MARKET SPOTLIGHT: INDIA

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Renewable Energy Markets™ Asia 2025

Renewable Energy Markets

India Spotlight Session

Gagan Sidhu
Director – CEEW Green Finance Centre

REM Asia Conference
April 30, 2025

Impacting sustainable development at scale with data, integrated analysis, and strategic outreach

TRANSFORMATIONS

- Low-carbon Economy
- Energy Transitions
- Power Markets
- Industrial Sustainability
- Sustainable Livelihoods

QUALITY OF LIFE

- Clean Air
- Sustainable Water
- Sustainable Food Systems
- Sustainable Cooling
- Sustainable Mobility

ENABLERS

- Sustainable Finance
- Technology Futures
- Circular Economy
- Climate Resilience
- International Cooperation

SPECIAL INITIATIVES

- CEEW Green Finance Centre
- Powering Livelihoods
- Emerging Economies
- UP State Office

330+
Multidisciplinary team

440+
Peer-reviewed publications

190+
Instances of increased data transparency

590+
Roundtables & conferences

20+
Indian states engaged

130+
Bilateral & multilateral initiatives promoted

India electricity sector snapshot

1st city electrified in Asia (Bengaluru)

97.5 USD billion of electricity generated FY25[2,3]

3rd largest producer and consumer of electricity worldwide[1]

109 distribution companies, with 53% state owned[4]

475 GW of installed capacity[2]

275+ million consumers of electricity[3]

1,841 BU of electricity generated in FY25[2]

