

# Workshop on Challenges and Prospects for Regional Electricity Cooperation and Trade in Central Asia and the Caucasus

Energy transit and cross border electricity trade-  
Pakistan

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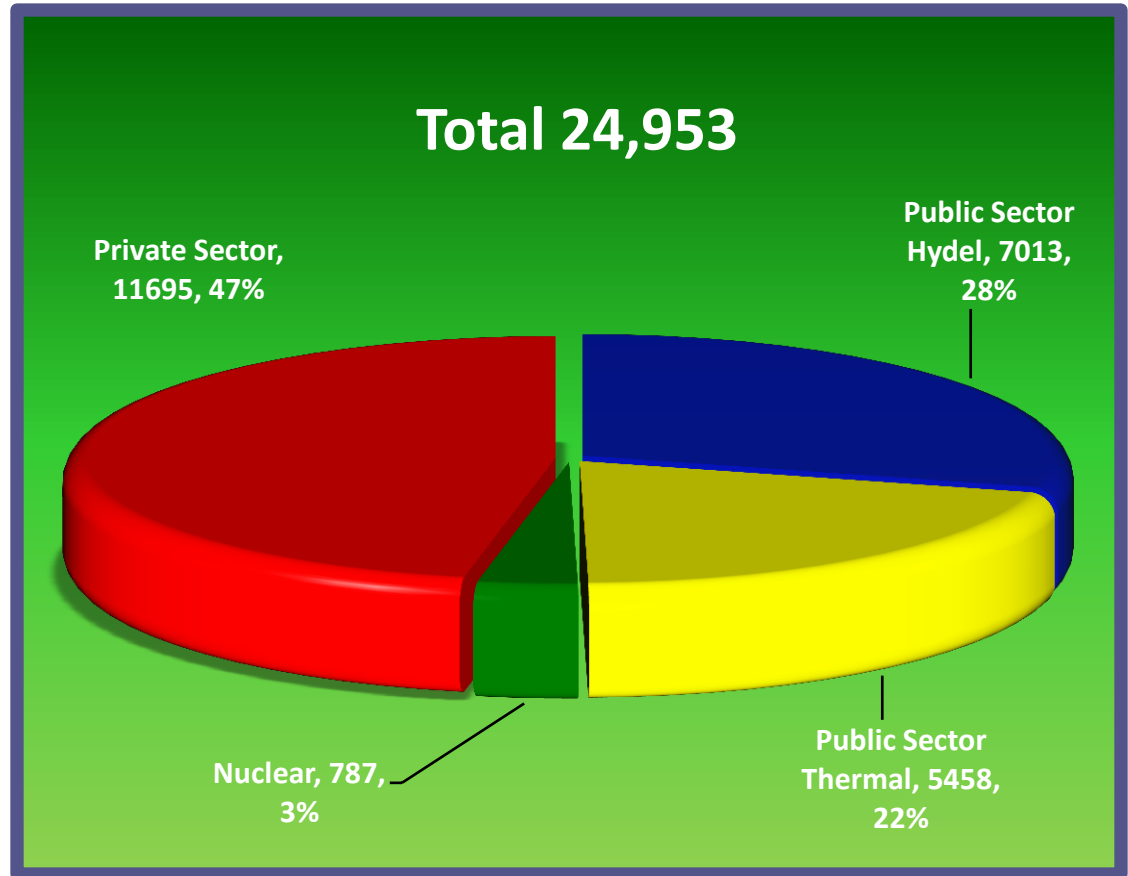
# Scheme of Presentation

- Overview of the national energy sector, its role in the country's socio-economic performance, energy mix
- Power sector structure and regulatory framework
- Existing physical energy infrastructure and its development strategy for Energy Security
- Energy transit and cross border electricity trade

# PAKISTAN POWER SECTOR - TOTAL INSTALLED CAPACITY

	MW	%
<b><u>Public Sector</u></b>		
Hydel	7,013	28
Thermal	5,458	22
Nuclear	787	3
Total	<u>13,258</u>	<u>53</u>

<b><u>Private Sector</u></b>		
IPPs	9,273	37
KESC	2,422	10
Total	<u>11,695</u>	<u>47</u>



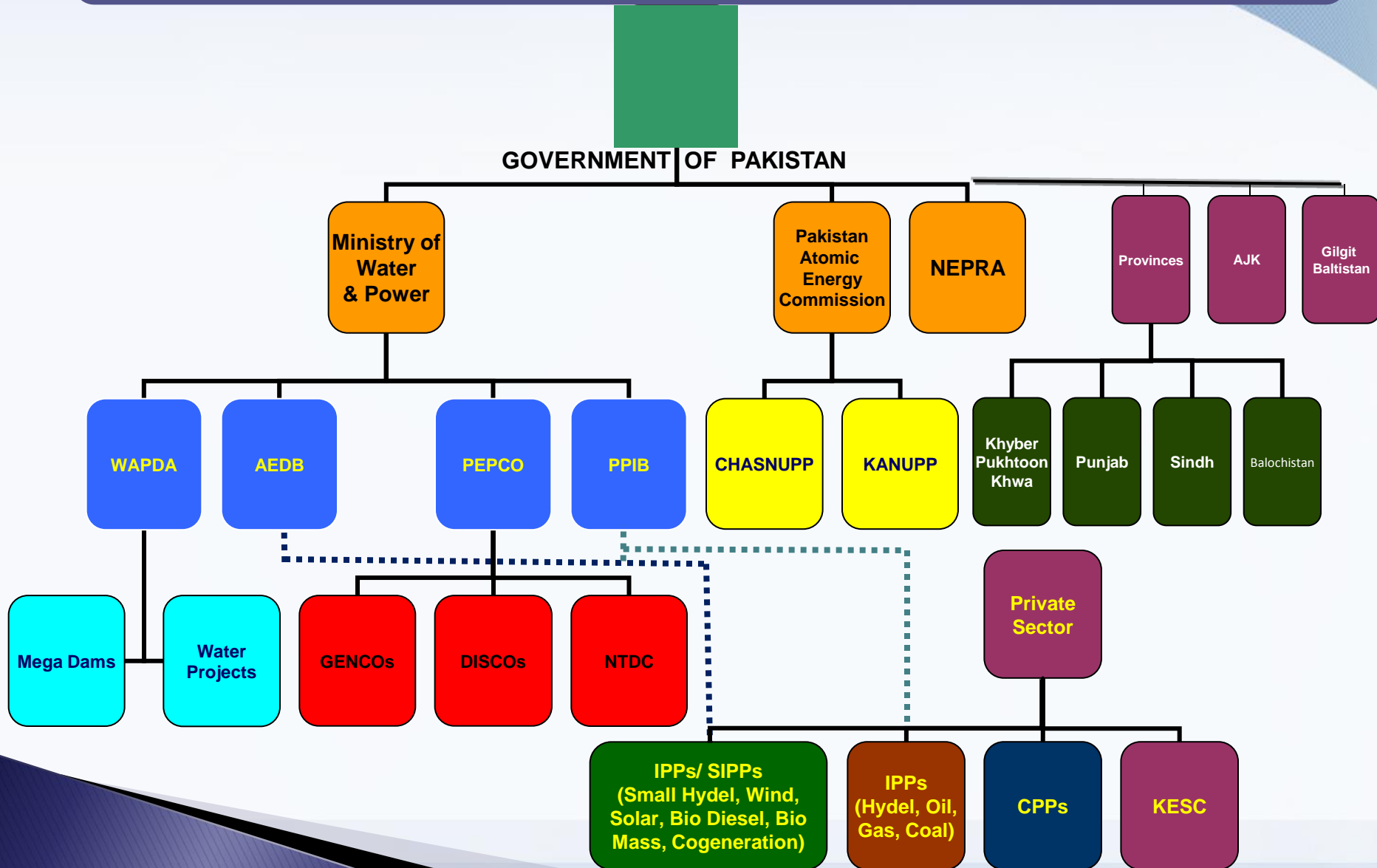
*Total Installed Capacity*      **24,953 MW**

