PTC India

Electricity Trader's Perspective on Electricity Derivatives

19th February 2024

Why is an Electricity Derivatives Market Necessary

- Helps in lowering price volatility over time.
- Better price discovery and transparency.
- Helps hedge open positions in the physical forwards market.
- Helps a market participant locked in long-term contracts to express short-term views.
- Can boost the internal rate of return of investments in electricity assets.

Tailwind behind Introduction of Derivatives

- **Government's stated policy to make short-term markets 20-25% of the overall electricity generation.**
- **Jurisdictional clarity: SEBI to regulate.**
- **Allows merchant capacity and open positions to be assumed by market participants. Challenges to long-term contracting can be overcome.**
- **Increased adoption of variable renewable energy sources and newer elements like storage (BESS/PSP, Ancillary services) need a Financial market for hedging/speculation.**
- **500 GW of renewable energy addition in a 400 GW installed capacity will need a financial market.**

Basic Parameters

Cash settled contracts regulated by SEBI.

Underlying reference prices to be discovered on physically settled contracts on power exchanges (IEX, PXIL, HPX).

To begin with, monthly futures contracts are being designed.

Can be used for risk management and investment.

MCX AND NSE CURRENTLY WORKING ON CONTRACTS DESIGN

International Exchanges with Electricity Derivatives

New York Mercantile Exchange (NYMEX)

Nord Pool

European Energy Exchange (EEX)

Intercontinental Exchange (ICE)

Singapore Exchange Limited (SGX)

Common Derivatives

1) Forwards

2) Futures

3) Swaps

4) Options

5) Contract for Difference

Forwards (OTC Contracts)

Obligation to buy or sell a fixed amount of electricity at a pre- specified contract price(the forward price), at certain time in the future (called maturity or expiration time)

Electricity forwards are custom tailored supply contracts between a buyer and a seller

Buyer is obligated to take power and Seller is obligated to supply

Electricity forward prices are:

Based on forward (long-term) expectations Stable behavior

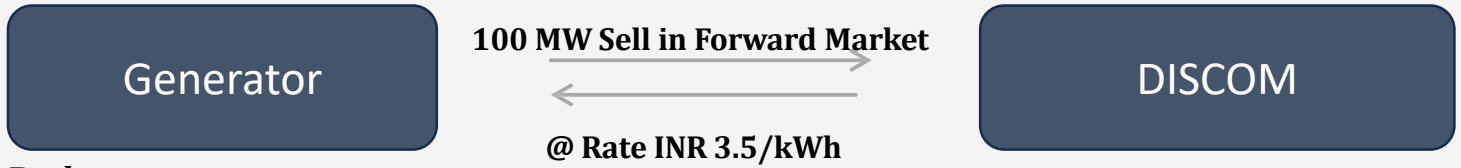
Long-term forwards have low volatility, short-term forwards may have high volatility correlation with fuels

In India, long term Forwards called 'PPA' with >7 year offtake & levelized tariff are in vogue

Risks in Forward Market

Example

- Forward Contract Entered in Feb'24 for Delivery in July'24



- Two types of Credit Risk

1. **Replacement Risk:**

   i) Definition: Occurs before delivery if a counterparty defaults (e.g., buyer refuses to accept power in July 2024).

   ii)Quantification: The seller incurs losses by securing a new contract at the prevailing market price, which may be lower than the agreed price. Here, the example calculates the loss assuming a new price of INR 3/kWh and a contractual volume of 100MWh/day for 30 days.

   iii)Mitigation: Creditworthiness checks, collateral requirements, and diversification of counterparties can reduce exposure.

