

RENEWABLE ENERGY MARKETS PANEL DISCUSSION

LATEST CORPORATE PPA TRENDS AND LESSONS THAT CAN BE APPLIED IN EMERGING MARKETS



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**Renewable Energy
Markets™ 2023**

Common Options for Corporations

There are many renewable energy supply options available to corporations

- Buy green power through a PPA (with RECs) with an offsite project
- Buy green power through a PPA (with RECs) with an onsite project
- Buy a green power product from an electric service provider (bundled REC product)
- Own, operate, generate and consume green power from an onsite project (with RECs)
- Buy unbundled RECs

The right option will depend on your renewable energy goals

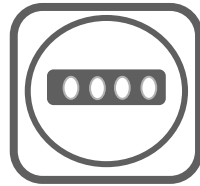
Case Study:

PPA For Off-Site Generation with RECs

Who are the entities involved?



Developer - builds, owns, and operates the project and delivers the energy output

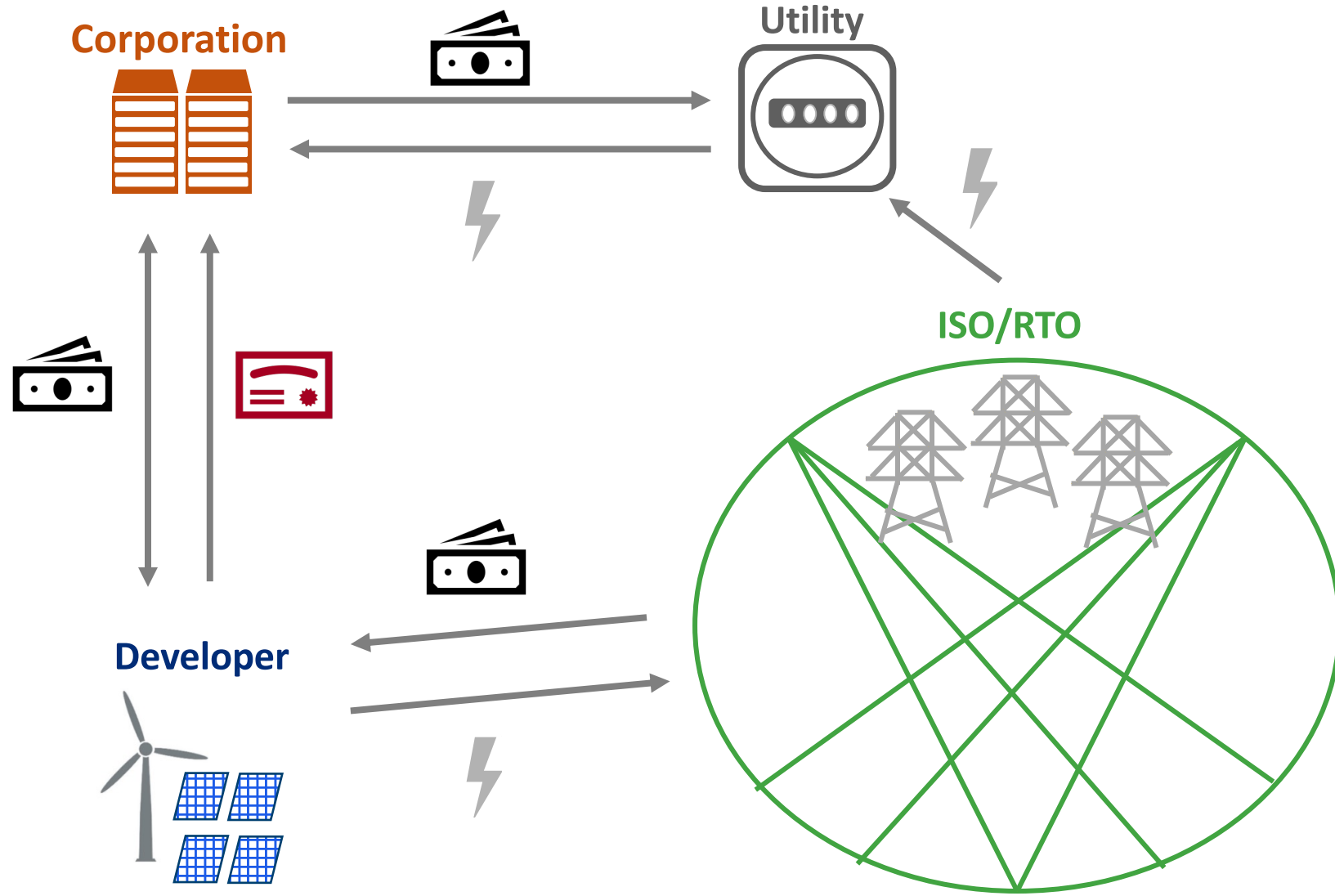


Utility – local electric distribution company that will continue to deliver electricity to and bill the corporation



ISO/RTO – responsible for managing the regional energy market and dispatching electricity

