00</b>	<b>0.81</b>	<b>25.93</b>	<b>51.51</b>	<b>89.21</b>	<b>144.13</b>

Note: Greater explorations as proposed should result in increased indigenous supplies and narrow the demand-supply gap. The dependence on imported energy would accordingly go down and timely adjustment for import of fuel taken to reduce outflow of foreign exchange.



# ENERGY GAP COVERAGE STRATEGY

MTOE



	2005	2010	2015	2020	2025	2030
<b>SUPPLY</b>	54.04	76.19	98.66	127.11	168.16	220.37
<b>DEMAND</b>	54.05	79.40	120.17	177.34	255.37	361.31
<b>GAP</b>		(3.21)	(21.51)	(50.23)	(87.21)	(140.94)
Gas Import-1	--	3.0	15.6	15.6	15.6	15.6
Gas Import-2	--	--	5.0	27.0	27.0	27.0
Gas Import-3	--	--	--	5.0	27.0	27.0
Gas Import-4	--	--	--	--	15.0	27.0

# Power Generation Plan (2005-30)

M.W

Years	Nuclear	Hydel	Coal	Renewable	Oil	Gas	Total	Cumulative
Existing (2005)	400	6460	160	180	6400	5940	19540	
Addition:								
2010	-	1260	900	700	160	4860	7880	27420
2010-15	900	7570	3000	800	300	7550	20120	47540
2015-20	1500	4700	4200	1470	300	12560	24730	72270
2020-25	2000	5600	5400	2700	300	22490	38490	110760
2025-30	4000	7070	6250	3850	300	30360	51830	162590
Total:	8800	32660	19910	9700	7760	83760	162590	

**Note:** KANNUP to be retired in 2019

# Projected Hydel Power Projects (2005-30) MW

Years	CAPACITY	CUMULATIVE
<b>EXISTING (2005) (Including Ghazi Barotha)</b>	<b>6,460</b>	<b>6,460</b>
<b>ADDITION 2010</b>	<b>1,260</b>	<b>7,700</b>
<b>ADDITION 2010-15</b>	<b>7,570</b>	<b>15,300</b>
<b>ADDITION 2015-20</b>	<b>4,700</b>	<b>20,000</b>
<b>ADDITION 2020-25</b>	<b>5,600</b>	<b>25,600</b>
<b>ADDITION 2025-30</b>	<b>7,070</b>	<b>32,700</b>

# New Hydro Power Projects (2005-30) MW

2010		2015		2020		2025		2030	
Public		Private/BOT		Public		Public		Public	
Pehur	19	Neelum Jhelum	969	Basha	4500	Small/Low Head Hydel	200	Small/Low Head Hydel	2400
Alai Khwar	121	Swat Cascade	469	Small/Low Head Hydel	200	Bunji Dam	5400	Dasu	3700
Duber Khwar	130	Suki Kinari	655	<b>Total</b>	<b>4700</b>	<b>Total</b>	<b>5600</b>	Karot	240
Khan Khwar	72	Taunsa	120					Partind Akhori	133 600
Malakand-III	81	Munda	740					<b>Total</b>	<b>7073</b>
Jinnah Barrage	96	Private							
Keyal Khwar	130	Kohala	740						
Golen Gol	106	<b>Public</b>							
<b>Private/BOT</b>		Kalabagh	3600						
New Bong Hydro Power	79	Small/ Low Head Hydel	100						
Rajdhani Power Project	132	<b>Total:</b>	<b>7573</b>						
Matiltan Distt Swat	84								
Kotli Hydro Power Project	97								
Gulpur Hydro Project	60								
Small/ Low Head Hydel	50								
<b>Total</b>	<b>1257</b>								

# Progress on Hydropower Plans (2010)

No.	Status	Capacity (MW)
1	Hydel Stations in Operation	6,444
2	Under Construction	1,505
3	Ready for Construction	4,689
4	Project under Feasibility Studies	24,341
Total		36,979

# Projected Coal Power Projects (2005-30) (MW)

Years	CAPACITY	CUMULATIVE
<b>EXISTING (2005)</b>	<b>160</b>	<b>160</b>
<b>ADDITION 2010</b>	<b>900</b>	<b>1,060</b>
<b>ADDITION 2010-15</b>	<b>3,000</b>	<b>4,060</b>
<b>ADDITION 2015-20</b>	<b>4,200</b>	<b>8,260</b>
<b>ADDITION 2020-25</b>	<b>5,400</b>	<b>13,660</b>
<b>ADDITION 2025-30</b>	<b>6,250</b>	<b>19,910</b>
<b>Mainly based on Thar, Lakhra and Sonda Jherak</b>		

# Projected Renewable Power Projects (2005-30)

Years	CAPACITY	CUMULATIVE
	MW	
EXISTING (2004-05)	180	
ADDITION 2010	700	880
ADDITION 2010-20	2270	3150
ADDITION 2020-30	6550	9700

## NEW SOLAR WIND POWER PROJECTS (CAPACITY IN MW)

2010		2020		2030	
WIND/ SOLAR / OTHERS	700	WIND/ SOLAR /OTHERS	2270	WIND/ SOLAR /OTHERS	6550

**Additional availability through Solar products development to minimize energy imports**

## Achievements of Energy Security Plan (2005-10)

- The targets set in the Energy Security Plan for five years (2005-10) could not be fully accomplished
- Against the target of 1,260 MW of hydel power, the progress was very slow and only 536 MW of projects will be completed by 2011.
- The plan for coal based power generation was 900 MW. However, it is expected that 300 MW will be added in 2012-13 and 2,440 MW by year 2015.