2. **Settlement Risk:**

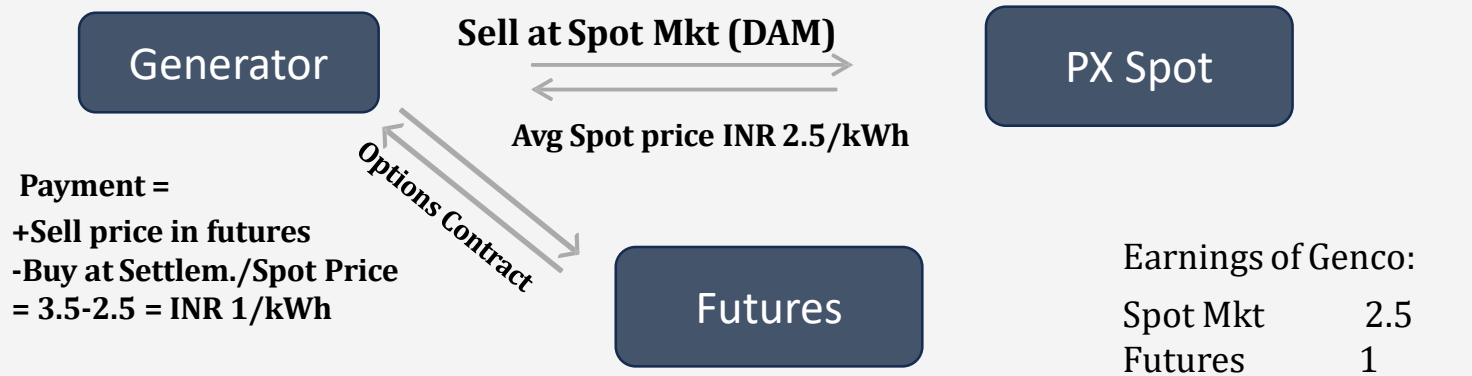
   i) Definition: Occurs after delivery if a counterparty fails to pay for received power.

   ii)Quantification: The example illustrates the potential loss using the agreed price (INR 4/kWh) and the same volume and duration as the replacement risk scenario.

   iii)Mitigation: Similar to replacement risk, various strategies can be employed, including payment guarantees, credit limits, and prompt collection procedures.

Hedging with Futures

- Sells a Future contract at a future price in Feb '24 @ **INR 3.5/kWh** which settles at spot market price
- Scenario 1:- Avg. spot market price during delivery period **INR 2.5/kWh.**

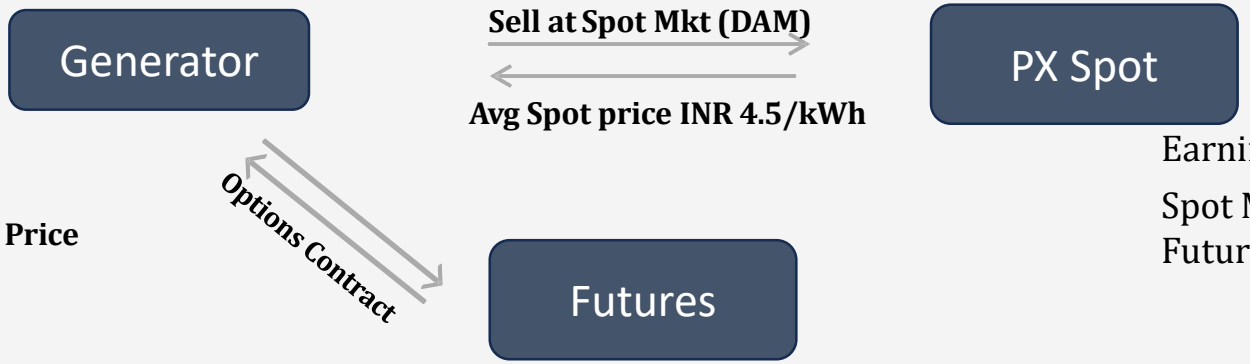


Payment =
+Sell price in futures
-Buy at Settlem./Spot Price
= 3.5-2.5 = INR 1/kWh

Earnings of Genco:

Spot Mkt	2.5
Futures	1
	3.5

- Scenario 2:- Avg. spot market price during delivery period **INR 4.5/kWh**



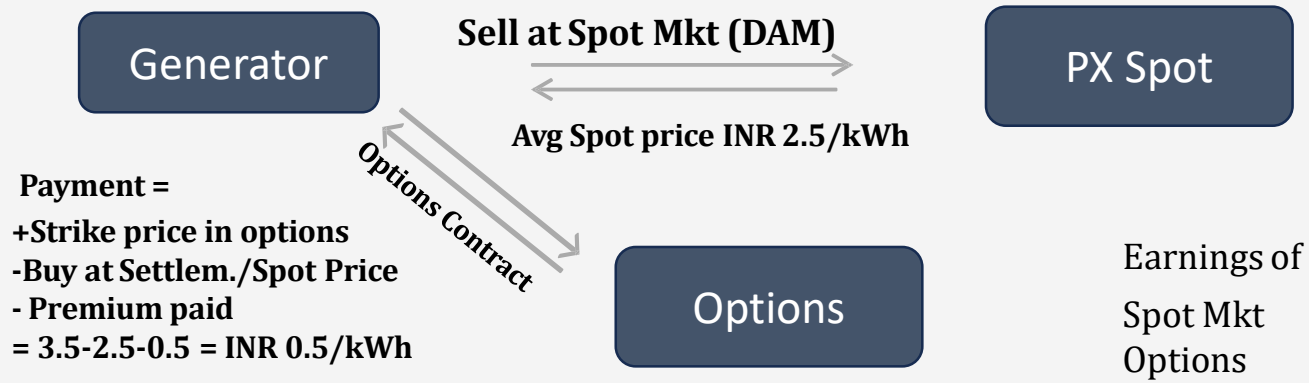
Payment =
+Sell price in futures
-Buy at Settlem./Spot Price
= 3.5-4.5INR -1/kWh

Earnings of Genco:

Spot Mkt	4.5
Futures	-1
	3.5

Hedging with Options

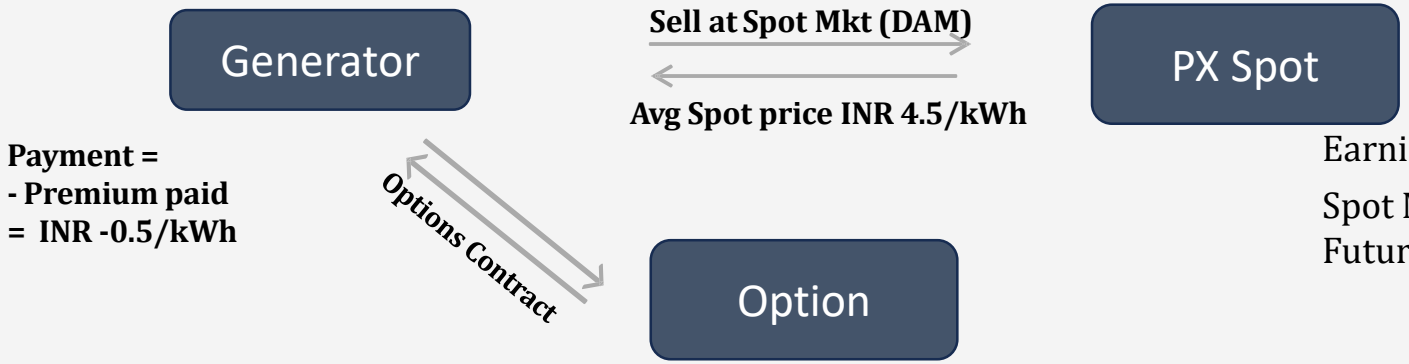
- Buy a put contract in Feb'24 at a strike price of **INR 3.5/kWh** by paying a premium @ Rs. 0.5/kWhr
- Scenario 1:- Avg. spot market price during delivery period **INR 2.5/kWh. Hence Exercise Option**



Earnings of Genco:

Spot Mkt	2.5
Options	0.5
	3

- Scenario 2:- Avg. spot market price during delivery period **INR 4.5/kWh, Option not exercised**



Earnings of Genco:

Spot Mkt	4.5
Futures	-0.5
	4

Swaps

1) Financial contracts

2) Holders pays fixed price for electricity, regardless of floating electricity price, or vice versa, over the contracted time period.

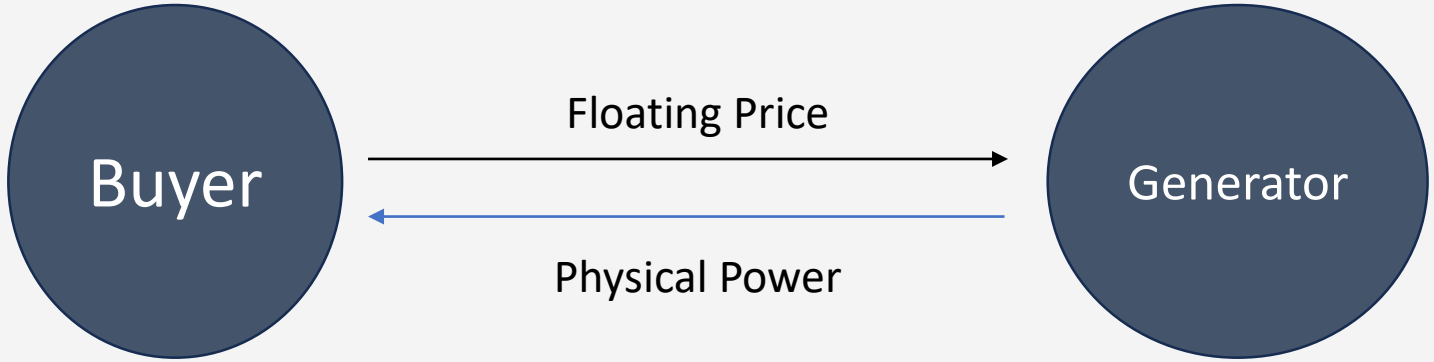
3) Established for fixed quantity of power referenced to a variable spot price at either a generator's or a consumer's location.

