



2ND EXPERTS GROUP MEETING
ESTABLISHMENT OF ECO REGIONAL ELECTRICITY MARKET (ECO-REM)

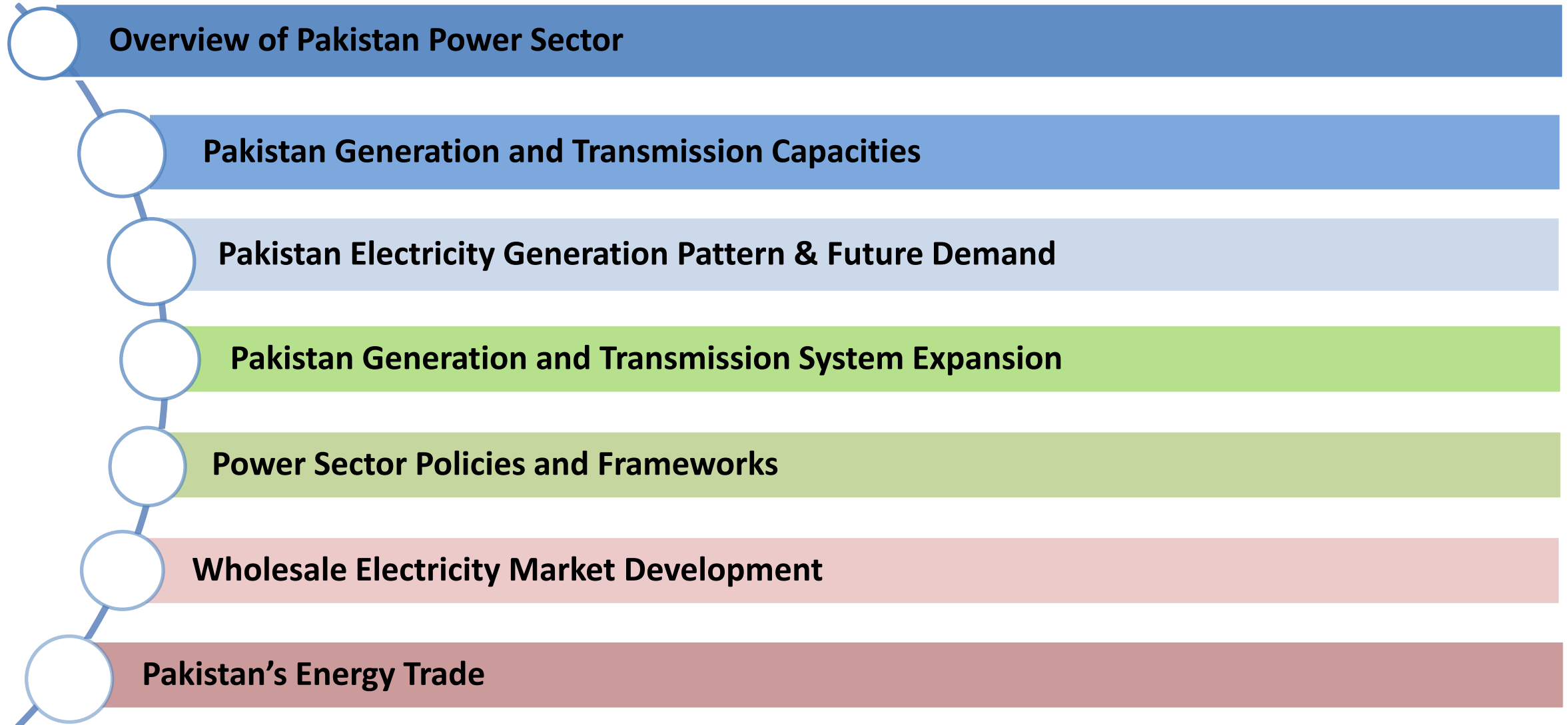
PAKISTAN POWER SECTOR



SHAHZAD ANWAR
Director General (CB)
Private Power & Infrastructure Board
Ministry of Energy (Power Division)
Government of Pakistan

27th November 2024

OUTLINE



PAKISTAN – A LAND OF OPPORTUNITIES

- Population of over 242 million - 5% (~ 12 million) unelectrified
- Target of 100% electricity access by 2030
- Per capita electricity consumption 570 kWh - World average 3,200 kWh
- Projected demand increase 4-5% per year, annual addition of 3,500 MW
- 53% RE share planned by 2034, including hydro
- 25-year history of reliable operations of IPPs
- Consumers encouraged to utilize RE potential by self-generation
- By 2030, CO₂ emissions reduction to 198 gCO₂/kWh from current 356 gCO₂ /kWh – less than average of regional countries and many OECD member countries
- Transmission & distribution network augmentation - AMI and smart grid installations

