



Art'o'val
True Art of Valuation

Valuation of Renewable Energy Sector

February 2026



Renewable Energy Sources

Renewable Energy Sources

Hydro Energy

Electricity generated using flowing water, typically through dams or run-of-river projects; reliable and suitable for large-scale power generation.

Small Hydro Power (Project ≤ 25MW)

Smaller, decentralized hydro projects with lower environmental impact, ideal for remote or hilly regions.

Wind Power

Electricity produced by wind turbines converting wind energy into power; cost-effective and widely deployed in high wind-speed regions.

Bio-Power

Energy derived from organic materials such as agricultural residues, wood, and waste.

Biomass Power

Uses plant and animal matter to generate electricity, often supporting rural income.

Other Renewable Energy

Solar Power

Energy generated from sunlight using photovoltaic (PV) panels or solar thermal systems; scalable, clean, and the fastest-growing renewable source.

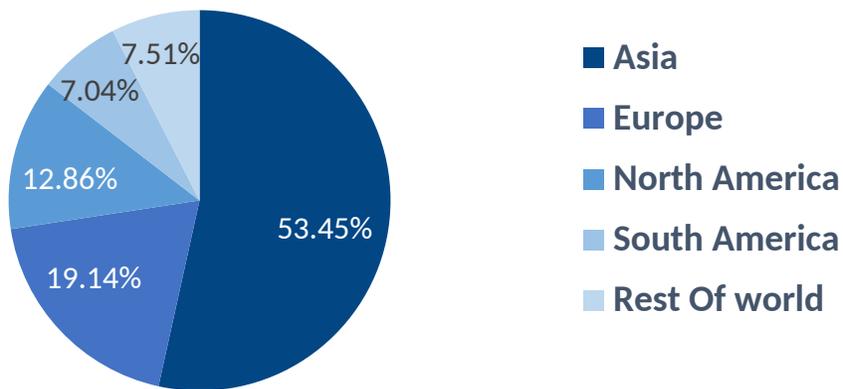
Urban & Industrial Waste Power

Converts municipal solid waste and industrial waste into energy, addressing both power generation and waste management.

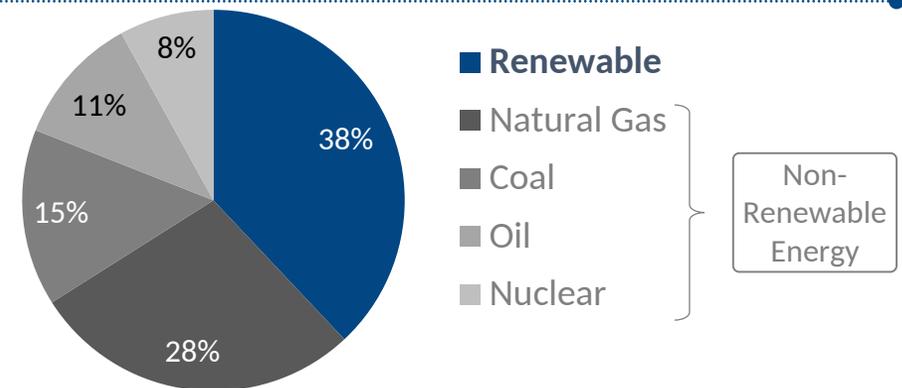
Renewable Energy Sector at a Glance (Global)

- Renewable Energy is a core **global infrastructure sector** with capital-intensive, utility-scale assets and **20-25-year operating lives**
- **Renewables account for >80% of net global power capacity additions (IEA)**
- **~700 GW of new renewable capacity added in 2024**, led primarily by **solar PV**
- **Renewables + nuclear supplied ~40% of global electricity generation**
- **Long-term offtake structures (PPAs) and regulated markets** provide high revenue visibility
- **Annuity-like, stable cash flows** post-commissioning
- Structural growth supported by:
 - **Rising global electricity demand (~4% growth in 2024)**
 - **Declining technology and installation costs**
 - **Strong policy support** linked to decarbonisation and energy security

