Energy Situation in Pakistan

Presentation to the

Institute of Engineers Pakistan
Institute of Electrical & Electronics Engineers Pakistan

By:
Engr. Syed Hassan Nawab
January 30, 2013

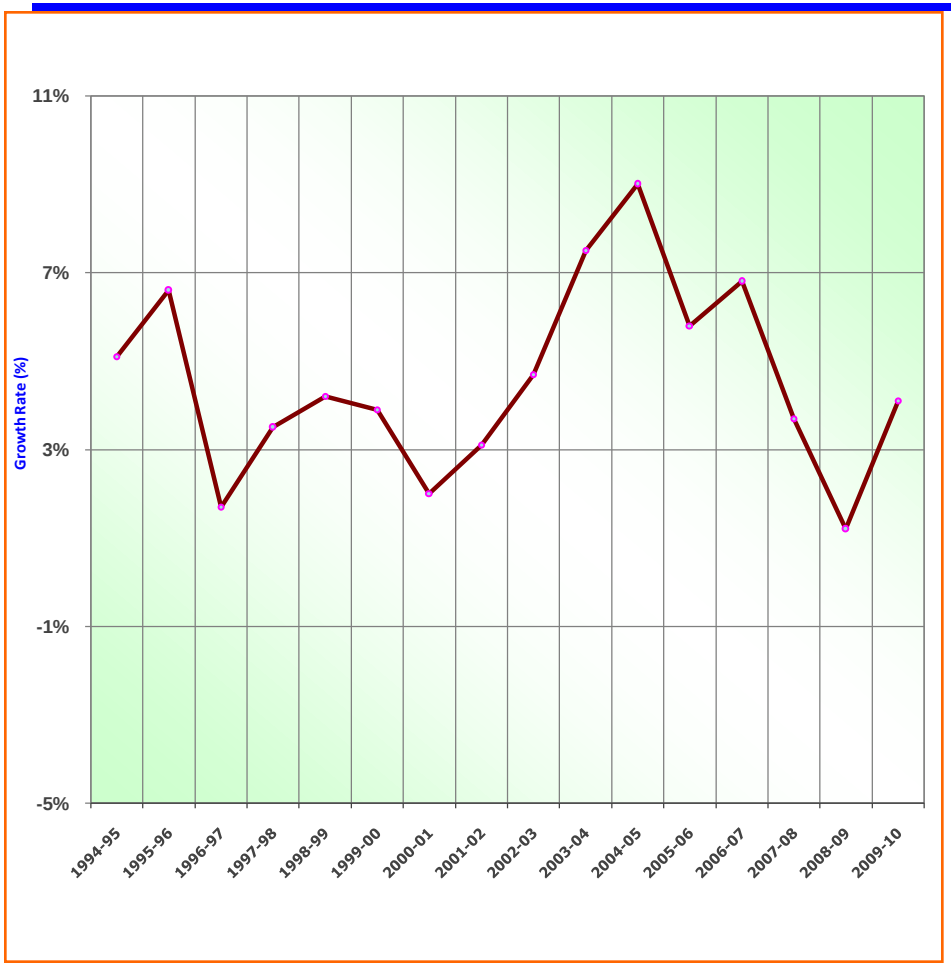
Pakistan Economic Profile

- **GDP: $240 billion (2011-12 nominal)**
- **GDP growth: 3.7% (2011-12)**
- **GDP per capita: $1,378 (nominal)**
- **Exports (2011-12) $30bn, Imports $40bn Deficit: $10bn**
- **GDP by sector: Agriculture: 21.2%, Industry: 25.4%, Services: 53.4% (2010 est.)**
- **Inflation (CPI): 10 % (2012)**
- **Annual Petroleum Imports: $14.5 billion (50% of export earning)**
- **Main industries: textiles and apparel, food processing, dairy, fertilizer, pharmaceuticals, construction materials, paper products**

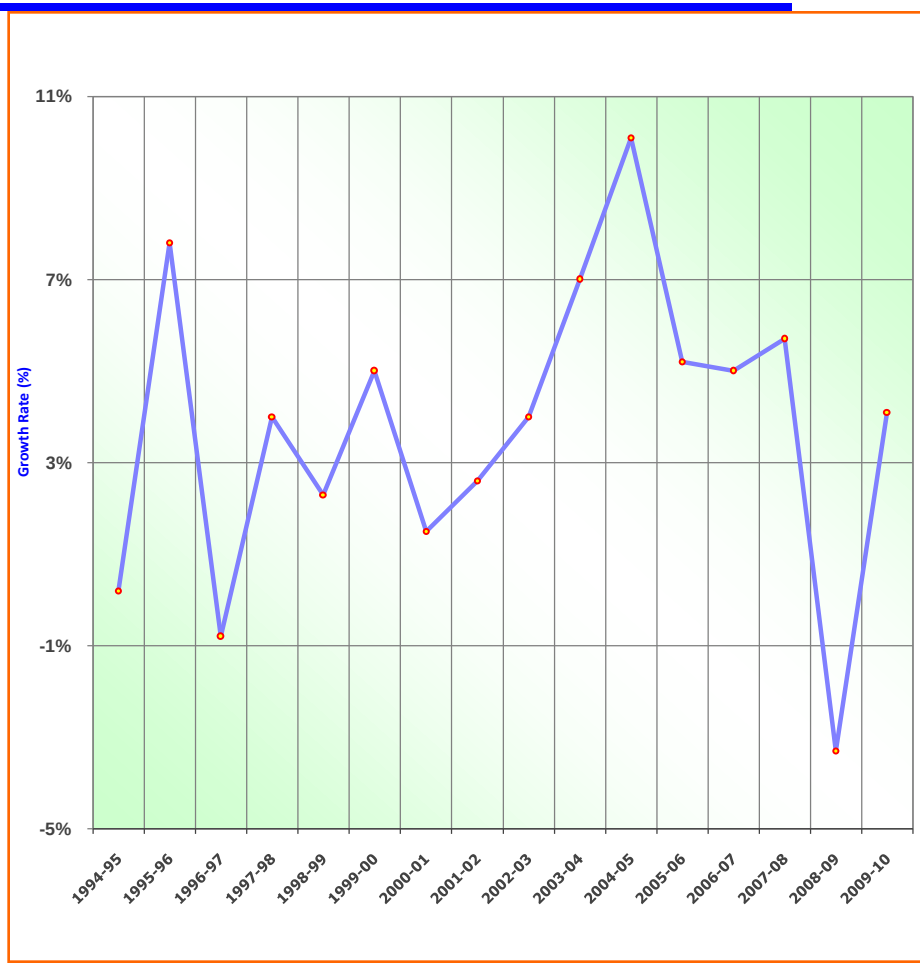
Pakistan Demographic Profile

- **6th largest country, population175 million growing at 2.2% annually, 60% under age 25**
- **880,000 square kilometers land area, latitudes 25-35 North**
- **Population below poverty line: 24%**
- **Lowest literacy rate**
- **Lowest per capita energy consumption**
- **High dependence on imported energy**
- **Large energy shortages impeding industrial output, jobs and exports**