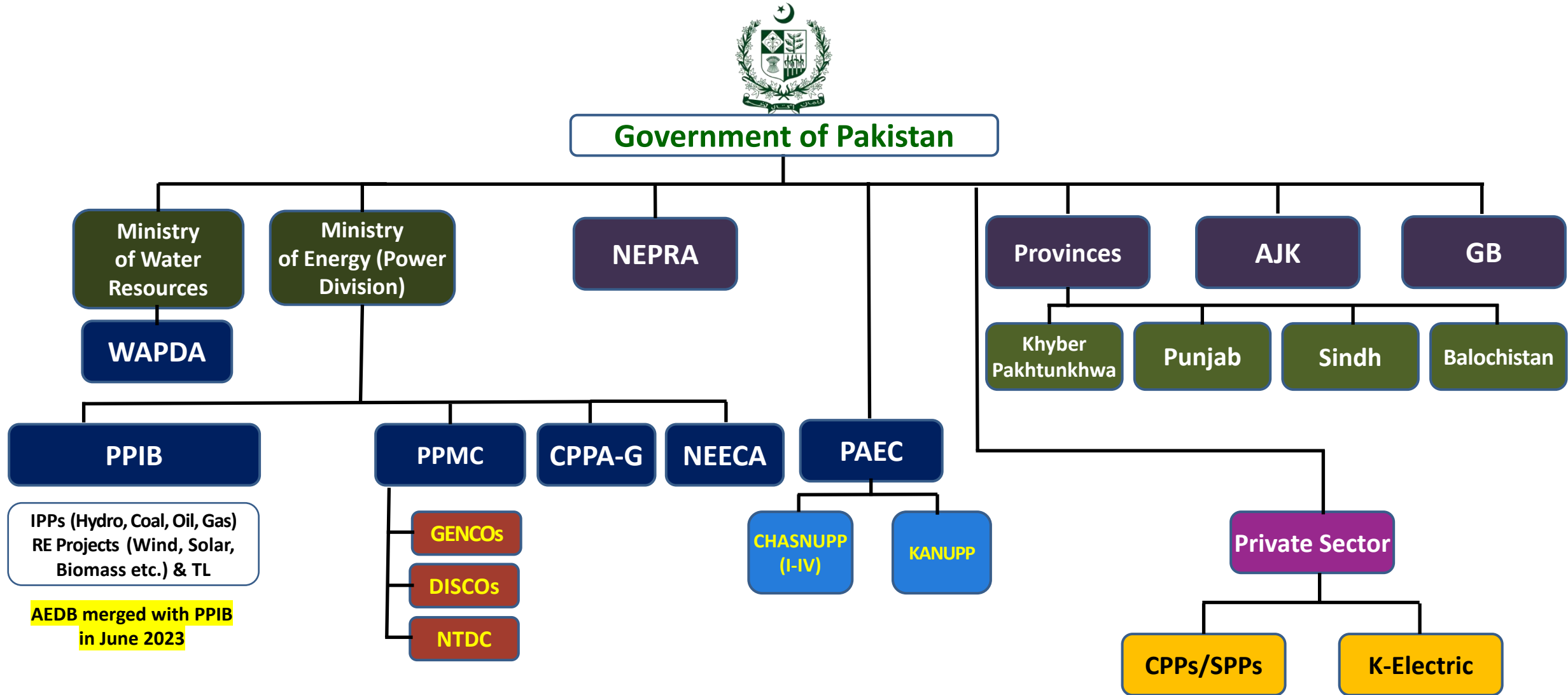


Area:
881,913 km² (340,509 sq. mi)

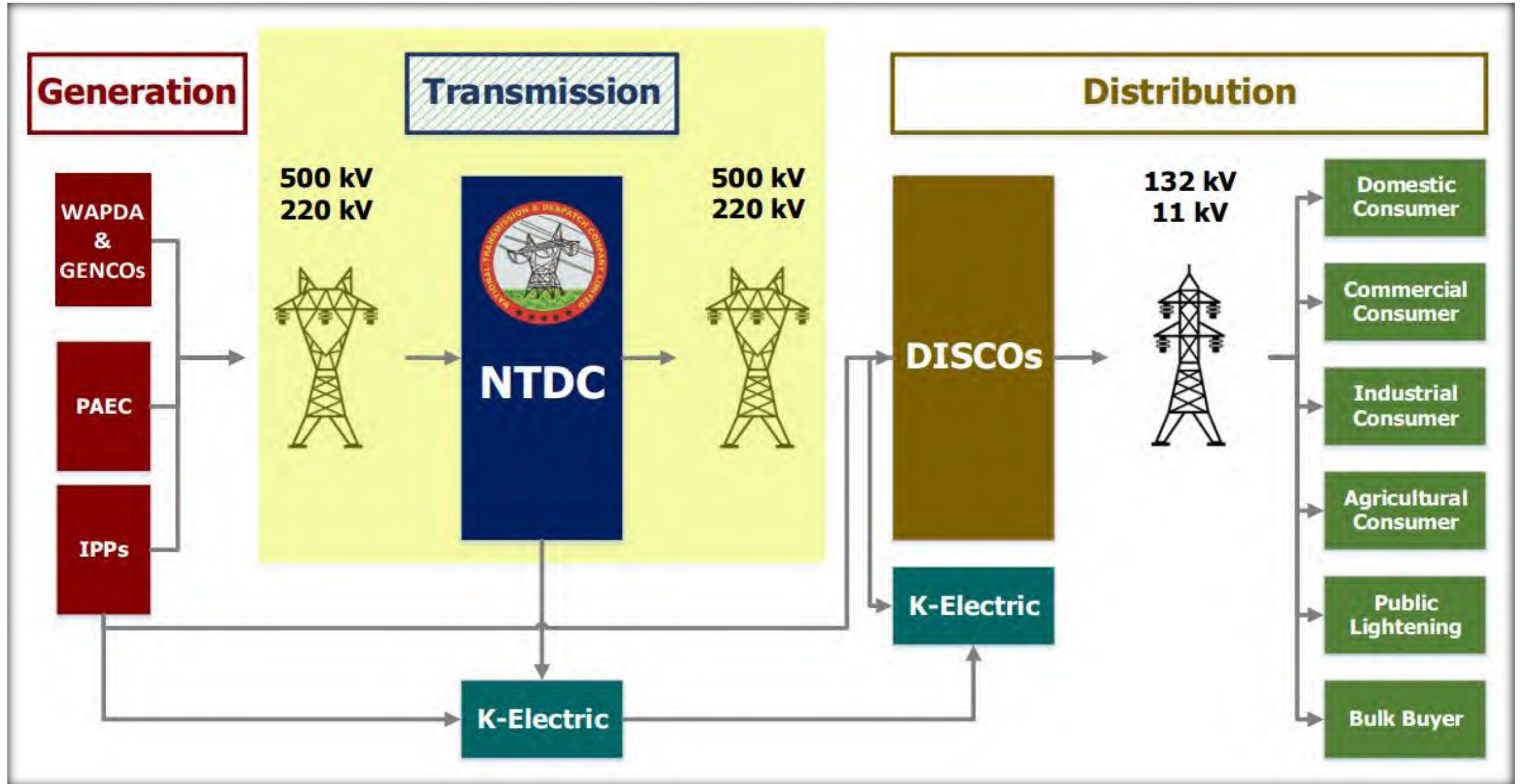
GDP
2024 - \$375 billion
Per Capita Income - \$1,588

Population – 2023 census
241.5 million – (273.8/km²)

OVERVIEW OF PAKISTAN POWER SECTOR – KEY PLAYERS



OVERVIEW OF PAKISTAN POWER SECTOR – STRUCTURE



OVERVIEW OF PAKISTAN POWER SECTOR – GENERATION & TRANSMISSION CAPACITIES

Installed Generation Capacity

Public Sector – MW		Private Sector - MW	
Hydro:	9,491 (22%)	Hydro IPPs:	2,089 (5%)
Thermal:	3,727 (9%)	Thermal IPPs:	18,723 (43%)
Nuclear:	3,530 (8%)	RE:	2,991 (7%)
		KE (Oil/Gas/RE):	2,962 (6%)
Total (Public)	16,748 (39%)	Total (Private)	26,765 (61%)
NTDC System	40,551 MW	K-Electric	2,962 MW