Installed Capacity



Demand Rate

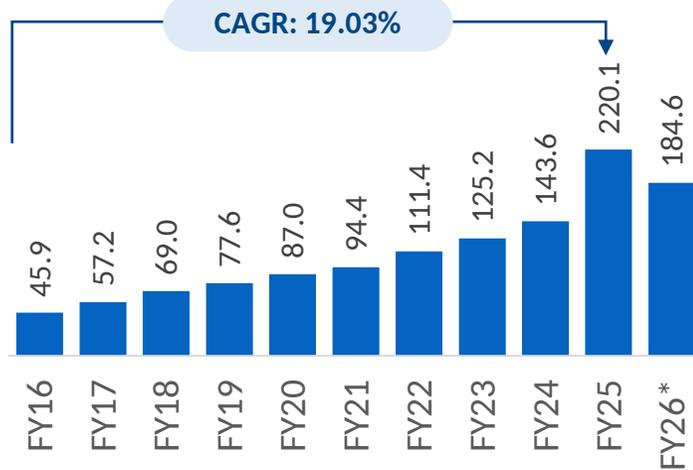


Source: Installed Capacity: Renewable energy statistics 2024-25 By MNRE; Demand Rate: Global Energy Review by IEA

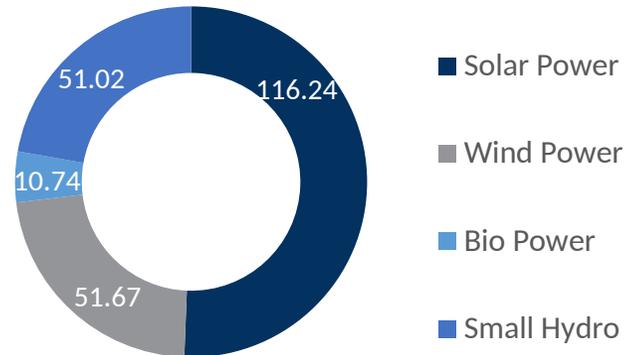
India Renewable Energy – Rapid Scale-Up with Strong Growth Visibility

- **Strong and sustained capacity expansion** driven by policy-led growth, falling technology costs, and structurally rising power demand
- **Installed renewable power generation capacity has grown rapidly over the past few years, recording a CAGR of 19.03% between FY16 and FY25 .**
- India ranks among the **top four global renewable energy markets**, alongside **China, the US, and Germany**
- **Robust long-term growth outlook** supported by clear policy direction
- **Government of India target of 500 GW non-fossil fuel capacity by 2030**
- Target provides **long-term policy visibility and investment certainty** for developers and capital providers

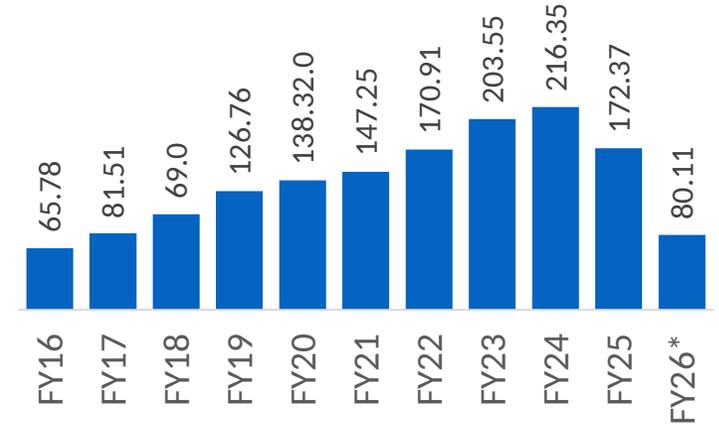
Installed Renewable Energy Capacity (GW)



Installed Renewable Capacity Breakup (GW)
FY26 (cumulative achievement)



Electricity Generation from RES (billion units)



Source: IBEF Renewable energy report;

* FY26 is as of June 2025

Future Power Demand & Capacity Expansion in India

Peak Power Demand in India (GW)



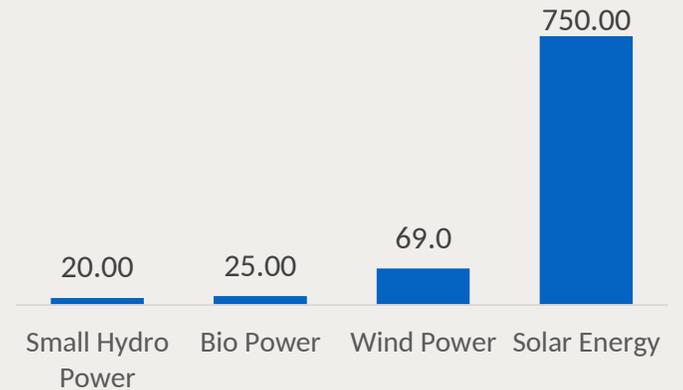
Peak power demand is on a steep upcycle: India's peak electricity demand has already crossed **250 GW** and is projected by the CEA to reach **~817 GW by 2030**, highlighting a widening demand-supply gap and the need for rapid capacity addition.

