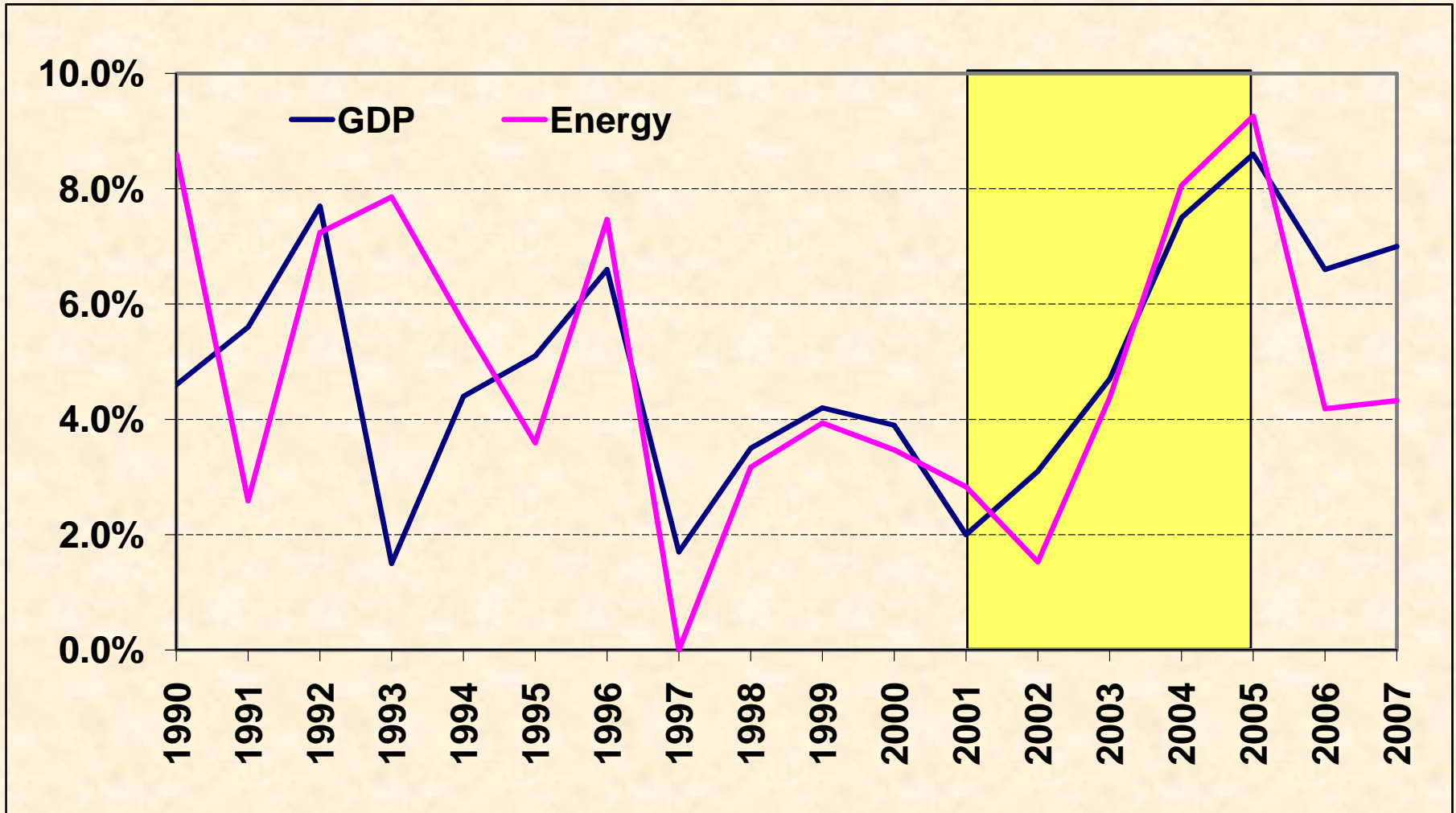


Renewable Energy and Pakistan

Dr. Akhtar A. Awan
Member (Energy) Planning Commission
Islamabad
2008

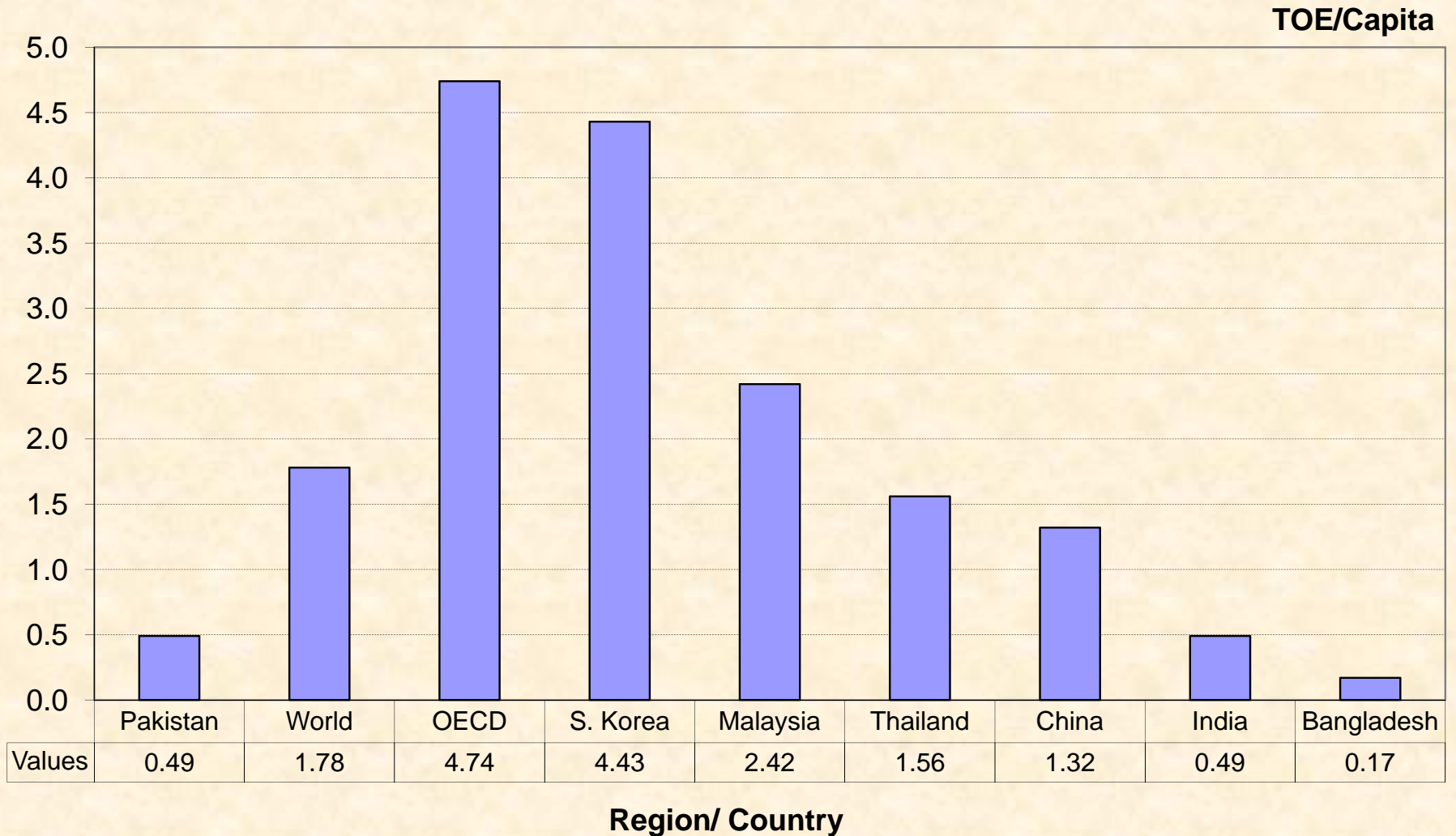
Pakistan's Economic & Energy Growth (1990 - 2007)



Pakistan has shown a close relationship between economic and energy growth, for more than a decade. Unprecedented growth during 2001 – 2005.