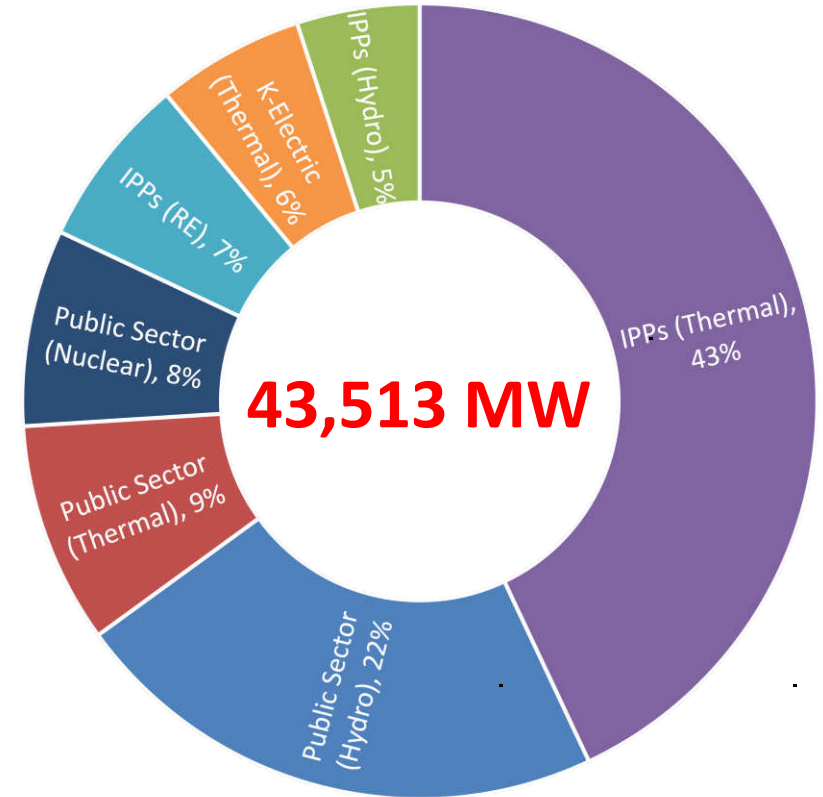
Total Generation Capacity: 43,513 MW

Transmission Capacity – NTDC Network

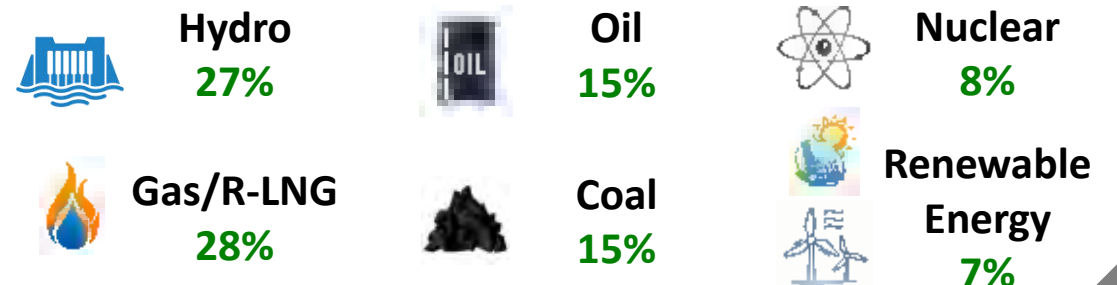
High Voltage AC				High Voltage DC			
Voltage Level	No. of Grid Stations	Length (km)	Capacity (MVA)	Voltage Level	No. of Converter Stations	Length (km)	Capacity (MW)
500 kV	18	9,275	25,950	±660 kV	2	886	4,000
220 kV	51	12,416	39,840				
	69	21,691	65,790		2	886	4,000

Transmission Capacity - K-Electric

1,354km of 220kV, 132kV and 66kV lines - 71 Grid Stations – 7,704 MVA

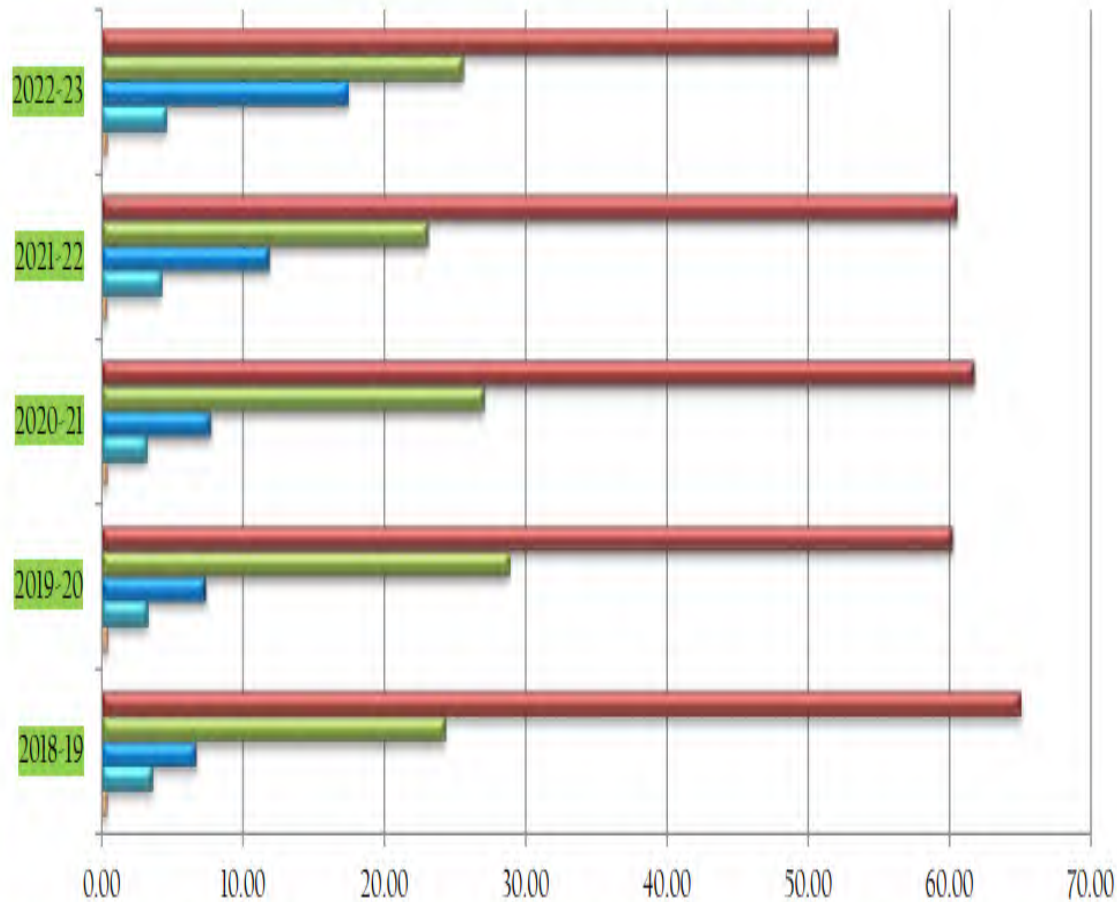


Fuel Mix:



PAKISTAN – ELECTRICITY GENERATION PATTERN

Electricity Generation by Type (%)

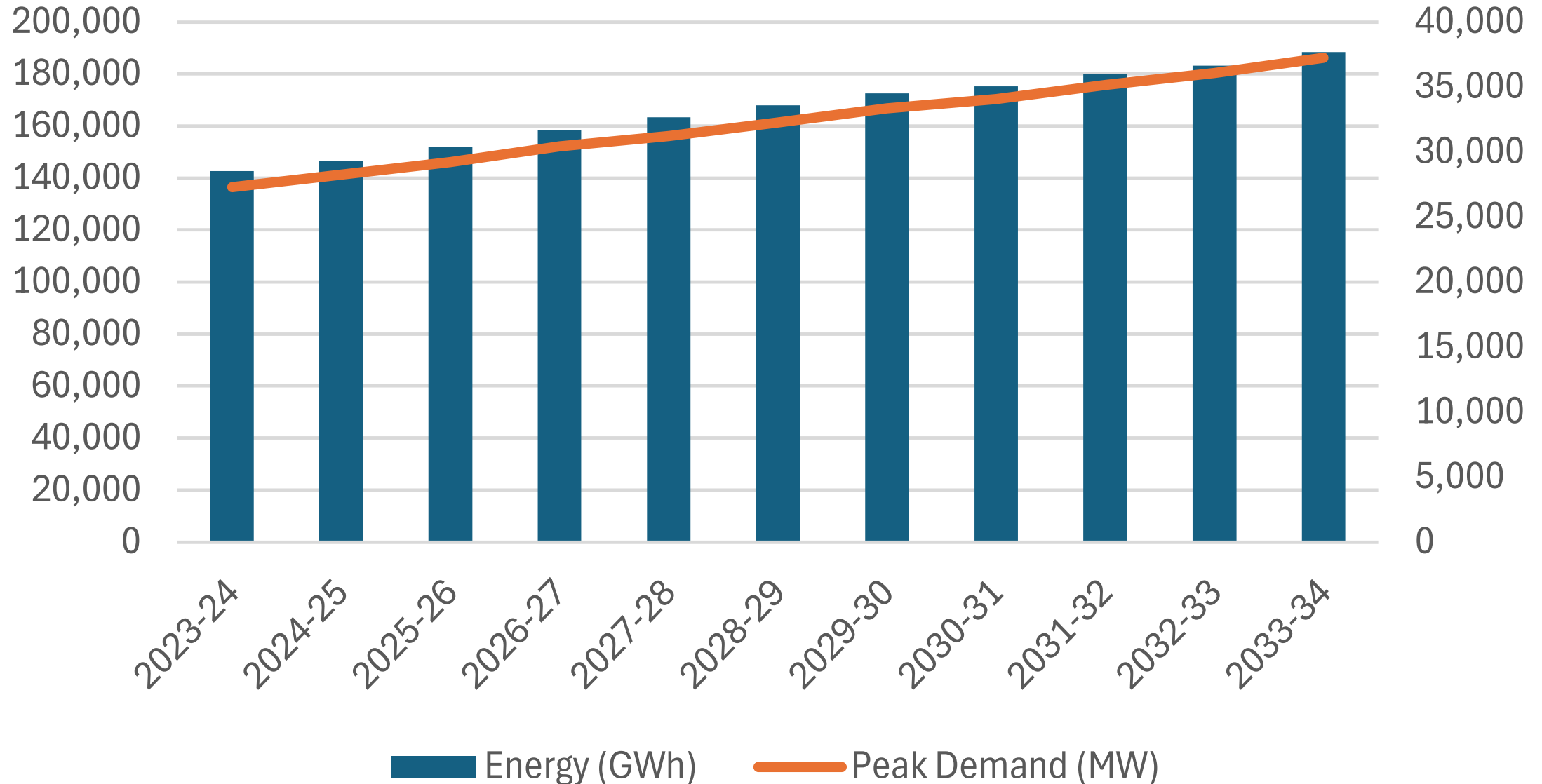


■ % Share (Thermal Electricity Generation)
 ■ % Share (Hydel Electricity Generation)
 ■ % Share (Nuclear Electricity Generation)
■ % Share (RE Electricity Generation)
 ■ % Share (Imported Electricity Generation)

Electricity Generation by Type (GWh) (Net)