## Achievements of Energy Security Plan Cont...

- The Plan for renewable energy was 700 MW . However, it is expected that 320 MW from wind will be added by 2011-12 and 1070 MW up to 2014-15.
- The project import of gas from Iran has been delayed by 3-4 years. Gas Sale Purchase Agreement (GSPA) in December 2007 was initialed; still many aspects to be finalized.
- The plan envisages the import of LNG up to 2009 and now is expected to be commissioned in next two to three years.

# Power Crises

# Electricity Supply & Demand Position(2007-08)

YEAR 2007-08	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total Demand
<b>DEMAND</b>	17675	17681	17873	16218	14537	14653	14994	14689	15620	16958	18196	19100	19100
<b>SUPPLY</b>	13974	13978	14130	12821	11493	11584	11854	11613	12349	13407	14386	15100	15100
<b>Deficit</b>	3701	3703	3743	3397	3044	3069	3140	3076	3271	3551	3810	4000	4000

Note: The total installed capacity is 19,420 MW.

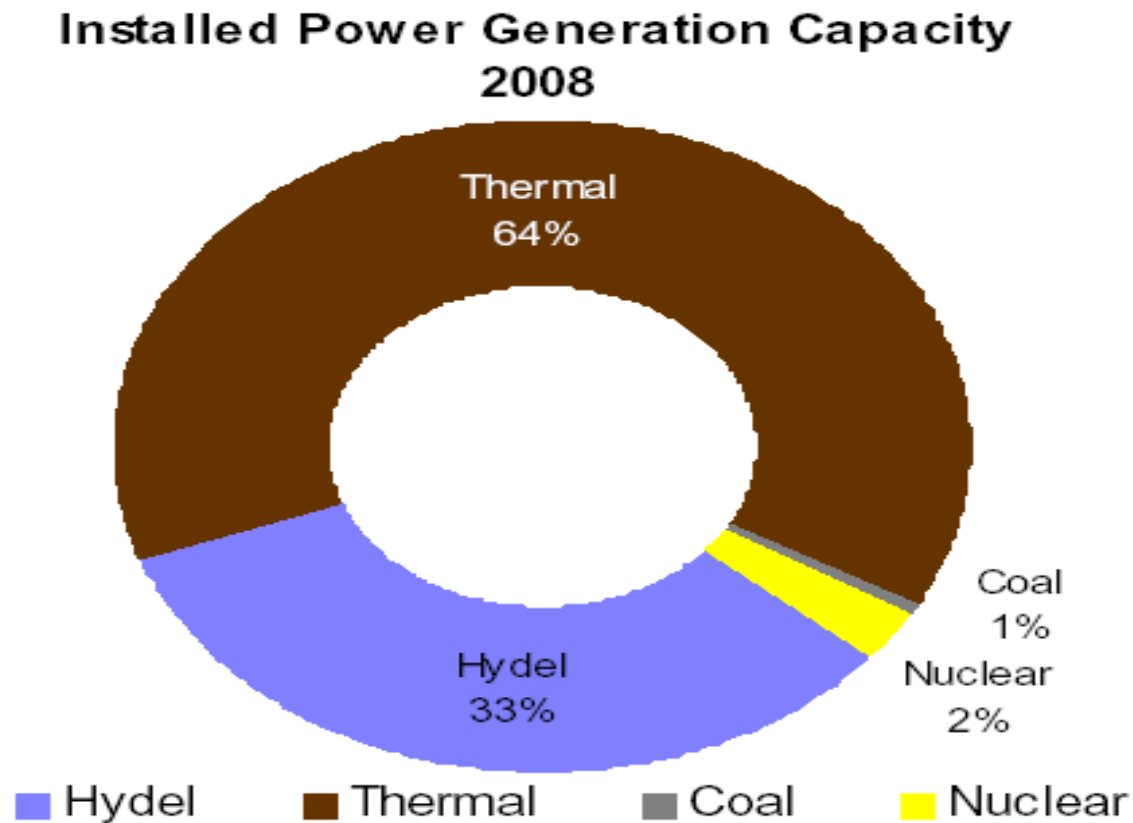
# Transmission & Distribution Losses and Theft

