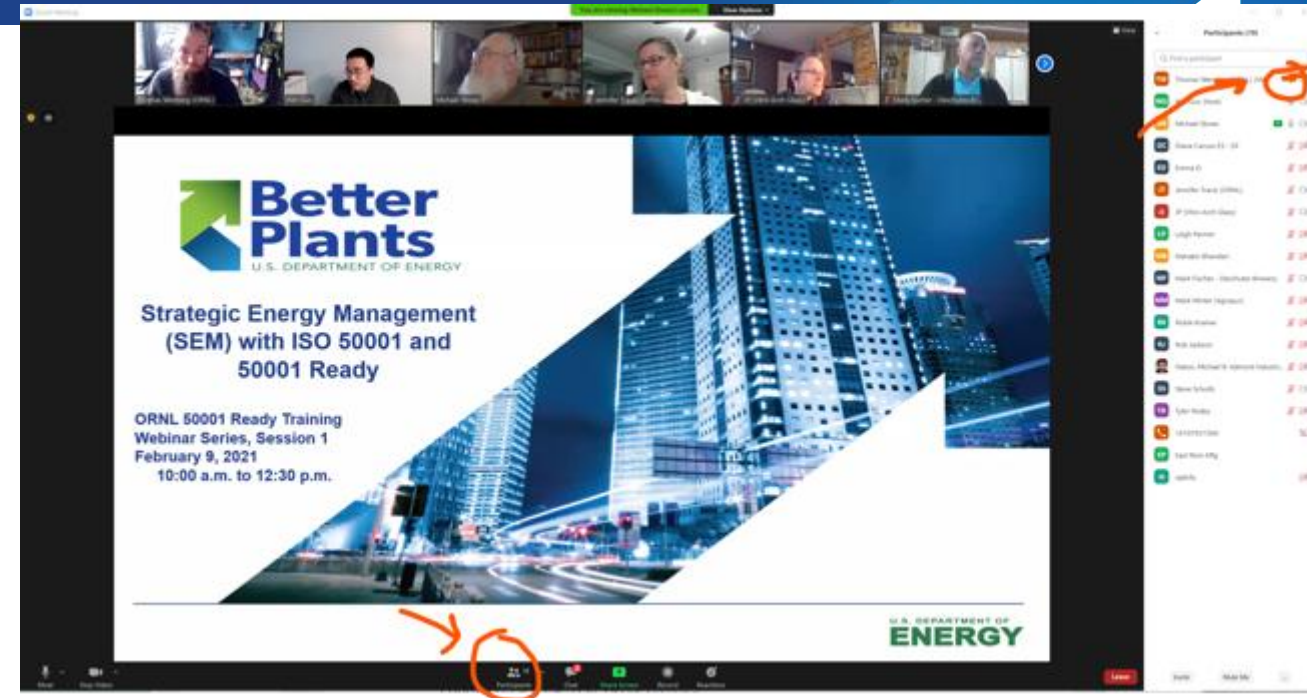


Rename Yourself to be your Real Name (Company Name)

1. Click on Participant list
2. Go to the right and hover over your name
3. Select “More” & “Rename”
4. Enter your company name in brackets
5. Turn on your camera 😊



Rename [X]

Enter a new screen name:

☒ Remember my name for future meetings

OK **Cancel**



Virtual Training: Renewable Energy Contracting Options and RECs

Renewable Electricity Supply Options: Financing Models and Strategies

Session #6

September 9, 2025

10:00am – 12:00pm EST

General Information

- Schedule: Every Tuesday (Aug 5th – Sep 9th) morning @ 10am ET
- Sessions will be recorded
- We want these VT to be interactive!
- We're hoping you finish the VT with some big progress
- There will be homework – just try your best!
 - “You’ll get out what you put in!”

Links:

<https://bptraining.ornl.gov/>

<http://betterbuildingsolutioncenter.energy.gov/better-plants>

<https://measur.ornl.gov>



Training Overview

1. 08/05: Fundamentals Of Renewable Electricity And Emissions Inventory
2. 08/12: Understanding The U.S. Electricity Markets And Procurement Roadmap
3. 08/19: Purchasing Renewable Electricity: PPAs, VPPAs, and Other Supply Options
4. 08/26: Navigating Voluntary Electricity Markets
5. 09/02: Purchasing Renewable Electricity: Best Practices and Success Stories
6. **09/09: Renewable Electricity Supply Options: Financing Models and Strategies**



Renewable Electricity Supply Options: Financing Models and Strategies

Indraneel Bhandari

Paul Lemar

Oak Ridge National Laboratory



Today's Speakers



Paul Lemar

*Technical Account Manager,
Oak Ridge National Laboratory*

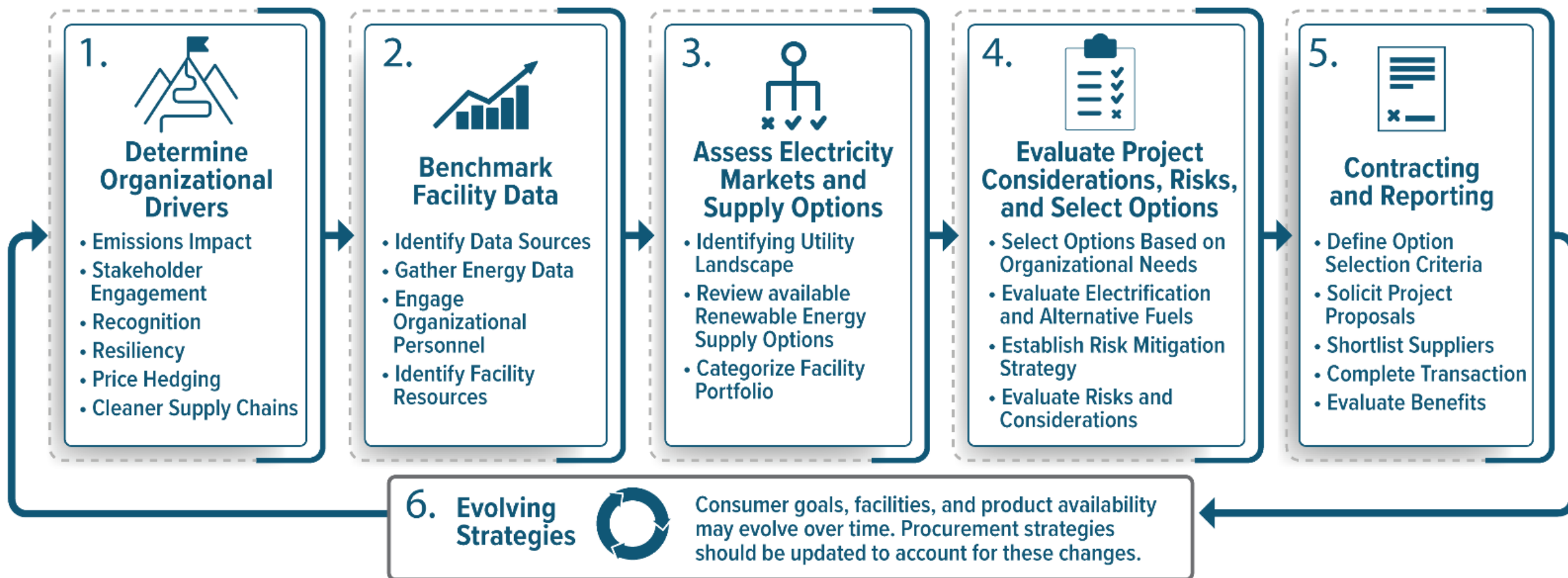


Indraneel Bhandari

*R&D Associate,
Oak Ridge National Laboratory*

Training Recap

Renewable Electricity Procurement Roadmap



Renewable Electricity Procurement Roadmap

Determine Organizational Drivers

- Determine your drivers:
 - Emissions Impact
 - Stakeholder Relations
 - Recognition
 - Energy Independence
 - Hedging Price Risks
 - Cleaning Supply Chains
- What are your goals?
 - Outcomes
 - Metrics



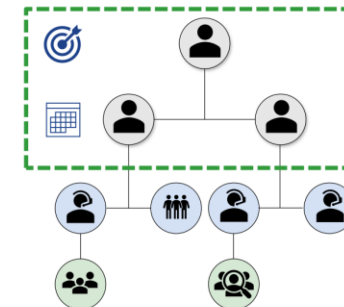
¹ Solar power cost in some states reach below \$0.10/kWh, average fossil fuel electricity cost is \$0.13/kWh. Ref: <https://www.investopedia.com/articles/personal-finance/042315/how-profit-solar-energy.asp>

² According to IRENA's estimates: <https://www.irena.org/Publications/2023/Step/Renewable-energy-and-jobs-Annual-review-2023>



Identify Key Stakeholders

- Who are the key decision-makers?
 - Procurement Team
 - Executive Leadership
 - Energy Team
 - Internal Accounting
 - Legal
- What is your timeline?
 - Commercial Operation Date or COD
 - Based on your renewable energy targets
 - Technology preference
 - Due date



What is a GHG inventory

GHG Inventory is a list of all the emissions sources and associated emissions within an organization boundary.

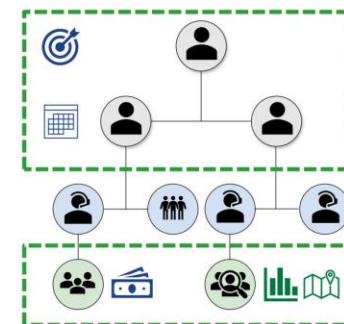
Reasons for GHG inventory:

- Identifying emissions reduction opportunity
- Managing risk related to high GHG emissions
- Setting and tracking towards a goal

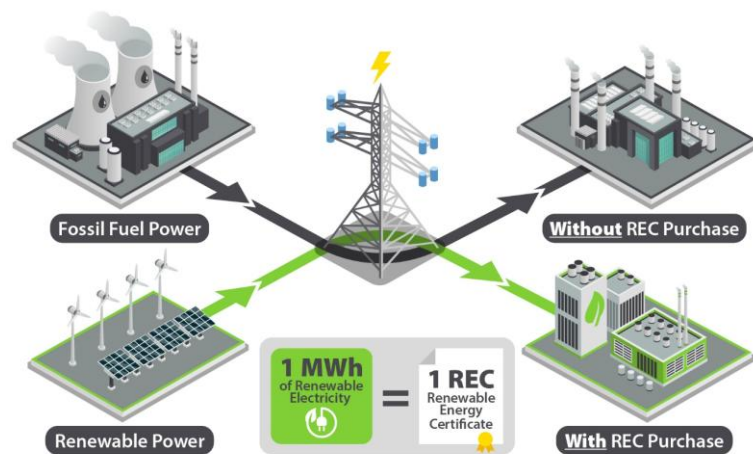


Benchmark Facility Data

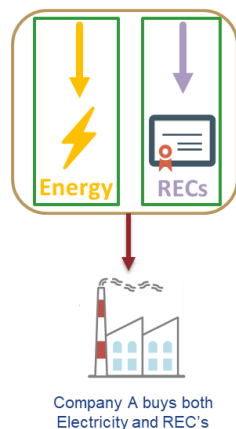
- Where do you need to procure?
 - Number of facilities
 - Location of facilities
 - Emissions Inventory
- How much energy do you need?
 - Purchase Volume
 - Short term vs Long term goals
 - Hedging future energy costs
 - Highest value RECs
- Utility Landscape
- Financial Bandwidth



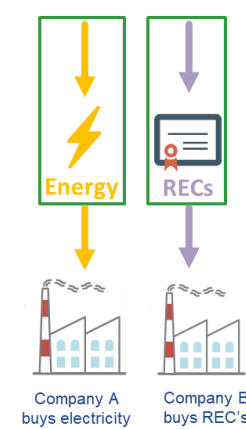
Energy Attribute Certificates (EAC)



