Pakistan Renewable Energy Potential

Muhammad Basit Ghauri
Sr. Program Associate,
Renewables First

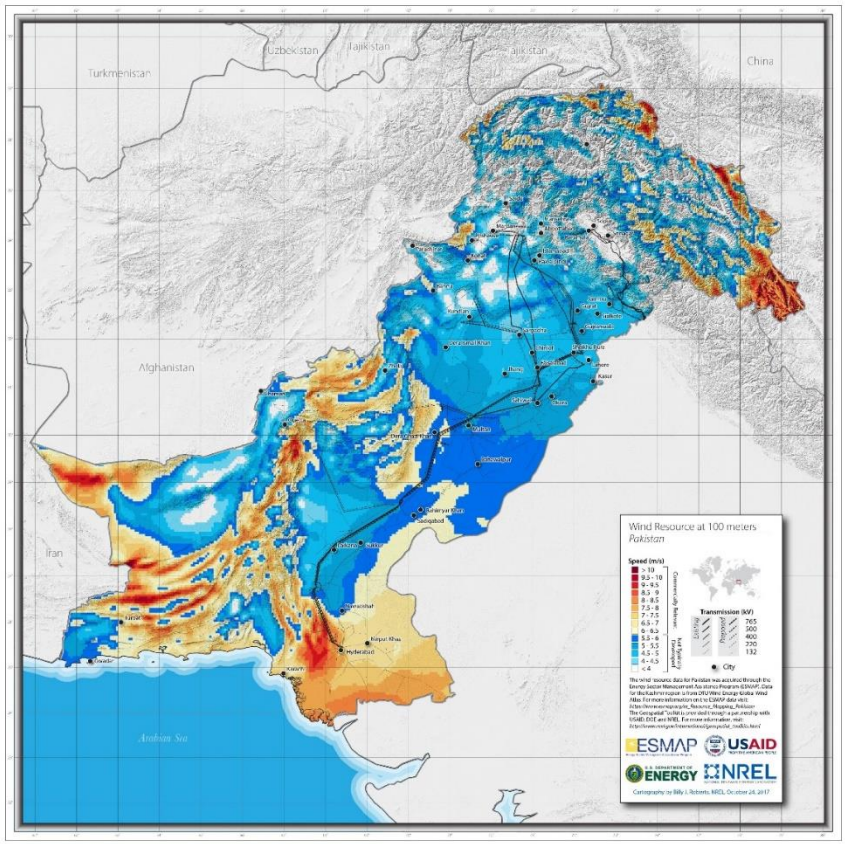
RENEWABLES FIRST

CONTENTS

RESOURCE POTENTIAL - WIND

Pakistan has huge potential of 346 GW Wind power projects, mainly in the southern region of Baluchistan and Sindh.

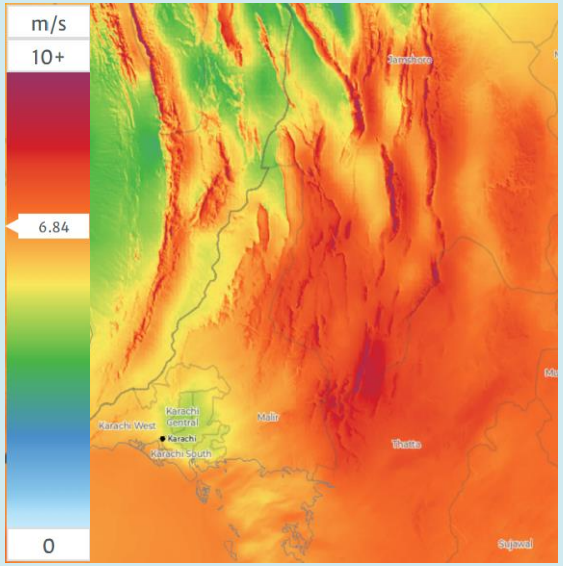
- Potential sites in Baluchistan remain untapped due to lack of grid infrastructure, and large distance from load centers.



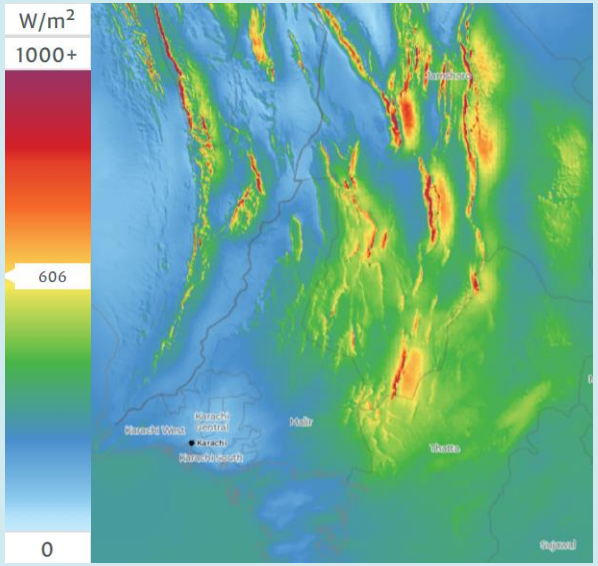
Jhimpir Gharo Wind Corridor

- Landmark corridor housing all wind farms installed to date.
- Potential of up to 40 to 60 GW
- The capacity factor for IEC-II type (for windier sites up to 8.5 m/s) wind power plants reach as high as 60%.