DISCO	Transmission Losses (%)	Distribution Losses (%)	
LESCO	6.6%	13.02	Areas with greater private industrial load
GEPCO		11	
FESCO		10.8	
IESCO		11.5	
MEPCO		16.8	
PESCO+TESCO		34.5	
HESCO		31.8	
QESCO		21.5	
Total WAPDA		24	
KESC	5.1%	29.0	
Expected	Total: 7 – 8 %		

***The high losses need to be reduced.***

***i) Up-gradation of transmission & distribution system; ii) improvement in recovery in Electricity consumption bills***

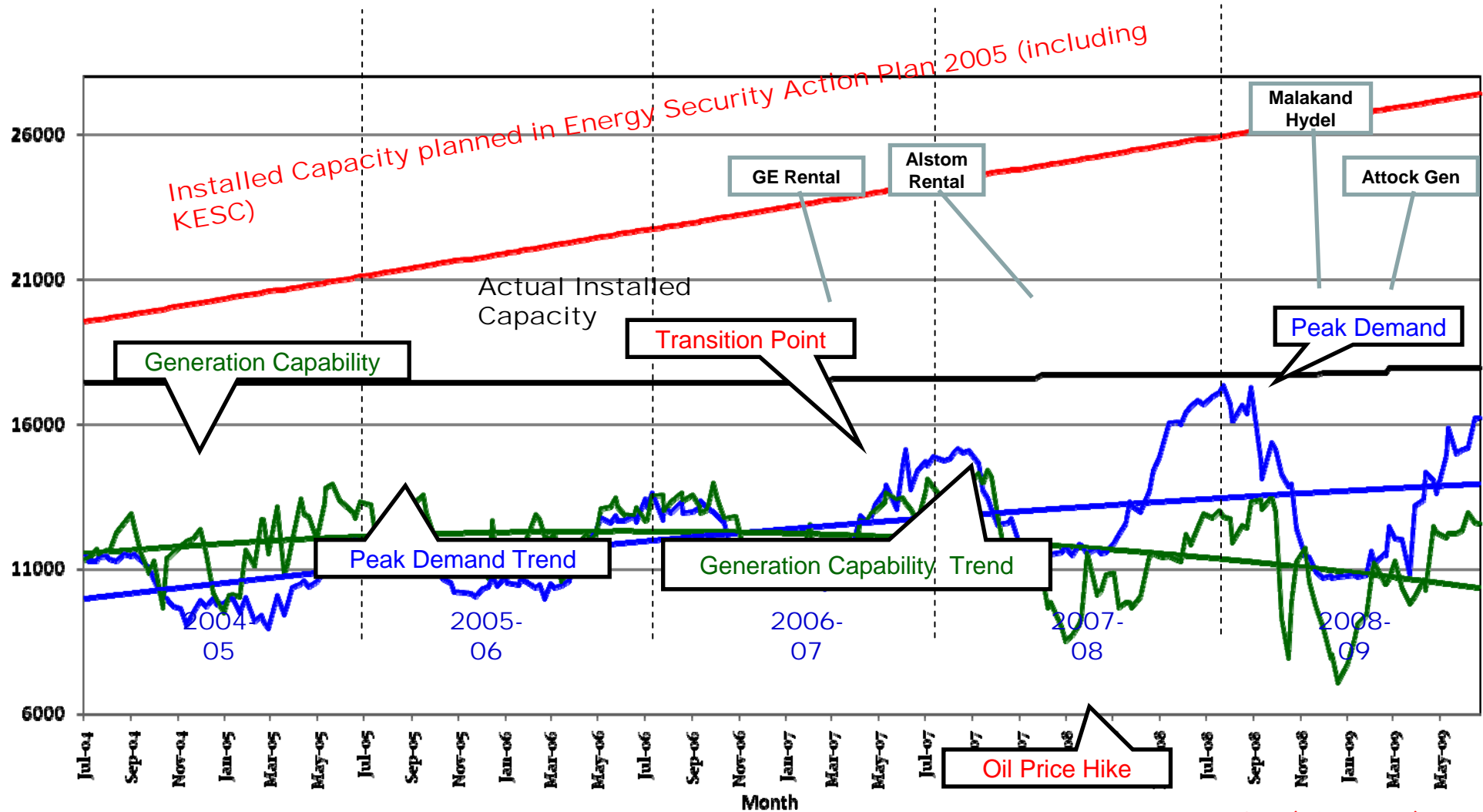
# Existing Generation Capacity and Supply Position



- Higher thermal generation pushed the tariff upwards creating financial difficulties for the public and the Government.