Bundled REC



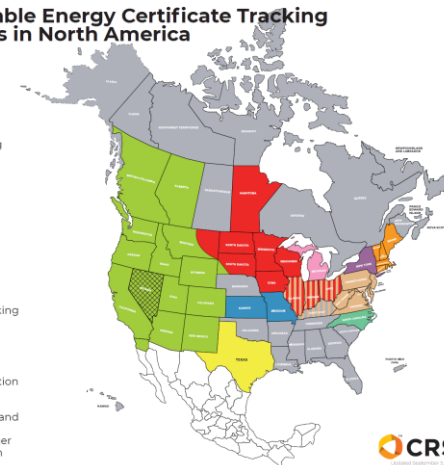
Unbundled REC



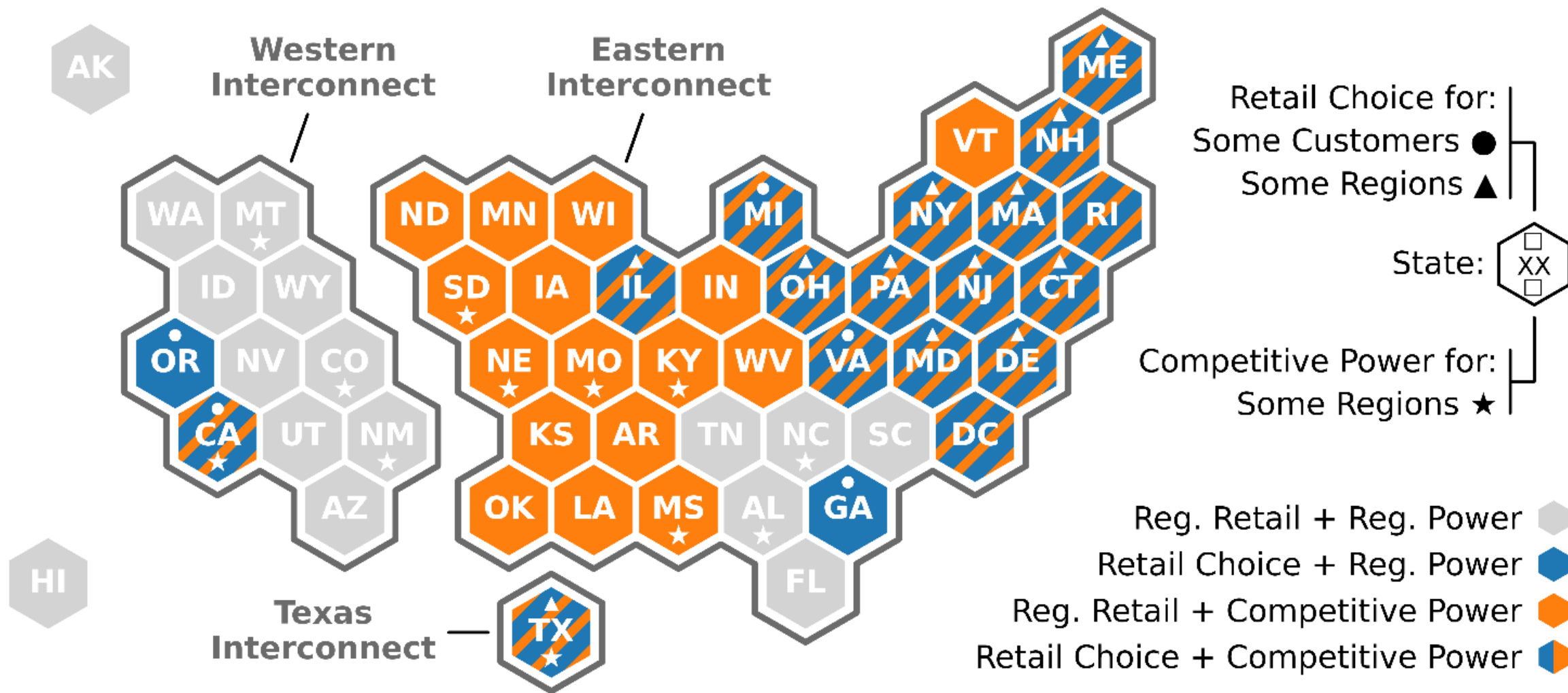
Renewable Energy Certificate Tracking Systems in North America

KEY

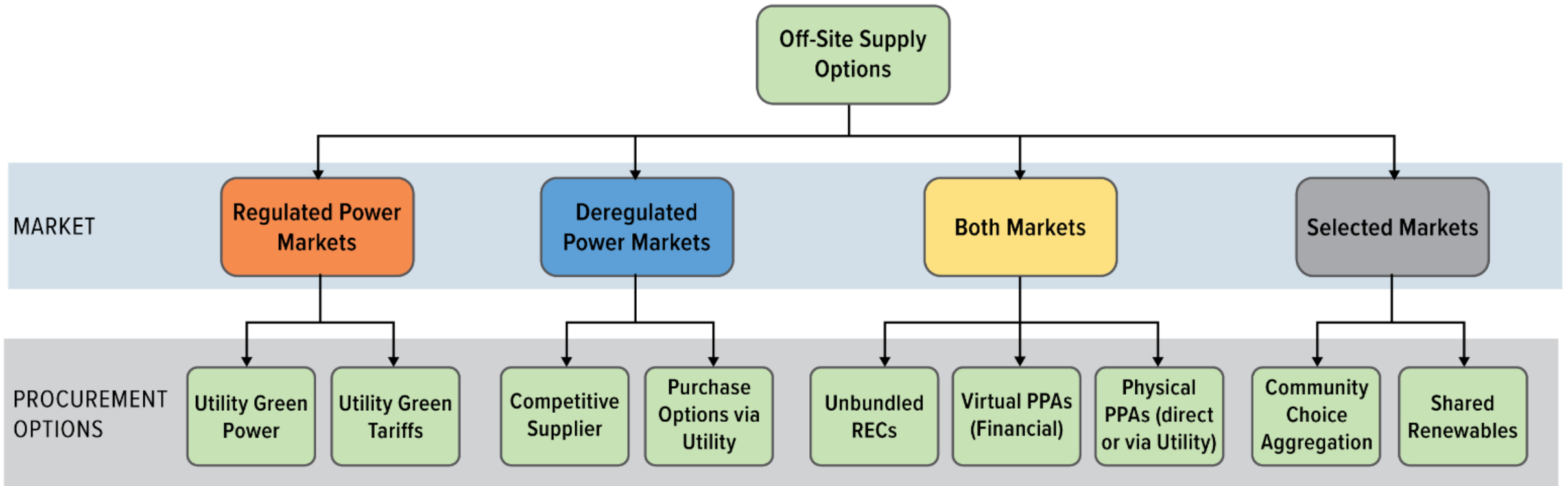
- ERCOT: Electric Reliability Council of Texas
- MIRECS: Michigan Renewable Energy Certification System
- M-RETS: Midwest Renewable Energy Tracking System
- NAR: North American Renewables Registry
- NC-RETS: North Carolina Renewable Energy Tracking System
- NEPOOL-GIS: New England Power Pool Generation Information System
- NVTREC: Nevada Tracks Renewable Energy Credits
- NYGATS: New York Generation Attribute Tracking System
- PJM-GATS: PJM EIS's Generation Attribute Tracking Information System
- WREGIS: Western Renewable Energy Generation Information System
- No tracking system formally adopted. NAR and M-RETS allow registration from generators located anywhere in the U.S. and Canada. Other tracking systems may allow registrations from outside their geographic territory.













Options May Vary With Location



Purchasing Supply Mechanisms



Compare All Options

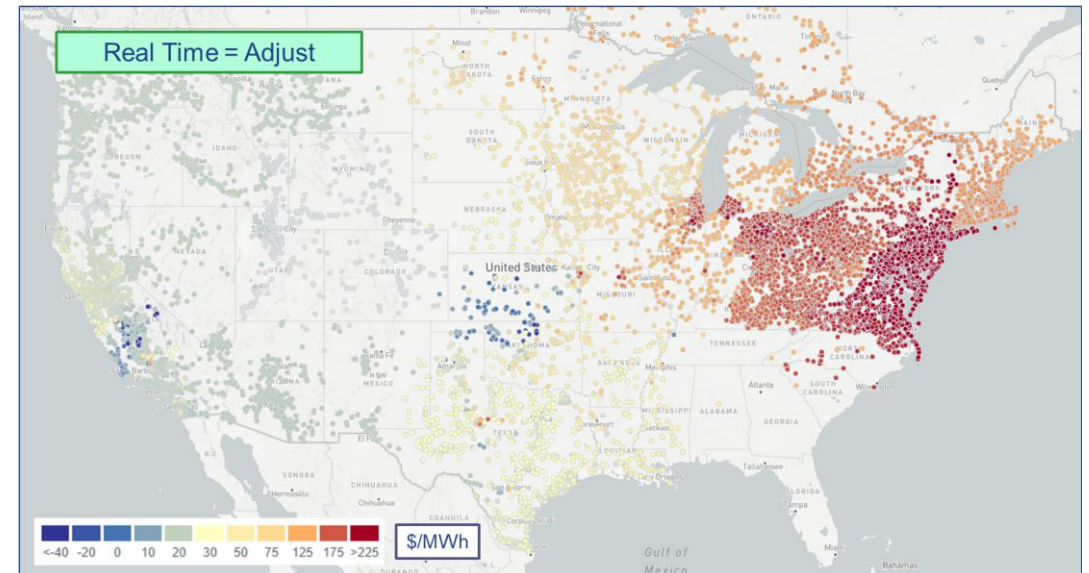
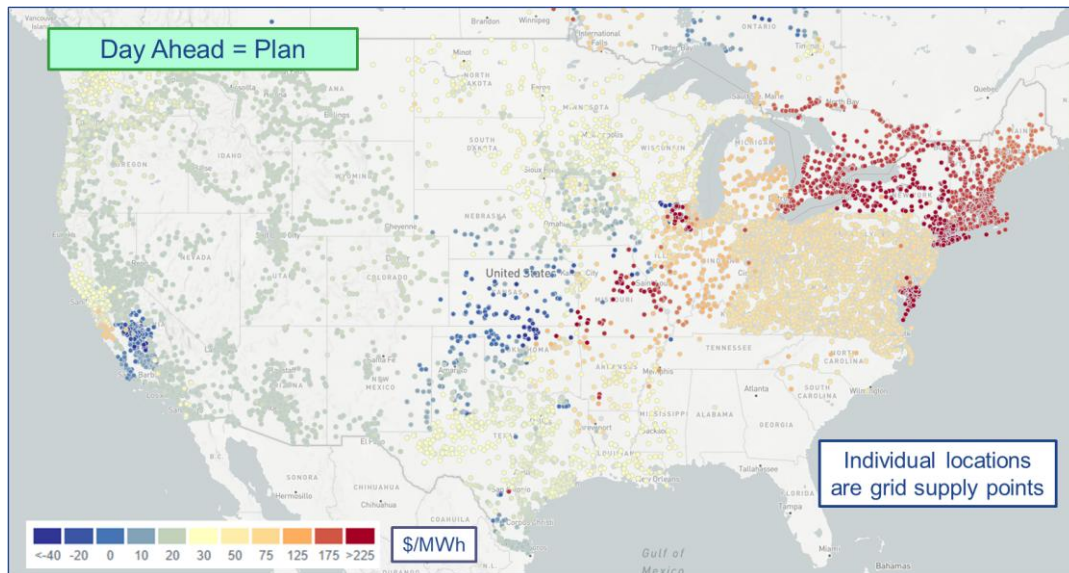
		Characteristics								Supply Options Includes	
RE Supply Mechanism		 Transaction Speed	 Hedging Potential	 Capital Investment	 Recurring Costs	 Contract Length	 Supply Impact	 Availability	 Emission Impact	 RECs	 Commodity Electricity
REGULATED MARKET	Utility Green Power	●●●●	○○○○	○○○○	○○○○	○○○○	○○○○	●●●●	●●●●	●●●●	●●●●
	Utility Green Tariffs	●○○○	●●●●	●●●●	○○○○	●●●●	●●●●	●○○○	●●●●	●●●●	●●●●
AVAILABLE IN BOTH (REGULATED AND UNREGULATED) MARKETS	Virtual (Financial) PPAs	○○○○	●●●●	●●●●	●●●●	●●●●	●●●●	●●●●	●●●●	●●●●	○○○○
	Unbundled RECs	●●●●	○○○○	○○○○	●●●●	○○○○	○○○○	●●●●	●●●●	●●●●	○○○○
	Physical PPAs*	○○○○	●●●●	●●●●	●●●●	●●●●	●●●●	●○○○	●●●●	●●●●	●●●●
	Self-Supply*	○○○○	●●●●	●●●●	●●●●	●●●●	●●●●	●●●●	●●●●	●●●●	●●●●
DEREGULATED MARKET	Competitive Green Power	●●●●	●●●●	○○○○	○○○○	○○○○	○○○○	●●●●	●●●●	●●●●	●●●●
AVAILABLE IN SELECTED MARKETS	Community Choice Aggregations	●●●●	●●●●	●●●●	●●●●	○○○○	●○○○	●○○○	●●○○	●●○○	●●●●
	Shared	●●●●	●●●●	●●●●	●●●●	●●○○	●●○○	●○○○	●●○○	●●○○	●●○○