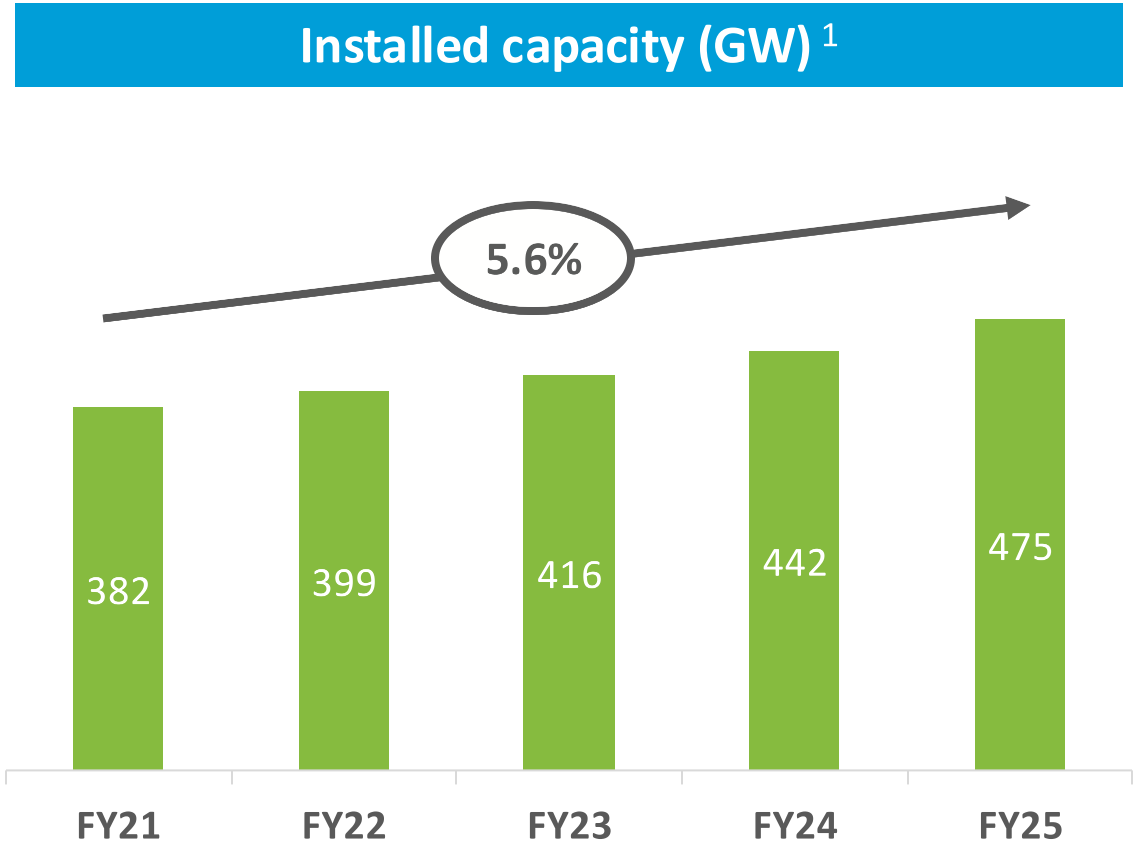
3 power exchanges

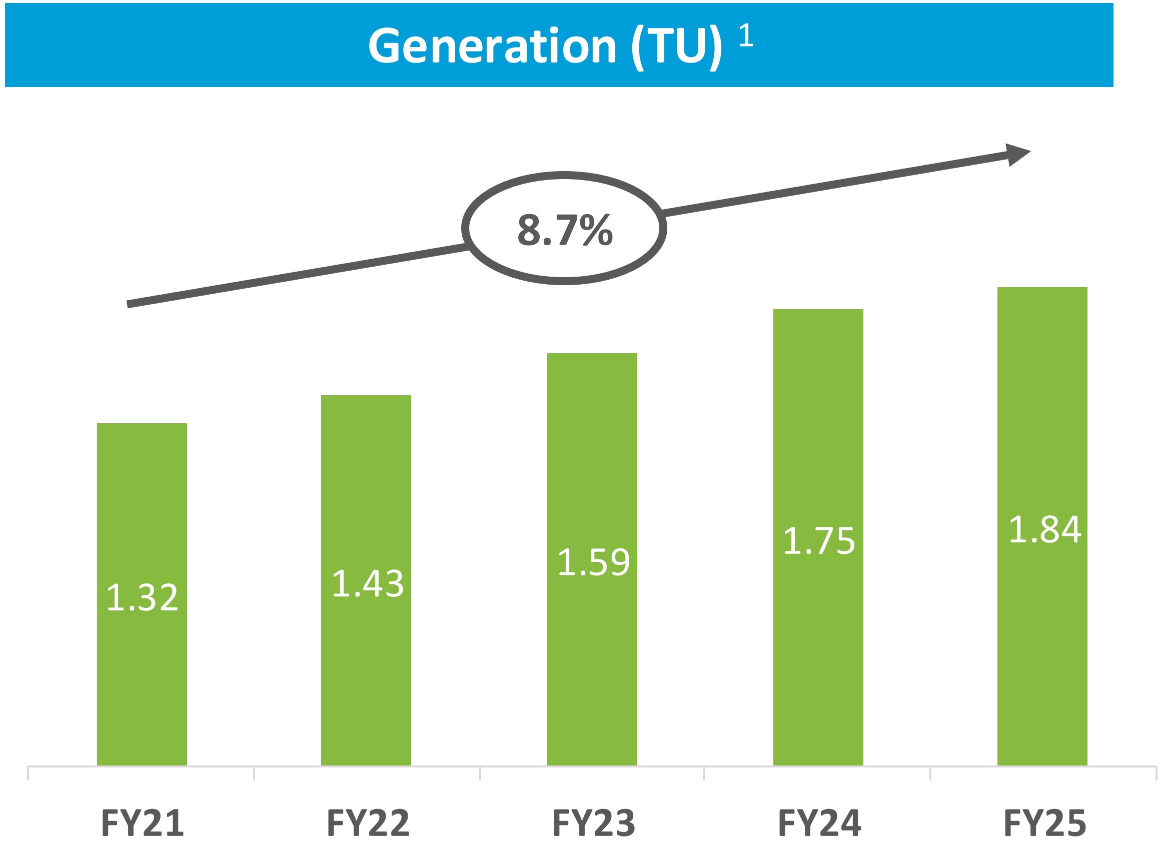
11 generating technologies

Biomass/cogeneration, coal, diesel, gas, hydro (large), hydro (small), lignite, nuclear, solar, waste-to-energy & wind

[1] IBEF (MCA) [2] CEEW "Market Handbook" [3] NITI Aayog: "India Climate and Energy Dashboard" [4] Ministry of Power (2023): Answer to Lok Sabha Unstarred Question 70

How is the electricity sector growing?