Strong correlation between GDP growth rate and energy consumption growth rate …



GDP Growth Rate

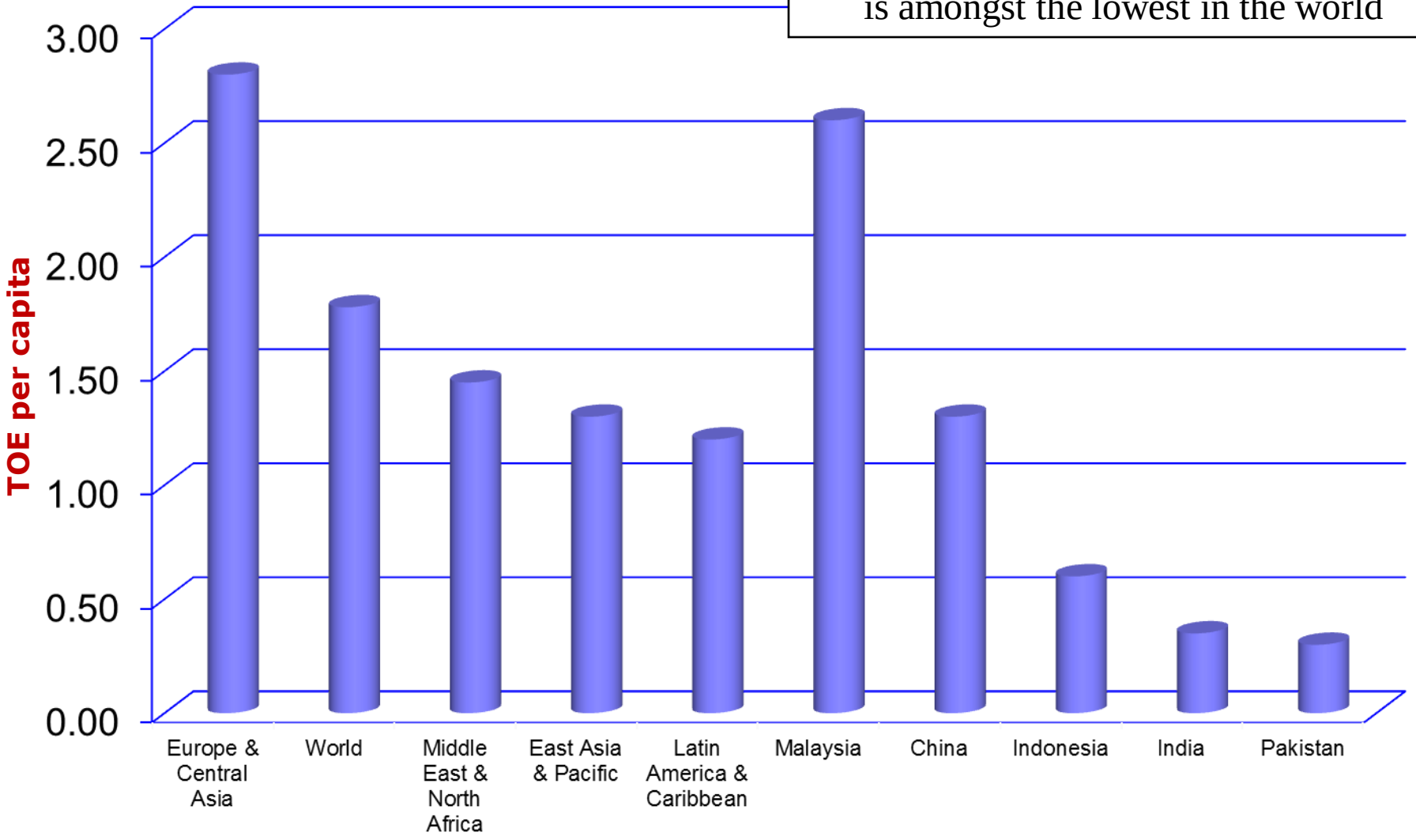


Energy Consumption Growth Rate

Source: Petroleum Institute of Pakistan(PIP)

PER CAPITA ENERGY CONSUMPTION

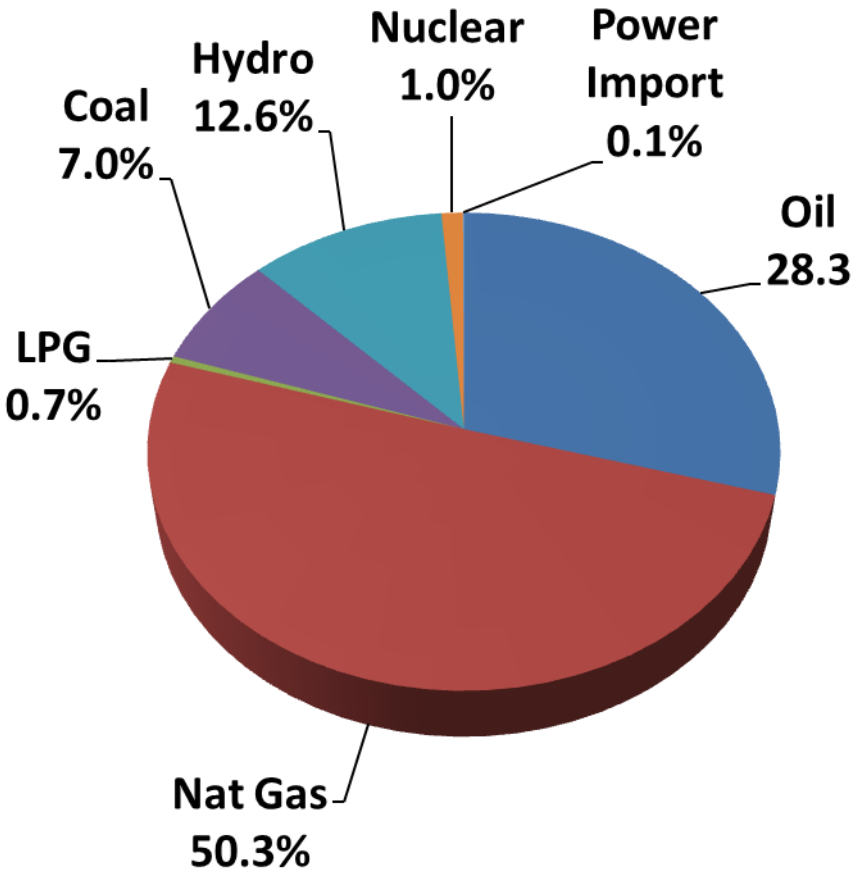
Pakistan's per capita energy consumption is amongst the lowest in the world



