STAKEHOLDER CONSULTATION WORKSHOP

On

Designing a BCS-Style Framework for India

Session 4 : Pilot Project Selection and Design, Modelling & Study Scenario Definition

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Objective, Purpose and Scope

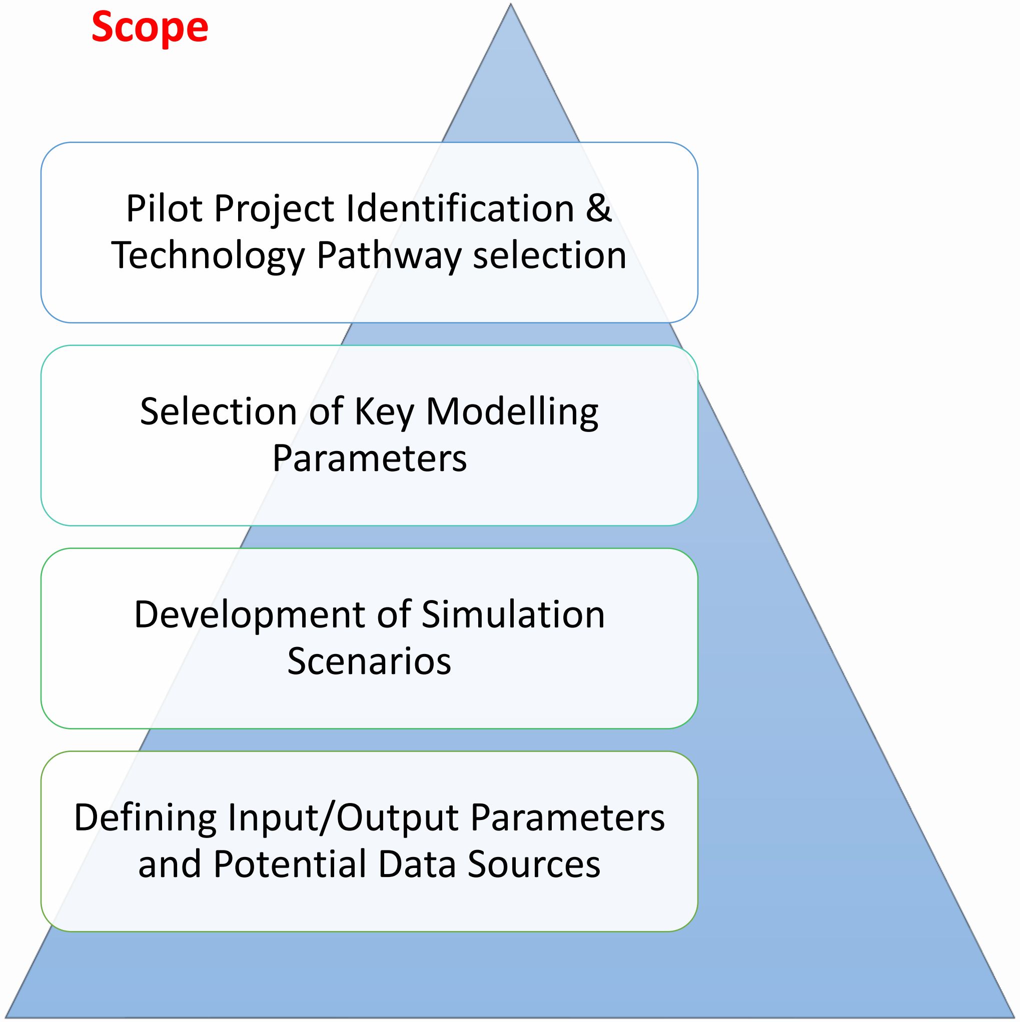
Purpose

- To develop a structured framework for designing and evaluating a BCS-style mechanism for renewable and clean energy in India.
- To identify suitable pilot pathways through which market-linked revenues can be tested while preserving bankability for generators and affordability for buyers.