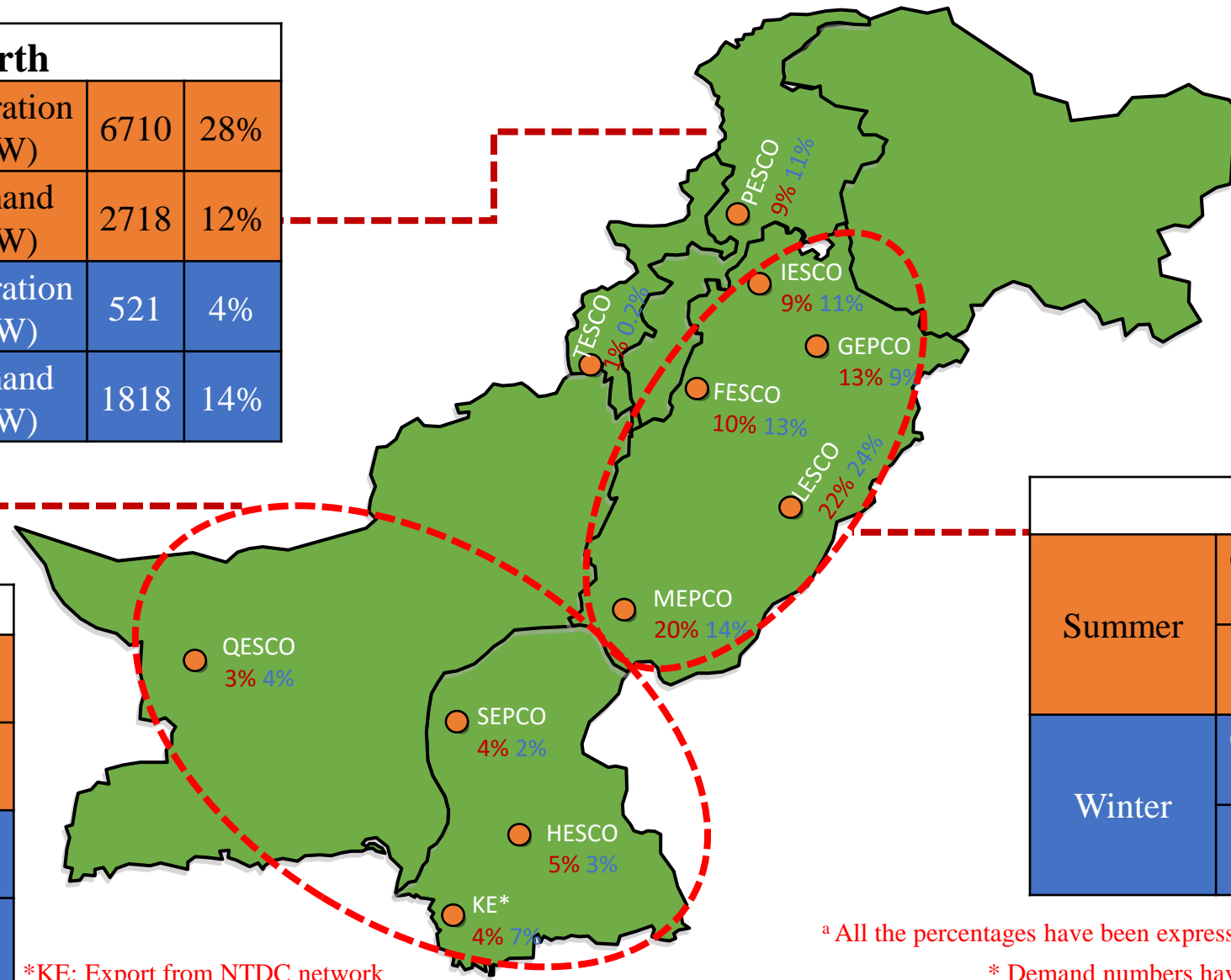
As on 30 th June	2018-19	2019-20	2020-21	2021-22	2022-23
HYDEL					
WAPDA Hydel	31,167.85	37,136.04	36,856.88	32,522.88	30,410.47
IPPs Hydel	1,928.04	1,562.55	1,943.66	3,023.40	4,863.15
Sub-Total	33,095.89	38,698.59	38,800.54	35,546.28	35,273.63
% Share (Hydel Electricity Generation)	24.30	28.83	27.02	23.07	25.56
THERMAL					
GENCOs: CPPA-G System	13,016.93	7,907.85	6,802.93	6,349.56	5,945.94
KE Own	9,928.92	9,628.90	10,185.60	7,889.96	7,093.09
IPPs: CPPA-G System	62,597.73	60,720.31	68,708.63	76,280.90	56,697.83
IPPs Connected with KE	2,118.31	1,863.60	2,184.57	2,130.46	1,606.81
SPPs/CPPs/N-CPPs: CPPA-G System	405.13	170.99	216.80	136.31	150.02
SPPs/CPPs/N-CPPs connected with KE	523.74	534.30	578.90	482.94	406.90
Sub-Total	88,590.76	80,825.95	88,677.43	93,270.13	71,900.59
% Share (Thermal Electricity Generation)	65.04	60.21	61.76	60.54	52.09
NUCLEAR					
CHASNUPP (I, II, III and IV)	9,005.68	9,704.89	9,172.09	9,450.30	9,709.21
KANUPP (I, II and III)	129.99	193.13	1,917.96	8,843.25	14,345.35
Sub-Total	9,135.67	9,898.02	11,090.05	18,293.55	24,054.56
% Share (Nuclear Electricity Generation)	6.71	7.37	7.72	11.87	17.43
IMPORT					
Import from Iran	486.80	513.74	498.37	514.36	478.62
Sub-Total	486.80	513.74	498.37	514.36	478.62
% Share (Imported Electricity Generation)	0.36	0.38	0.35	0.33	0.35
RENEWABLE ENERGY (WIND, SOLAR AND BAGASSE)					
RE Power Plants: CPPA-G System	4,840.59	4,151.91	4,322.13	6,195.64	6,023.28
RE Power Plants connected with KE	56.92	153.28	199.56	236.22	298.19
Sub-Total	4,897.51	4,305.19	4,521.69	6,431.86	6,321.47
% Share (RE Electricity Generation)	3.60	3.21	3.15	4.18	4.58
Total Electricity Generation of the Country	136,206.63	134,241.49	143,588.08	154,056.18	138,028.87

PAKISTAN DEMAND FORECAST – IGCEP 2024-34



ELECTRICITY SUPPLY AND DEMAND – GEOGRAPHICAL CHALLENGE

North			
Summer	Generation (MW)	6710	28%
	Demand (MW)	2718	12%
Winter	Generation (MW)	521	4%
	Demand (MW)	1818	14%



South			
Summer	Generation (MW)	7599	32%
	Demand (MW)	3952	16%
Winter	Generation (MW)	7110	54%
	Demand (MW)	2372	18%

Centre			
Summer	Generation (MW)	9311	40%
	Demand (MW)	16950	72%
Winter	Generation (MW)	5609	42%
	Demand (MW)	9050	68%

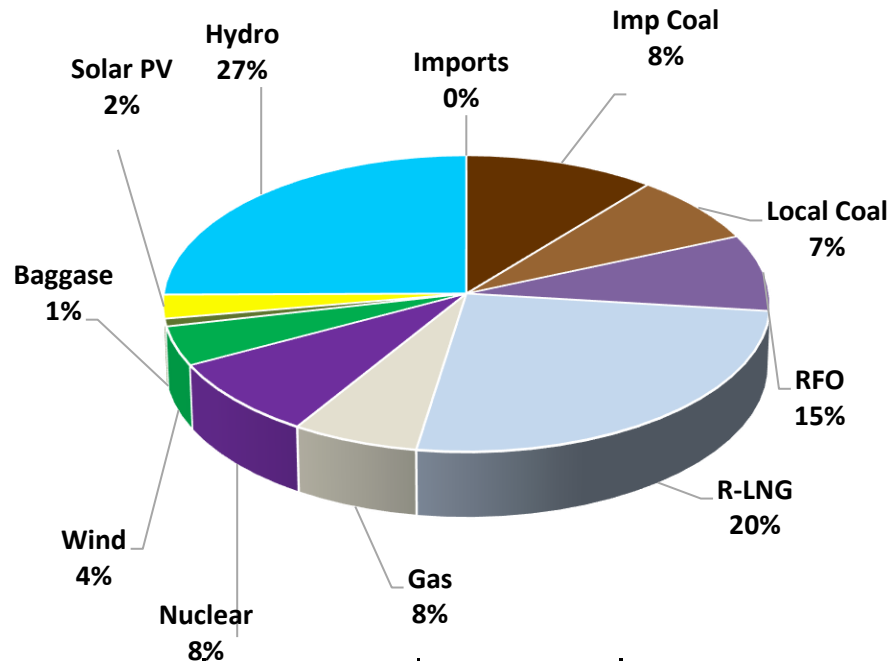
*KE: Export from NTDC network

^a All the percentages have been expressed as percentage of National Total

* Demand numbers have been computed on served basis.