PRIMARY ENERGY SUPPLIES BY SOURCE

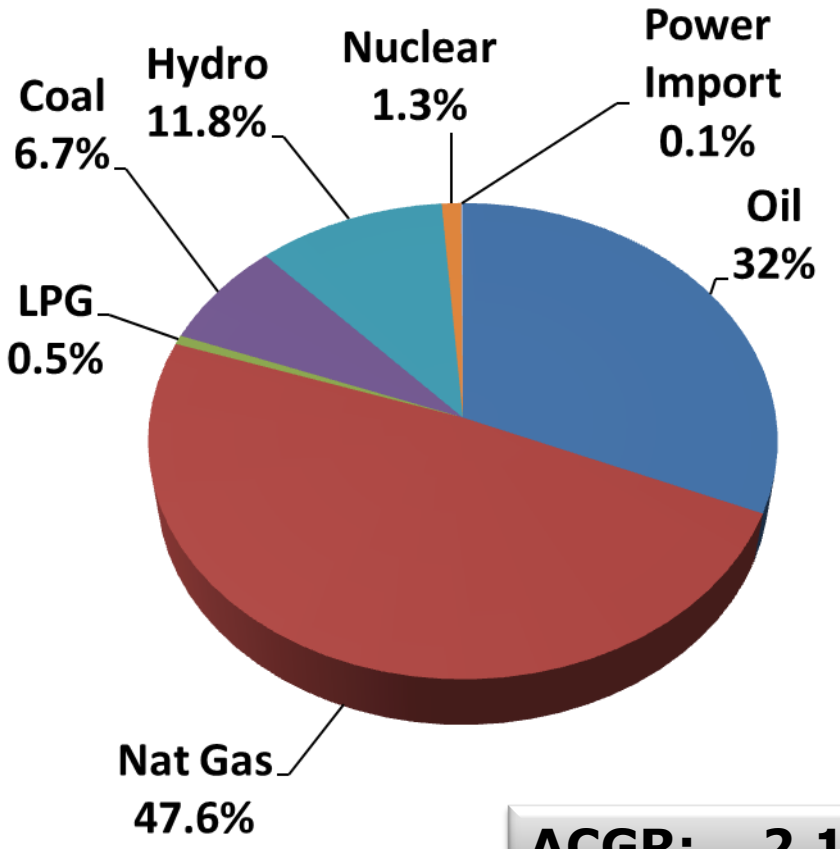
2005-06

58.06 MTOE



2010-11

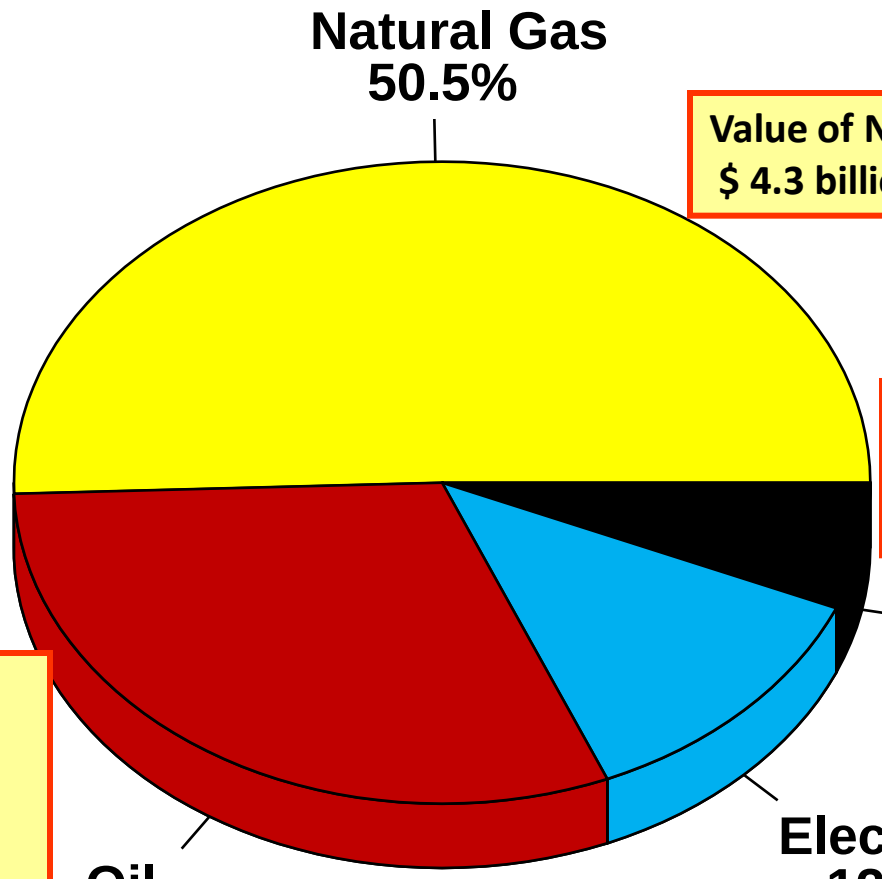
64.5 MTOE



ACGR: 2.1%

PRIMARY ENERGY SUPPLIES 2011-12

64.9 Million TOE



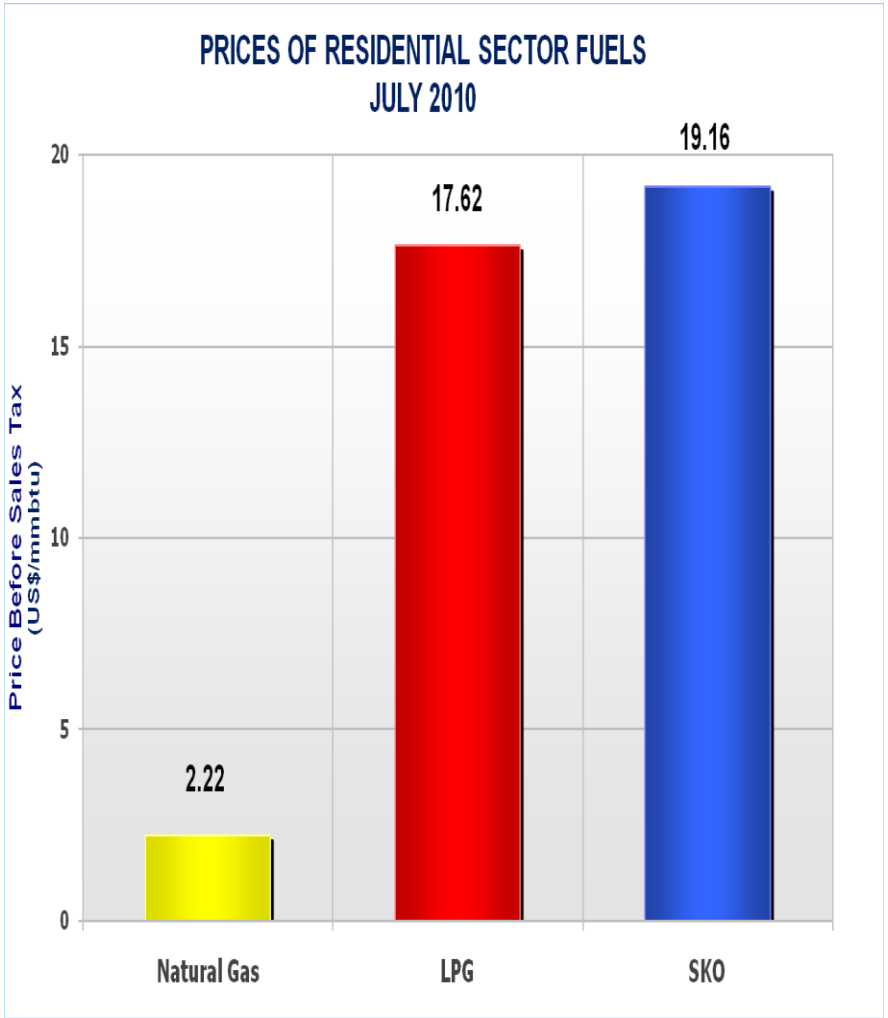
Value of Natural Gas
$ 4.3 billion (4 BCFD)

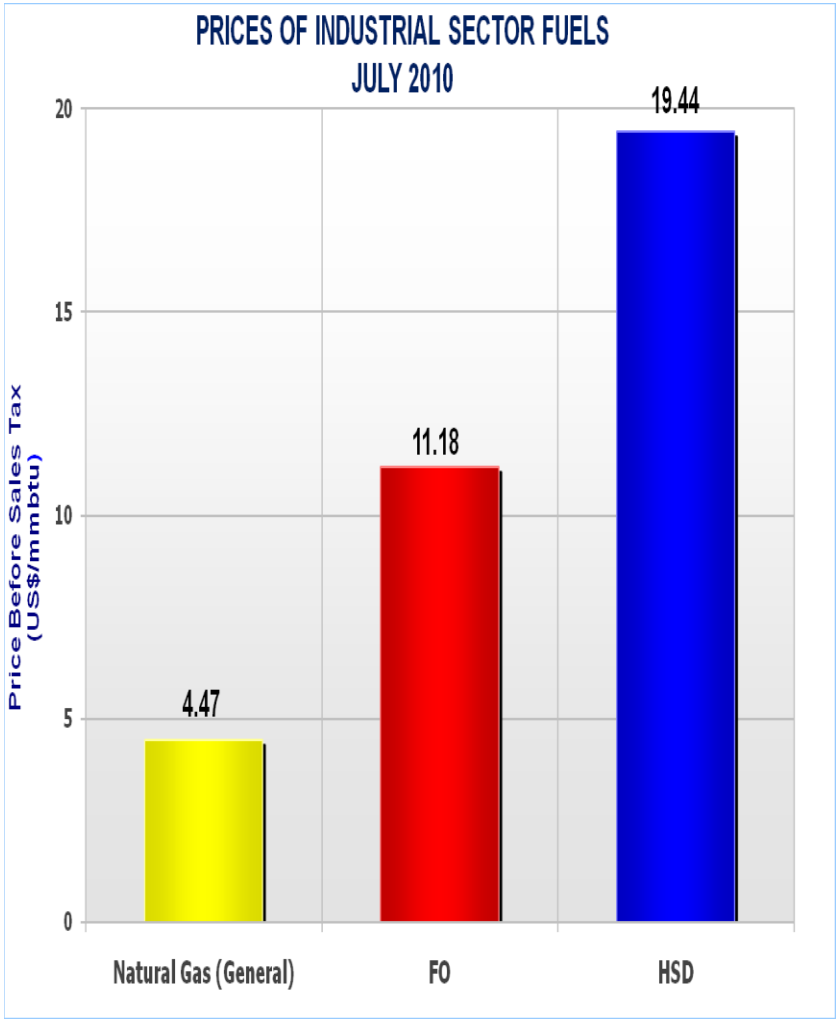
Coal
Local - $ 0.2 billion
Imported - $ 0.5 billon

Value of local crude: $ 2.4 billion
(67,000 Barrel/Day)

Oil Import Bill: $14.5 billion
(36% of total imports)
(380,000 barrels/Day)