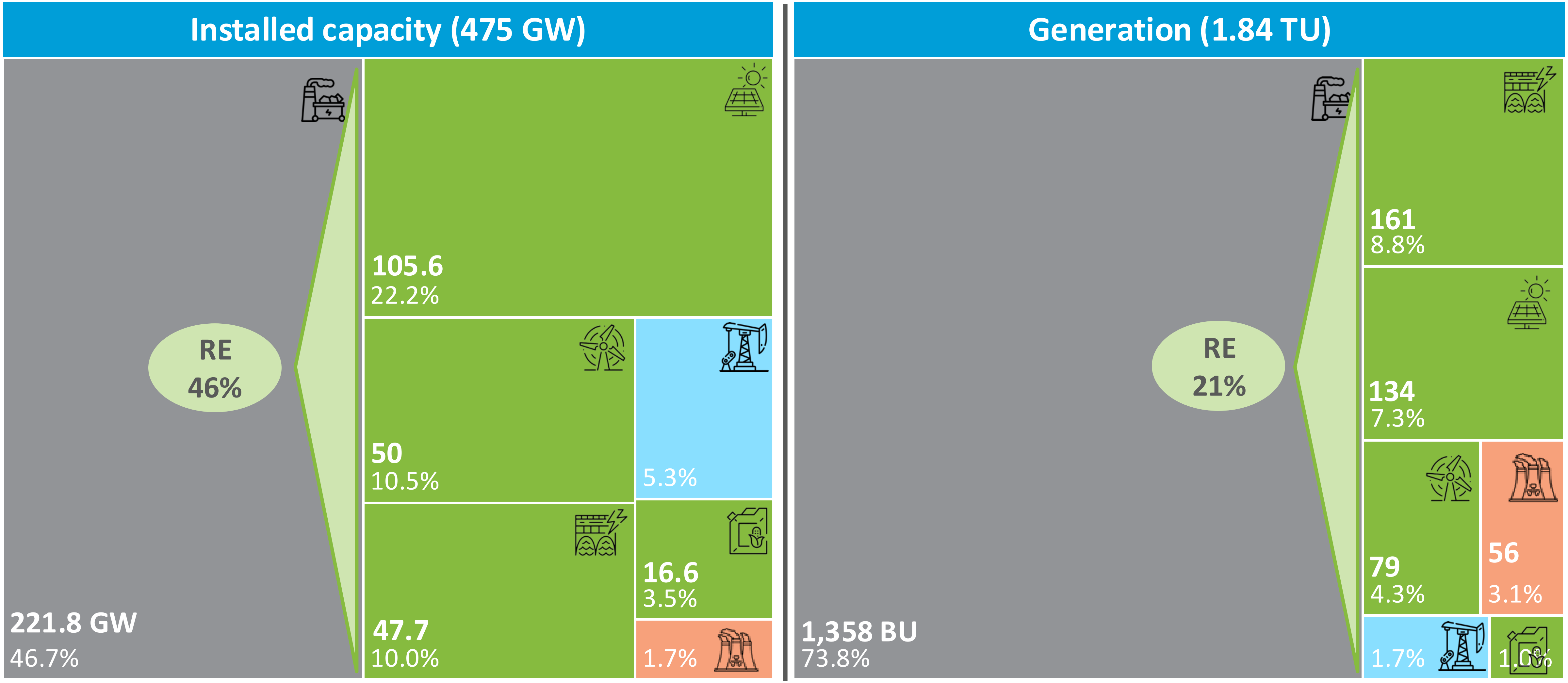




4yr CAGR on generation basis exceeds GDP growth rate

[1] CEEW *"Market Handbook"* [2] CEEW (2025) *How can India Meet its Rising Power Demand?*

How do the various generating technologies stack up?