Wind Speed



Wind Density



Source: Global Wind Atlas

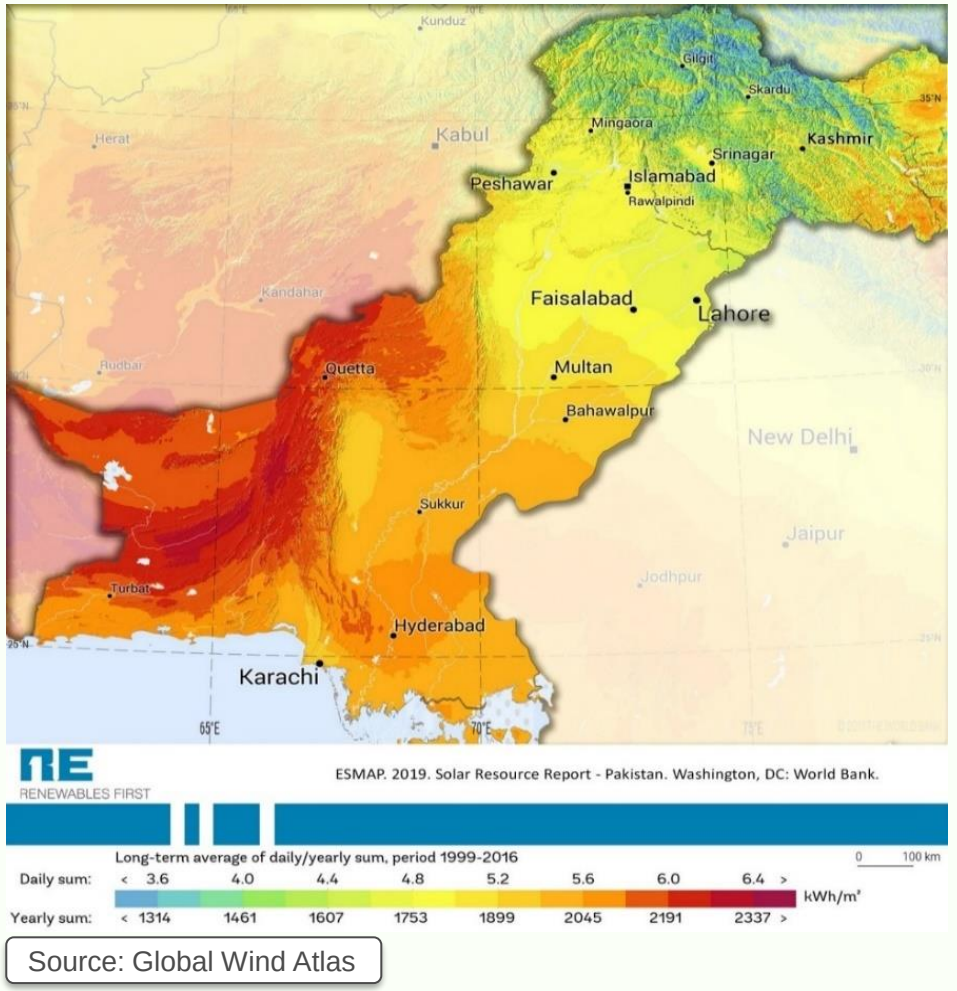
RESOURCE POTENTIAL - SOLAR

Pakistan is among the countries with long-term daily PVOUT averages exceeding 4.5 kWh/kWp.

- South western region of Balochistan offer the best sites for PV based generation.
- Except few area up north, the country shows tremendous potential for solar PV generation.
- Terrain shading in the mountainous regions up North reduce PV output significantly by 20% or more.

		Pakistan (Range)	Pakistan Average	Australia*	Spain*	Greece*
Specific PV power output	PVOUT (kWh/kWp)	3.32 - 5.55	4.67	4.95	4.35	4.11
Direct Normal Irradiation	DNI (kWh/m2)	2.44 - 6.94	4.63	6.83	5.11	4.40
Global Horizontal Irradiation	GHI (kWh/m2)	3.62 - 6.22	5.34	5.76	4.58	4.45

Countries with highest solar energy penetration (IEA 2021)



Source: Global Wind Atlas

INSIGHTFUL DISCOVERIES

Pakistan has huge solar resource potential: According to a recent World Bank study, utilizing just 0.071 percent of the country's area for solar PV would meet Pakistan's current electricity demand!