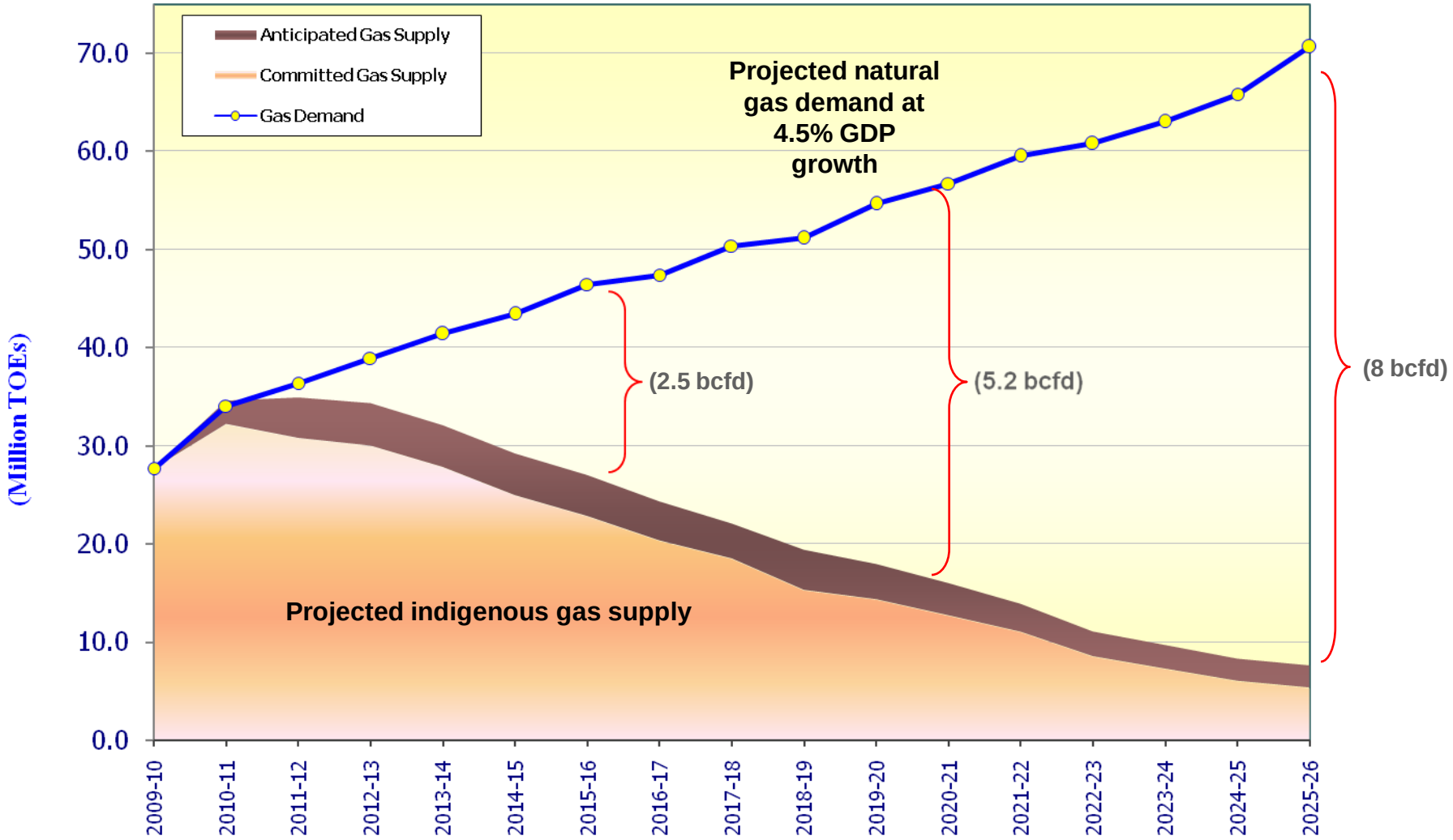
High consumption of natural gas is being driven by a low gas price versus alternate fuels…





Source: Petroleum Institute of Pakistan(PIP)

Natural demand is growing while reserves are declining leading to increasing deficits …



Source: Petroleum Institute of Pakistan(PIP)

Oil and Gas Reserves of Pakistan

As of 30 June 2011

Crude Oil (Million barrels)

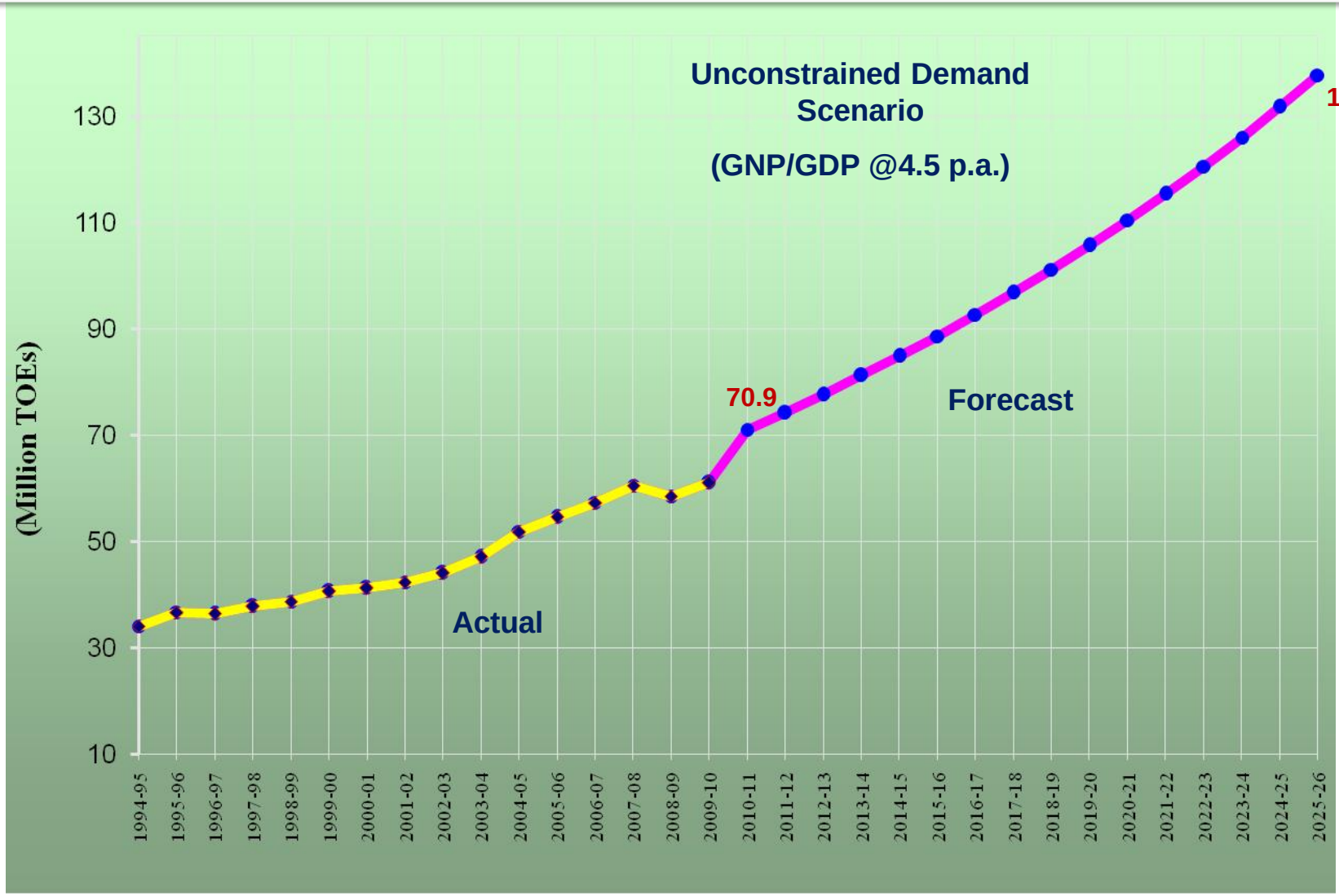
– Original Recoverable Reserves:	944.319
– Cumulative Production:	680.308
– Balance Recoverable Reserves:	264.011
– Average Daily Production:	65,866 Bbl/day
– Annual Production 2011-12:	24.03
– Reserve to Production Ratio :	11 years

Natural Gas (Trillion Cubic Feet TCF)