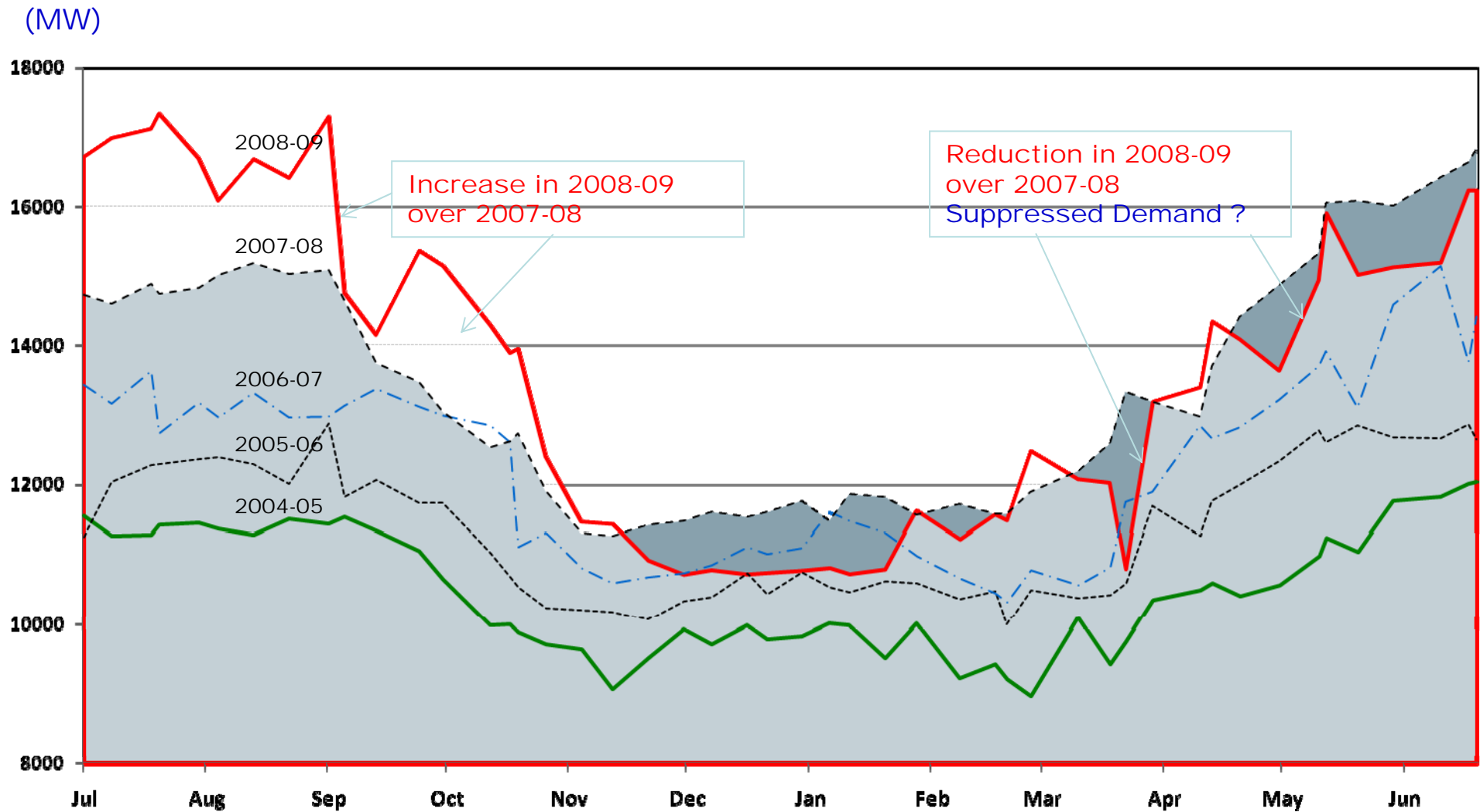
# Peak Demand vs. Generation Capability 2004-05 to 2008-09

(MW)