Sources: Pakistan Energy Yearbook 2007; Pakistan Economic Survey 2007.

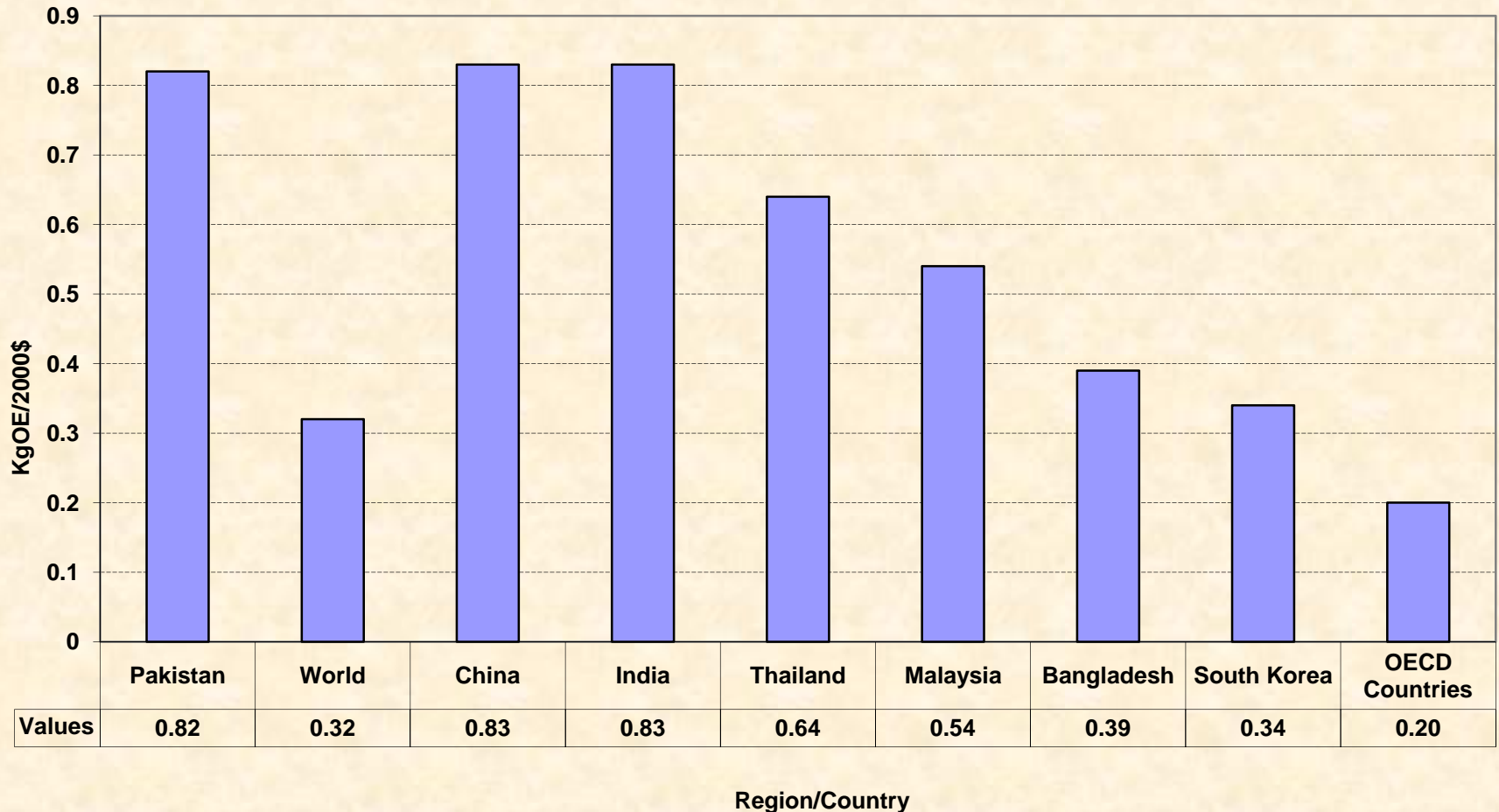
Comparison of per capita Energy Supply (2005)



Pakistan's per capita energy consumption is significantly below the world average.

Sources: Pakistan Energy Yearbook 2007; IEA Energy Statistics, 2007.

Energy Utilization per \$ of GDP (2005)