* Direct or via utility

Prices Vary Hourly

The LMP (Locational Marginal Price) reflects:

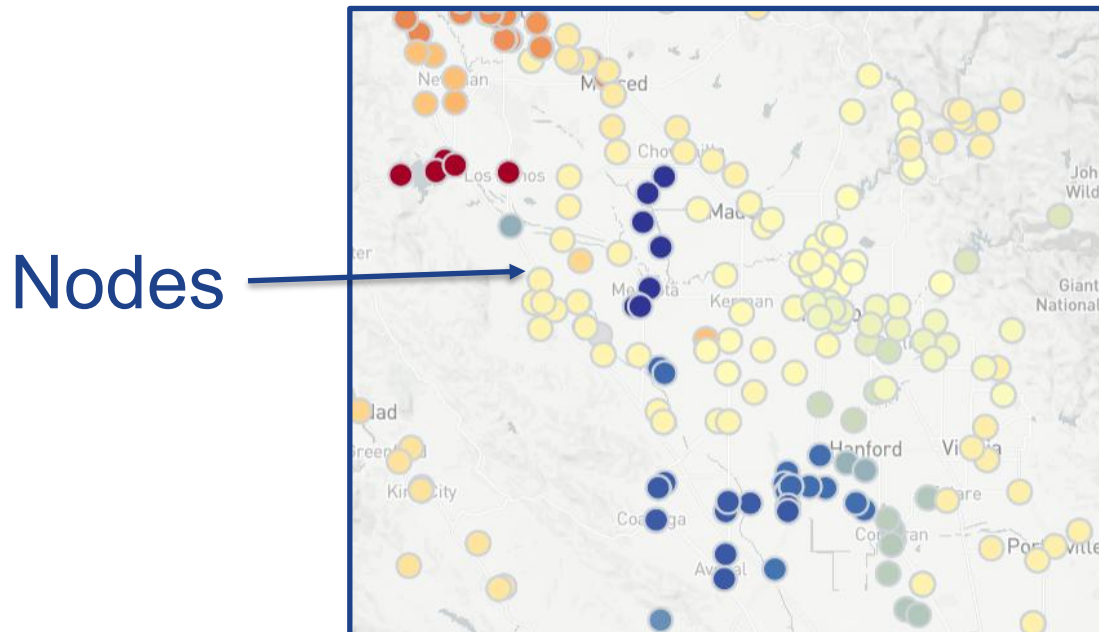
- Generation cost
- Delivery cost
- Transmission constraint cost at a specific location



Pricing Considerations: Hubs vs Nodes

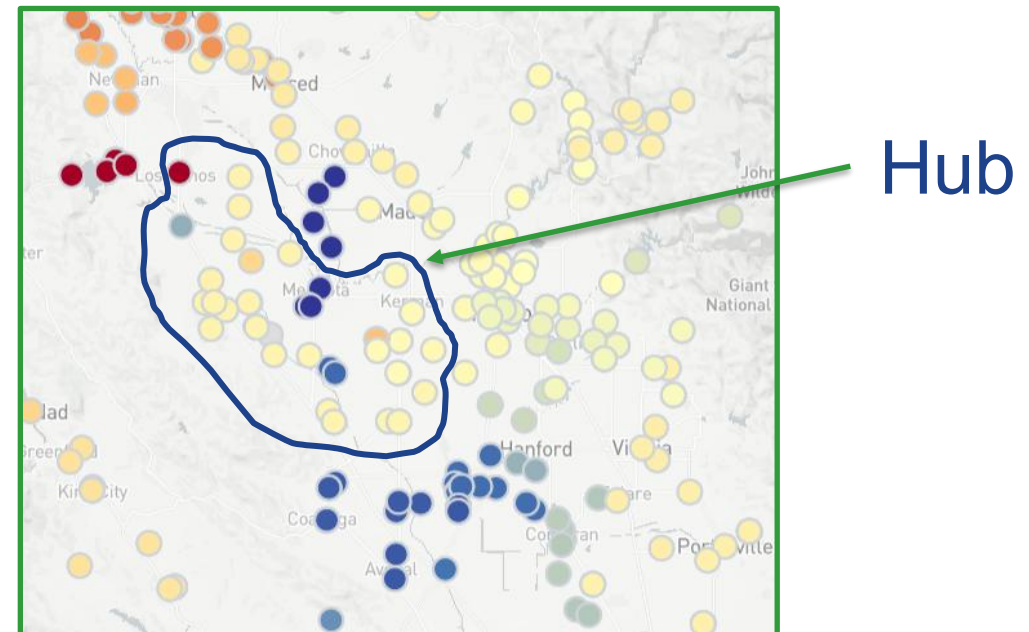
- LMP or Nodal Price

- Nodes are different locations
- Function of congestion, demand, price of energy, and other losses



- Hub Price

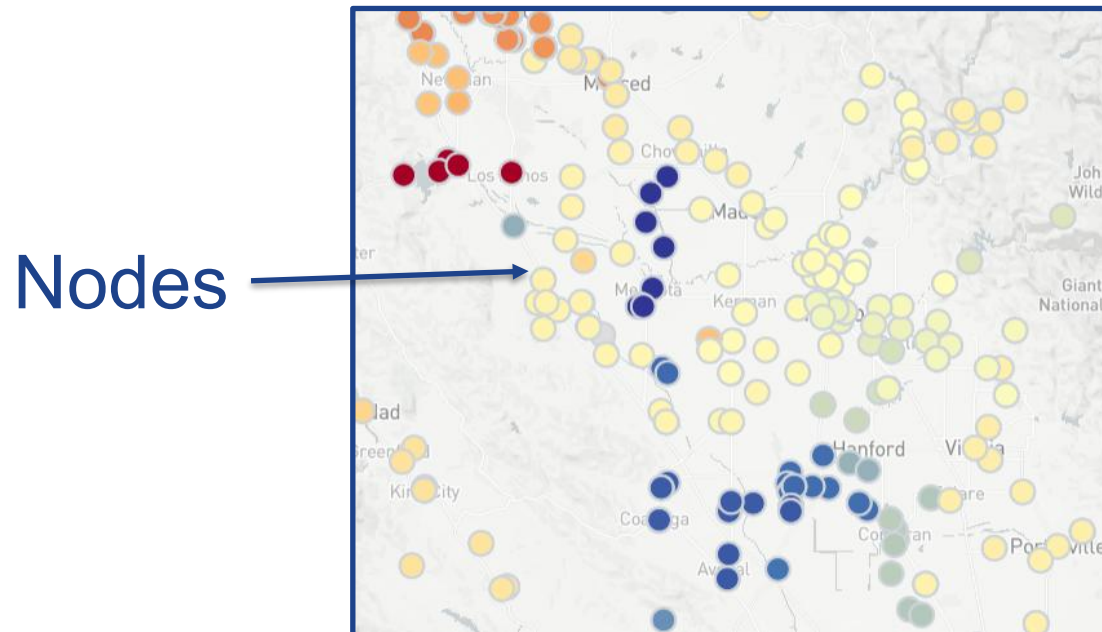
- Collection of nodes
- Intended to represent an uncongested price for electric energy



Pricing Considerations: Hubs vs Nodes

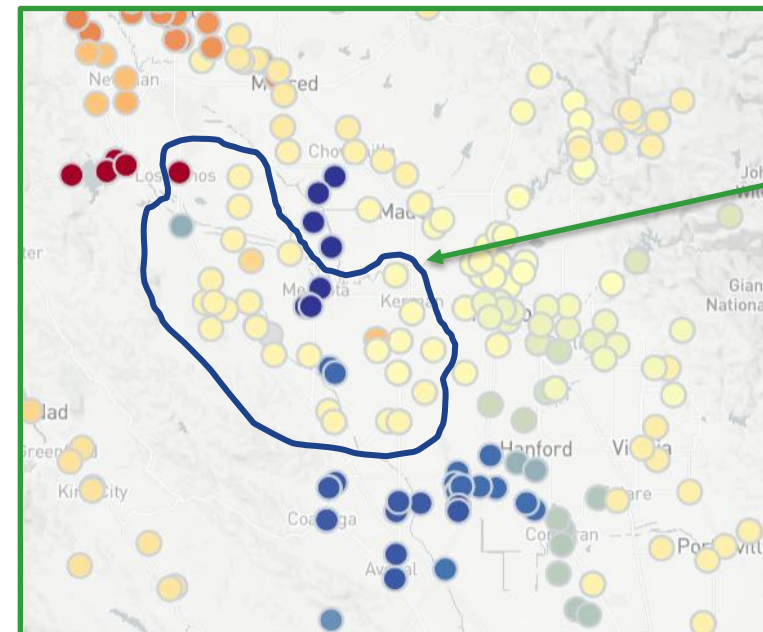
- LMP or Nodal Price

- Where the projects connect
- System operator price
- Prone to volatility



- Hub Price

- Average of nodal price = less volatility
- Traded in the liquid market
- Typical in VPPA contracts



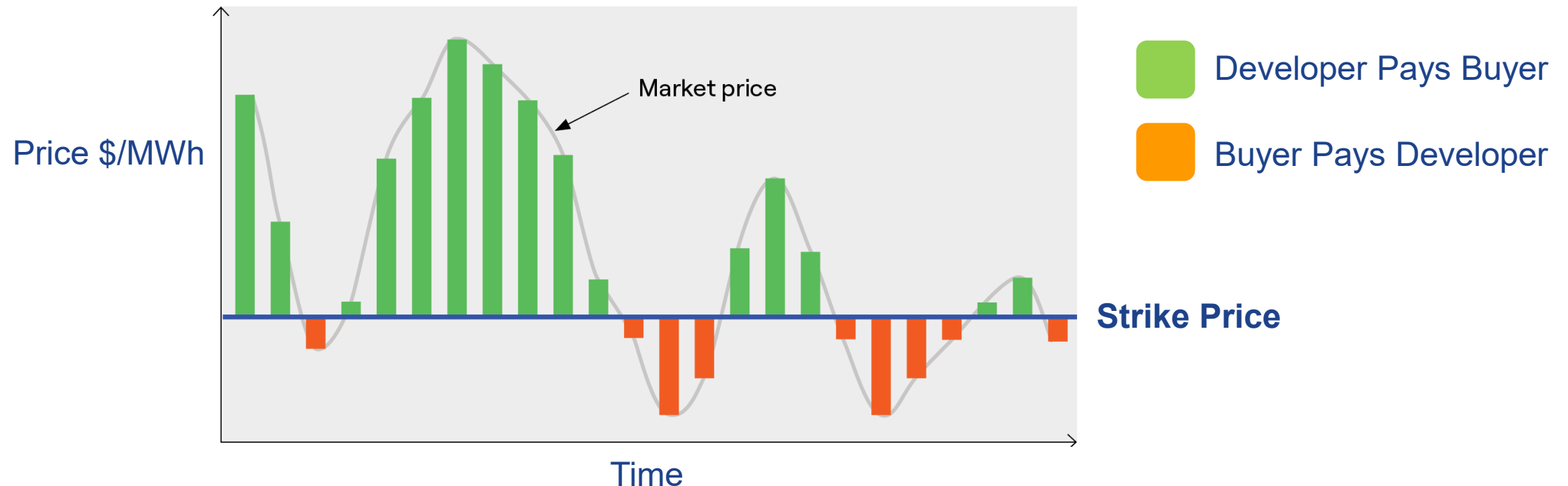
Hub

“Contract for Differences”