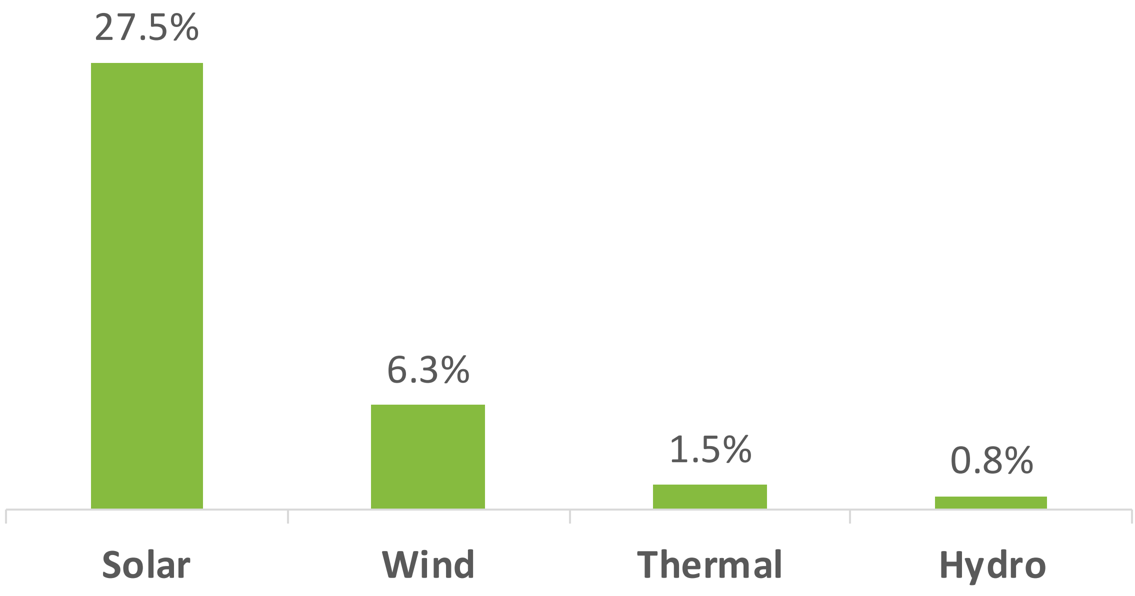


Note: Data points for FY25

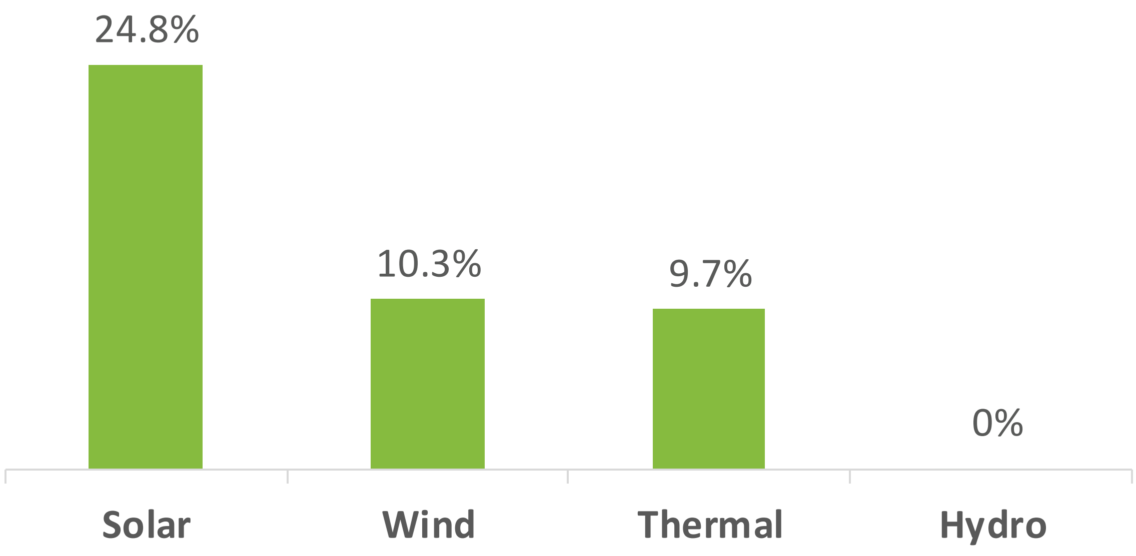
Source: ["Market Handbook"]

Solar growth leads the pack

GW installed capacity (4yr CAGR)



MU generation (4yr CAGR)



Solar growth (generation basis) 2.5x of thermal

Source: CEEW *"Market Handbook"*

Policies driving RE growth

	Policy Target	When?	Progress
Capacity	**500 GW** **Non-fossil energy capacity** (by 2030[1])	**November 2021** (COP26 Glasgow)	**220 GW** (as of March 2025[3])
	50% **Electric power installed capacity from non-fossil fuel-based** (by 2030[2])	**August 2022** (NDCs)	**46.3%** (as of March 2025[3])
Renewable Purchase Obligation (RPO)	**43.33%** **Energy generation from non-fossil resources** (by 2030[4])	**October 2023** (MoP Notification)	**21.4%** (for FY25[3])
Bidding Trajectory	**50 GW** **Annual RE bids** (from FY 2023-24 to FY 2027-28[5])	**March 2023** (MNRE Memorandum)	**33.1 GW** (as of March 2025[3])