Source: GM (Planning), NTDC

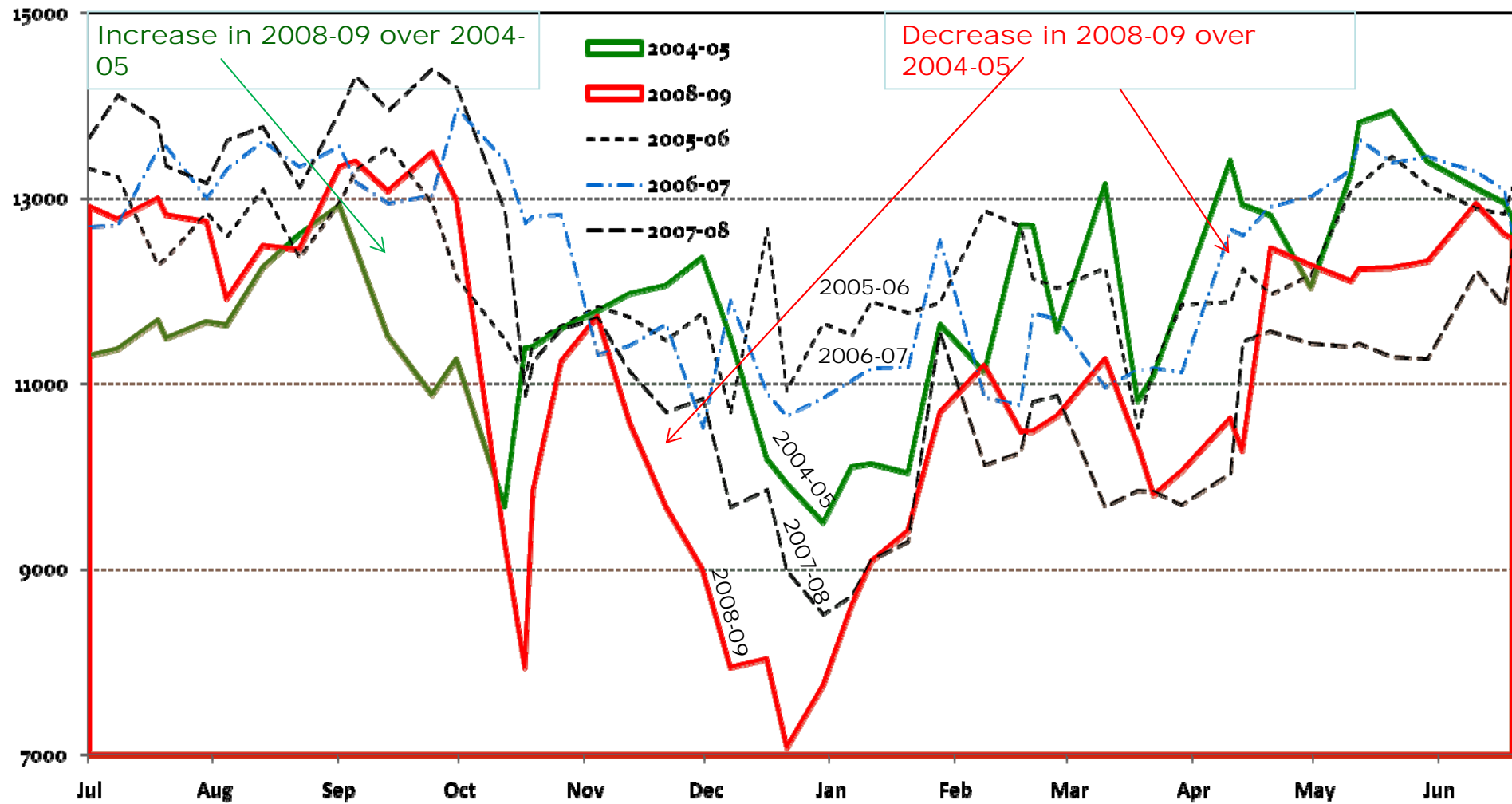
# Seasonal Variation in Peak Demand 2004-05 to 2008-09



Source: GM (Planning),  
NTDC

# Seasonal Variation in Generation Capability 2004-05 to 2008-09

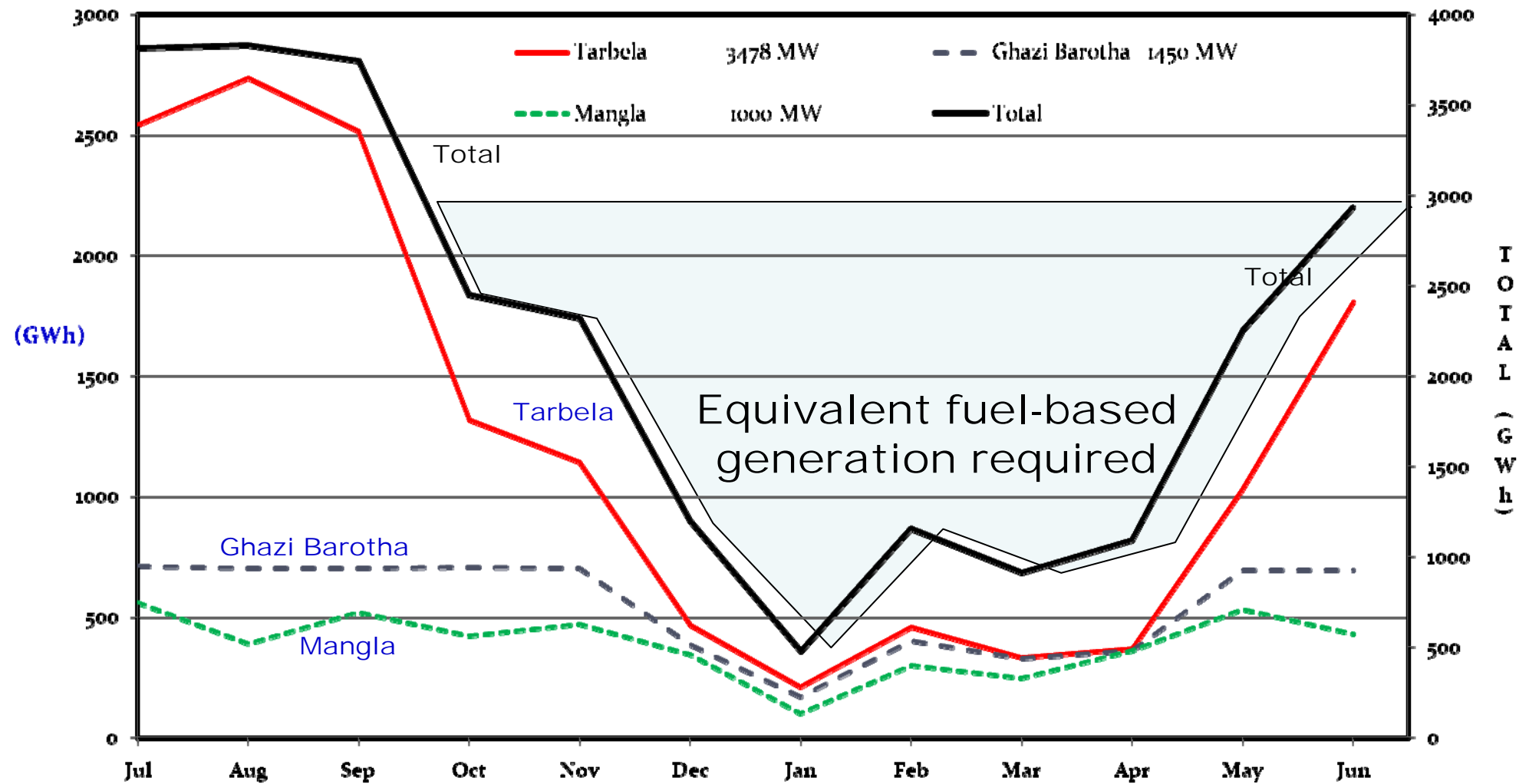
(MW)



