Towards Pakistan's Energy Security and Competitiveness…

The Pakistan Business Council
FOSTERING ECONOMIC GROWTH
(A Company set up under Section 42 of the Companies Ordinance 1984)

Pakistan Economic Forum – Energy Panel

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Mr. Khalid Mansoor

Mr. Khalid Mansoor is a Graduate in Chemical Engineering with distinction and honors. He has been the Chief Executive Officer of Hubco, the first and largest Independent Power Producer (IPP) in Pakistan, since May 20, 2013. The Company generates approximately 10% of the Country's electricity and is a leading private sector player in addressing the energy crisis currently being faced by Pakistan. After becoming the CEO of Hubco in May 2013, he has transformed the Company and has initiated growth initiatives with Projects worth over US$ 3.5 billion under execution.

He is also Chairman of the Boards of Laraib Energy Limited, Narowal Energy Limited, Hub Power Services Limited, CEO of Hub Power Holding Limited and a Director on the Board of Thar Energy Limited.

He is the President of the Overseas Investors Chamber of Commerce & Industry (OICCI) for the term 2017.

He held the position of CEO of Algeria Oman Fertilizer Company (AOA) where he was responsible for setting up the world's largest Ammonia and Urea Fertilizer Complex.

He has been the CEO of various Companies of the Engro Corporation and a Director on the Boards of various Engro Group Companies and Sui Northern Gas Pipeline Limited.

He has over 38 years of experience in Energy and Petrochemical Sectors in leading roles for mega size projects development, execution, management and operations.

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Mr. Nadeem Babar

Mr. Babar is a senior executive with extensive worldwide experience in power generation, infrastructure finance and corporate finance. He holds a M.S. in Civil Engineering Management from Stanford University, a B.A. in Economics from Columbia University and a B.S. in Civil Engineering from Columbia University.

Mr. Babar is currently the CEO of Orient Power Company (Pvt) Limited, Saba Power Company (Pvt) Limited, Orient Operating Company (Pvt) Limited, Oursun Pakistan Limited, as well as Oursun Pakistan Limited and Saba Generation Company (Pvt) Limited. He serves on the Board of Port Qasim Authority and PPRA for the Government of Pakistan, in addition to being an independent director on the Board of Samba Bank. In the past, he has held numerous board positions for the Government of Punjab and Government of Pakistan in various government owned entities and authorities.

Mr. Javed Akbar

Javed Akbar has over 40 years of experience in fertilizer and chemical business with Exxon, Engro and Vopak in Pakistan and overseas. He was part of the buyout team in 1991 when Exxon divested its stake in Engro. Prior to his retirement in 2006, he was Chief Executive of Engro Vopak Terminal Limited, a joint venture between Engro and Royal Vopak of Holland. After retirement, he established a consulting company specializing in analyzing and forecasting petroleum, petrochemical and energy industry trends and providing strategic insight.

He currently serves on the board of companies involved in fertilizer, petroleum, power and renewable energy.

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Mr. Syed Muhammad Ali

Mr. Ali holds a Bachelor's degree in Electrical Engineering from University of Engineering Technology Lahore and graduated from the Advanced Management Program from INSEAD in France. He has over 20 years of experience and expertise in Energy & Petrochemical Sectors. He has recently taken over the energy business portfolio of the JS group of companies as CEO of JS Energy where he looks after the group's oil and gas, power generation, and energy storage and handling businesses. He has been a board member of the Hub Power Company, Laraib Energy, Engro Powergen, Engro Powergen Thar Ltd, GEL Nigeria, and Petroleum Institute of Pakistan.

Mr. Tayyab Tareen

Mr. Tayyab Tareen was appointed as the Chief Executive Officer (CEO) by K-Electric's Board of Directors on November 27th, 2014. He has been on the KE Board since 2009 and has also served as its Chief Financial Officer (CFO) and Chief Strategy Officer, before moving back to the parent company, The Abraaj Group, in 2013. Mr. Tareen joined The Abraaj Group in 2006 and has over 22 years of experience, mainly with multinationals, covering areas of business turnarounds, financial management, planning and business acquisitions. Prior to joining Abraaj, he was the CFO at the Coca-Cola Company managed bottler in the UAE and Oman, a business that saw a successful turnaround from losses to sustained profitability within two years. From 1997 to 2001, he was with Coca-Cola Beverages Pakistan as CFO and Company Secretary. He started his career in 1995 with Packages Limited in Pakistan as Manager Project Financing, responsible for investment reviews and project financing. Mr. Tareen is a qualified Chartered Accountant from The Institute of Chartered Accountants in England and Wales.

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Mr. Mumtaz Hasan Khan

Mr. Mumtaz Hasan Khan, Chairman of Hascol Petroleum Limited, has over 54 years of experience in the Oil Industry. From February 1976 to July 1980 he served as Managing Director, Pakistan Services Limited, which was the owning company of four Intercontinental Hotels in Pakistan. In August 1980 he moved to London to start his own oil trading business and established Hascombe Limited. Mr. Mumtaz Hasan Khan is also the Chairman of Hascol Terminals Limited, and Trustee of the Foundation of Museum of Modern Art (FOMMA) and is also on the Board of Pakistan Refinery Limited (PRL).

Mr. Yacoob Suttar

Mr. Yacoob Suttar is MD and CEO of Asia Petroleum Limited since Febuary, 2013 and also DMD Finance and CFO of Pakistan State Oil Company Limited. He commenced his career with A.F. Ferguson & Co. in 1981 where he completed his four years of training in audit and finance related work. He is a Fellow Member of the Institute of Chartered Accountant of Pakistan (ICAP) and the Institute of Cost and Management Accountant of Pakistan (ICMAP), and has over 30 years of professional work experience. He has recently been elected to the board of International Federation of Accountants (IFAC) for the term 2018-2020.

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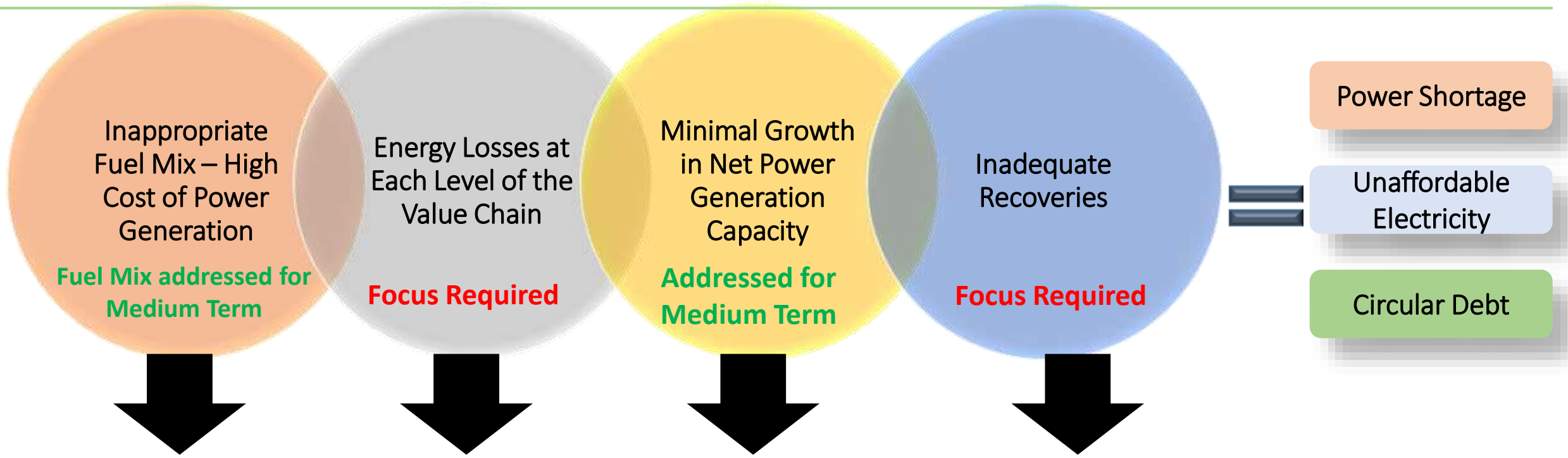
Mr. Muhammad Saqib

Mr. Muhammad Saqib is MBA from IBA, Karachi and is also a Chartered Financial Analyst. Currently, Mr.Saqib is CFO of Sindh Engro Coal Mining Company Limited. He has been with Engro for the past sixteen years and has worked in finance division of almost all businesses of Engro including Engro Fertilizer, Engro Polymer and in the Energy Division. He led the finance team that arranged USD 2bn for First phase of Thar coal mining and power project which is the flagship CPEC project and first project in the Energy domain of CPEC which achieved financial close. He has also served as CFO of 220 MW gas fired plant owned by Engro – Engro Powergen Qadirpur Limited

PAKISTAN POWER SECTOR

Genesis of Power Crisis



- High reliance on most expensive imported fuel source - Oil (32%) with no power generation from coal (vs. 41% world average)
- Oil and LNG import totaling US$ 11BN in FY2017 (22% of entire import bill)

- Pakistan's power T&D losses stand at 19.6% which is highest amongst the comparable countries
- Pakistan's weighted average consumer power tariff @ 12.51 Cents/kwh*, highest in comparable countries due to high T&D losses, duties, surcharges etc.

- Only minimal 4000 MW Power Capacity added during 2004 – 2013 coupled with continuous capacity derating of existing public sector power plants which were supposed to be privatized
- A shortfall of 5,000 to 7,000 MW experienced in the years 2013 to 2016
- Growth in power sector installed capacity has been significant after 2013 with an addition of approx. 10,000 MW by 2018 and a total of approx. 24,000 MW by 2025

- Discos experienced a huge shortfall of ~PKR 80 Billion in recoveries in FY 2015-16 vs the billed amount
- Around 2% of distribution losses not allowed by Nepra to Discos resulting in additional revenue shortfall of around PKR 30 Billion/Annum
- Circular debt has ballooned to over **PKR 525 Billion**

**13.05 Rs./KWh*

Government's Initiative to Address Power Crisis

Imported Coal Based Power Projects

Local Coal Based Power Projects

RLNG Power Projects

Hydel Power Projects

Solar Power Projects

Wind Power Projects

Nuclear Power Projects

Transmission Network Projects

The Government of Pakistan policies have currently resulted in creating a surplus power generation capacity in Pakistan. Power supply availability has been ensured for the medium term, however, the focus needs to move beyond 2025 for which investments should continue. Key emphasis is also required on the Transmission & Distribution Sectors

China Pakistan Economic Corridor – The Game Changer

Participation by Large Chinese Equipment Suppliers, EPC Contractors & Banks

Economic Benefits for Pakistan and China

Fast Track Solution for Energy Crisis

More than $56 Billion Bilateral Investment Package

CPEC Cooperation Fields:

Energy

Infrastructure

Technology

Power Generation Capacity Outlook

Year Wise Projected Increase in Generation Capacity (MW)

Calendar Year	2017	2018	2019	2020	2021	2022	2023	2024	2025	Total	Availability Factor	Adjusted
Imported Coal	1,980	660	1,320	0	0	0	0	0	0	**3,960**	85%	**3,366**
Thar Coal	0	0	660	1,650	1,320	0	0	0	1,320	**4,950**	85%	**4,208**
Wind	300	100	445	0	0	0	0	0	0	**845**	31%	**262**
Solar	0	42	600	0	0	0	0	0	0	**642**	17%	**109**
RLNG	2,500	1,500	1,250	0	0	0	0	0	0	**5,250**	93%	**4,883**
Nuclear	680	0	0	0	0	1,100	1,100	0	0	**2,880**	85%	**2,448**
Hydel	147	2,487	102	0	720	870	0	1,100	600	**6,026**	50%	**3,013**
Total New Nameplate Capacity	**5,607**	**4,789**	**4,377**	**1,650**	**2,040**	**1,970**	**1,100**	**1,100**	**1,920**	**24,553**		**18,288**
Total Net New Capacity (Aux. Load Adjusted)	**5,331**	**4,666**	**4,180**	**1,518**	**1,927**	**1,895**	**1,034**	**1,089**	**1,808**	**23,450**		
Availability Factor Adjusted Net New Capacity	**4,513**	**3,138**	**2,966**	**1,290**	**1,389**	**1,310**	**879**	**545**	**1,329**	**17,359**		

Total Nameplate Capacity	**30,981**	**35,770**	**40,147**	**41,797**	**43,837**	**45,807**	**46,907**	**48,007**	**49,927**			
Total Net Capacity (Aux. Load Adjusted)	**25,452**	**30,119**	**34,299**	**35,817**	**37,744**	**39,639**	**40,673**	**41,762**	**43,571**			

**Existing name plate capacity assumed to be 25,374 MW*
***Does not include Captive Power Generation*

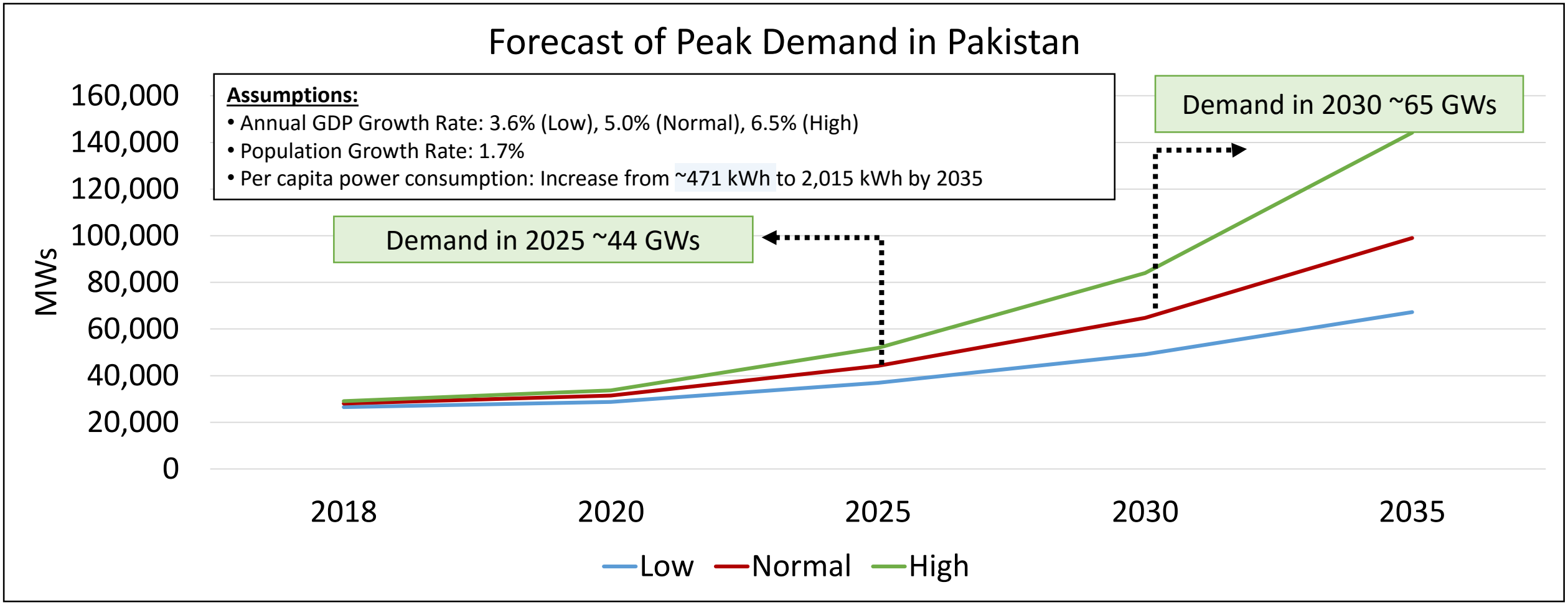
Note: *The above power generation capacity outlook has been prepared on the basis of in-house assessment and industry networking. Timing of incremental capacity projected as per current expected COD of various projects.*

Details

Pakistan Energy Fuel Mix – Based on Installed Capacity

- Coal ~18% of Total Installed Capacity by 2025
- No additional Oil Based Plants. Share of Oil based power capacity is projected to be 12% vs. 24% presently
- Power Generation from clean sources to increase by 3%