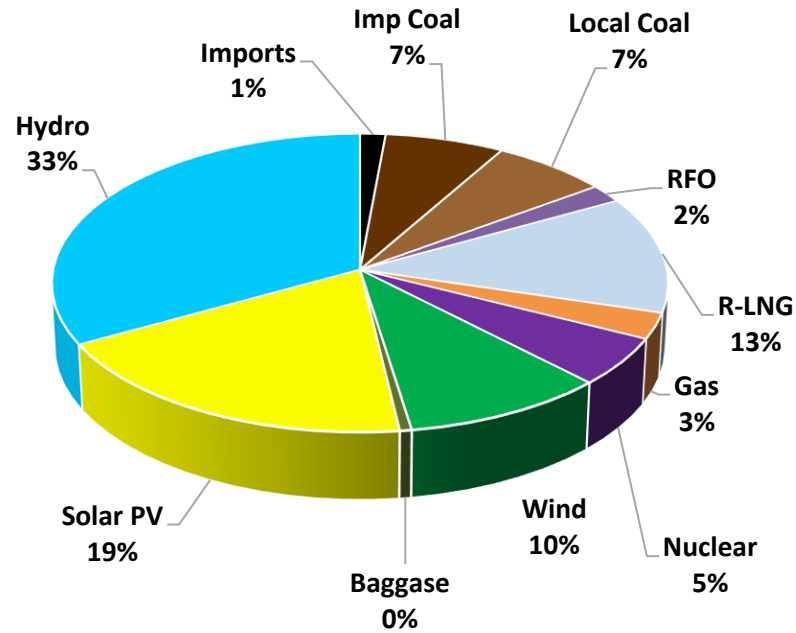
TRANSITION TO CLEAN, GREEN AND SUSTAINABLE ENERGY

2024



Total Installed Capacity **44 GW**
Total RE **31%**

2034



Total Installed Capacity **56 GW**
Total RE **53%**

Fuel	2024	2034
Hydro	27%	38%
Solar PV	2%	10%
Wind	4%	3%
Baggasse	1%	2%
RFO	15%	2%
R-LNG	20%	15%
Gas	8%	5%
Nuclear	8%	8%
Local Coal	7%	6%
Imported Coal	8%	9%
Cross Border	0%	2%

PAKISTAN ESTIMATED RENEWABLE ENERGY POTENTIAL



Solar: 2,900 GW



Wind: 132 GW



Hydro: 64 GW



Biomass: 2 GW



Waste-to-Energy: 0.4 GW



NTDC TRANSMISSION NETWORK EXPANSION

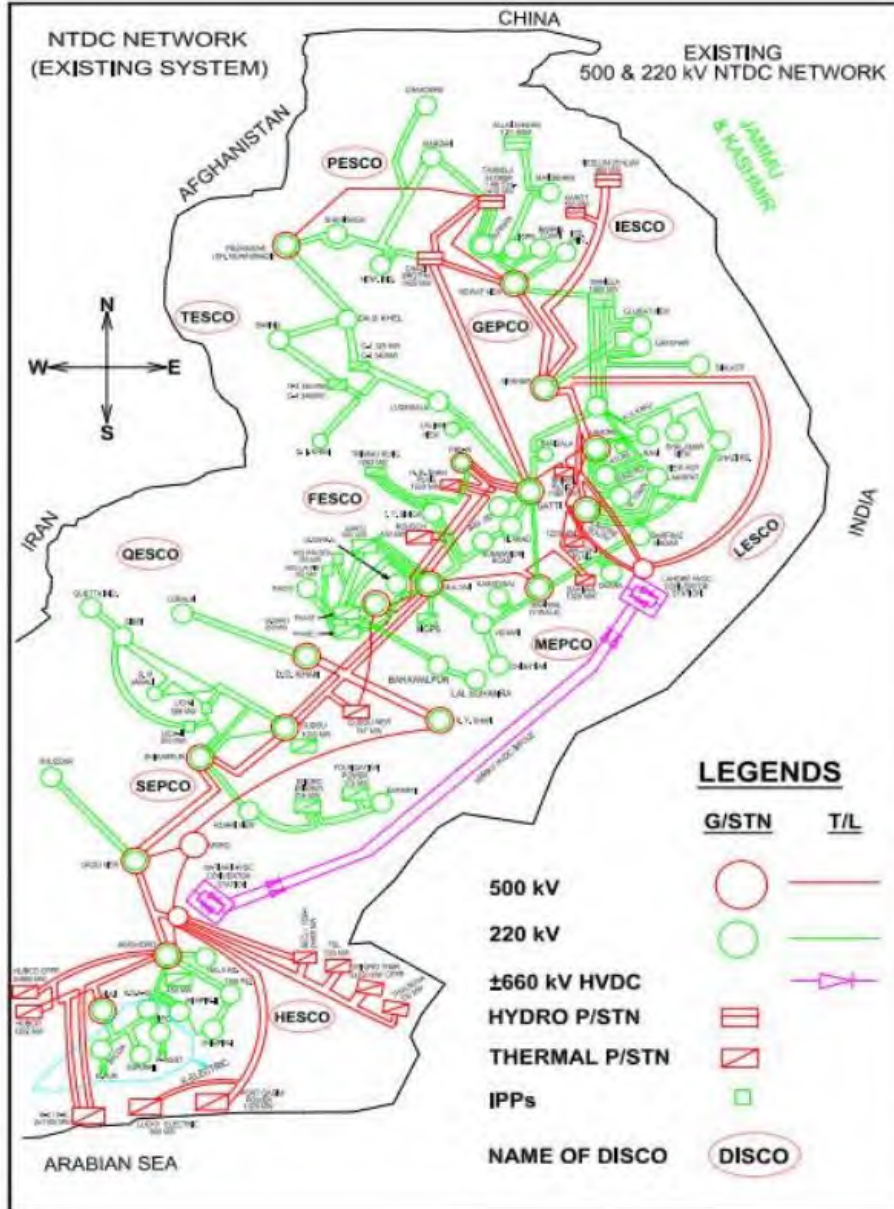
Year	765 kV			500 kV			220 kV			±660 kV	±500 kV
	No. of G/S	T/F Capacity (MVA)	T/L (Length) km	No. of G/S	500/220 kV T/F Capacity (MVA)	T/L (Length) km	No. of G/S	220/132 kV T/F Capacity (MVA)	T/L (Length) km	T/L (Length) km	T/L (Length) km
Existing April 24	-	-	-	18	25,950	9,275	51	39,840	12,416	2 x 886	-
Planned 2026-27	3	9,600	2,152	28	48,550	14,683	67	56,470	15,088	2 x 886	2 x 113