[1] PIB Delhi. "India's Stand at COP-26" [2] UNFCCC. "India's Updated First Nationally Determined Contribution Under Paris Agreement" [3]CEEW "Market Handbook"
[4]Ministry of Power. "Notification" [5]MNRE. "Bidding trajectory for renewable energy power projects regulation".

How is RE being generated (and purchased)?

Rooftop solar	Utility scale (Discom)	Utility scale (Corporate)	Power exchanges
• <u>Residential:</u> driven by GoI subsidy (USD 8.8 billion budget) • <u>Commercial:</u> - Cost advantage (vs thermal) - Scope 2 emissions disclosures (listed Cos)	• Direct PPAs with Discoms • Tripartite agreements (PPAs and PSAs) with quasi-sovereign entities – SECI, NTPC, NHPC, SJVN	• Cost advantage and emissions disclosures (same as rooftop solar) • Developers offering innovative formats (flexible generation profiles) on competitive terms	• Market places for producers & consumers to trade electricity • 2 trading formats based on power delivery timing
Long term RE			**Short term RE**

Green tariff

- Allows consumer to buy RE power from Discoms (without capex)
- Tariffs notified by SERCs

Renewable energy certificates (REC)

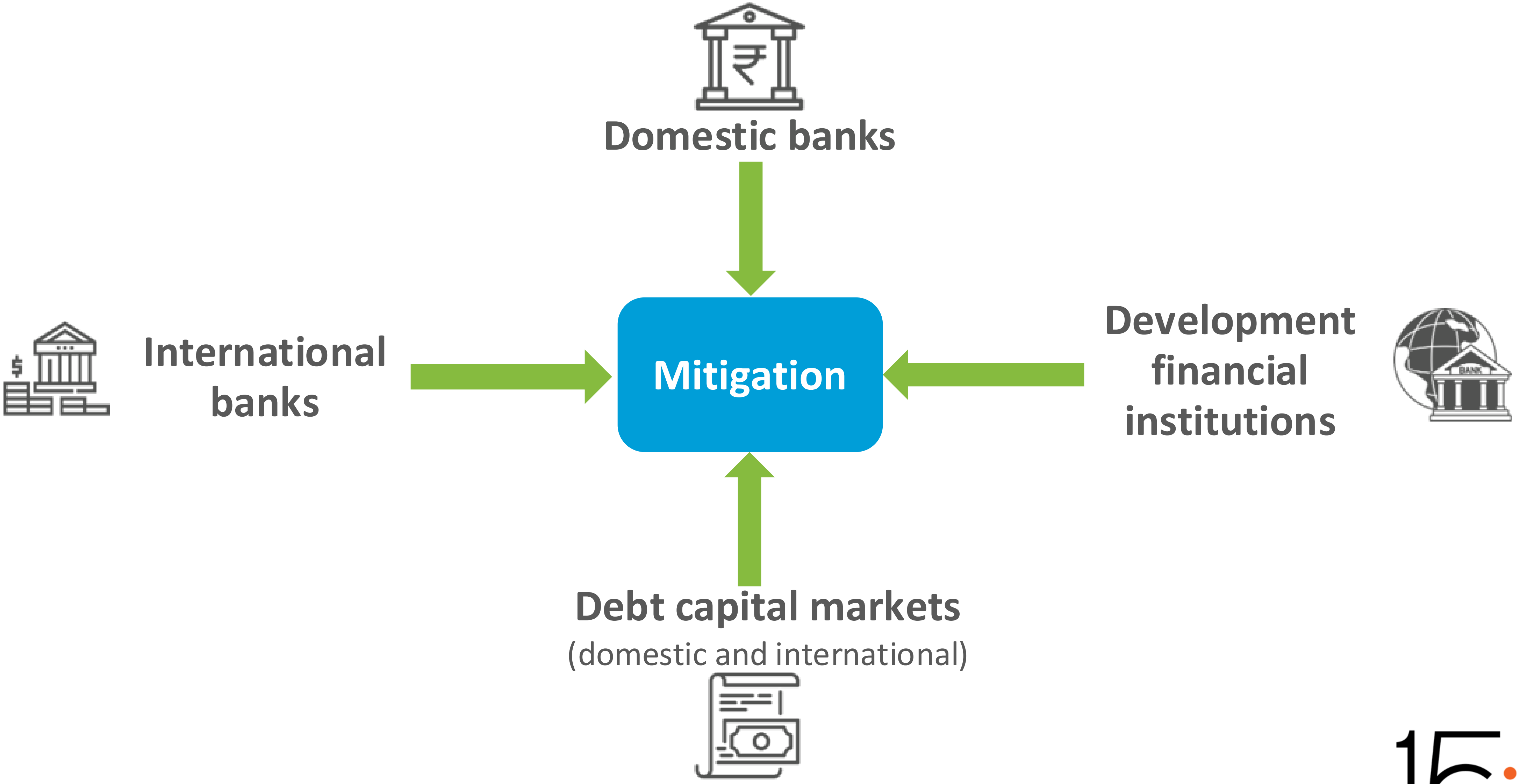
- Allows obligated entities to comply with RPOs (without purchasing RE)
- Tradable instruments