Pakistan Power Peak Demand Forecast

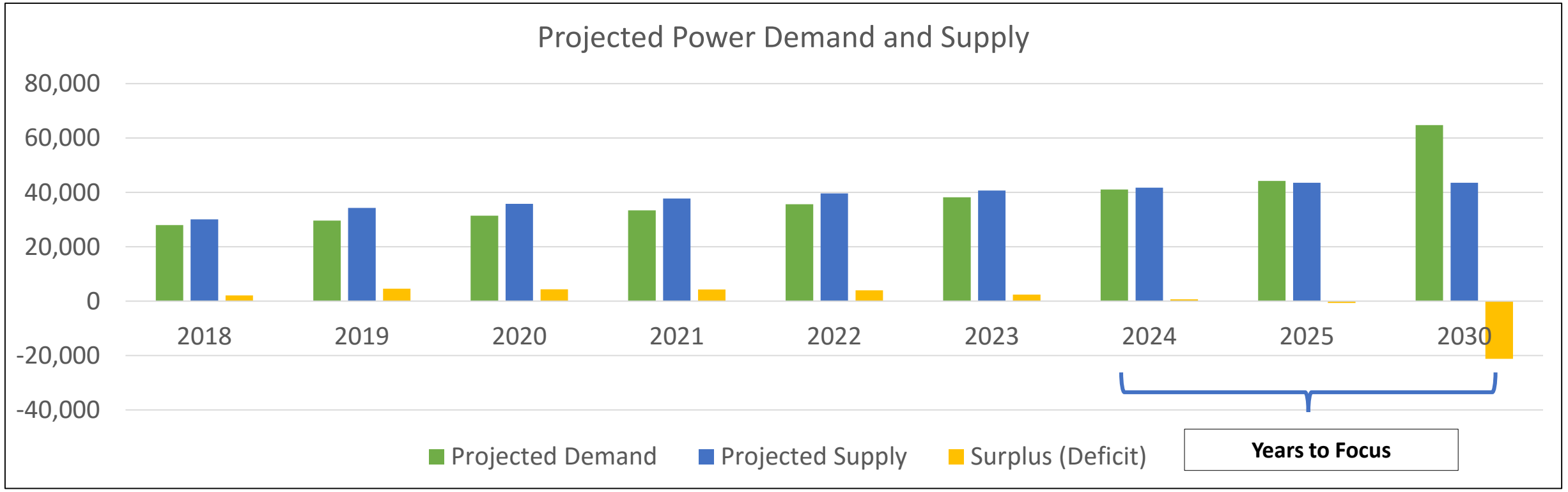


Assumption: Demand for captive power not included in the above projections

***Source**: National Transmission & Distribution Co. (NTDC), Pakistan (March 2014)*

Details of Captive Power Plants

Projected Peak Demand/Supply Balance

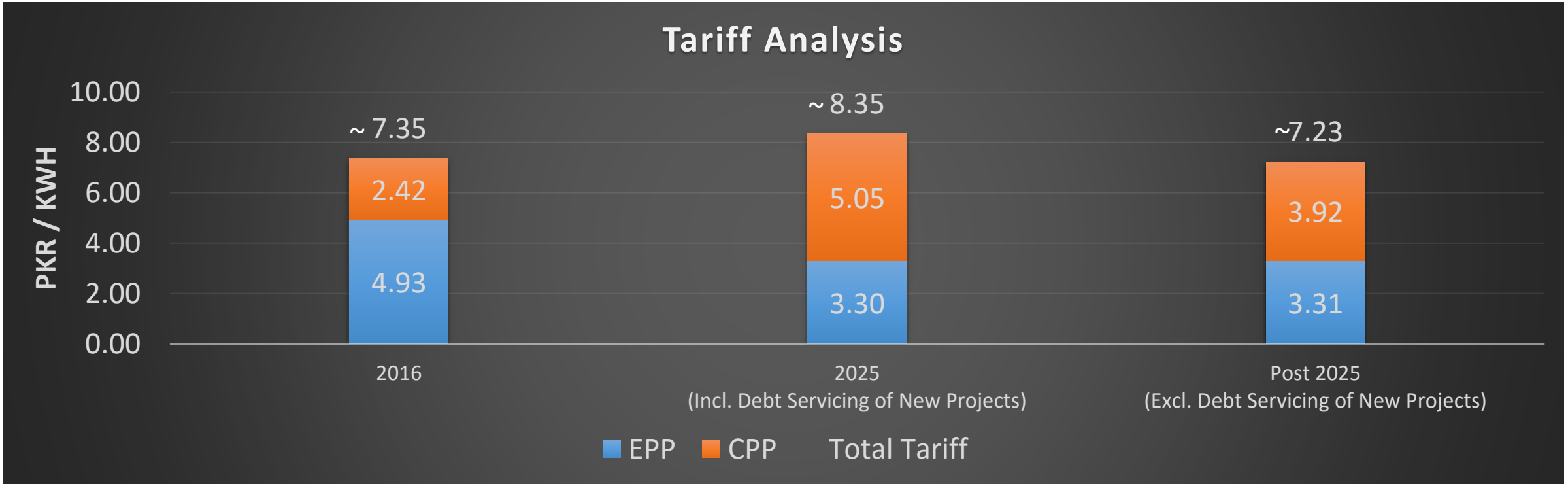


Notes:

- ***Existing derated capacity and future deterioration in public sector plants not assumed***
- *Demand Projection based on NTDC forecast for Peak Demand under "Normal GDP Growth Scenario"*
- *In order to ensure Zero Load-shedding, it is imperative to plan for Peak Demand rather than average demand*
- *Net capacity (aux. load consumption adjusted) of upcoming power plants used for supply projection*
- *The above scenario to be true in case all projects come online by their expected CODs and are available during peak demand*

Projections of peak power demand and supply situation show a balanced position until year 2024. However, average power capacity should be higher than average demand in order to effectively create a spinning reserve for smooth operations of the grid and uninterrupted power supply. However, if retirement of old and in-efficient plants is also considered, then there is a need to add approx. 2000MW each year to maintain a balanced demand/supply situation in future years for which planning must be done at least 5 years in advance

Representative Tariff Analysis – Power Generation Cost to DISCOs



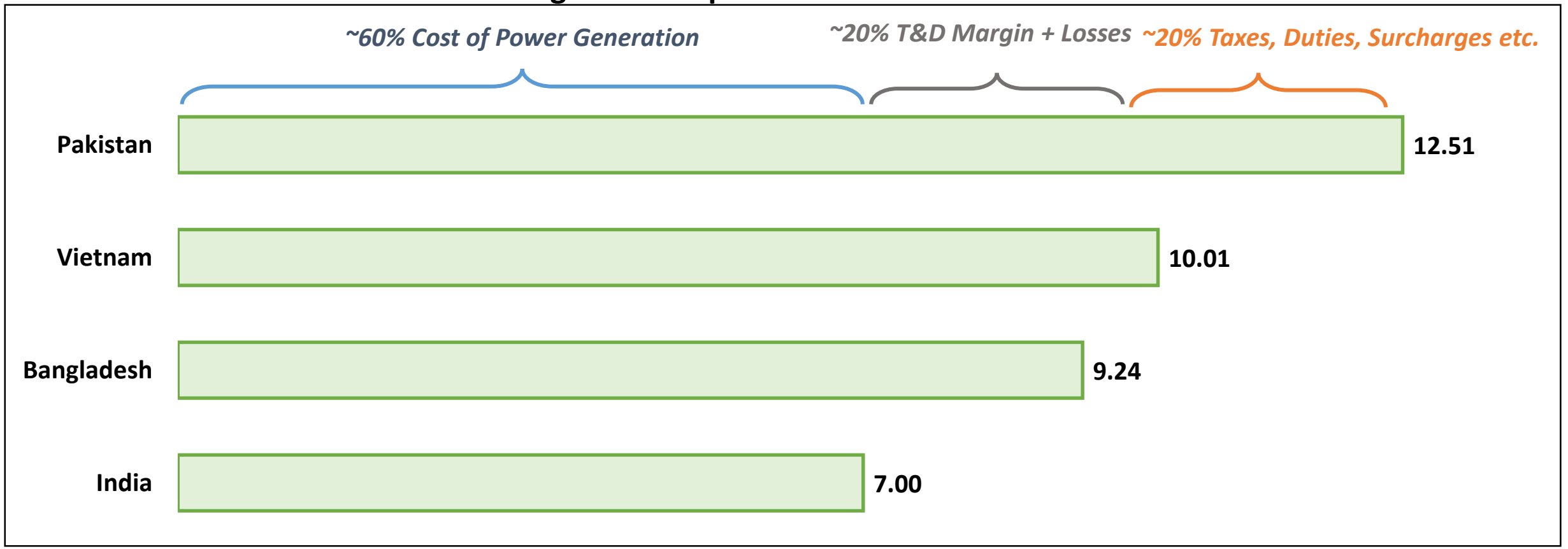
Assumptions:

1. Current Tariff based on cost of power purchase by Discos as allowed by NEPRA (*Source: Relevant NEPRA Tariff Determinations*)
2. Projected electricity generation in 2025: 208 TWh vs. 112 TWh in 2016 (growth rate of 7%, in line with NTDC Demand Forecast 2014)
3. 2025 Tariff based on weighted average cost of power to DISCOs including:
   i. Entire new capacity addition (EPP + CPP)
   ii. EPP of most economical existing plants
   iii. CPP of all existing plants as per current rates
4. Current FX and fuel rates assumed to prevail

Even though cost of power generation is going to marginally increase, availability of sustainable power will be far beneficial to the economy of the country. "Expensive power is better than no power!"

W. Average Consumer Tariffs (Usc/kwh)

Regional Comparison of Power Tariff



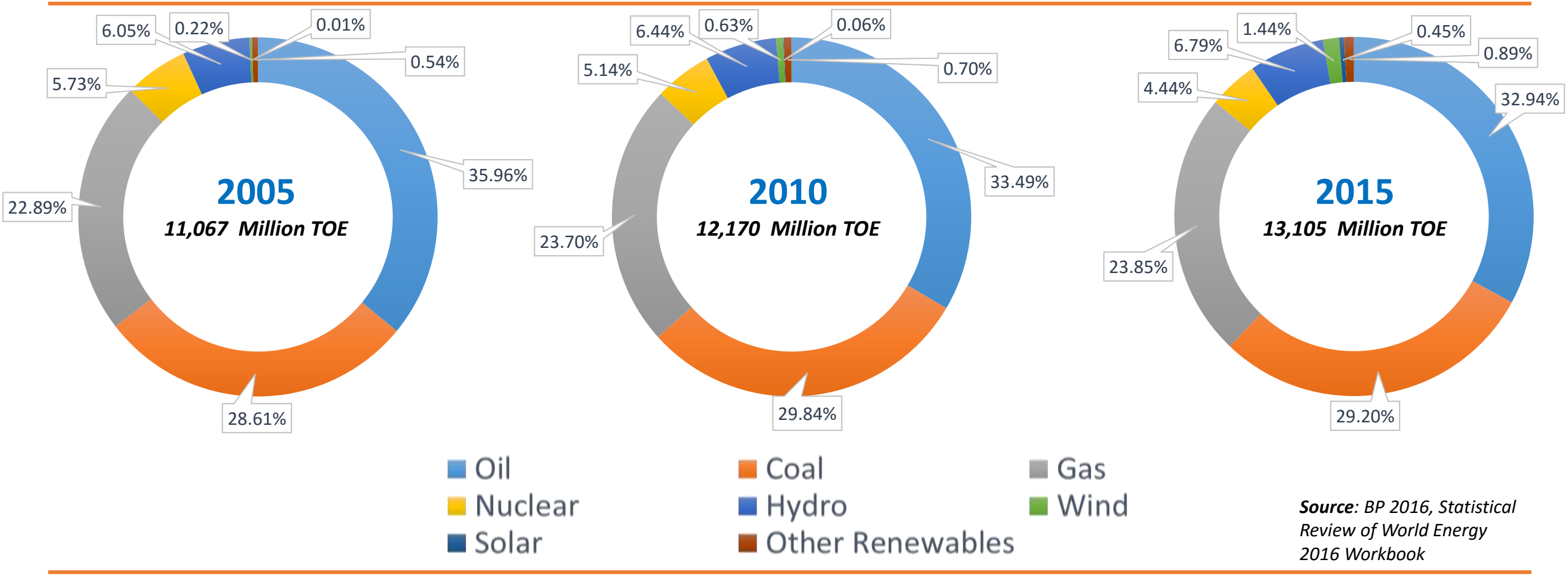
***Sources**:*

1. NEPRA State of Industry Report, 2015-16
2. Central Electric Agency Government of India, 2014
3. Vietnam Electricity Prices, Thomson Reuters, 2011
4. The Bangladesh Energy Regulatory Commission, 2014

Pakistan has the highest electricity tariff amongst comparable countries. However, recently the Government has given a subsidy of Rs.3/KWh to industrial consumers

GLOBAL ENERGY SITUATION

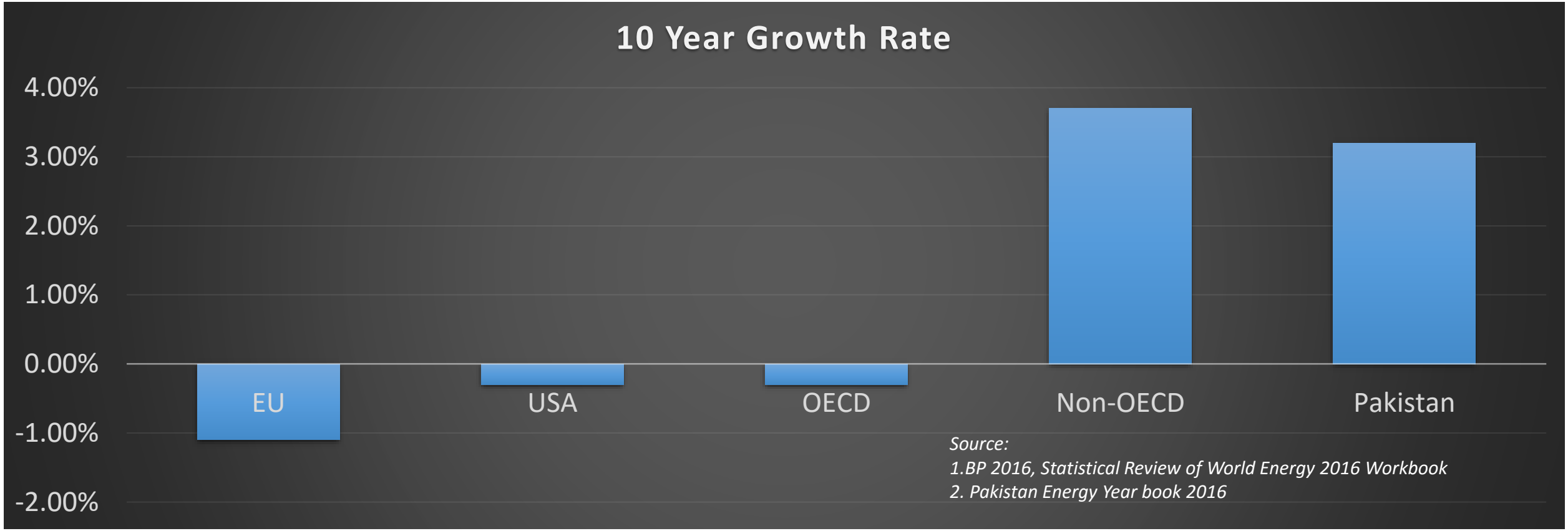
Global Energy Consumption – Historical Perspective



***Source**: BP 2016, Statistical Review of World Energy 2016 Workbook*

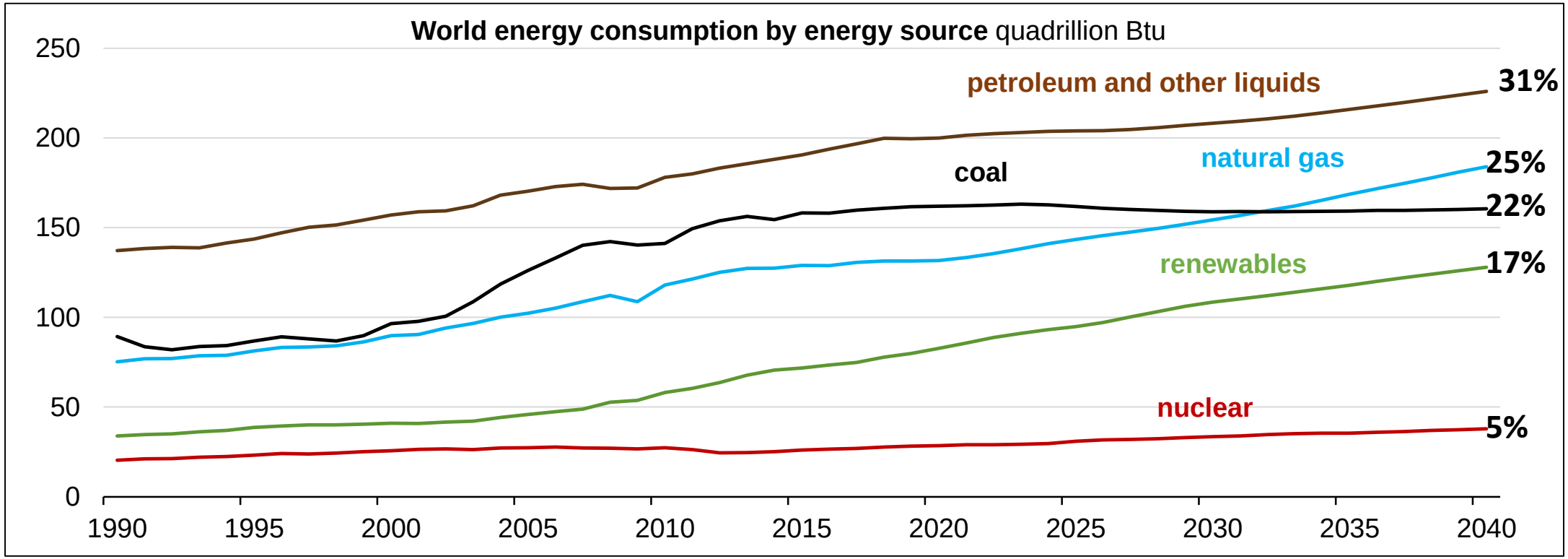
Global energy consumption traditionally has largely been reliant on fossil fuels.
The share of renewables has increased from 6.82% to 9.57% in a period of 10 Years from 2005 to 2015

Global Energy Consumption – Historical Perspective



- ***Though Pakistan represents a small fraction (0.6%) of global energy consumption, there is a high growth rate of consumption in line with other developing nations***
- ***Organization for Economic Cooperation and Development (OECD) Countries have reduced energy consumption due to the energy conservation measures and adoption of energy efficient technologies***