Source: World Bank

compared to a total installed capacity of 40,532 MW. **By utilizing only 14% of the total wind power generation potential, wind energy has the capability to replace the country's entire power capacity.**[6] Assuming an average wind power

Source: Renewables First

Reality: Wind farms have a smaller land footprint than thermal power plants when considering the overall impact

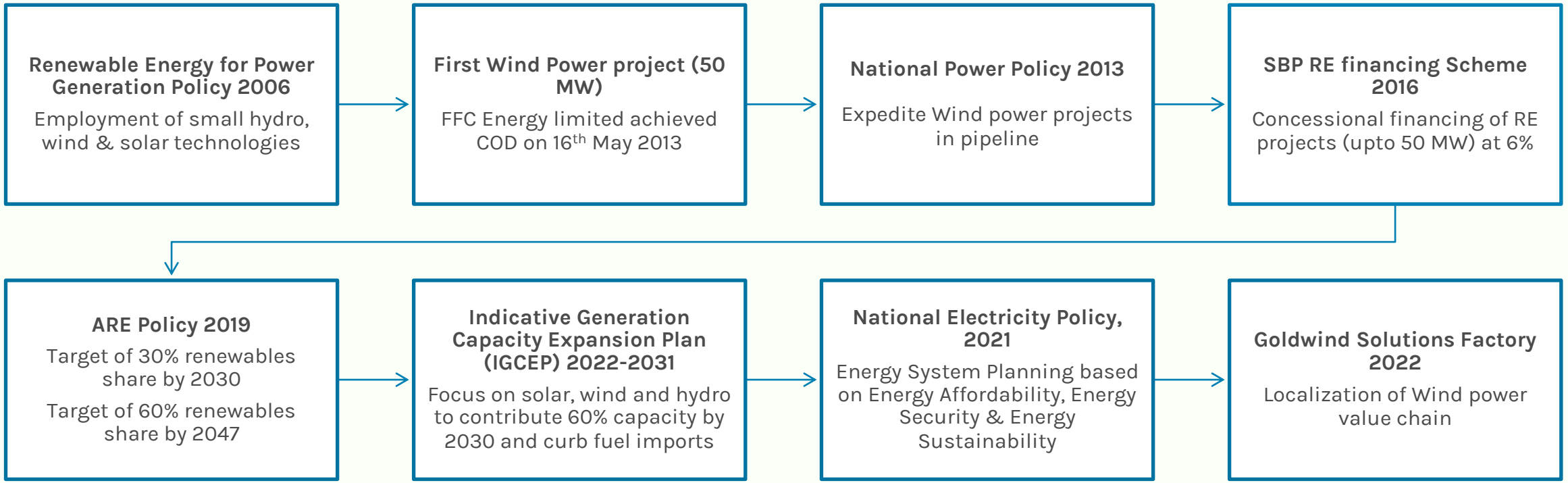
Source: Renewables First

consultants from Tractebel (previously Lahmeyer), the study (available via this feature story) determined that increasing solar and wind capacity to at least 30% of total installed capacity by 2030 would represent a "least-cost" expansion scenario, resulting in fuel savings equal to $5 billion over 20 years, increased energy security, and reduced greenhouse gas emissions. This will require