Additionally, other entities own and operate the following transmission capacities as part of the NTDC integrated system:

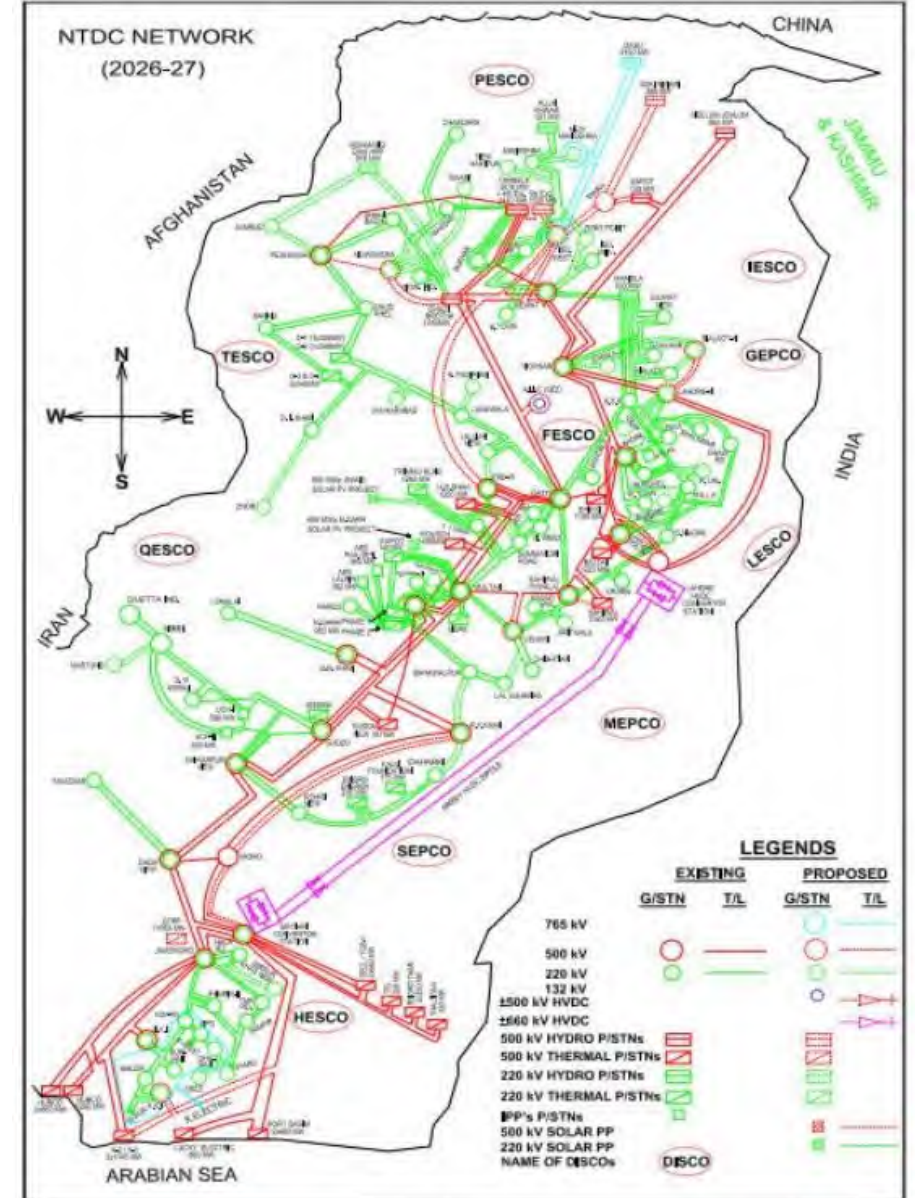
- 500 kV Tarbela and Ghazi Brotha HPPs with capacities of 1,350 MVA and 1,200 MVA respectively.
- 220 kV Mangla, KAPCO, and Bahria Town with capacities of 414 MVA, 500 MVA, and 63 MVA respectively.

NTDC NETWORK EXPANSION 2024-2027 (Based on TSEP 2024 - 2034)

Existing NTDC Network 2024



Planned NTDC Network 2026-27



POWER SECTOR POLICIES / FRAMEWORKS

- **National Electricity Policy 2021**
- **National Electricity Plan 2023-27**
- **Alternative & Renewable Energy Policy 2019**
- **Power Generation Policy 2015**
- **Policy Framework for Private Sector Transmission Line Projects 2015**

NATIONAL ELECTRICITY POLICY

Universal access to electricity and self-sustainable power sector

- Optimal utilization of indigenous resources
- Integrated planning approach
- Efficient, dynamic and competitive market design
- Affordable and environment friendly outcome for consumers