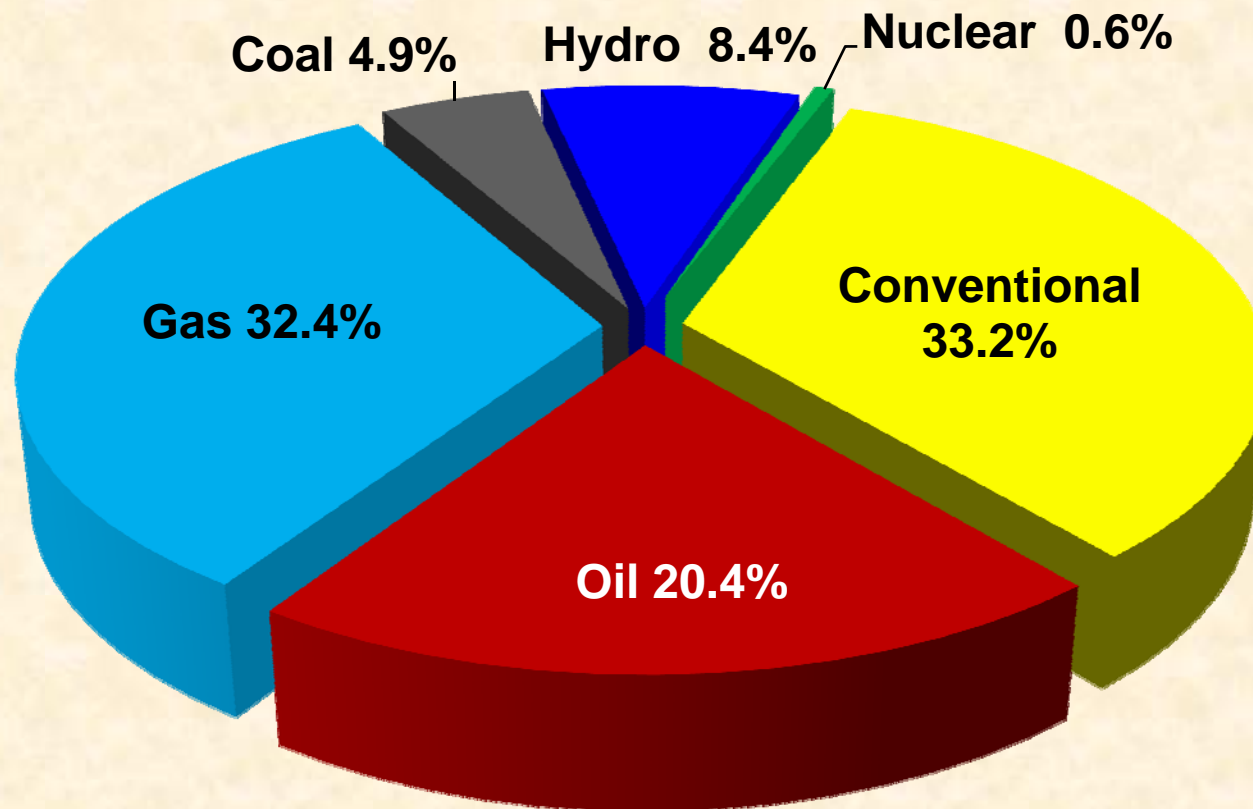


Pakistan's energy consumption per \$ of GDP is much higher than the world average and somewhat above the average for the developing countries.

Sources: Pakistan Energy Yearbook 2007; IEA Energy Statistics, 2007.

Pakistan's Primary Energy Supply Mix 2007

Total : 90.3 MTOE

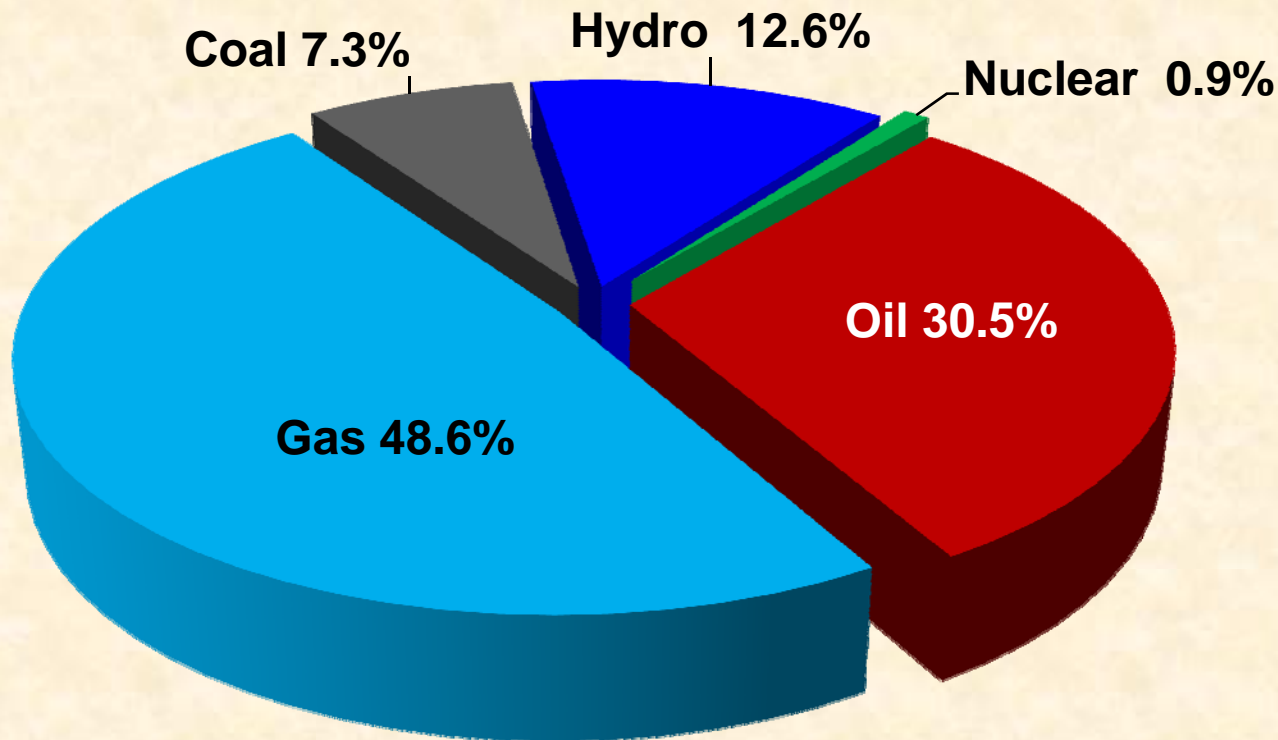


Conventional energy supplies account about one third of the total primary energy supplies.

Source: Pakistan Energy Yearbook 2007.

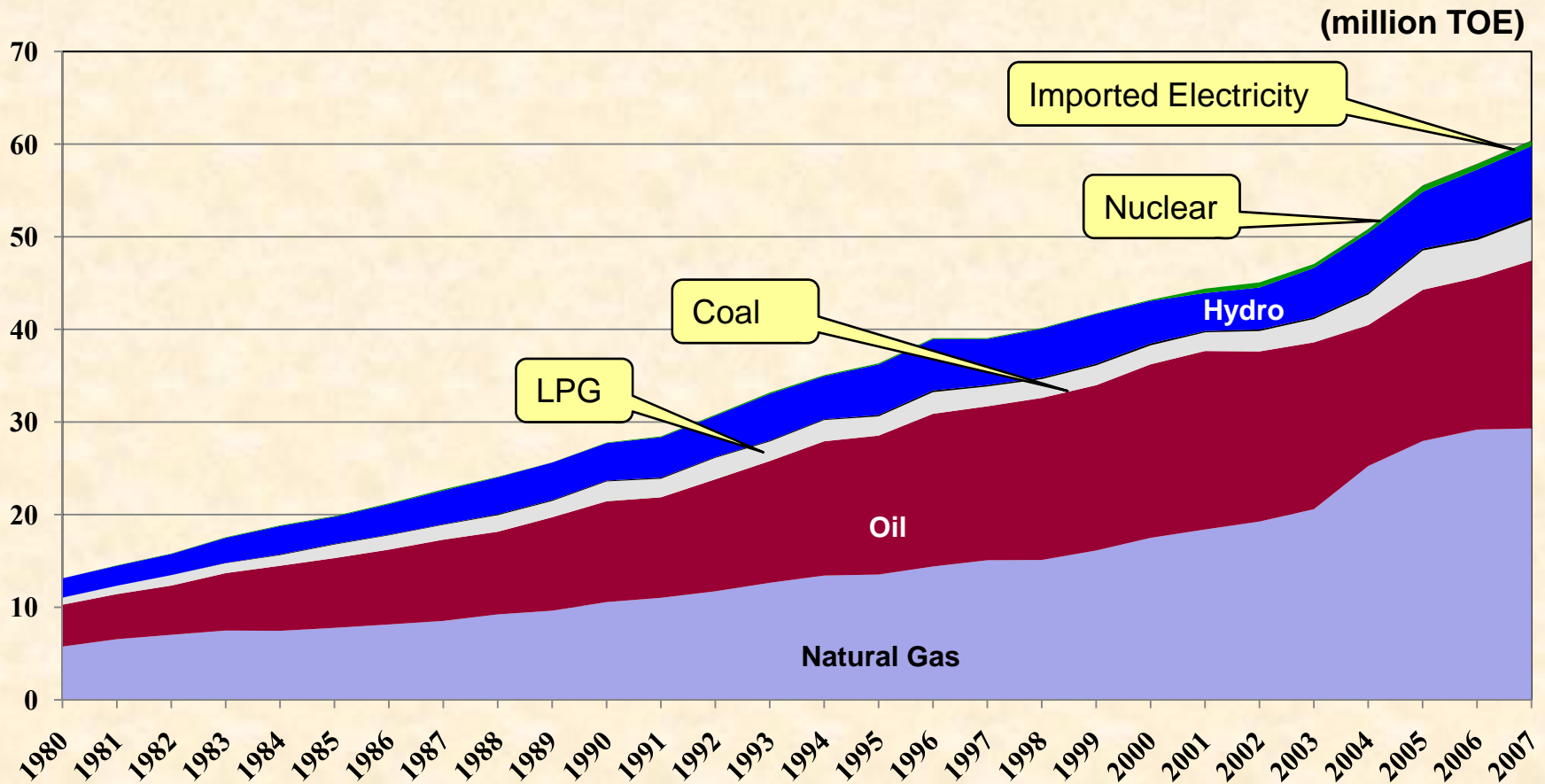
Pakistan's Commercial Energy Supply: 2007

