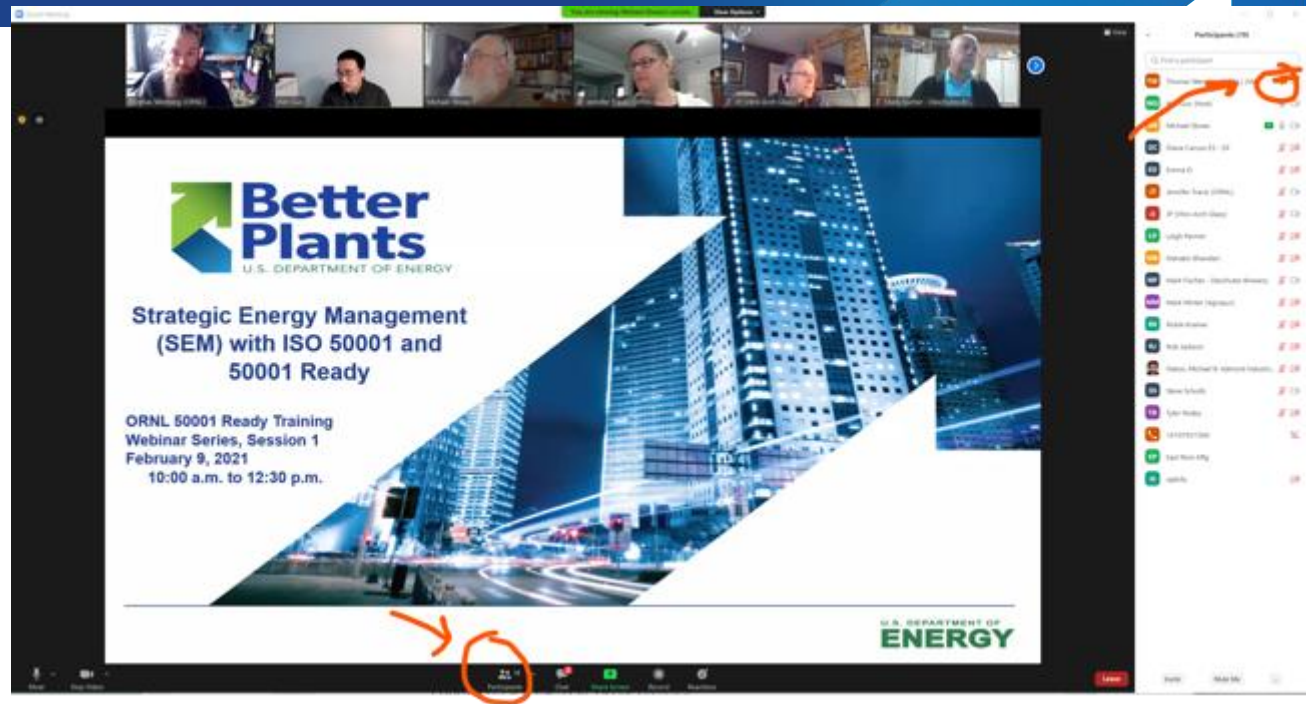
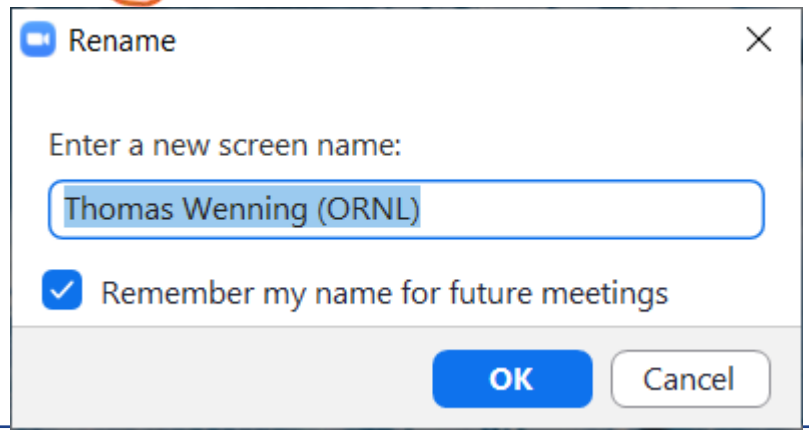
Rename Yourself to be your Real Name (Company Name)

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 ☺





Better Plants®
U.S. DEPARTMENT OF ENERGY

Virtual Training: Renewable Energy Contracting Options and RECs

Purchasing Renewable Electricity: PPAs, VPPAs, and Other Supply Options

Session #3
August 19, 2025
10:00am – 12:00pm EST

U.S. DEPARTMENT OF ENERGY

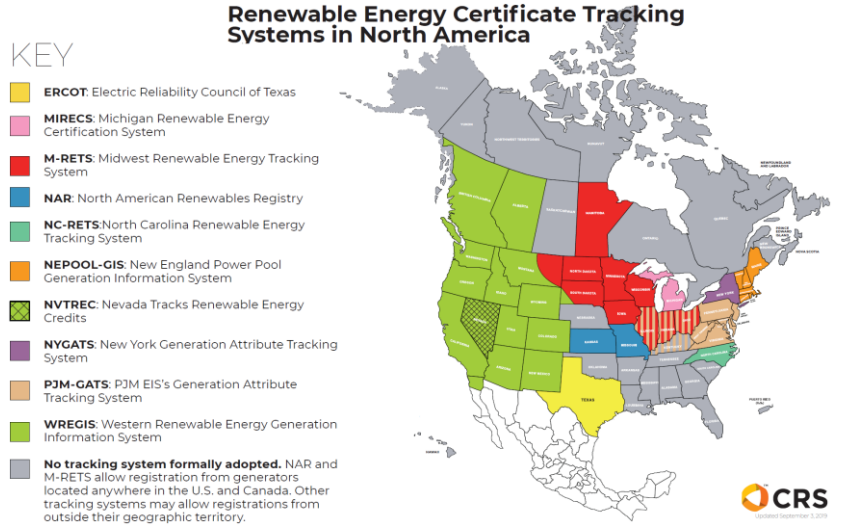
General Information

- 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://betterbuildingssolutioncenter.energy.gov/better-plants
https://measur.ornl.gov

Review of Session #2 Homework

1. Which entity is typically responsible for issuing and tracking RECs in the U.S.?
   - EPA
   - DOE
   - Regional Transmission Organization (RTO)
   - ✓ REC Tracking Systems (e.g., WREGIS, M-RETS)

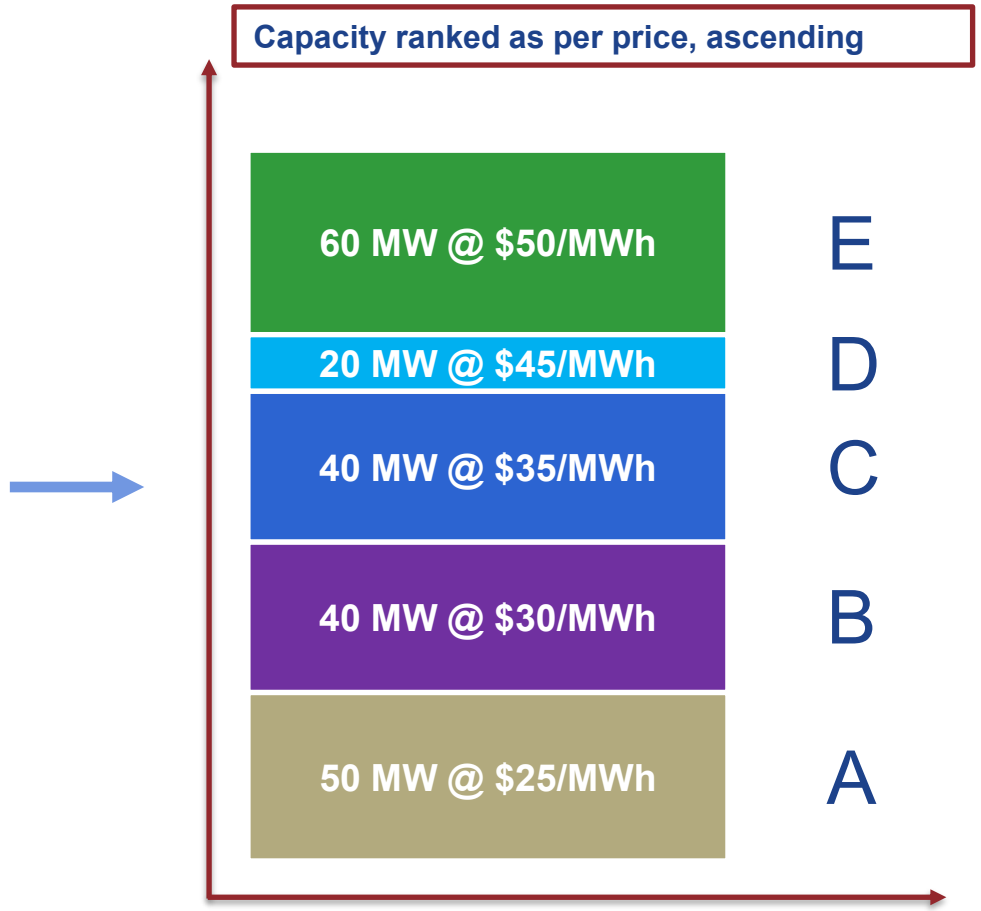


Review of Session #2 Homework

- Calculating the Market Clearing Price in a Wholesale Electricity Market

Bids from Producers:

Generator	Capacity (MW)	Offer Price ($/MWh)
Gen A	50	$25
Gen B	40	$30
Gen C	40	$35
Gen D	20	$45
Gen E	60	$50



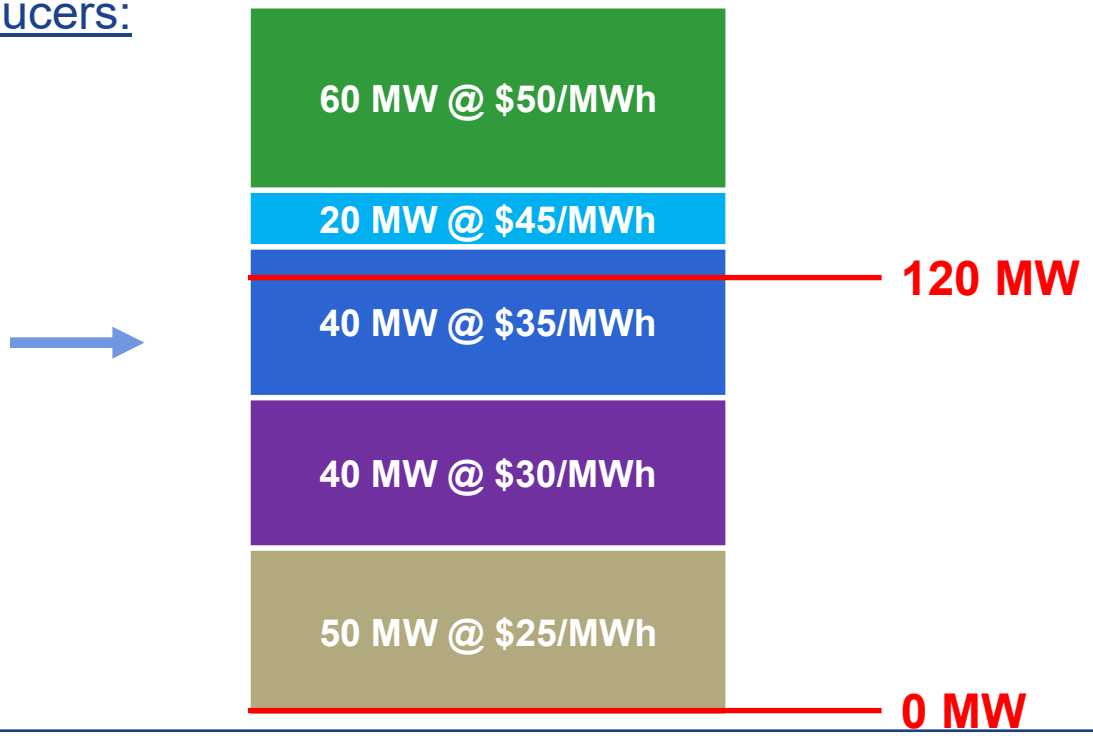
Review of Session #2 Homework

- Calculating the Market Clearing Price in a Wholesale Electricity Market
- Utility calls for **120 MW** of demand for a given hour

Highest-priced resource that is needed sets the price for everyone

Bids from Producers:

Gen A
Gen B
Gen C
Gen D
Gen E



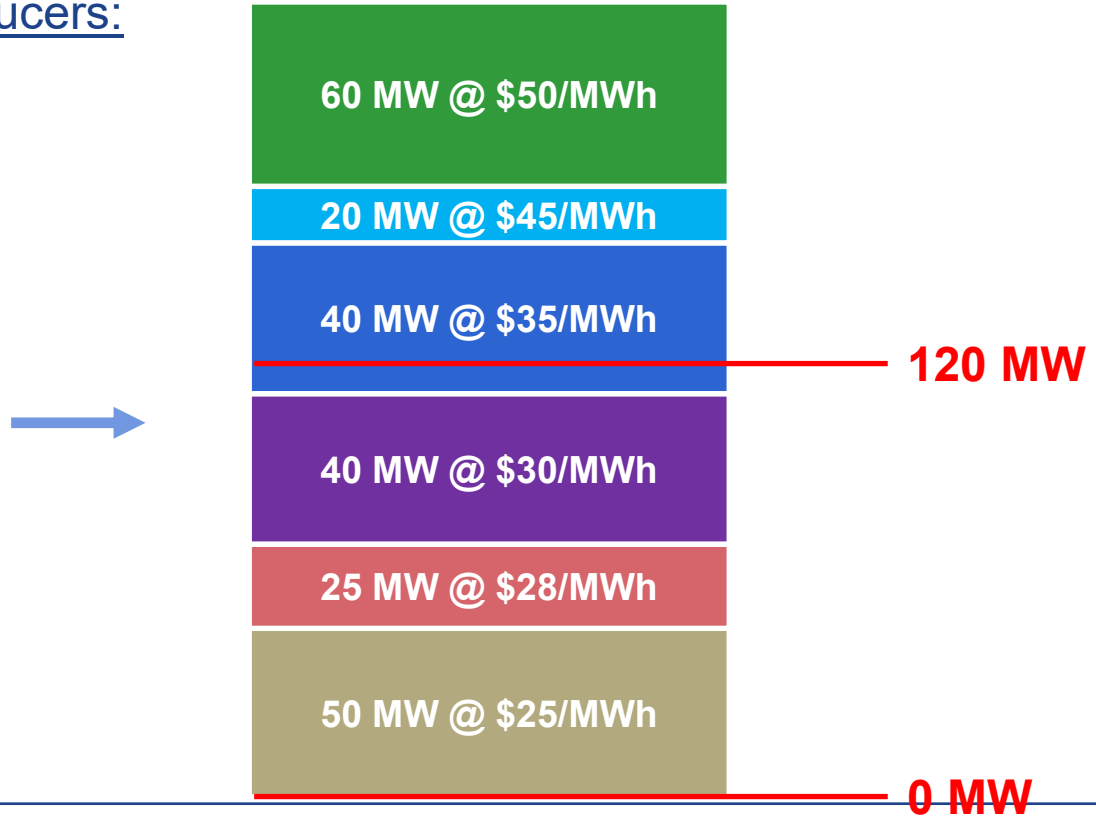
The **Market Clearing Price (MCP)** for this auction is **$35/MWh**. All dispatched bidders receive this price for their energy.