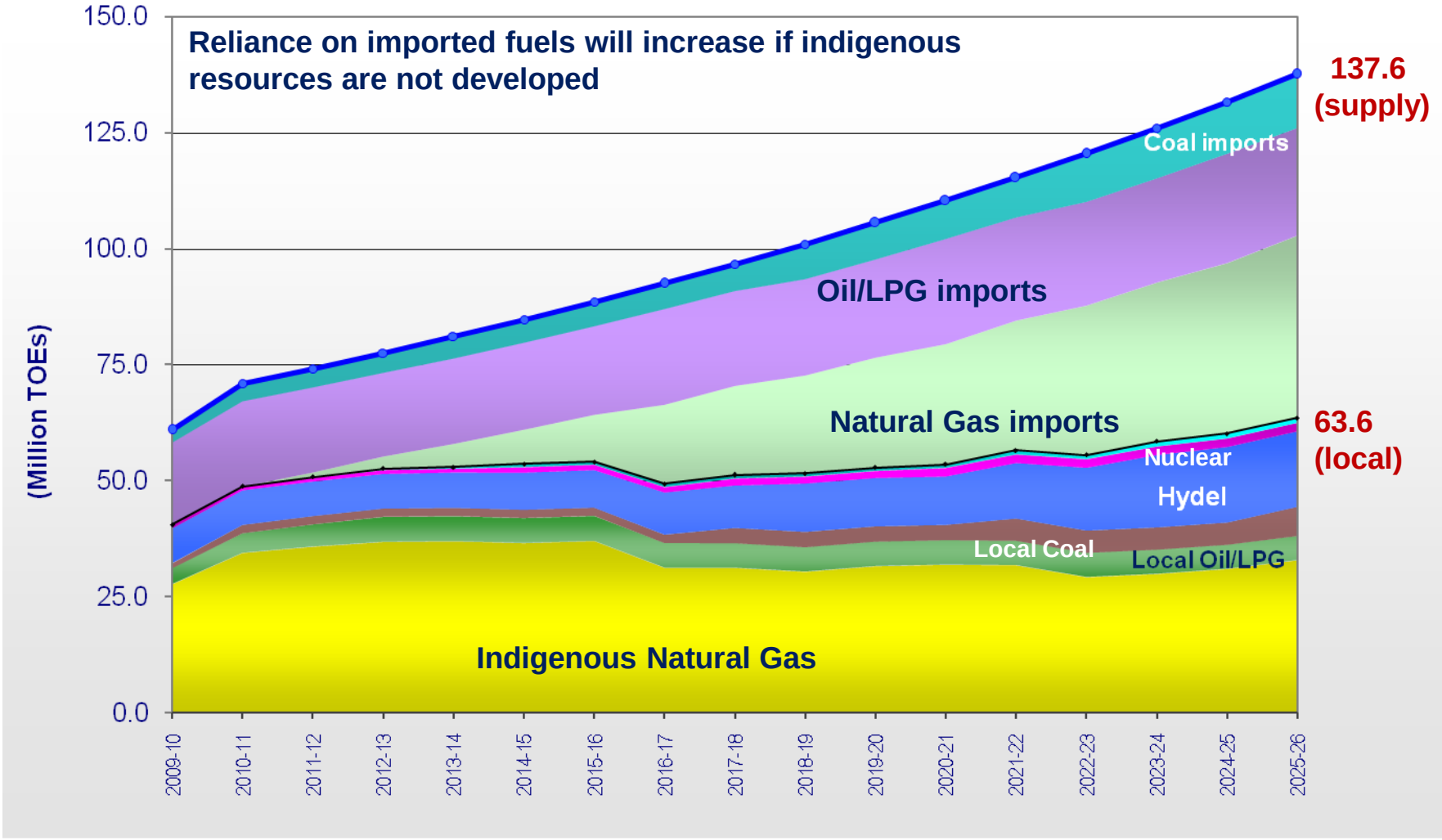
– Original Recoverable Reserves:	55.103
– Cumulative Production:	27.603
– Balance Recoverable Reserves:	27.500
– Average Daily Production:	4.031 BCFD
– Annual Production 2011:	1.471
– Reserve to Production Ratio:	18 years

Source: Pakistan Energy Year Book 2011

Energy supply will have to be doubled over the next 15 years to achieve 4.5% p.a GDP growth …



Current Planning to increase Primary Energy Supplies …



Source: Petroleum Institute of Pakistan(PIP)

Tight Gas

- **Tight gas, shale gas and coal bed methane now account for roughly half of the worldwide recoverable gas resources**
- **Tight gas is natural gas produced from a tight geological formations having low permeability, which restricts free gas flow**
- **It requires enhanced technologies for processing, drilling, reservoir stimulation and production which involve huge investment with recovery periods of 10 to 15 years**
- **Tight gas reserves in Pakistan are estimated in the range of 24 trillion cubic feet (TCF) to 40 TCF**
- **SSGC has signed the first agreement with Polish Oil and Gas Company or PGNiG to get 30 mmcfd tight gas from Kirthar block in Dadu Sindh**
- **The price of 'tight gas' is at 40% premium to normal gas, at around $6 per mmbtu, compared to around $16-17 for LNG**

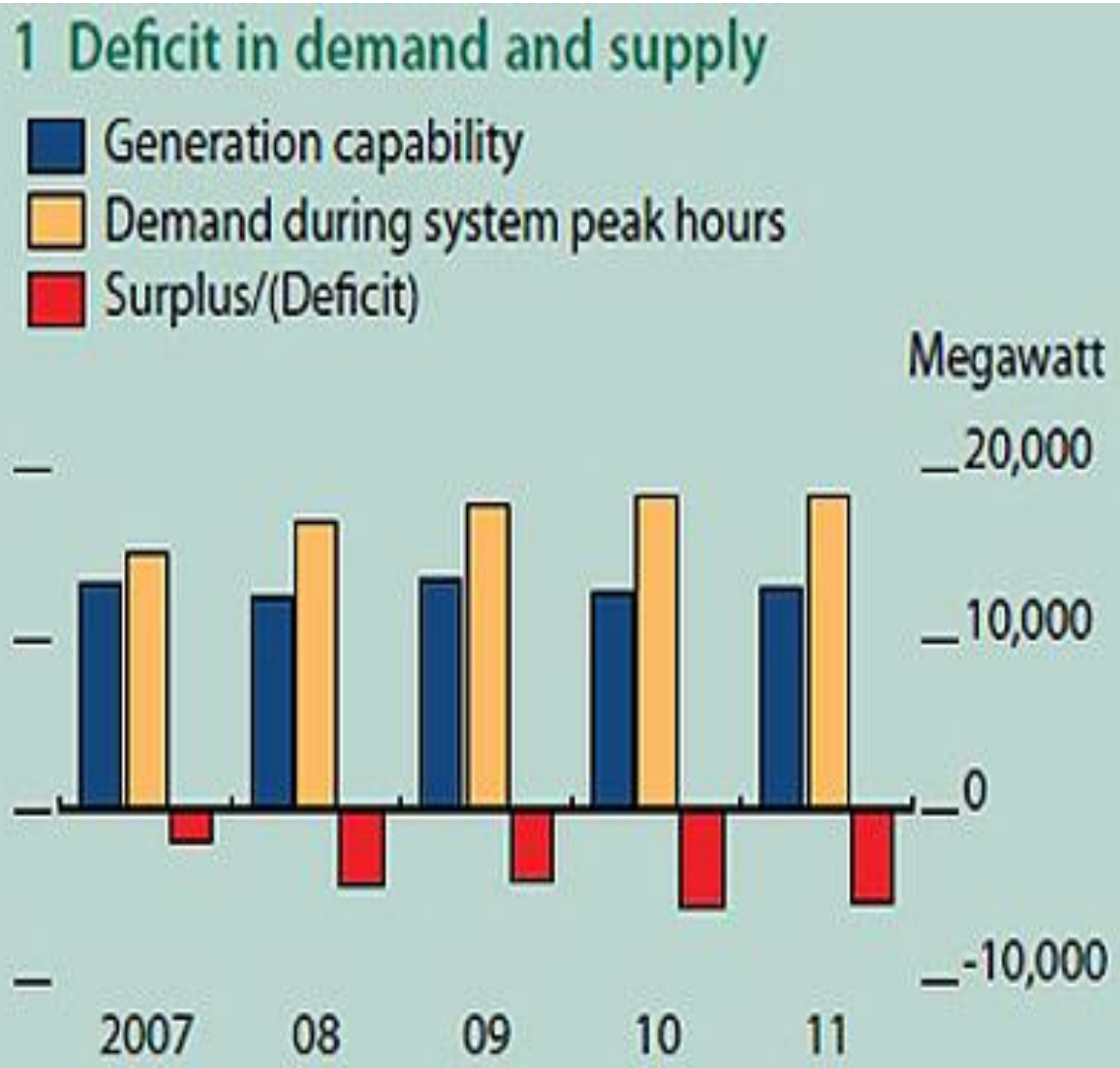
Shale Gas

- **Pakistan stands 17th in the world in terms of total Technically Recoverable Shale Gas Resources. Pakistan has about 51 trillion cubic feet (tcf) of shale gas reserves**
- **Currently no Shale Gas is being produced in Pakistan and significant work is required to kick start this high potential energy source**
- **The Government is in the process of preparing Shale Gas Framework providing incentives to E & P Companies to jump start Shale Gas exploration to meet the energy shortage in Pakistan**