Total : 60.387 MTOE



Natural gas accounts for about **one half** of Pakistan's commercial energy supplies.

Growth in Energy Supply by Fuel

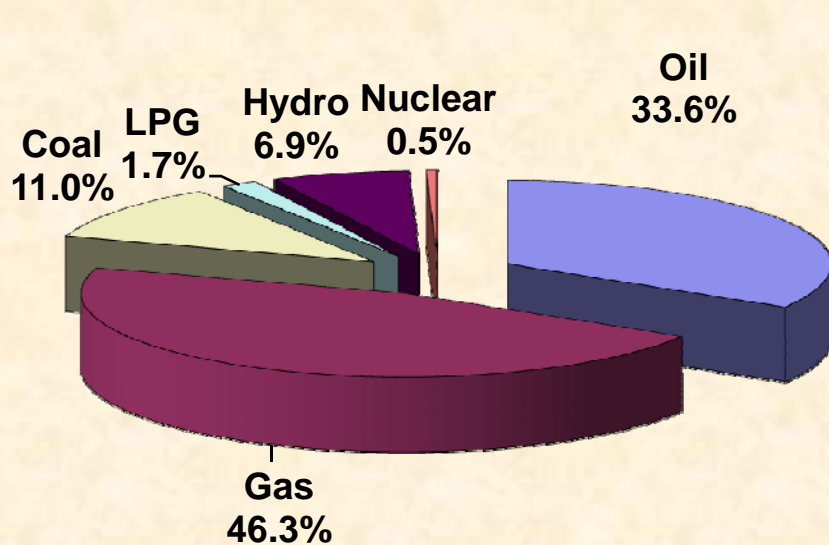


Source: Pakistan Energy Yearbook 2007

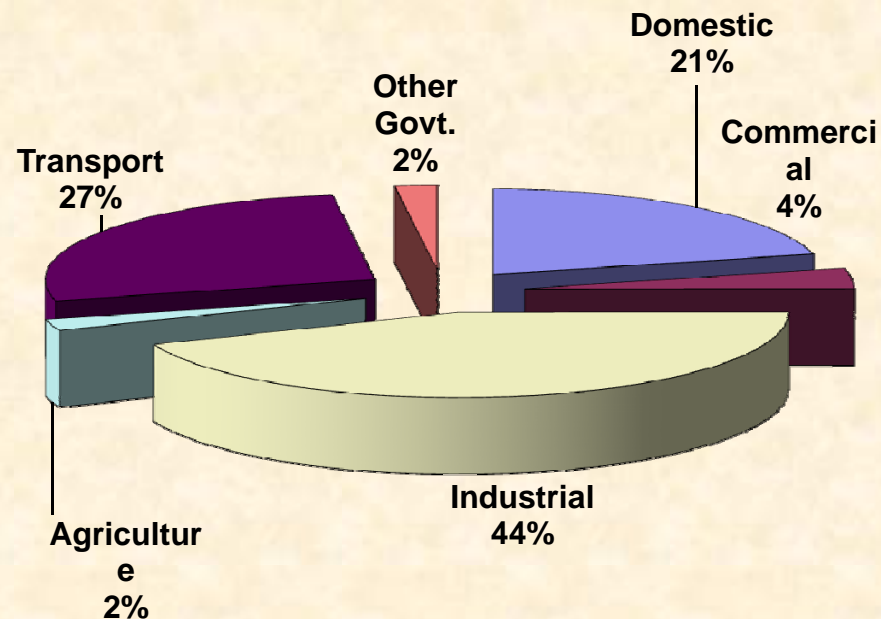
The leveling off of natural gas supply (after rapid increase in 2003-05) has resulted in growth in oil imports – a phenomenon which is expected to accelerate unless production of gas and other indigenous sources of energy can be ramped up.