Review of Session #2 Homework

- Calculating the Market Clearing Price in a Wholesale Electricity Market
- Generator F is added with a bid of $28/MWh for 25 MW capacity

Bids from Producers:

Gen A
Gen B
Gen C
Gen D
Gen E
Gen F



Utility calls for **120 MW** of demand

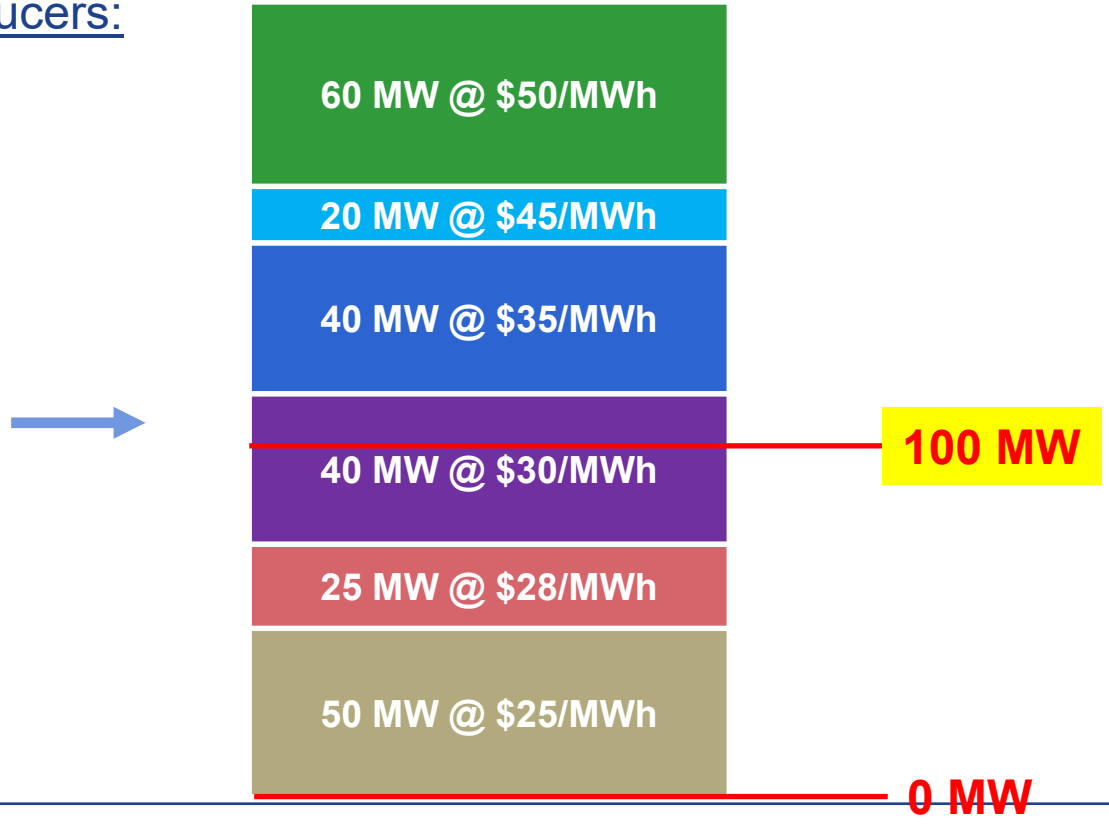
The Market Clearing Price (MCP) for this auction is still $35/MWh. All dispatched bidders receive this price for their energy.

Review of Session #2 Homework

- Calculating the Market Clearing Price in a Wholesale Electricity Market
- Generator F is added with a bid of $28/MWh for 25 MW capacity

Bids from Producers:

Gen A
Gen B
Gen C
Gen D
Gen E
Gen F



If utility calls for **100 MW** of demand

The Market Clearing Price (MCP) for this auction is now $30/MWh. All dispatched bidders receive this price for their energy.

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

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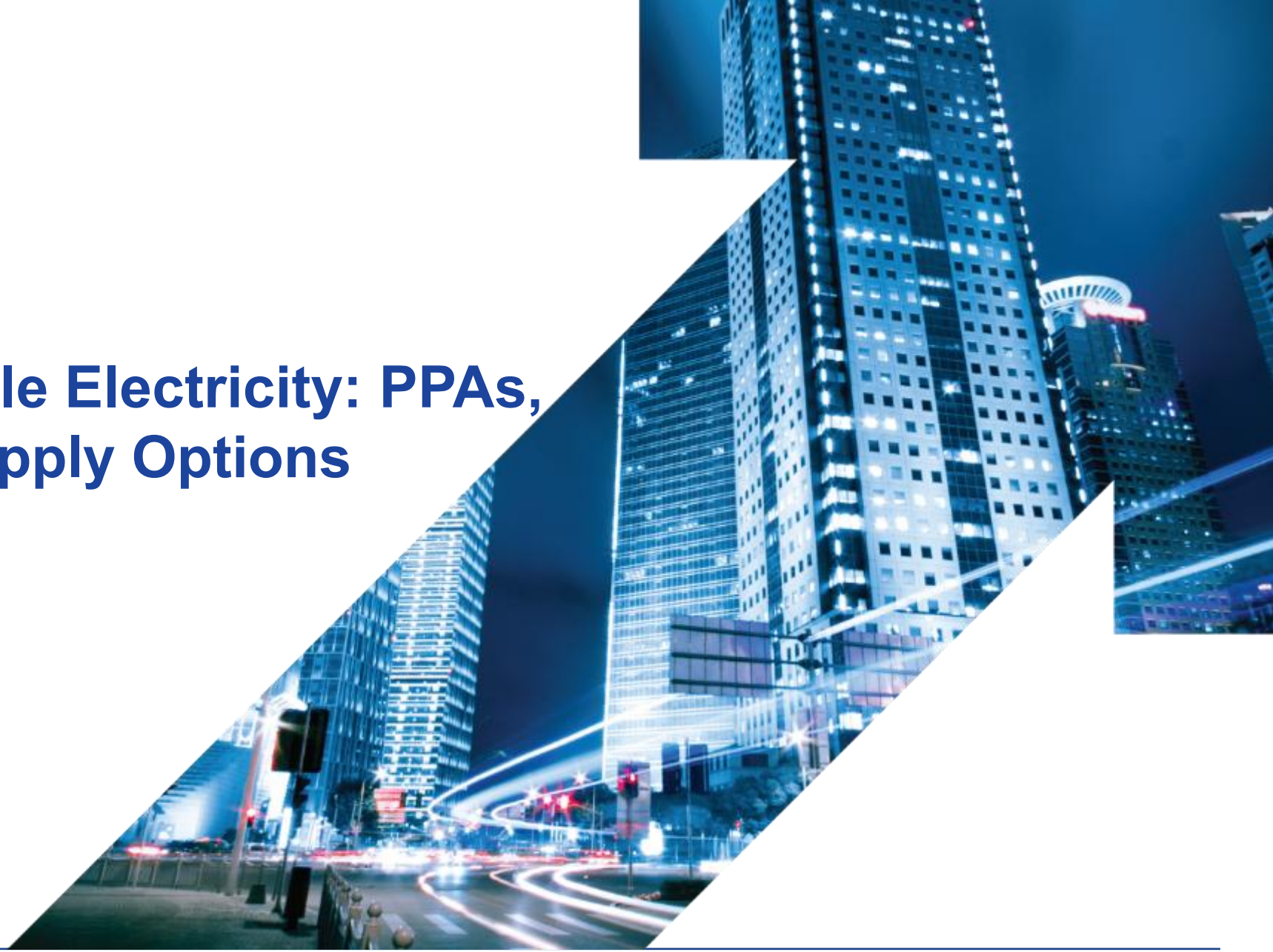

Purchasing Renewable Electricity: PPAs, VPPAs, and Other Supply Options

Indraneel Bhandari
Oak Ridge National Laboratory

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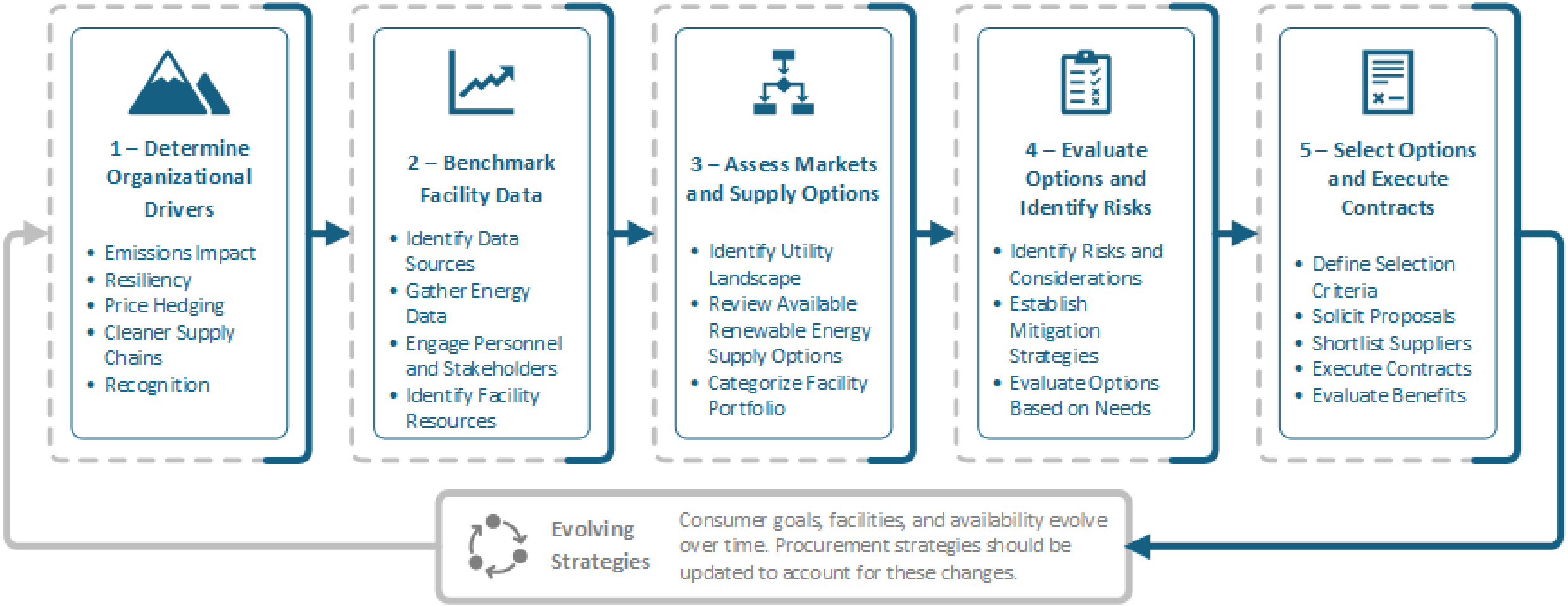
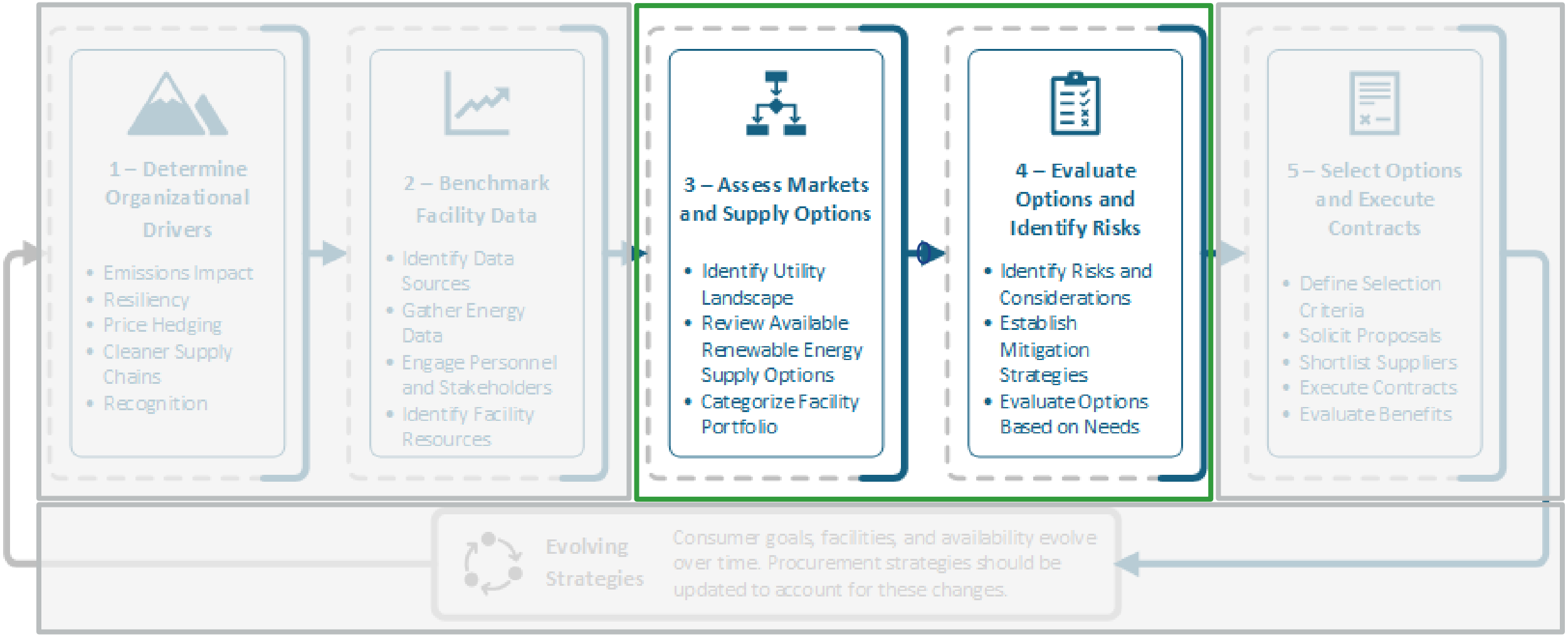
Renewable Electricity Procurement Roadmap

