
بسم الله الرحمن الرحیم








Rationale for Cross Border Electricity Interconnections and Trade in South Asia

Monday, 9th March 2020

Borders are opportunities not hurdles

National Transmission & Dispatch Company Limited

Personal Introduction

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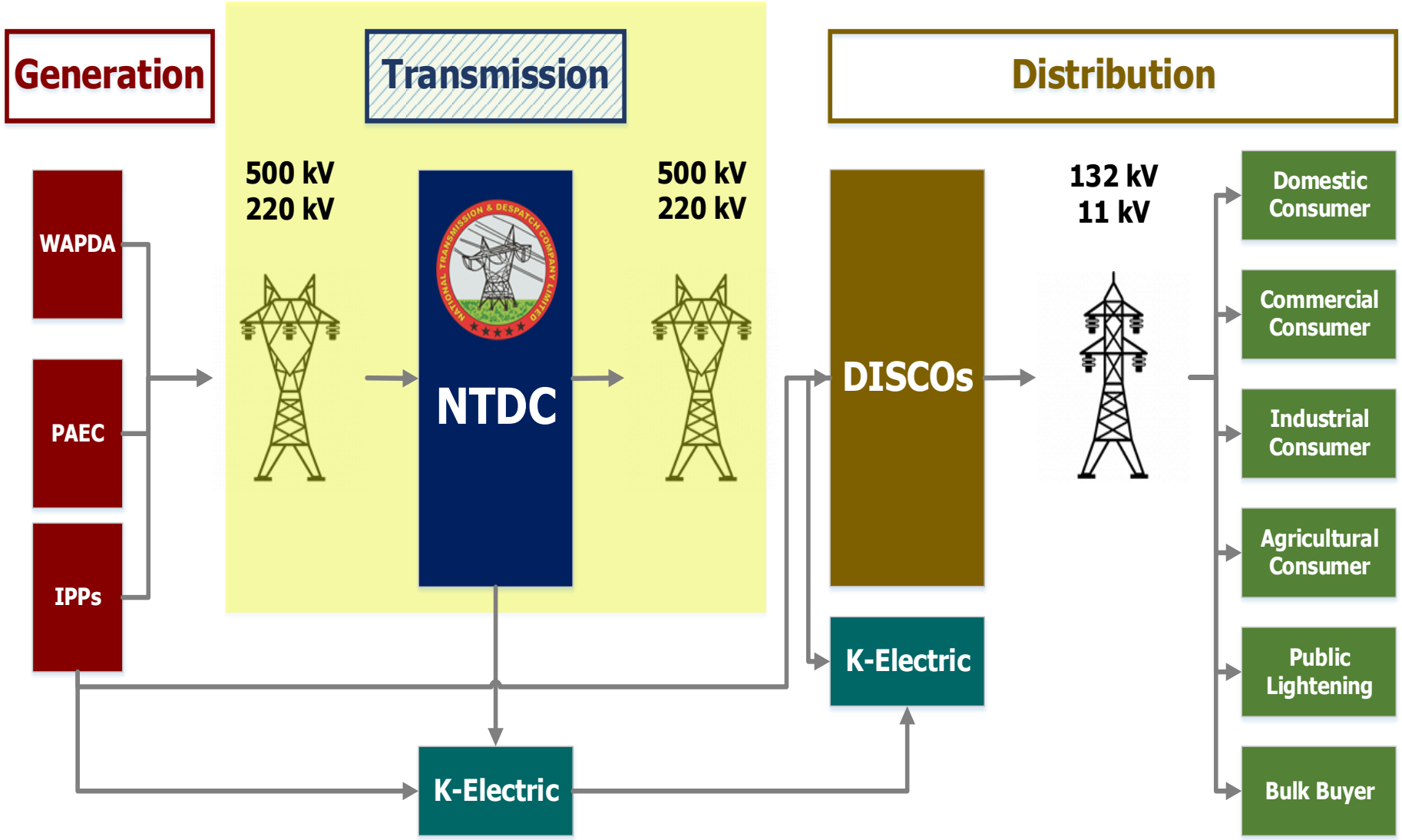
- Knowledge Worker
- Electrical Engineer
- IEEEP Fellow
- General Manager, Power System Planning, National Transmission & Despatch Company (NTDC)
- Former Advisor Business Systems - USAID Project; Regulatory Analyst - Saudi Electric Company; and Program Leader (Energy Trade) SAARC Energy Centre
- A social activist
- **A proud learner**

