

PROSPECTS OF NUCLEAR POWER IN PAKISTAN

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OUTLINE

- ❑ Current Status of Power Sector in Pakistan
- ❑ Electricity demand projections and prospective supply options
- ❑ Current status of nuclear power and expansion plans
- ❑ Policy and Initiatives after Fukushima
- ❑ Summary

❑ Installed Capacity* : 22,477 MW (Gross)

- Oil & gas : 67.0%
 - Coal : 0.7%
 - Hydro : 28.8%
 - Nuclear : 3.5%
- } Fossil Fuels 67.7 %

❑ Peak Demand : 21,063 MW (Last summer)

❑ Shortages of electricity supply primarily due to:

- Capacity shortfall
- De-rated capacity of some plants,
- Shortage of fuel (natural gas due to other uses and furnace oil due to circular debt),
- Seasonality of hydro (Capacity factor ~50%).

The above resulted in load shedding. On June 16, 2012, load shedding was ~ 8500 MW

* July 2011, Pakistan Energy Yearbook 2011

❑ Electricity Generation (2010-11): 95.6 TWh

Hydro:	33.6%
Oil:	35.1%
Gas:	27.3%
Coal:	0.1%
Nuclear:	3.6%
Imported:	0.3%

Fossil Fuels
62.5%

**Heavy Dependence
on Oil/gas
Mix Not Sustainable**

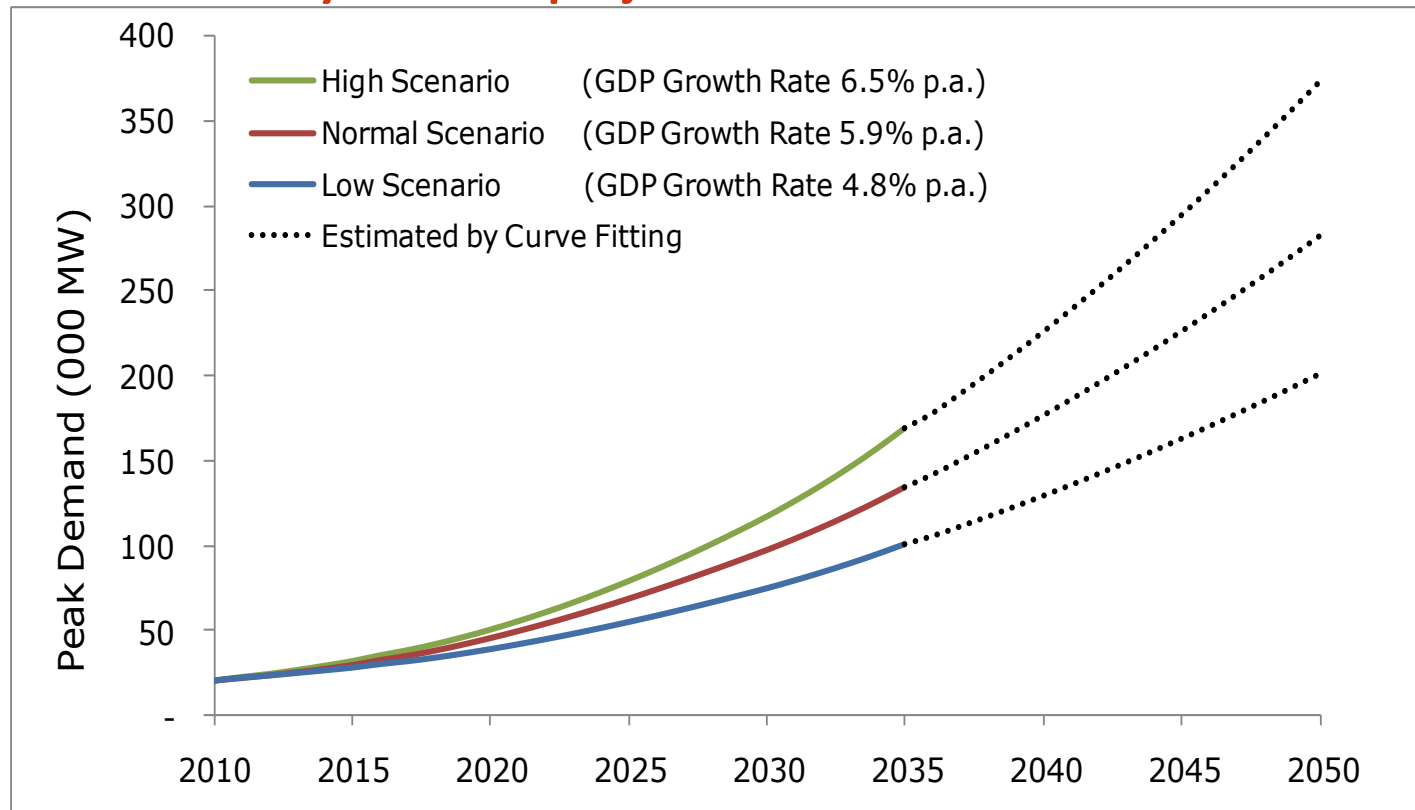
❑ Access to Electricity: ~ 80% of households