Source: Power System Statistics – 39<sup>th</sup> Issue

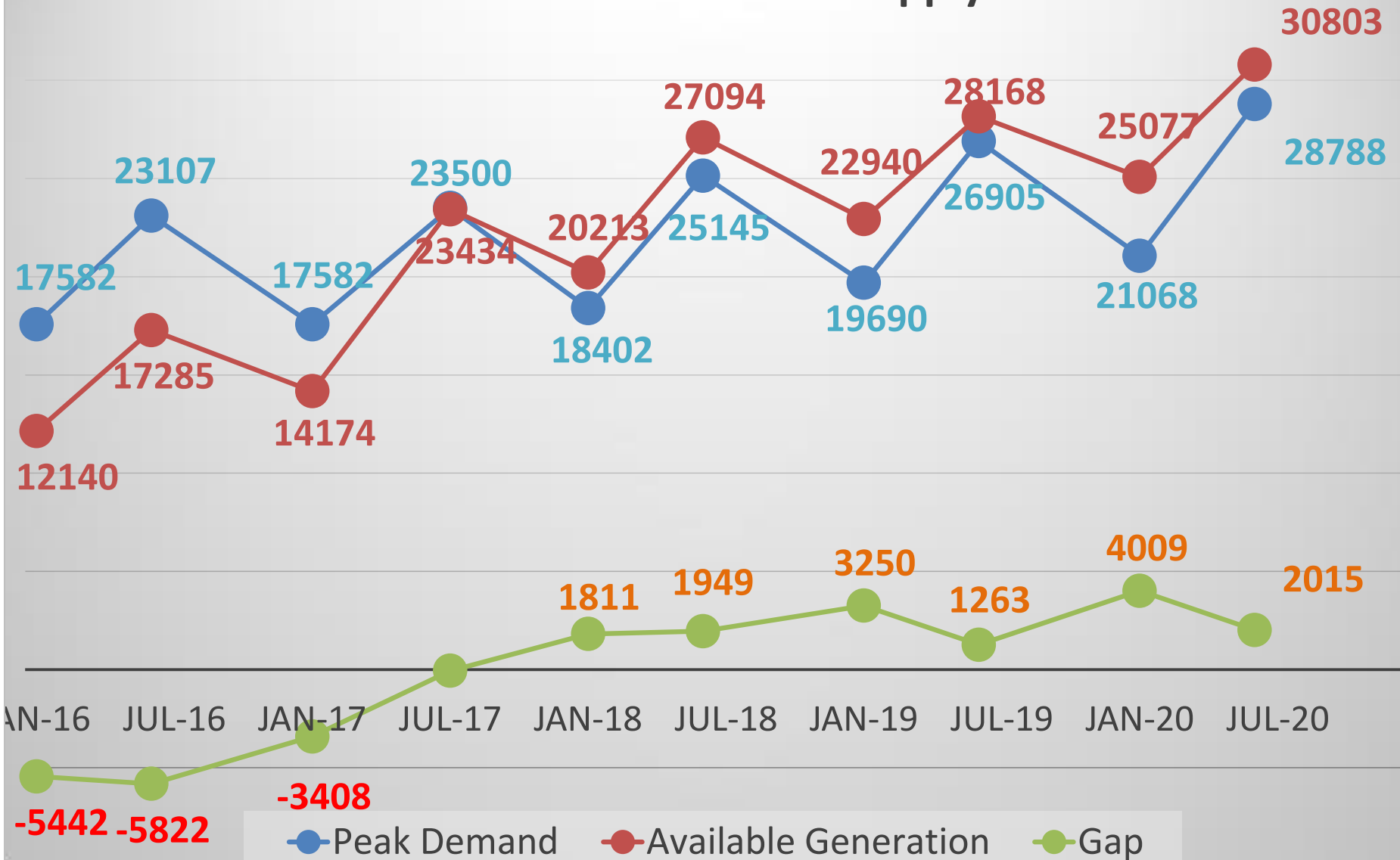
# PAKISTAN POWER SECTOR – TRANSMISSION SYSTEM



# PAKISTAN POWER SECTOR – KEY PLAYERS



## Power Demand and Supply



# Energy Security

- International Energy Agency defines Energy Security as:
  - “The uninterrupted availability of energy sources at an affordable price”
- Prominent features of Energy Sources:
  - Indigenousness
  - Affordability
  - Reliable & Predictable Availability
  - ***Sustainability***

# Policy Choices

- How much of Energy Security is:
  - Achievable
  - Affordable
  - Desirable
- Policy for Energy Security has to balance all the characteristics (**Indigenous, Affordable, Reliable & Predictable**) while making choice of Energy Sources to meet the expected requirements

# Pakistan's Scenario

- Indigenousness
- Reliable & Predictable Availability
- Affordability
- Regulatory Framework

# Where do we stand - Availability

## **Power:**

- Generation Deficit – 5000-6500 MWs
- Financial Deficit – Circular Debt of Rs. 320 bn
- Cyclical & Unpredictable Generation from Dams
- Foreign Exchange reserves – always a challenge

## **Gas:**

- Local reserves depleting
- Gas loadshedding in Winters
- Exploration and development requires costly incentives

# Where do we stand - Affordability

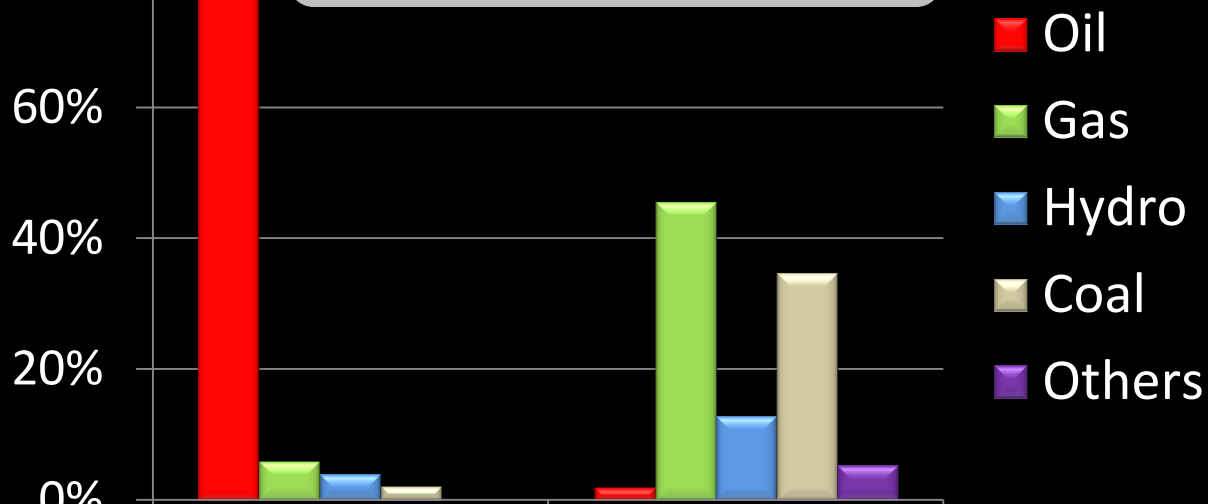
<b>Electricity</b>	<b>Tariff cents/kWh</b>
Pakistan	11
Vietnam	7
India	9
Bangladesh	7.3
<b>Gas</b>	<b>Tariff USD/mmcf</b>
Pakistan	6 (+2 GIDC)
Vietnam	4.2
India	4.2
Bangladesh	3.1