Today's Focus

1. Intro to NTDC System
2. Rationale for Regional Energy Connectivity
3. SAARC Energy Ring
4. Connecting Central Asia with South Asia: CASA-1000
5. Scheme to Cope with the Power Sector Challenges
6. Questions and Answers

1. Intro to NTDC System

National Transmission & Despatch Company



NTDC National Grid 2025

Category	Grid Stations	Transmission Lines	Capacity
	Nos.	km	MVA
Existing System 2020			
500 kV	16	5,970	22,350
220 kV	45	11,322	31,060
Total	**61**	**17,292**	**53,410**
Future System 2025			
500 kV	24	12,633	39,150
220 kV	71	15,894	54,100
765 kV	1	500	3,600
± 660 kV	2 (Converter Stations)	890	4,812
± 500 kV	1 (Converter Station)	110	1,576
Total	**99**	**30,027**	**103,238**

Long Term Forecast 2018-40

Fiscal Year	Low (4.5% GDP Growth)		Normal (5.5% GDP Growth)		High (7% GDP Growth)	
	Generation	Peak Demand	Generation	Peak Demand	Generation	Peak Demand
	GWh	MW	GWh	MW	GWh	MW
2018-19	144,665	27,072	**145,674**	**27,261**	147,188	27,545
2019-20	151,062	27,814	**152,914**	**28,155**	155,718	28,671
2020-21	158,842	28,782	**161,841**	**29,325**	166,429	30,157
2021-22	166,267	30,127	**170,645**	**30,921**	177,416	32,147
2022-23	173,178	30,889	**179,142**	**31,953**	188,476	33,618
2023-24	181,051	32,294	**188,914**	**33,696**	201,374	35,919
2024-25	188,749	33,640	**198,744**	**35,422**	214,788	38,281
2025-26	193,948	34,062	**206,155**	**36,206**	226,011	39,693
2026-27	202,763	35,610	**217,664**	**38,227**	242,228	42,541
2027-28	211,718	37,183	**229,603**	**40,324**	259,492	45,573

Long Term Forecast 2018-40

Fiscal Year	Low (4.5% GDP Growth)		Normal (5.5% GDP Growth)		High (7% GDP Growth)	
	Generation	Peak Demand	Generation	Peak Demand	Generation	Peak Demand
	GWh	MW	GWh	MW	GWh	MW
2028-29	220,940	38,802	**242,104**	**42,519**	277,960	48,816
2029-30	231,142	40,594	**255,989**	**44,958**	298,670	52,453
2030-31	241,889	42,481	**270,792**	**47,557**	321,130	56,398
2031-32	253,101	44,451	**286,441**	**50,306**	345,315	60,645
2032-33	265,289	46,591	**303,554**	**53,311**	372,070	65,344
2033-34	278,069	48,835	**321,710**	**56,500**	400,940	70,414
2034-35	291,403	51,177	**340,888**	**59,868**	431,973	75,865
2035-36	305,685	53,686	**361,590**	**63,504**	465,916	81,826
2036-37	320,652	56,314	**383,529**	**67,357**	502,479	88,247
2037-38	336,293	59,061	**406,719**	**71,429**	541,779	95,149
2038-39	352,917	61980	**431,584**	**75,796**	584,509	102,653
2039-40	370,348	65,042	**457,939**	**80,425**	630,529	110,736