❑ Per Capita Electricity Consumption: 435 kWh (Around one-sixth of the world average of 2,730 kWh)

Sources: Pakistan Energy Yearbook 2011, and Key World Energy Statistics 2011

ELECTRICITY DEMAND PROJECTIONS

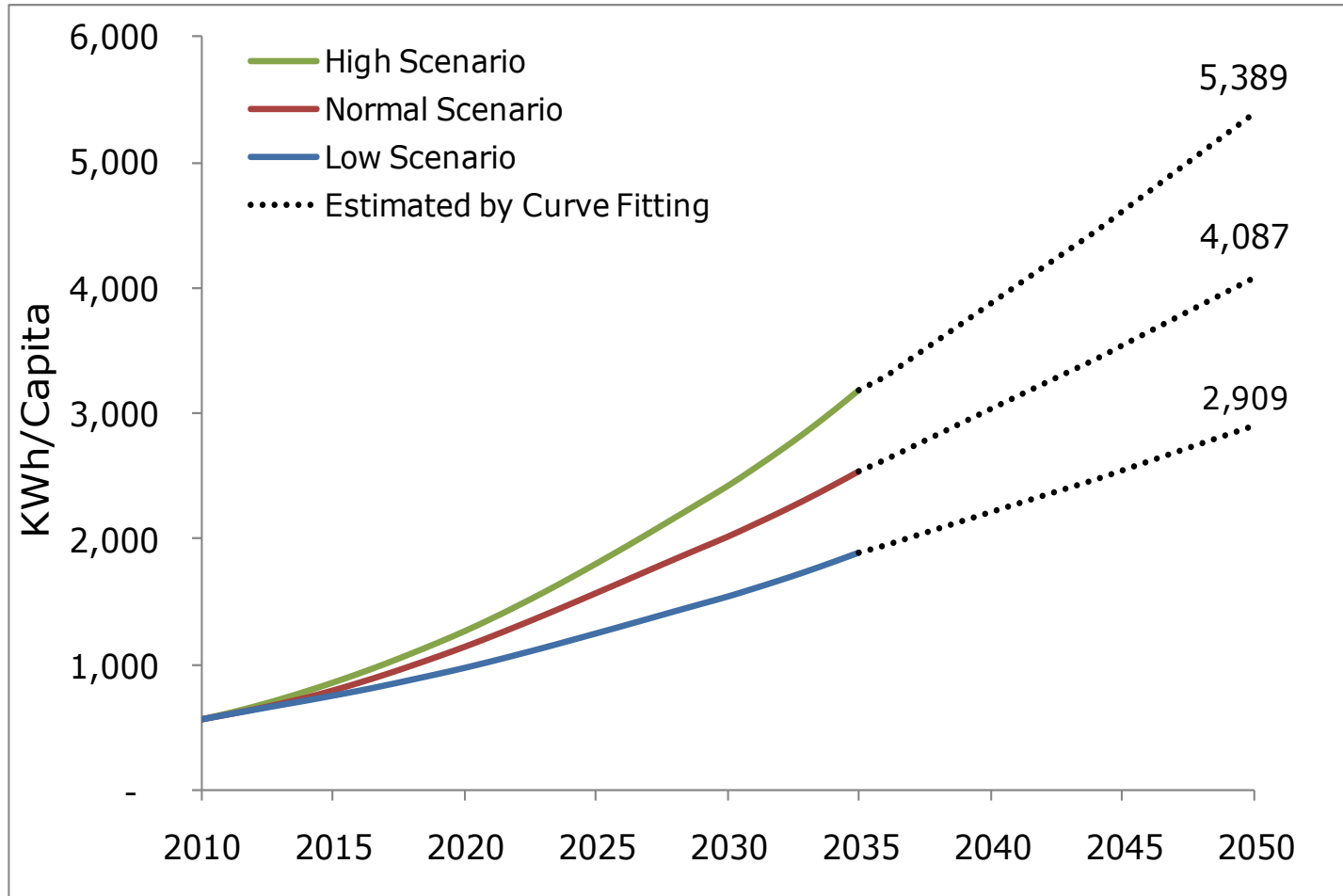
Peak electricity demand projections



	2010	2020	2030	2035	2040	2050
High Scenario	20.2	50.4	117.1	169.4	226.0	373.7
Normal Scenario	20.2	45.4	97.5	134.8	177.1	283.4
Low Scenario	20.2	38.7	74.5	100.5	129.2	201.7