Overview of Power and Money Flow



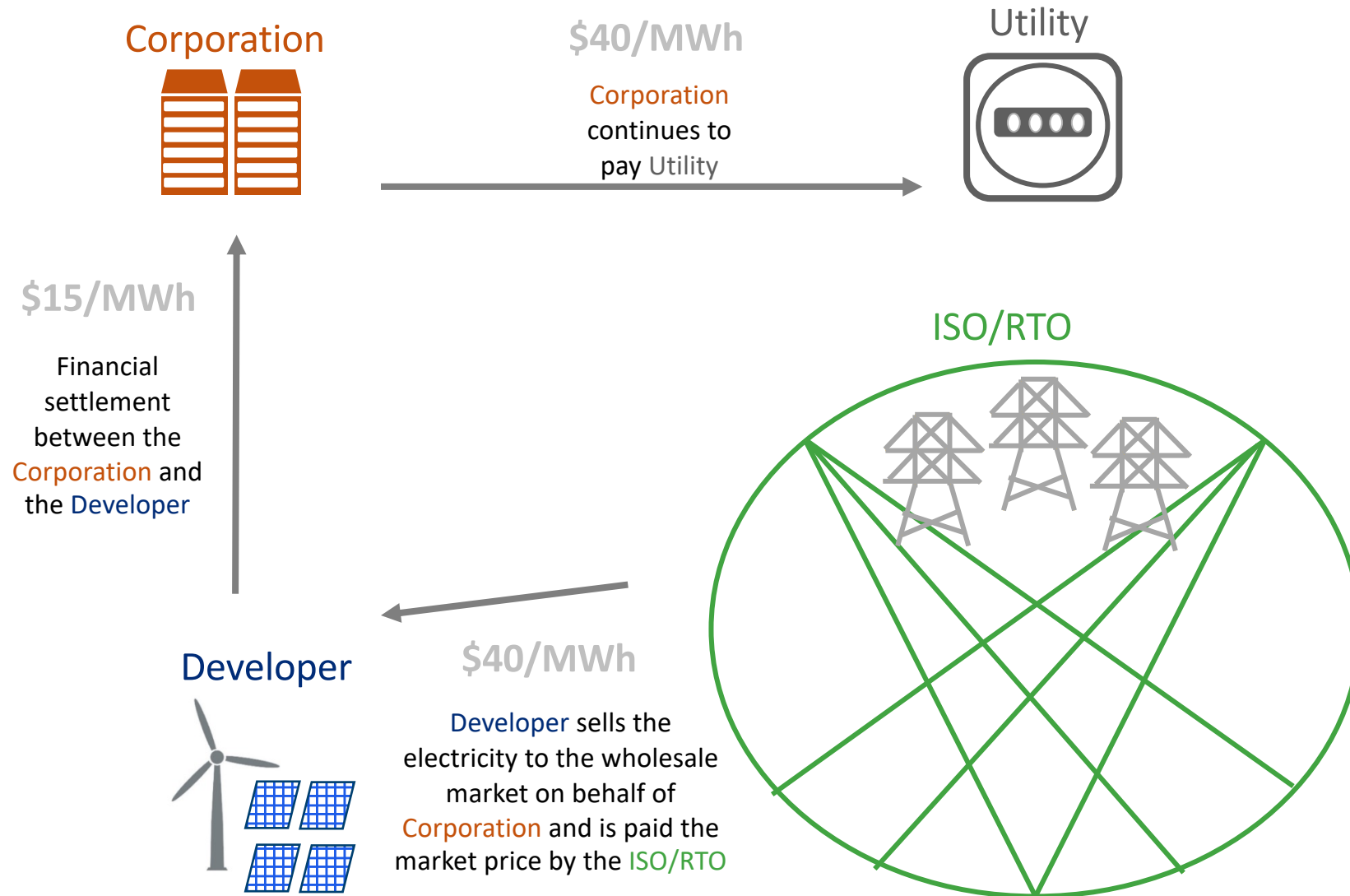
Assumptions for Examples

We will provide two example scenarios on the following slides. For simplicity, we made the following three assumptions to facilitate understanding.

- The corporation and the renewable facility are located within the same wholesale market
- The corporation pays the utility the same wholesale price, i.e., the locational marginal price (“LMP”) that the renewable facility receives from the ISO/RTO
- The corporation consumes the same amount of MWh that the renewable facility generates

Scenario 1:

PPA Price $\$25/\text{MWh} < \text{LMP } \$40/\text{MWh}$



Scenario 1 Results

Certainty for the Corporation

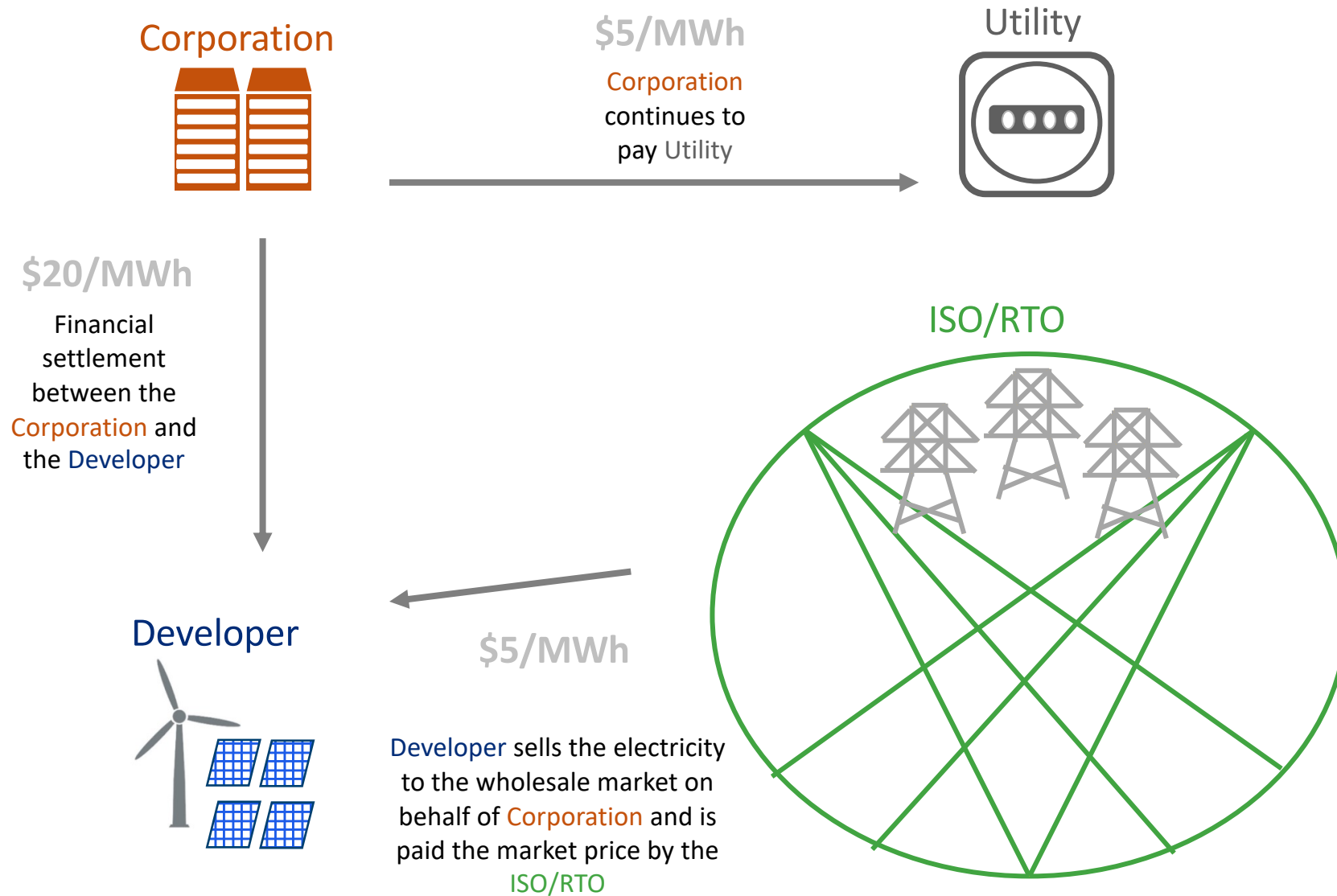
- The corporation pays the utility \$40/MWh, and receives \$15/MWh from the developer. The resulting cost of electricity is \$25/MWh, the fixed price under the PPA.

Certainty for the Developer

- The developer receives \$40/MWh from the ISO/RTO, and pays the corporation \$15/MWh. The resulting revenue is \$25/MWh, the fixed price under the PPA.

Scenario 2:

PPA Price $\$25/\text{MWh} > \text{LMP } \$5/\text{MWh}$



Scenario 2 Results

Certainty for the Corporation

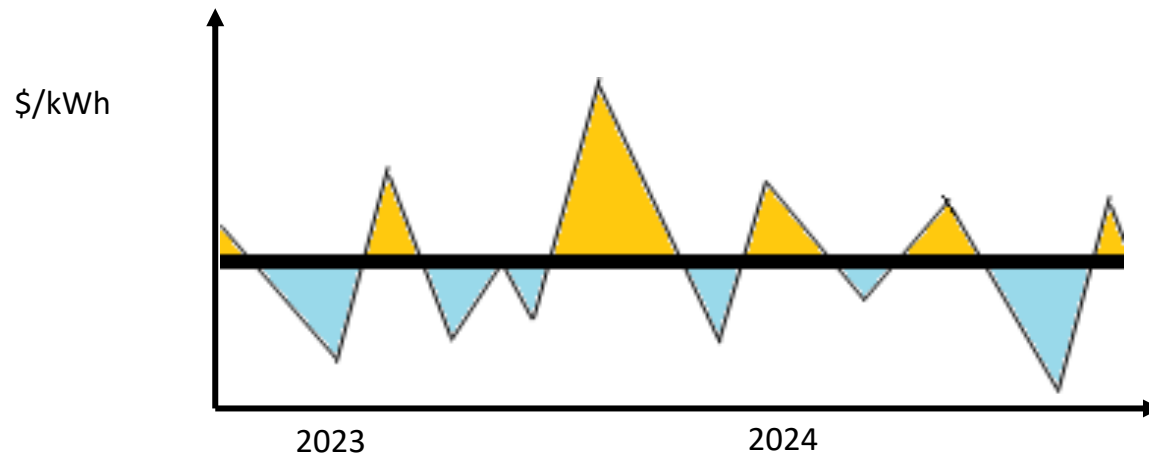
- The corporation pays the utility \$5/MWh, and pays the developer \$20/MWh. The resulting cost of electricity is \$25/MWh, the fixed price under the PPA.