Objective

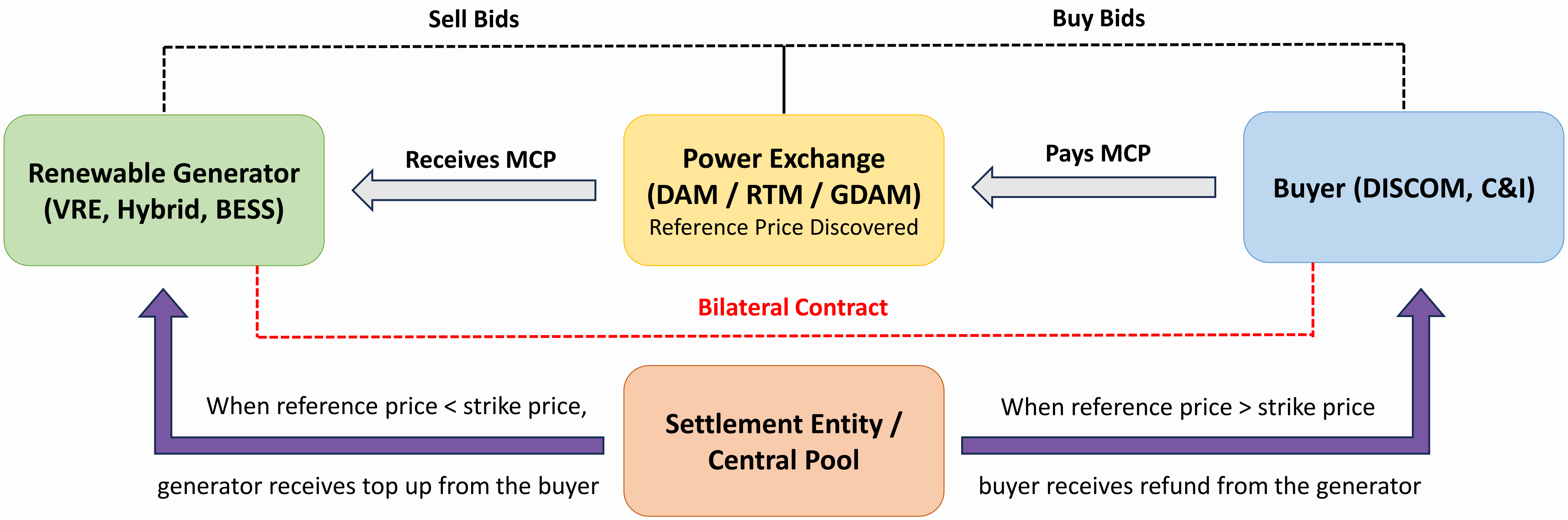
- To assess how alternative BCS-style design configurations perform relative to the existing contracting approach under Indian market conditions.
- To examine the implications of different technology mixes, contract structures, strike-price designs, and reference-price choices on revenue stability, settlement outcomes, and buyer cost exposure.

Scope



Bilateral Contract Settlement Style Mechanism

- A BCS-style mechanism separates physical dispatch from financial settlement
- Physical electricity is cleared through organised market segments (Power Exchanges) such as DAM and RTM, while the contractual obligations is settled financially against a pre-agreed price called strike price.



Key Elements for Design, Modelling, & Simulation

Technology Mix and No. of technologies

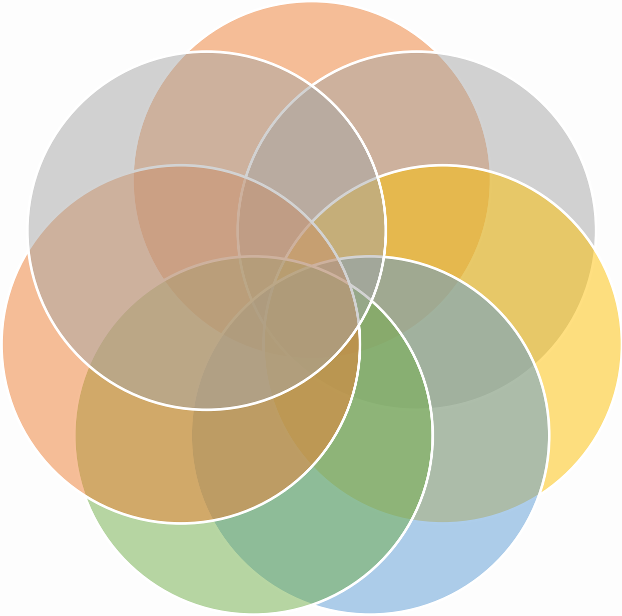
(Solar / Wind / Hybrid / ESS)