Pakistan Power Sector

- **Current installed generation capacity: 22,500 MW of which, WAPDA (Hydel) 6500 MW, WAPDA (Thermal) 4900 MW, KESC 1950MW, IPPs 8363MW, Nuclear 787MW**
- **Electricity generated during 2010-11: 94,635 Gwh based on Oil 35%, Hydel 34%, Natural Gas 27%, Nuclear 4% & Coal .1%**
- **Current Power Availability: 17,000 MW Peak Demand 22,000 MW. Average shortfall 5000MW**
- **Electricity demand growing @ 10 % annually Vs supply @ 7 %.**
- **Resulting outages: Urban 7-10 hours daily, Rural 15-20 hrs daily**
- **Projected 2030 power requirement > 45,000 MW**

Pakistan Power Deficit



Pakistan's Coal Reserves

Sindh
186.560 billion tonnes
Thar 175 billion tonnes

Punjab
235 million tonnes

Balochistan
217 million tonnes

KP
90 million tonnes

Azad Kashmir
9 million tonnes

Thar Coal deposits have the potential to be a game-changer …

- Thar Desert contains the world's 7th largest coal reserves:

175 Billion Ton = 50 Billion TOE = 2,000 TCF

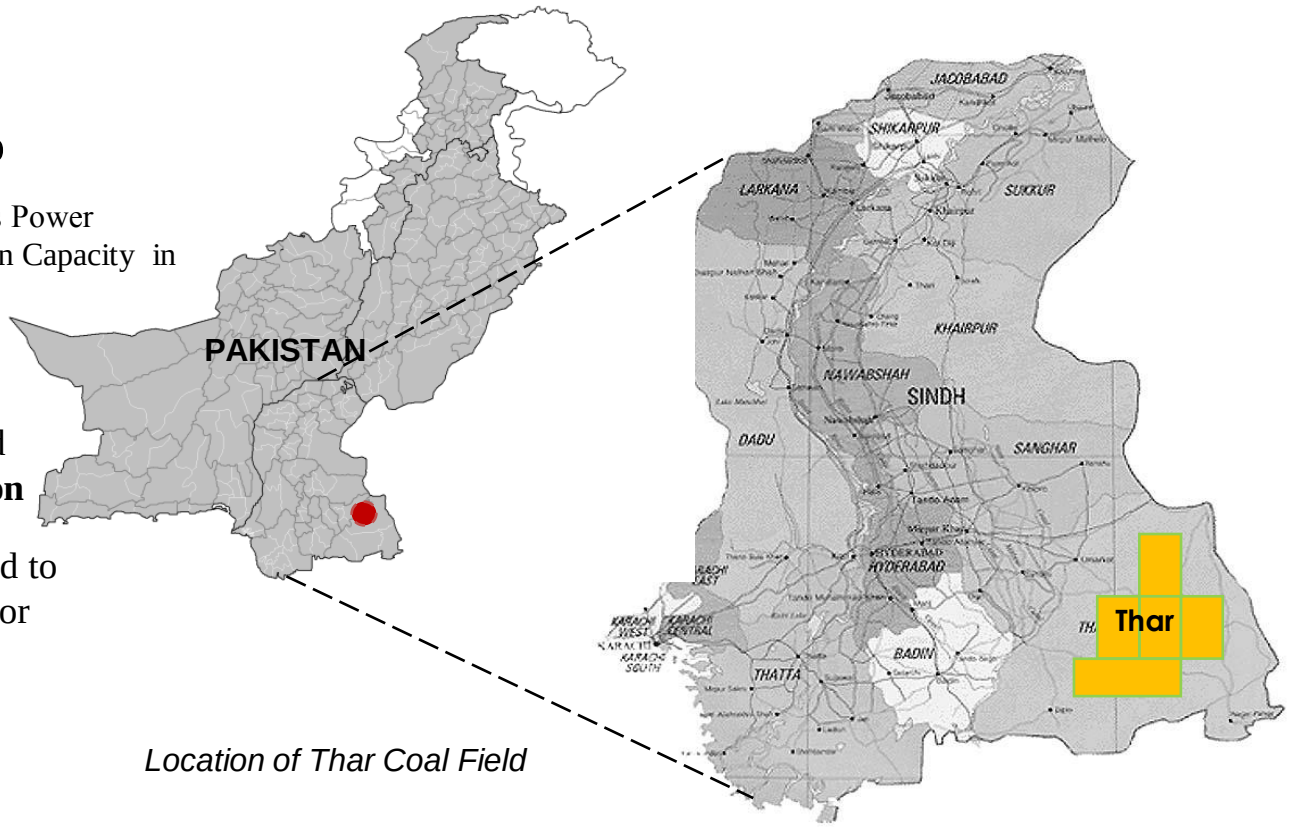
Total Thar Coal Reserve — More than Saudi Arabia & Iranian Oil Reserves — 68 times higher than Pakistan's total gas reserves

1% = 25%

Thar Coal Reserve — Pakistan's Power Generation Capacity in 2010

Development of Block II alone would bring in investment of **USD 12 Billion**

Entire Thar Coal Reserves can be used to generate **100,000 MW** of electricity for over **200 years**