Source: GM (Planning), NTDC



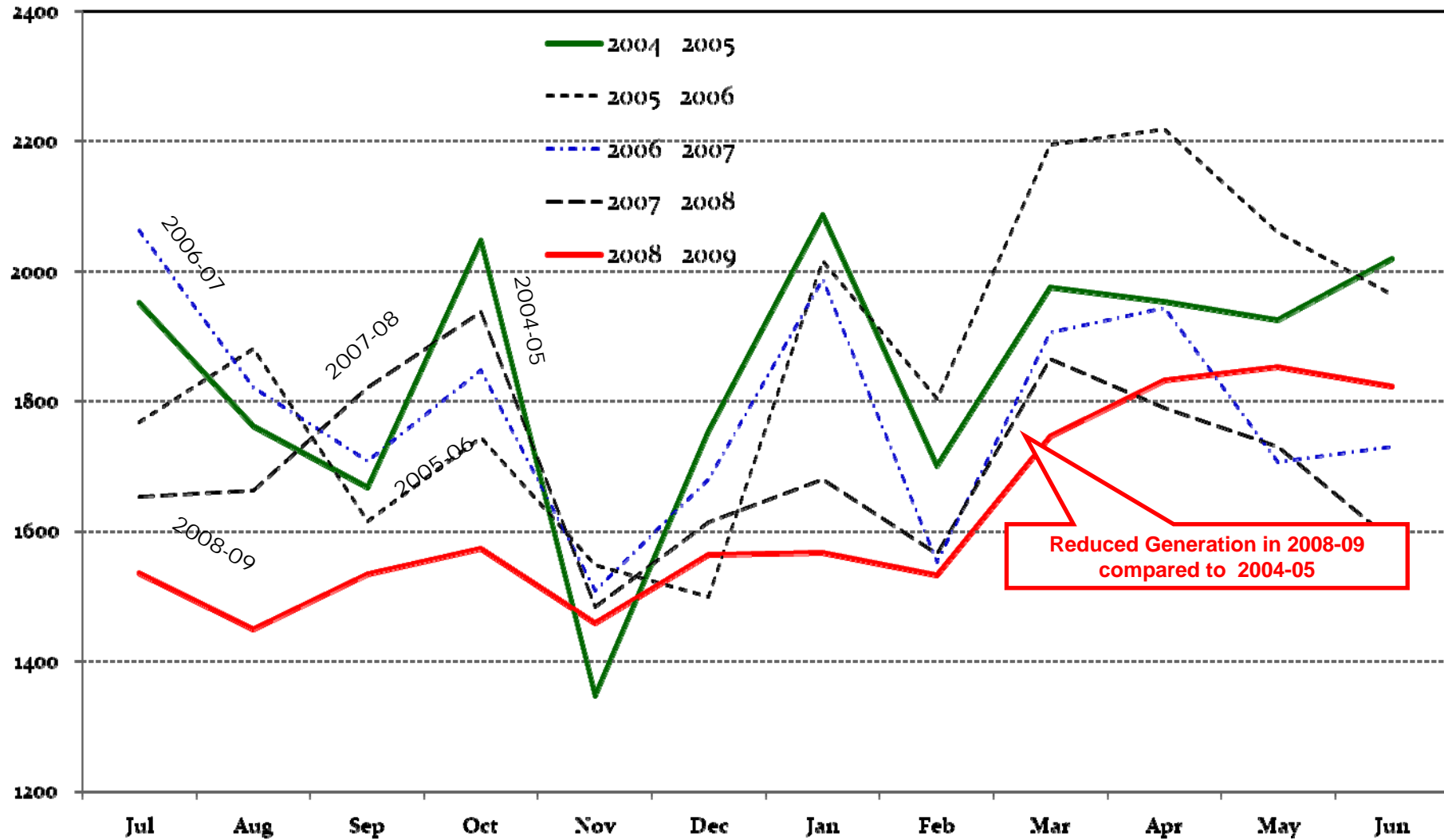
# Seasonal Variation of Hydel Generation (2007-08)