# Where do we stand - Sustainability

Table 1: Key Data for the 10 Largest CO<sub>2</sub> Emitters

Country	CCPI Rank		Share of Global GDP	Share of World Population	Share of Global CO <sub>2</sub> Emissions*	Share of Global Primary Energy Supply
	2014	2013				
Germany	19	8	4.02%	1.18%	2.23%	2.38%
India	30	24	5.66%	17.84%	5.14%	5.72%
Indonesia	34	36	1.41%	3.48%	2.30%	1.59%
Brazil	36	34	2.87%	2.83%	4.12%	2.06%
United States	43	43	18.81%	4.48%	15.50%	16.71%
China	46	48	14.63%	19.42%	22.95%	20.91%
Japan	50	44	5.59%	1.84%	3.54%	3.52%
Korea	53	50	1.95%	0.72%	1.76%	1.99%
Russian Federation	56	55	2.99%	2.04%	4.90%	5.57%
Canada	58	58	1.75%	0.50%	1.58%	1.92%
Total			59.69%	54.32%	64.03%	62.37%
Pakistan				2.6%	0.4%	

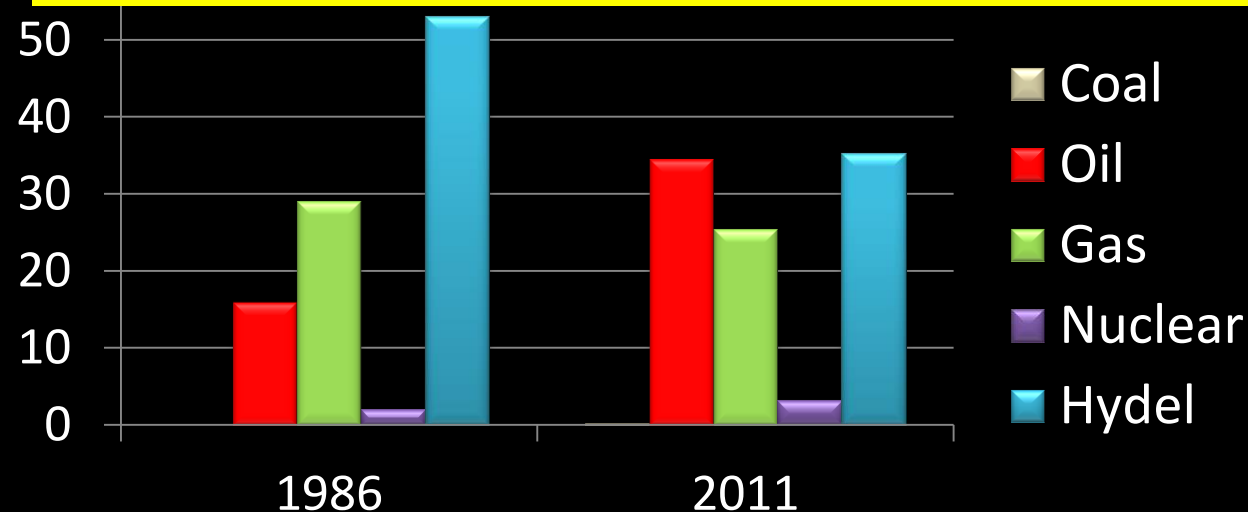
## Energy Mix for Power Generation



Oil  
Dependency

Malaysia

When the world was moving from oil to coal for energy security, we moved into greater oil dependency



Pakistan

Data Sources: Abdul Rahman Mohamed\* and Lee Keat Teong, *Energy Policy for Sustainable Development in Malaysia*, The Joint International Conference on "Sustainable Energy and Environment (SEE)" 1-3 December 2004, Hua Hin, Thailand  
 2. National Electric Power Regulatory Authority, *State of Industry Report 2011*, 11.  
 3. Hydrocarbon Development Institute of Pakistan, *Pakistan Energy Yearbook 2010*

# Challenges & Prospects

## Challenges:

- Removing deficits that are hurting the economy
- Moving away from costly & imported towards cheaper & indigenous sources
- Striking a workable balance which provides both Affordability and Availability while enhancing the Energy Security
- Reconciling the interests of Power Sector, Power Investors and Power Consumers by reforming the Regulatory Framework

# Prospects

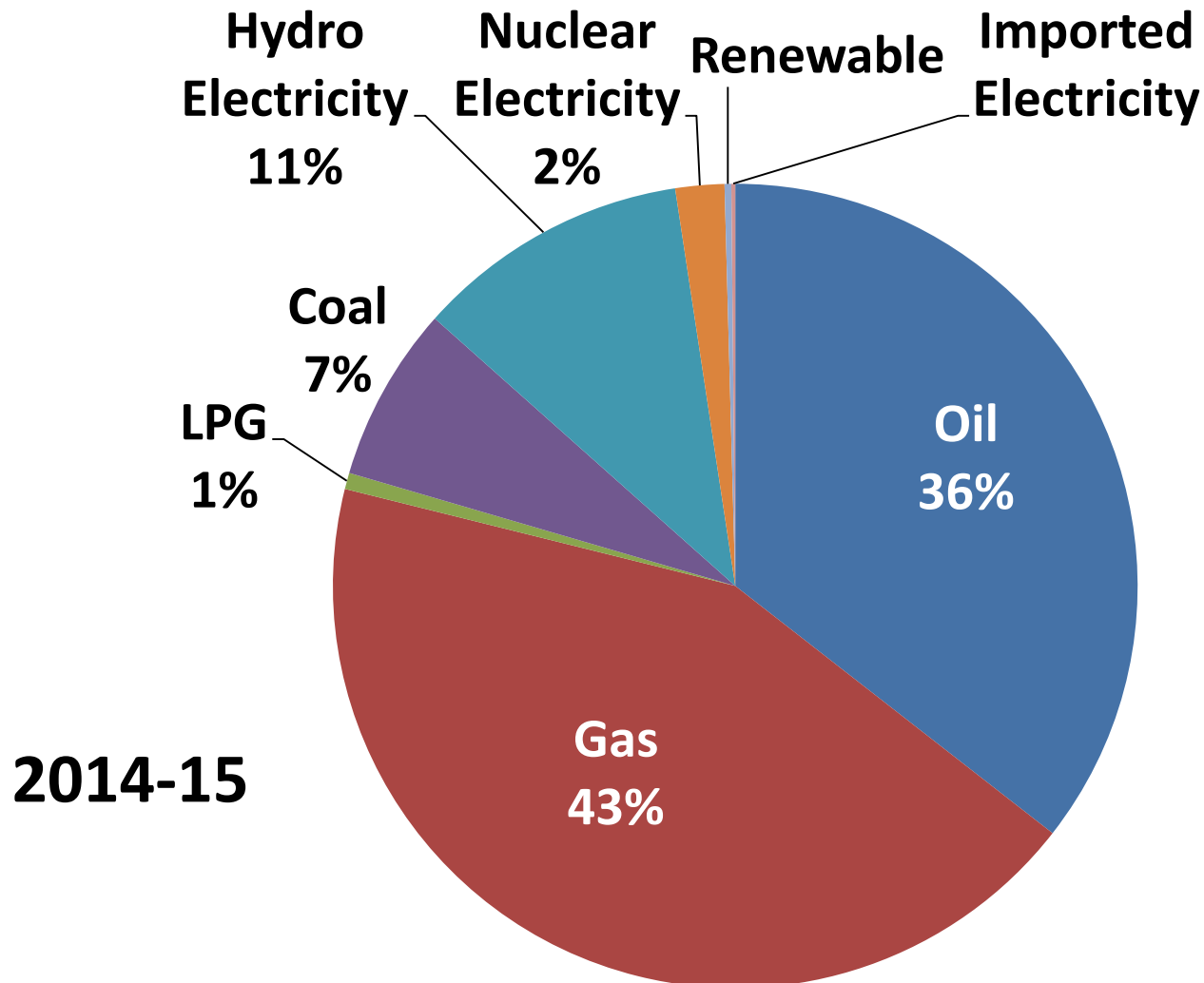
## Massive Unexploited Indigenous Resources:

- Thar Coalfields – 175 bn tons of lignite – can produce 100,000 MWs of electricity for 300 years
- Hydel Power – an estimate of more than 50,000 MWs on Indus and Jehlum – grid connectivity with GB can bring in 30,000 MWs more
- Solar – Unlimited
- Wind – around 50,000 MWs in Sindh, Balochistan and other parts of the country
- Shale Resources –

Shale Gas:	105 trillion cft (recoverable, out of a total of 586 tr cft)
Tight Oil:	9 billion barrels (recoverable, out of a total of 227 bn barrels)

**(Current resources: 20 tr cft of gas and 385 m barrels of oil)**

# Pakistan's Primary Energy Mix



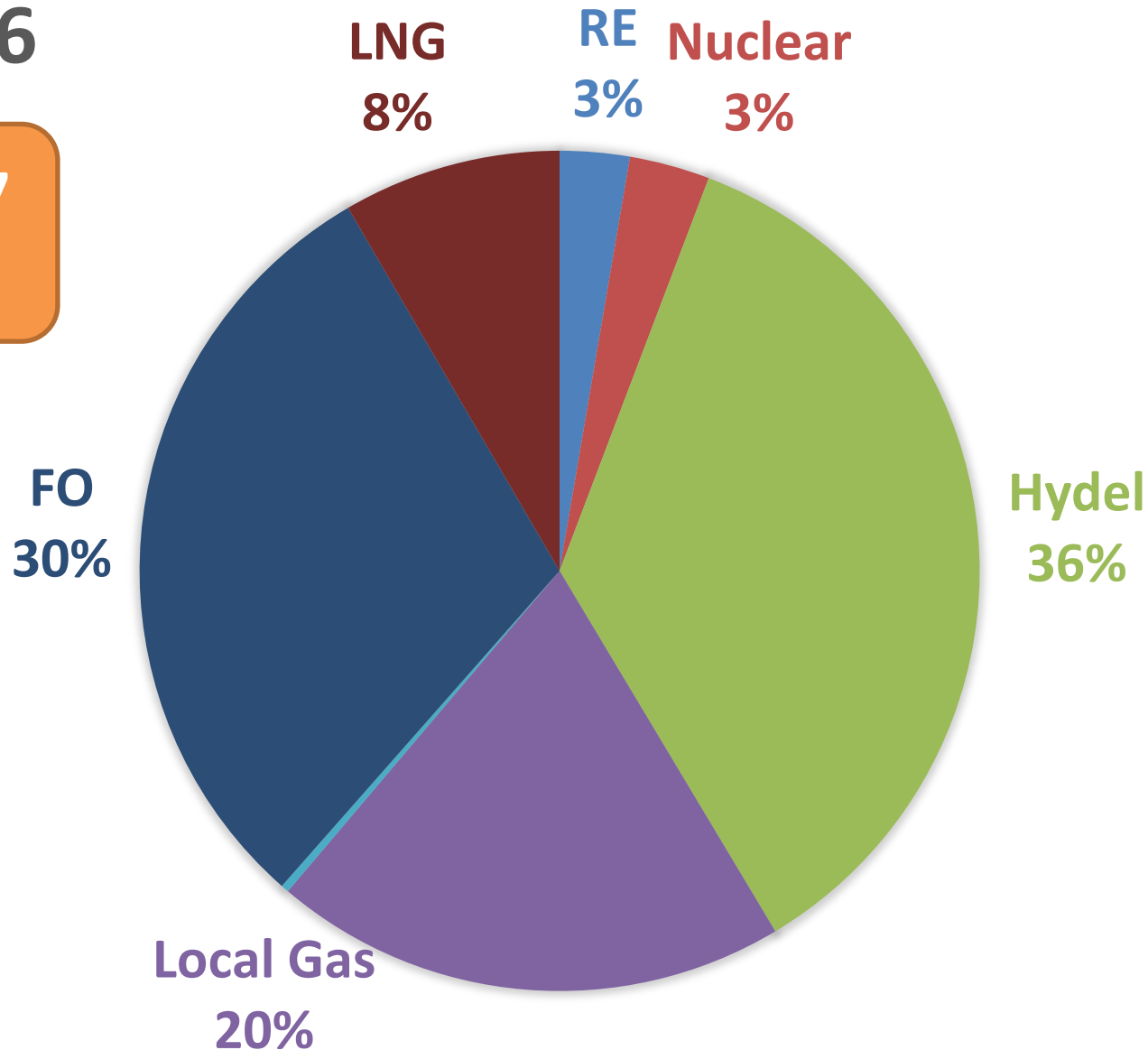
# Choices

Source	Indigenuity	Afford-ability	Reliability	Predict-ability	Sustainability / Safety
<b>Oil</b>	No	No	Partially	No	No
<b>Hydel</b>	Yes	Yes	No	No	Yes
<b>Local Gas</b>	Yes	Yes	No	Yes	Partially
<b>Imp. Gas</b>	No	Yes	Partially	No	Partially
<b>Nuclear</b>	Yes	No	Yes	Yes	Yes & No
<b>Thar Coal</b>	Yes	Yes	Yes	Yes	No
<b>Imp. Coal</b>	No	Yes	Partially	Partially	No
<b>Solar</b>	Yes	No (but becoming affordable)	Yes	No	Yes
<b>Wind</b>	Yes	No (but becoming affordable)	Yes	No	Yes

# Generation Capacity - Fuel Mix

2016

19917  
MWs



# Current Policy Scenario

## **Policy and achievements towards:**

- Improving Availability
- Enhancing Affordability
- Moving towards Indigenous Sources

# Improving Availability - Power

- Reducing the damage to economy and Optimisation of available Capacity
  - By handling generation more competently
  - By improving cash flows in the sector by reducing the inefficiencies and improving performance
- Bringing in more investment
  - By providing enabling policy cover to the Private sector
  - By bringing back the Public Sector into sponsoring and executing power projects
- Increasing Affordability:
  - Rationalising Generation Tariffs for different Fuels/Sources
  - Rationalising Distribution Tariff to cover costs realistically and avoid Circular Debt