- Settlement = Difference between PPA or strike price and market price

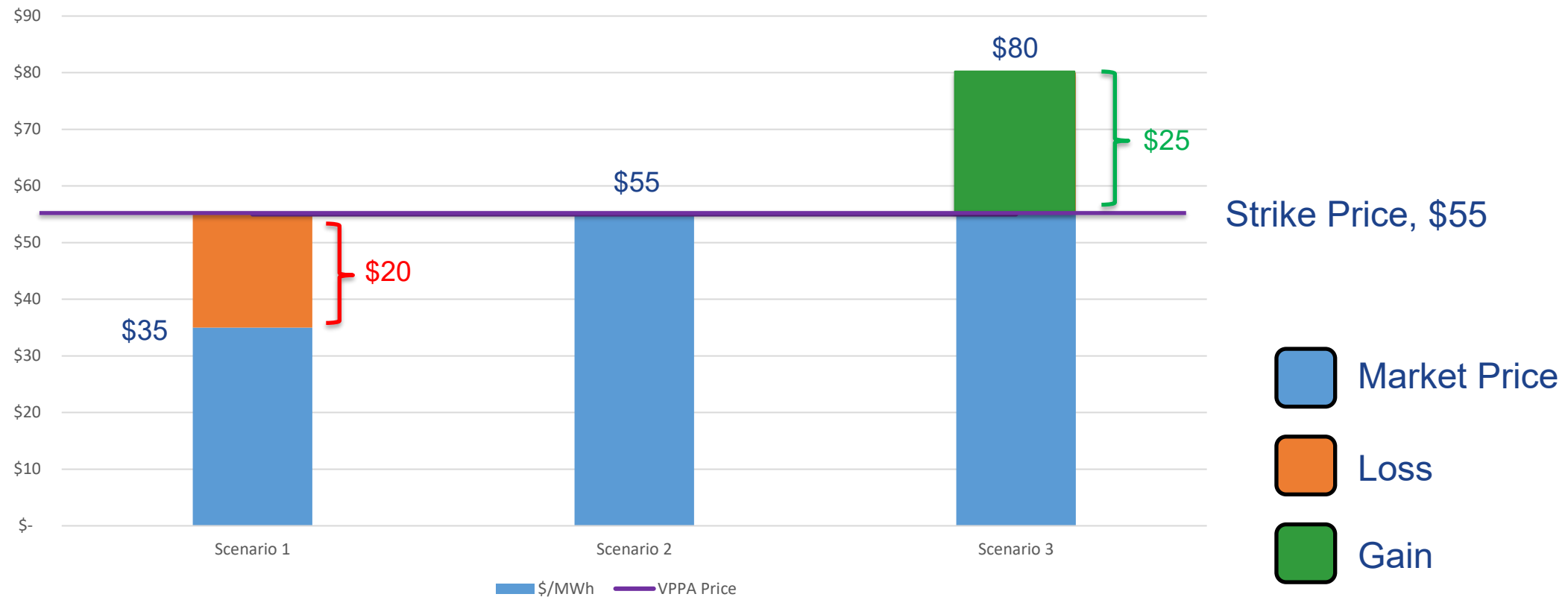
Contract Price

LMP Selling Price



“Contract for Differences”

- Buyer may pay the generator or vice versa



Considerations and Risk Management

■ Risks and Considerations

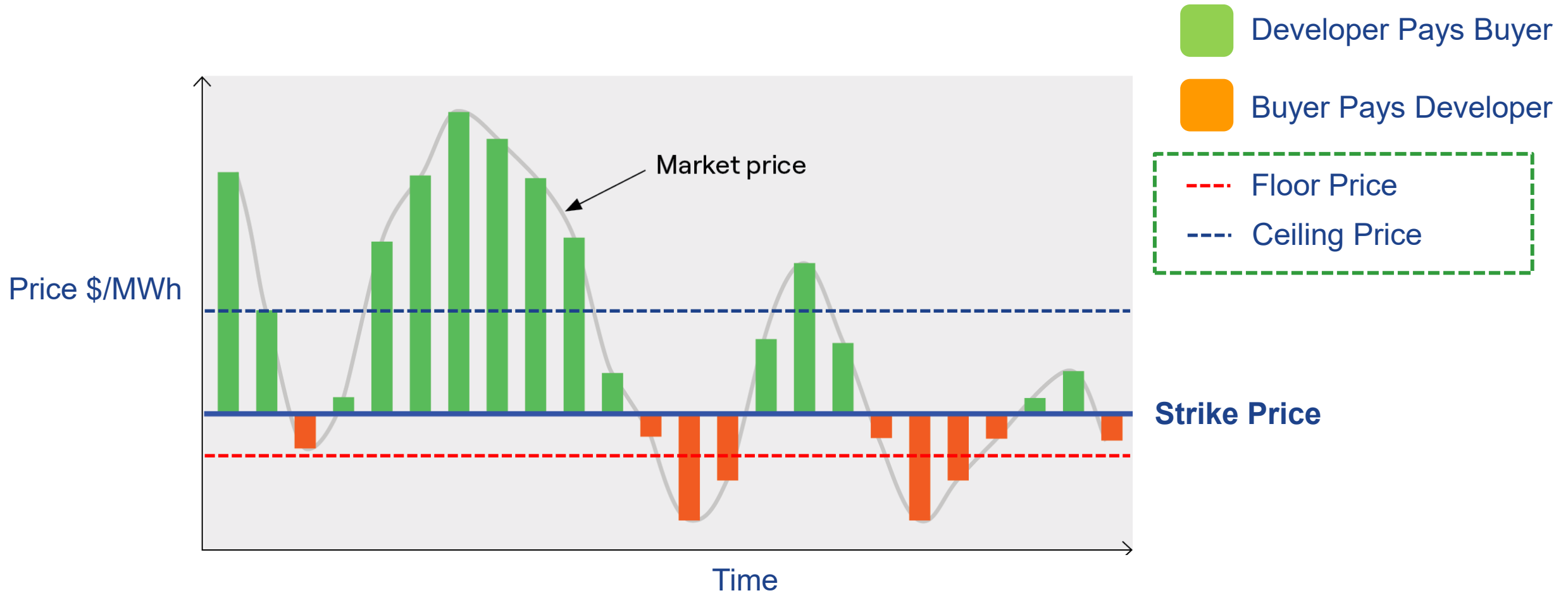
- Location
- Resource and Technology
 - Volume
 - Shape
- Price volatility
- Transaction complexity
- Market insight
- Congestion
- Curtailment
- Basis risk

Virtual PPAs	Physical PPAs	Utility Options	Other Considerations
<ul style="list-style-type: none">• Financial Exposure• Energy Ownership• Length of Contract• Credit Support• Incremental Impact• Regionality	<ul style="list-style-type: none">• Interconnection• Permitting and Siting• Contracting Process• Price Volatility• Resource Type	<ul style="list-style-type: none">• State and Local Regulations• Length of Contract• Pricing Constraints• REC Ownership	<ul style="list-style-type: none">• Operation Schedule• Additionality• Community Acceptance• Third Party Certifications• Grid Congestion

Mitigating Risk

- Floors and Ceilings (Collars)
 - \$0 floor to limit exposure = reduced downside risk \$\$
 - “No settlement” during curtailment
- Developer “Parent Guarantee”
 - Secure your long-term contracts
- Forecast and Sensitivity
 - Forecast load and requirements
 - Forecast price of electricity with and without escalators
- Proxy Generation
 - Consumer compensated based on calculated generation
 - Reduced curtailment and availability risk

Mitigating Risk: Collars



Source: Enel North America

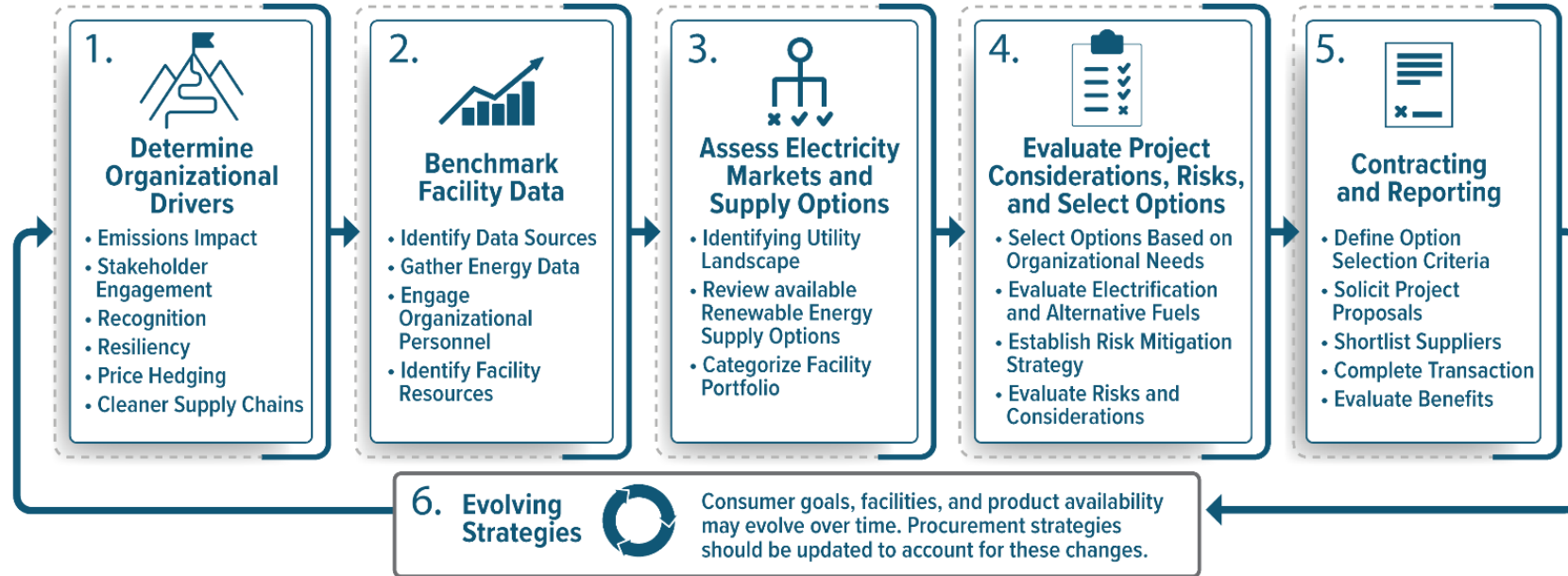
Mitigating Risk

- Forward Strip of RECs (Bridge RECs)
 - Future proof against delays and *forced majeurees*
- Purchase at Hub pricing
 - Reduce the price volatility between strike price and LMP
 - Avoid negative pricing nodes (excess generation)
 - Consumer will receive the generator's hub pricing as its floating market price
- Transmission Buildout
 - New transmission buildout will ease grid congestion
- Diversify assets
 - To manage supply of RECs
 - Spread the risk across resource type

5 Minute Break

Financing Strategies for Purchasing

Project Checklist



■ Potential Team Members

- Leadership and Stakeholders
- Engineering and Plant Operations
- Utility, legal, regulatory
- Government, local entities

■ Selection Criteria

- Implementation schedule
- Risk Tolerance
- Experience and preferences

Financing Options – Industrial Sector



The industrial sector is a significant consumer of energy, accounting for nearly a third of energy consumption in the US. Industrial facilities are often energy intensive due to their size and the energy consumption of process and cross-cutting industrial technologies such as furnaces and compressed air systems. There are important opportunities to save energy by implementing best practices and energy saving technologies. Manufacturers are using a variety of financing strategies to fund energy efficiency, some of them quite innovative.