RES as Percentage of Total Installed Capacity (%)



Renewables are steadily gaining share in installed capacity: The share of renewable energy in total installed capacity has risen from **~14% in FY16 to ~48% in FY26 (as of June 2025)**, reflecting sustained policy support and accelerated deployment.

Renewable Energy Potential in India



Solar is the dominant driver of renewable potential: Out of India's estimated **~900 GW renewable energy potential**, solar alone accounts for **~750 GW**, far exceeding wind (~102 GW) and other sources, making it central to achieving the **500 GW renewable target by 2030**.

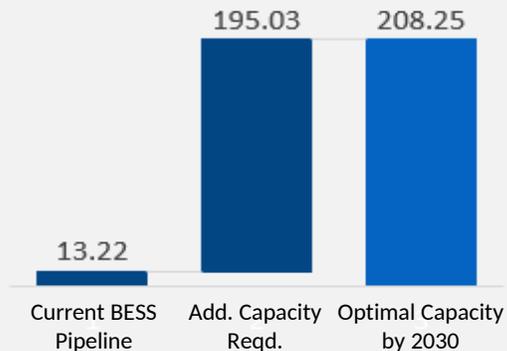
Energy Storage: The Backbone of India's Renewable Transition

Energy Storage - Key Enabler of India's Renewable Grid

- Rising renewable penetration makes energy storage critical for managing intermittency, grid stability, and reliable power supply
- **Total storage requirement** projected to rise from **~16.1 GW (FY2026-27)** to **~73.9 GW (FY2031-32)**

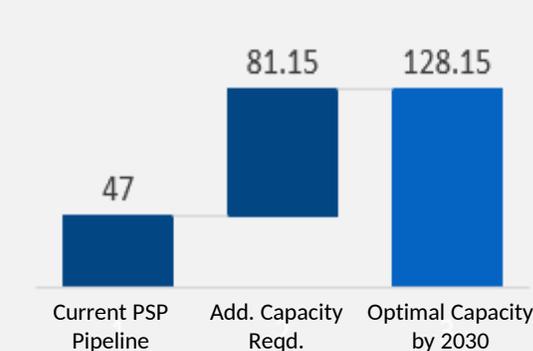
Battery Energy Storage Systems (BESS)

- Flexible, **location-agnostic** solution with rapid response to supply-demand fluctuations
- Suitable for **frequent charge-discharge cycles** with minimal degradation
- **Optimal capacity required: ~208 GWh by 2030**
- **Current pipeline: ~13 GWh** → significant growth headroom



Pumped Storage Projects (PSP)

- Enables **large-scale, long-duration** energy storage
- High storage capacity with **fast ramp-up/down** for grid balancing
- **Optimal capacity required: ~128 GWh by 2030**
- **Current pipeline: ~47 GWh**