Location of Thar Coal Field

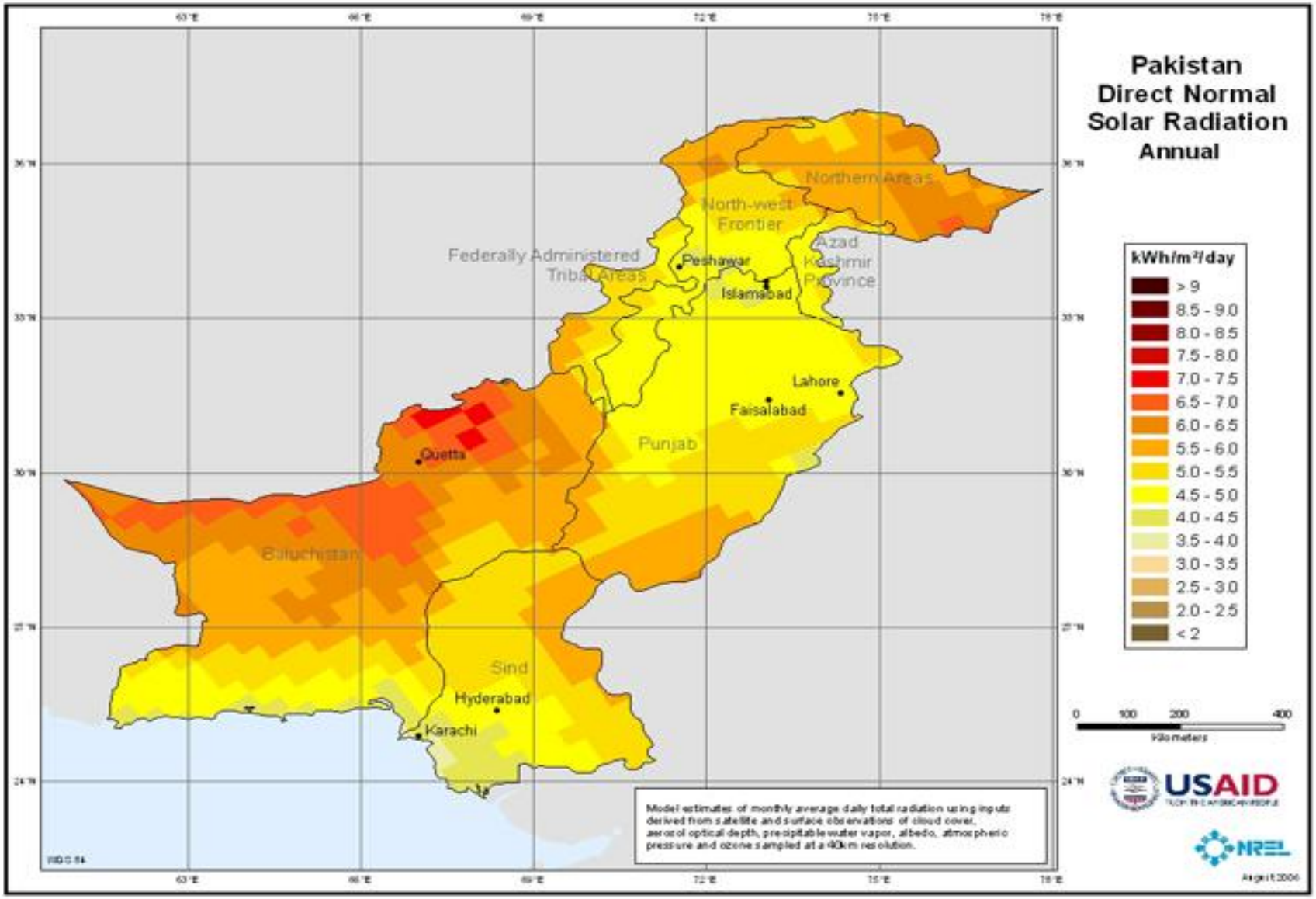
Hydro Power Potential

- **Pakistan is endowed with vast hydropower potential, out of which only 11% has been developed**
- **The installed capacity of hydropower projects is 6,500 MW**
- **Economically viable Hydro power plants can be sited on the rivers of Indus system and its tributaries, of upto 60,000 MW**
- **Smaller sized hydro power projects are being built in the private sector as a result of incentives announced by the GOP from time to time**
- **Hydropower development is one the best options for meeting growing energy requirements**

Solar Energy Potential

- **Recent developments in solar photovoltaic and CSP technologies have made it competitive with conventional energy resources.**
- **Pakistan is blessed with rich solar resource. Average annual solar irradiance 5.5 Kwh/m^2/day**
- **Over 2500 hrs of sunshine (25 to 35 degrees North latitude)**
- **Exploitable Solar Energy Resources > 50,000 MW**
- **Solar PV prices falling rapidly to reach $ 2/KW installed**
- **Solar Energy prices becoming competitive with fossil fuels , have already reached grid parity, opening market opportunities for Solar PV in Pakistan**
- **Solar energy is now affordable for large factories , hotels and households to reduce their dependence on grid supplied power**

High Solar Irradiance



Current Solar Energy Players

Direct International Investment

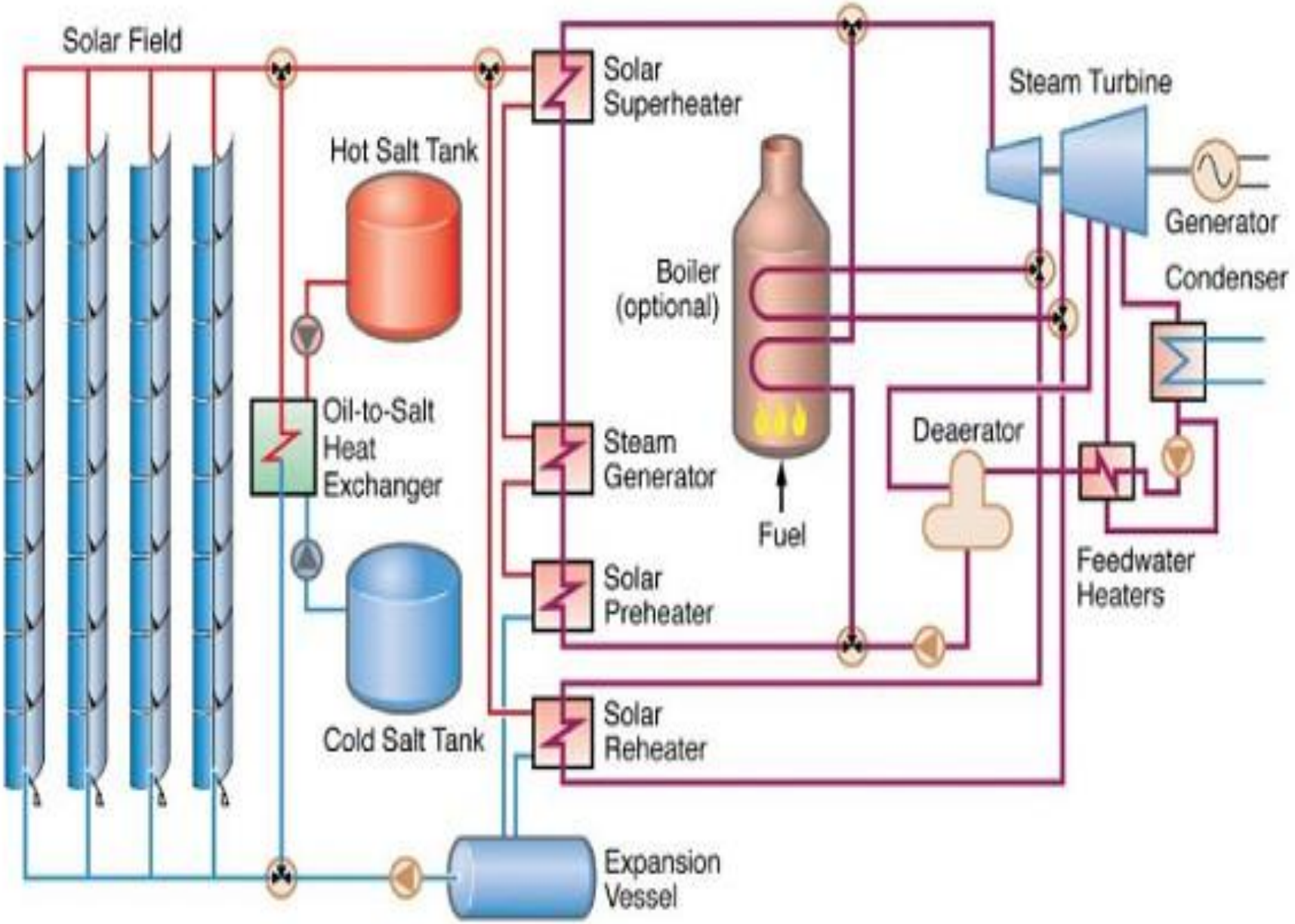
1. Suntech/China: 5 x 20MW PV sites nationwide =100 MW +
2. Conenergy/Germany: 50MW PV Bahawalpur, Punjab
3. CX Solar/S.Korea : 300 MW CSP near Quetta Balochistan
4. RenuEN/US; 50 MW PV Sindh
5. Japanese firms: Pakistan government buildings Grid tied

Provincial Initiatives

1. All five provinces providing liberal incentives for solar irrigation wells (1.1 million wells to be converted), Solar village electrification (Over 70,000 villages to be electrified)