Source: Lahmeyer

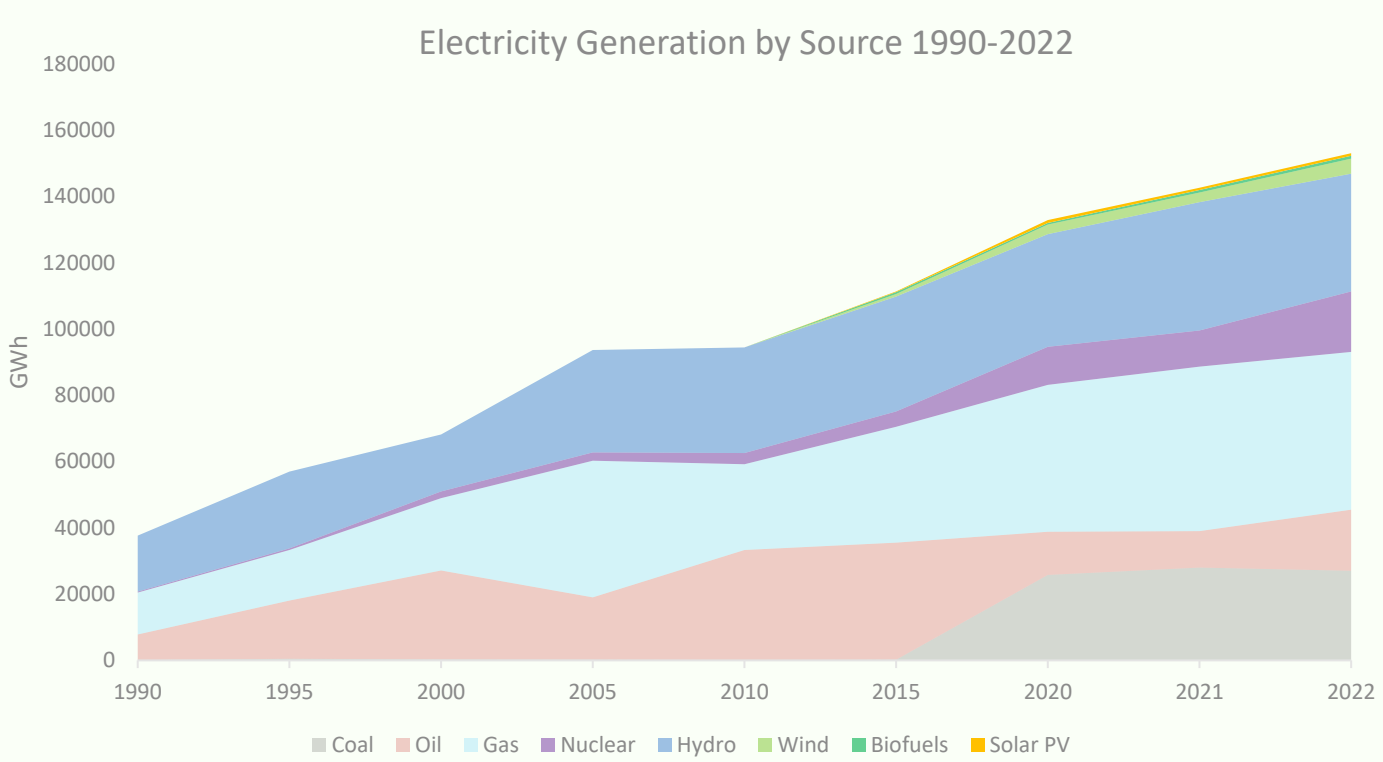
EVOLUTION OF RENEWABLE ENERGY SECTOR

The initial focus on policy incentives and financing schemes is now shifting towards building a local value chain

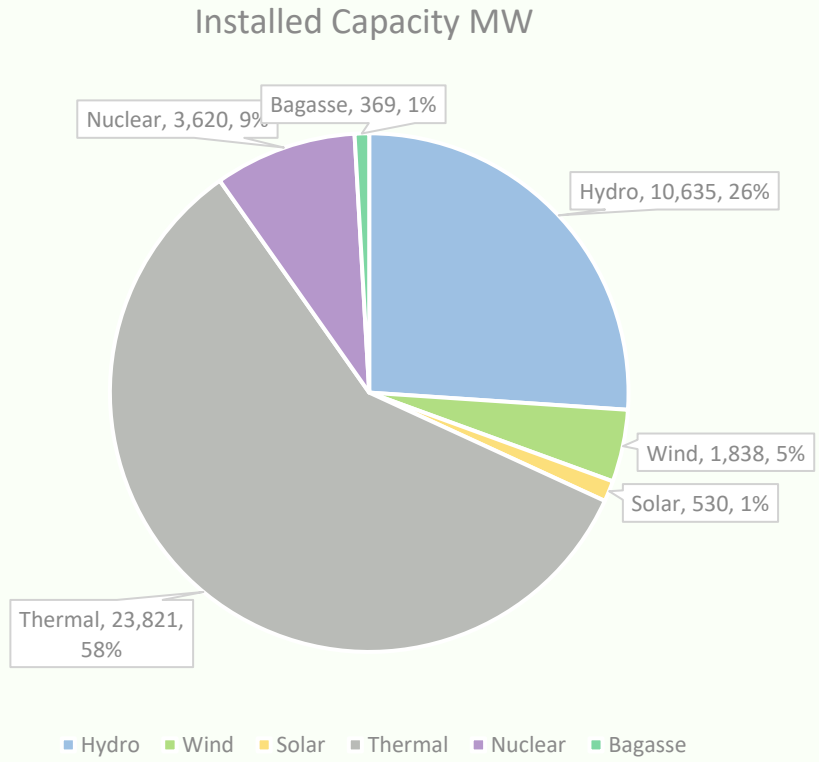


POWER MARKET - OVERVIEW

Total Installed Capacity 41,000 MW	GDP growth 6% (2%)	Peak demand in Summer 2,8000 MW	Average consumer tariff 12-14 cents/kwh	Growth in electricity demand ~ 9%	Peak Shortfall in electricity ~ 3,000 to 4,000 MW



Source: IEA, NEPRA



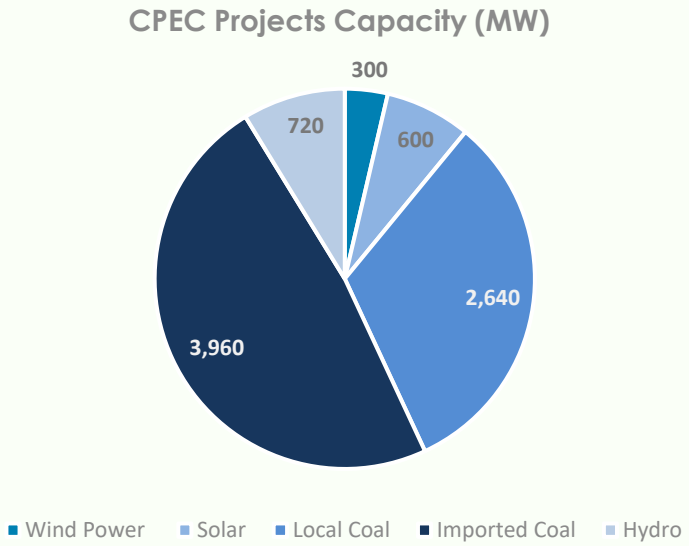
Source: NEPRA, NTDC

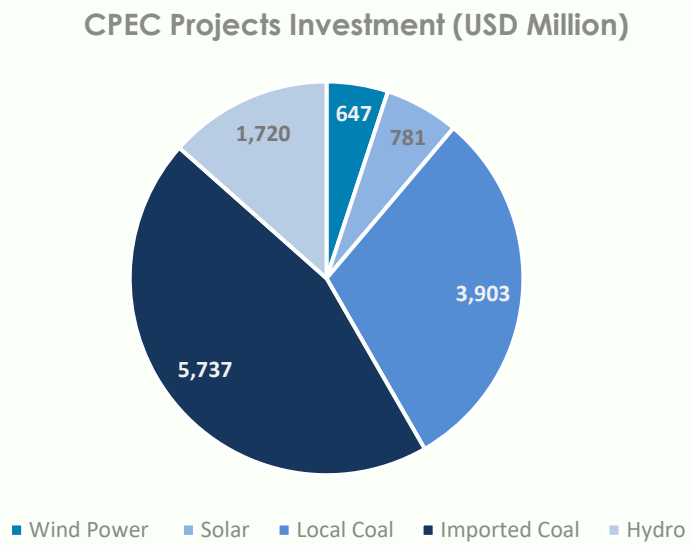
China remains one of the major and vital player in power market of Pakistan