4) For short- to medium-term price certainty up to a couple of years.

5) Strip of electricity forwards with multiple settlement dates and identical forward price for each settlement.

Example: Electricity Swap

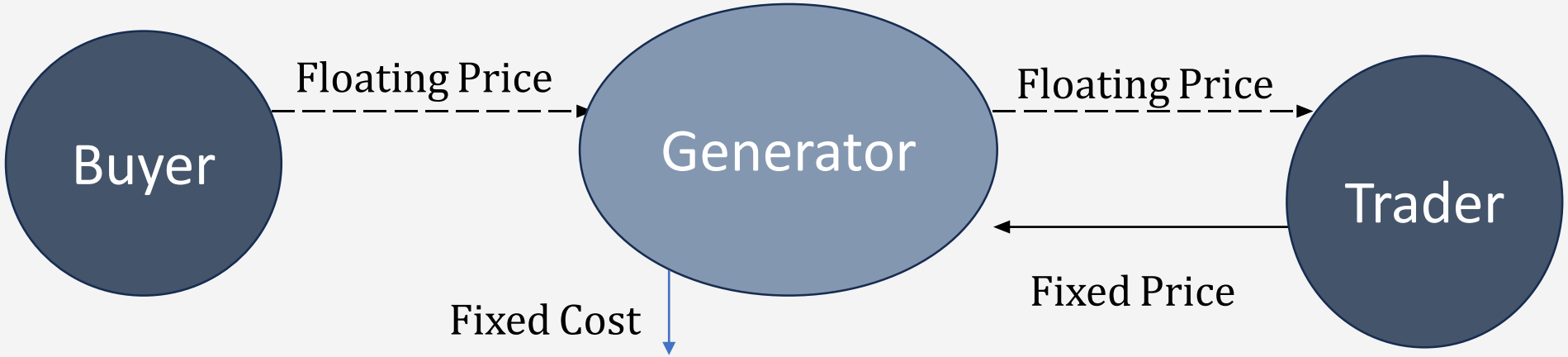
Imagine it is August 2024 and a generator enters into a contract to sell 100 MW of electricity for the period of September 2024 at a daily floating price. The power can be generated at INR 2500/MWh. What is the Market Risk?



Supply Unhedged: What is the floating price structure, considering a volume of 100 MW to be supplied over a 30-day period from 01/09/24 to 30/09/24, with no fixed price but production costs set at INR 2500?