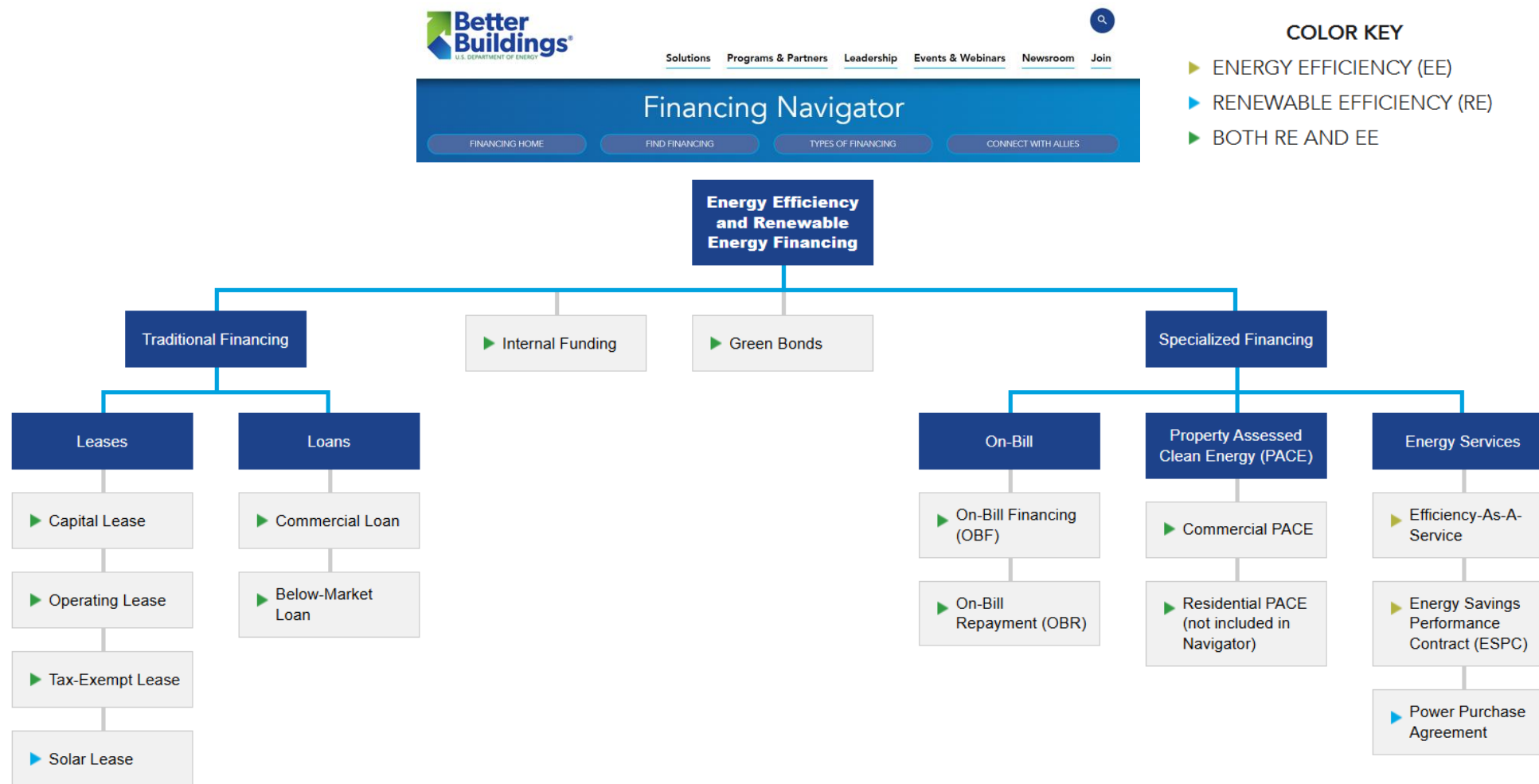
SEE CASE STUDIES



CONNECT WITH PROVIDERS



Financing Options



Source: <https://betterbuildingssolutioncenter.energy.gov/financing-navigator/explore>

Financing Options – Common Terminology

PPA	Long-term contract to buy electricity from generator at agreed terms
SPV/SPE	A legal entity created to own and operate a specific project
Off-taker:	The buyer who agrees to purchase electricity or RECs under a contract
Commodity Electricity	Physical electricity or standard electricity traded without environmental attributes
Tariff	Rate structure that defines how electricity service is priced and billed
Anchor Customer	Large, creditworthy buyer whose commitment underpins project financing
CFD (VPPA)	financial contract; settle the difference between market price and an agreed strike price
Strike Price	Fixed purchase price in a contract
LMP	Locational Marginal Price or Nodal Price

Financing Options – Terminology

- **Special Purpose Vehicles/Entities (SPV/SPEs)**
 - **Dedicated Entity:** Formed solely to own and operate a specific renewable energy project
 - **Risk Isolation:** Shields parent companies from project-related financial and legal risks
 - **Simplifies Financing:** Enables project-specific debt and equity investment
 - **Holds Assets & Contracts:** Owns the project's assets, PPA, permits, and liabilities
 - **Captures Incentives:** Facilitates use of tax credits and depreciation benefits
 - **Revenue Channel:** All project revenues and payments flow through the SPV
 - **Limited Liability:** Creditors' claims are restricted to the SPV's assets only

Basic Financing Options: Expense vs Capital Purchase

- Unbundled RECs
 - Simple to execute
 - Widely available
 - Repeated Expense
- Direct Ownership
 - High upfront costs, longer ROI
 - Impact on property (land, structural, etc.)
 - Project oversight
 - Attributes tied to consumer

Financing Options – Source of Funding

Capital

- Critical for preconstruction
- Owner takes risks
- At-risk capital raised through equity

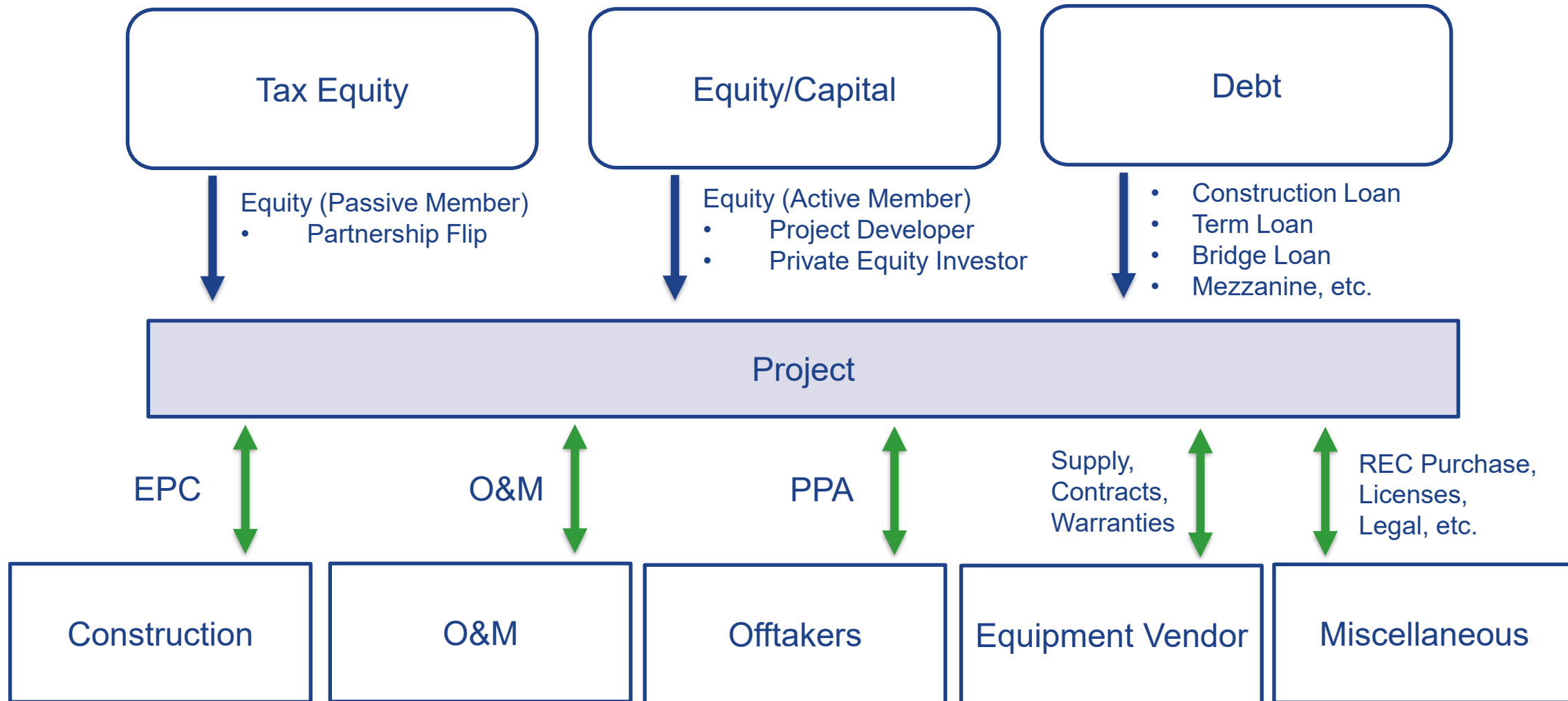
Tax Equity

- ITC and PTC
- US Specific
- Cash for credits
- Expanded to Tax Credit Transfer

Debt

- Assets are collateral
- Construction phase liquidity

Financing Options – Funding and Parties



One Big Beautiful Bill Act (OBBBA) Impact on Wind and Solar Project Tax Credits

- Clean electricity tax credits (PTC 45Y and ITC 48E) generally would be unavailable for wind and solar projects placed in service after December 31, 2027
- Grandfather rule preserves eligibility of credits for wind and solar clean electricity projects that start construction before 12 months following Bill enactment
- Non-wind/solar clean electricity projects will begin to phase out after 2032 (nuclear, geothermal, and clean-hydrogen, potentially energy storage technology, qualified biogas property, and microgrid controllers)
- Applies more restricted conditions regarding application of domestic content bonus
- Transfers of credits to SPEs are not permitted, but transferability conditions are generally otherwise preserved
- Restrictions on foreign entities of concern (FEOC) are in place
- More details to follow, pending Treasury/IRS guidance