Energy Consumption by Source and Sector

2007: By source



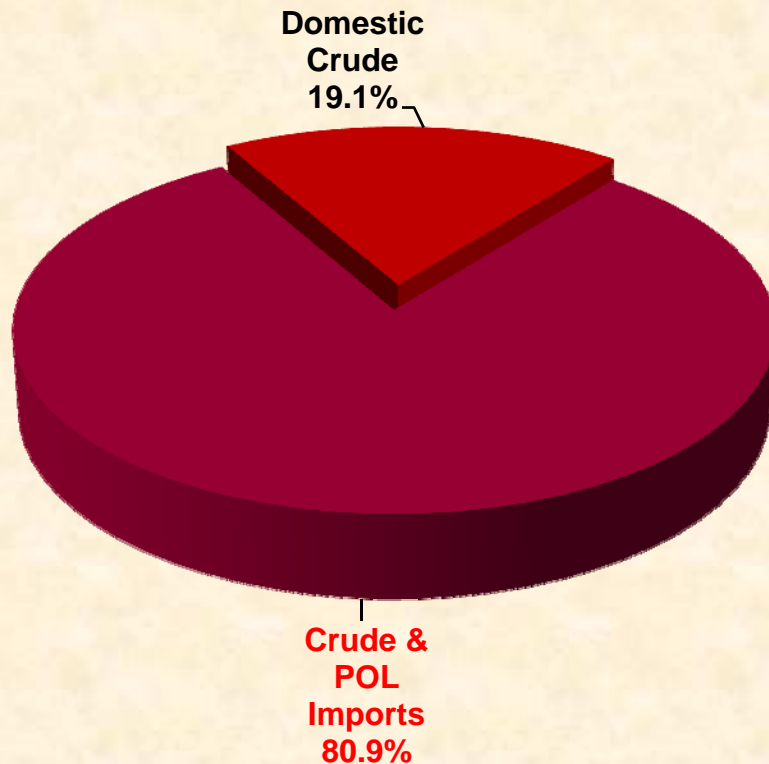
2007: By sector



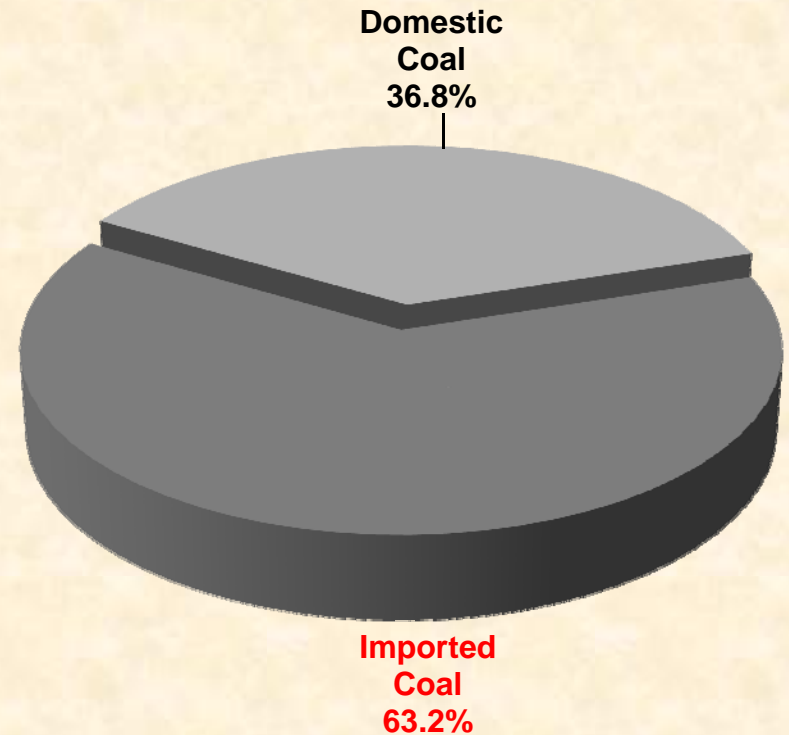
Petroleum and natural gas made up 80% of Pakistan's energy consumption. Industrial sector accounts for about 44% of total energy consumption.

Energy Import Dependence (Oil & Coal): 2007

Oil imports: 16.926 MTOE



Coal imports: 2.797 MTOE



**Pakistan imports about one third of its energy requirements.
(19.835 MTOE out of 60.388 MTOE)**

Fossil Fuel Resource Potential of Pakistan (as of 30 June 2007)

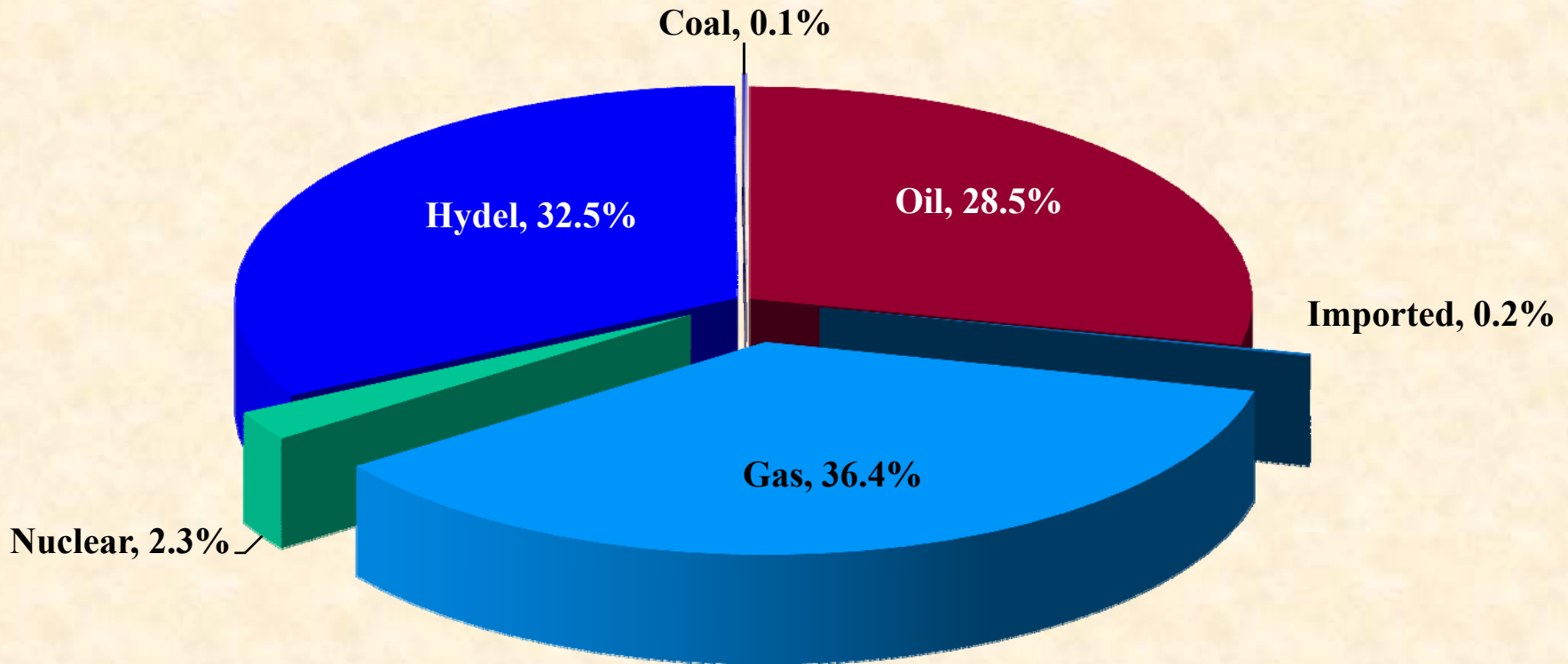
	(MTOE)		
	Oil	Natural Gas	Coal
Resource potential	3,622	6,849	82,846
Proven recoverable reserves	126	1,075	886
Cumulative production, so far	78	470	~89
Remaining recoverable reserves	47	605	797
Annual production	3.3	29.3	1.6
Reserves to production ratio	14 years	21 years	~400 years

Note: proven recoverable reserves of coal reported above assume a recovery factor of 60 percent for the measured resources of 3.30 billion tonnes.

Pakistan has limited oil and gas reserves as compared to huge untapped coal reserves.