Certainty for the Developer

- The developer receives \$5/MWh from the ISO/RTO, and receives \$20/MWh from the corporation. The resulting revenue is \$25/MWh, the fixed price under the PPA.

Both Parties Gain Certainty from Entering into PPA

- The PPA is a hedge that gives price certainty to the corporation
- The developer receives a set revenue stream and is not subject to volatility of the electricity market

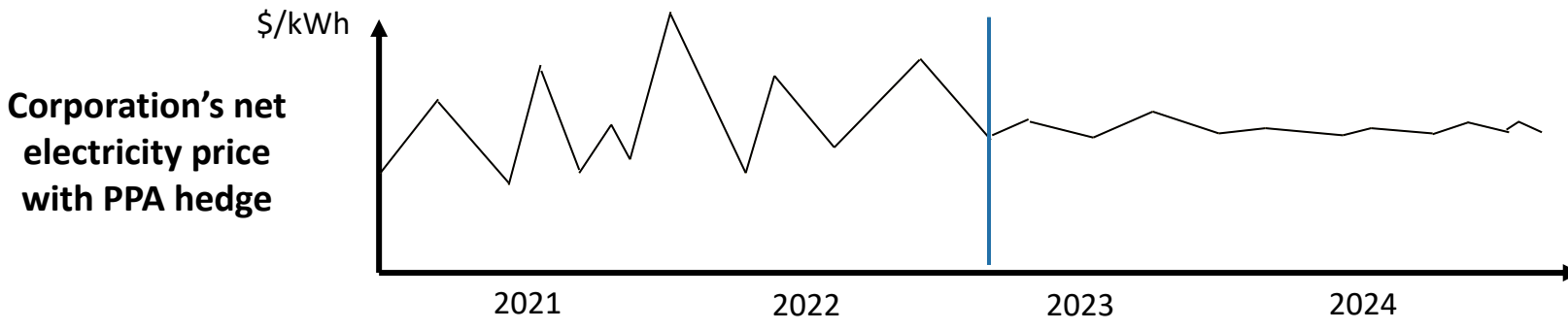
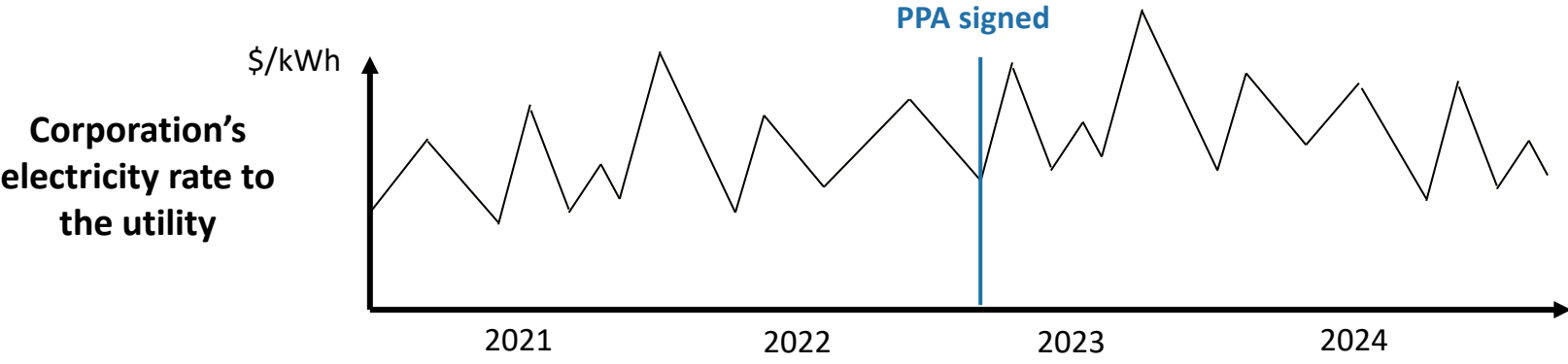


Relaxing the Assumptions will Lead to Variance

These three assumptions are not usually true. The degree to which these deviate from the truth is the magnitude of the variance under the PPA.