# Facilitating new initiatives

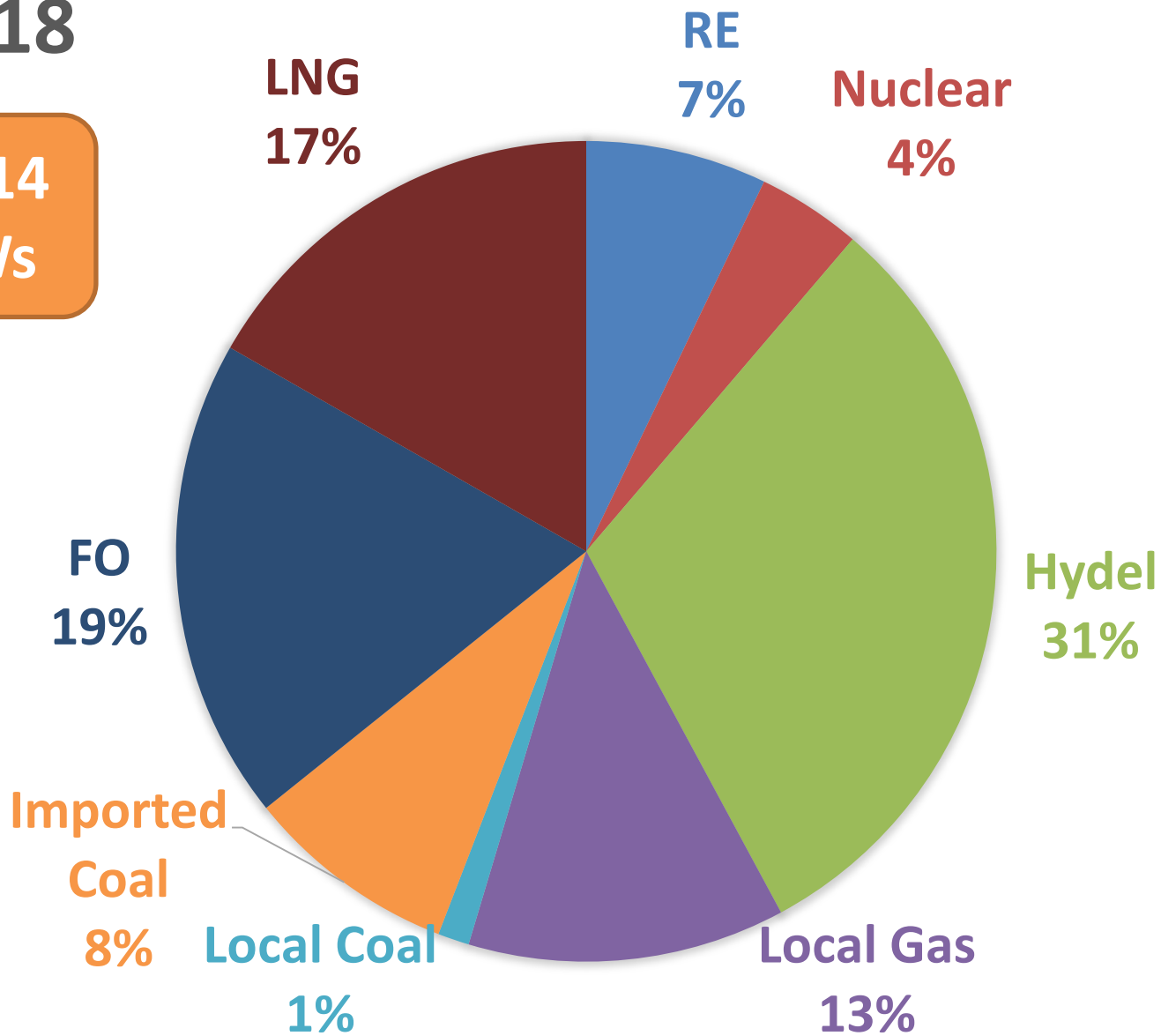
- Power Generation Policy 2015
- Transmission Lines Investment Policy
- Coal Based Power – Security Documents
- LNG Based Power – Security Documents
- CPEC – 8630 (out of 10400) MWs on execution path
- Public Sector LNG Power Plants – 3600 MWs have reached execution stage
- CASA-1000 project agreements executed
- Mega Hydel projects - on track

# More Indigenisation

- Bringing Three Thar Coal based projects in CPEC –  $1320 \times 3 = 3960$  MWs
- Actively working on 11,642 MWs of Hydel Power
- Completed Land acquisition of Diamer Basha Dam - another 4500 MWs of Hydel Power
- Capping new generation on imported fuels
- Bringing in Wind and Solar components into the National Grid
- Removing duties on Solar panels and components
- Solarisation of tubewells, Net metering and Solar Village Electrification