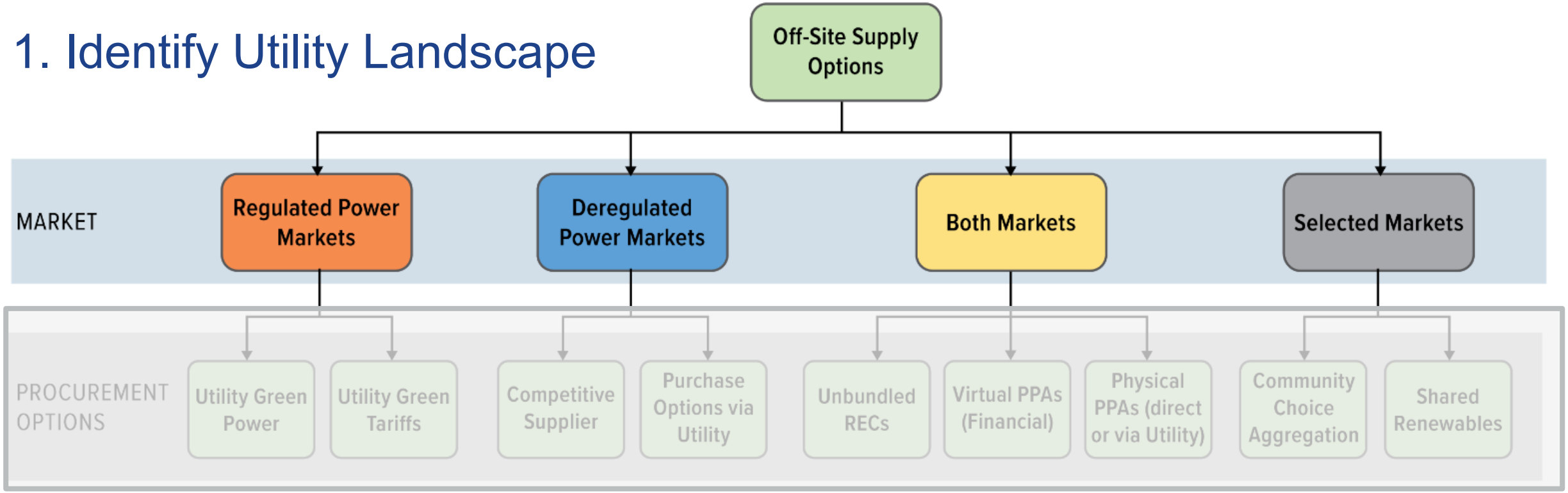


Renewable Electricity Procurement Roadmap



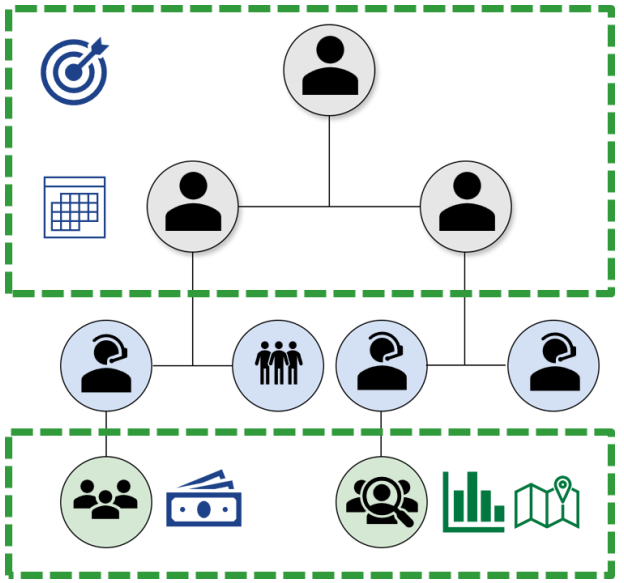
Assess Markets and Supply Options

1. Identify Utility Landscape

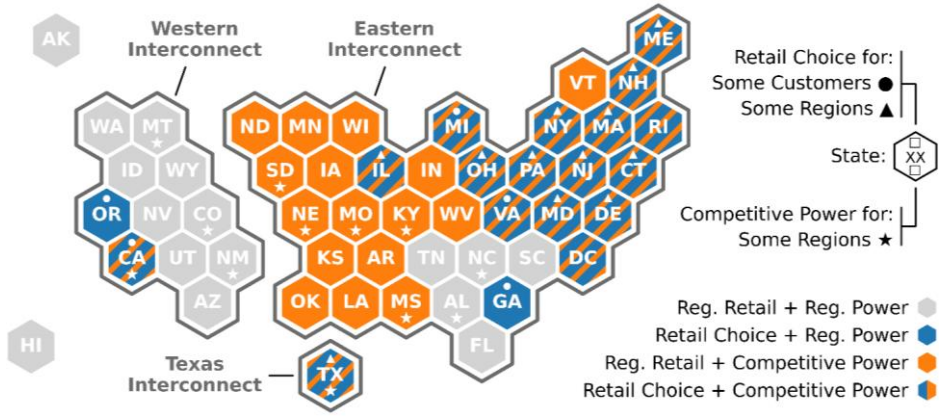


2. Categorize Your Portfolio

- How much energy do you need?
  - Purchase Volume
  - Short term vs Long term goals
  - *Other factors*

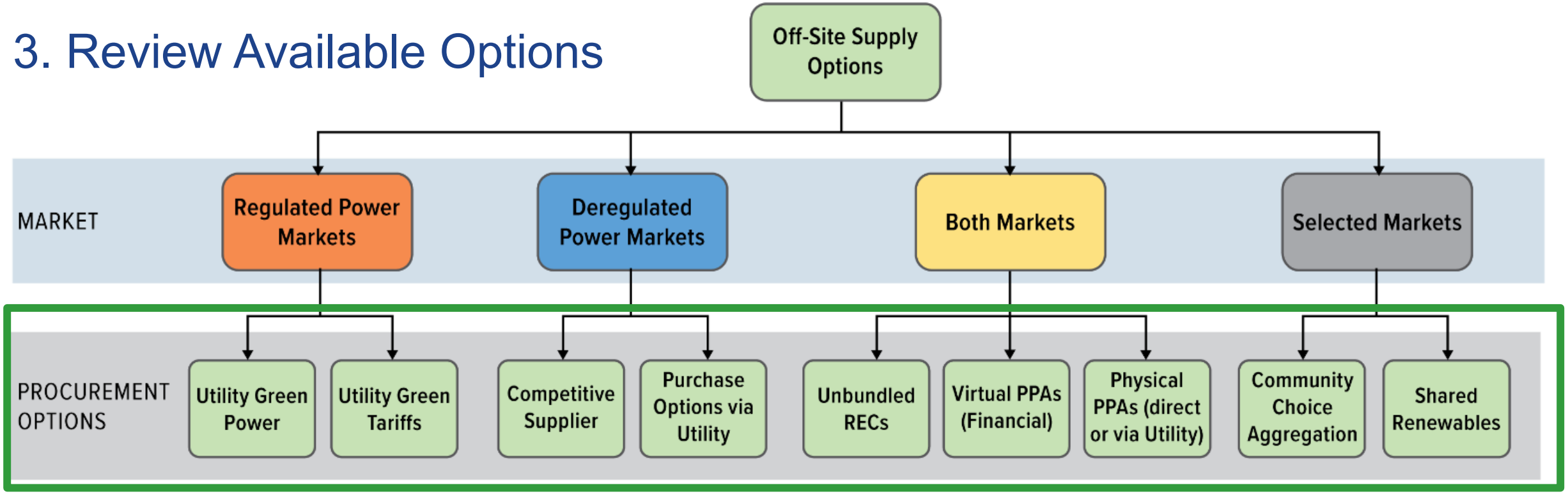


- Where do you need to procure?
  - Number of facilities
  - Location of facilities
  - Emissions Inventory

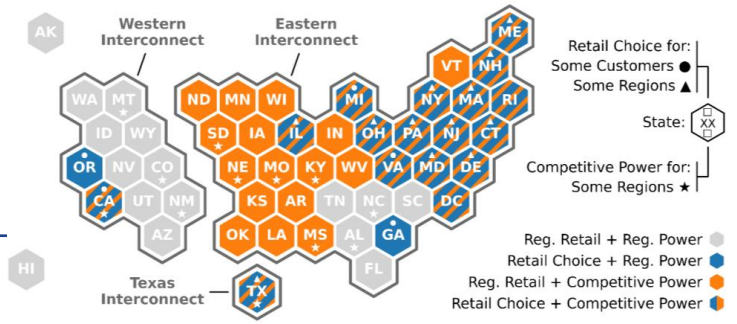


Assess Markets and Supply Options

3. Review Available Options



Options will vary with location



Power Purchase Agreements (PPAs)

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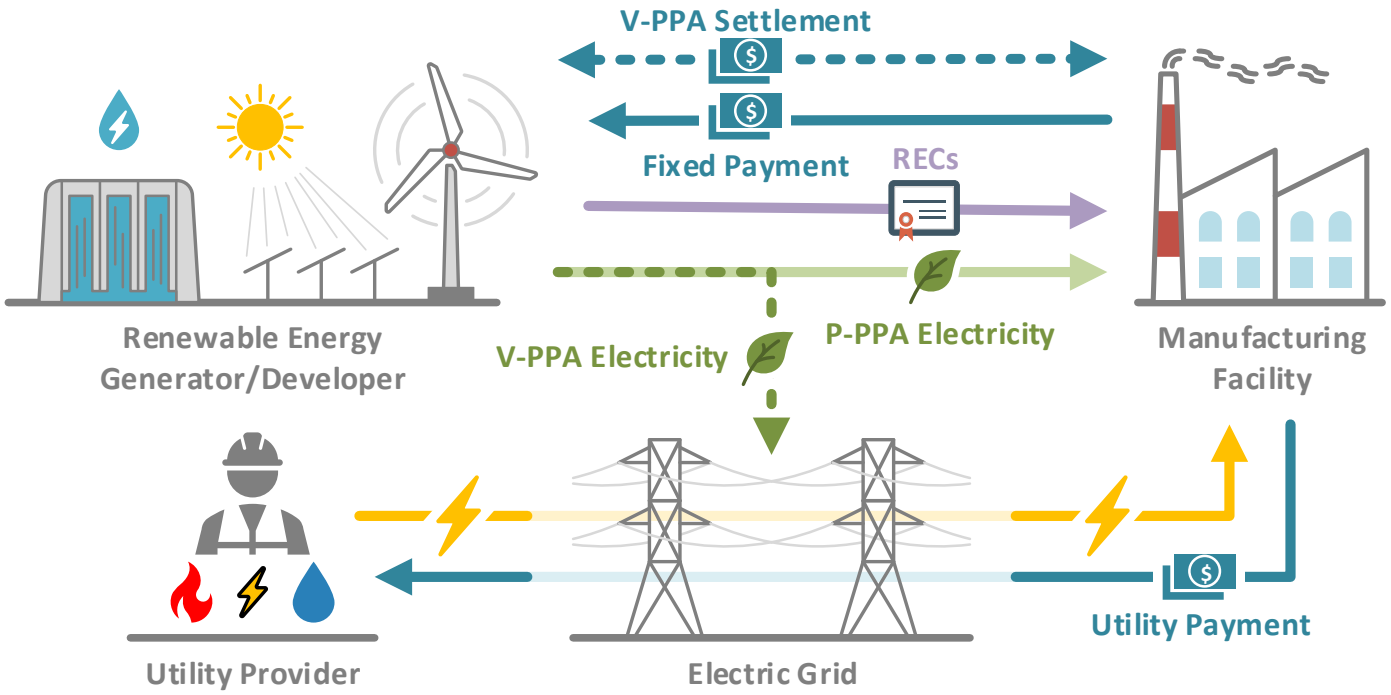
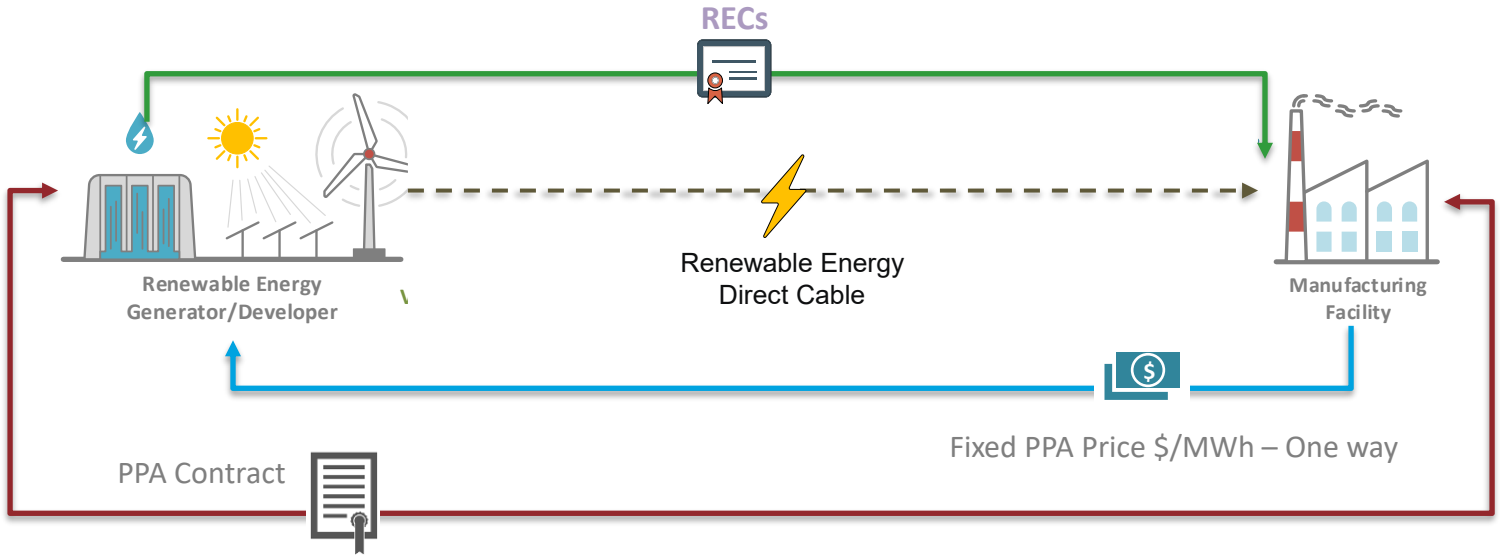
Power Purchase Agreements: PPAs & VPPAs