Global Energy Consumption – Future Projections



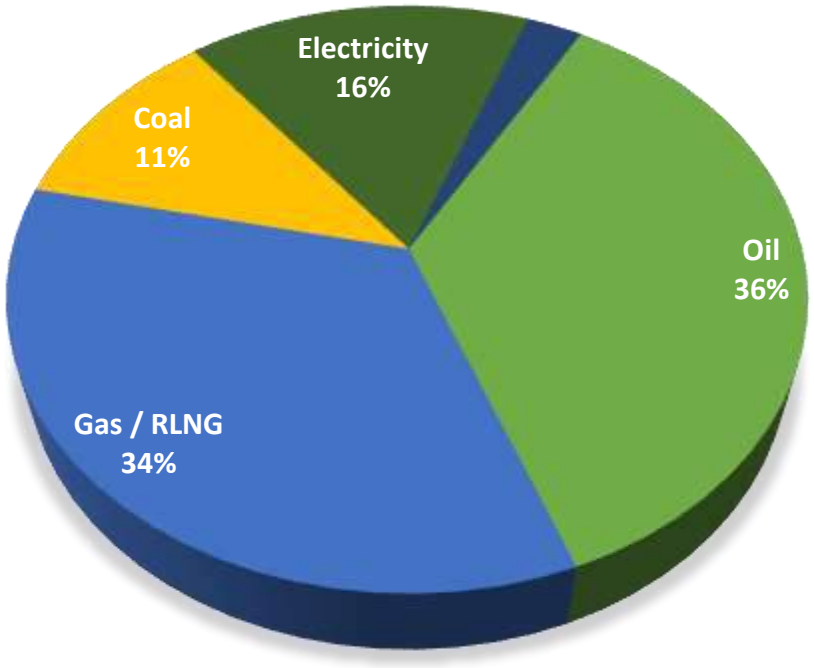
Global energy consumption forecast predicts a sharp rise (from 10% in 2015 to 17% in 2040) in contribution of renewable sources. However, reliance on Fossil Fuels including coal is projected to continue

International Energy Outlook, 2017

PAKISTAN ENERGY SITUATION

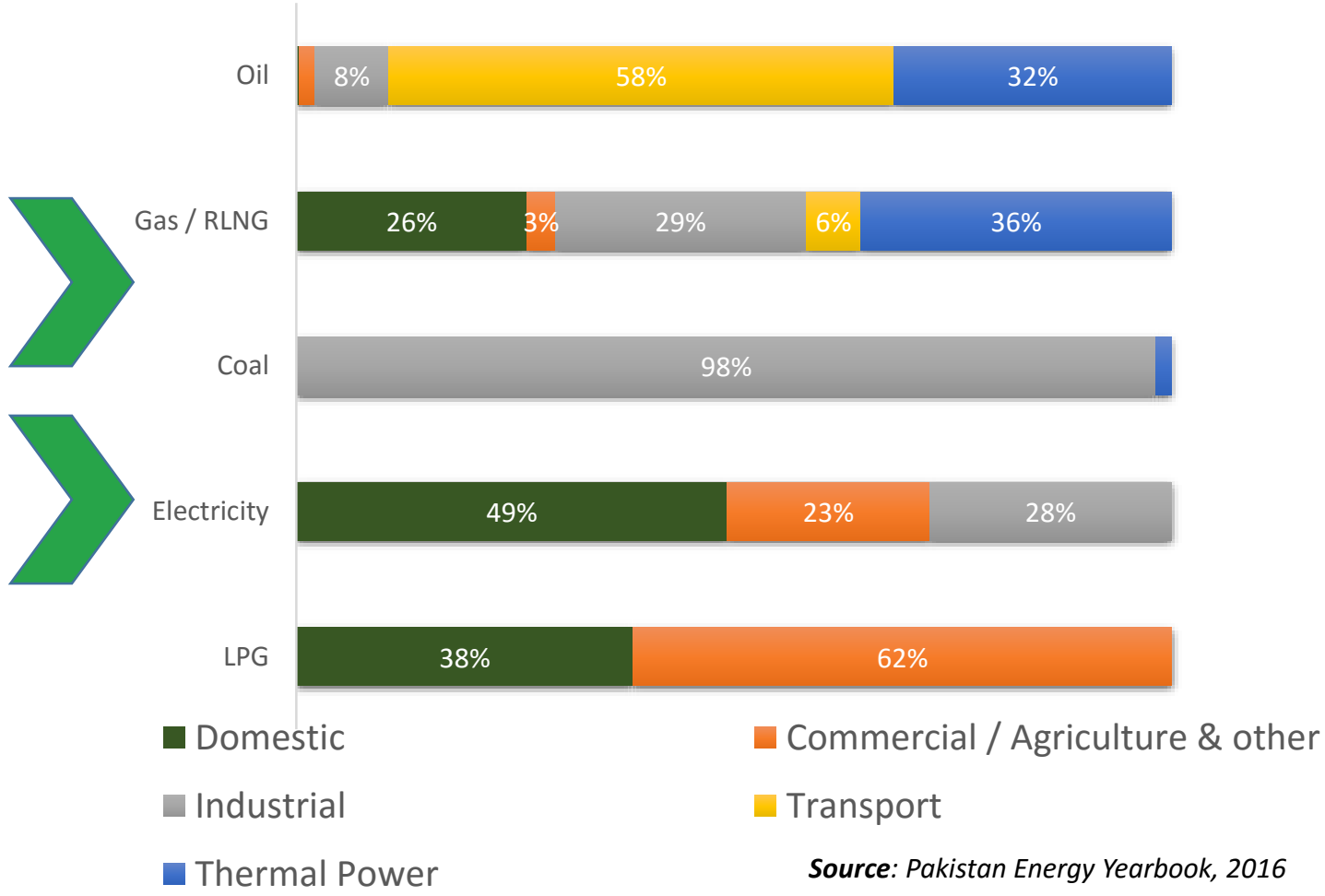
Pakistan Energy Consumption Pattern – FY 2016

Energy Consumption by Fuel



Total Energy Consumption: 45.3 MTOE

Sector Energy Consumption by Fuel Type



***Source**: Pakistan Energy Yearbook, 2016*

- Pakistan's energy consumption expected to grow by approx. 70% in the next 10 years
- Expected incremental power generation from indigenous Thar coal and Renewables to only cater to 15-20% of incremental energy demand
- Remaining 80-85% incremental demand to be met through imports, resulting in additional impact of USD 6-8 Billion on Balance Of Payments

Challenges of Pakistan Energy Sector

High Reliance on Imported Fossil Fuel

- Heavy reliance on fossil fuels -particularly oil and natural gas (over 90% of energy consumption in 2016
- Energy imports totaling $11 Bn. worth of Oil and LNG in FY 2016-17 – nearly 22% of the entire import bill!

Depletion of Indigenous Gas

- Indigenous natural gas has reduced (from 43% of energy mix in 2011 to 34% in 2016) with indigenous reserves only sufficient to sustain current levels of gas consumption of (15.5 MTOE) for the next 25 years
- Indigenous supplies are expected to decline by approx. 50% in the next 10 years, which will also have to be covered through LNG imports in addition to catering incremental demand growth
- Current consumer prices of indigenous gas range between US$1-7/MMBTU. LNG prices are currently @ 11 US$/MMBTU
- This necessitates a complete overhaul of the consumer gas pricing structure under the projected scenario of indigenous gas depletion

Energy T&D Losses

- Pakistan's energy sector has been marred by transmission and distribution losses mainly due to:
  1. Leakages
  2. Theft
  3. Poor Maintenance
- Natural Gas Unaccounted for Gas (UFG) in Pakistan is approximately 14%, which is much higher than global industry best practices

INTEGRATED ENERGY PLANNING

Formulation of Integrated Energy Policy – Key Considerations

National Energy Security / Minimize Burden on Balance of Payments

Long Term Environmental Sustainability

Ensure Competitive Tariffs

Energy Efficiency and Conservation

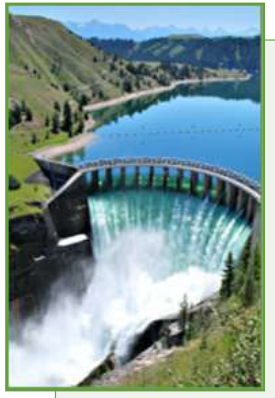
Integrated Energy Policy – National Energy Security

Expand Thar Coal

- Thar Desert contains the world's **7th largest coal reserves**
- **175 billion tons** of Lignite grade coal, which is equivalent to:
  - **50 billion ton of Oil** (more than Iran & Saudi Arabia combined oil reserves) or;
  - Over **2000 TCF of Gas** (42 times greater than total gas reserves discovered in Pakistan so far)
- Power Generation potential of **100,000-200,000MW for over 100 years**

Exploit Solar/Wind Potential

- Estimated wind potential of approx. **132 GW** as estimated by USAID
- Estimated Solar potential is more than **2.9 Million MW** according to studies from ADB, various authors and research papers
- Cost of power generation from solar and wind based projects are on the decline and have become the cheapest source @ **Rs. 6-8 / KWh**
- Solar Thermal / solar off-grid applications need to be encouraged



Maximize Storage Based Hydro Projects

- Total potential for Hydropower generation in Pakistan is approximately **60,000 MW (Existing 7,116 MW)**
- Currently, **approx. 4000 MW** of Hydel Power projects are at different stages of execution
- Multiple projects of **over 25,000 MW** at feasibility / engineering stage are in hand with WAPDA
- Since upcoming run of the river power projects are becoming increasingly expensive vs other renewables, Large scale **storage based projects** must be encouraged to ensure power and water availability for the country

Exploit Tight & Shale Gas / Shale Oil

- Shale gas and Shale Oil reserves estimated at **105 tcf** and **9.1 billion barrels respectively as per** US Energy Information Administration (EIA)
- Recent combined cycle RLNG based power plants have demonstrated **60-62% efficiency** resulting in electricity tariff of 6-7 Cents/KWh
- Indigenous gas availability through exploration of tight and shale gas should be ensured to reduce the electricity tariff further

Recommendations – Indigenization to Ensure National Energy Security

Expand Thar Coal

- Incentivized Mining and Power Generation Tariffs should be continued to promote private sector investment
- Availability of water for power generation and other infrastructure to be ensured by federal and provincial governments for future expansion
- Tax incentives should be continued

Maximize Storage Based Hydro Projects

- Technical feasibility studies of storage based projects must be expedited
- Adequate budget allocations must be made to ensure expeditious implementation
- Solar projects at existing hydro power projects must be encouraged to leverage existing infrastructure

Exploit Solar/Wind Potential

- Import tariff policy for solar equipment must be revised to encourage solar applications
- Local solar manufacturing industry must be developed
- Utility companies should be tasked to propagate 'net metering'
- Promote off-grid applications to ensure power supply to remaining 27% of population

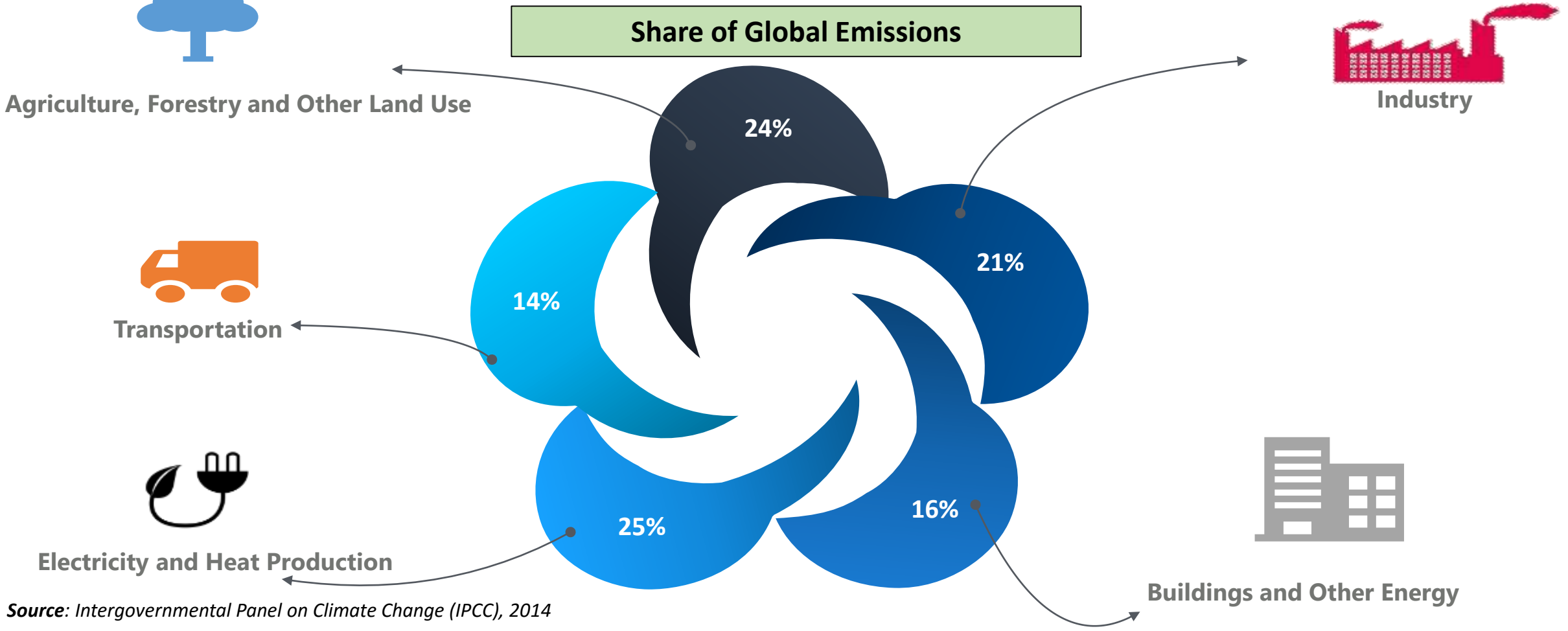
Exploit Tight & Shale Gas / Shale Oil

- Adequate incentives should be provided in the policy framework for expeditious development of tight and shale gas/oil potential
- New areas must be opened for gas and oil exploration

Tight and Shale Gas Projects having equivalent economic cost of LNG delivered price must be allowed for exploration and development

The above interventions for indigenization of energy mix are essential in achieving self reliance in energy and reducing burden on balance of payments

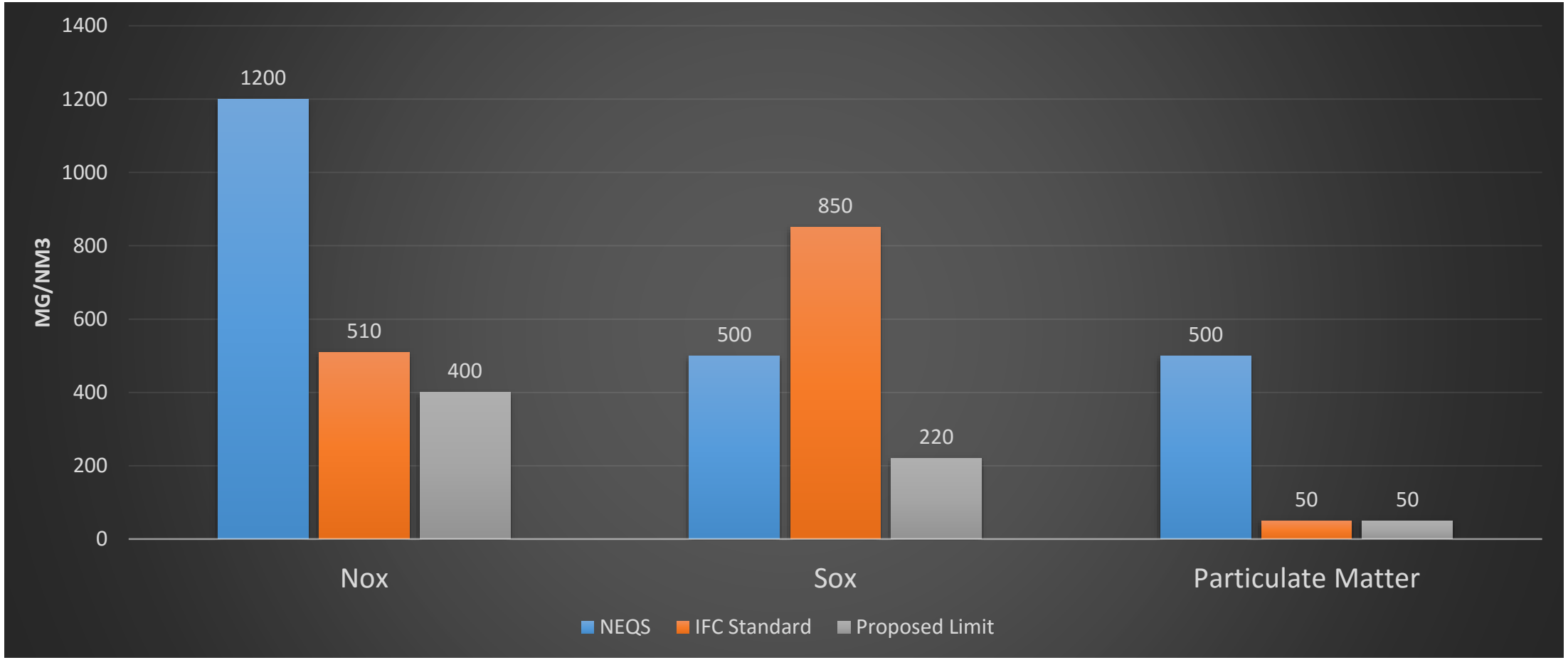
Long Term Environmental Sustainability



***Source**: Intergovernmental Panel on Climate Change (IPCC), 2014*

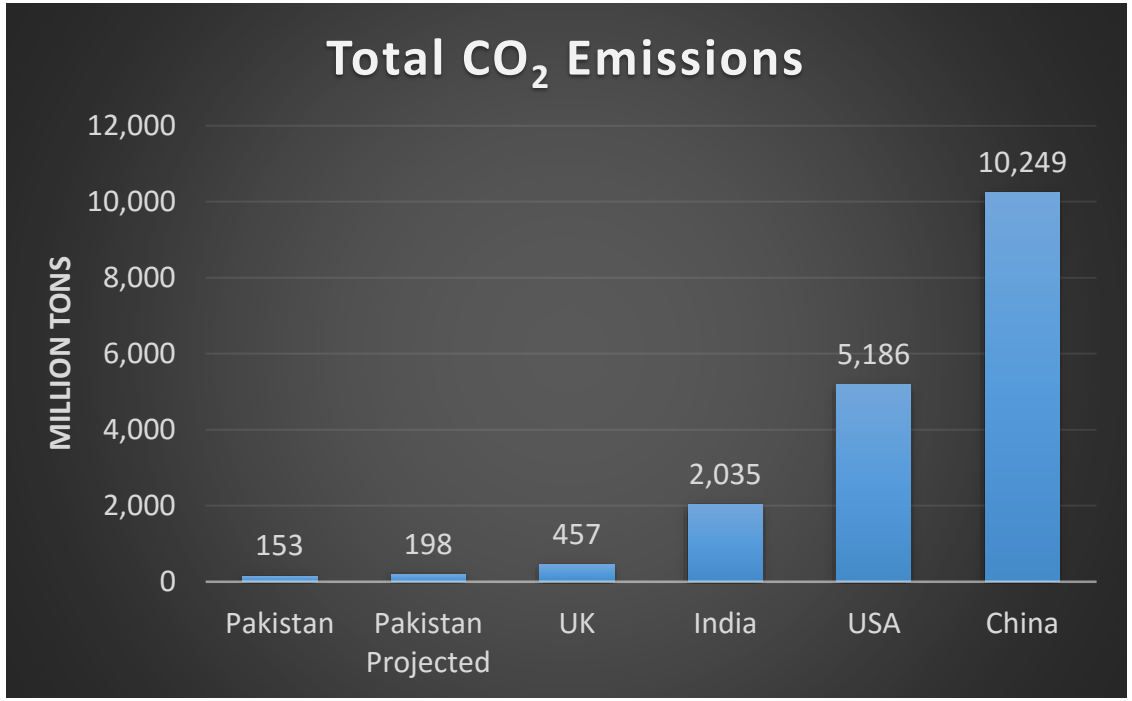
- ***Environmental impact must be viewed holistically. Power sector contributes only 25% whereas agriculture, transportation, industry and buildings contribute the remaining 75% of global emissions***
- ***Environmental standards of all sectors must be revisited and aligned with benchmarks of comparable countries***
- ***Regulatory structure for environmental compliance must be reviewed to ensure comprehensive oversight on all sources of emissions***