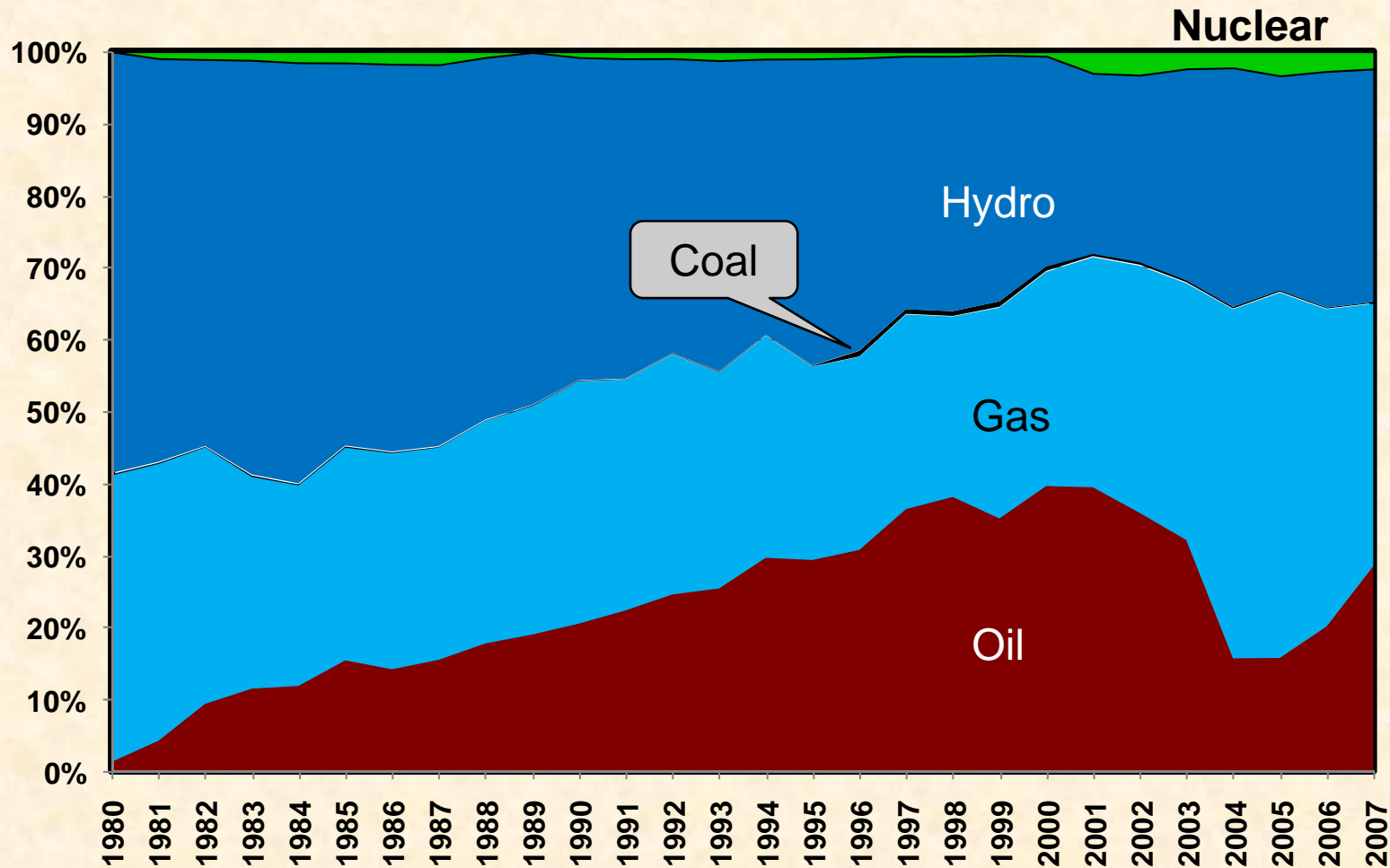
Electricity Generation Mix: 2007

Total: 98,384 Million kWh



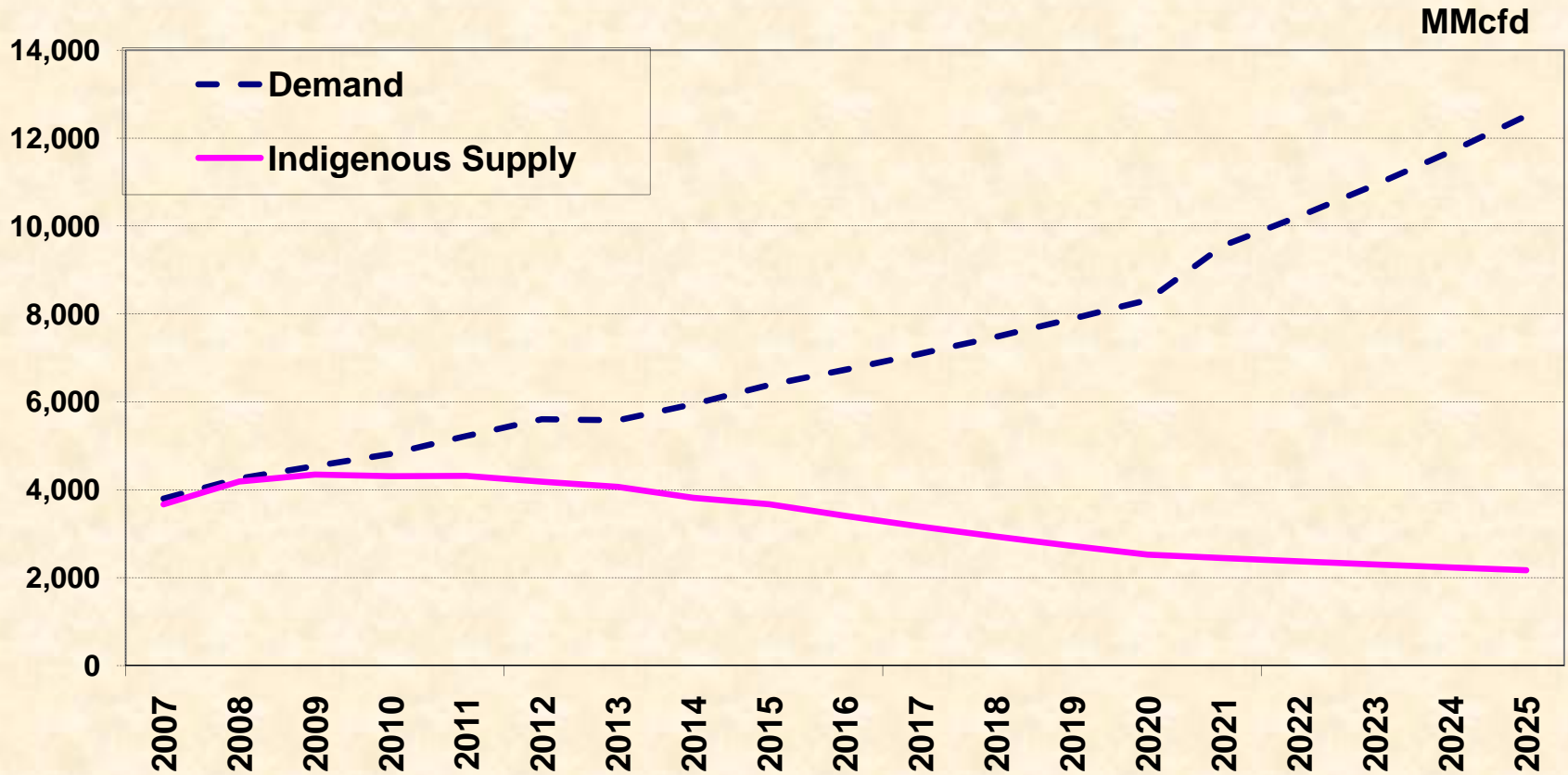
Natural gas accounts for more than one third of electricity generation.