Virtual power purchase agreement

- Purchase of green attributes (without capex or purchasing RE)
- Consumer continues to buy power from Discoms

RE derivatives

Utility scale RE: where is debt coming from?



Utility scale RE: where is equity coming from?

USD 5.1bn
FDI for RE[1]
28% 4yr CAGR[2]

Sovereign wealth funds/ Pension funds

Private equity
(primarily international)

Mitigation

Public equity
(primarily domestic)

Venture capital
(primarily domestic)

[1] CY2024 [2] FY20-FY24

Utility scale RE: shifting away from plain vanilla at competitive pricing

Capacity Auctioned (FY25)[1]

- **Innovative formats: 59%**
  - Wind-solar hybrid: 36%
  - FDRE: 13%*
  - Solar with storage: 10%**
- **Vanilla solar: 37%**
- **Vanilla wind: 4%**

*FDRE: format to deliver RE on demand (with some conditionality); storage component mandated
** Auctions for stapled storage typically feature 2 hrs BESS

Lowest Price Discovered (FY25)[1]

- **Vanilla solar:** USD 2.5 cents
- **Solar with storage:** USD 3.6 cents
- **Wind-solar hybrid:** USD 3.7 cents
- **Vanilla wind:** USD 4.2 cents
- **FDRE:** USD 5.0 cents
- **New Thermal:** USD 6.6 cents

(1) With increase in RE penetration in the grid, storage increasingly central – features in 23% of auctioned capacity **(2)** FDRE 24% lower than new thermal

[1] CEEW-CEF *"Market Handbook"*

Exchange traded RE: exchanges, products & derivatives

3 exchanges

- India Energy Exchange **(IEX)**
- Power Exchange India Limited **(PXIL)**
- Hindustan Power Exchange **(HPX)**

2 green power products

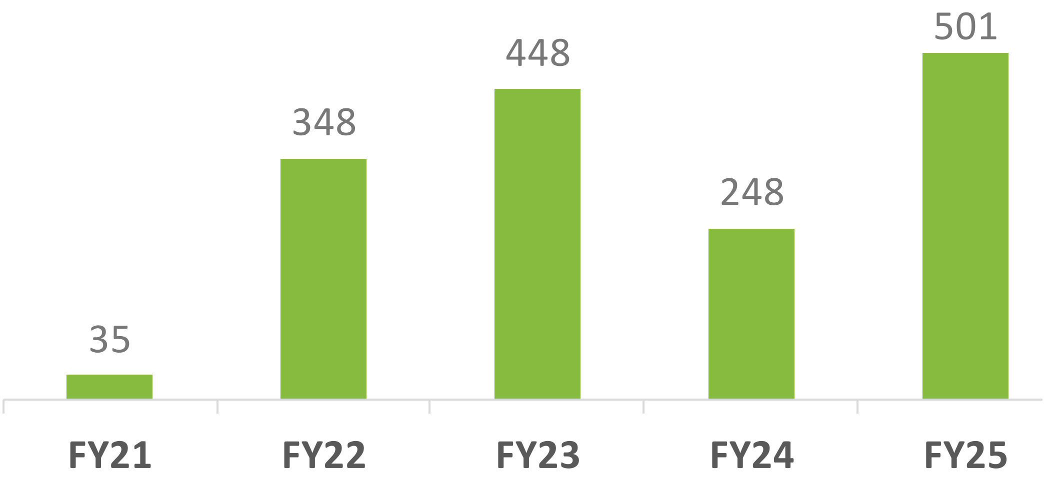
- Green Term Ahead Market **(GTAM):** contracts for up to 90 days delivery
- Green Day Ahead Market **(GDAM):** next day delivery