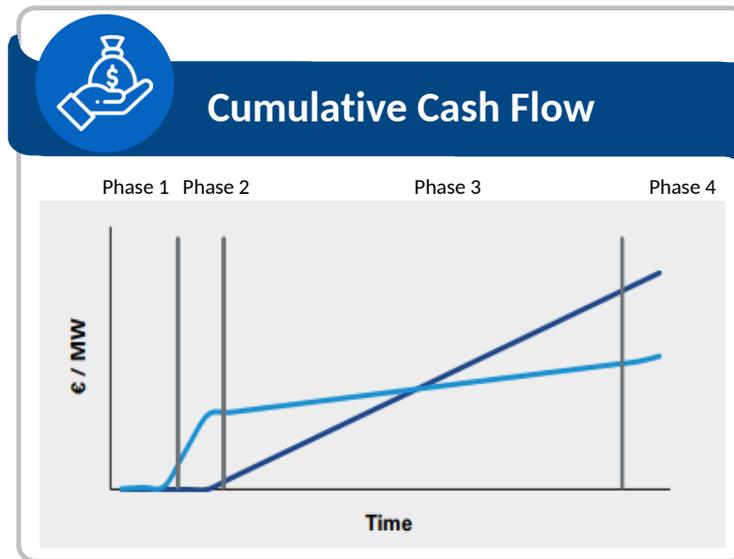
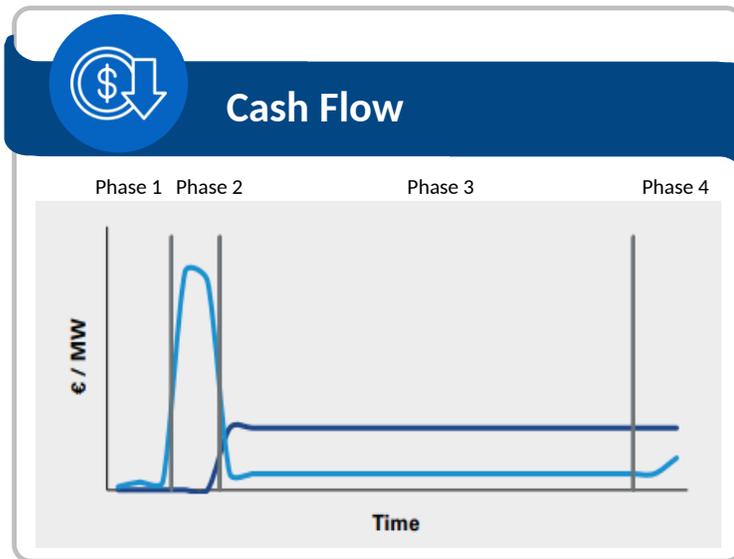


Key Demand & Policy Drivers

- **Energy Storage Obligations (ESO):** Mandates storage-backed power procurement, creating long-term demand visibility
- **Replacement of Diesel Generators (DG):** BESS emerging as a cleaner, cost-effective alternative for C&I backup power

Renewable Power Projects: Cash Flow & Risk Dynamics

- Renewable power projects (solar & wind) are **long-life infrastructure assets** characterized by **contracted revenues, front-loaded capex, and low operating costs**.
- Projects typically operate under **long-term PPAs (up to 25 years)**, resulting in a **J-curve cash flow profile** — negative cash flows during construction followed by stable, annuity-like operating cash flows post-commissioning.
 - **Phase 1 – Pipeline:** Low business risk with limited cash outflows (feasibility, approvals, land, PPA negotiation).
 - **Phase 2 – Under Construction:** Highest risk due to heavy capital deployment and exposure to delays and cost overruns.
 - **Phase 3 – Operational (Post-COD):** Stable, predictable cash flows under FITs/PPAs; risk comparable to regulated utilities.
 - **Phase 4 – Merchant Exposure:** Revenues linked to spot prices unless new PPAs are secured, increasing price volatility risk.



— Phases — Cash Inflow — Cash Outflow



Revenue Model

$$\text{Revenue} = \text{Contracted Tariff} \times \text{Actual Energy Generated}$$

Actual generation (and hence revenue) is driven by the following operating and resource factors

	<h3>1. Capacity (MW Installed)</h3> <ul style="list-style-type: none"> • Represents the maximum possible output of the plant under ideal conditions. • Higher installed capacity directly scales revenue potential under fixed tariffs. • Capacity addition is often phased, impacting ramp-up of revenues post-COD. 		<h3>4. Performance Ratio (PR)</h3> <ul style="list-style-type: none"> • Indicates the efficiency of the plant in converting available resource into usable electricity. • Accounts for losses due to temperature, inverter efficiency, wiring, dust, and degradation. • Higher PR signals superior design, technology selection, and O&M effectiveness.
	<h3>2. Plant Availability (%)</h3> <ul style="list-style-type: none"> • Measures the percentage of time the plant is technically capable of generating power. • High availability reflects strong O&M practices and equipment reliability. • Availability shortfalls can trigger penalties or reduced billing under PPA terms. 		<h3>5. CUF/PLF (Capacity/Plant Load Factor)</h3> <ul style="list-style-type: none"> • Represents actual generation as a percentage of maximum possible generation. • Captures combined impact of resource quality, availability, PR, and curtailment. • CUF/PLF is a critical metric used by lenders and investors to assess revenue stability.
	<h3>3. Irradiation/Resource Availability</h3> <ul style="list-style-type: none"> • Refers to solar irradiation (for solar) or wind speeds (for wind projects). • Natural variability directly impacts energy output despite constant capacity. • Long-term P50 / P90 resource assessments are used to estimate sustainable revenues. 		<h3>6. Downtime & Curtailment</h3> <ul style="list-style-type: none"> • Downtime: Generation loss due to equipment failure, maintenance, or grid outages. • Curtailment: Forced reduction in generation due to grid congestion or off-taker constraints. • Increasing curtailment risk is driving adoption of hybrid, storage, and RTC PPAs.