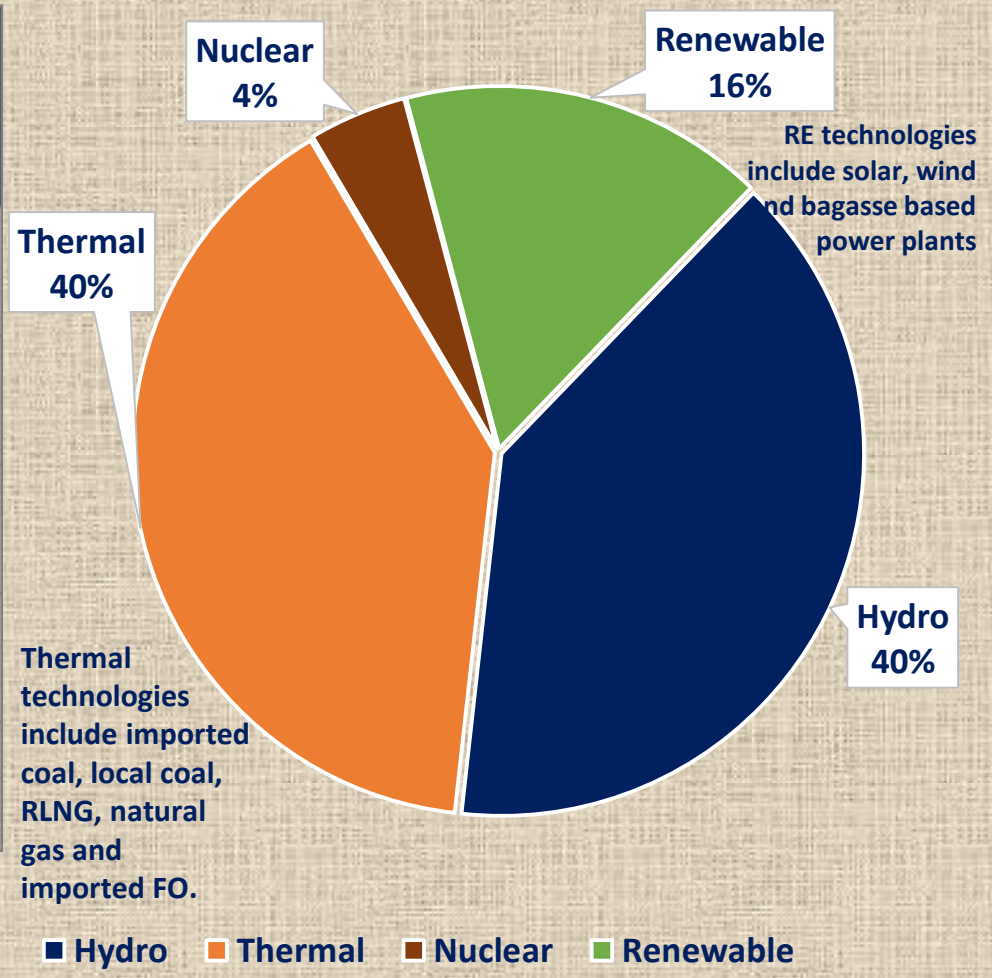
2. Rationale for Regional Energy Connectivity

Major Features of Long term Gen Plan 2040

1. Massive utilization of hydro power (29 to 40%). 
2. Further balancing the overall basket price with high share of indigenous coal (2 to 25%). 
3. Less reliance on imported fuel i.e. coal, RLNG and RFO (48 to 13%). 
4. Renewables accounts for the overall share of 16% of the installed capacity (4 to 16%). 
5. By the year 2040, a capacity of around 9,000 MW is meant to be retired.

Reshaping the Generation Mix 2040

Power Plants	Installed Capacity	%Age
Hydro	38,790	40%
Thermal	38,983	40%
Nuclear	4,278	4%
Renewable	16,040	16%
Total	**98,091**	**100%**



Seasonal Demand Variation 2018-19

Month	Demand Factor
July	0.902
August	0.965
September	0.823
October	0.770
November	0.614
December	0.601
January	0.599
February	0.582
March	0.682
April	0.786
May	0.947
June	1.000

Pakistan: Rationale for Regional Connectivity

1. Energy security due to diversity with respect to cross border interconnection
2. Generation adequacy
3. Optimal utilization of available resources (Investment can be avoided or at least delayed)
4. Interconnections offer opportunities to Pakistan for exporting energy when surplus particularly in winter when demand is low (November to March)

Demand Complementarity in Power Systems

Member State
Bangladesh
India – NE
Bhutan
India – E
Nepal
India – N
India – W
Pakistan
India – S