Comparison of Upcoming Imported Coal Plants Emissions with NEQS and IFC Standards

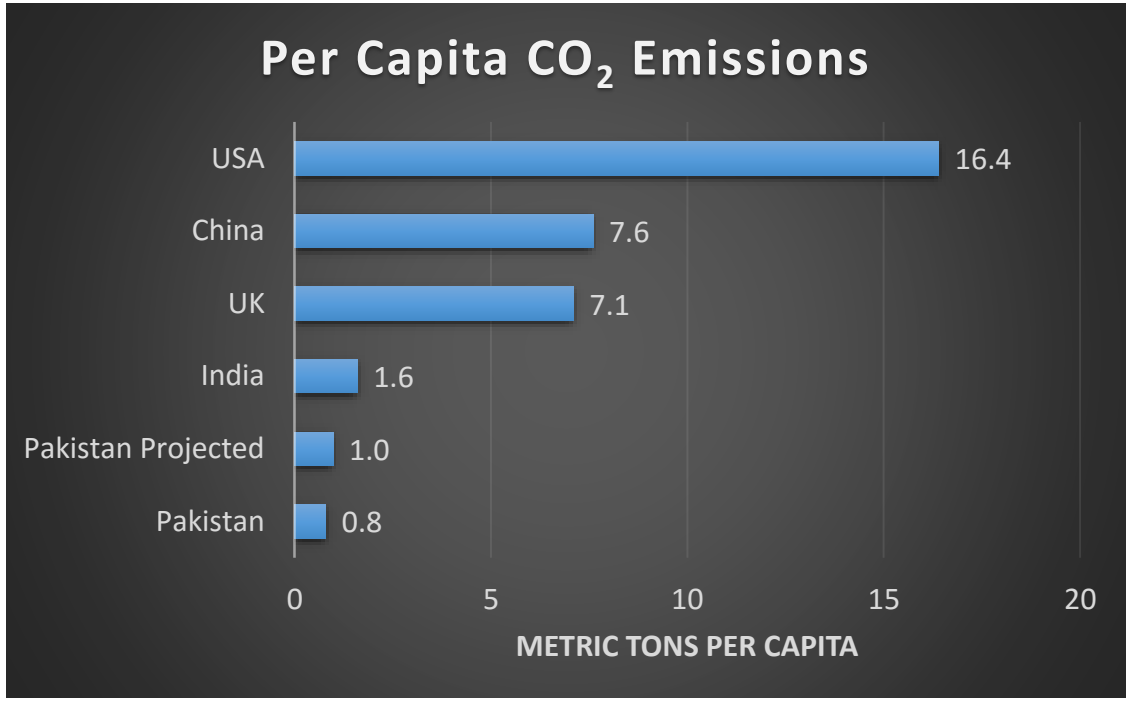


Significant Investment as part of project cost being made to ensure compliance with NEQS and IFC Emissions Standards

Environmental Impact of Change in Fuel Mix



Source: The World Bank, 2013

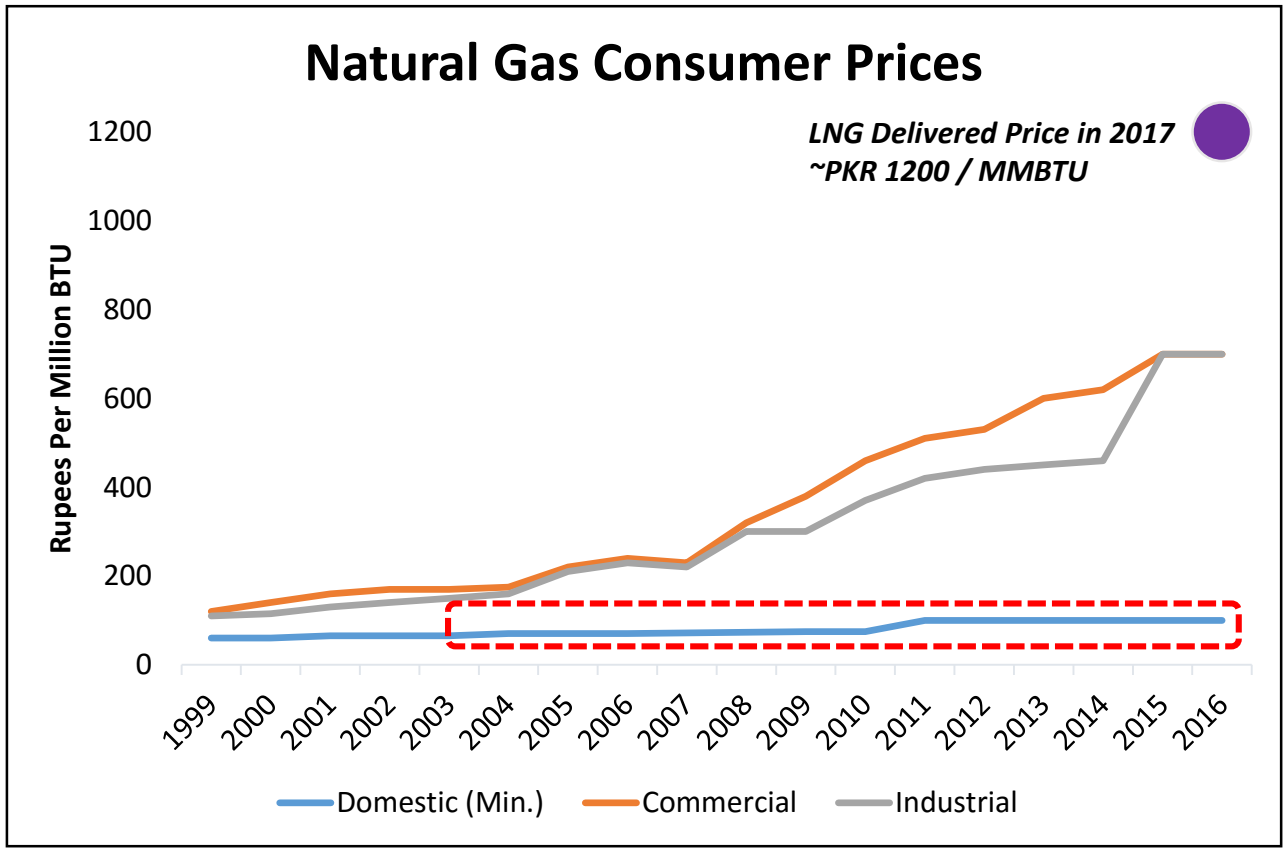


Source: The World Bank, 2013

Upcoming power plants will result in a marginal increase in CO_2 emissions for Pakistan. The overall emissions level on absolute and per capita basis will still be far less than many countries. Moreover, Environmental impact of coal based power plants will be controlled through industrially proven technological interventions ensuring compliance with NEQS and IFC Emissions Standards

Note: Pakistan's projected CO_2 emissions based solely on impact of upcoming power plants by Year 2025

Ensure Competitive Tariffs – Natural Gas



- The domestic sector gets gas at significantly lower rates putting extra burden on industrial and commercial sectors
- Low domestic sector gas prices do not create any compulsion for consumers to conserve gas
- Captive power plants receive selective advantage in terms of gas allocation and pricing. In current power surplus situation, captive power plants must move to national grid. Gas pricing to captive power plants must also ensure levelized cost of power generation at par with new RLNG based power plants

Gas pricing structure should be revamped to ensure complete recovery of imported LNG cost and equitable gas tariffs for all types of consumers

***Source**: Pakistan Energy Yearbook, 2016*

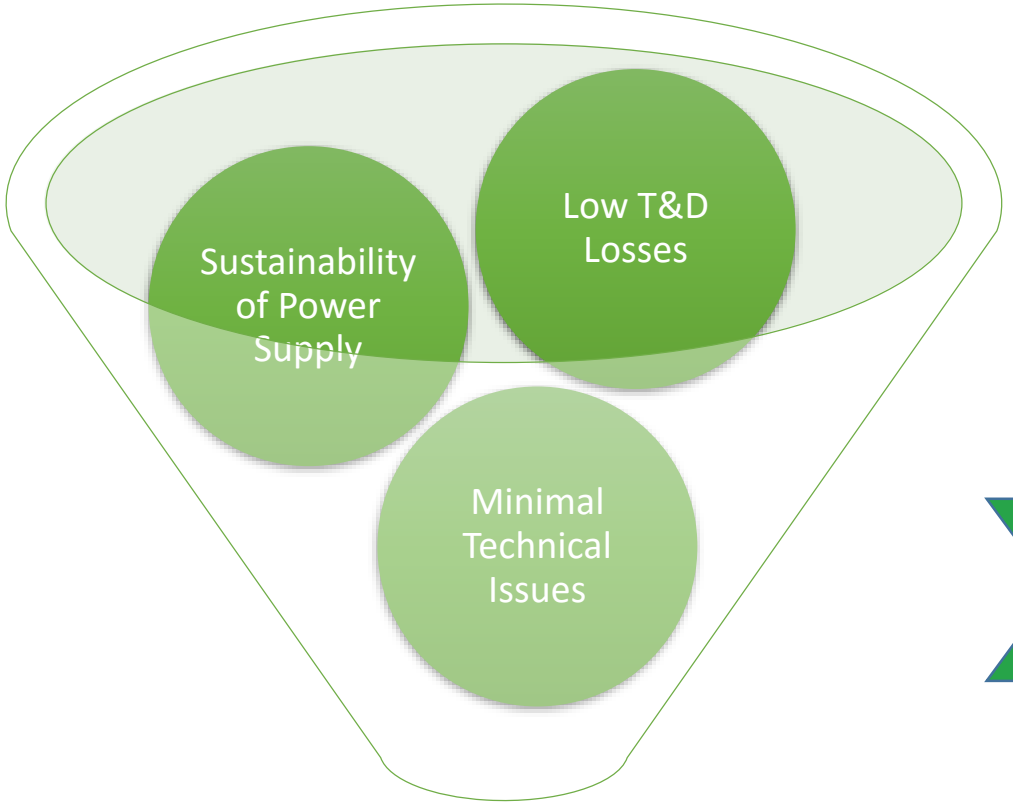
Power Sector Tariff

- The upcoming energy fuel mix will lower fuel cost component of power tariff
- The key focus area to ensure competitive electricity tariff to all consumers is to curtail transmission and distribution losses
- Reduction in T&D losses from 20% to 10% in the next 5 years should reduce the consumer tariffs by around 1-1.5 cents/kwh
- Discos should be allowed recovery of capital investment for investment in replacement/upgradation of technology required for reducing T&D losses
- Discos should be privatized after curtailing the current high T&D losses to comparable international benchmarks

Potential Solutions for Reducing T&D Losses

- Performance and cost management of operations
- Accountability and audit processes. **Power theft should be made a non-bailable offence**
- Technology –insulated conductors, protection equipment, isolations
  - To protect revenue (theft reduction)
  - Loss and outage minimization
- Innovation in governance models
- Network visibility and energy accounting
  - Consumer indexing, Metering
- Automation and digitization of operations

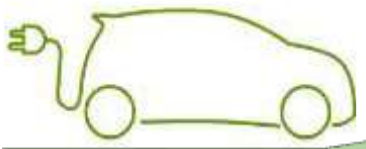
Power Grid Reliability



Power Grid Reliability

- Reduce losses to the national exchequer and curtail circular debt
- Industries with captive power plants will have an incentive to move to National grid
- Power wheeling could be initiated to benefit national economy as a whole

Integrated Energy Policy – Energy Efficiency & Conservation



Hybrid/Electric Vehicles

- Conventional gasoline vehicles only convert about **17%–21%** of the energy
- Hybrid vehicles improve energy efficiency and consumption of gasoline
- EVs improve thermal efficiency to **25-40% vs. 17-21% using gasoline**
- EVs also do not cause any emissions
- **Hybrid & Electrical Vehicles should be promoted/incentivized in the new Auto Policy including installation of battery charging stations**

LED Lighting

- LED bulbs are approximately 50-80% more efficient than other alternates
- **Import duties and sales tax on LED bulbs should be removed**

Building codes and Commercial Shopping Centers

- Building codes should be revised to achieve energy conservation
- Shopping centers in big cities of Pakistan do not fully utilize day light, start businesses by midday and remain open till midnight
- Resultantly, there is a stress on the electricity grid during peak hours of the day
- **Strict adherence to business timings should be ensured for commercial centers**

There is a need to change the mindset of the local population with regards to energy conservation through persistent awareness and education

Conclusions & Recommendations

Government should focus on making energy costs competitive in order to generate jobs, increase value-added exports and substitute imports

Oil based power plants should be kept as strategic back-up for the following scenarios:

- To cater for gas shortages in Pakistan during winter months when gas is diverted for domestic consumers
- To hedge against volatility of LNG price which has potential to rapidly increase due high demand as it has environmental (smog) and health related benefits vs. other fossil fuels

Government must honor all its contracts with the existing power producers to improve Power sector risk perception which continues to deteriorate due to non-compliances, defaults and disputes as evidenced by recent IPP arbitration cases

- Reforms should be introduced so that private parties willing to enter power generation on B2B basis and do not have to go through cumbersome NEPRA Generation License and Tariff Determination processes
- Practical implementation hurdles must be removed to encourage power wheeling

Conclusions & Recommendations

Public sector thermal power plants currently operating at low efficiency should be considered for privatization and substituted with new units operating at higher efficiency

Recently announced power generation policy of “Take and Pay” contracts than “Take or Pay” contracts should be implemented after DISCOs are financially viable

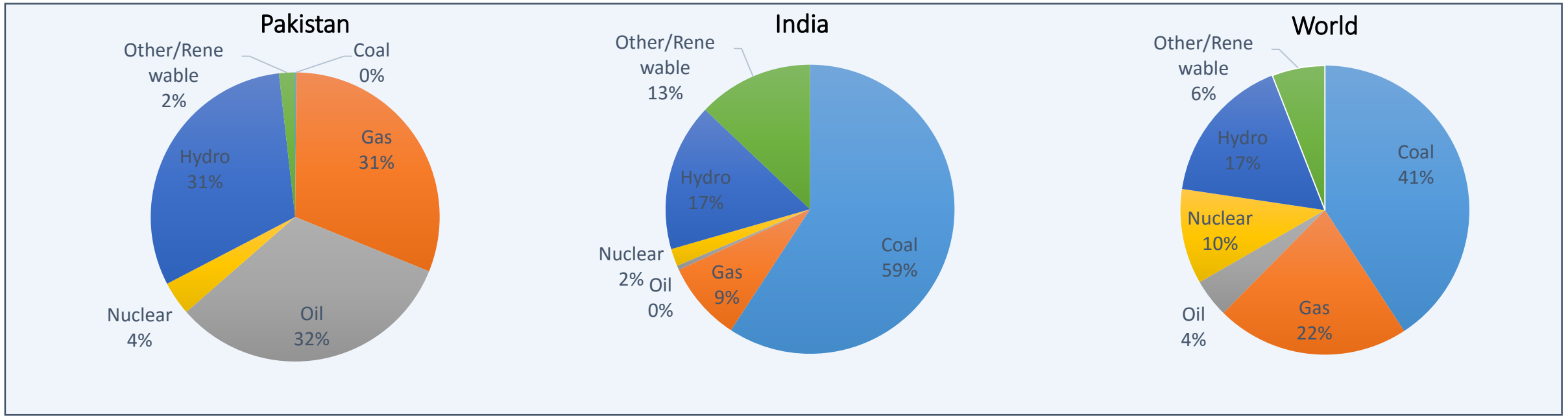
The availability of FOREX and capital for the upcoming capacity would be a major challenge. The prevalent regulations of State Bank of Pakistan must be reviewed holistically and changes made to enable arranging capital and FOREX for the additional capacity to be installed in future