2. USAID, UNDP, ADB funded Rural PV = 4000 + villages
3. NGOs Rural Homes PV electrification kits distribution funding

Concentrated Solar Power



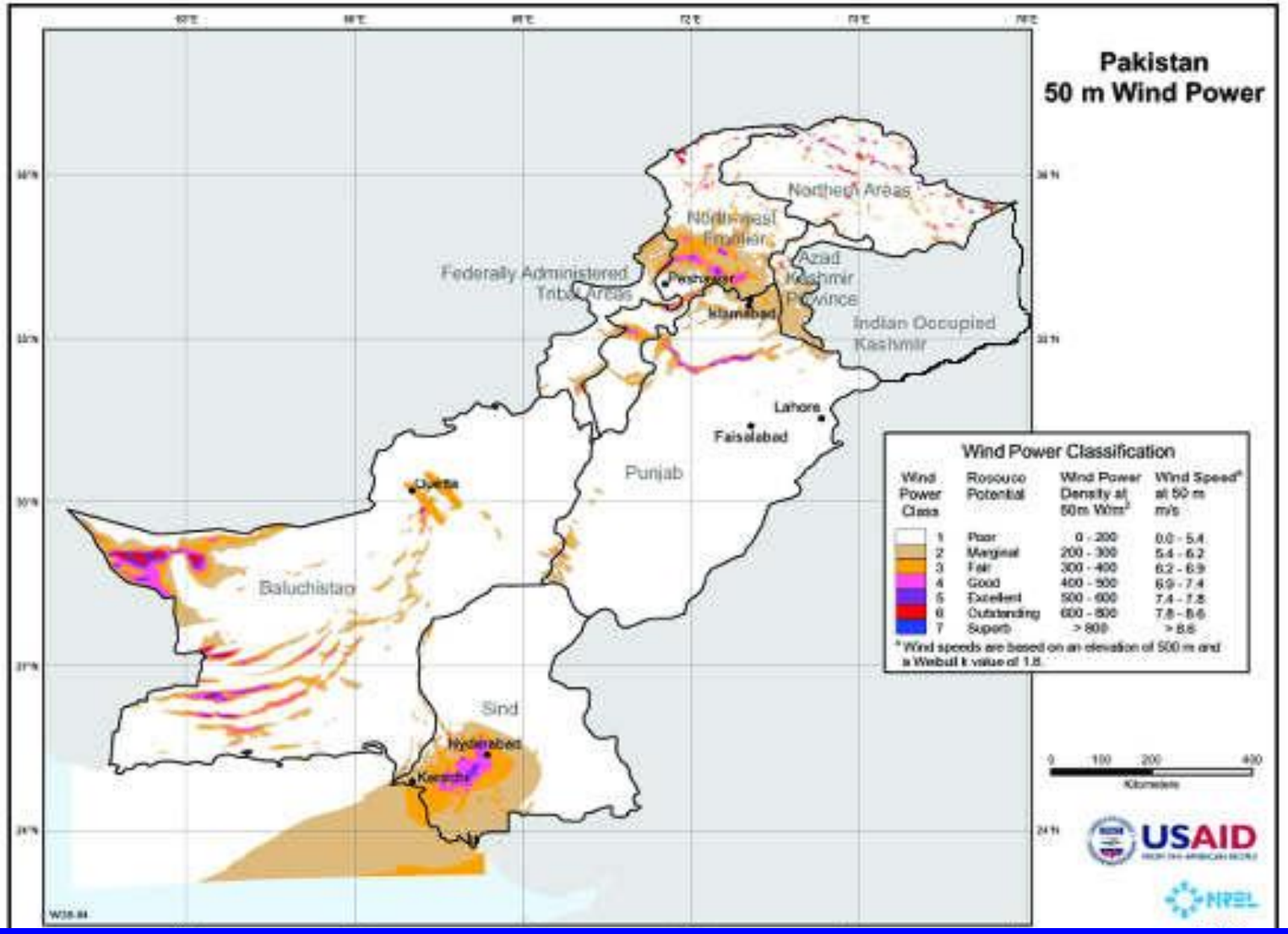
Concentrated Solar Power (CSP)

- **Concentrated Solar Power (CSP) industry in the U.S. is on the brink of a major turning point**
- **Significant technological breakthroughs have allowed utility-scale CSP plants to generate base load power**
- **US government funded research program aims to reduce the cost of CSP from a current price of $0.21/kWh to a goal of $0.06/kWh**
- **CSP is thus poised to become the base load power source in the near future**

International Wind Energy Outlook

- **Worldwide production of wind energy has increased at more than 25 percent each year in the last decade**
- **Worldwide wind capacity is growing by about 40 gigawatts (GW) each year, has reached 254 GW**
- **China with an installed capacity of around 67.7 GW represents the largest wind market, followed by the US with an installed capacity of 49 GW**
- **Europe continues to dominate with Germany 30 GW, Spain 22 GW, Italy 7.2 GW, France 7.2 GW, the United Kingdom 6.5 GW and Portugal 4.4 GW**
- **India is far ahead of Pakistan in terms of wind and other renewable energies. It makes its own wind turbines, and has reached a capacity of 17.3 GW in wind energy.**
- **Industry experts believe that if the current pace continues, by 2050 Wind Energy will provide one third of the World's electricity needs**

Pakistan Wind Energy Map



Pakistan Wind Energy Potential

- **Pakistan is also blessed with abundant wind resources**
- **A wind map of Pakistan has been developed after extensive analysis**
- **A 60 km wide 170 km deep wind corridor has been mapped at Gharo ~ Keti Bandar having the potential to produce more than 60,000 megawatts (MW)**
- **Wind Energy can provide three times the presently installed power generation capacity of Pakistan**

Wind Energy Incentives

GOP offers the following incentives:

- ✓ **Wind Risk in Certain Areas (risk of variability of wind speed). Attractive Tariff (Cost plus up to 17% ROE)**
- ✓ **Up-front power tariff of US Cents 14.66/Kwh for parties willing to take wind risk**
- ✓ **Guaranteed electricity purchase. Grid provision is the responsibility of the purchaser.**
- ✓ **Protection against political risk.**
- ✓ **Tariff indexed to inflation & exchange rate variation (Rupee / Dollar), Euro/Dollar parity allowed.**
- ✓ **Carbon Credits available.**
- ✓ **No Import Duties on Equipment.**
- ✓ **Exemption on Income Tax/Withholding Tax and Sales Tax.**
- ✓ **Permission to issue corporate registered bonds in Pakistan.**

Wind Energy Projects

- **Approval granted for setting-up to 41 wind power projects exceeding 3000 MW**
- **22 parties allocated sites for setting up projects totaling 1100 MW**
- **Land has been allocated to 18 parties, out of which 13 have submitted detailed feasibility studies for 650 MW**
- **7 projects have been issued generation license and are under construction**
- **One project has started production, and another is reported in trial production**
- **Another 5 to 6 projects are in various stages of construction, and are expected to start producing within an year**
- **It is aimed to have share of at least 5% of total National On-Grid Power generation capacity through wind energy by year 2030**

Biogas

- **Pakistan is the fourth largest dairy producer in the World with a livestock population exceeding 50 million heads**
- **Biogas is produced by the anaerobic digestion of biodegradable materials such as manure, municipal waste, farm products waste etc.**
- **Pakistan is blessed with all the ingredients to produce large quantities of biogas, i.e. abundant cattle & other animal waste, farm waste, municipal waste, water and favourable climate**
- **Biogas comprises typically methane (60%) and carbon dioxide (30%), small amounts of hydrogen sulphide (H_2S), moisture and siloxanes. It is ideal fuel for heating/cooking purposes**
- **Biogas has the potential of changing the lifestyle of Pakistan's agricultural and rural communities, as is being amply demonstrated in some parts of the Punjab province**

Bio-methane

- **Biogas can be refined to produce Bio-methane, which is nearly 98 % methane, equivalent to natural gas**
- **Bio-methane can be used in CNG automobiles and natural gas engines for producing power, and being directly injected in the natural gas grid**
- **It is estimated that on the average one animal can sustain production of 40 standard cubic feet (scf) of bio-methane daily**
- **Field studies in Germany and USA have established that biomethane can be produced at between 7-10 $/MMbtu, which is cheaper than imported LNG or LPG**
- **Bio-methane potential exceeds 2,000 MMcfd, which can alone meet half of Pakistan's natural gas requirements, and therefore needs to be given serious consideration**

Recommendations

- **Renewable energy offers the only real solution to Pakistan's perennial energy crisis**
- **Pakistan is blessed with abundant amounts of renewable energy easily accessible to all sections of the population**
- **Solar PV on distribution generation and biogas are available and affordable options for our rural population**
- **Municipal waste, sugar industry waste and agricultural waste can be harnessed to supply sufficient energy**
- **Wind Energy, Solar PV Solar CSP, Bio-methane are the viable solutions for our commercial/industrial requirement**

Recommendations

- **Five essential components for development of successful renewable energy business models:**
  - ✓ **Resource Availability: Abundant**
  - ✓ **Market size: Large, willing to pay for affordable energy**
  - ✓ **Entrepreneurship: Business houses looking for viable businesses**
  - ○ **Technology: Developed internationally, but limited local availability**
  - ○ **Capital: Available for viable businesses, limited for R&D funding**

- **Technical universities should setup faculties of renewable energy with focus to develop, disseminate & refine renewable energy resources suitable for local environment**
- **Training institutes should focus on renewable energy training**
- **The Federal & Provincial Governments should provide R&D funding to Universities and Research Institutes to commercialize Renewable Energy Technologies**

THANK YOU and Q&A