1 derivative

- Renewable Energy Certificates **(REC):** issued to and bought by obligated entities (OA – mainly discoms); voluntary purchase also permitted

Exchange traded RE: quantifying the market

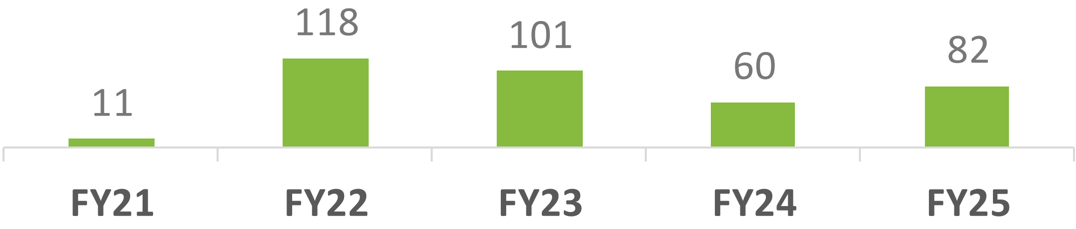
GDAM & GTAM traded value (USD mn)[1]



- IEX dominates at present representing 99% of traded value
- GDAM 95% of value vs GTAM at 5%

USD 1,580 mn (5 year cumulative)

REC traded value (USD mn)[1]



- REC trading more evenly spread between exchanges than GDAM & GTAM: IEX (59%), PXIL (38%)
- FY24 & FY25 → supply increase, but sharper price decline

USD 373 mn (5 year cumulative)

[1] *Datapoints for FY21 till FY24 from CERC "Annual Report on Short-term Power Market: 2023-24" and FY25 from CEEW "Market Handbook"*

Thank you

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Market Spotlight : India
Regulatory Environment for Voluntary RE Procurement: vPPAs & Beyond

Megha Kaladharan

Drivers of RE Power Procurement by Corporates

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C&I energy demand

Commercial and industrial (C&I) segment accounts for approx. 40-45% of India's energy demand

High grid tariffs

Discom tariffs for C&I segment range from INR 6-8 per unit (higher than other countries with 10-25% mark up over cost of supply)

Declining cost of RE

Cost of direct procurement of RE power cheaper than discom tariff

Climate commitments

Corporates have net neutrality targets/aligned with global initiatives like RE 100

Incentives/favourable regulations

ISTS waiver | exemption from cross subsidy surcharge and additional surcharge for captive procurement

Modes of RE Procurement by Corporates

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- Third party open access (physical PPA)
- Power exchanges
- Captive structure (physical PPA)
- REC purchase

What are VPPAs? How do they work?