Data Sources

(Generation & Despatch data, Market Price data)

Contracting Structures

(Hybrid, RTC, FDRE, Storage)



Settlement Design Parameters

(Frequency of settlement, Settlement Entity)

Reference Market Price

(DAM, RTM, GDAM, Combination / Weighted Index)

Contract Tenure

Short-term / Medium-term

Strike Price

(Fixed, Range, Weekly Benchmarking)

1. Technology Scope & Portfolio Options

Objective: To define the technology coverage and portfolio composition for pilot projects to test the BCS-style mechanism under varying operational and market conditions.

Key Design Considerations

Number of Technologies for Pilot

- Single technology vs multi-technology portfolio
- Limited set vs broader representation of RE mix

Type of Technologies to be Included

- Solar / Wind
- Hybrid
- Storage

Portfolio Configuration

- Individual Project-based modelling
- Aggregated portfolio approach

Test-Bed Project Selection Considerations

- Use of Operational RE Project(s) with historical data
- Preference for:
  - REIA-tendered projects
  - Projects with at least 1 year of operational data

Modelling Considerations

- Assess impact of Technology on:
  - Generation variability and intermittency patterns
  - Exposure to market price volatility
  - Settlement outcomes under BCS-style mechanism

Suggestion for discussion:

- **Technology**: Solar, Solar+Storage, Hybrid
- **Minimum Project Size**: 100 MW, 100 MW/200 MWh, 200 MW (hybrid)

Recent Market Data: Capacity & Price Ranges (FY 2025)

2. Contracting Structures – Design Consideration

Objective: To define the types of contracting structures to be evaluated under the BCS-style mechanism and assess their suitability across different market and system conditions.

Key Design Considerations

Types of contracting structures to be included

- Hybrid
- Round-The-Clock (RTC)
- Firm and Dispatchable Renewable Energy (FDRE)
- Battery Energy Storage System (BESS)

Level of firmness

- Non-firm (VRE output)
- Partially firm (through hybridisation)
- Fully firm (enabled via storage)