- PPAs are agreement to purchase energy from a third party
- Consumer buys electricity at a set rate and the associated RECs
- Benefits include reduce energy costs, shifted O&M costs, and renewable energy
- There are two main types of PPAs:
  - **Physical PPA:** Energy is delivered directly to consumer
  - **Virtual PPA:** Energy is delivered to the grid through wholesale market
- PPAs are location dependent
  - State regulations can affect your ability to enter into PPAs



Onsite Power Purchase Agreements (PPAs)

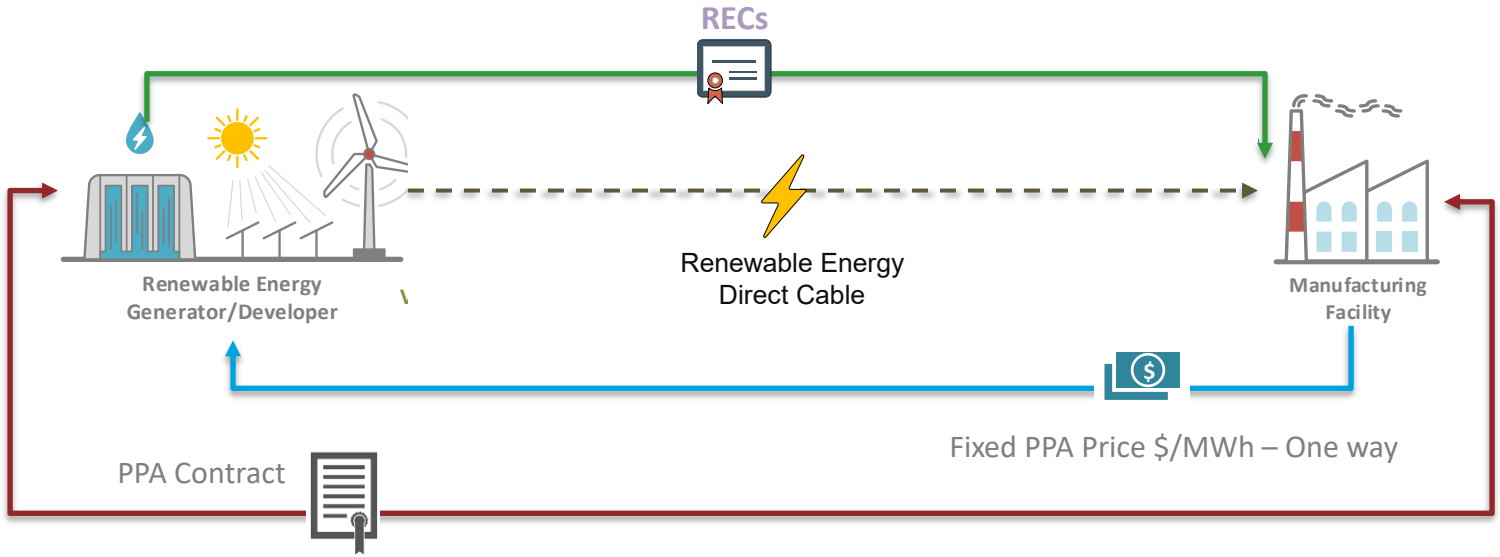
- When space available
- Generator is a third party
- Direct cable connection to the facility
- PPA price does not include grid fee which makes it cheaper than offsite PPA



Onsite Power Purchase Agreements (PPAs)

- ✓ Visibility and Accessibility
- ✓ Price hedging potential
- ✓ Reduced exposure
- ✓ Resiliency

- ○ REC ownership may vary
- ○ Resource limitations
- ○ Volume constraints



Virtual Power Plant Agreement (VPPA)

- Financial PPAs
- Fixed PPAs
- Contract for Differences

RECs only

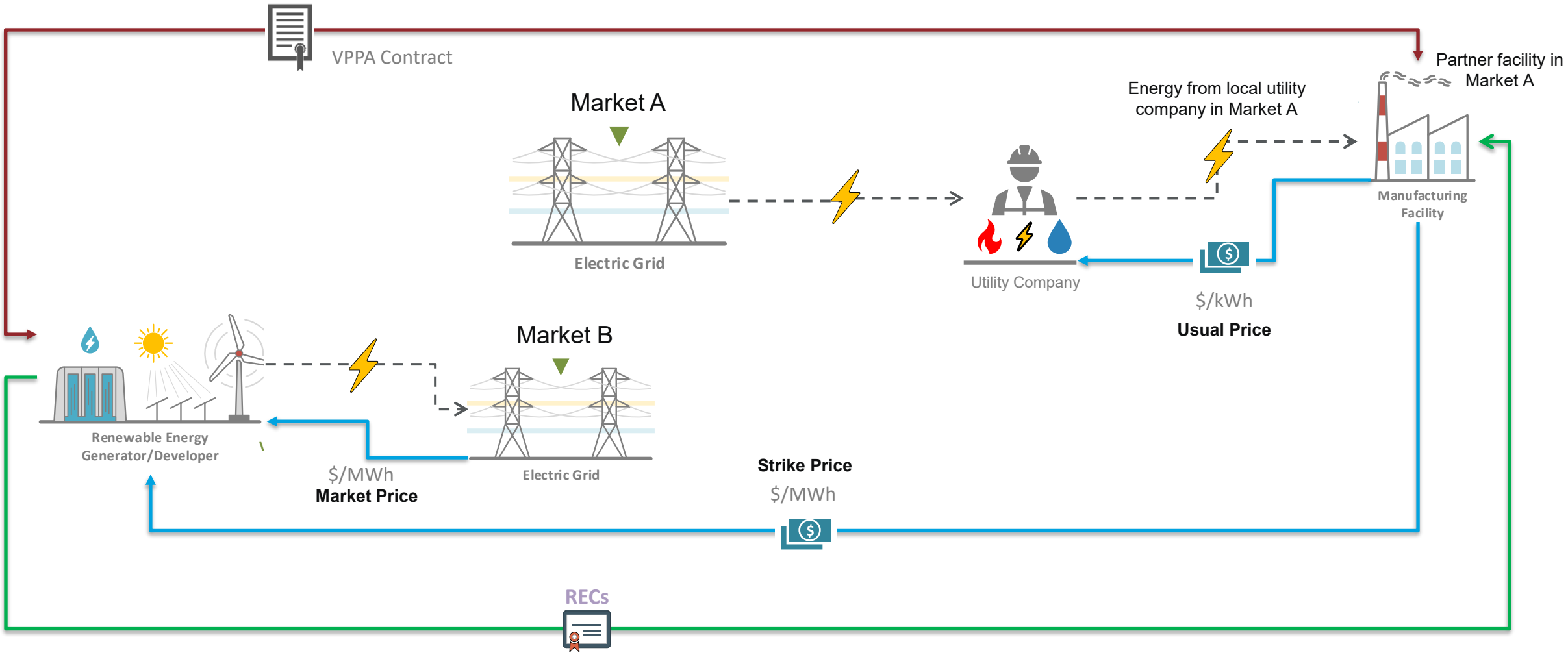
No title to electricity commodity

Payment is netted

- ✓ Flexibility with project siting
- ✓ Longer term availability
- ✓ Potential benefits – ITC and PTC
- ✓ Large volume transaction

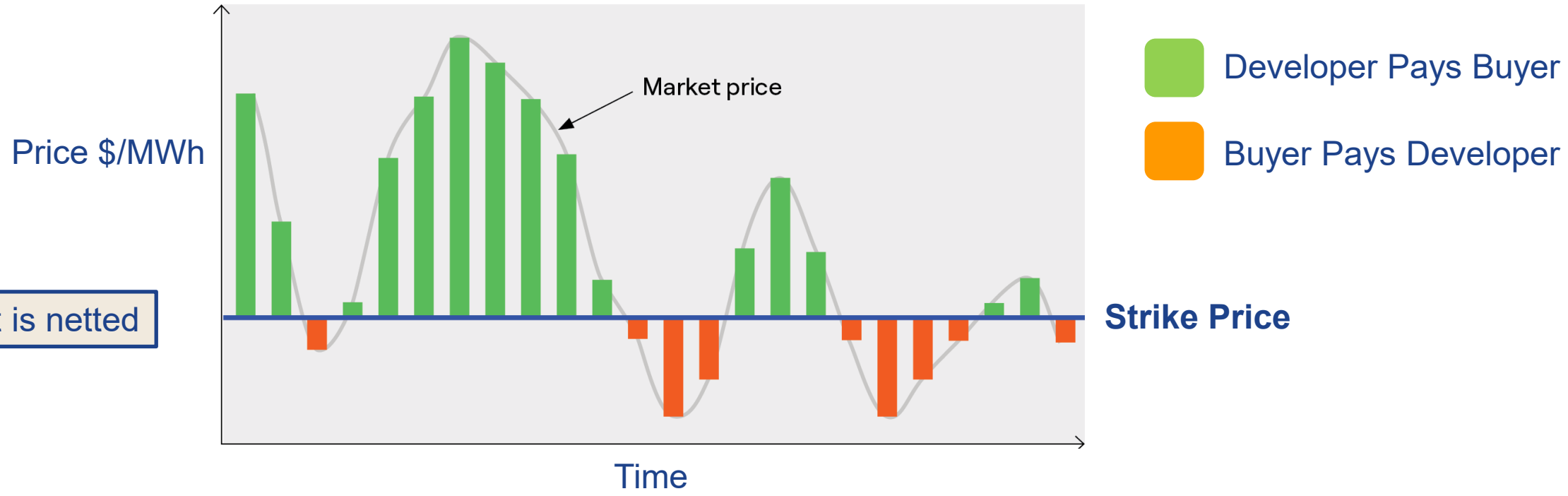
- ○ No title to electricity
- ○ Transaction complexity
- ○ Exposure and curtailment risk
- ○ Provide credit support

Virtual Power Plant Agreement (VPPA)



Strike Price (PPA and VPPA)

- Strike Price = Fixed Price that buyer agrees to pay for the RECs to the developer

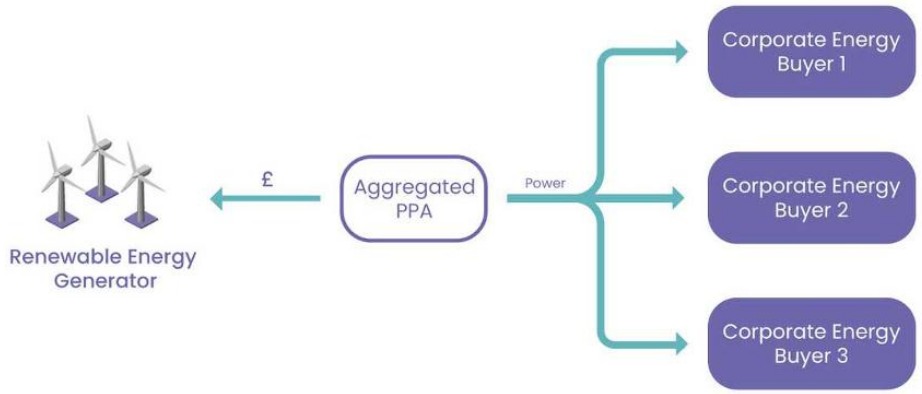


Payment is netted

Image Source: Enel North America

Aggregate PPA

- Most PPAs are large projects centered around large developers and companies
- Aggregate PPAs provide access to small and medium sized companies to purchase renewable energy
- Opportunity to make “Additionality” claims by small and medium sized companies
- Aggregation brings companies (all sizes) into a buying group to reduce costs (negotiation, transaction, pricing etc. that comes with large bulk purchases) and creates economies of scale.
- Opportunities to engage supply chain and reduce scope 3 emissions



L/M – Large Manufacturers; M/S – Medium scale Manf;

Aggregate PPA – Case Study

- Apple, Akamai, Etsy and Swiss Re partnered to purchase RE from PJM market
- 6 PPAs
- Largest > 130 MW, Smallest < 5 MW
- Illinois Wind project and Virginia Solar Project were selected
- 290 MW of additional renewable energy came on-line by the end of 2019 due to the collaboration

CASE STUDY

DOWNLOAD PDF

Apple, Akamai, Etsy and Swiss Re partner on largest renewable energy aggregation to date

While many companies seek to make a demonstrable impact on climate change by bringing new renewable energy projects into their electricity supply portfolio, this aspiration has been challenging for companies with smaller or geographically distributed loads whose needs are too small to enable a project to come to fruition. Enter aggregation.

By joining together, smaller energy users can create enough buying power to make a material impact on a project's financial outlook, attracting the attention of project developers and opening this impactful solution to a wider range of companies. In addition, by bringing multiple companies into a single procurement, aggregation has the ability to reduce transaction costs and create economies of scale.

In 2018, 3Degrees supported Apple, Akamai Technologies (Akamai), Etsy and Swiss Re as they leveraged their collective buying power in the largest aggregated corporate renewable energy transaction to date. This aggregation resulted in six power purchase agreements – the largest one greater than 130 MW and the smallest less than 5 MW. The companies' efforts demonstrate how corporate energy buyers of all sizes can successfully purchase renewable energy directly from new renewable projects.