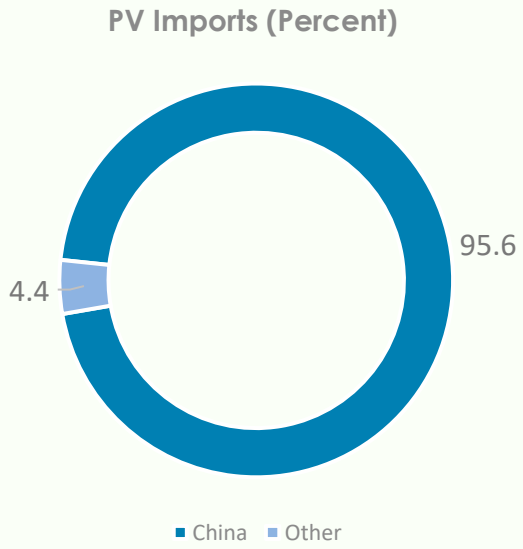
Chinese investment in Pakistan's power sector has significantly increased, reaching $21 billion under the China-Pakistan Economic Corridor (CPEC) initiative. This investment has led to the addition of several projects, with a combined capacity of 8220 MW, to the grid. Currently, there are five projects, worth $6 billion with a combined capacity of 4328 MW, that are still under development.

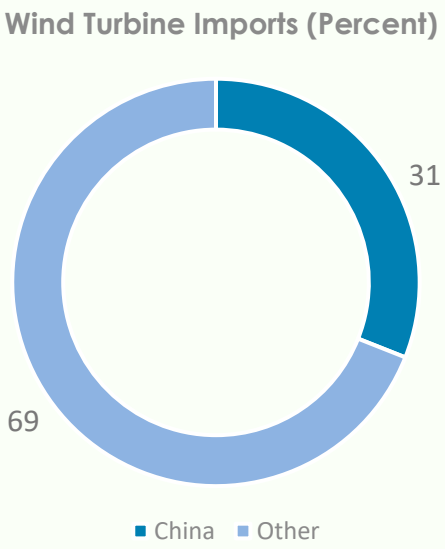
It is worth noting that almost all the coal power projects in Pakistan are sponsored by China, accounting for 80.3% of the total capacity under the CPEC portfolio. **While China is a leader in renewable energy deployment, with over 30% global deployment in solar and wind energy,** its reliance on coal is a concern, especially considering that it is responsible for about half of the world's coal production and consumption.

Nevertheless, China has shown commitment to transition away from fossil fuels. President Xi has reiterated this commitment by announcing a coal moratorium.