Source: GM (Planning), NTDC

# Seasonal Variation in Generation from GENCOs 2004-05 to 2008-09

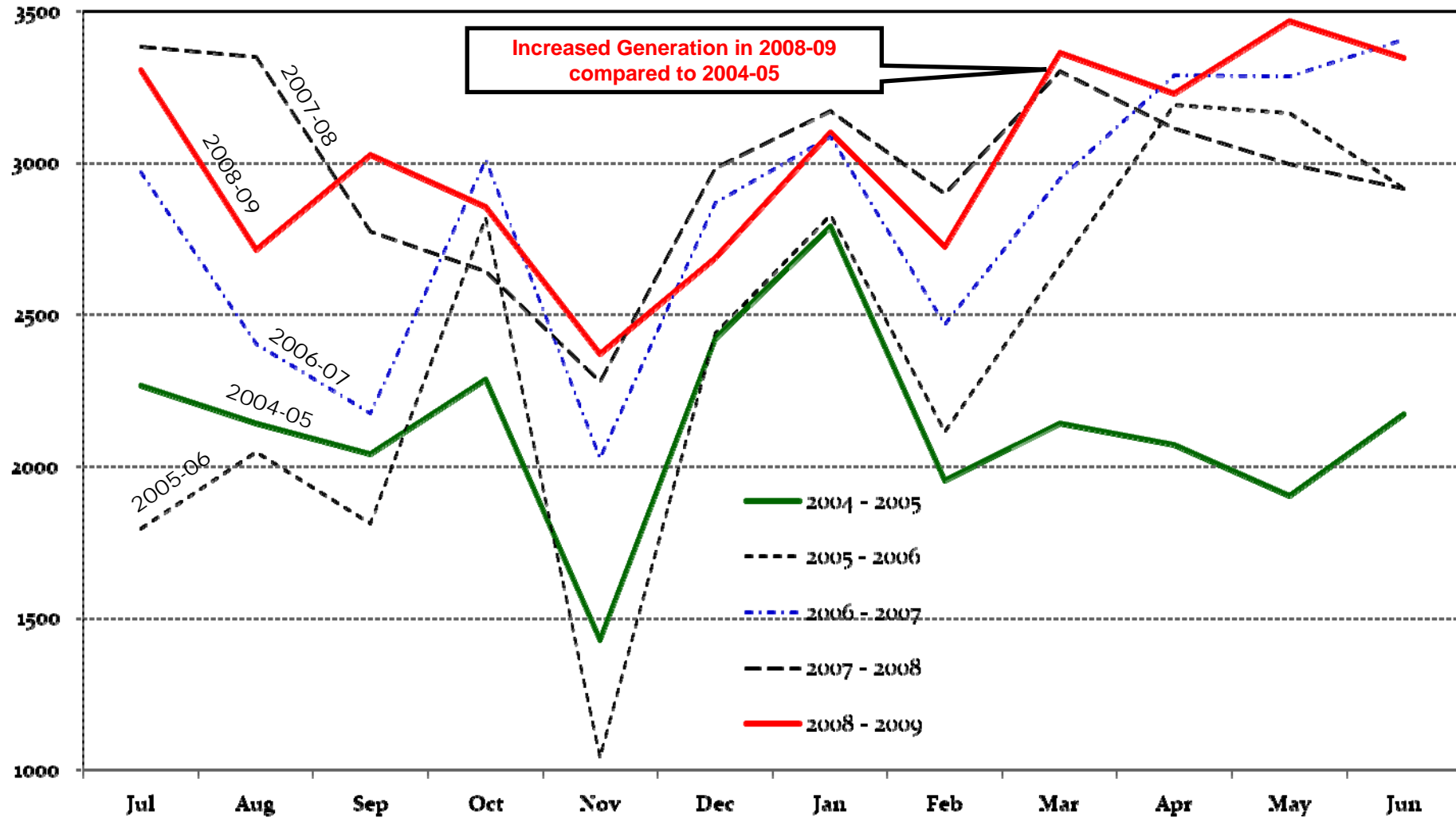
(GWh)



Source: GM (Planning), NTDC

# Seasonal Variation in Generation from IPPs 2004-05 to 2008-09

(GWh)



Source: GM (Planning), NTDC

# Electricity Generation - Capacity Factors WAPDA/ NTDC

Type	No. of Plants	Capacity (MW)	Capacity Factor (%)		
			2005-06	2006-07	2007-08
Hydro	14	6,444	54%	56%	51%
IPPs	17	5,923	53% <sup>**</sup>	63%	64% <sup>***</sup>
PEPCO	10	4,779	54%	52%	49%
Nuclear	1	325	76%	68%	86%
<b>Total</b>	<b>42</b>	<b>17,471</b>	<b>54%</b>	<b>57%*</b>	<b>56%*</b>

\* Had this been 70%, load-shedding would not be so severe.