RESULTS

+ 290 MW of additional renewable energy will be coming on-line by the end of 2019 thanks to the joint collaboration of Apple, Akamai, Etsy and Swiss Re.
+ The PJM Gang aggregation is a clear demonstration of how **corporate energy buyers of all sizes can successfully purchase renewable energy.**

Source: 3degreesinc

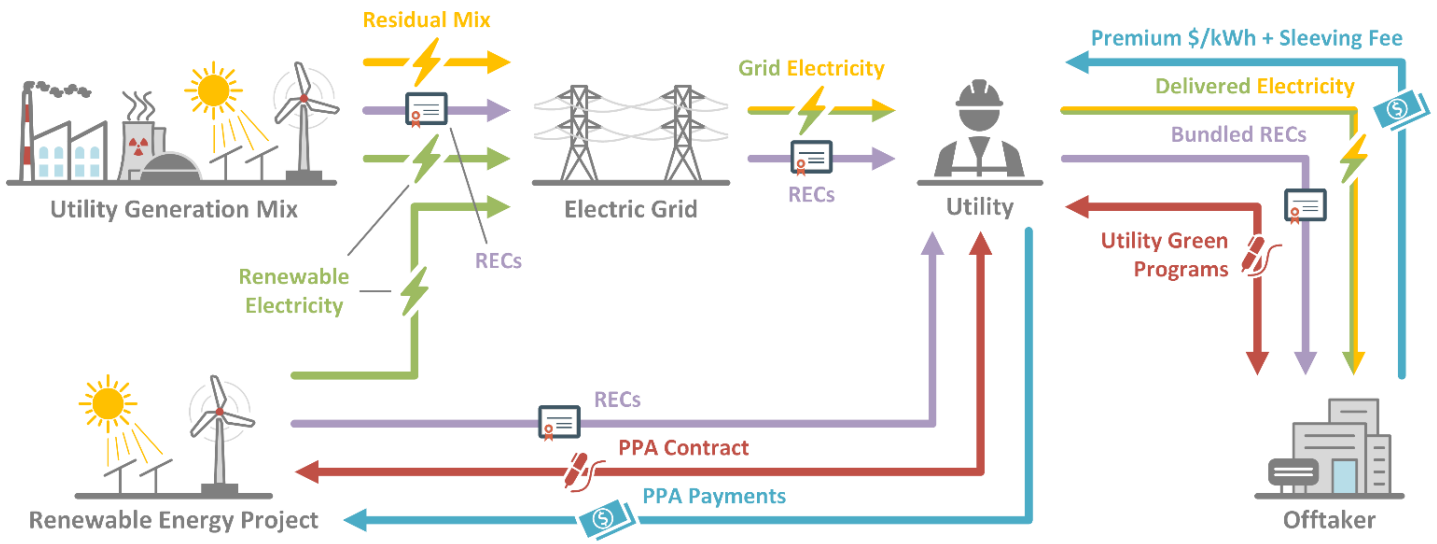
Green Tariffs and Green Power Products

U.S. DEPARTMENT OF ENERGY

Green Power

- ✓ **Voluntary programs**
- ✓ Bundled: Electricity + RECs
- ✓ Flexibility in volume: % or blocks
- ✓ Low risk
- ✓ No long-term commitment
- ✓ Simple transaction
- ✓ Known/Pre-selected projects

- ○ Premium costs*
- ○ Availability*
- ○ Duration
- ○ Limited additionality



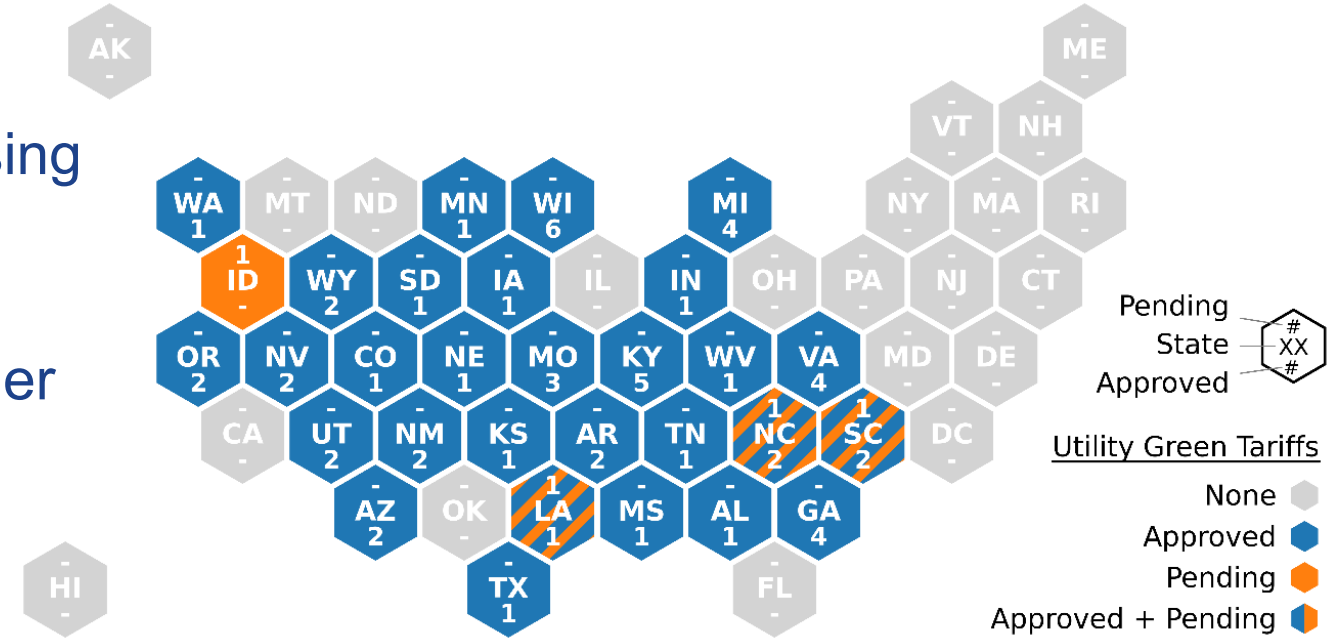
Option	Electricity Market	Agreement Term	Supply Type
Competitive Green Power Products	Deregulated (check local market)	Short (6-36 months)	Retail
Utility Green Power Products	Regulated (check with utility)	Month-by month	Retail

*depends on programs and utility landscape;

Green Tariff

✓ What is a Green Tariff?

- Voluntary utility programs for purchasing renewable energy + RECs
- Structured as independent tariff or rider on current bill
- Offered by local electric utilities
- Approved by state public utility commissions (PUCs)



States with utility green tariff programs as of October 2023

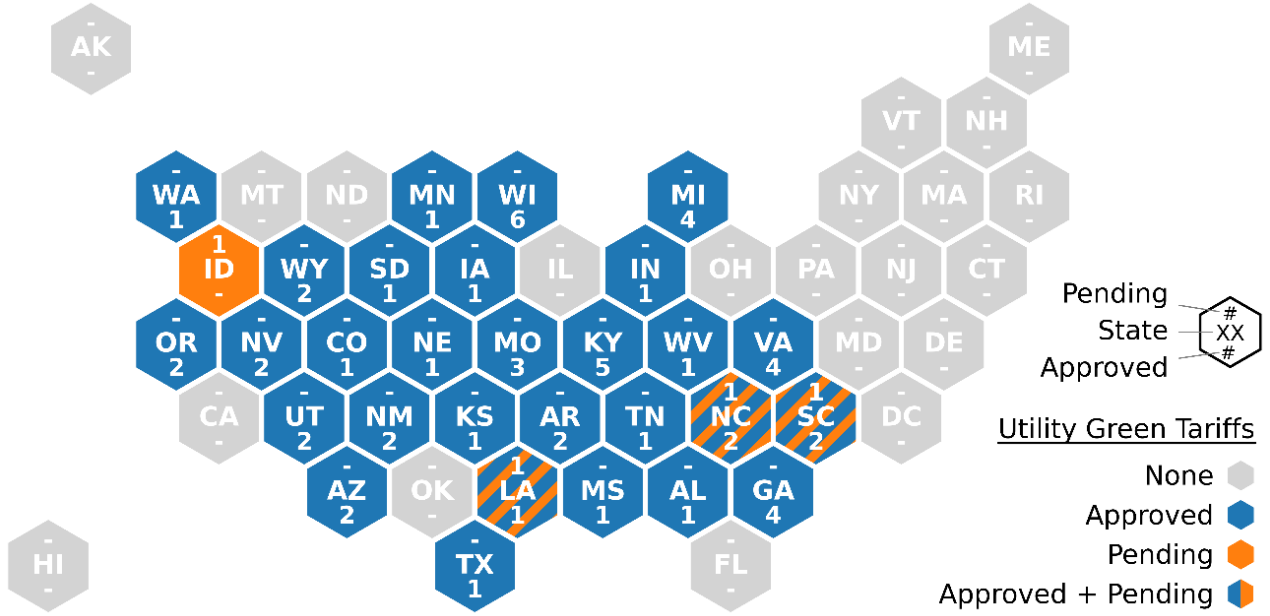
Also known as Green Tariffs or Utility Green Tariffs

Image adapted from: CEBA, U.S Electricity Markets, https://cebuyers.org/solutions/procure-clean-energy/green-tariffs/

Green Tariffs

- ✓ Voluntary programs
- ✓ Bundled: Electricity + RECs
- ✓ Flexibility in volume: % or blocks
- ✓ Low risk
- ✓ Known/Pre-selected projects
- ✓ Project involvement

- ○ Premium costs
- ○ Market-based pricing
- ○ Availability*
- ○ Duration and landscape



States with utility green tariff programs as of October 2023

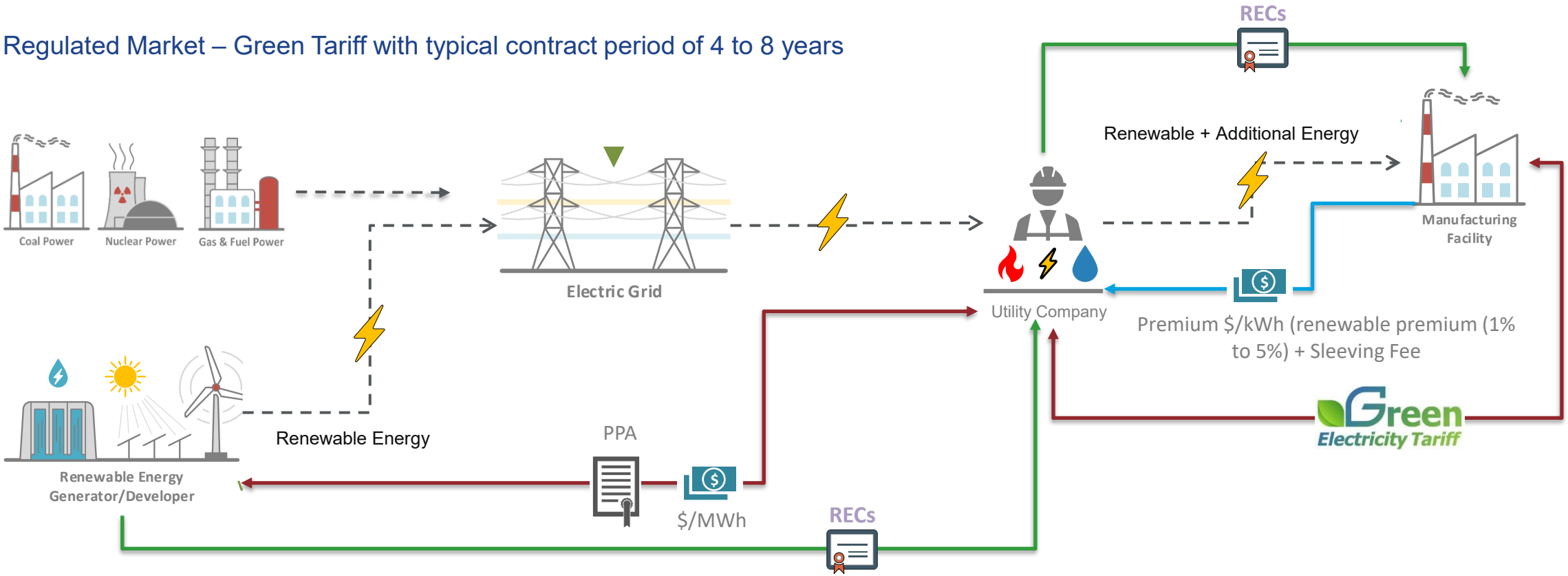
Option	Electricity Market	Agreement Term	Supply Type
Utility Green Tariffs	Regulated (check with utility)	Long (4-8 years)	Project-specific

*depends on programs and utility landscape

Data source: CEBA, U.S Electricity Markets, https://cebuyers.org/solutions/procure-clean-energy/green-tariffs/

Green Tariff – Program offered by Utilities

Regulated Market – Green Tariff with typical contract period of 4 to 8 years

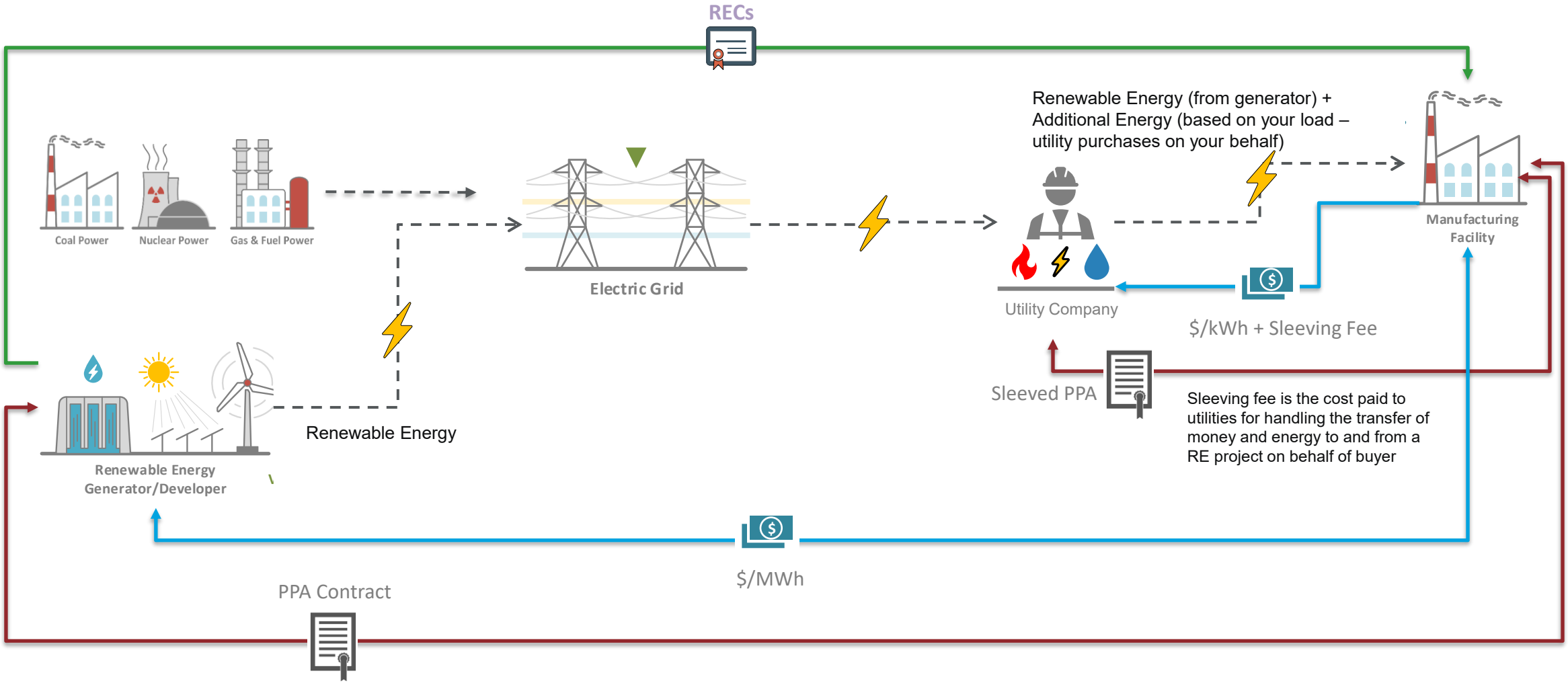


Green Tariff – Customer may have a say on RE source, Typical contract period of 4 to 8 years
Green Power – Utility determines the RE source, Shorter contract period (sometimes month to month)