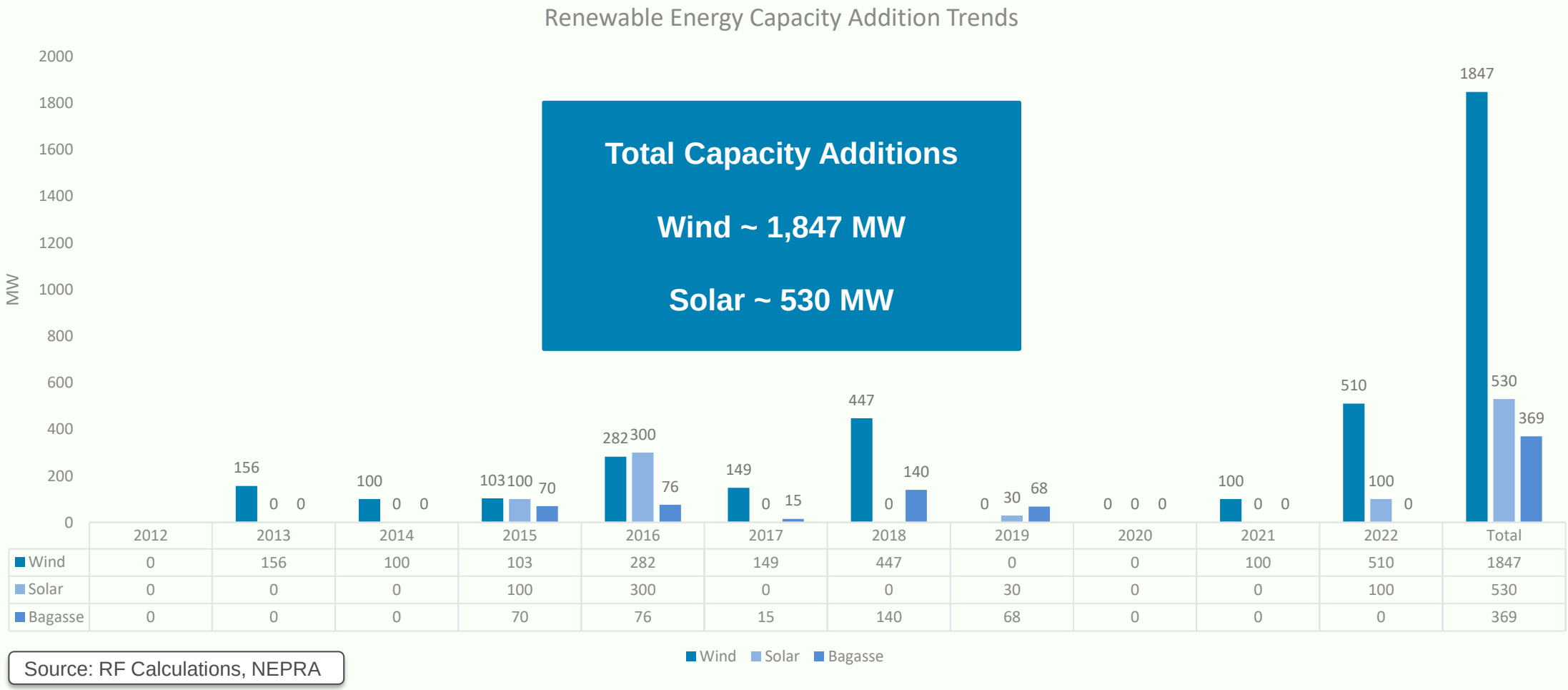






TRENDS AND CURRENT STATUS

Surplus capacity and delays pertaining to Covid subdued wind development from 2019 to 2021



	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Total
Wind	0	156	100	103	282	149	447	0	0	100	510	1847
Solar	0	0	0	100	300	0	0	30	0	0	100	530
Bagasse	0	0	0	70	76	15	140	68	0	0	0	369

Source: RF Calculations, NEPRA

CAPACITY EXPANSION FORECAST

IGCEP 2022-2031 guides rigorous expansion of renewables, with more focus on solar power.

All capacity additions will be done according to the issued Indicative Generation Capacity Expansion Plan (IGCEP) and updated annually.

TECHNOLOGY	INSTALLED CAPACITY BY 2030 IGCEP 2021-2030	INSTALLED CAPACITY BY 2031 IGCEP 2022-2031
Target	30% RE share by 2030	60% RE share by 2031
SOLAR PV	7,932 MW	13,670 MW
WIND	5,005 MW	6,868 MW
BAGASSE	748.6 MW	394 MW
HYDRO POWER PROJECT	23,653 MW	22,560 MW