A special team / task force should be constituted amongst GOP and private sector representatives to develop specific policy framework & target driven implementation plan for the above recommendations. The Panelists of Pakistan Business Forum for Energy Security are available for any support required

BACKUP

Inappropriate Fuel Mix

Pakistan's Power Generation Fuel mix is not sustainable due to the high share of oil based power generation resulting in very high cost of electricity



Sources:
- State of Industry Report, Pakistan (*Figures as of 2016*)
- Growth of Electricity Sector in India, Ministry of Power, India, Key World Statistics, International Energy Agency *(Figures as of 2014)*

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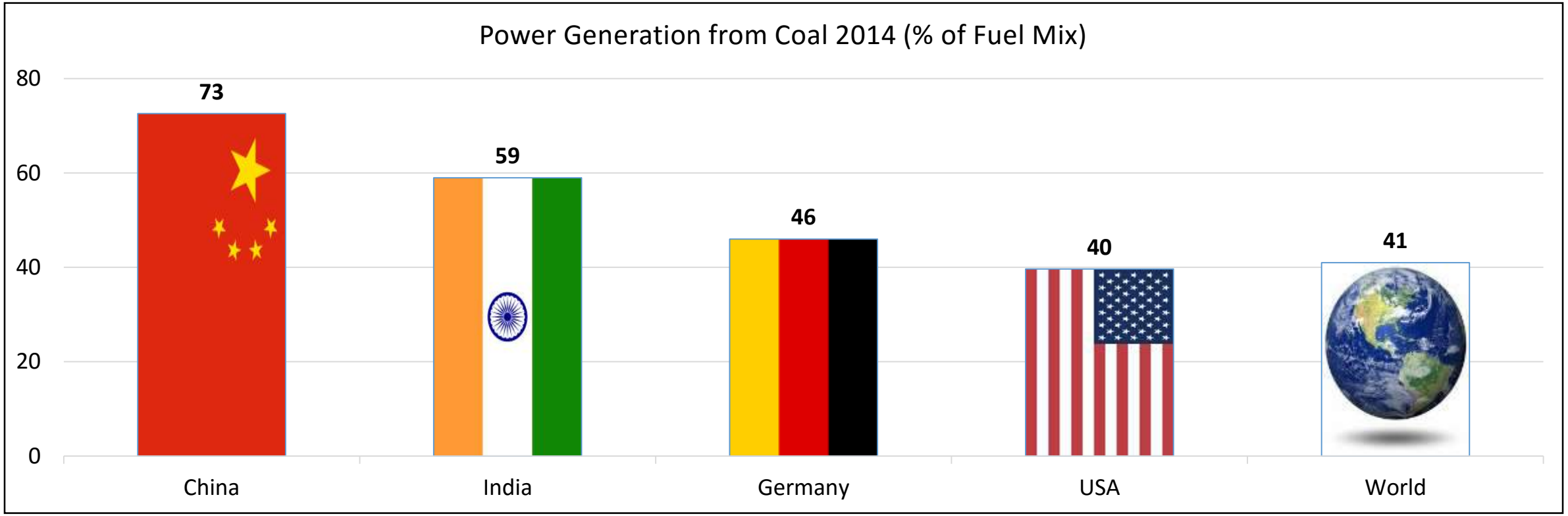
According to SBP, the country imported approximately $10 Bn worth of oil and approximately $1 Bn worth of LNG in FY 2016-17 – nearly 22% of the entire import bill!

Despite being a poor country, Pakistan has one of the most expensive choice of fuel mix for power generation

World Power Generation from Coal



- Coal is a predominant fuel source for power generation globally due to its low cost and reliable operability making it an ideal option for base load thermal power generation
- In the absence of adequate indigenous gas reserves, coal is the most viable option for base load power generation in Pakistan

Source: International Energy Agency (IEA), 2014

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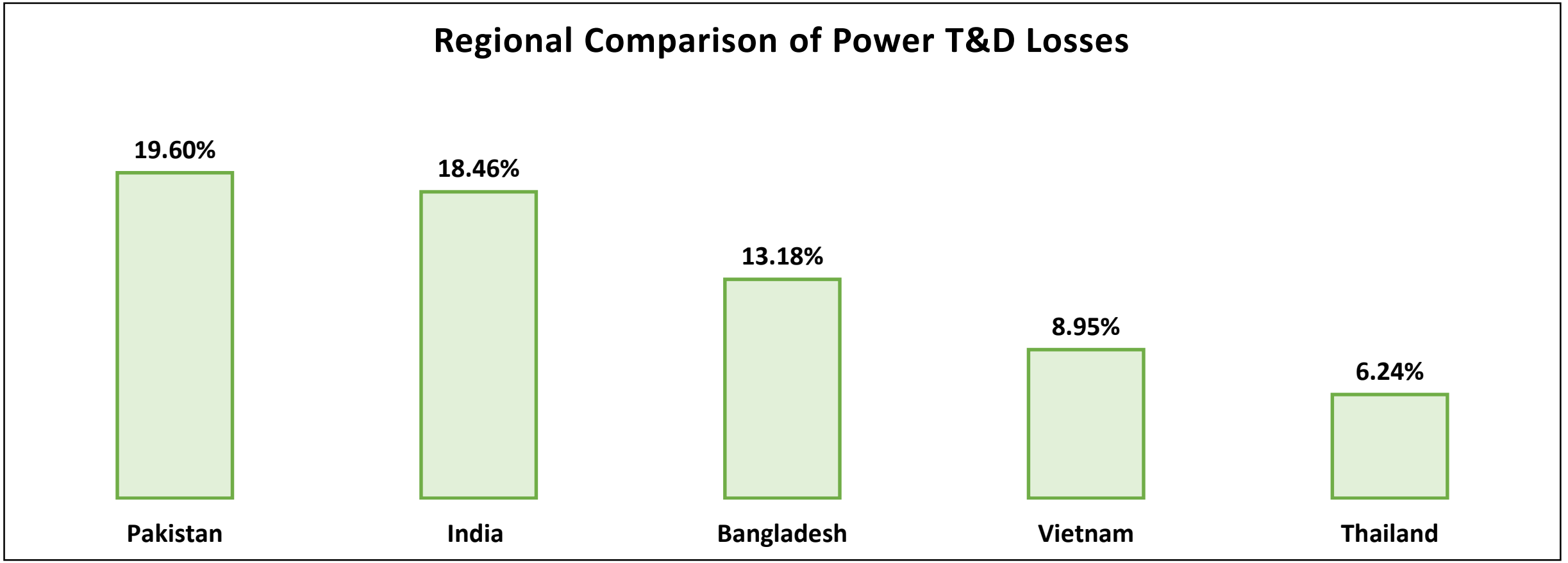
Transmission and Distribution Losses



***Sources**:*
1. Power System Statistics 2015-16 (NTDC)
2. International Energy Agency (IEA) Statistics, 2014

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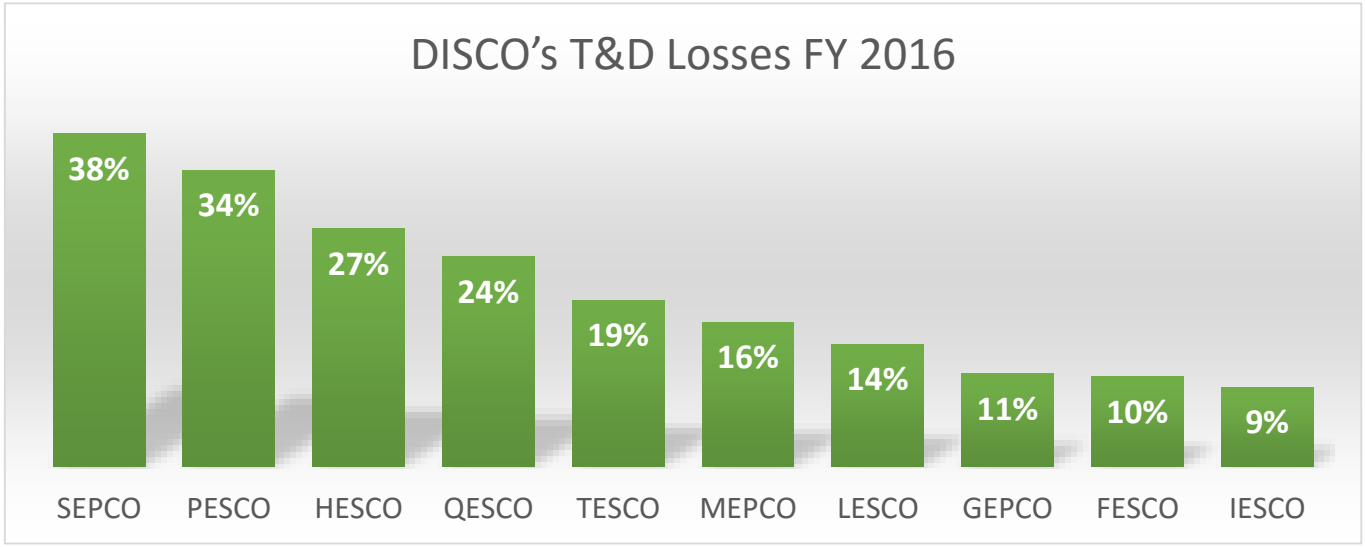
Pakistan has the highest power T&D losses amongst comparable countries

Transmission & Distribution Losses

Units Available for Transmission	100,871 GWh
Transmission Losses (NTDC)	2,623 GWh (2.60%)
Distribution Losses (DISCOs)	16,762 GWh (17.02%)
Total T&D Losses	19,385 GWh (19.6%)

Source: Power System Statistics 2015-16 (NTDC)



Source: NEPRA State of Industry Report 2016

Degraded network and thefts contributing to high Transmission and Distribution Losses

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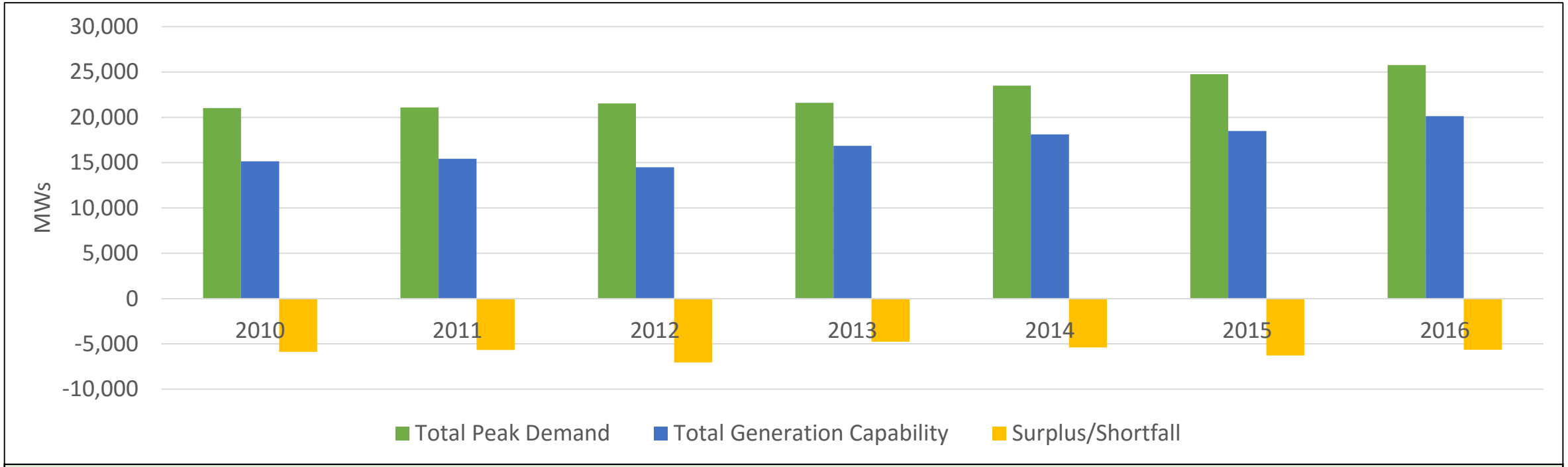
Historical Peak Demand & Supply Gap



- There had been a **5,000 – 7,000 MW** shortfall in the country during peak hours demand resulting in almost 8-12 hours of load shedding in various parts of the country
- Industrial and Domestic consumers rely on inefficient backup sources (gas/diesel generators, UPS) putting extra burden on oil/gas network and electricity grid
- Shortfall had caused significant slow down of the economy (GDP drop by 2%) and job losses

Source: NEPRA State of Industry Report 2016

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Future Project Details

Projects	MW	Expected Completion	Plant Factor	Dependable Capacity
Imported Coal				
Sahiwal	1,320	2017	85%	1,122
Port Qasim (Part 1)	660	2017	85%	561
Port Qasim (Part 2)	660	2018	85%	561
Hubco	1,320	2019	85%	1,122
Subtotal	**3,960**			**3,366**

Projects	MW	Expected Completion	Plant Factor	Dependable Capacity
Renewables				
Wind	300	2017	31%	93
Wind	100	2018	31%	31
Wind	445	2019	31%	138
Solar	42	2018	17%	7
QA Solar Park	600	2019	17%	102
Subtotal	**1,487**			**371**

Projects	MW	Expected Completion	Plant Factor	Dependable Capacity
Thar Coal				
Block II Phase I (Engro)	660	2019	85%	561
Block I (SSRL & Shanghai)	1,320	2020	85%	1,122
Block II Phase II (Hubco)	330	2020	85%	280.5
Block II Phase II (ThalNova)	330	2021	85%	280.5
Block II Phase III (Lucky)	660	2021	85%	561
Block II Phase III Siddiqsons	330	2021	85%	280.5
Block VI (Oracle)	1320	2025	85%	1122
Subtotal	**4,950**			**4,208**

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Future Project Details

Projects	MW	Expected Completion	Plant Factor	Dependable Capacity
RLNG/Gas				
Bhikki (Open Cycle)	700	2017	85%	595
Nandipur	400	2017	85%	340
Balloki (Open Cycle)	700	2017	85%	595
Haveli Badhur shah (Open Cycle)	700	2017	85%	595
Bhikki (Combined Cycle)	500	2018	85%	425
Balloki (Combined Cycle)	500	2018	85%	425
Haveli Badhur shah (Combined Cycle)	500	2018	85%	425
Trimmu Jhang Punjab	1,250	2019	85%	1,063
Subtotal	**5,250**			**4,463**
Nuclear				
CHASHNUPP III & IV	680	2017	85%	578
KANUPP II	1,100	2022	85%	935
KANUPP III	1,100	2023	85%	935
Subtotal	**2,880**			**2,448**

Projects	MW	Expected Completion	Plant Factor	Dependable Capacity
Hydel				
Patrind	147	2017	50%	74
Gol Golden	108	2018	50%	54
Tarbela IV (Ext)	1,410	2018	50%	705
Neelam Jhelum	969	2018	50%	485
Gulpur	102	2019	50%	51
Karot	720	2021	50%	360
Sukki Kinari	870	2022	50%	435
Kohala	1100	2024	50%	550
Mahal	600	2025	50%	300
Sub Total	**6,026**			**3,013**

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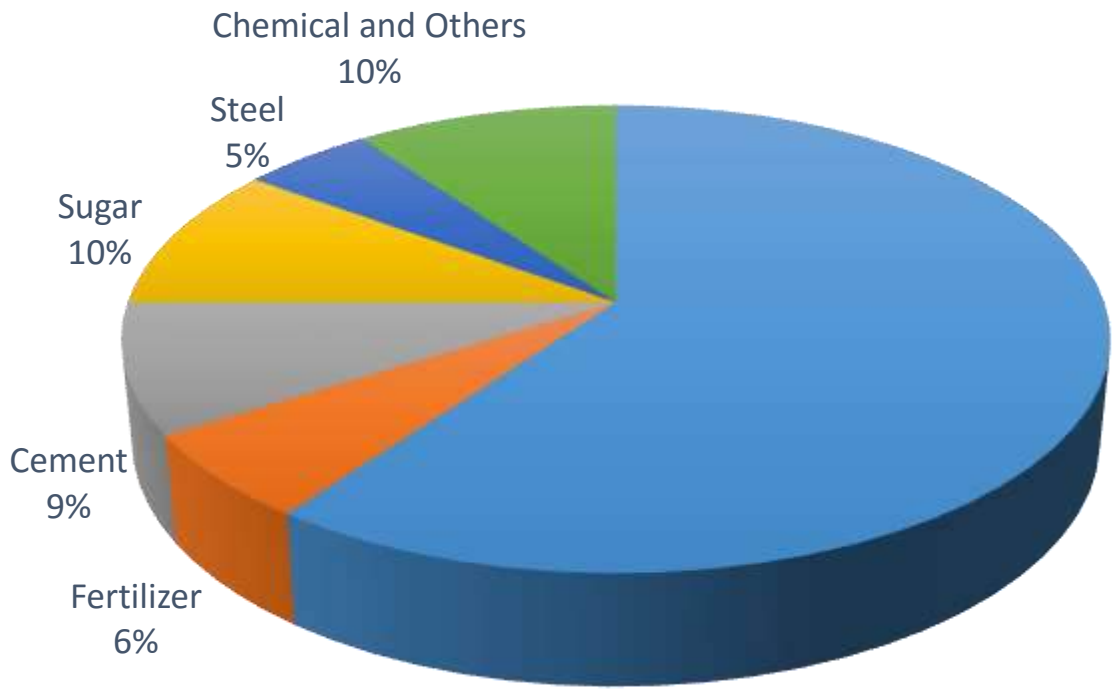
Captive Power Plants