Goals for Power Sector

- Access to Affordable Energy
- Energy Security
- Sustainability

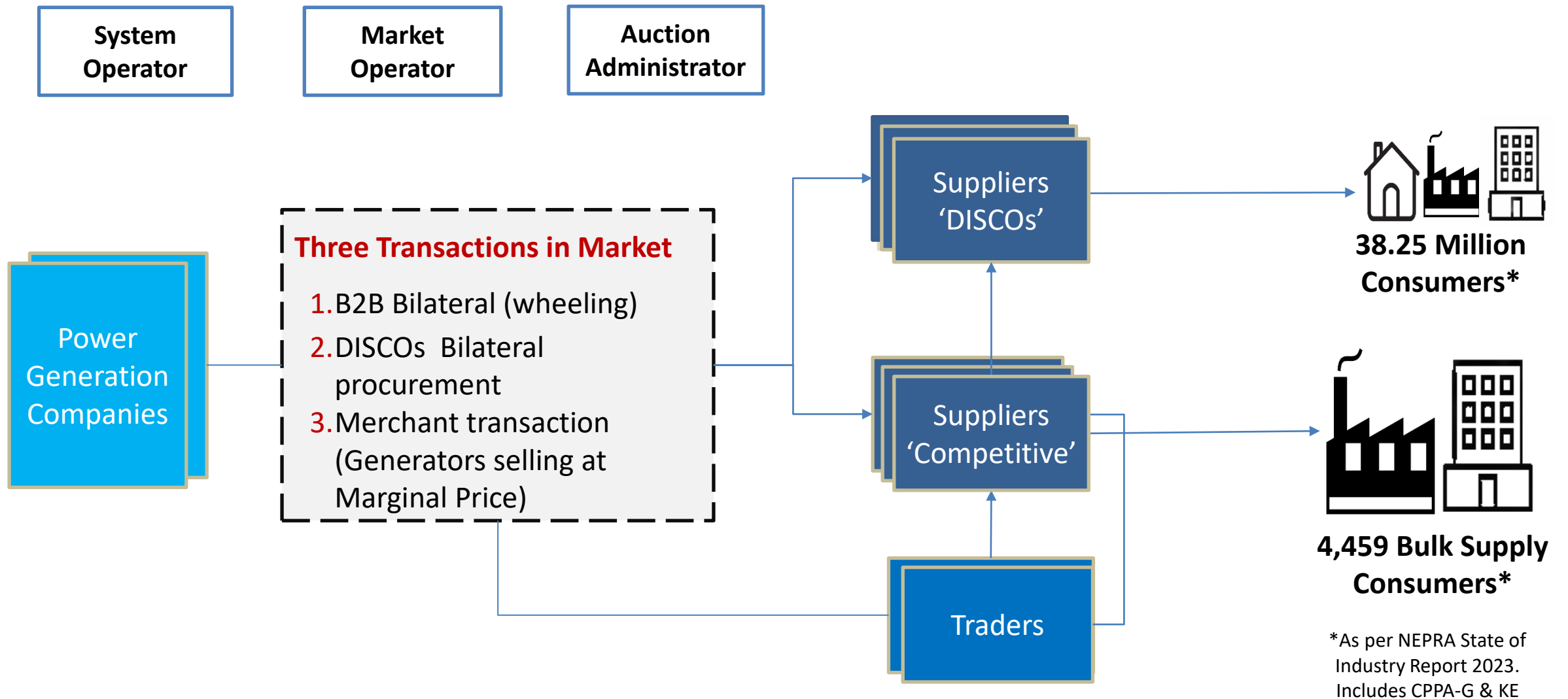
National Electricity Plan developed and Sectoral Policy Frameworks are being developed based on these guiding principles

NATIONAL ELECTRICITY PLAN 2023-27

- Provide guidelines, implementation mechanisms and tools for the realization of the National Electricity Policy goals
- Entails inclusion of high-level tasks, timelines and responsibilities of respective entities to meet policy directives
- Presents a five-year plan with fifteen years' perspective
- Shall inform the subservient policy frameworks, guidelines, roadmaps and business plans on a rolling basis.



COMPETITIVE WHOLESALE MARKET DESIGN



COMPETITIVE TRADING BILATERAL CONTRACT MARKET (CTBCM)

Concept

- CTBCM is new market mechanism to buy and sell electricity with a limited role from the government.
- Power generators will be able to sell electricity directly to the consumers.

Benefits:

- Increased competition among suppliers, resulting in lower electricity prices
- Flexible negotiable terms & more choices for consumers
- More investment opportunities

CTBCM – Main Entities

1. Ministry of Energy (Power Division)

2. Regulator – NEPRA

3. Service Providers

Provide non-discriminatory services to all Market

Participants, but do not buy or sell electricity in market

- Market Operator
- System Operator
- Transmission Service Provider / Transmission Network Owners (TNOs)
- Metering Services Providers
- Planners
- Distribution Network Services Providers
- Independent Auction Administrator

4. Market Participants

Entities that buy and/or sell electricity in the market

- Generators
- Captive Generators
- Suppliers
- Traders
- Bulk Power Consumers

CPPA-G

For Legacy Contracts

PAKISTAN'S ENERGY TRADE WITH REGIONAL COUNTRIES

Pakistan Transmission System Expansion Plan (TSEP) 2024-34

▪ CASA-1000 Project

NTDC will be having a 1000 MW HVDC interconnection with Tajikistan which is expected to be commissioned by August 2027.

- HVDC Bi-pole Line from Tajikistan to Nowshera Azakhel (CASA-1000)
- ± 500 kV DC - 113 km
- HVDC Converter Station at Nowshera (Azakhel) - Expected Completion: February-2025

▪ Import from Iran

- 70-100 MW through existing 132 kV T/Line from Jackigoor (Iran) to Mand (Gwadar)
- 100 MW from Polan (Iran) – Jiwani (Pakistan)
- The interim 132 kV supply link has been completed from Pak-Iran border (Gabd) to Gwadar-Jiwani T/Line. The permanent 220 kV supply link shall be completed in 2027-28.

PAKISTAN'S ENERGY TRADE WITH REGIONAL COUNTRIES

- Efforts underway for gradually shifting to cheaper indigenous resources with high preference to renewable energy sources.
- Mechanism of energy pricing for cross-border electricity trading is particularly important in case Pakistan to export electricity based on existing energy mix to its neighbouring countries such as Afghanistan.
- Draft report - Regional road map on power system connectivity:
 - Zonal division of ECO REM - Pakistan is in Eastern Zone along with Afghanistan, based on geographical positioning.
 - An Electricity Trading Centre in Pakistan would be established to handle trading transactions (technical and economic) between Pakistan and Afghanistan and with other zones.
- Under given circumstances, keeping in view huge infrastructural investment requirements and security situation in Afghanistan, other than trading on bilateral basis, the Eastern zone would have limitations, in achieving the optimum benefits from the interconnectivity initiative.

PAKISTAN'S ENERGY TRADE WITH REGIONAL COUNTRIES

- **Security and Sustainability of Electricity Supply – If these are included in Plans but there are supply constraints.**
- **Economical to reach the consumer. Tariff.**
- **Timely implementation – Supply and Demand scenarios changes especially with current induction of large scale Solar PV.**
 - **Pakistan has surplus electricity now but it was electricity-scarce when CASA was initially envisaged.**
- **Framework for Regional Electricity Trade.**
- **Security Package.**



Thank You!