Power Purchase Agreements

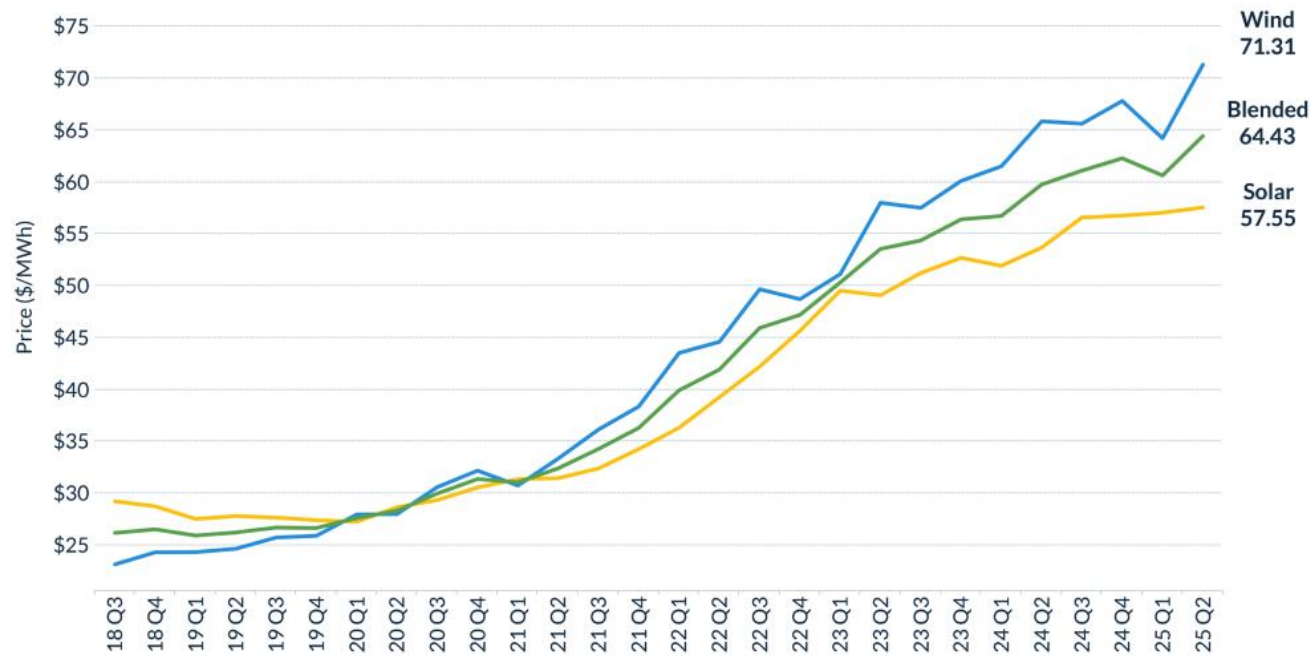
- **Power Purchase Agreement (PPA)**

- Contract with renewable facility located within same power grid, to purchase share of generation via long term contract
- Offtaker purchases power and renewable attributes (physical delivery of energy)

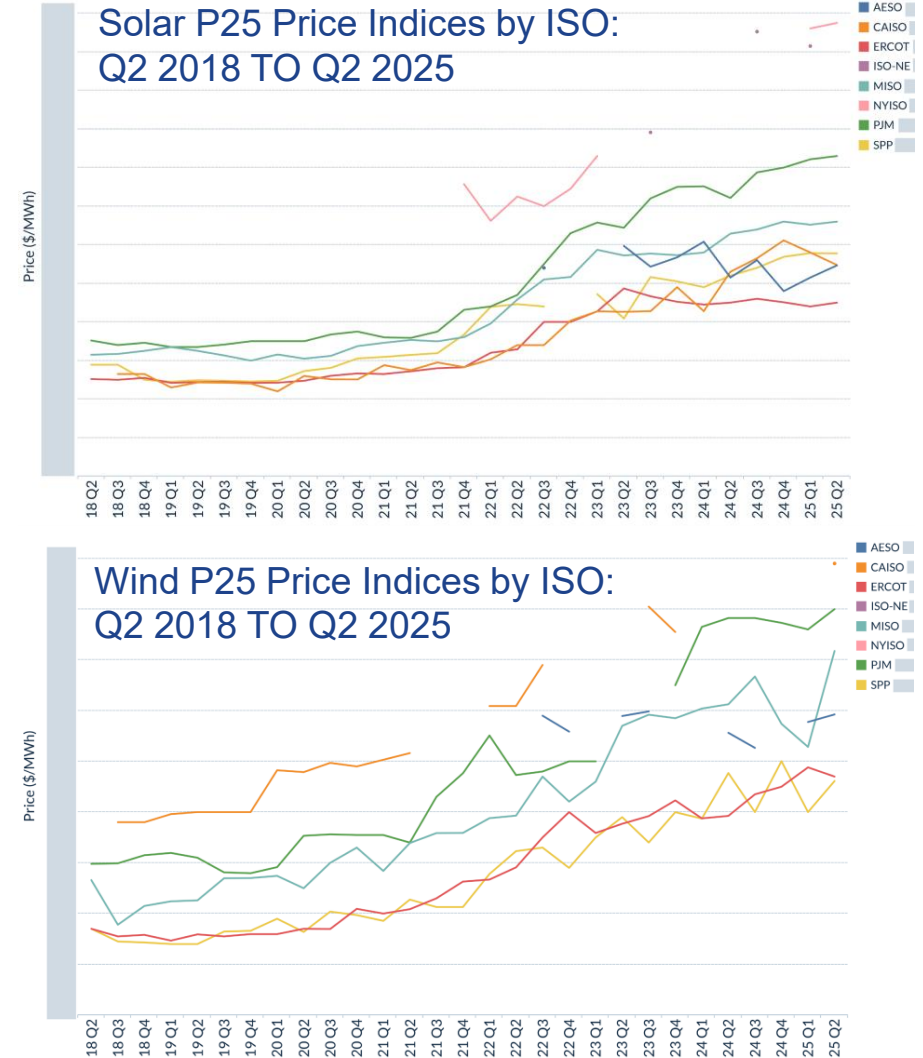
- **Virtual PPA (VPPA)**

- Also known as a financial PPA
- Renewable facility located in a different grid (must be retail choice), so offtaker does not directly purchase energy generated
- Offtaker purchases environmental attributes and financial benefits of fixed vs floating grid price, also using long term contract
- Additional value to VPPA within same power grid, both for additionality and long-term hedge against future power prices

PPA Prices in 2025 Q2

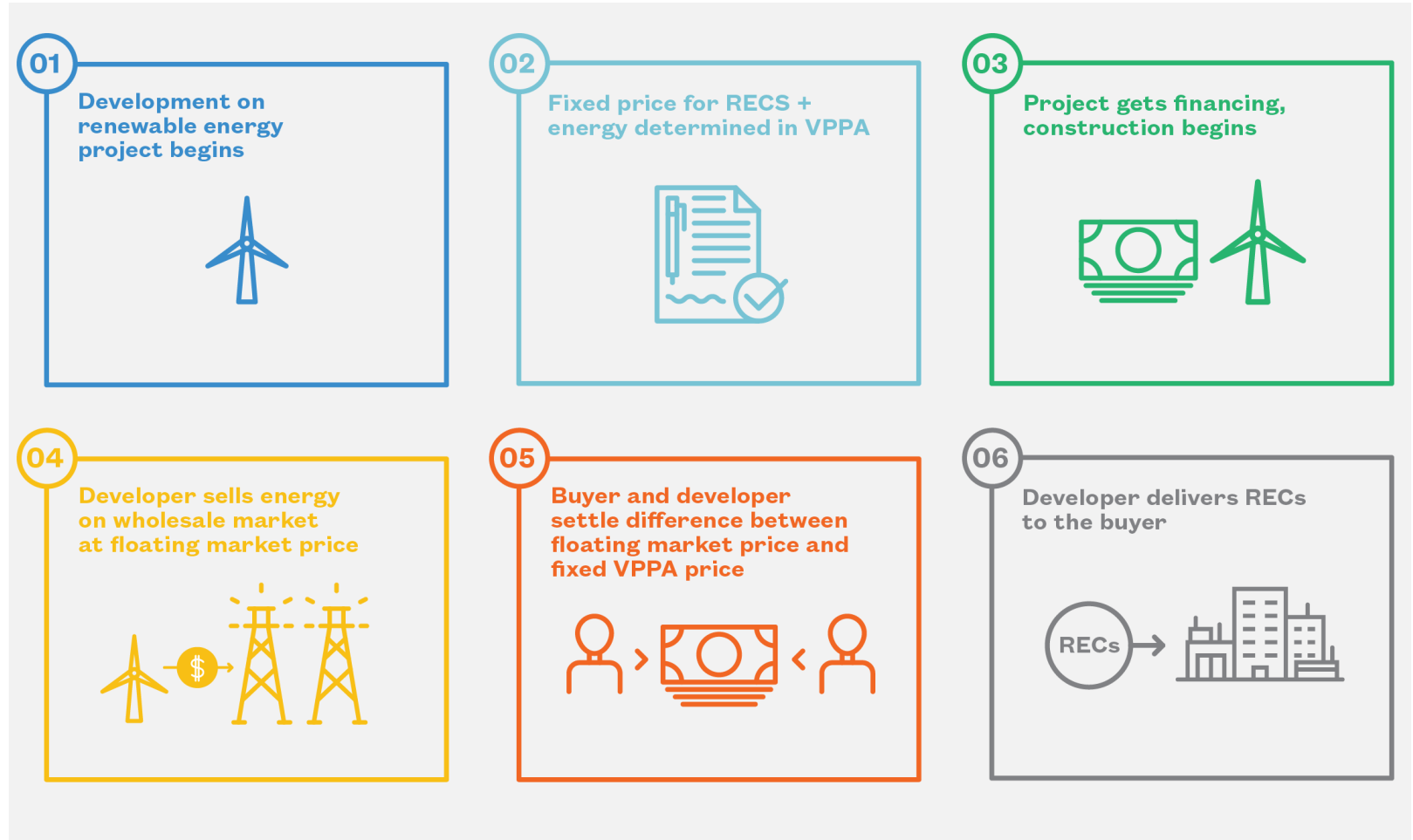


- Market-Averaged Continental Index
 - Q3 2018 TO Q2 2025



Mechanics of Virtual Power Purchase Agreements (VPPAs)

- Establishing VPPA contract can take 6-18 months or more
- Contract terms usually extensive
- Recommendation: understand settlement terms and conditions under which developer may opt to curtail

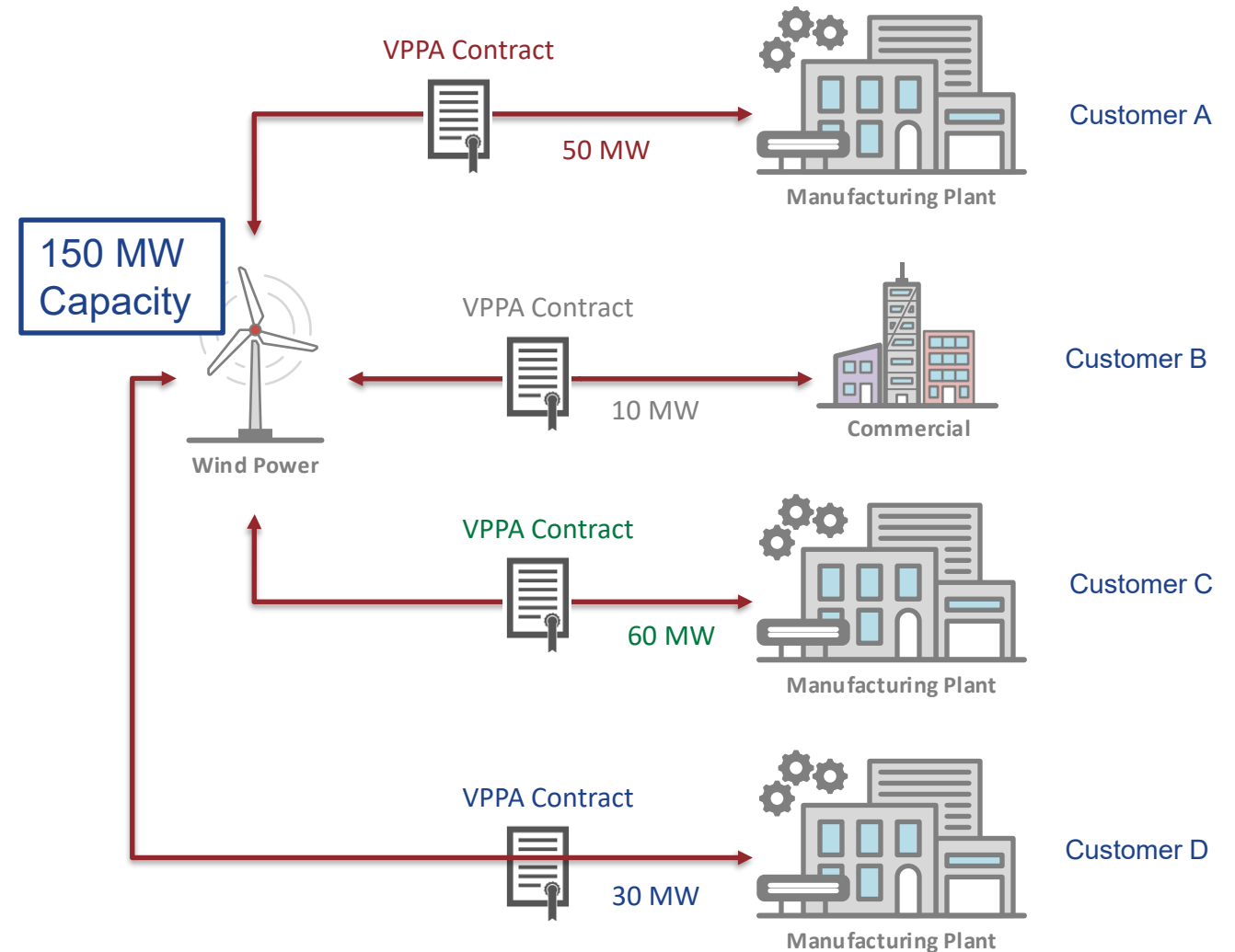


Source: [Leveltenenergy](#)