In a Green tariff, the utility delivers power from a defined set of power projects within the grid region serving the partner facility

Offsite Power Purchase Agreements (PPAs) – Direct/Sleeved PPA

De-regulated Market – Typical contract period range of 10 to 20 years



In a Direct/Sleeved PPA, the generator and partner company must be on the same grid

In Summary: Green Power and Green Tariffs

Utility Green Tariff & Utility Green Power Products:

- Both offered by utilities in **regulated** markets
- Consumer receives **bundled** green power through both
- Green Tariff attached to a **specific project** through utility (long-term agreement)
- Green Power Products, customers pay premium for extra line item on bill to support “off-the-shelf” renewable electricity product from a **mix of renewable energy resources**.

5 Minute Break

Other Common Supply Options

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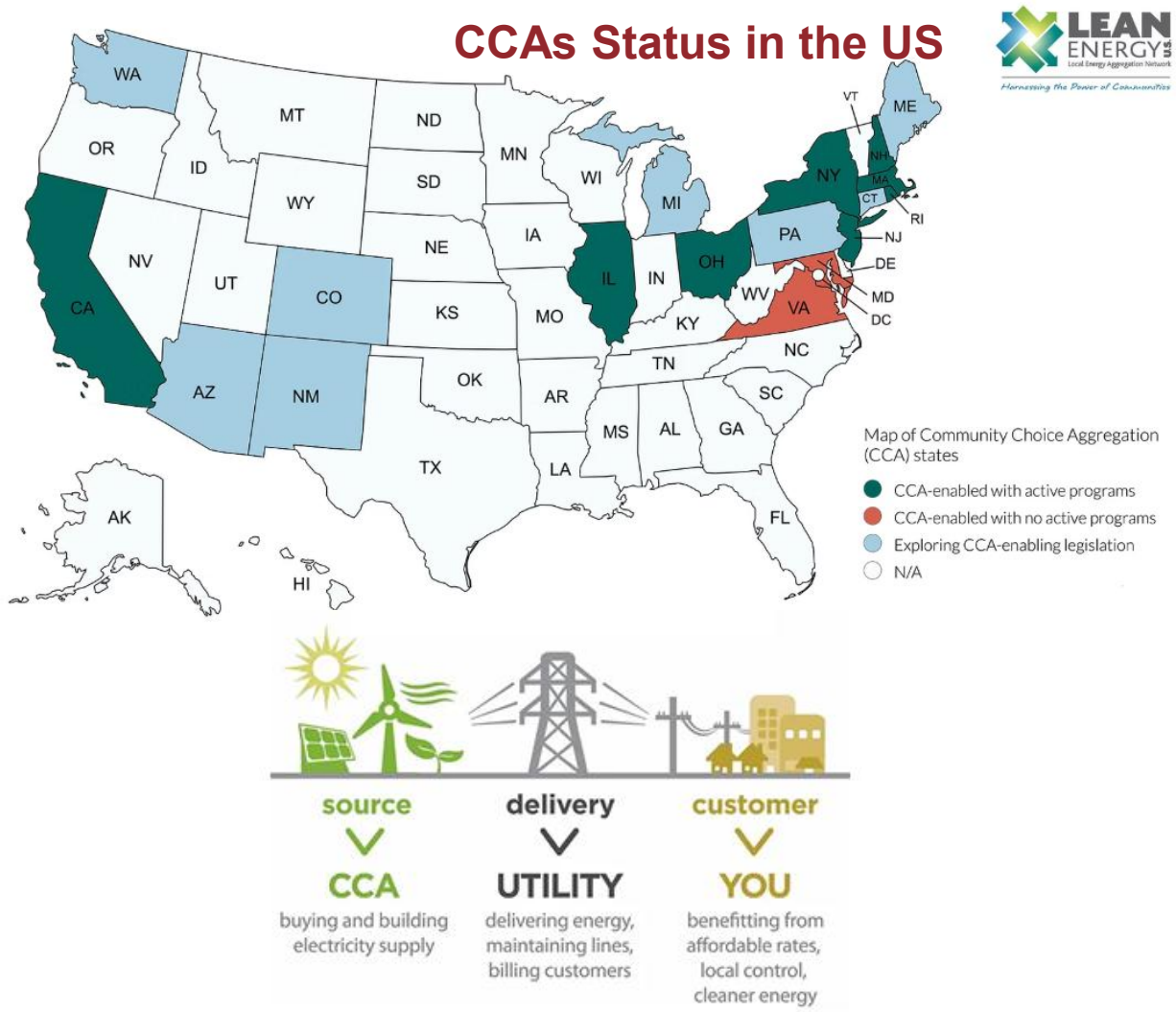
Community Choice Aggregations (CCAs)

- Also known as **Municipal Aggregation**: Programs that **allow local governments to procure power on behalf of their residents, businesses, and municipal accounts** from an alternative supplier while still receiving transmission and distribution service from their existing utility provider.
- CCAs are an attractive option for **communities that want more local control over their electricity sources**.
- CCAs are currently authorized in California, Illinois, Ohio, Maryland, Massachusetts, New Jersey, New York, Rhode Island, New Hampshire, and Virginia.

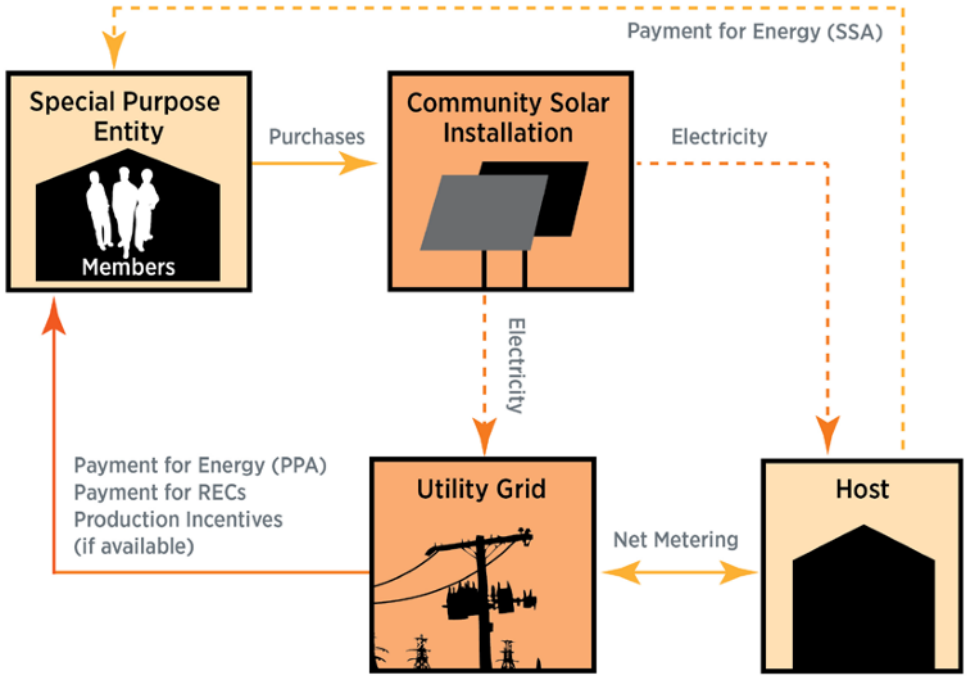


Source: Local Energy Aggregation Network (LEAN) Energy US, https://www.leanenergyus.org/cca-by-state

Shared Renewables (Community Renewables or Community Solar)

Shared Renewables, also known as or Community Renewables or **Community Solar**

- A procurement model **allowing multiple customers to buy, lease, or subscribe to a portion of a shared green power system** that is usually located away from their home or business.
  - Utility-Sponsored Model: Utility owns/operates the project; customers opt in voluntarily
  - Special Purpose Entity (SPE): Investors form a business entity to develop and own the project
  - Non-Profit Model ("Buy a Brick"): Donors fund the project, which is owned by a charitable organization.



Community Shared Solar Installation

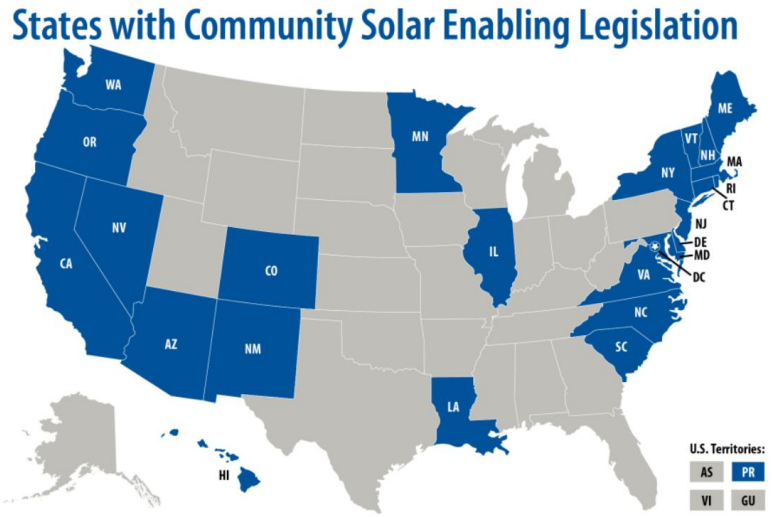
Image source: NREL, https://www.nrel.gov/docs/fy12osti/54570.pdf

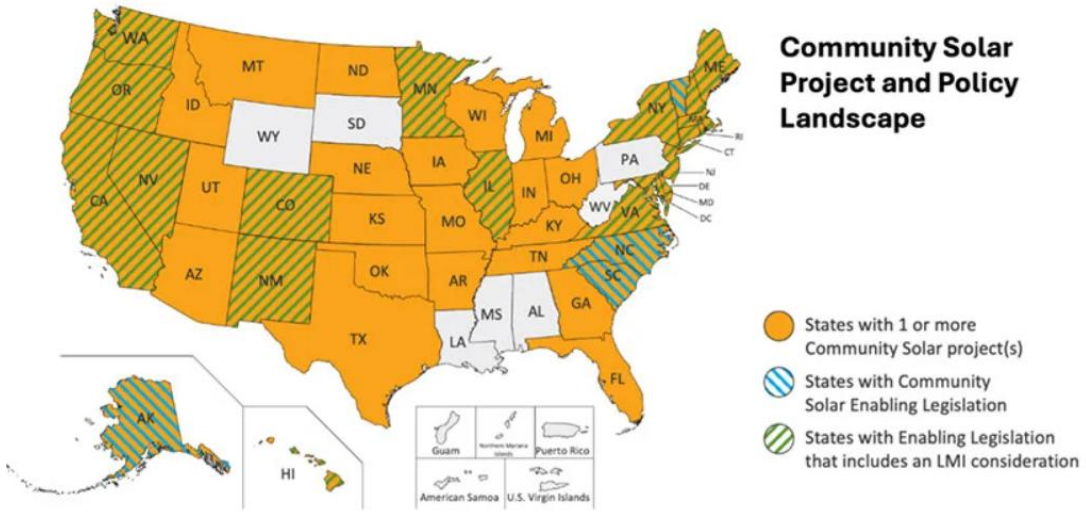
Shared Renewables (Community Renewables or Community Solar)

- Shared renewables legislation, specifically community solar legislation, has been enacted in 24 states, Washington D.C., and Puerto Rico.