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Nonetheless the PPA will Smooth Electricity Rate Volatility

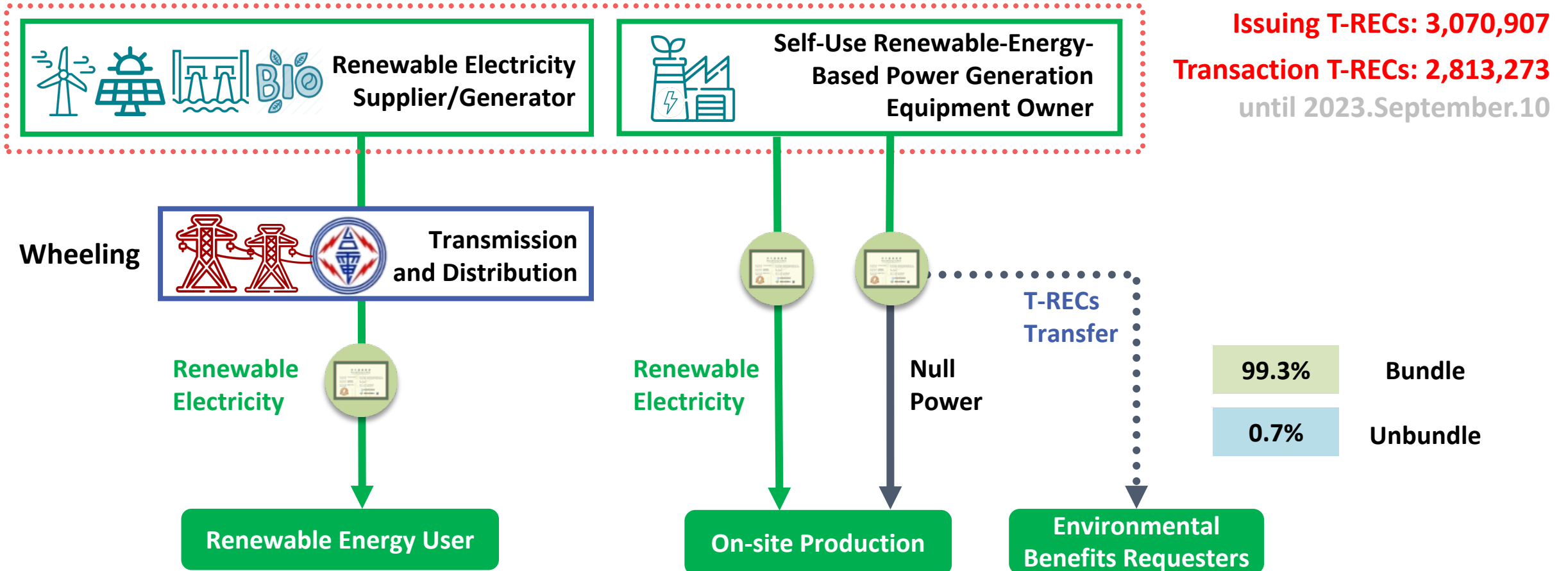


Pricing under PPA and Long-term REC contracts

- Generally price is inversely related to the length of contract
- The developer recovers the cost of installation and a reasonable return on their investment
- For PPAs, consider a settlement price based on a liquid electricity hub price within the same region
 - Energy price levels and volatility vary substantially between different regions, so settlement prices based on hubs that are not located within the same region may not be a good hedge