<h3>Structural Enhancements to Revenue Stability</h3>	<ul style="list-style-type: none"> • Long-tenor PPAs (20-25 years) provide tariff visibility and cash flow certainty. 	<ul style="list-style-type: none"> • Hybrid & RTC structures smooth generation profiles and improve offtaker value. 	<ul style="list-style-type: none"> • Policy-linked incentives (where applicable) can provide upside, subject to regulatory stability
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Cost Framework

Renewable energy projects are capex-heavy and opex-light, with most lifetime costs incurred upfront before COD(Commercial Operation Date), followed by stable and predictable operating expenses.

1. Operations & Maintenance (O&M)

- Covers routine maintenance, breakdown repairs, spares, cleaning (especially critical for solar), and site operations.
- Typically contracted under long-term O&M agreements, providing cost visibility.
- Directly impacts plant availability, PR, and long-term revenue sustainability.

2. Insurance

- Includes coverage for property damage, business interruption, natural calamities, and liability risks.
- Premiums are relatively stable and often fixed or inflation-linked.
- Protects cash flows against low-probability, high-impact events.

3. Asset Management Fee

- Paid to the asset manager overseeing technical, commercial, and contractual performance.
- Includes compliance monitoring, PPA management, reporting to lenders/investors, and covenant tracking.
- Enhances governance, reduces operational risk, and supports refinancing or monetisation.

4. Monitoring Fee

- Covers real-time performance tracking systems (SCADA, data analytics, alarms).
- Enables early identification of underperformance, downtime, or grid issues.
- Supports optimization of generation and faster corrective actions.

5. Finance Cost

- Comprises interest on debt, commitment charges, hedging costs (if any), and refinancing expenses.
- A key determinant of project IRR, DSCR, and equity returns due to high upfront leverage.
- Sensitive to interest rates, debt tenor, and project risk perception.

6. Cost Structure Characteristics

- **High upfront capex** → front-loaded investment risk.
- **Low and predictable opex** → stable long-term cash flows.
- **Financing efficiency** often matters more than marginal opex savings.

Asset Life & Cash Flow Dynamics

Renewable energy assets typically have a **20-25 year economic life**, closely aligned with **PPA tenures**, resulting in long-duration, predictable cash flows with limited reinvestment requirements.

Power Purchase Agreement (PPA)



- Long-term PPAs (typically **20-25 years**) provide revenue visibility and pricing certainty.
- Tariffs may be fixed, escalated, or partially indexed, influencing long-term cash flow profile.
- Offtaker credit quality and PPA enforceability are key determinants of cash flow stability.
- Post-PPA, assets may shift to **merchant sales, contract renewals, or captive/RTC structures**.

Tenure (Asset & Contract Life)



- Asset life broadly matches PPA tenure, enabling full recovery of capex and debt amortization.
- Debt is typically structured with a shorter tenor than PPA, allowing post-deleveraging equity upside.
- After PPA expiry, assets often retain residual value due to:
 - Remaining useful life of equipment
 - Lower operating costs post debt repayment
 - Repowering or technology upgrades

Cash Flow Profile Over Asset Life



- **Pre-COD:** Negative cash flows due to capex and financing costs.
- **Post-COD:** Stable operating cash flows with high visibility.
- **Mid-life:** Limited capex for inverter replacement / major maintenance.
- **Late-life:** Optional repowering, life extension, or PPA renegotiation enhances terminal value.

Core Financial & Operational Metrics



KPI

- **Capex/MW:** Measures the capital cost required to install 1 MW of capacity, indicating project cost efficiency.
- **Net Production (MWh/MW):** Represents annual energy generated per MW after losses, reflecting asset utilization and performance.
- **Revenue (\$/MWh):** Average realized price per unit of electricity sold, capturing tariff quality and pricing power.