Consumer Aggregations

■ Customer Aggregation

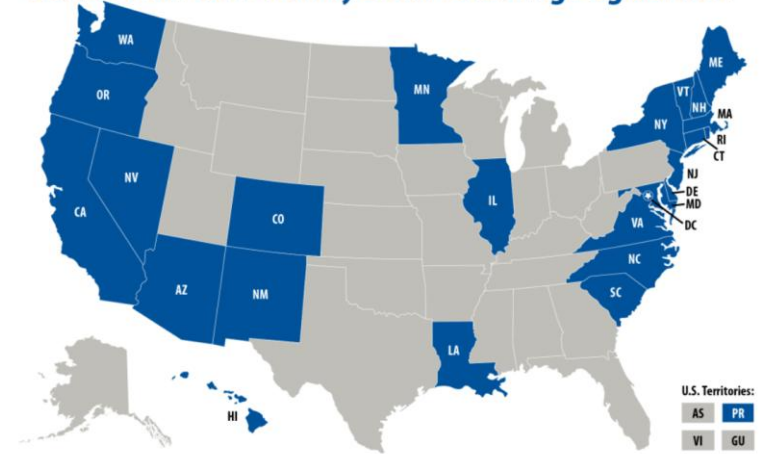
- ✓ Increased purchasing parity
 - ✓ Shared resources
 - ✓ Ability to purchase low volume
-
- Negotiations can be complex, as individual customers may not have significant leverage
 - Stakeholder alignment and difference in goals can be factors making it challenging for aggregation to reach agreement



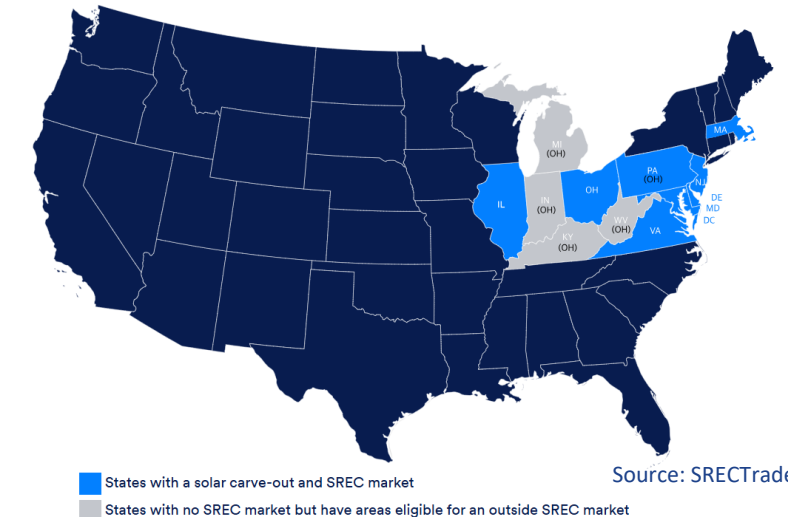
Solar Power Purchase Agreement (SPPA)

- Large customers can often serve as “anchor” to community solar projects
- Check with state utility commission for confirmation on Third Party PPA
- SREC Pricing may vary with length of contract: spot market or forward contract.
 - For example, RECMint estimates an 11%–24% and 33%–46% discount over spot prices for 3- and 5-year contracts, respectively.

States with Community Solar Enabling Legislation

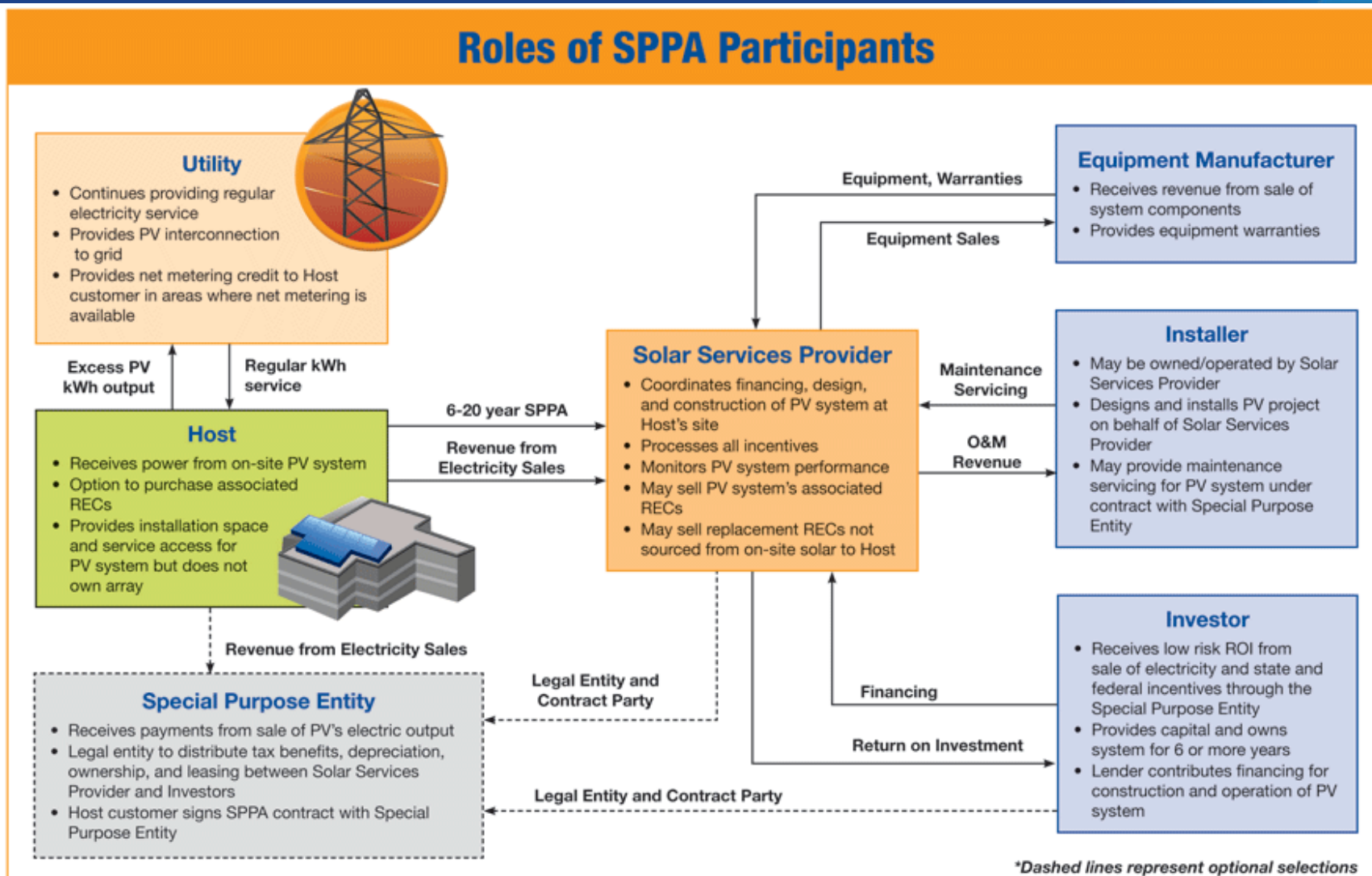


Source: EPA Green Power Market



Source: SRECTrade

Solar Power Purchase Agreement (SPPA)



Sample Contract Structure PPA

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Note: For illustrative purposes only and may not represent actual conditions

Claims and Post-Contract

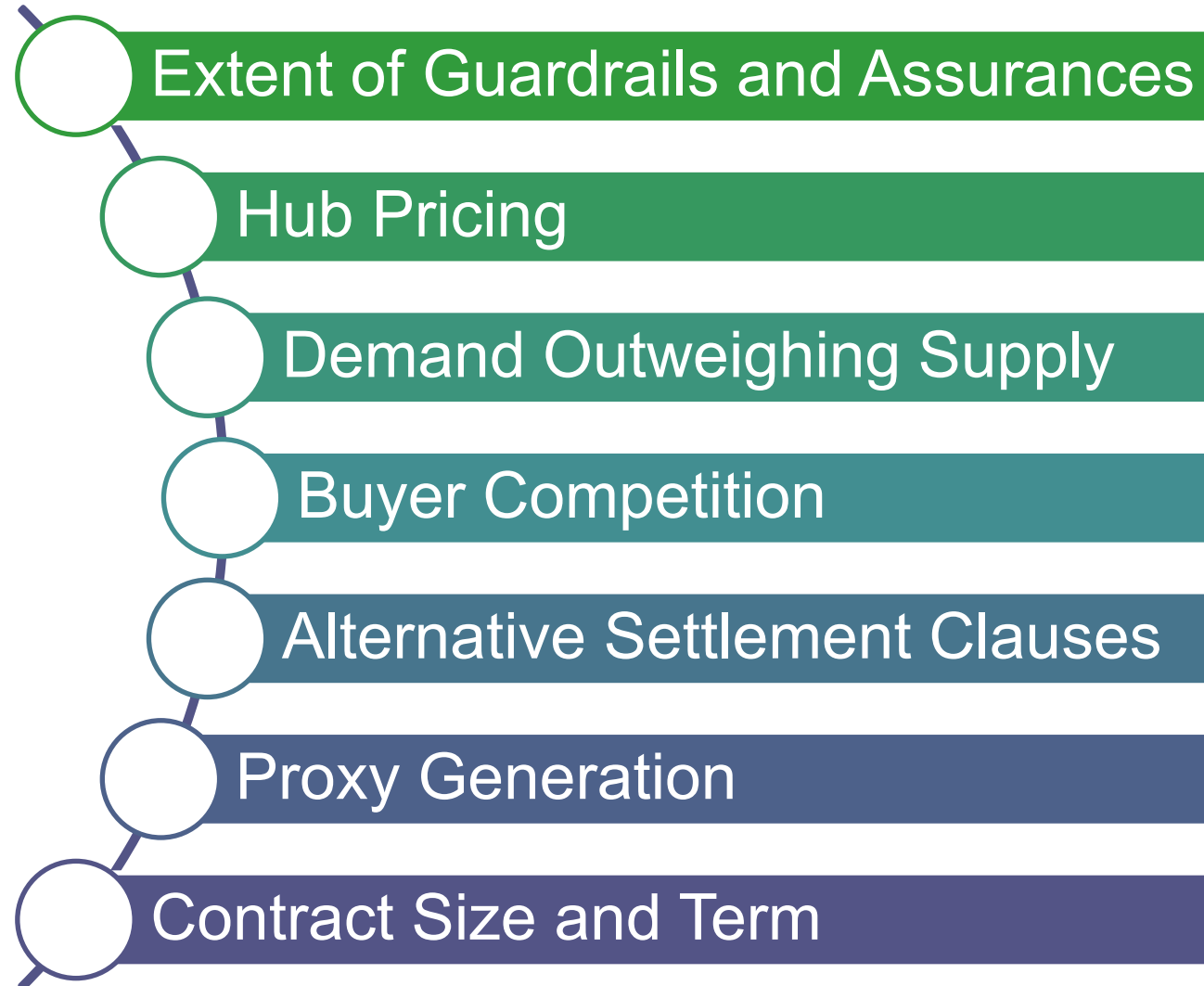
Buyer's Share	The percentage of a renewable energy project's energy generation agreed to purchase
Trade Quantity	The amount of energy that is produced by the facility/ exchanged between parties
Calculation Interval	The time period used to measure and settle delivered quantities; typically, hourly
Guaranteed COD	This is typically the day the project starts delivering to buyer
Settlement Point	Point where your Market Price is published; Hub or Node. Hub pricing is typically more stable
Associated Products	Additional attributes tied to generation, such as RECs or capacity rights
Buyer's Performance Assurance	Financial assurance provided by the buyer; consumer credit rating
Seller's Performance Assurance	Financial assurance posted by the developer; seller credit rating
Facility Guarantee	A commitment to how often the facility must be operational and able to produce per contract