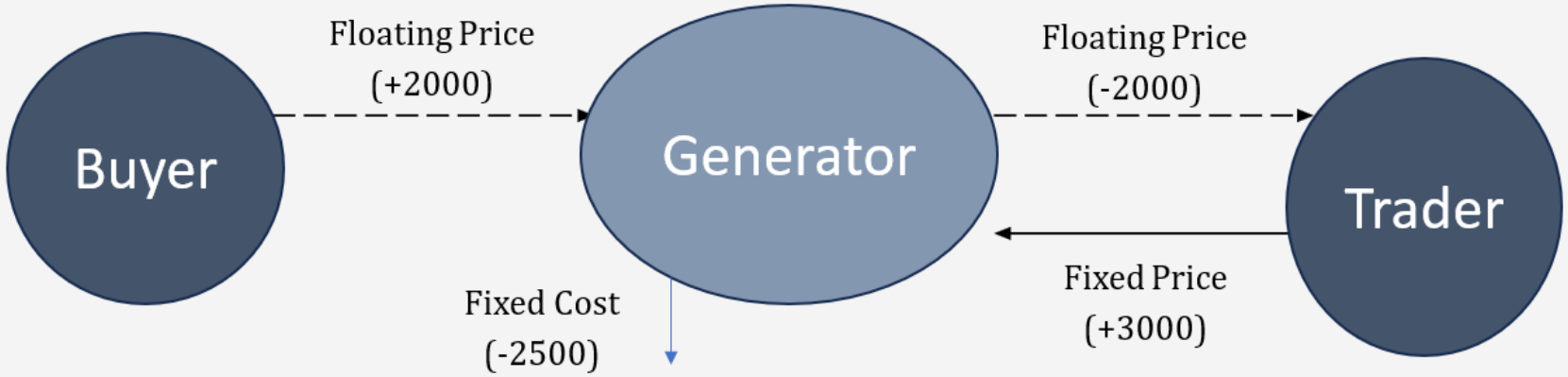
Example: Electricity Swap

- Trader commits to paying Generator INR 3000/MWh for a total power capacity of 100 MW throughout September 2024.
- In return, Generator undertakes to compensate Trader with cash flows based on a fluctuating price corresponding to the agreed-upon electricity quantity, spanning a one-month duration.
- The integration of this swap with an indexed electricity supply contract enables the Generator to secure a stable income while facilitating sales to PX



Supply Hedge

In the outlined supply hedge scenario, encompassing a volume of 100 MW throughout the period from 01/09/24 to 31/09/24, the pricing structure is as follows. A fixed price of INR 3000/MWh is established in accordance with the Swap Aggregate. Simultaneously, a floating price of INR 2000/MWh, reflective of the average for September '24, is incorporated into the arrangement. Additionally, production costs for the same period are set at INR 2500.



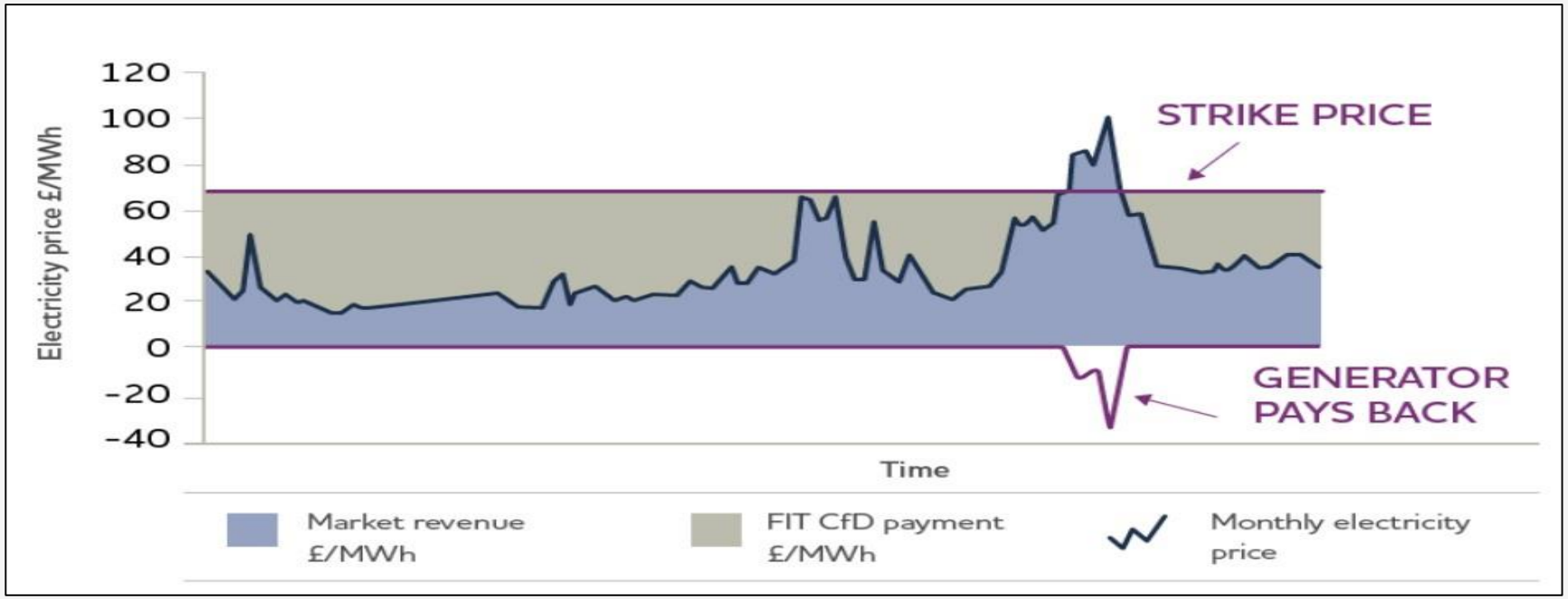
Net Gain from Hedging= INR 500/MWh

Contract for Difference (CfD)