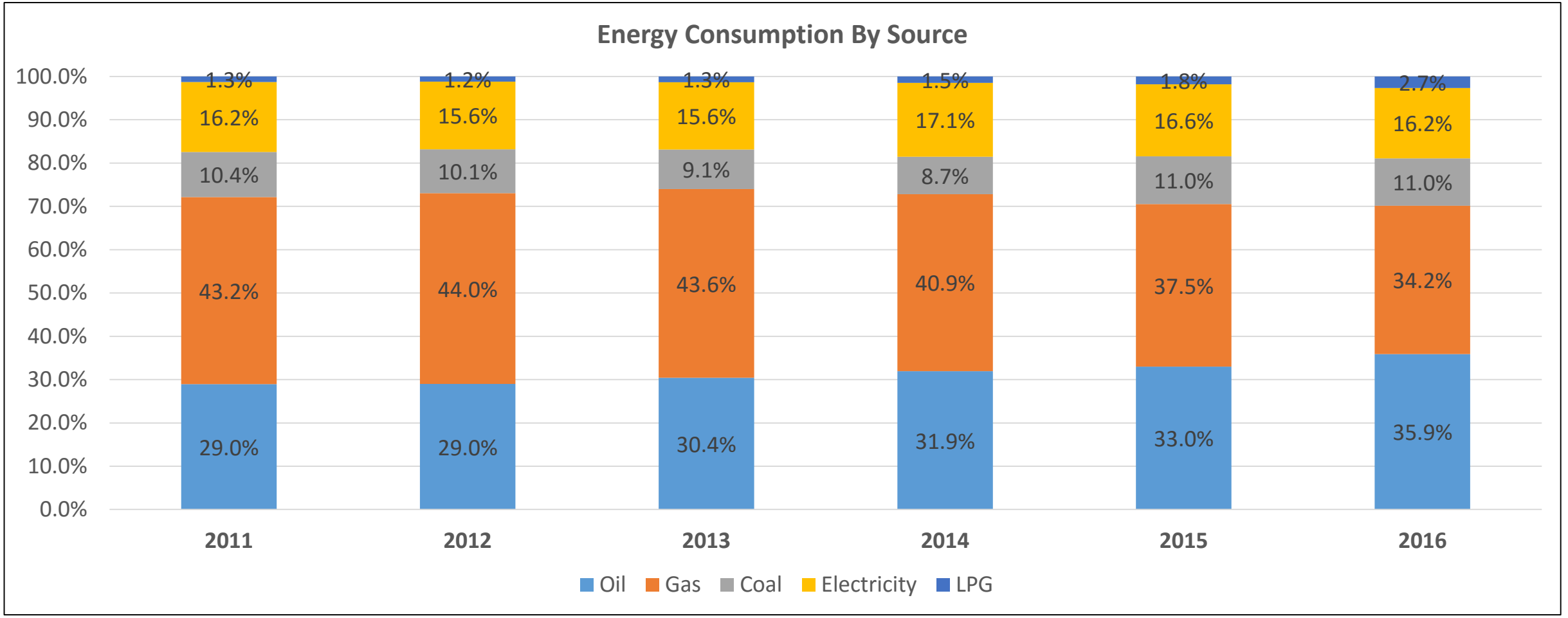
Total Installed Captive Plant Capacity: ~5,000MW

- Captive power plants are used for
  1. Base load operations
  2. Emergency backup
- Base load plants primarily use fuels such as natural gas, coal, biomass etc. whereas emergency backup plants mainly utilize diesel / RFO
- Once reliable grid and affordable power is available, high cost RFO and diesel based captive power plants are likely to switch on to the national grid
- Price of gas for gas based captive power plants should be aligned with delivered LNG price to alleviate disparity. This will further increase demand for grid connected power

outlook

Source: Pakistan Energy Outlook, Petroleum Institute of Pakistan

Pakistan Historical Energy Consumption



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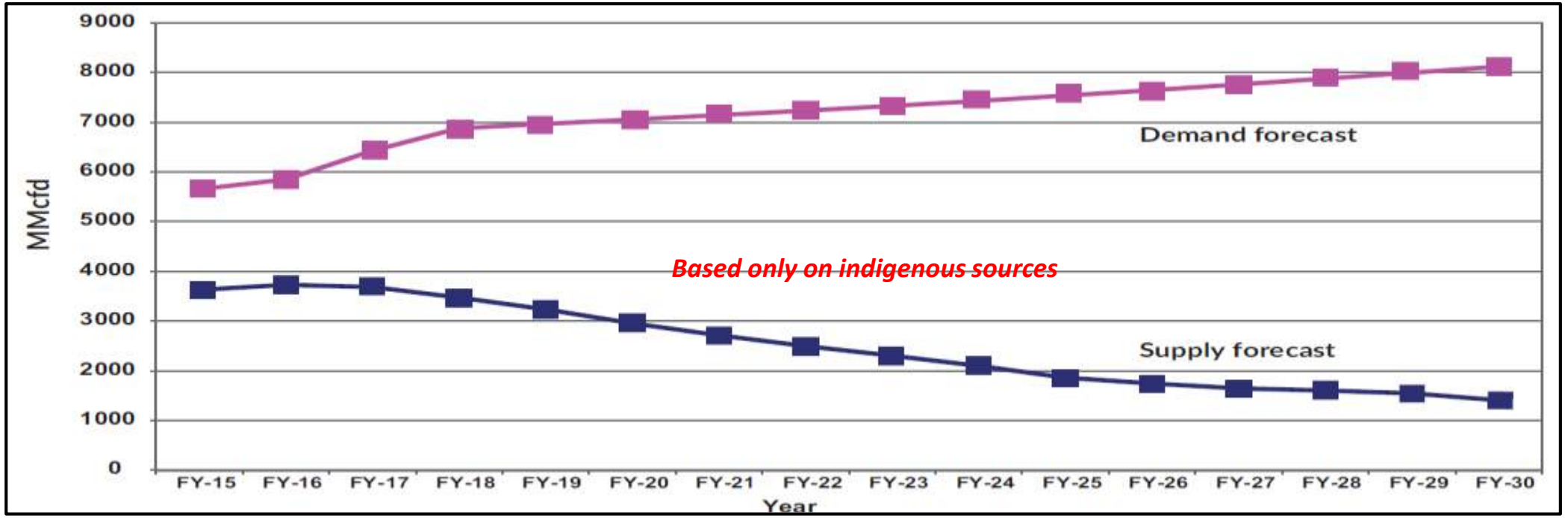
*Renewables have been included in electricity only. Renewable utilization in other applications not included

***Source**: Pakistan Energy Yearbook, 2016*

Pakistan Projected Gas Demand / Supply Situation



- Pakistan's demand for natural gas is projected to rise significantly in the coming years
- Indigenous sources (without accounting for tight gas) will be on a fast declining curve

***Source**: OGRA State of Regulated Petroleum Industry Report, 2016*

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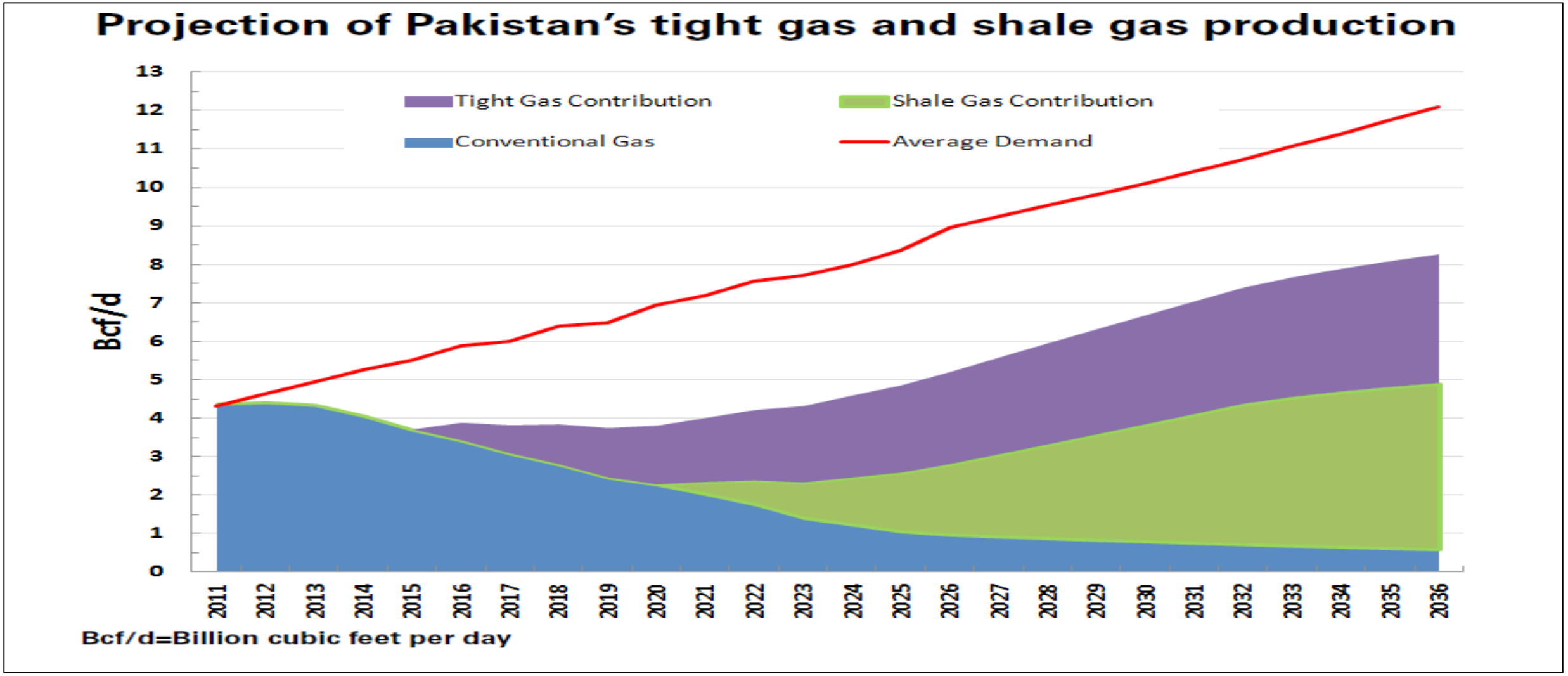
Tight & Shale Gas Potential

Projected Contribution of Tight and Shale Gas



Shale gas reserves estimated at **105 TCF of** and tight gas reserves estimated at **40 TCF+**

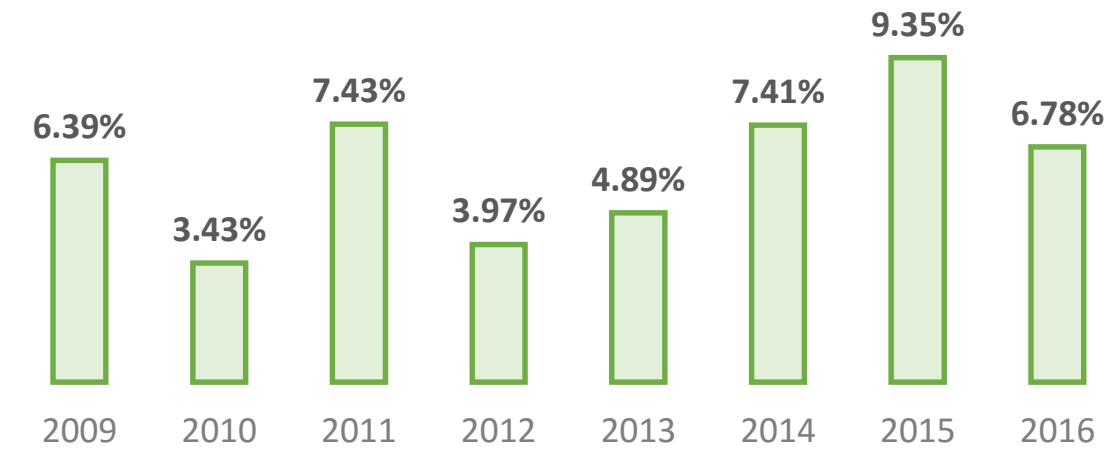
Pakistan Energy Losses

Pakistan's energy sector has been marred by transmission and distribution losses mainly due to:

Leakages

Theft

Poor Maintenance



Pakistan Natural Gas Sector T&D Losses

Units Available for Transmission (2016)	18.08 MTOE
Total T&D Losses	**2.54 MTOE (14.1%)**

Source: Power System Statistics 2015-16 (NTDC), Pakistan Energy Yearbook 2016

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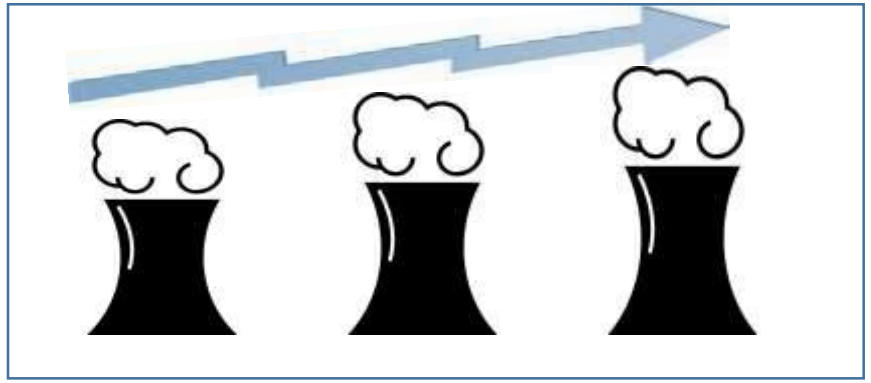
Historically Minimal Growth in Power Generation

Avg. Population Growth in last Five Years

2.4%

Avg. GDP Growth in last Five Years

4.3%



Power Plants Net Installed Capacity Growth in last Five Years

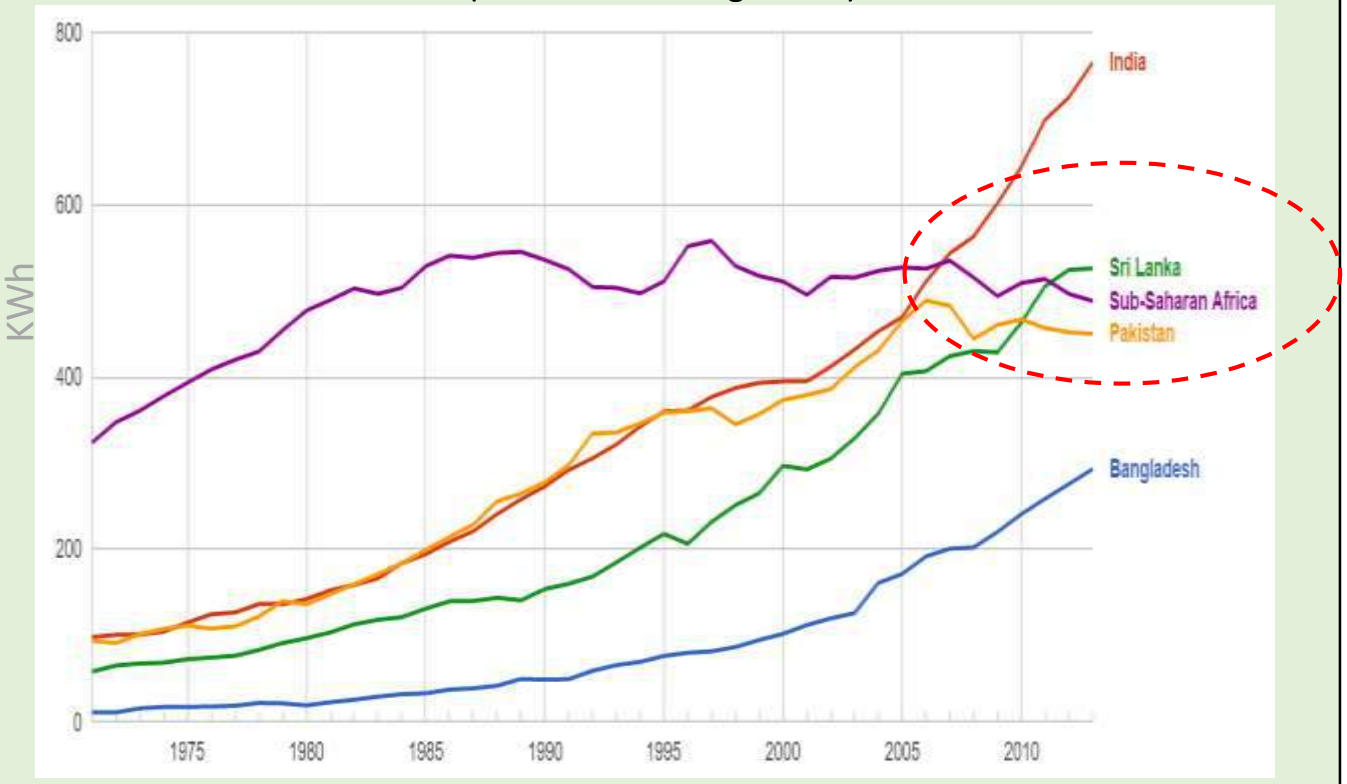
2.0%

Growth in power generation had not been catching up with GDP and population growth

Source : World Bank, NEPRA State of Industry Report, Census 2017

Regional Comparison

Regional Comparison of Electricity Consumption Per Capita*
(from 1970 Through 2013)



Per Capita consumption of electricity in Pakistan in recent years has fallen below even Sub-Saharan Africa levels and is also far below the regional countries