- Considerations
  - ✓ Access without onsite installation
  - ✓ Easy subscription, low cost
  - ✓ Low or no maintenance
  - ✓ Economies of scalable

    - Often no RECs = no environment claims
    - Less visible commitment
    - Not available in all states





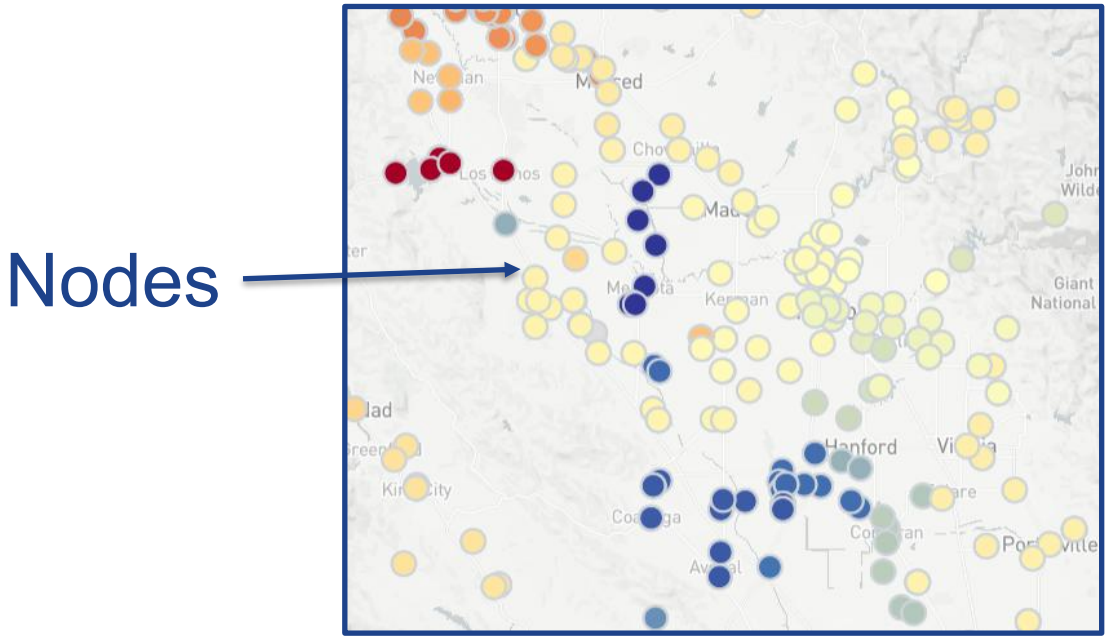
Source: EPA Green Power Market

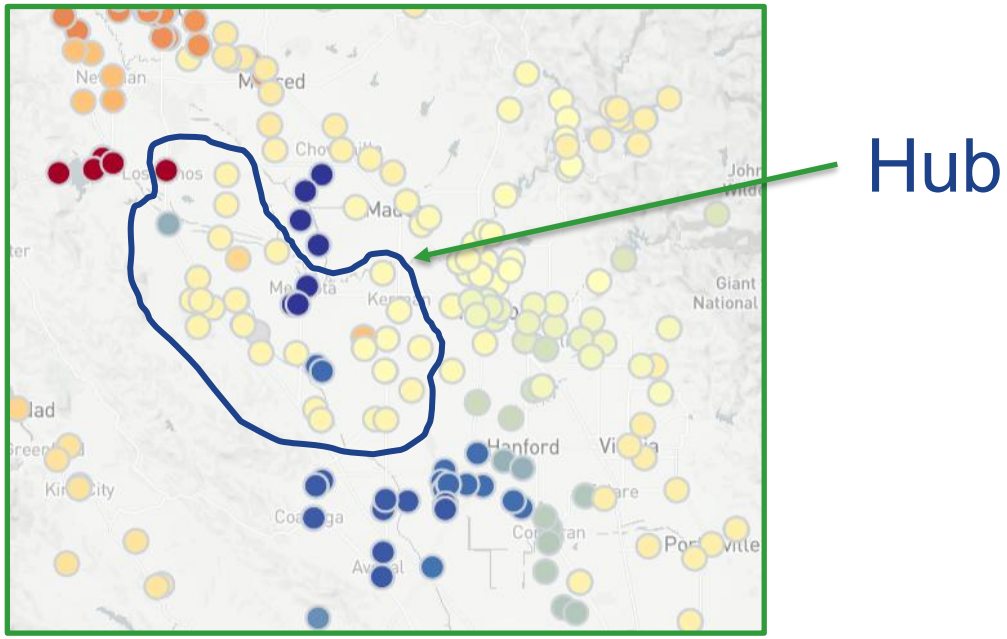
Considerations

U.S. DEPARTMENT OF ENERGY

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

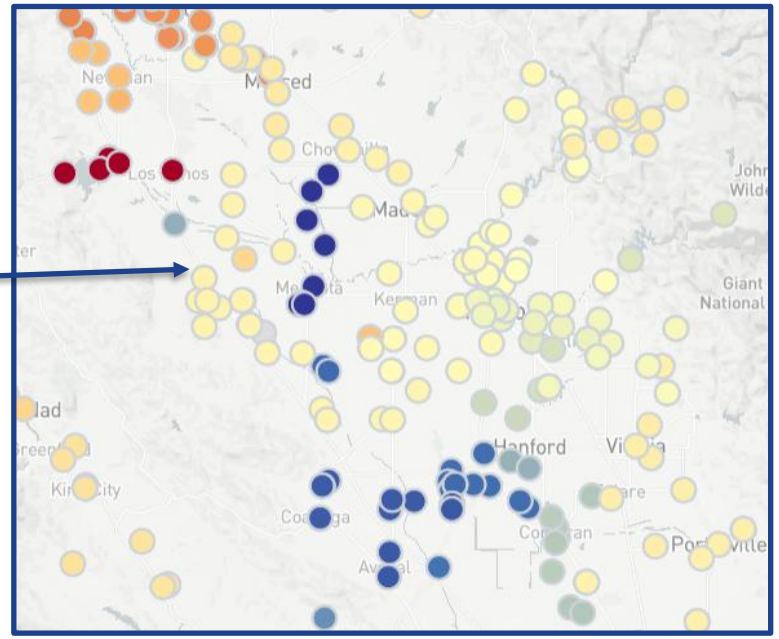


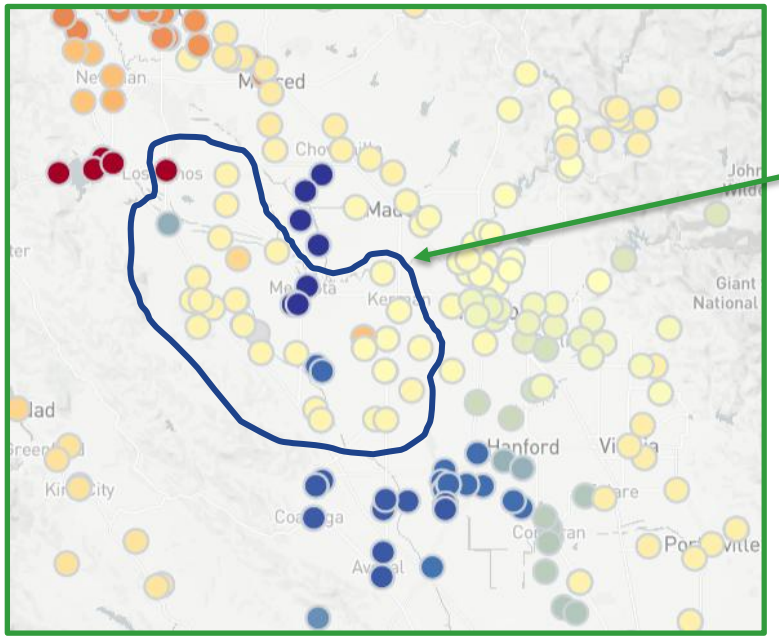


Pricing Considerations: Hubs vs Nodes

- 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

Nodes





Hub

“Contract for Differences”

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

Contract Price **LMP Selling Price**

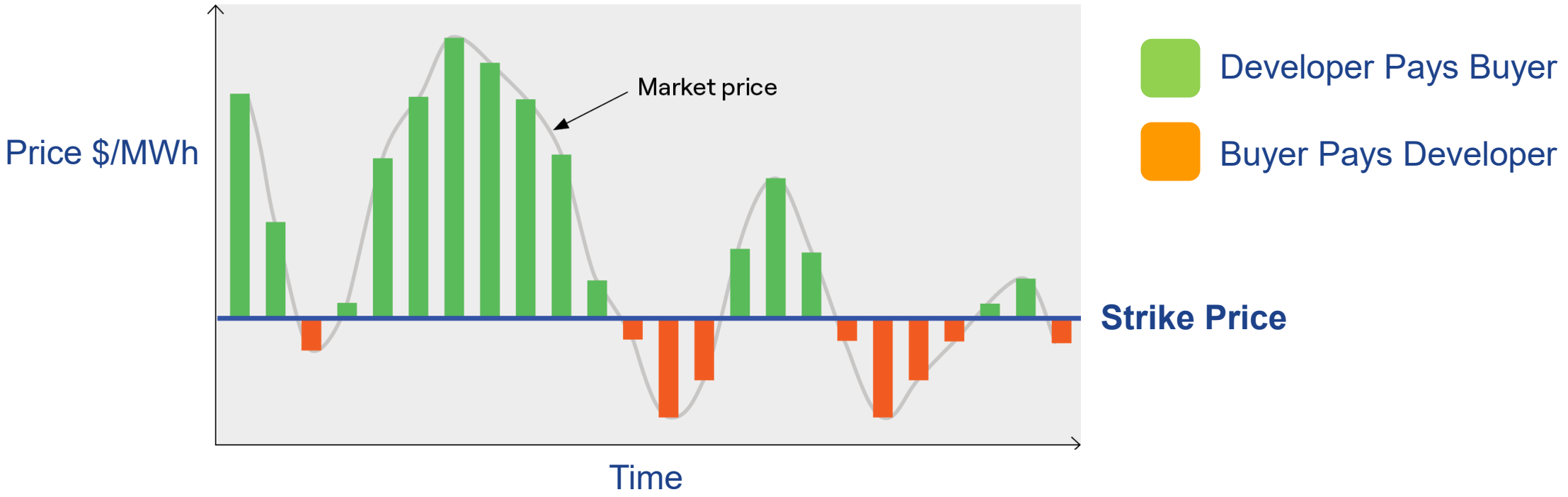


Image Source: Enel North America

“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
• Financial Exposure • Energy Ownership • Length of Contract • Credit Support • Incremental Impact • Regionality	• Interconnection • Permitting and Siting • Contracting Process • Price Volatility • Resource Type	• State and Local Regulations • Length of Contract • Pricing Constraints • REC Ownership	• Operation Schedule • Additionality • Community Acceptance • Third Party Certifications • Grid Congestion

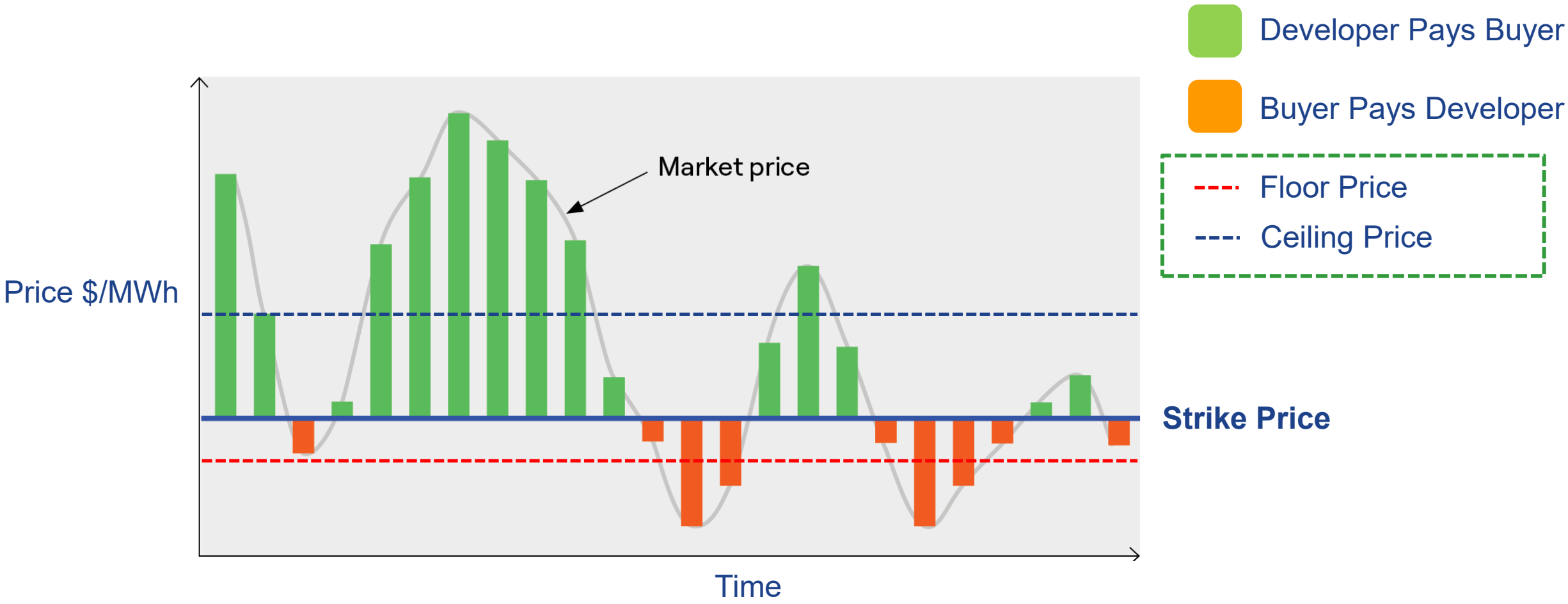
Mitigating Risk

- Forward Strip of RECs (Bridge RECs)
  - Future proof against delays and *forced majeures*
- 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

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

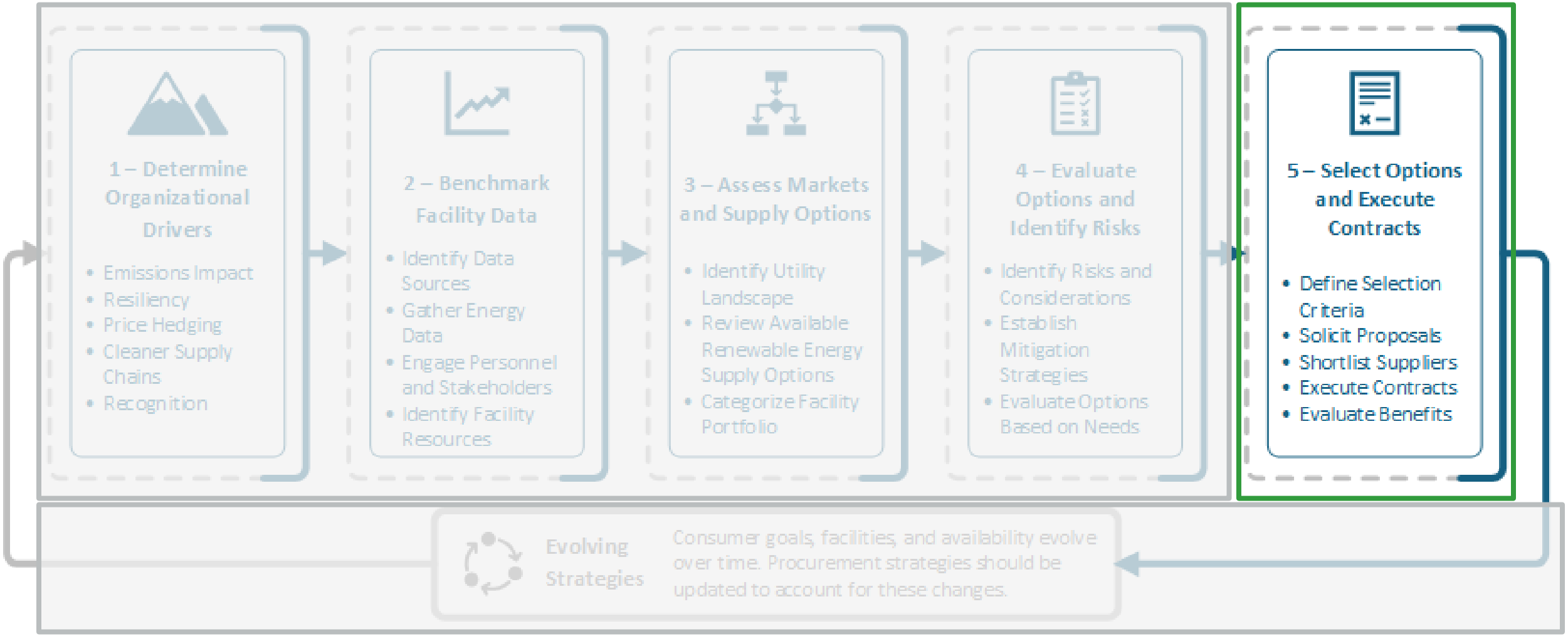


Source: Enel North America

How do we select options and execute contracts?