The International Experience

The T-REC Issuance Static

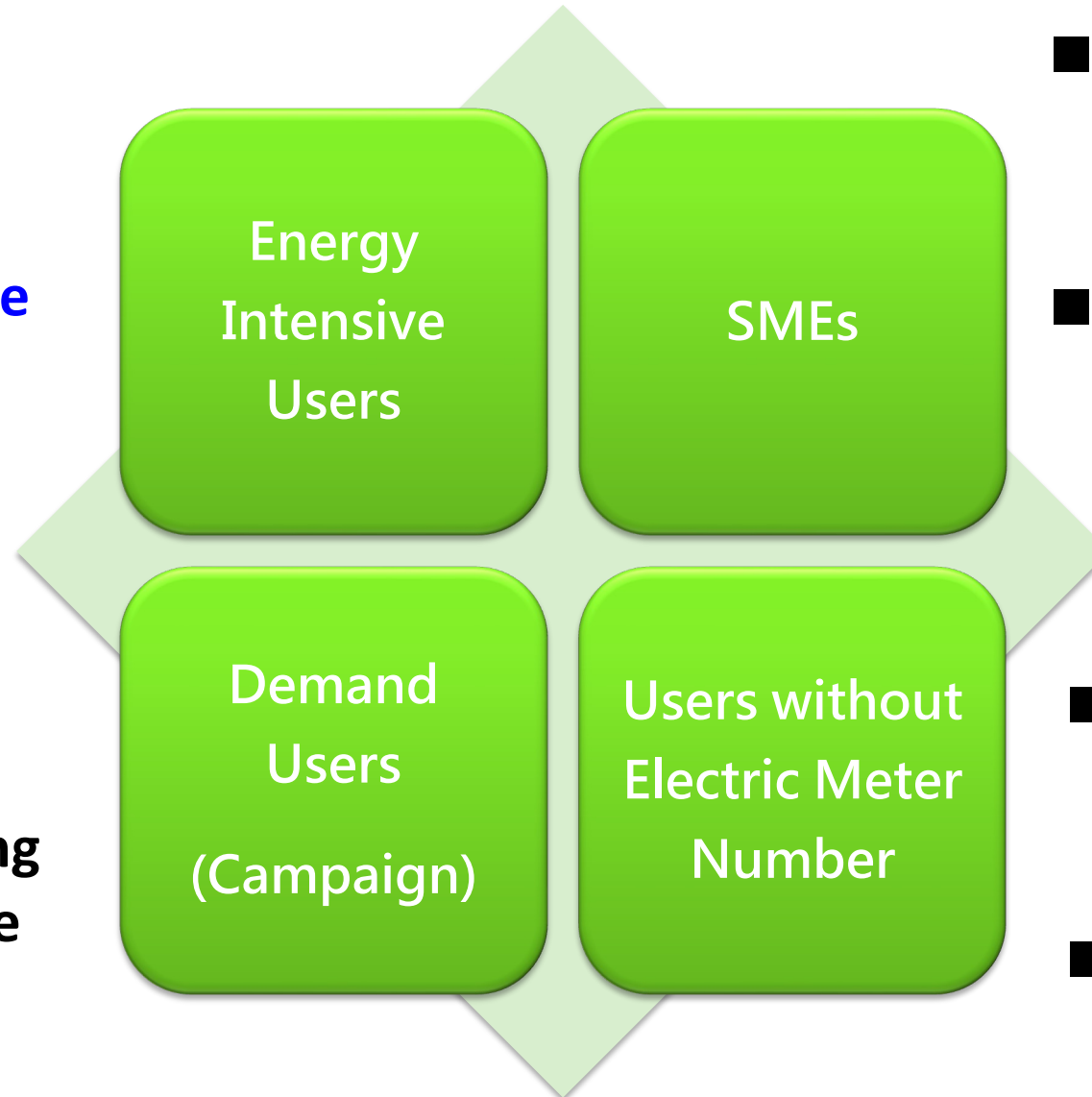


	Wheeling T-RECs	Self-Generation T-RECs	Buying only T-RECs
Number	2,790,974	257,634	22,299
%	91%	8.3%	0.7%

Renewable Market Electricity Supporting Policy

- **Corporate Power Purchase Guarantee (CPPG) Scheme**

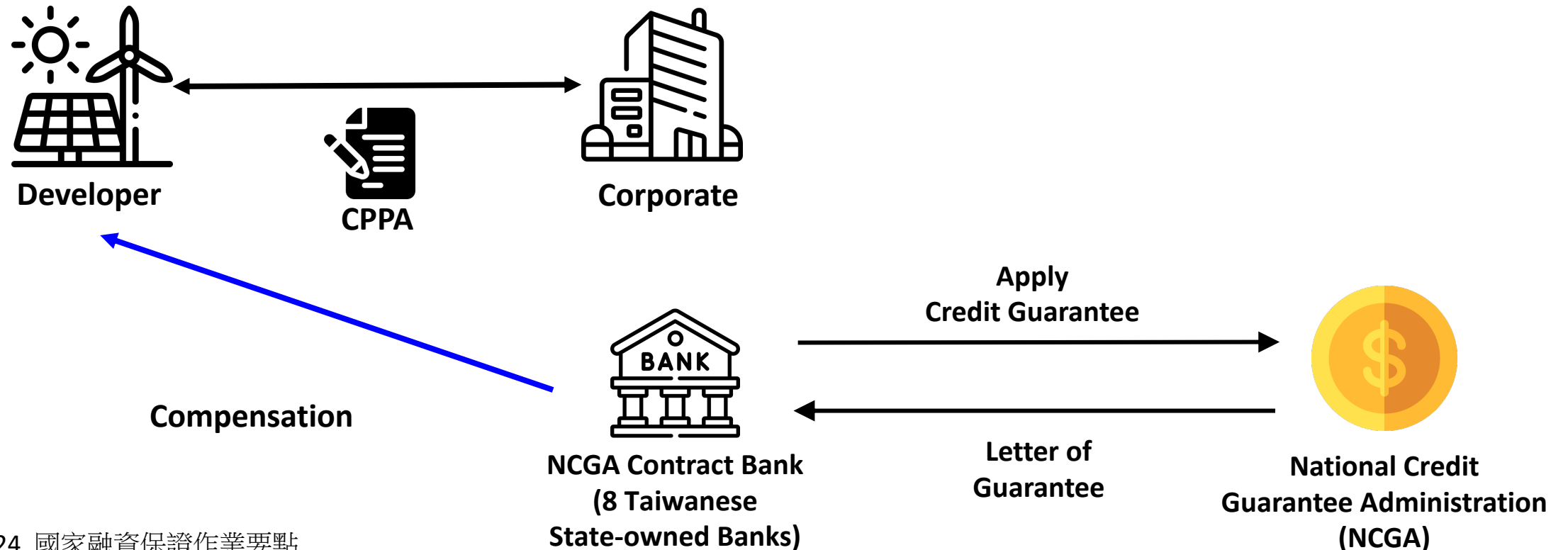
- **Green Marketplace activity**
- **Green power trading consultation service**



- **Taipower small green power commodity pilot project**
- **Public & State-owned land tendered PV project reserved 30% green power for SMEs**
- **Multi-user in Single Electric Meter Number Program**
- **Green Leasing Program**