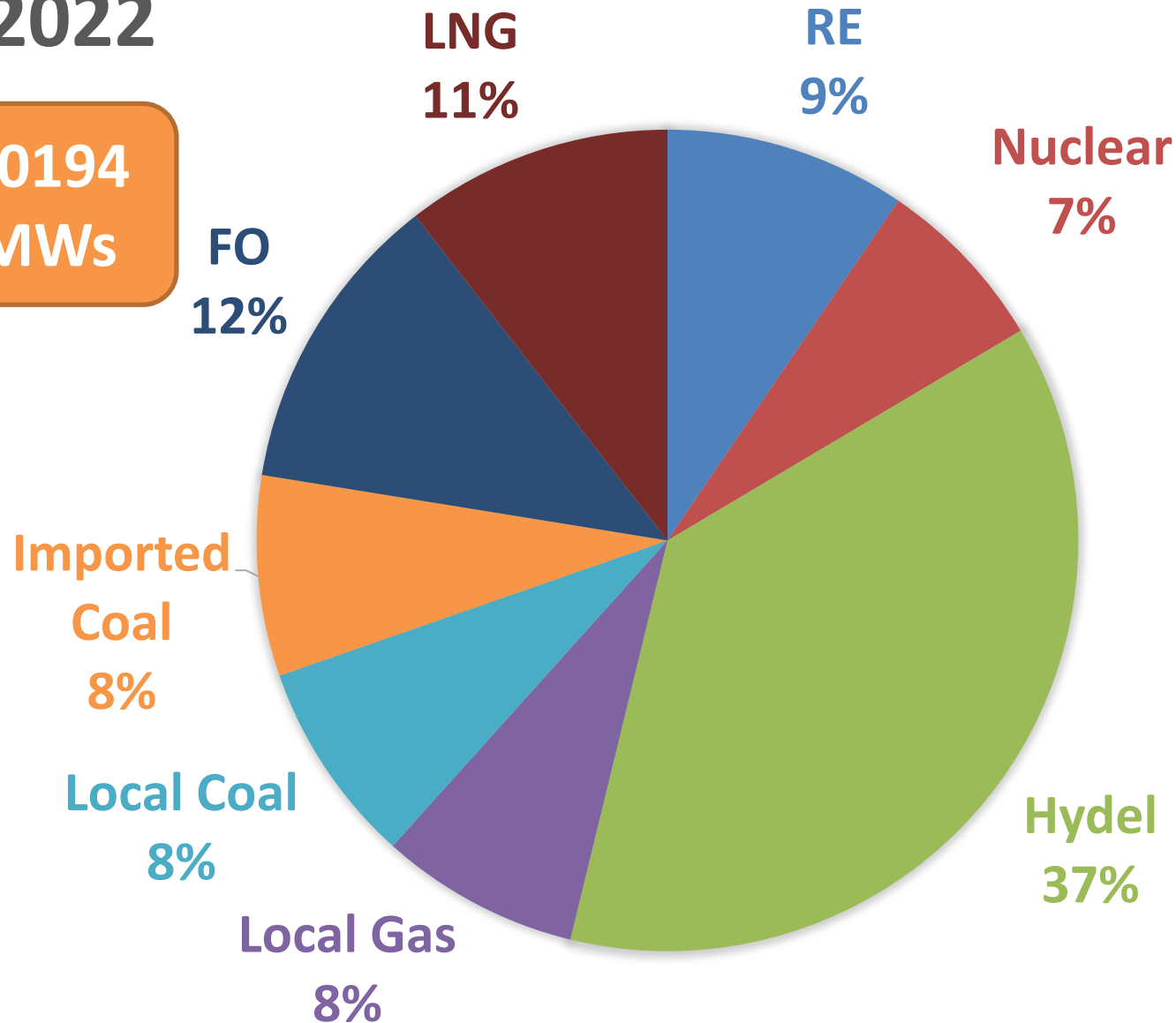
**2018**

**31514  
MWs**



**2022**

**50194  
MWs**



# Way forward – Stabilisation and moving towards greater Energy Security

- Continuous Exploration and Investment in Indigenous resources: chiefly in Hydel and Thar Coal, turning imported fuel based generation into standby capacities in coming years
- Renewable resources' share to be increased incrementally
- Bringing end-to-end transparency through digital interventions:
  - Bringing in components of a Smart Grid
  - SCADA based National Grid from Generation to DISCOs
  - Smart Metering in DISCOs upto consumer level
- ERP based operational and financial monitoring systems
- Rationalising energy reforms and regulatory framework towards futuristic challenges – market operations without guarantees
- Keep on pushing Generation Tariff downwards
- Realistic Cost-recovering Tariff Regime

# Regional Power Connectivity Concept

## Objective

- : Collective use of abundant resources through regional interconnection
- Early power delivery from neighbouring countries to meet urgent power needs in Pakistan

## Requirements

- Power delivery to Pakistan should be in near future term (2017-18 target)
- Investment required and cost of power delivered to Pakistan grid should be competitive with locally produced power
- Power delivered to Pakistan should be year around
- Transmission line should provide benefits to communities along the way

## Collateral Benefits

- Power transmission corridors to complement other regional initiatives and projects leading to accelerated economic growth in the area.

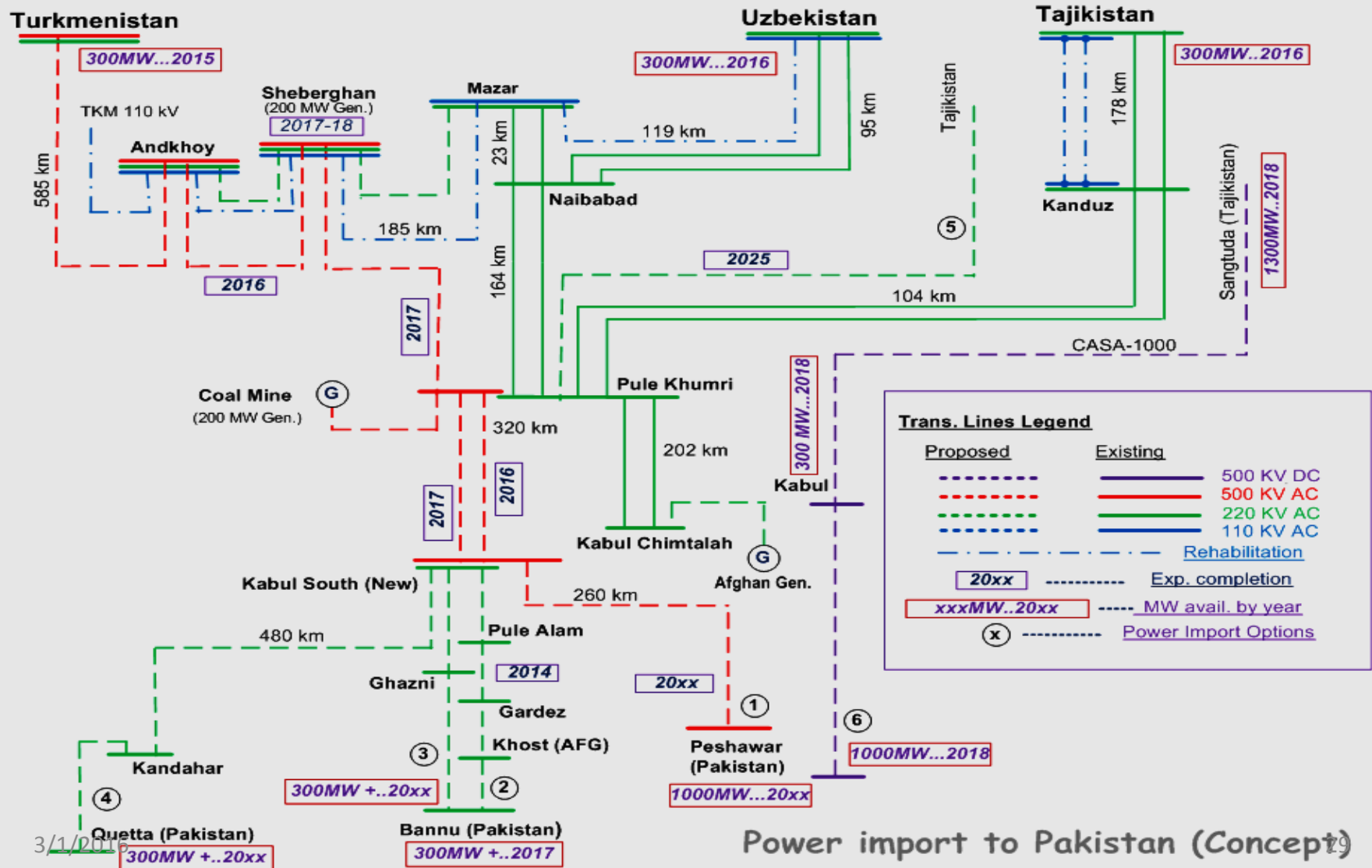
## CAR Surplus Power versus Afghan Power Demand

- Afghan power imports, as per ADB Afghan Master Plan, will be: (i) 300 : MW (year-around) from Uzbekistan by 2016 (ii) 300 MW from Tajikistan in CASA (summer only) by 2019 (ii) An additional 300 MW from Turkmenistan is expected by 2018.
- Projected capacity available in Afghan grid from imports and local generation by 2020 is 2557 MW against a forecast peak demand of 1766 MW with a surplus of 790 MW. As per Afghanistan Master Plan, by 2032 Afghanistan will have 5,546 MW available in grid versus 3502 MW as per demand forecast. Projected surplus will be 2044 MW
- Afghanistan peak demand is in December with minimum consumption in July. In contrast Pakistan has its maximum demand in July. Needs are complementary.

# Regional Power Connectivity Options

- Import of Power from Tajikistan/Kyrgyzstan (CASA-1000 Project)
- Import of Power from Iran
- Import of Power from India
- Import of Power from Turkmenistan/Uzbekistan
- Import of Power from Tajikistan

# Power Import for Pakistan- Single Line Diagram



# CASA 1000

CASA DC lines.....

500-kV AC line.....

CASA DC substation.....

1300 MW from Tajik, Kyrgyz

300 MW..... to Kabul

1000 MW..... to Peshawar

Total cost:.... \$ 1.17 billion

Length:..... 750 km DC

.....477 km AC

Completion:..... 2018

Seasonal power: .....