U.S. DEPARTMENT OF ENERGY

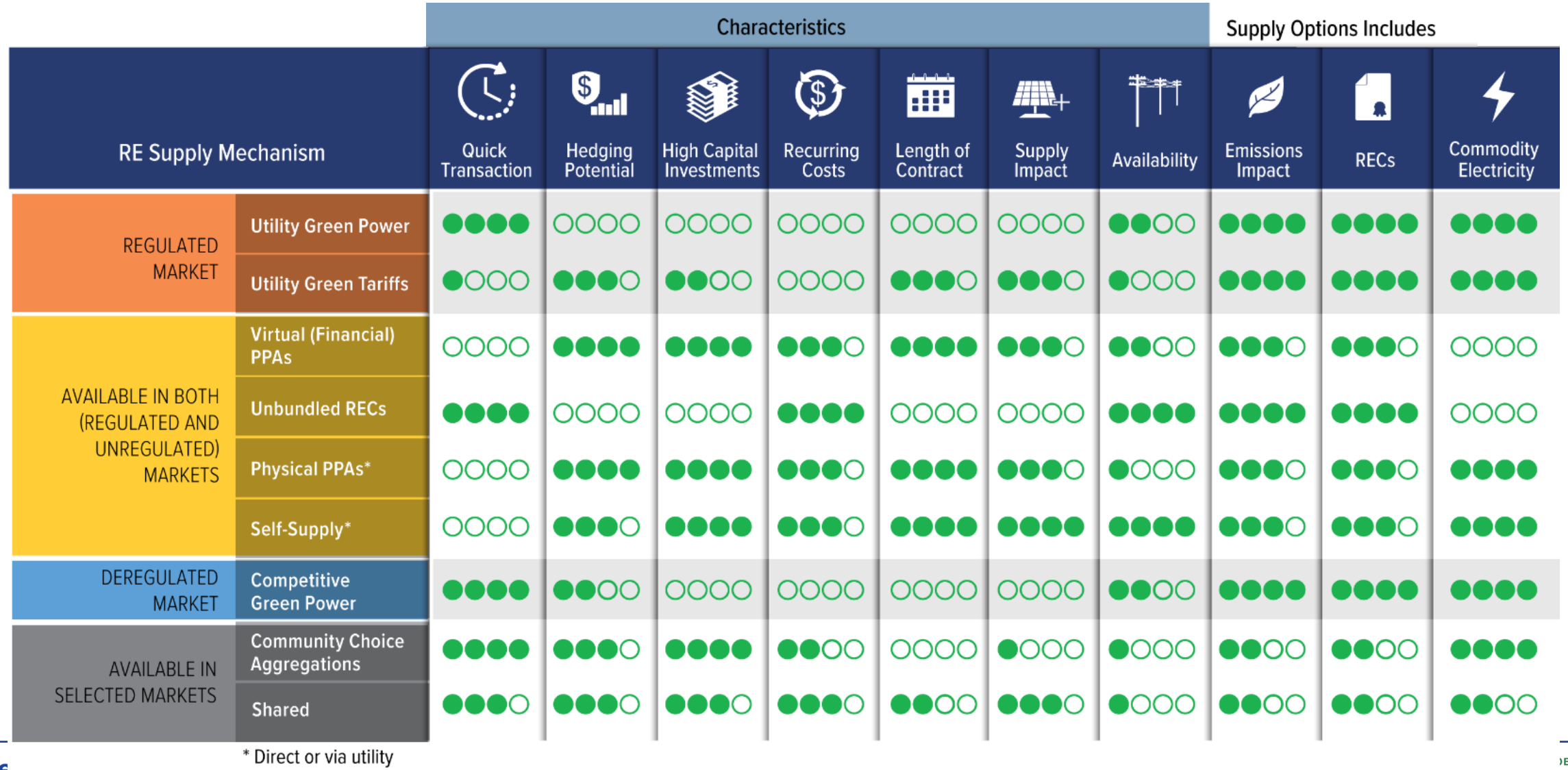
Renewable Electricity Procurement Roadmap



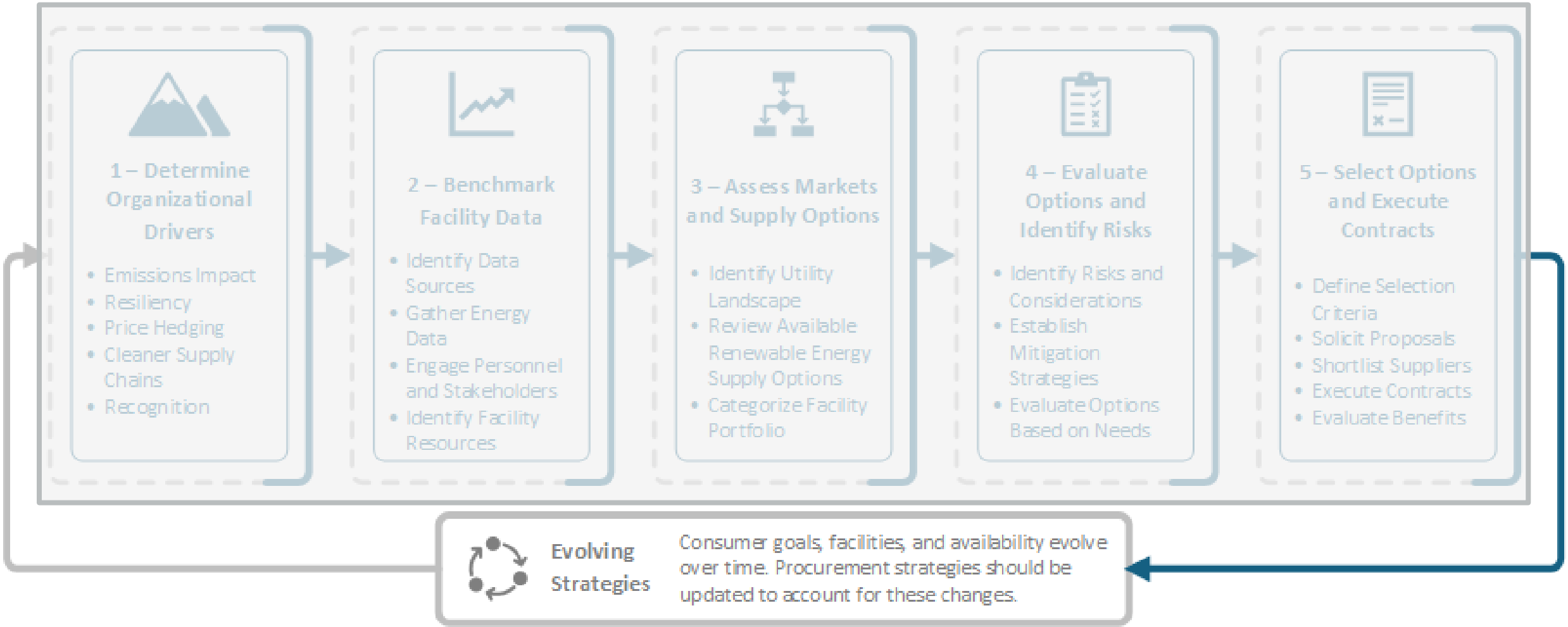
Contracting and Ownership

- Establish evaluation criteria and form a stakeholder committee
- Develop and issue an RFP to solicit supplier bids
- Review and compare bids using set criteria
- Shortlist or select finalists based on bid quality
- Interview or award based on RFP responses
- Finalize contracts to secure delivery and ensure compliance
- Follow internal procurement protocols throughout

REC Characteristics



Renewable Electricity Procurement Roadmap

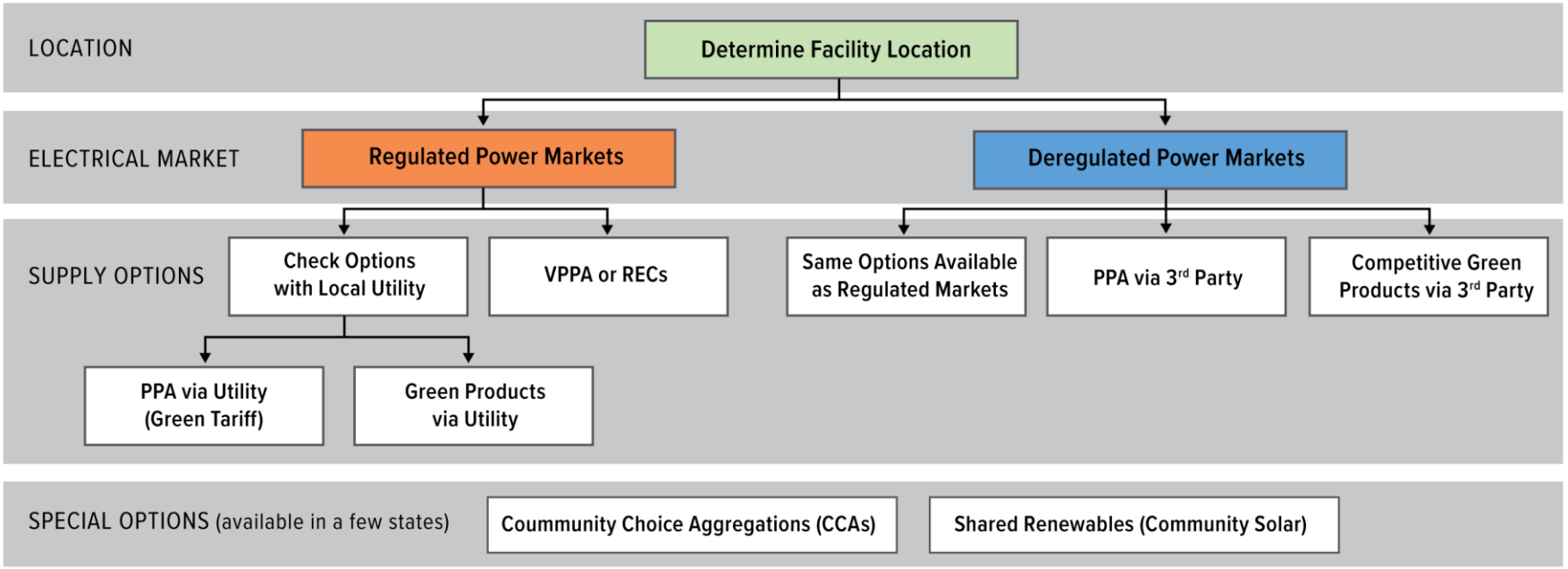


Takeaway Notes

- Clear targets make a clear business case
- Buying renewable energy is a cost
  - Customer driven
  - REC purchase is a market signal
- How customers buy electricity depends on where they are located
  - Emissions (factor additionality)
  - Availability – location and volume
  - Pricing

Takeaway Notes

Simplified Approach to Procure Renewable Electricity



Considerations:

1) For BP energy reporting purposes, as long **renewable electricity are being delivered** to the plant the site-to-source multiplier is reduced from 3 to 1.

2) Regarding carbon emissions and per SBT, **PPAs, RECs**, and other renewable electricity purchases can help reducing **Scope 2 emissions**.

3) An energy stream is **"renewable" only** if you have the associated **RECs**.

4) Location can affect the availability of renewable electricity supply options.

Other Programs and Platforms for Renewable Energy

EPA's Green Power Partnership (GPP) [https://www.epa.gov/greenpower]	EPA GREEN POWER PARTNERSHIP	Center for Resource Solutions (CRS) [https://resource-solutions.org]	CRS
Clean Energy Buyers Association (CEBA) [https://cebuyers.org]	CEBA Clean Energy Buyers Association	Green-e Energy and Green-e Marketplace [https://green-e.org/programs/energy]	Green-e
Database of State Incentives for Renewables & Efficiency (DSIRE) [https://www.dsireusa.org]	DSIRE® | NC CLEAN ENERGY TECHNOLOGY CENTER	GHG Protocol Scope 2 Guidance [https://ghgprotocol.org/scope_2_guidance]	GREENHOUSE GAS PROTOCOL
RE100 [https://www.there100.org]	RE100 | CLIMATE GROUP | CDP	The Renewable Thermal Collaborative (RTC) [https://www.renewablethermal.org]	RENEWABLE THERMAL COLLABORATIVE
Solar Energy Industries Association (SEIA) [https://www.seia.org]	SEIA Solar Energy Industries Association®	American Council on Renewable Energy (ACORE) [https://acore.org]	ACORE AMERICAN COUNCIL ON RENEWABLE ENERGY

Other Resources:

- Onsite Energy Program
- Better Plants Solutions Center
- Federal Battery Storage Tax Credit
- State-Level Incentives
- General Energy Storage Facts
- U.S. Solar Photovoltaic System and Energy Storage Cost Benchmarks
- Energy Storage Cost and Performance Database
- DOE Factsheets on Energy Storage
- Grid-scale Energy Storage Technologies Primer – NREL
- 2024 Electricity ATB Technologies and Data Overview

Questions?

Thank you!