Debt Ratio

- **Leverage (% -Debt/Capex):** Indicates the proportion of project cost funded through debt, reflecting financial risk and capital structure.
- **DSCR:** Measures the project's ability to service debt from operating cash flows, with higher ratios indicating stronger debt coverage.
- **Debt/EBITDA:** Shows how many years of operating earnings are required to repay debt, indicating balance sheet leverage



Return Metrics

- **Project IRR:** Returns generated by the project based on total invested capital, independent of financing structure.
- **Equity IRR:** Returns earned by equity investors after accounting for leverage and debt servicing.
- **Payback Period:** Time required to recover the initial investment from project cash flows.
- **Discounted Payback Period:** Time required to recover the initial investment considering the time value of money.

Valuation Methods – Renewable Energy



1. Income Approach (Primary Method)



2. Market / Multiple Approach



3. Cost Approach (Limited Use)

1. Income Approach (Primary Method)

Discounted Cash Flow (DCF)

- Values renewable assets based on **long-term, contracted cash flows** under PPAs (typically **20-25 years**)
- Cash flows driven by:
 - Contracted tariffs
 - Expected generation (CUF/PLF assumptions)
 - O&M costs and financing structure
 - Asset life and residual value
- Best suited for **operational and contracted renewable projects**
- Captures the **annuity-like, infrastructure cash flow profile**
- **Cost of Capital**
 - Valuation commonly benchmarked using:
 - Project IRR (equity perspective)
 - WACC (enterprise valuation)

Discount rates reflect

- **Offtaker credit quality**
- **Regulatory risk**
- **Technology maturity**
(solar < wind < storage)



India utility-scale renewables typically valued at **lower risk premiums vs other infra** due to contracted revenues.

- **Exit Value or Termination Value:** In a DCF, it represents the present value of all cash flows beyond the explicit forecast period, capturing the company's long-term value once it reaches a stable growth phase.

2. Market / Multiple Approach

EV per MW (Capacity-Based Valuation)

- Benchmarks enterprise value against installed capacity
- Commonly used in asset acquisitions and platform transactions
- Valuation influenced by:
 - Technology mix (solar, wind, hybrid)
 - Project maturity (operational vs under construction)
 - Tariff profile, offtaker quality, and leverage



EV/EBITDA

- Applied to **operational and stabilised renewable platforms**
- EBITDA reflects steady-state performance due to:
 - Low fuel costs
 - Limited operating variability post-commissioning



Transaction/M&A Comparables

- Uses valuation benchmarks from:
 - Renewable asset sales
 - Platform acquisitions
 - InvIT monetisation transactions
- Provides market-based reference for similar asset profiles



3. Cost Approach (Limited Use)

Replacement Cost Method

- Estimates value based on the current cost of developing similar renewable capacity
- Adjusted for:
 - Asset age
 - Technology efficiency
 - Remaining useful life
- Typically used as a **secondary reference or reasonableness check**



Conclusion



Renewables Are Now Core Global Infrastructure

Renewables account for >80% of net global power capacity additions, with ~700 GW added in 2024 alone. Long-term PPAs and regulated markets provide annuity-like, stable cash flows post-commissioning.



India is on a Structural Growth Trajectory

India's installed renewable capacity has grown at a 19.03% CAGR (FY16–FY25), with renewables now at ~48% of total installed capacity. The government's 500 GW non-fossil fuel target by 2030 provides long-term policy and investment certainty.



The Revenue & Cost Model is Built for Predictability

Revenue is driven by **Contracted tariffs X Actual generation** - underpinned by CUF/PLF, plant availability, and resource quality. The cost structure is capex-heavy but opex-light, with high cost visibility through long-term O&M, insurance, and financing agreements.



Energy Storage is the Critical Enabler

Total storage requirements are **projected to surge from ~16.1 GW (FY27) to ~73.9 GW (FY32)**. BESS and PSP combined need **~336 GWh of optimal capacity** by 2030, against a current pipeline that leaves significant headroom -making storage a major investment frontier.



DCF is the Primary Valuation Tool, Supported by Market Multiples

Renewable assets are **bestvalued using DCF**, given their contracted 20-25 year cash flow profile. **EV/MW and EV/EBITDA multiples** from comparable transactions and InvIT monetisations serve as market-based cross-checks, while the replacement cost method provides a reasonableness floor.

Thank You...!



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