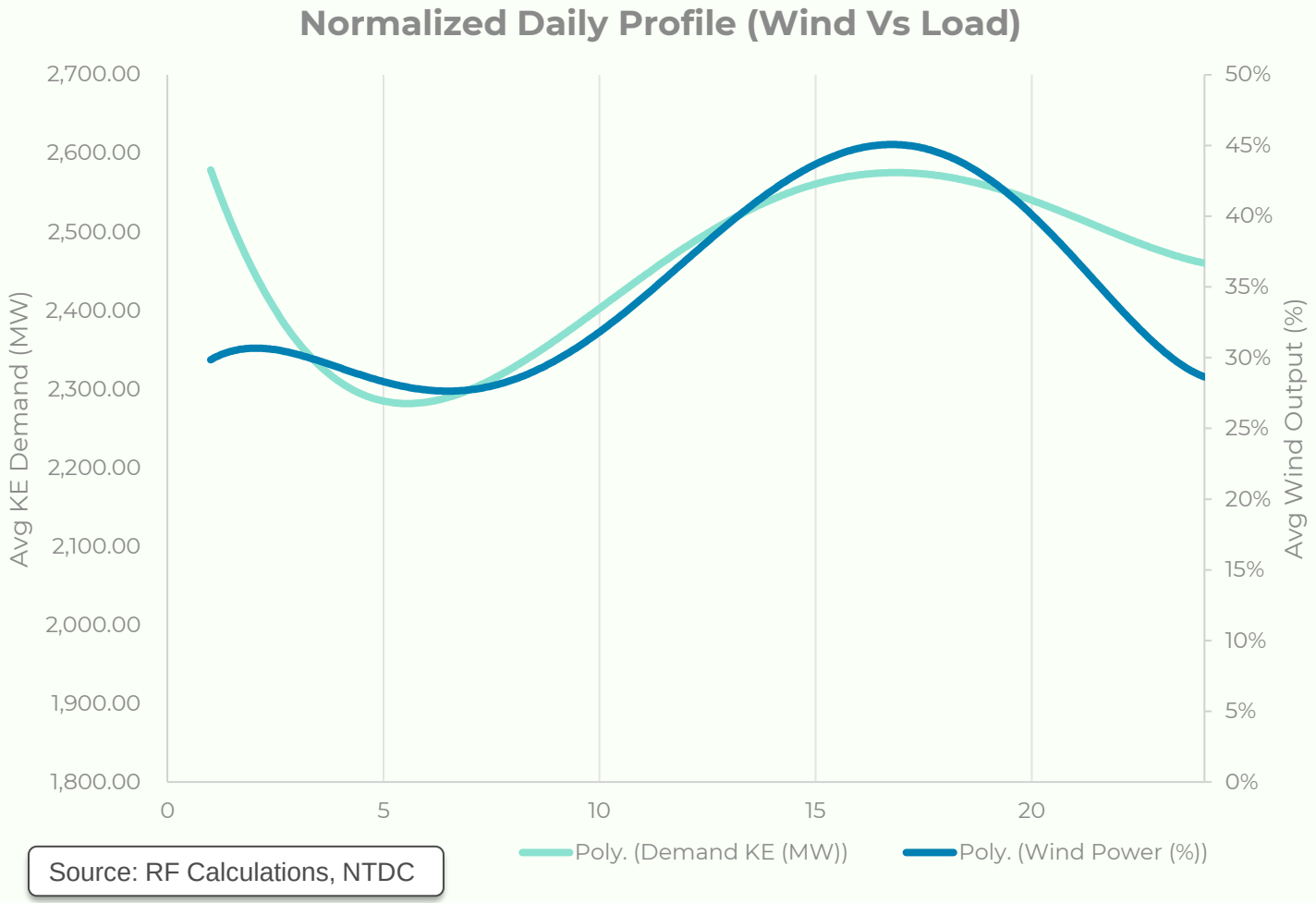
Source: IGCEP, NTDC

A 4,320 MW of Solar addition is also planned through net-metering with 480 MW annual additions.

WIND VS LOAD COMPLEMENTARITY

Wind Profile of the Jhimpir Gharo corridor is synchronous to nearby metropolitan's (Karachi) load demand.

- Excess capacity remains one of the critical factors impacting the power sector.
- 40,813 MW is currently installed against peak summer load requirement of 28,253 MW
- Wind profile peaking in the evening, also complements the solar resources profile peaking in the morning.

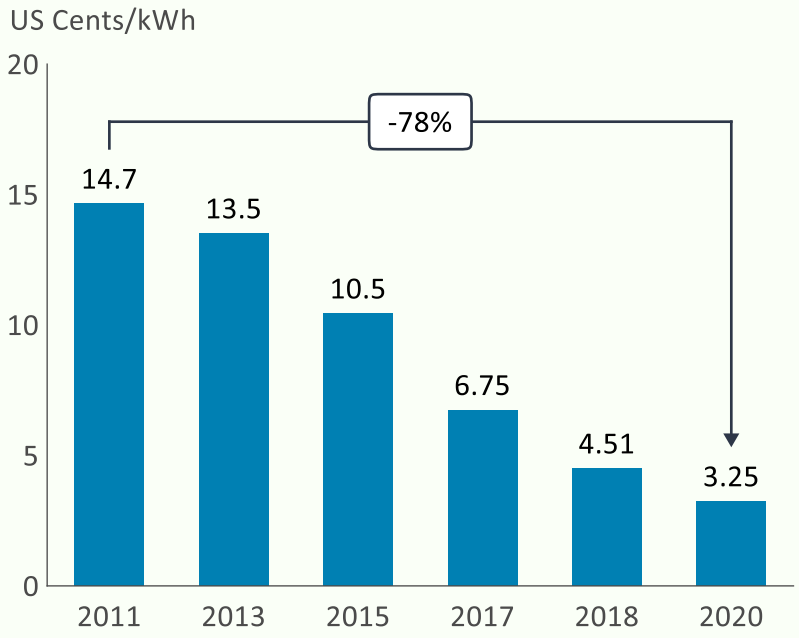


Source: RF Calculations, NTDC

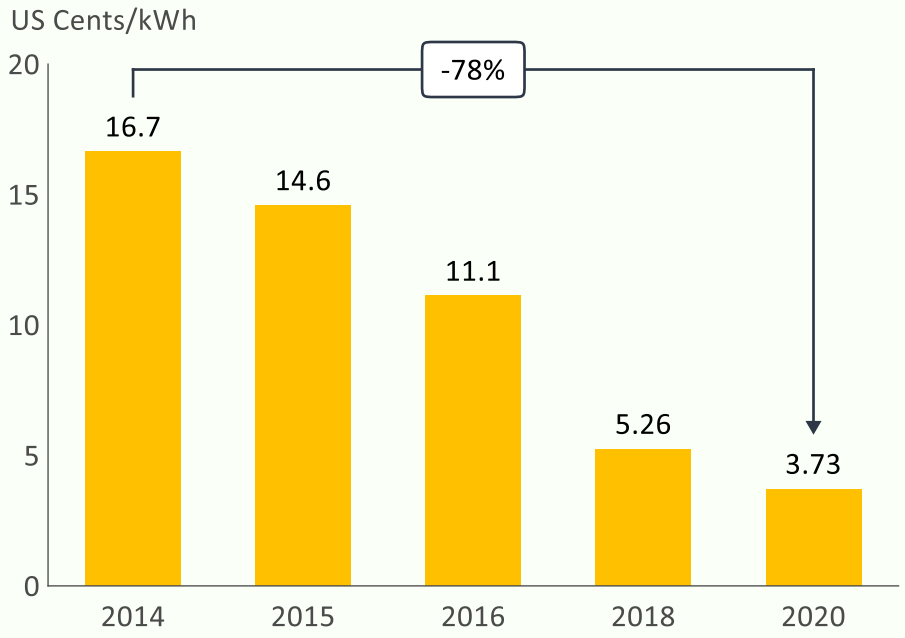
COST AND TARIFF TRENDS

Pakistan has experienced 78% cost reduction in RE in less than a decade

LEVELIZED TARIFF TREND FOR WIND ENERGY



LEVELIZED TARIFF TREND FOR SOLAR PV



Wind

- 78% reduction in levelized tariff for wind power projects in less than a decade
- 60% contraction in EPC costs over the same period
- The difference in levelized tariff and EPC costs reductions may be attributed to declining cost of finance, market maturity and lower return on investment