Evolution of Electricity Generation Mix



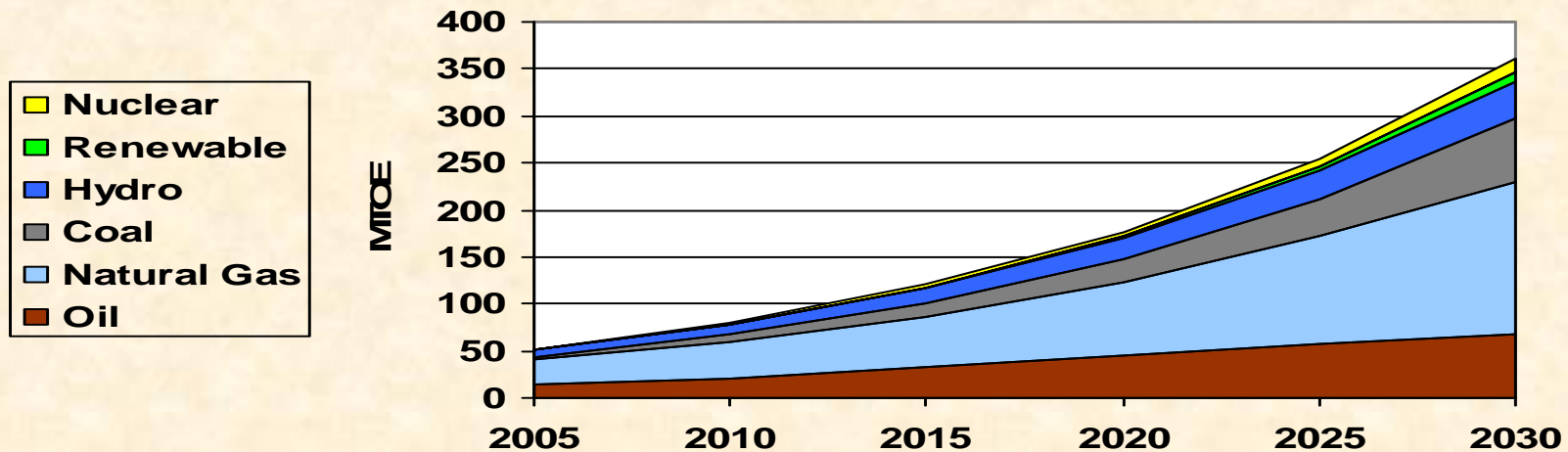
Higher use of natural gas had slowed down oil imports in 2001 – this gain has now eroded as gas supply limits have been reached and the country has not been able to dramatically increase production of gas.

Natural Gas Supply-Demand Balance



Expected shortages in indigenous gas supply 2.7 Bcfd in 2015, 5.8 Bcfd in 2020, and 10.3 Bcfd in 2025.

Pakistan's Energy Mix Projections

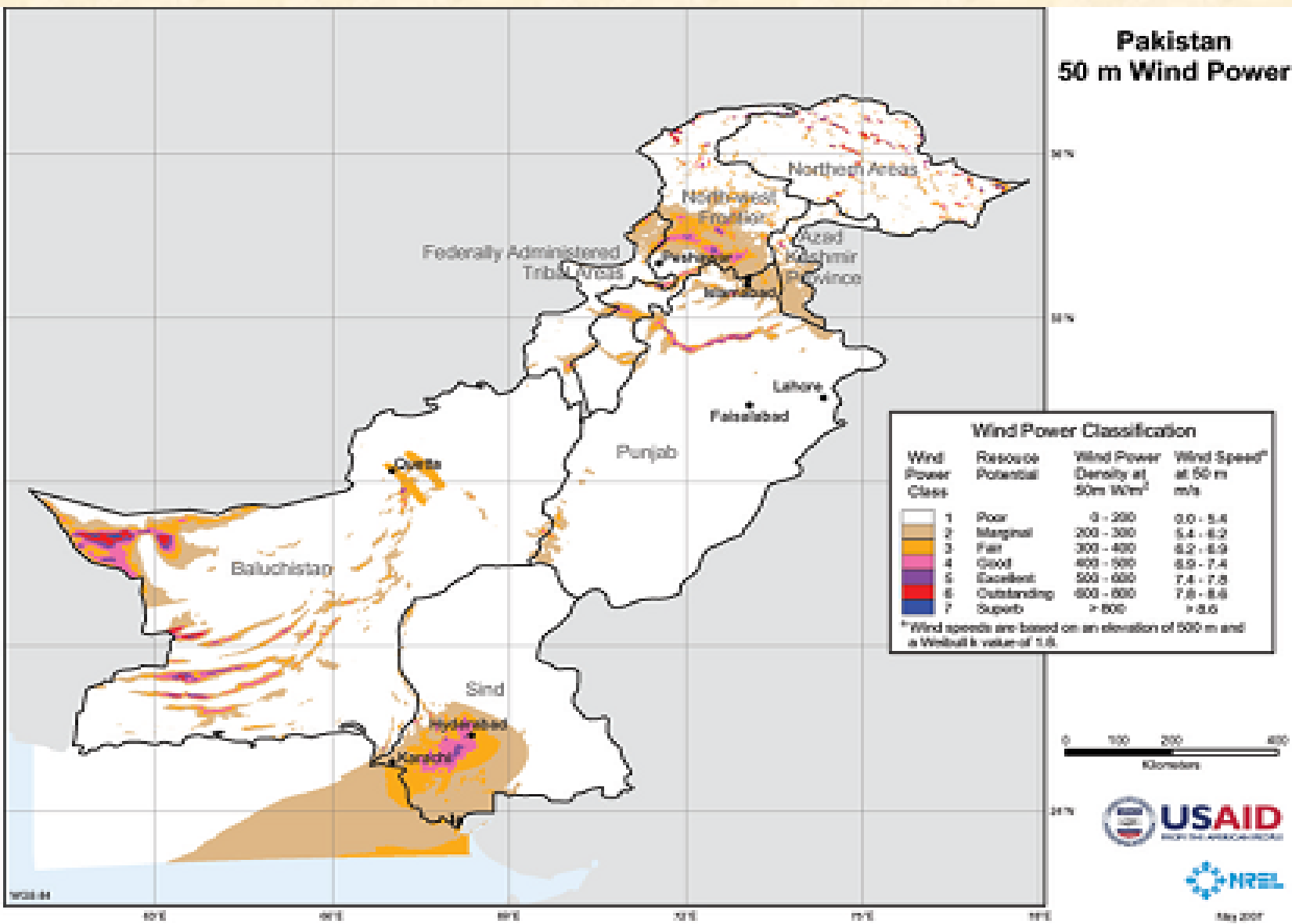


	2007	2010	2015	2020	2025	2030
Oil	18.12	20.69	32.51	45.47	57.93	66.84
Gas	29.31	38.99	52.98	77.85	114.84	162.58
Coal	4.4	7.16	14.45	24.77	38.28	68.56
Hydro	7.62	11.03	16.4	21.44	30.5	38.93
Renewable	0	0.84	1.6	3	5.58	9.2
Nuclear	0.54	0.69	2.23	4.81	8.24	15.11
Total	60.38	79.4	120.16	177.34	255.37	361.82