Source: National Transmission and Dispatch Company (NTDC), 2010

Per capita electricity demand



Source: National Transmission and Dispatch Company (NTDC)

- Hydro (with storage/run-of-river plants)
- Simple and Combined Cycle plants on indigenous gas
- Oil-fired Steam/Diesel engine (expensive option)
- Nuclear
- Wind
- Combined Cycle plants based on imported gas.
- Steam plants on domestic coal and imported coal
- Solar Energy

Prospects of hydro power development

- ❑ Potential : 55,000 MW
- ❑ Already exploited : 6,634 MW (12% of the potential)
- ❑ High investment cost of major hydro-power projects
- ❑ Socio-political issues i.e., water allocation among provinces, and resettlement of people.
- ❑ Total hydro built – last 15 years: 1808 MW

□ Oil

- Small Reserves
- Pakistan meets its more than 80% oil requirements through import

□ Gas

- Production is already insufficient to meet the current requirement
- Demand/supply gap could be 17 billion cubic feet per day by 2030 (Medium Term Development Framework)

SUPPLY OPTIONS FOR ELECTRICITY

If whole Indigenous fossil fuel reserves are used for power generation:

Fuel	Unit	Proven reserves	
		Quantity	For 1000 MW size plants of 30-year life
Oil	Million Barrels	307	1
Gas	Trillion Cubic Feet	27.6	15
Coal	Billion Tonnes	3.5*	33

* Total resource potential is around 186 billion tonnes
(~ 1746 plants of 1000 MW of 30 year life)

Prospects of renewable development

□ Wind

- Potential
 - Theoretical = $\sim 55,000$ MW
 - Exploitable = $\sim 11,000$ MW

(considering availability of land and assuming 23 -28% capacity factors)

- Upfront Tariff for wind generation projects is 14.7 cent/kWh

□ Solar

- Potential is high. But have techno-economic issues.

Nuclear Power Plants in Operation



KANUPP

Capacity : 137/90 MW
Commercial Operation : Dec 1972
Lifetime availability Factor : 55.51%
Life time capacity factor : 28.51%



CHASNUPP-1

Capacity : 325 MW
Commercial Operation : Sep 2000
Lifetime availability factor : 76.60%
Life time capacity factor : 72.84%



CHASNUPP-2

Capacity : 325 MW
Commercial Operation : May 2011
Lifetime availability factor : 86.50%
Life time capacity factor : 84.87%

Nuclear Power Plants Under Construction in the Country



CHASNUPP-3

Capacity : 340 MW
First Concrete Pour : Mar 4, 2011
Commercial Operation : Dec 31, 2016



CHASNUPP-4

Capacity : 340 MW
First Concrete Pour : Dec 18, 2011
Commercial Operation : Oct 31, 2017

Nuclear power deployment plans

	Current 2012 ¹	Projections 2022 ²	Projections 2030 ³
Installed Capacity (MW)	22,477	55,000	162,590
Economic Growth	3.7%	5% Average for 13 year	7% - 8% Average for 25 year
Nuclear Capacity (MW)	787	4,345	8,800
% of installed capacity	3.5%	7.9%	5.4%

1. Economic Survey 2011-12, Finance Division, Govt. of Pakistan
2. Integrated Energy Plan (IEP) 2009-2022, Economic Advisory Council, Ministry of Finance, March 2009
3. Medium Term Development Framework 2005-10, developed in 2005.

- ❑ Continuation of operations of existing NPPs and expansion plans
- ❑ Fukushima Response Action Plan (FRAP) was formulated for all nuclear power plants. Under the Plan
 - Internal safety reviews have been carried out,
 - Safety features of the existing plants are being further upgraded,
 - Emergency response programs are being strengthened,
 - Design safety of future plants is being revisited.

Major items under FRAP

- ❑ Reassess external natural hazards and incorporate greater safety margins for events such as earthquakes, tsunamis, and floods
- ❑ Add more sources of emergency power supply for greater protection against prolonged station blackout
- ❑ Add diverse means of emergency cooling

Continued

- ❑ Ensure that spent fuel can also be cooled under all conditions
- ❑ Add means to maintain containment integrity at all times
- ❑ Emphasize Emergency Operating Procedures (EOP's) and Severe Accident Management Guidelines (SAMG's)
- ❑ Increase off-site emergency preparedness

SUMMARY

- ❑ Growing energy needs and inadequate indigenous energy resources dictate large scale use of nuclear power in Pakistan
- ❑ Safety remains top priority in nuclear power program of Pakistan. Fukushima accident provides an even bigger drive to enhance safety and develop emergency response program
- ❑ Post Fukushima Policy:
 - No change in nuclear power deployment plans up to 2030

THANK YOU.....