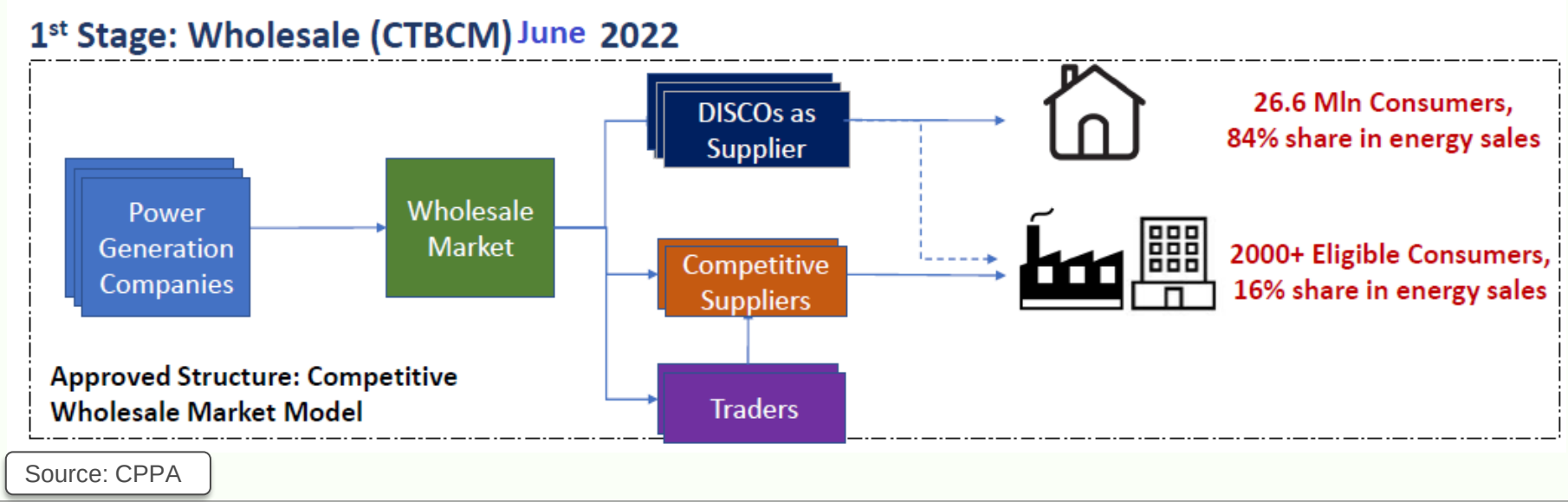
Solar

- 78% reduction in levelized tariff for solar PV projects between 2014 to 2020

LEVERAGING BILATERAL COMPETITIVE MARKET

CTBCM provides opportunity for private developers to bypass multiple constraints pertaining to existing power system

- Pakistan is all set to deploy its first bilateral contracts market moving away from the single buyer model and opening up its power sector for increased competition between generators and suppliers.
- Any BPC of 1 MW and above will be able to procure power directly from Generators or through a Competitive supplier by entering into a bilateral contract.
- The pending recoveries for the utilities according to the State of Industrial Report stand at RS 1.68 trillion. The shift of BPCs towards the new market model will further deteriorate DISCOs consumer base adding to the existing liabilities.



Source: CPPA

LOCALIZATION OF WIND VALUE CHAIN

Goldwind Solution factory is the first step towards localization of wind value chain

Goldwind's Solution Factory launched in December 2022, aims to provide a sound after-sales service system for overseas markets, with three major business directions: warehousing of spare parts, global supply of spare parts, and local after-sales maintenance & retrofit.

Source: Launch Event 2022

Potential areas for cross border collaboration remain vast, but dependent on stable market and resolution of issues

Potential Solutions

- ❑ **Reduce barriers to market entry**
  - Strengthen one-window facility for renewables
  - Simplified and time-bound land acquisition process
  - Rationalize the solar and wind tariff
  - Additional incentives for Chinese investors.
- ❑ **Streamlining payment issues**
  - Priority payment mechanisms for renewable generators
  - Deferred payment mechanism for imports of spare parts
- ❑ **Stabilize the market**
  - Consistent and complementing policies
  - Quick decision making from Government
  - Improve coordination between federal and provincial authorities
  - Reducing losses and improve collections
- ❑ **Inclusive Development**
  - Equal opportunities for large and small players
  - Robust community and local engagement

Thank You

RENEWABLES FIRST

11, 3rd Floor, Executive Complex, G-8 Markaz, Islamabad Capital Territory Pakistan