.....available for 5 month

Delivery cost....10 C /kWh

# Power from Iran

## ***1. Existing Interconnection Projects:***

Import of 74 MW Power by Pakistan in border areas of Pakistan (in Baluchistan Province):

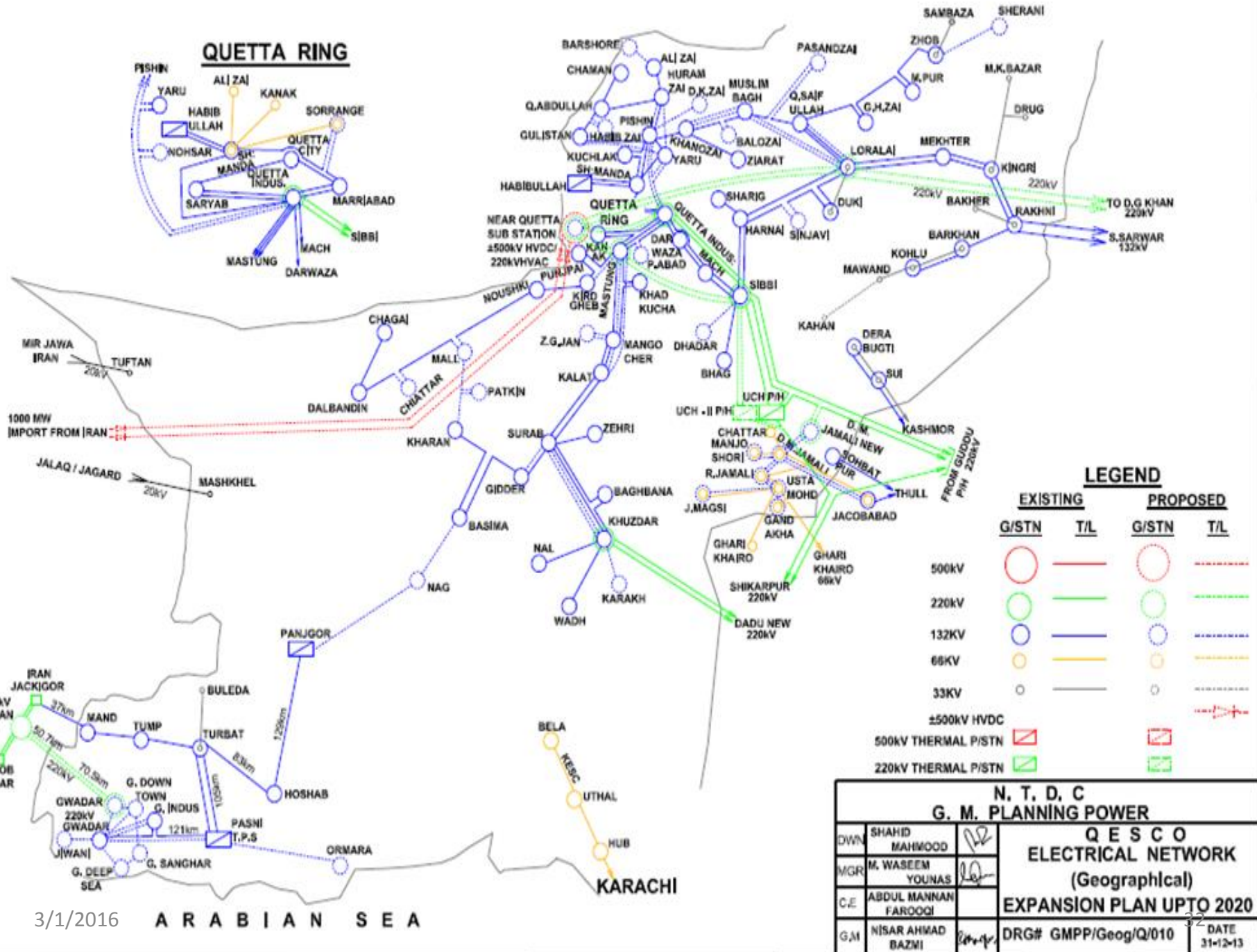
- i. 70 MW at 132 kV (continued since 2003. Initially, it was 35 MW)
- ii. 4 MW at 20 kV (continued since 2002)
- iii. (Tariff: US cents 7-10. Contracts is renewed after every 3-years)

## ***2. Planned Interconnection Projects:***

- i. Import of 100 MW at Gwadar through 220 kV D/C T/Line (contract signed)
- ii. Import of 1000 MW at Quetta through  $\pm 500$  kV HVDC Bipole (MoU signed)

*(For import of power from Iran, Tariff is linked with International Oil prices)*

## QUETTA RING



# Power from India

A pre-feasibility study for import of 500 MW power by Pakistan from India was conducted by consultants. The study was funded by World Bank.

In the study report, the following scope of transmission interconnection was proposed:

- 400/220 kV HVDC Back-to-Back Converter Station in Pakistan
- 400 kV D/C T/Line (approx. 26 km) from Balachak to Pak-India Border.
- 400 kV D/C T/Line (approx. 10 km) from Converter Station to Pak-India Border
- 220 kV D/C T/Line from Ghazi Road to Converter Station
- Cost Estimates: US\$ 200 million.

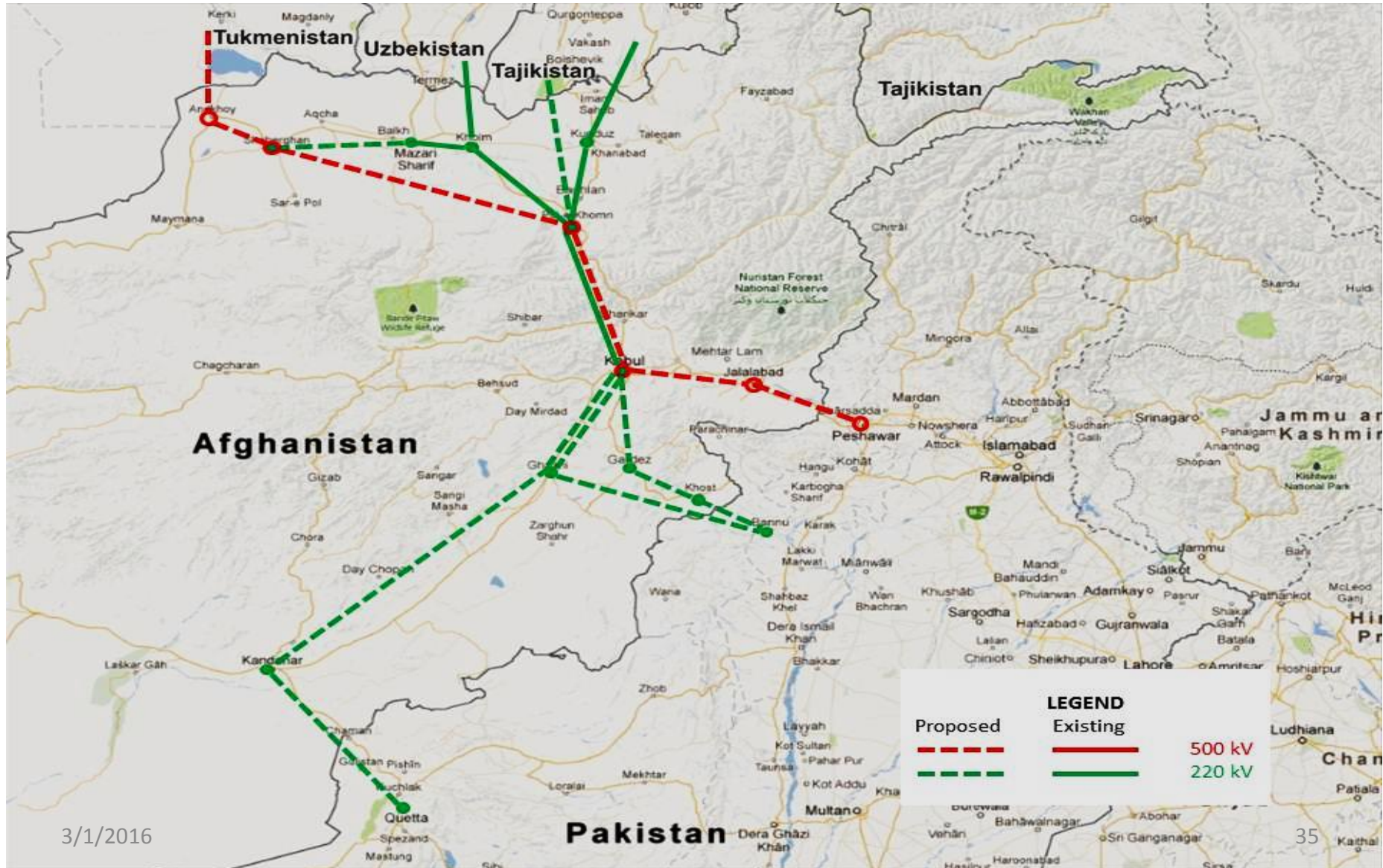
(Pakistan could purchase power from Indian suppliers through their power exchanges under a competitive trading of electric power regime)