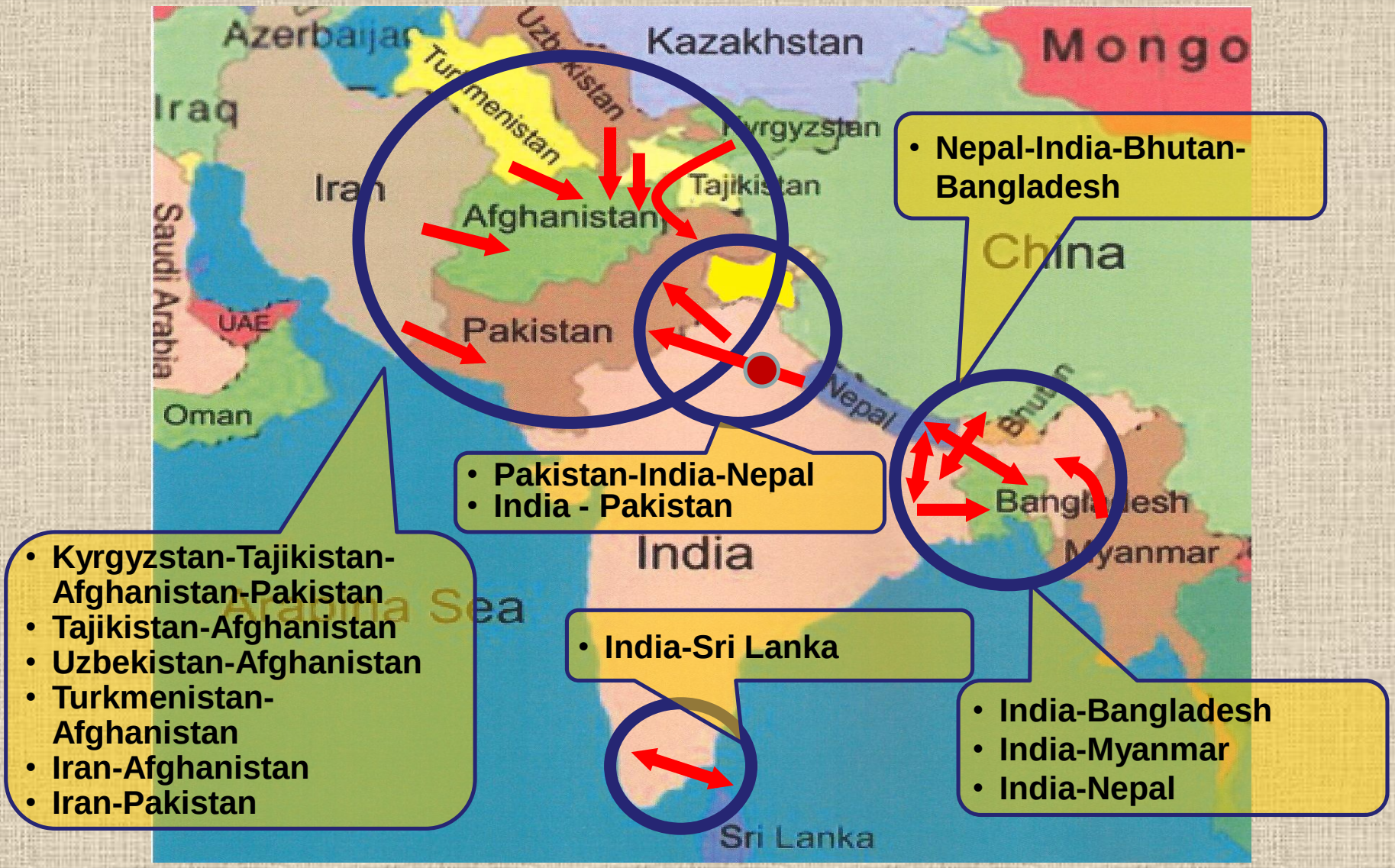
L Low M Medium H High

A Few Examples of Regional Interconnections

1. Middle East: Gulf Cooperation Council Interconnection Authority (GCCIA) including Bahrain; Kuwait; Oman; Qatar; Saudi Arab; and United Arab Emirates
2. European Network of Transmission System Operators for Electricity (ENTSOE)
3. Central Asian States and Pakistan (Afghanistan, Kazakhstan, the Kyrgyz Republic, Pakistan, Tajikistan, Turkmenistan, and Uzbekistan) ***under study***

3. SAARC Energy Ring

SAARC Energy Ring: Power Grid



SAARC Energy Ring
Power Interconnection Opportunities

Grid Interconnection	Capacity (MW)
India-Bhutan	2,100
India-Nepal	1,000
India-Sri Lanka	500
India-Bangladesh	Over 1,000
India-Pakistan	500
CASA 1000	1,000 (+300)