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FINANCIAL CONTRACT

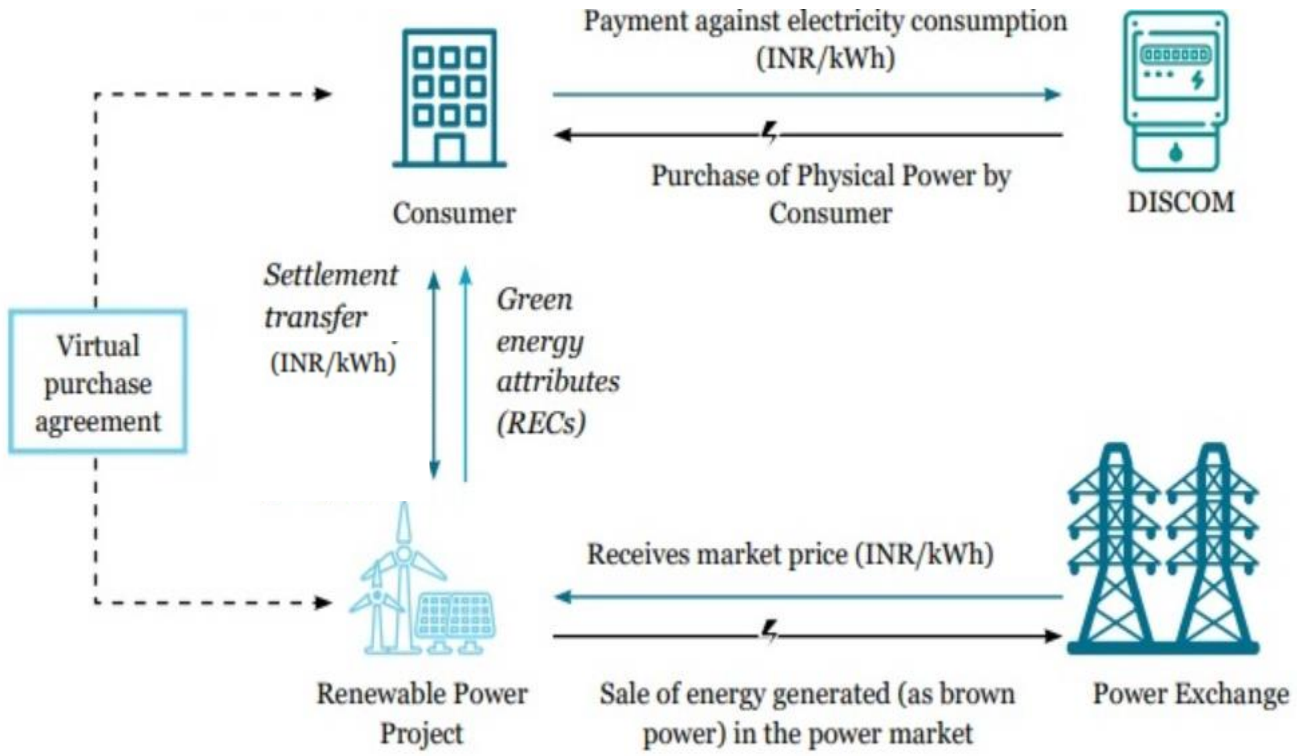
VPPA is a financial contract between an electricity buyer and a renewable energy generator - no physical delivery of power

BUYER'S SCOPE

The electricity buyer, often a large corporation, guarantees tariff over long-term for renewable power generation without actual consumption/delivery; Continues to receive power from state utility

GENERATOR'S SCOPE

The renewable energy generator, such as a wind or solar farm, sells "brown power" on power exchange – RECs/environmental attributes retained by buyer



Virtual Power Purchase Agreements are a valuable tool for corporations and organizations to support renewable energy development and achieve sustainability goals, while providing long-term financial stability for renewable energy generators

Legal Challenges in VPPA Adoption

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1

Notified Commodity

Electricity is a ‘notified commodity’ under the Securities Contracts (Regulation) Act, 1956 (**SCRA**)

2

SCRA Position

Any commodity derivative transaction where the commodity is a notified commodity is prohibited under SCRA except in certain limited circumstances

3

Bar on bilateral transactions

Classic VPPA structure would be categorised as commodity derivative under SCRA since it involves a bilateral arrangement for a notified commodity without physical delivery

4

Jurisdictional uncertainty

Uncertainty regarding which regulator will have jurisdiction over vPPAs –SEBI or CERC

Future Outlook

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01 **VPPAS ALLOWED**

Once regulatory landscape is clear, Indian market ripe for VPPA boom – estimated demand of 104 GW by 2030

02 **NEW AVENUES OF DEMAND**

Green power demand of data centres ramping up, particularly Big Tech data centres

03 **ESG AND SUSTAINABILITY**

ESG targets often exceed pace of physical RE capacity addition, which aids adoption of innovative structures by driving investment/financing

04

GROWTH OF REC MARKET

Increasing demand for RECs; growth of domestic trading platforms

05

POOLING DEMAND

Smaller corporates/MSMEs can meet ESG goals through VPPAs collectively, without complexity of physical power purchase

VPPAs & other innovative power procurement structures key to meet India's power demands as it aims to become a USD 55 trillion economy by 2047 (~100x electricity generation growth) while balancing its clean energy goals

Q&A

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