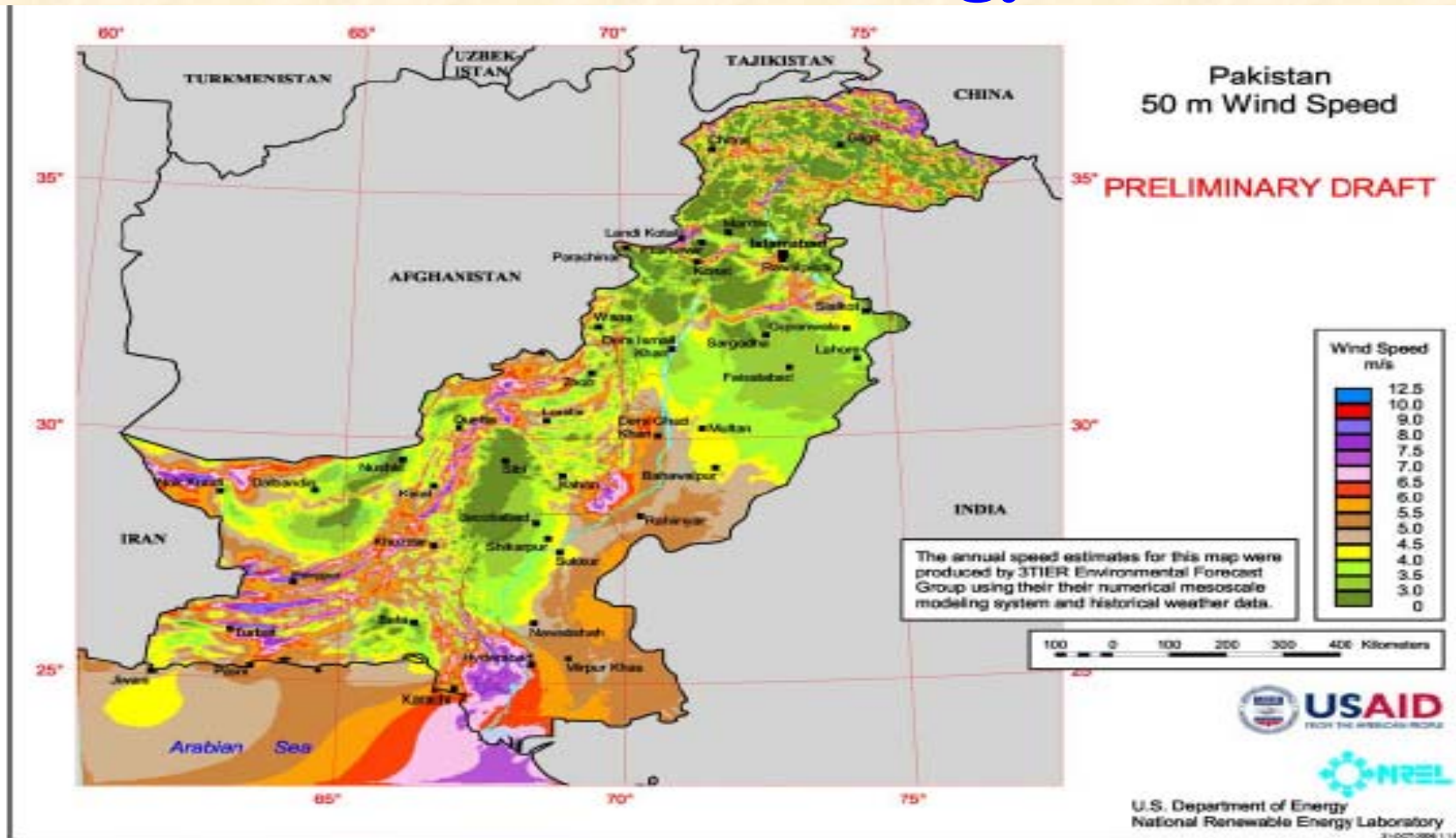
Pakistan's Renewable Energy Potential

Source	Potential (MW)
Solar	∞
Wind	About 41,000
Hydro	About 46,000
Bio-fuels	~
Others	~

Pakistan's Wind Energy Potential



Pakistan's Wind Energy Potential



Pakistan windy regions – preliminary findings

- Karachi-Hyderabad region, especially hilltops
- Ridges in northern Indus valley
- Wind corridor areas in western Pakistan (eg, near Quetta)
- High mountainous regions
- Higher hills and ridges in southwestern Pakistan

Wind Survey & Potential

Pakistan's Wind Electric Potential (Utility Scale Wind Resources at 50-m)

Wind Resources Utility Scale	Wind Class	Wind Power W/m ²	Wind Speed m/s	Land Area km ²	Percent Windy Land	Total Potential Capacity MW
Fair	3	300-400	6.5 - 7.5	42,864	4.9	214,321
Good	4	400-500	7.0 - 7.5	18,105	2.1	90,529
Excellent	5	500-600	7.5 - 8.0	5218	0.6	26,091
Excellent	6	600-800	8.0 - 8.8	2495	0.3	12,475
Excellent	7	>800	>8.8	543	0.1	2,716
Total				69,225	7.5	346,132

Assumptions

Installed capacity per km² = 5 MW

Total land area of Pakistan = 877,252 km²

Assume land area only

MINI HYDEL POTENTIAL IN PAKISTAN

BELOW 50 MW

S U M M A R Y

Sr. No.	PROVINCE/ AREA	IN OPERATION (MW)	UNDER CONSTRUCTION (MW)	AVAILABLE POTENTIAL (MW)	TOTAL (MW)
1	PUNJAB	64	-	174	238
2	SIND	-	-	87	87
3	NWFP	49	20	439	508
4	NORTHERN AREAS	25	35	308	368
5	AJK	36	6	220	262
TOTAL:		174	61	1228	1463

Recent Initiatives Taken by Government

- **Created a body to promote and encourage renewable energy development:-**
 - ✓ **Alternative Energy Development Board (AEDB) created in May 2003.**
 - ✓ **AEDB announced renewable energy policy in 2006.**
- **Created a body to carry out research and development in renewable energy based products at consumer level:-**
 - ✓ **Pakistan Council for Renewable Energy Technologies (PCRET) created in May 2001.**
 - ✓ **Developing and installing biogas, solar, wind and micro hydro based projects in villages.**

Initiatives Taken by Government

- Mission:
 - Introduce Alternative/Renewable Energy at an accelerated rate to achieve 5-10% share of renewable energy in the energy mix of the country.
- Set Targets:
 - 800 MW by 2010
 - 1,600 MW by 2015
 - 3,000 MW by 2020
 - 9,700 MW by 2030

Initiatives Taken by Government

- Wind Power: 94 LOI's (4605 MW)
- Waster to Power: 6 LOI's (276 MW)
- Hydropower: 16 MW in Northern Areas.
140 MW in Punjab.

Concluding Remarks

Need to Maximize use of Renewable Energy Technologies

- **40,000 villages in Pakistan are still un-electrified.**
- **Renewable energy can solve the “hidden” energy demand in rural areas not yet connected to the grid.**
- **Wind , Solar and small hydro are ideally suited to cover small-scale, decentralized demands.**

A solution for the “hidden” energy demand through renewable sources

Thank You