Claims and Post-Contract

- Guarantee for delivery
 - Buyers should monitor progress and asset management
 - Communicate with developer
 - RPS states – expect audits
- REC Management
 - Ownership and claims
 - Transparency in accounting
- Force majeure
 - Grace period for *unexpected* events
 - Penalties for delays
 - Bridge RECs or forward strips

Market Influences Pricing

Several Factors
May Influence
Pricing



Partner Case Studies

AstraZeneca  |  
100%, 272 GWh/year

LOCKHEED MARTIN  |    
20%, 301 GWh/year





Johnson Controls  |  
100%, 281 GWh/year

 | 
100%, 434 GWh/year

 **General Mills** | 
100%, 1,007 GWh/year

 **ARLINGTON VIRGINIA** |   
100%, 84 GWh/year

Northwestern University |  
39%, 100 GWh/year

 |   
52%, 1,795 GWh/year

Other Programs and Platforms for Renewable Energy

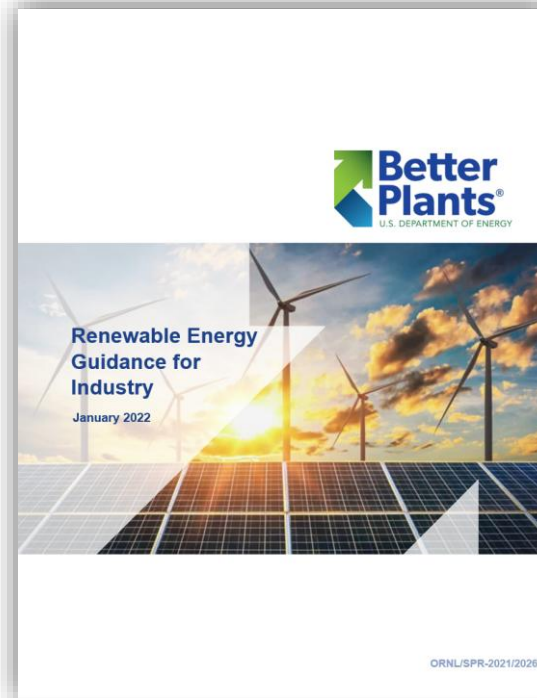
<p>EPA's Green Power Partnership (GPP) [https://www.epa.gov/greenpower]</p>		<p>Center for Resource Solutions (CRS) [https://resource-solutions.org]</p>	
<p>Clean Energy Buyers Association (CEBA) [https://cebuyers.org]</p>		<p>Green-e Energy and Green-e Marketplace [https://green-e.org/programs/energy]</p>	
<p>Database of State Incentives for Renewables & Efficiency (DSIRE) [https://www.dsireusa.org]</p>		<p>GHG Protocol Scope 2 Guidance [https://ghgprotocol.org/scope_2_guidance]</p>	
<p>RE100 [https://www.there100.org]</p>		<p>The Renewable Thermal Collaborative (RTC) [https://www.renewablethermal.org]</p>	
<p>Solar Energy Industries Association (SEIA) [https://www.seia.org]</p>		<p>American Council on Renewable Energy (ACORE) [https://acore.org]</p>	

Renewable Energy for Industry Guidance Documents

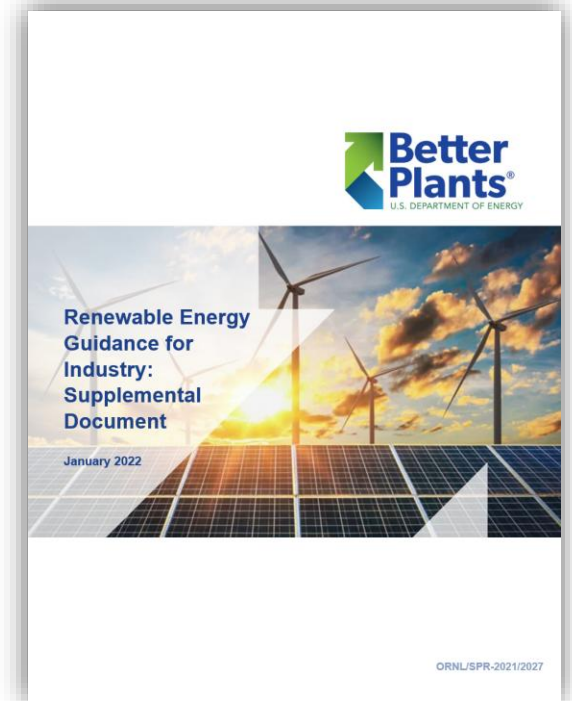
- Access the full main document [here](#).



- Access the supplemental document [here](#).



Main Document



Supplemental Document

Renewable Energy Purchasing Factsheets

Better Climate CHALLENGE
U.S. DEPARTMENT OF ENERGY

Overview

RENEWABLE ENERGY CERTIFICATES

This document is designed as an overview of renewable energy certificates in the US renewable energy market. For more information about renewable energy technologies (e.g., solar energy, wind power, water power) and other renewable electricity supply options (e.g., power purchase agreements, green tariffs), please reference the [Renewable Energy Guidance for Industry 2022](#)¹ and the [Renewable Energy Guidance for Industry 2022: Supplemental Document](#)².

1. What Are Renewable Energy Certificates?

A renewable energy certificate (REC), also known as a renewable energy credit or a green tag, is a tradable, nonphysical commodity in the US energy market that represents certain attributes associated with 1 MWh of generated renewable energy, including the type of renewable energy, the emissions rate associated with that energy, and the grid to which the energy was delivered.^{3,4}

► **How are RECs created and tracked?**

Renewable power has two key aspects: (1) the generated electricity itself and (2) the environmental attributes of that electricity, which may then be monetized and sold separately on the open market. Generated electricity is sold to the grid or can be delivered directly to consumers. The environmental attributes can be sold as RECs. They may be sold with the electricity as **bundled** RECs or sold independently as **unbundled** RECs.

¹ Abbas, A., Price, C., Nandy, P., and Wiering, T. 2022. *Renewable Energy Guidance for Industry*. ORNL/SPR-2021/026. Oak Ridge National Laboratory, Oak Ridge, TN. <https://doi.org/10.21202/251662>.

² Abbas, A., Price, C., Nandy, P., and Wiering, T. 2022. *Renewable Energy Guidance for Industry: Supplemental Document*. ORNL/SPR-2021/026. Oak Ridge National Laboratory, Oak Ridge, TN. <https://doi.org/10.21202/251663>.

³ US Environmental Protection Agency. 2024. *Renewable Energy Certificates (RECs) Green Power Markets*. Retrieved January 29, 2024. From <https://www.epa.gov/green-power/markets/renewable-energy-certificates-recs>.

⁴ National Renewable Energy Laboratory. 2015. *Renewable Electricity: How do you know you are using it?* <https://www.nrel.gov/docs/fy15osti/64548.pdf>.

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Renewable Energy Certificates

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Power Purchase Agreements

OVERVIEW

This document is designed to help Better Buildings, Better Plants, and Better Climate Challenge partners learn about power purchase agreement (PPA) options. For more information about renewable energy and other renewable electricity procurement options, please see the [Renewable Energy Resources Hub](#).

Power Purchase Agreements (PPAs)

A power purchase agreement (PPA) is a contract between a renewable energy developer and an electricity consumer, often called an "offtaker." The off-taker purchases renewable energy and renewable energy certificates (RECs) from a specific power generation asset at a set price (\$/MWh) that is usually lower than their utility's retail price. Unlike the fluctuating cost of fossil fuels or the market rate for electricity, the fixed energy price of a PPA can help insulate organizations from increasing utility costs. Responsibility for installing, maintaining, and operating equipment usually falls on the developer, reducing liability for the off-taker. Organizations with limited space can use PPAs for renewable energy procurement as the development and their facilities do not need to be in the same location.

PPAs promote clean energy on the grid and generate RECs for off-takers to purchase. Organizations can compare renewable energy developers and projects to find the ones that best align with their sustainability goals. The two most common types of PPAs are Physical and Virtual PPAs and their structure dictates how energy is delivered to a facility and its cost. This overview provides information on how the most common types of PPAs operate.

Physical (PPAs)

In a physical PPA, a renewable energy developer delivers electricity directly to an off-taker's facility or to their local utility electric grid. The developer owns, operates, and maintains the renewable asset for the duration of the PPA contract. The rate offered to the off-taker is usually lower than the local utility retail electricity price and can be fixed or escalated by a set percentage every year to cover inflation, decreased system efficiency, O&M costs, and increases in retail electricity prices. Physical PPA contracts are typically long-term and can range from 10 to 25 years, after which the off-taker typically has the option to extend the contract term, purchase the system from the developer, or have the system removed from the property. Contract terms specify whether the off-taker or the developer will own and retire the associated RECs. Note that only RECs that have been retired can be used to claim renewable energy usage for carbon and renewable energy accounting purposes. There are two main types of physical PPAs:

1. Onsite Physical PPAs:

The off-taker provides physical space onsite or nearby for the developer to build, maintain, and operate renewable energy generation equipment. The generated electricity is delivered to the off-taker "behind the meter" through a direct connection (Figure 1). The off-taker's local

Figure 1: Structure of an Onsite Physical Power Purchase Agreement

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Power Purchase Agreements

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Utility-Based Renewable Electricity Supply Options

OVERVIEW

This document is designed to help Better Buildings, Better Plants, and Better Climate Challenge partners learn about utility-based renewable electricity supply options in the US energy market. For more information about renewable energy and other renewable electricity procurement options, please see the [Renewable Energy Resources Hub](#).

Introduction

In **regulated retail electricity markets**, electricity consumers are required to buy electricity from their local utility company. Utilities in these markets have developed various green power initiatives that allow their customers to still utilize and invest in clean energy resources like wind and solar. **Utility green power** and **utility green tariff** programs offer customers, known as "off-takers," a structured and convenient way to purchase renewable energy, providing supply and price stability while supporting clean energy in the overall electricity market. Consumers work with their local utility or renewable energy provider to discuss goals, energy needs, available options, and the procurement process. Similar products known as **competitive green power** products are also offered in deregulated retail markets where customers can purchase energy directly from suppliers. Figure 1 shows an example utility green power offering. This document provides a more detailed explanation of green tariffs and other utility-based green power programs.

Figure 1: Structure of typical Utility Green Power and Green Tariff offerings.

Utility Green Power Products

Electricity providers of all types across the US offer **green power products**, including municipal, investor-owned, and cooperative utilities. These products allow customers to pay an extra, per-kWh premium to receive electricity generated from renewable sources bundled with Renewable Energy Certificates (RECs). Charges are often an extra line item on the utility bill. Energy from these products does not necessarily come from a specific renewable energy project and the energy mix can be changed by the utility. Green products are generally flexible and do not lock customers into long-term contracts. There are two main procurement options for green power products:

- **Percentage-based:** Customers can choose a percentage of their electricity that will be sourced from renewables (e.g., 25%, 50%, or 100%).
- **Block-based:** Customers can purchase a set number of renewable electricity "blocks" per month. Each block represents a specific amount of generated renewable energy (typically 100 kWh).

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Utility Supply Options

Questions?

Thank you!