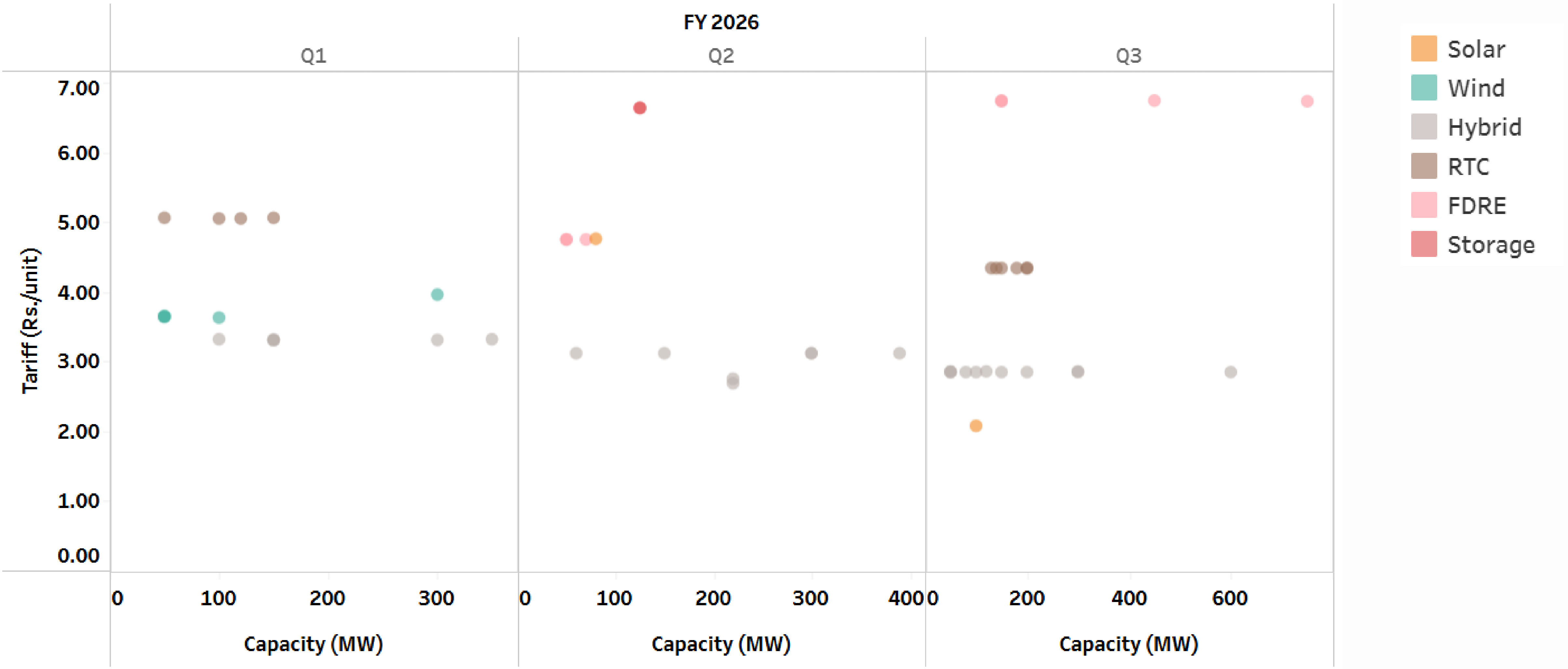
Modelling Considerations

- Assess impact on:
  - Dispatch behavior in market
  - Price realization pattern
  - Settlement flows under BCS-style mechanism
- Ability to test:
  - Different supply commitments vs actual generation

Suggestion for discussion:

- **Contracting Arrangement**: ISTS connected Solar, RE-RTC, FDRE, Standalone Storage

Recent Market Data: Capacity & Price Ranges (FY 2026)



3. Reference Price – Design Consideration

The Reference Price represents the **market-discovered price** used to:

- Settle difference with the Strike Price for BCS-style mechanism
- Reflect actual market conditions and price signals

Key Design Considerations

Choice of Market Segment

- Day-Ahead Market (DAM)
- Real-Time Market (RTM)
- Green Day-Ahead Market (GDAM)
- Combination of multiple markets

Single vs composite Reference Price

- Single market price (e.g., DAM only)
- Blended / Weighted index (e.g., DAM + RTM)
- Fully firm (enabled via storage)

Granularity of Price

- Block-wise (15-min)
- Hourly/Daily/Monthly Average

Modelling Consideration

- Sensitivity of outcomes to:
  - Price volatility across market segments
  - Temporal granularity (block vs average pricing)
- Impact on:
  - Revenue stability for generators & cost for DISCOMs

Suggestion for discussion:

- **Contracting Arrangement**: DAM with weekly average hourly price

4. Strike Price – Design Consideration

Strike price is the **pre-agreed contract price** for electricity that serves as the **benchmark for financial settlement** (difference payments)

Key Design Considerations

Method of Price Discovery

- Competitive bidding
- Administratively determined
- Bilaterally negotiated between contracting parties

Structure of Strike Price

- Fixed price over contract tenure
- Floor & Cap Style Arrangement
- One-way CfD style mechanism
- Weekly benchmarking mechanism

Technology vs Portfolio-Based Pricing

- Technology specific strike price (solar, wind, etc.)
- Common strike price for aggregated portfolio

Modelling Considerations

- Impact of strike price level on:
    - Settlement flows
    - Revenue Stability for generators and cost exposure for DISCOMs
- Sensitivity Analysis across:
    - Different strike prices vs market price
    - Interaction with contract structures (RTC, FDRE, etc.)
- Assessment of:
    - Bankability and investor attractiveness
    - Affordability and tariff impact for buyers

4.1. Option 1 – Single Fixed Strike Price

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- Strike price is a **single levelized ₹/MWh rate fixed** for the full contract duration.
- If the market price is below the strike price, the generator receives compensation for the difference.
- If the market price is above the strike price, the generator refunds the excess as per the settlement arrangement.
- Strike price remains constant regardless of ToD, season, or market conditions.