\*\* Due to lower demand?

\*\*\* Due to fuel shortage?

***There is a need to improve the Capacity Factors.***

***Incentive bonus related to production is one of the solutions.***

## Present Crisis of Circular Debt

- Low availability of water causes less cheap hydel power generation and thermal generation make the power tariff higher.
- Exceptional surge in oil prices in 2008 trading goes up from US \$ 50 per barrel to US \$ 147 per barrel. (Subsidized + Government pick up subsidy from own resource).
- Government subsidies and cross subsidies and non payment to producers on time.
- High distribution losses erode profitability of distribution companies and result into non-payment to generation companies including Independent Power Producers (IPPs).

# Circular Debt in the Energy Sector

- Pakistan Electric Power Company (PEPCO) in-ability to pay IPPs.
- IPPs have to pay to Pakistan State Oil (PSO) for furnace oil on a regular basis.
- PSO have to make payments to refineries and product imports on regular basis.
- The situation becomes even more complex when the government increases the power tariff to narrow the deficit, however with this the pilferage/losses goes up

Due to non-payments to IPPs, GENCOs results in less generation and causes power crisis

## **Short Term Arrangements-Energy Crisis**

- **To cover the acute shortage 2624 MW were planned to manage through Rental Power Generation.**
- **High tariff and political repercussions delayed this arrangement.**
- **2624 MW was to be commissioned in 2009, now will be online by end of 2010.**

# Rental Power Plants

No.	RPP Name	Net Capacity (MW)	Fuel Type	Rental Period (Months)	Rental Tariff <sup>5</sup> at 60% Plant Factor (Cents/kWh)	Estimated COD	Down Payment Disbursed	Contracts Status <sup>6</sup>
<b>PEPCO ICB Projects</b>								
1	Pakistan Power Resources, Guddu	110	Low BTU gas	36	8.44	10-Feb	14%	Effective
2	Pakistan Power Resources, Piranghaib, Multan	192	RFO	48	18.96	10-Jul	NIL	Signed
3	Techno Rental Power Project-I, Summmundri, Faisalabad	150	RFO	36	18.64	10-Jan	14%	Effective
4	Techno Rental Power Project-II, Sahuwal, Sialkot	150	RFO	48	18.7	10-Jun	7%	Effective
5	Young Gen Power, Faisalabad	200	RFO	36	15.59	10-Jun	14%	Effective
<b>PPIB ICB Projects</b>								
6	Gulf Rental Power, Gujranwala	62	RFO	60	17.82	10-Feb	14%	Effective
7	Independent Power Limited	200	RFO	60		10-Jun	NIL	Under Process
8	Kamoki Energy Limited	70	RFO	60	20.56	10-Aug	NIL	Signed
9	Karkey Karadeniz, Karachi (Karkey I)	232	RFO	60	22.36	10-Apr	14.16%	Effective
10	Premier Energy	58	RFO	60		10-Jun	NIL	Under Process
11	Reshma Power Generation, Manga-Raiwind Road	201	RFO	60	20.26	10-Mar	14%	Effective
12	Ruba Power Generation, Manga-Riawind	156	RFO	60	20.27	10-Jul	NIL	Signed

Source: Asian Development Bank Report 2010.



# Rental Power Plants Cont....

No.	RPP Name	Net Capacity (MW)	Fuel Type	Rental Period (Months)	Rental Tariff <sup>5</sup> at 60% Plant Factor (Cents/kWh)	Estimated COD	Down Payment Disbursed	Contracts Status <sup>6</sup>
13	Sialkot Rental Power, Eminabad	65	RFO	60	19.16	10-Jul	NIL	Signed
14	Walter Power International, Karachi	205	RFO	60	22.24	10-Oct	NIL	Signed
<b>Unsolicited Projects</b>								
15	Abbas Steel	100	RFO	60		10-Jun	NIL	Under Process
16	Karkey Karadeniz, Karachi (Karkey I)	222	RFO	60		10-Jun	NIL	Under Process
17	Techno-E-Power (Pvt.) Limited, Summundri Rd., Faisalabad	150	RFO	36	18.64	10-Jun	NIL	Signed
18	Walters Power International, Naudero-I	51	Gas	60	9.5	10-Jun	14%	Effective
19	Walters Power International, Naudero-II	50	Gas	60		10-Jun	NIL	Under Process

# Conclusion

- Energy Security Plan targets could not be accomplished in time.
- Political issues and provincial harmony
- Inefficiencies in energy sector including technical and management in public and private sectors both.
- Unavailability of funds.
- Law and order situation in the country.

# THANK YOU