SAARC: Rationale for Regional Connectivity

1. **Utilizing**, optimally, electric power resources
2. **Developing** a strong economy with good jobs, modern infrastructure, proper social services
3. **Facilitating** clean power export revenues for the certain member states and by reducing electricity shortages in other member states
4. **Delivering** reliable, affordable electricity to parts of the world that need it in summer and winter
5. **Prompting** inter-regional cooperation, investments in social services, and encourage community benefit-sharing

4. Connecting Central Asia with South Asia: CASA-1000

Salient Features of the Project

1. Supplying surplus central Asian power in the summers (May to Sep) to Afghanistan (300 MW) and Pakistan (1,000 MW).
2. Confirmed delivery of 4,000 GWh of energy or above
3. A World Bank study declared CASA Project as viable and beneficial, despite the security risks in Afghanistan.
4. HVDC lines from Sangtuda in Tajikistan passing through Kunduz, Pul-i-Khumri, Kabul and Jalalabad in Afghanistan and end up in Peshawar.
5. Total length of transmission lines: 750 km - 16% would pass through Tajikistan, 75% through Afghanistan and 9% through Pakistan.

Existing and Proposed 500 kV Network

CASA 1000: Scope

The CASA-1000 project consists of:

- 750 km 500 kV HVDC Transmission Line between Tajikistan and Pakistan via Afghanistan;
- Converter stations at Sangtuda (1000 MW), Kabul (300 MW) and Peshawar
- A 477 km 500 kV AC link between the Kyrgyz Republic (Datka) and Tajikistan (Khoujand)
- AC system upgrades on existing lines

CASA 1000: Potential Option

1. CASA-1000 will supply power in summer months (May to Sept).
2. For the remaining period countries have planned to use the CASA system under open access provision.
3. Pakistan has also offered Russian side to participate in the CASA System through open access regime for the effective utilization of the CASA system.
4. The CASA System is capable for reverse flow of Energy. Pakistan envisions to sell back the energy during winter months (low demand in Pakistan).
5. Project would pave the way for CASAREM (CASA Regional Electricity Market).