1) CfD is a long-term contract between an electricity generator and Low Carbon Contracts Company (LCCC), which can be a Distribution Company/Market Maker. The contract enables the generator to stabilise its revenues at a pre-agreed level (the Strike Price) for the duration of the contract.
2) Under the CfD, payments can flow from LCCC to the generator, and vice versa.
3) CfD provides long-term price security to renewable energy providers, allowing investment to come forward at a lower cost of capital and therefore at a lower cost to consumers.
4) The pool is maintained by the government entity with good credit rating to give comfort to the renewable energy developers.

Contract for Difference

Under the CfDs, when the market price for electricity generated by a CfD Generator (the reference price) is below the Strike Price set out in the contract, payments are made by LCCC to the CfD Generator to make up the difference. However, when the reference price is above the Strike Price, the CfD Generator pays LCCC the difference.



EEX Power Derivatives

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Example of EEX German Power Futures

Trading hours	Maturities	Delivery rate	Tick size	Fulfilment
Exchange trading 8:00 am to 6:00 pm (CET) Trade Registration 8:00 am to 6:00 pm (CET)	Day, weekend, current week and next 4 weeks, current month and next 9 months, next 11 quarters and next ten years.	1 MW	€ 0.01 per MWh	Cash settlement/ Physical fulfilment

Example of EEX German Power Options

Trading hours	Maturities	Delivery rate	Tick size	Fulfilment
Exchange trading 8:00 am to 6:00 pm (CET) Trade Registration 8:00 am to 6:00 pm (CET)	The respective next eight delivery months, six delivery quarters and the respective next 4 delivery years of the underlying. Up to four contracts with different expiry dates* (each at the end of a quarter in the preceding year) are available for every delivery year of the underlying.	1 MW	€ 0.01 per MWh	Contractually fulfilled

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Example of German Power Baseload Calendar Month Futures

Trading hours	Contract unit	Listed Contracts	Minimum Price Fluctuation	Fulfilment
Sunday - Friday 6:00 p.m. - 5:00 p.m. (5:00 p.m. - 4:00 p.m. CT) with a 60-minute break each day beginning at 5:00 p.m. (4:00 p.m. CT)	1 MWh per hour x 24 hours x # of days in the contract month adjusted for **Daylight Saving Time (**DST)	Monthly contracts listed for the current year and the next 4 calendar years. Add monthly contracts for a new calendar year following the termination of trading in the November contract of the current year.	€0.01 per MWh	Financially Settled

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Example of PJM West hub 50MW Same Day Options - Specs

Trading hours	Contract unit	Listed Contracts	Minimum Price Fluctuation	Fulfilment
Sunday - Friday 6:00 p.m. - 5:00 p.m. (5:00 p.m. - 4:00 p.m. CT) with a 60-minute break each day beginning at 5:00 p.m. (4:00 p.m. CT)	50 MW x 16 peak hours = 800 MWh	1 day	0.01 x 50 MW x 16 peak hours = $8.00	Financially Settled

How can you play?

- Knowledge of the short-term bilateral market with an understanding of nuances.
- Strong assessment of price and volume movements in the physical market during the duration of the derivatives contract.
- Understanding of price discovery on power exchanges.
- Ability to set up the classic front, middle, and back-office desks for setting up exposures, executing trades, and record-keeping.

List of Abbreviations

- **SEBI** – Securities & Exchange Board of India
- **BESS** – Battery Energy Storage System
- **PSP** - Pump Storage Plants
- **IEX** – Indian Energy Exchange
- **PXIL** – Power Exchange India Limited
- **HPX** – Hindustan Power Exchange
- **OTC** – Over The Counter
- **PPA** – Power Purchase Agreement
- **DISCOM** – Distribution Company

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