Potential benefits	**Potential limitations**
Simple and easy-to-understand mechanism, making it suitable for initial pilot implementation.	Reduces incentive for generators to innovate because it effectively guarantees a fixed price over the contract term.
Lower revenue risk for developers compared with more market-exposed BCS variants.	Does not reflect peak and off-peak price differences while setting the strike price.
Provides long-term visibility of future cash flows, which supports financing and bankability.	May not adequately reward flexible resources such as storage-backed RE that can optimize dispatch across time periods.
Helps build investor confidence in the early phase of market-based RE participation.	Can be less efficient over time if market conditions evolve significantly while the strike price remains fixed.

- Suitable for Initial Pilot Implementation to test the settlement mechanism. What approach should be adopted to determine a single fixed strike price that ensures financial viability for generators while maintaining cost efficiency for buyers?
- Will a fixed strike price over-insulate generators from market risk, thereby reducing incentives for efficient market participation?

4.2. Option 2 – Floor-and-cap style arrangement

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- A **lower and upper strike price** are defined for the contract **(Strike Price Range).**
- The RE generator sells power in the market and remains exposed to market prices within this band.
- If the market price moves outside the lower or upper bound, the resulting shortfall or excess is settled through BCS.
- This means the generator gets partial revenue protection, but not a fully fixed price.

Potential benefits	Potential limitations
Room for innovation in generation, as generators are exposed to market signals within the strike price band	Increases market exposure to both generators and buyers
Can reduce financial burden on buyer, since compensation obligation is not triggered as long as price stays within range	The strike price band may be difficult to set
Additional revenue for generators when market prices remain favorable within the range	The mechanism may be more complex to communicate, bid, and settle
Better support flexible operation & storage integration (resources incentivized to charge during surplus periods & discharge during high prices)	A narrow band may have limited impact, while a wide band may increase volatility

- Impact of partial price protection on revenue stability for generators and cost variability for buyers.
- What could be the appropriate range between the floor and cap levels to achieve balanced allocation of risk between parties?

4.3. Option 3 – One-way CfD Style Mechanism

- A **single strike price** is quoted for the full contract duration.
- If market price is below the strike price, the generator is compensated for the shortfall.
- If market price is above the strike price, the generator retains the gains above the strike price.

Potential benefits	Potential limitations
Substantial earnings during high market prices.	May lead to overcompensation for generators in the initial phase.
Can support faster recovery of project costs.	The mechanism may appear generous unless the market evolves as expected.
Can encourage lower strike prices over time.	Its success depends on market learning and increasing comfort with merchant exposure.

- Will the asymmetric allocation of risk (wherein generators retain upside gains) be appropriate from a market design and fairness perspective?
- Influence of the mechanism on bidding behavior, strike price levels, and overall procurement outcomes.

4.4. Option 4 – Weekly Benchmarking Mechanism

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- The RE generator sells power in the market and realizes actual market revenues during the week.
- At the **end of the week, its weighted average realized price is** compared with the **weekly average market price**.
- If its realized price is lower, it gets a top-up; if higher, it refunds the difference.
- The RE generator may retain a certain percentage of profits.

Potential benefits	Potential limitations
It keeps the generator linked to market signals instead of fully insulating it through a fixed strike price.	A generator may still end up with favorable gains even without making real operational improvements.
Provides only limited weekly revenue balancing instead of full strike-price protection, keeping the generator more exposed to market signals.	Because settlement is based on weekly averages, it weakens incentives to optimize output in high-price periods or integrate storage.
Since adjustment is done once a week rather than every settlement block, the mechanism is simpler and less rigid.	Since settlement is done at a weekly level, the price signal is weaker than in a design that settles against each time block.

- Will weekly benchmarking and settlement provide better balance between market exposure and revenue stability, or will it introduce complexity?
- How should the profit-sharing mechanism (if any) be structured to maintain fairness and efficiency?