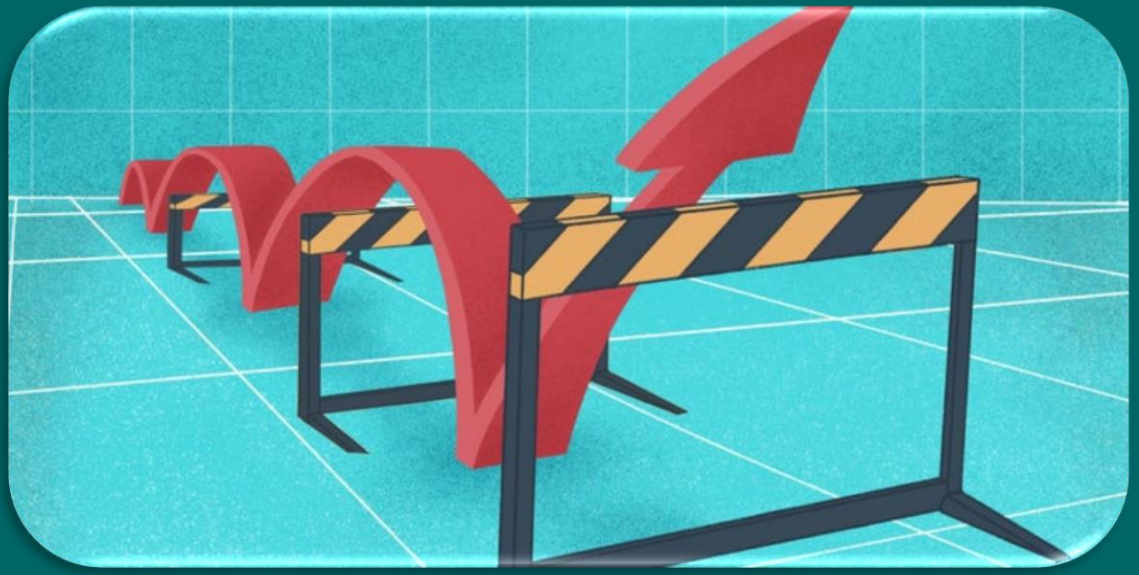
Current Status of CASA 1000 Project

1. **Project COD: December 2022**
2. **Converter Station**
   - Land Acquisition process has been completed and Award has also been announced in favour of NTDC.
   - **Boundary Wall:** The soil investigation for Boundary wall has also been completed and the results have been provided to M/S ABB and M/S Cobra for issuing the zero-reference level so that the same may be forwarded to NTDC Design team for boundary wall design
   - **Transmittals Status:** CASA Documentation flow is based on ERP. All the project documents come in the form of Transmittal and RFI by official emails, which are finally uploaded to Docubin-software. 604 documents (75 Commercial, 529 Technical) have been received for the TW01 package in Pakistan, and 470 (67 commercial, 403 technical) of those have been responded.

Progress of Convertor Station, Nowshera, Pakistan

1. Possession of land by NTDC is still under process (bottleneck).
2. Tender for Boundary Wall was opened on 14.1.2020 and evaluation is under preparation
3. Electrical design of the convertor station – 70% approved.
4. Manufacturing of HVDC Convertor transformers has started.
5. Civil works design of the convertor station shall be submitted for approval in Feb. 2020
6. Preliminary Studies for site selection of electrode station completed, soil investigation for its electrical properties is in process subsequent to which land acquisition process shall start.
7. Tender document for the 500 kV Nowshera Grid Station is on sale. The tender shall be opened on 26.3.2020. The grid station shall be used for the evacuation of the AC power from the convertor station.

5. My Scheme to Cope with the Power Sector Challenges



Coping with the Power Sector Challenges

1. Add cheap, clean MWs through indigenous resource and indigenous technology
2. Make and sustain the grid smart
3. Interventions for the low hanging fruit: Energy efficiency and energy conservation
4. Regional Inter-connections to cater shortage as well as surplus

My Vision on SAARC Initiatives

Domestic energy development and bilateral cooperation alone will not solve power crisis of South Asia.

Engagements have to be multi-lateral.

6. Questions and Answers

For your Patience

CASA 1000: Cost and Funding

1. The estimated cost of the CASA-1000 Project is US $1170 million including US $208 million IDC and Taxes.
2. Most of the funding for the project is being provided by the World Bank.
3. Funding for the Afghan portion (Transmission Line and Convertor Station) is fully secured while there is about 20% funding gap in other countries.
4. The gap is expected to be filled due to WB's serious commitment to the project.

CASA 1000: Energy and Tariff

1. Tariff is energy based (US Cents/kWh) on must run basis.
2. Hydrological risk is to be borne by the Sellers, i.e., have to deliver the guaranteed energy or pay LDs.
3. Purchaser will have to pay LDs if it does not off-take the energy
4. The tariff has 3 tiers:
   - P1 for the Min Guaranteed Quantity per annum;
   - P2: for Min Guaranteed Quantity for 5 yr block;
   - P3: for Excess Quantity
5. Total yearly energy committed by the Sellers vary between 4,072 to 4,434 GWh.

CASA 1000: Tariff Components

1. Transmission Charge Based on Actual Bid Cost & Agreed ROI (6%): Estimate: 3 Cents/kWh; Includes:
   - Kyrgyz T/L & Tajik T/L & Convertor Station Costs
   - Afghan T/L cost
   - DC & AC Operators' cost
   - Reserve Fund
   - Tajik Transit fee payable on Kyrgyz energy
2. Energy Charge (Payable to Sellers): 5.15 Cents/kWh
3. Transit Fee {Payable to Afghanistan (1.25 Cents/kWh)}
4. Total tariff is US Cents: 9.3/kWh

CASA 1000: Capacity and Energy

1. CASA-1000 Transmission Line (T/L) to Nowshera would be capable of delivering 1300 MW.
2. 1000 MW is Pakistan's share and 300 MW is Afghanistan's share; however, the Afghan share may be available for Pakistan as Afghanistan may not need the power in near future).
3. Total capacity will be available for Pakistan and Afghanistan will get their share through separate line between Tajikistan and Afghanistan (2017).
4. However Pakistan will be obligated to take only 1000 MW while additional 300 MW will be optional.