## CAR Options Outside CASA

Outside current CASA system, Turkmenistan will be the main supply source of power round the year

- Option A - Connect Afghanistan Khost 220 kV substation to Pakistan Bannu 220 kV substation. Line may pass through newly planned (NTDC) 220 kV Substation at Miran Shah in Pakistan border.
- Option B – Connect Kabul South 500/220 kV substation in Afghanistan to 500 kV Peshawar II substation in Pakistan
- Option C – Connect Ghazni 220 kV substation in Afghanistan to Bannu 220 kV substation in Pakistan.
- Option D – Connect Kandahar 220kV substation in Afghanistan to 220 kV substation in Quetta, Pakistan

**Phase I : 300 MW Khost-Bannu Line (by 2017-2018) &  
Phase II: 600 MW Khost-Bannu + 300 MW Kandahar - Quetta &  
1000MW Kabul-Peshawar (after 2018)**



## Other Available Power Import Options

**Power import from Tajikistan** Pakistan and Tajikistan are considering import of 1000 MW outside CASA. An MOU has been signed and a committee has been constituted to study the route options

**Power import from Turkmenistan** *there is a proposal for import of 1000 MW from Turkmenistan. An MOU signed. However this primarily is same proposal as detailed above for supply through Khost and Khandhar inter-connections*

**Power import from China** *offer to export 3000 MW from neighbouring Xinjiang province to Pakistan. The proposal is under study as the proposed route passes through the most difficult terrain in the world*

## Regional Energy Cooperation Can Lead to

- Large reallocation of generation investment across countries and technologies (especially but not only for hydro)
- More than 105,000 MW of transmission capacity by 2040 to support unlimited cross-border power flows
- USD 222 billion in net cost savings (USD 97 billion in present value at 5% discount rate)
- Fuel cost savings is the main source of benefits; these savings are more than five times the cost of additional investment

# Barriers to Cross Border Connectivity

- Lack of physical interconnection capacity
- Challenges like terrain, regional political considerations, and financial resource constraints
- Lack of regional regulatory infrastructure for prioritizing and coordinating increased interconnection
- Domestic sector policies that discourage increasing interconnection or power transactions using existing capacity
  - Pricing/revenue recovery; capital shortages
  - Risks to effective contract enforcement

Thanks

# **INVESTMENT INITIATIVES**

## **(Transmission Line Projects) (1/4)**

- **Transmission Line and Allied Infrastructure Projects under the proposed Transmission Line Policy (*to be announced shortly*)**
  - **List of Transmission System projects to be offered to Private Sector will be prepared by GOP**
  - **Award of Projects through ICB on BOOT basis**
  - **Policy to cover Transmission Line & Grid Station projects of 220 kV voltage level and above (EHVAC & HVDC)**
  - **Land & Legal Right of way *to be provided by* NTDC**
  - **Project Term: 25 years**
  - **Transmission utility (NTDC) to pay Transmission Service Charge in Rs./km/month, regardless of the quantum of energy transmitted**
  - **Exemption from Corporate Income Tax including turnover rate tax and withholding tax on imports**
  - **Standardized Security Package (IA & TSA)**
  - **One Window facility by PPIB**

# **INVESTMENT INITIATIVES**

## **(In progress Hydel Projects) (2/4)**

- **Hydropower projects in Public-Private Partnership Mode:**
  - 665 MW Lower Palas Valley Hydropower Project
  - 496 MW Lower Spat Gah Hydropower Project
- **International Competitive Biddings for establishment of:**
  - 80 MW Neckeherdim-Paur Hydropower Project
  - 350 MW Athmuqam Hydropower Project
- **Key Projects requiring support in areas of Equity Participation, EPC Contract, O&M Contract, Electro-Mechanical Equipment Supply and Lending/ Financing:**
  - 640 MW Azad Pattan Hydropower Project
  - 500 MW Chakothi Hattian Hydropower Project
  - 548 MW Kaigah Hydropower Project
  - 157 MW Madian Hydropower Project
  - 215 MW Asrit-Kedam Hydropower Project

# **INVESTMENT INITIATIVES**

## **(Coal based Power Projects) (3/4)**

- At present, various local and imported coal based IPPs are under process with PPIB, most of which are being developed under the China Pakistan Economic Corridor (CPEC)
- PPIB with the support of all stakeholders is in the process of finalizing Security Package Documents (Implementation and Power Purchase Agreements)
- The following imported coal based power projects have been issued Letter of Intent (LOI) / Notice to Proceed (NTP) for their fast-track development:
  - 1,320 MW power project at Port Qasim, Karachi by Sinohydro Resources Limited and Al Mirqab Capital
  - 660 MW Imported Coal Based Independent Power Generation Project at Port Qasim, Karachi by Lucky Electric Power Company Limited
  - 350 MW Imported Coal Based Independent Power Generation Project at Port Qasim, Karachi by Siddiqsons Limited
  - 163 MW Grange Holdings Power Project based on Imported Coal at Arifwala, Punjab by Grange Power Limited

## **INVESTMENT INITIATIVES (Coal based Power Projects) (4/4)**

- The total potential of Thar is estimated at 175 billion tons of lignite coal which may be sufficient to produce 100,000 MW electricity for 200 years
- The following Indigenous/ Thar coal based power projects are currently being processed by PPIB:
  - 600 MW Power Project based on Thar coal at Thar Block II, Sindh by Engro Powergen Limited (EPGL)
  - 2 x 600 MW power project based on Thar coal at Thar Block I, Sindh by China Power International Holding Limited (CPI)
  - 300 MW Indigenous Coal based Independent Power Generation Project at Pind Dadan Khan (Salt Range), Punjab by China Machinery Engineering Corporation (CMEC)
- Investors are encouraged to participate in development of power projects based on Coal and also propose new projects based on Coal