5. Contract Tenure – Design Consideration

Objective: To define the range of contract tenures to be evaluated within the pilot and simulation framework, to assess market outcomes, risk allocation, and financial performance under BCS-style mechanism

Option 1: 1 Year

- Minimum viable horizon for capturing seasonal generation variability (monsoon, summer, winter)
- Sufficient to observe DAM/RTM price fluctuations across all market conditions
- Practical given data availability as most operational RE projects will have at least 1 year of timestamped generation and revenue data

Recommended as the base case for simulation

Option 2: 2-3 Years

- Captures inter-year variability in RE generation and market price trends
- Allows stress-testing of settlement fund adequacy over a longer horizon
- Useful as a sensitivity scenario to test how BCS outcomes evolve as RE penetration increases
- Data availability may be a constraint for newer storage/hybrid projects

Can be run as a scenario extension if data permits

Scenario Matrix for Pilot Modelling

Scenario	Technology / portfolio	Contracting structure / firmness	Tenure	Strike price design	Reference price
Solar (base pilot)	Solar; single-technology; individual project-based modelling	Non-firm VRE output	1 year	Competitive bidding; single fixed strike price; technology-specific pricing	DAM; 15-min block-wise price
Wind	Wind; single-technology; individual project-based modelling	Non-firm VRE output	1 year	Competitive bidding; single fixed strike price; technology-specific pricing	DAM + RTM; 15-min block-wise price
Hybrid	Hybrid; single project or limited portfolio	Partially firm through hybridisation	1 year	Competitive bidding; floor-and-cap style arrangement, or weekly benchmark	DAM or DAM + RTM; 15-min block-wise price
RTC	Multi-technology aggregated portfolio	RTC; higher firmness than stand-alone VRE	1 year	Competitive bidding; common strike price for aggregated portfolio; fixed or floor-and-cap, or weekly benchmark	Composite reference price; 15-min or hourly granularity
FDRE	Hybrid / storage-oriented portfolio	FDRE; fully firm or near-fully firm	1 year	Competitive bidding; floor-and-cap or one-way CfD	DAM + RTM; 15-min block-wise price
BESS	Storage / BESS; individual project-based modelling	Fully firm enabled via storage	1 year	Bilaterally negotiated or competitively bid; floor-and-cap	Avg of top 3 Auction Price in last 6 months

Inputs Required and Potential Data Sources

Modelling input	What is needed for modelling	Potential Data Source
Historical generation data	15-min generation data for 1 year	Developer; Plant SCADA / metering records
Schedule data	Day-ahead schedule & revisions at block level	RLDC / SLDC / NLDC
Actual injection / metered data	Block-wise actual injection data	RLDC / SLDC / NLDC; project metering records
Storage operating data	Charge-discharge profile, SoC, round-trip efficiency, dispatch schedule vs actual	Developer; EMS logs; SLDC
Reference price data	DAM / RTM / GDAM MCP / Auction Price	IEX, PXIL,
Strike price inputs	Recent discovered tariffs for similar technologies and structures	SECI results and recent awarded tender data
Buyer-side benchmark	Relevant procurement structure and cost analysis of buyer for comparison	PSA / procurement documents; scenario assumptions
Business-as-Usual case	Existing revenue realization logic under current contract structure	Existing PPA / PSA terms plus historical project generation and price realization data

Output Parameters for Simulation Assessment

Output parameter	What will be assessed
Gross market revenue realization	Revenue earned by the generator from the market
BCS settlement flows	Magnitude & frequency of top-up payments / refunds under BCS-style mechanism
Net realized revenue to generator	Combined effect of market revenue plus/minus BCS settlement under selected scenario.
Generator Revenue stability / volatility	Extent to which selected scenario improves cash-flow stability for the generator relative to direct market exposure or Business-as-Usual outcomes
Buyer cost exposure	Total cost to the buyer after accounting for market purchase cost & BCS settlements
Risk allocation shift	How risk moves between generator and buyer when moving from Business-as-Usual to BCS-style mechanism
Sensitivity to strike price	How outcomes change when strike-price is varied
Bankability / investor attractiveness	Whether the design provides sufficient revenue visibility & downside protection for project financing.
Tariff Impact for buyer / consumer	Whether the design remains commercially viable for buyers while supporting market-linked procurement.

Thank You