Corporate Power Purchase Guarantee Scheme

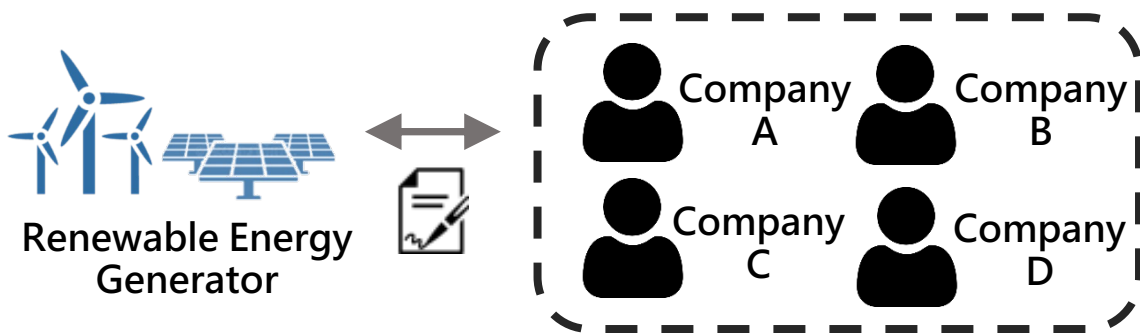
- Provide credit guarantee to corporates when signing CPPAs
- Compensate for **electricity sale revenue loss** if the corporate off-taker **cannot fulfill payment obligations**.



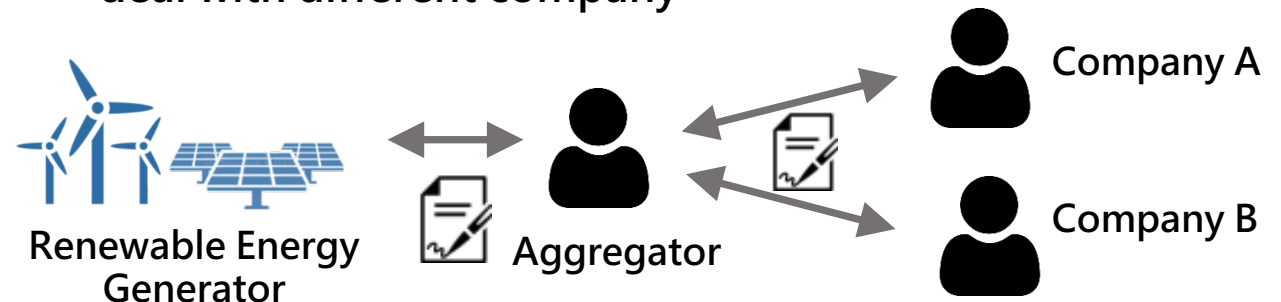
Aggregated Power Purchase Agreement (APPA)

- In response to the rapid growth of green power market and diverse transaction, in addition the offshore wind power will enter market in 2026-2027 in bulk.
- Many corporates have expressed interest in obtain green power in the form of group purchases to facilitate using green power for their operations and supply chains.

1 All members in one CPPA



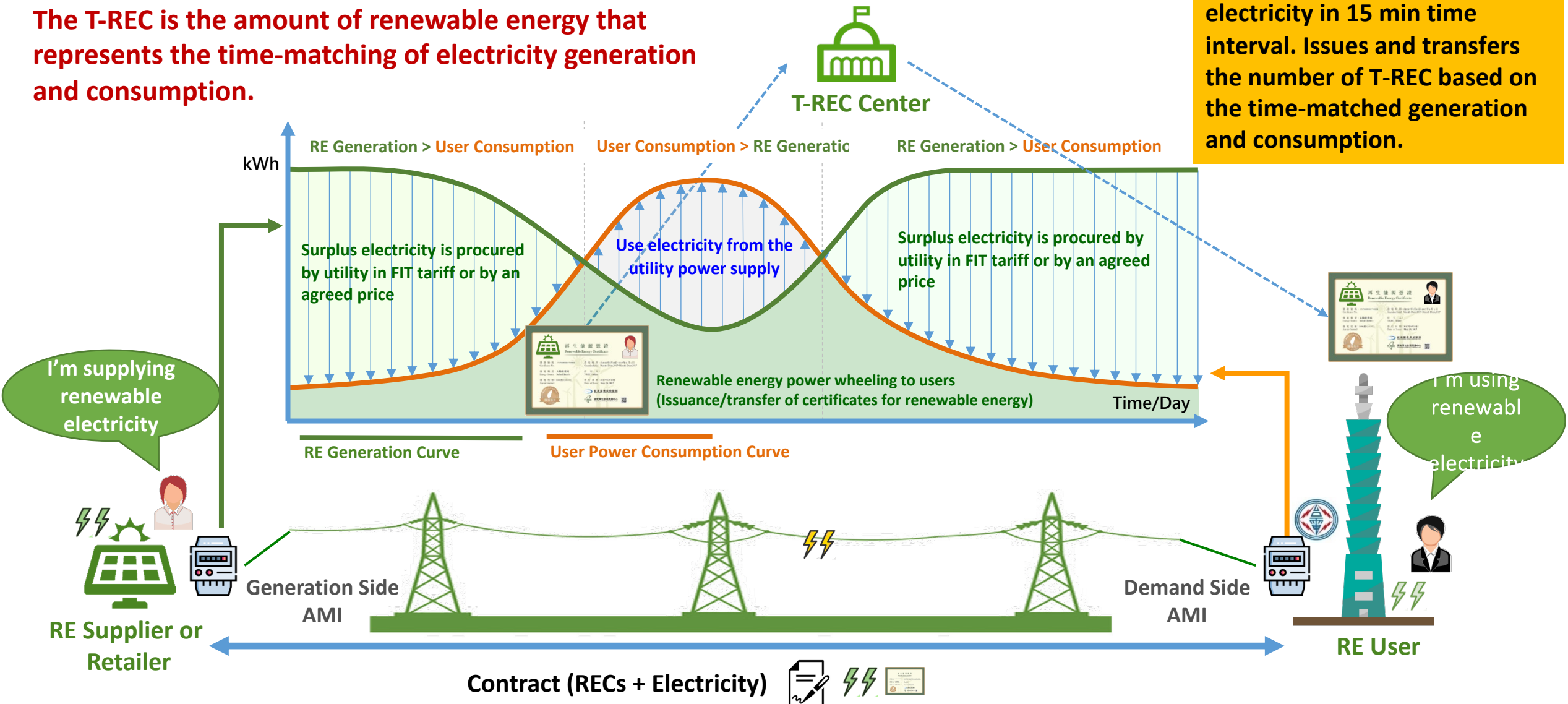
2 Aggregator sign CPPA with RE generator, then separate deal with different company