**In comparison, Malaysia is now at 3,724 kWh/y*

Population Without Access to Electricity

Sri Lanka
1%
0.3 Mil. People

India
19%
244 Mil. People

Pakistan
27%
51 Mil. People

Sub-Saharan Africa
65%
632 Mil. People

A large population in Pakistan still remains without any access to electricity

Source : World Energy Outlook Electricity Access Database 2016, IEA, World Bank

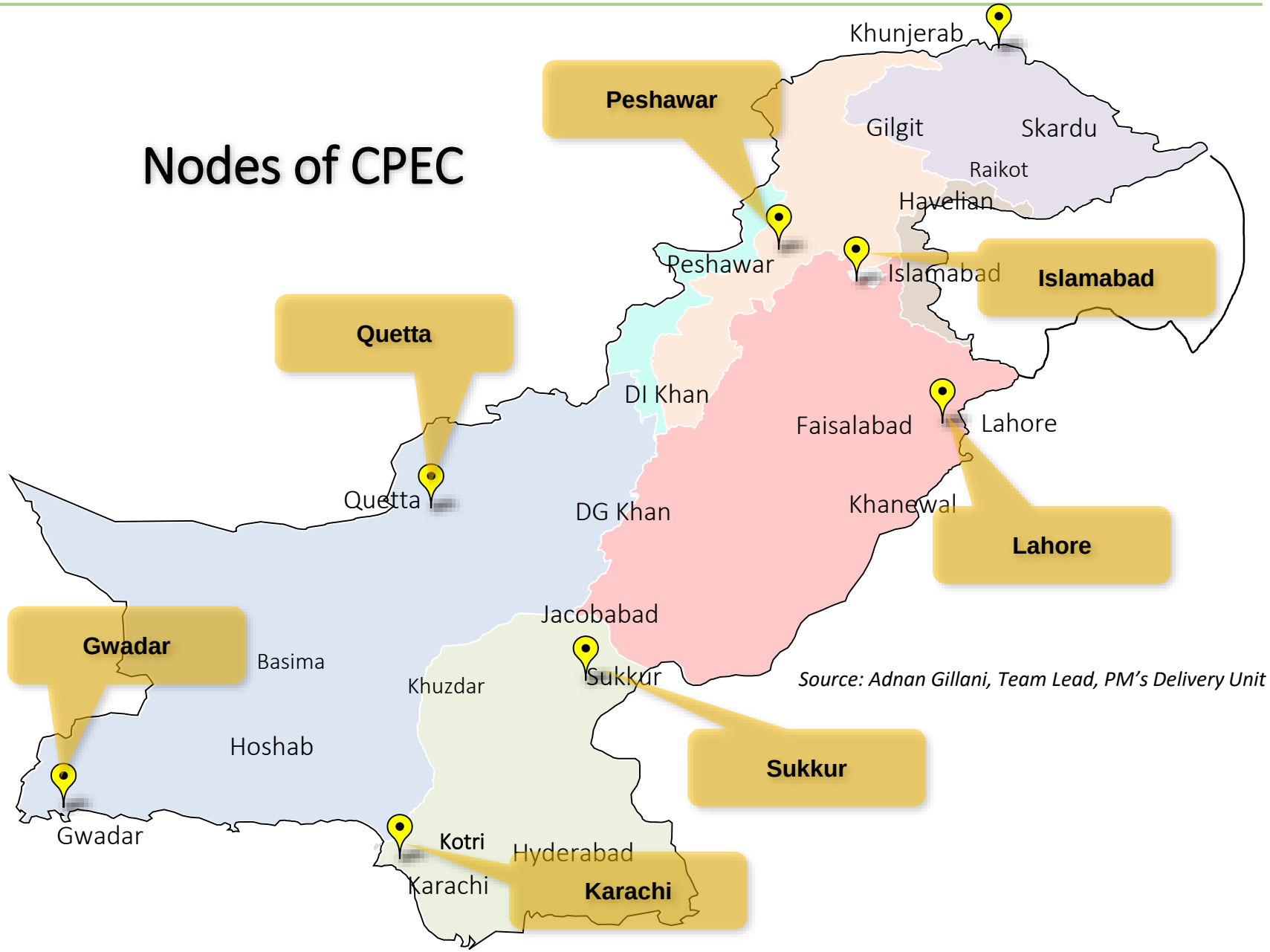
China Pakistan Economic Corridor – Background

Regional Connectivity is the 7th Pillar of Pakistan Vision 2025

Integrates/links Silk Road Economic Belt and 21st Century Maritime Silk Route

Serves Asia's over 3 Billion population

Nodes of CPEC

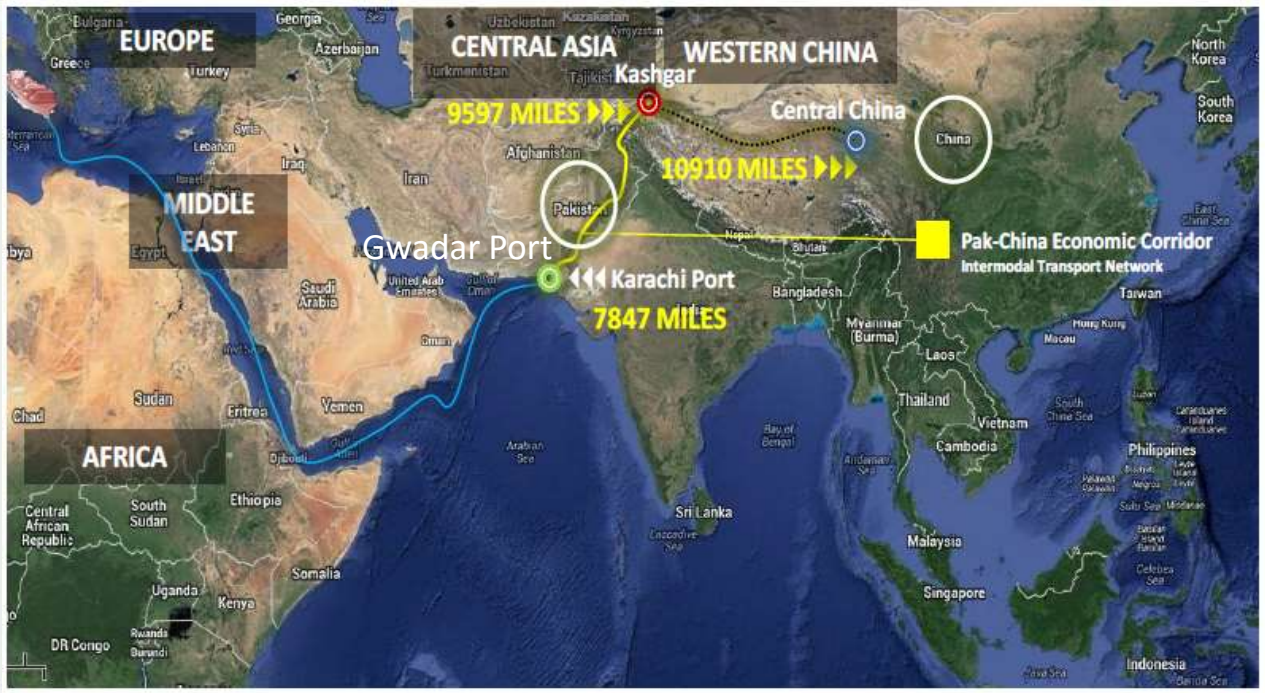


Source: Adnan Gillani, Team Lead, PM's Delivery Unit

China Pakistan Economic Corridor – Benefits for China

Western China to Eastern Europe
Existing Distance: 19,132 Miles

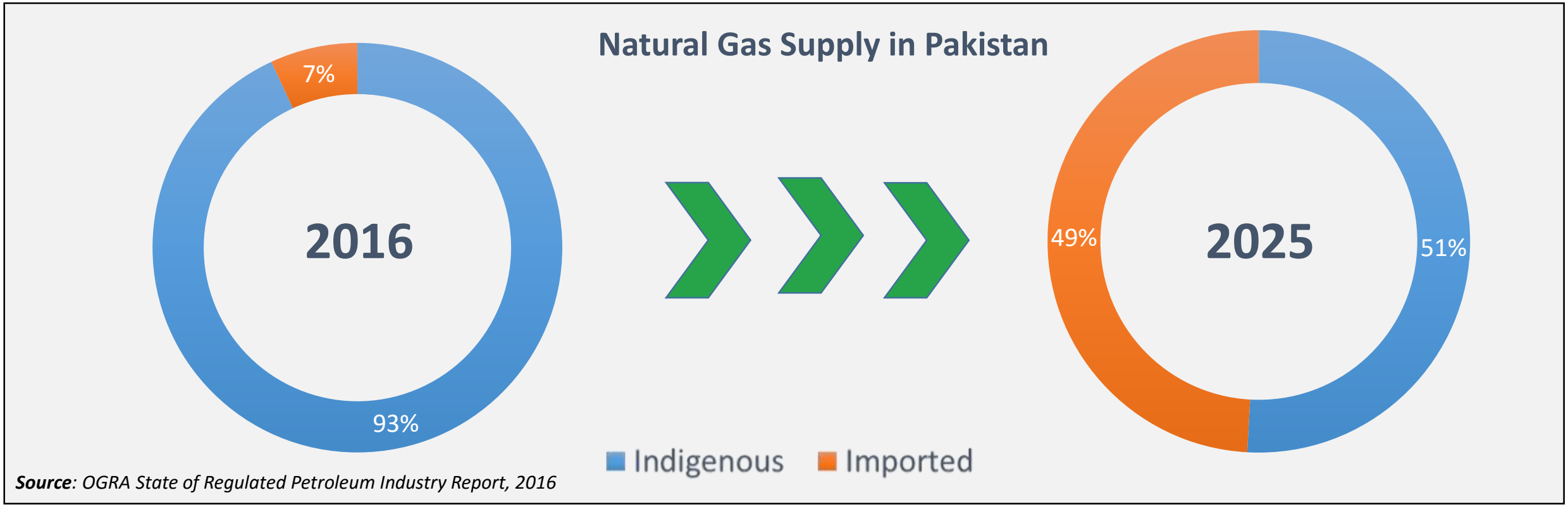
Western China to Eastern Europe
New Distance: 9,597 Miles – Distance Saved: 9,535 Miles



Europe- Western China	Existing Route	Post CPEC	Savings to China
Total route	By Sea = 16,507 By Land = 2,625 Total Route = 19,132 miles	By Sea = 7,847 By Land = 1,750 Total route = 9,597 miles	Distance is reduced by 50%
Freight charges and time for a unit (40 ft container) from Hamburg to Shanghai range	Cost = 2500-3000 USD Time = 50 days	Cost= 1000 USD (Approx. Impact) Time = 25 days (Approx. Impact)	Cost of transportation are lowered by 50-65%. Time is cut by 50%

Source: Adnan Gillani, Team Lead, PM's Delivery Unit

Competitive Tariffs – Natural Gas

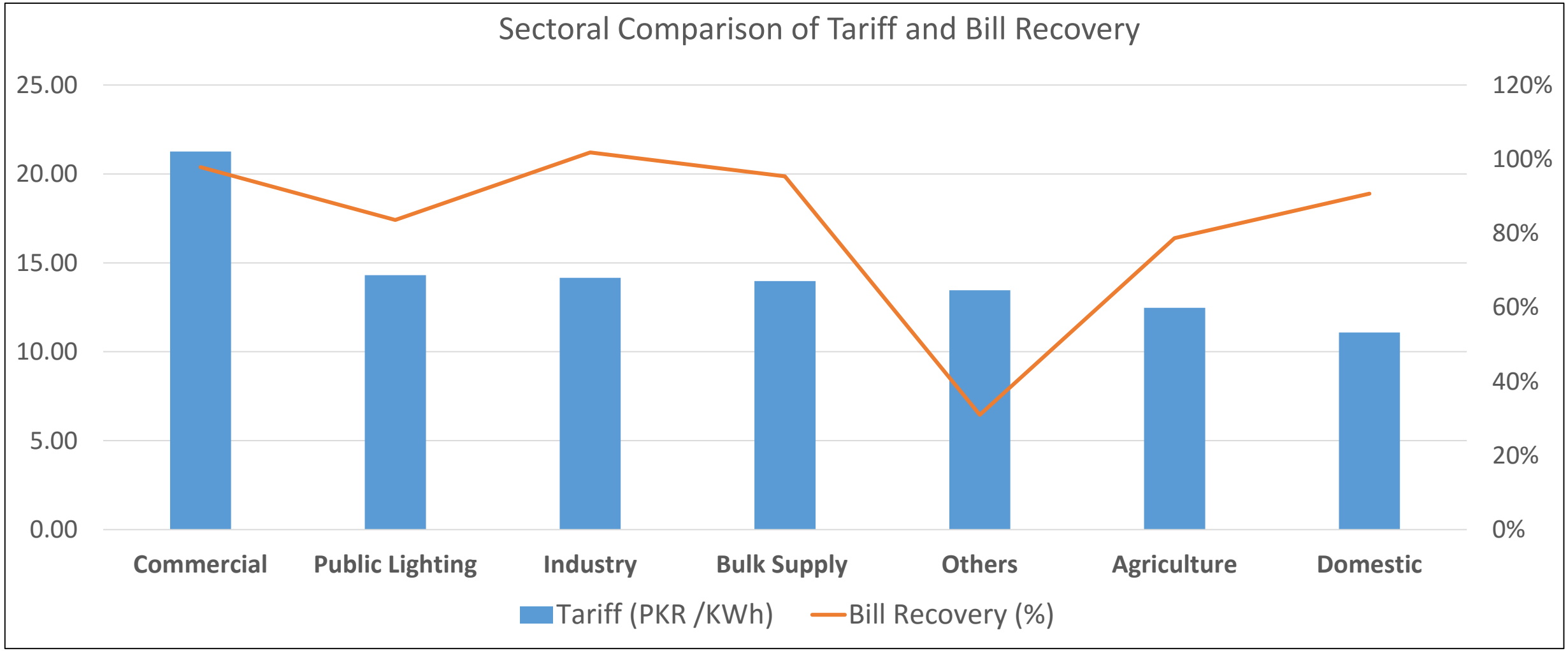


***Source**: OGRA State of Regulated Petroleum Industry Report, 2016*

***Assumption**: Imported gas in 2025 scenario only based on LNG Imports of 1800 MMCFD*

Given the current gas shortage scenario and further depletion of available indigenous resources, LNG imports will inevitably constitute a large share of the total gas supply in Pakistan. Consumer pricing of natural gas must also reflect the higher cost of LNG. Current mechanism of different pricing for RLNG consumers and local gas consumers is not sustainable. It is proposed that domestic gas tariff be increased to at least 50% of delivered cost of LNG by the year 2020

Competitive Tariffs - 2016



Despite having the highest bill recovery rate amongst all other sectors, industries in Pakistan face a higher electricity tariff

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Thar Coal Potential

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

175 Billion Tons
Total Thar Coal Reserve

=

50 billion ton of Oil
More than combined oil reserves of Iran & Saudi Arabia

=

2000 TCF of Gas
42 times greater than total gas reserves discovered in Pakistan so far

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

Thar Coal Field has been divided into Blocks: I - VIII

Realizing the Potential of Thar Coal

Plan is to generate ~4000 MW from Block II by 2025

2019

Phase I

2 x 330 MW

2020-21

Phase II & III

3 units of 330 MW and 1 unit of 660 MW*

Subsequent Phases

2022-25

Multiple units of 330/660 MW

4000 MW

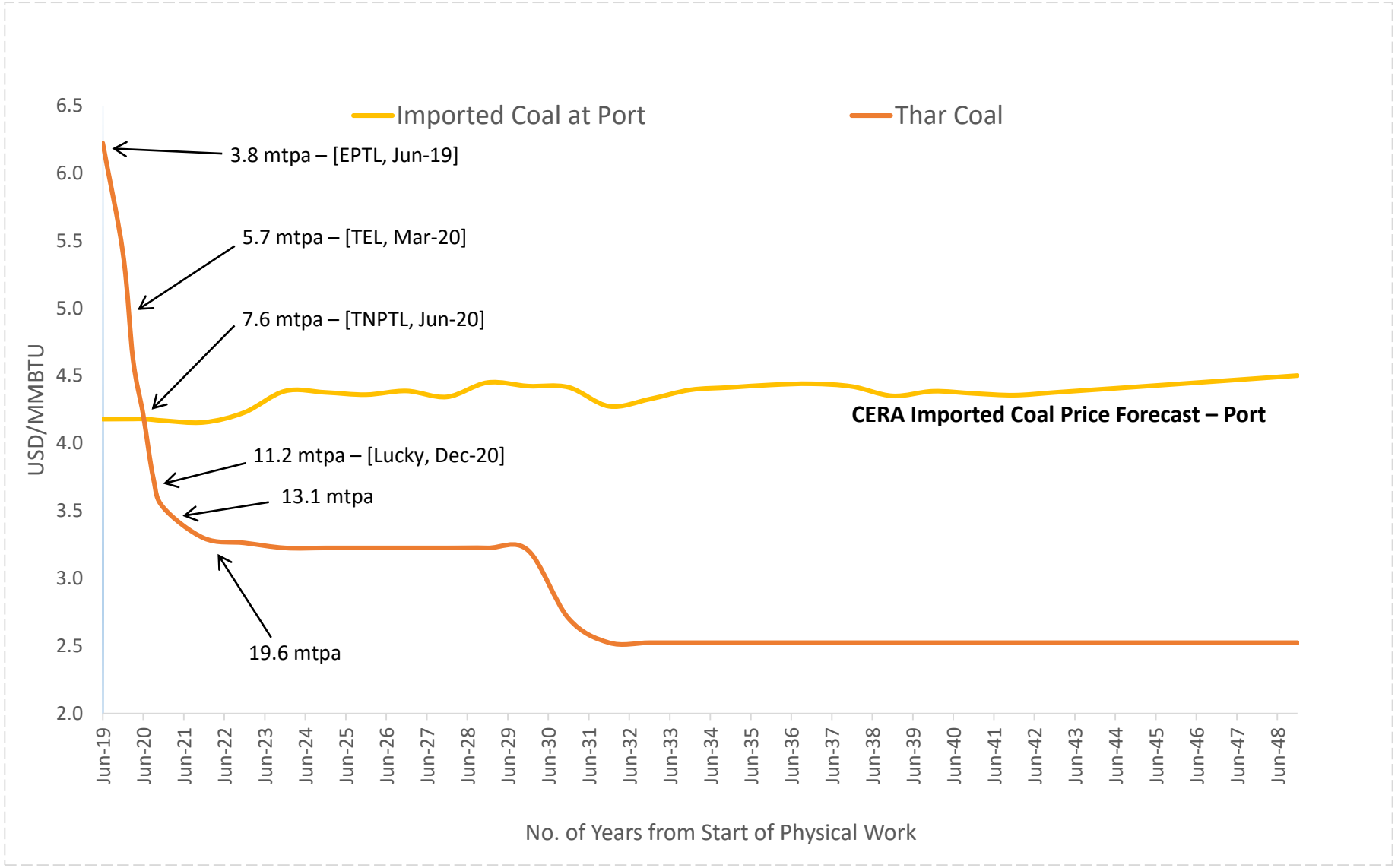
*TEL, TN, Lucky and Siddiqsons

Phase 1 Update:

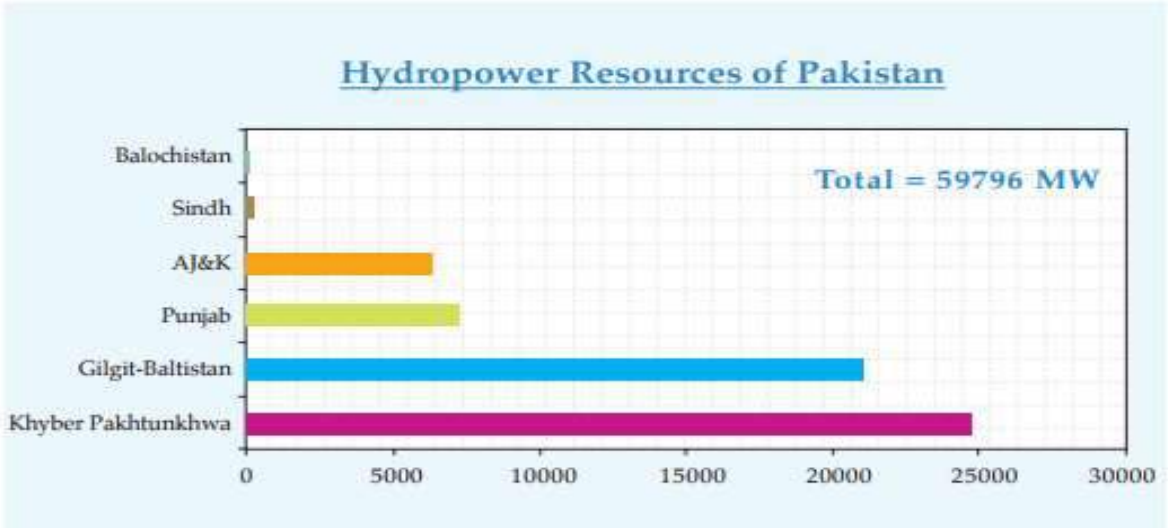
- Mine and Power plant construction is ahead of schedule, with more than 50% of the over burden removed for mine by SECMC

Thar Block II alone has the potential to generate 4,000 MW consistently for the next 50 Years which is only 1% of the Total Reserves

Benefit of Expansion – Thar Block II



Pakistan Renewable Power Potential – Hydel



PPIB, 2011

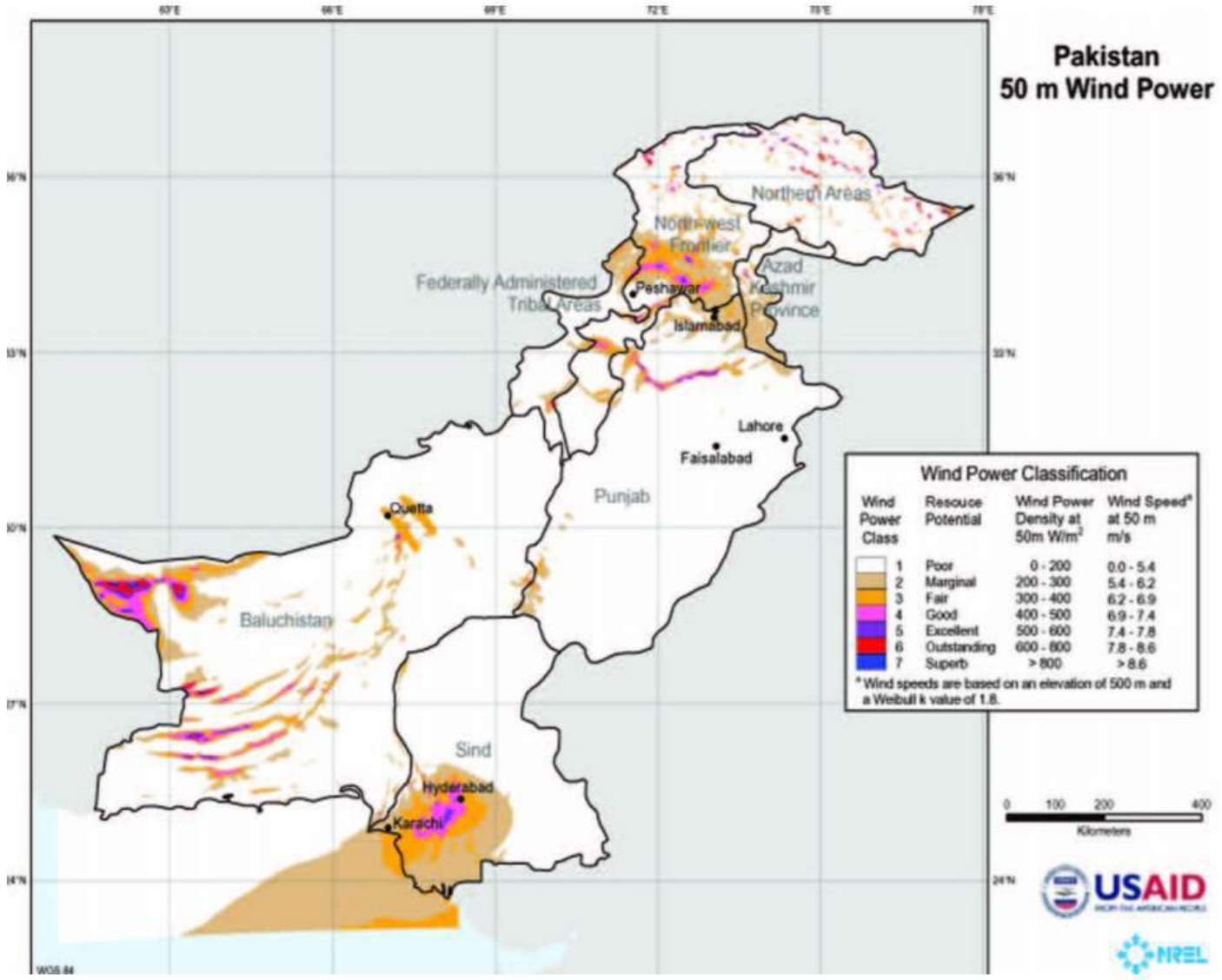
Description	Tariff
Levelized tariff (Rs./kWh)	7.6958
Levelized tariff (Cents/kWh)	7.5746

Source: Karot Plant Upfront Tariff, Feb 2016

- Total potential for Hydropower generation in Pakistan is approximately **60,000 MW**
- Hydropower Projects currently installed in Pakistan by WAPDA and IPPs is around 7,000 MW indicating that **88% of Hydropower Resources are still untapped**
- Hydel capacity in operation includes major plants at Tarbela (3,478 MW), Ghazi Barotha (1,450 MW) and Mangla (1,000 MW)
- Currently, **approx. 4000 MW** of Hydel Power projects are at different stages of development
- In addition, currently feasibility and engineering design studies for numerous hydropower projects (HPP) with cumulative installed generation capacity of **over 25,000 MW** are in hand with WAPDA (MoW&P)
- Large scale projects under developments need to be expedited in order to improve energy security of the country
- Small hydel projects ranging from 1 MW to more than 10 MW can also be installed in order to meet the local needs

World Energy Data, 2016

Pakistan Renewable Power Potential – Wind

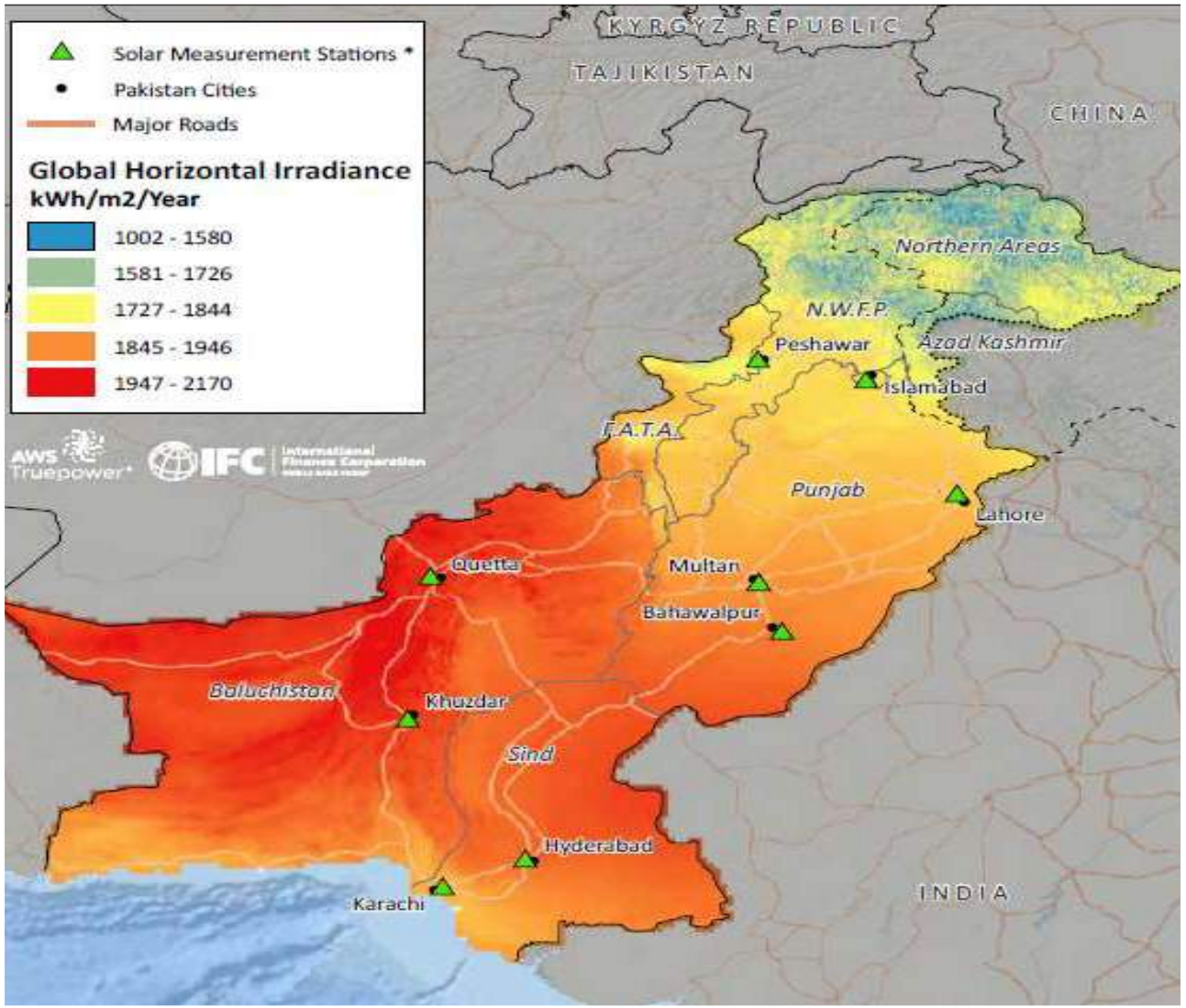


- Estimated wind potential of approx. **132 GW** as estimated by USAID
- Pakistan has a 1,046 Km coastline in the South
- Average wind speed more than 7 m/s above 60 m in Gharo Wind Corridor
- Till date, projects of ~600 MW cumulative capacity have achieved COD and and projects with capacity of approx. 650 MW are under construction. Thus, **only approx. 1.25 GW (less than 1%) of wind potential has been exploited so far**
- With latest technology developments and reduced tariffs, electricity generation through wind will become more lucrative
- However, key challenges remain availability of grid connection and frequency mismatch

Description	Tariff
Levelized tariff (Rs./kWh)	6.7466
Levelized tariff (Cents/kWh)	6.4253

Source: Wind Upfront Tariff, Jan 2017

Pakistan Renewable Power Potential – Solar



- Pakistan has tremendous potential to meet its power demand needs from solar power
- **As per studies from ADB, various authors and research papers, Solar potential in Pakistan is estimated to be more than 2.9 Million MW**
- Solar irradiance levels in parts of Pakistan are on par with the best in the world with global horizontal irradiance (GHI) values over 1500 kWh/m2/year in over 90% of the country's land area
- Four solar projects with cumulative capacity of 400 MW are operational. 34 Solar projects with cumulative capacity of 600 MW are at different stages of project development
- Presently, less than 1% of Pakistan's total solar potential has been utilized

Description	Tariff
Levelized Tariff (Rs./kWh)	6.30
Levelized Tariff (Cents/kWh)	6.00

Source: Zorlu Tariff Petition, May 2017

IFC Study, 2016

Pakistan Renewable Power Potential – Solar Hydel Hybrid

- Optimum locations for hydel plants are generally quite remote
- Connecting such plants to the national grid result in heavy investment in transmission lines
- Average Hydel plant load factor is approximately 50% annually
- Solar plants may be installed on available land near existing hydro power plants in order to maximize power evacuation from the Site using existing transmission line infrastructure

HUBCO
LARAIB ENERGY LIMITED

- Laraib Energy Limited has started development of such a Project
- Feasibility Study is being carried out for a **15MW Solar Project** to complement the existing 84MW hydro power plant
- The Project promises to result in higher dispatch from the same site while synergizing available transmission infrastructure
- Similar concept can be adapted and implemented in other existing hydel plants

Solar Power Applications

Street Lighting

Commercial Lighting (Billboards, garden lighting etc.)

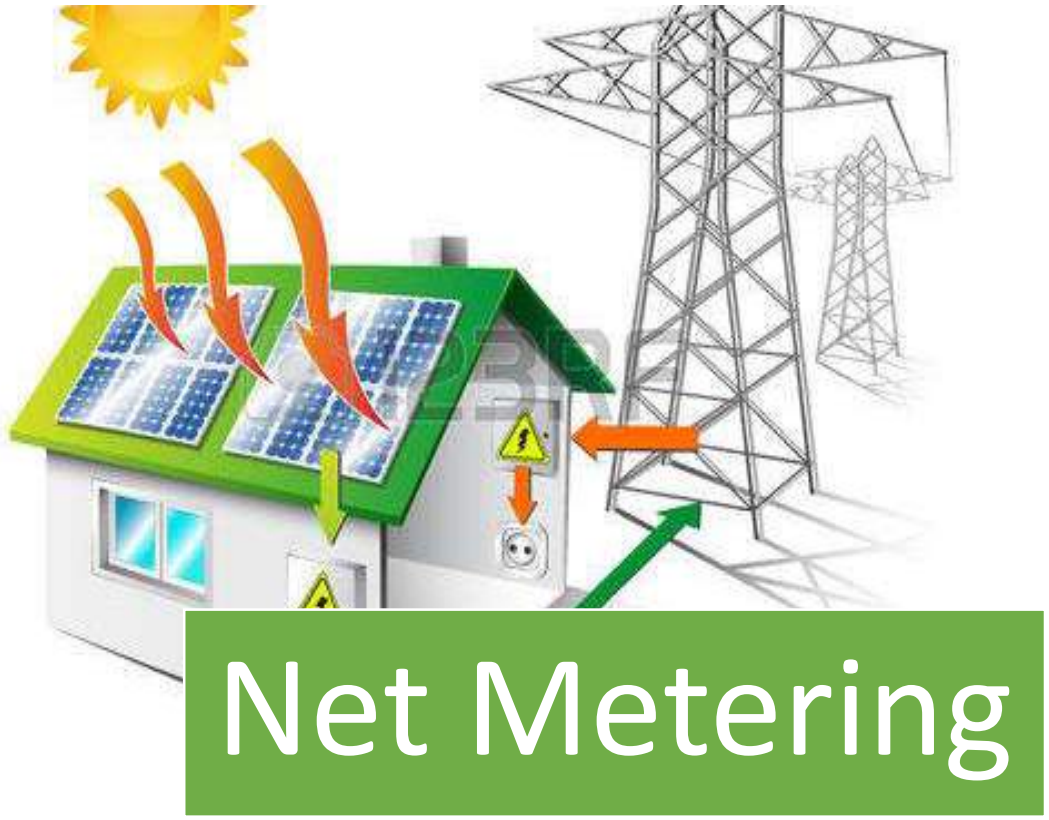
Solar Water Pumping

Solar Rural Electrification

Solar Geysers

Pakistan Energy Policy should encourage usage of solar power across the spectrum to improve national energy security situation

Net Metering



- ✓ Generates low cost electricity during daytime, when power demand maximizes and utility companies are unable to provide peak demand load
- ✓ Relieves distribution system overloading, as solar power though net metering is consumed in homes and adjoining areas
- ✓ Power generation through net metering can be rapidly financed/implemented by home owners through own resources or bank loans
- ✓ Enables conservation of hydel power during daytime to provide higher dispatch of hydel power at night
- ✓ Potential to rapidly grow distributed power through 'net metering' resulting in saving on power transmission cost and losses

Utility companies should be tasked to propagate 'net metering' at the earliest due to the above benefits