The Usage Model of T-REC to Supports 24/7 Renewable Electricity

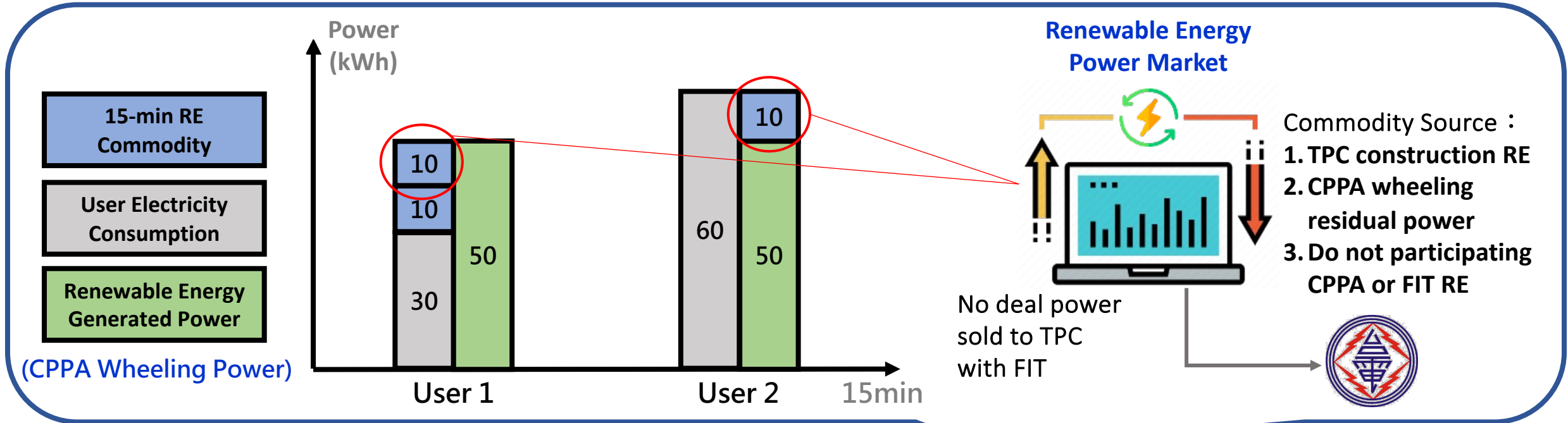
The T-REC is the amount of renewable energy that represents the time-matching of electricity generation and consumption.

The AMI records the generation and consumption of electricity in 15 min time interval. Issues and transfers the number of T-REC based on the time-matched generation and consumption.

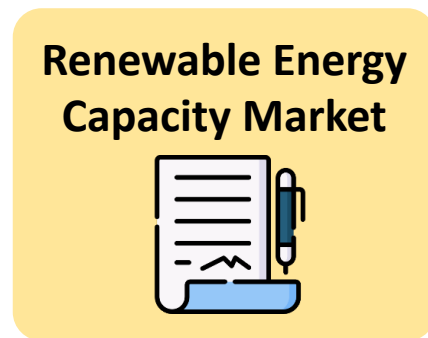


The Concept of RE Market Mechanism Support RE Supply & Demand Balancing

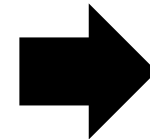
Wheeling Residual Power Double Auction Matching



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**Achieve 24/7
Carbon-Free Electricity**

(CPPA + CPPA Orientated Wheeling)

(Power Trading+ Trading result Orientated Wheeling)

Q&R