



**TimberRock**

*PJM Emerging Technology Forum 9-1-21*

# PJM ETF | Agenda



- TimberRock background & vision (5-min)
  - Overview and track-record in PJM
  - Our Vision - What does a low-CO<sub>2</sub> energy future look like? Where does TimberRock fit?
- Our Tech - CO<sub>2</sub>-Tracking and Aggregation Platform (20-min)
  - The *What*:
    - Digitization – Integration of all components of energy ecosystem
    - Aggregation – Harmonization of data sources, enrichment
    - Optimization - Forecasting, simulation
  - The *How*:
    - Customer case study – GM's Supplier Program
    - Technology building blocks
- PJM's New Marginal Emissions Signal (5-min)
- Q&A and discussion (15-min)

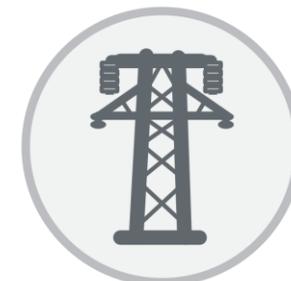


# Background & Vision

# PJM ETF | TimberRock Overview



- Power, gaseous fuels, and liquid fuels – are critical for modern civilization and enable economic prosperity, mobility, productivity, security, and comfort
- But every unit of energy has hidden costs in the form of CO<sub>2</sub> and other emissions that
  - Endanger the global climate
  - Damage local environments
  - Harm the health of individuals



Power



Gaseous



Liquid

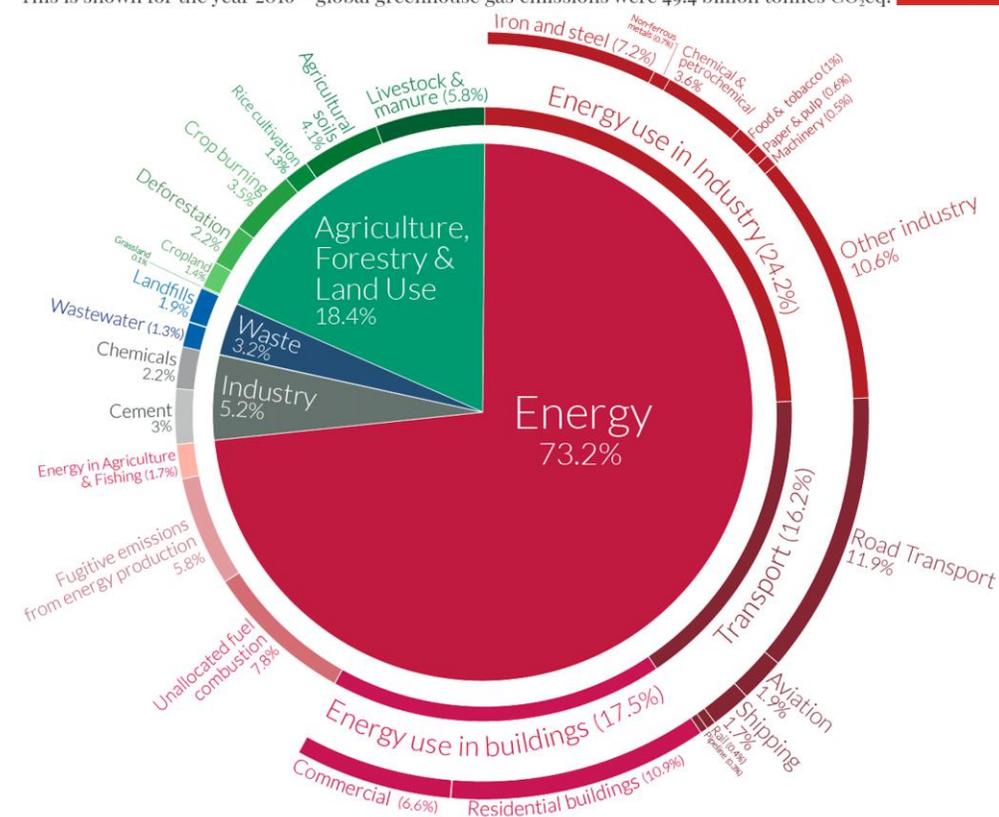


- In fact, energy use represents 70%+ of total GHG emissions and 92% of CO<sub>2</sub> emissions\*
- Transitioning to low-CO<sub>2</sub> energy is the biggest impact most organizations can make in reducing GHG

\*<https://www.eia.gov/energyexplained/energy-and-the-environment/where-greenhouse-gases-come-from.php>

## Global greenhouse gas emissions by sector

This is shown for the year 2016 – global greenhouse gas emissions were 49.4 billion tonnes CO<sub>2</sub>eq.



OurWorldinData.org – Research and data to make progress against the world's largest problems. Source: Climate Watch, the World Resources Institute (2020). Licensed under CC-BY by the author Hannah Ritchie (2020).



- TimberRock believes in an energy future with low or no CO<sub>2</sub>
- Our **CO<sub>2</sub>-Tracking & Aggregation** software and services help companies, municipalities and utilities lower CO<sub>2</sub> and achieve:
  - RE100
  - Science-Based Targets
  - Or other low-CO<sub>2</sub> or no-CO<sub>2</sub> goals
- We provide precise CO<sub>2</sub> accounting across all elements of an energy ecosystem – including scope 2 and scope 3 – and data-driven solutions to “bend the curve” to meet CO<sub>2</sub> goals

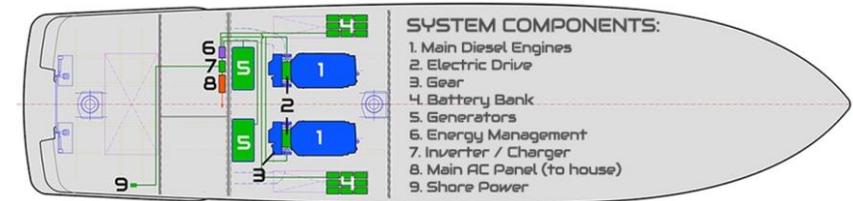
# PJM ETF | TimberRock Overview



- Senior team together 15+ years
- Initially served two energy markets:
  - Traditional/Centralized Generation: Sophisticated control systems for centralized nuclear & natural gas power plants. Siemens white-labeled
  - Emerging/Distributed "Microgrids": Complex energy systems in the marine market. Generators, battery storage and grid
  - Core competencies: Moving data and moving electrons
- About 10 years ago, we concluded that renewables, EVs and energy shift tech were increasingly ready for prime time. We refocused on helping customers move to low-CO<sub>2</sub> energy future...

# SIEMENS ENERGY

Traditional/Centralized



Emerging/Distributed

# PJM ETF | TimberRock Overview - A Low-Co2 Energy Future?



1

High penetration of renewables - PV and wind – along with existing nuclear, hydro & geothermal

2

- High penetration of EV – significant decline of liquid fuels in short and medium haul transport

Energy shift technologies (temporal)

- Short duration – minutes to hours – EVs, flexible load, stationary storage
- Medium duration – hours to days – stationary storage
- Long duration – days to weeks – hydrogen, electrolyzers, fuel cells

3

- Connective-tissue (TimberRock's focus):

- Software that aggregates energy assets and tracks CO<sub>2</sub>
- Power conversion tech that moves energy between DC and AC efficiently

4



Power



Gaseous

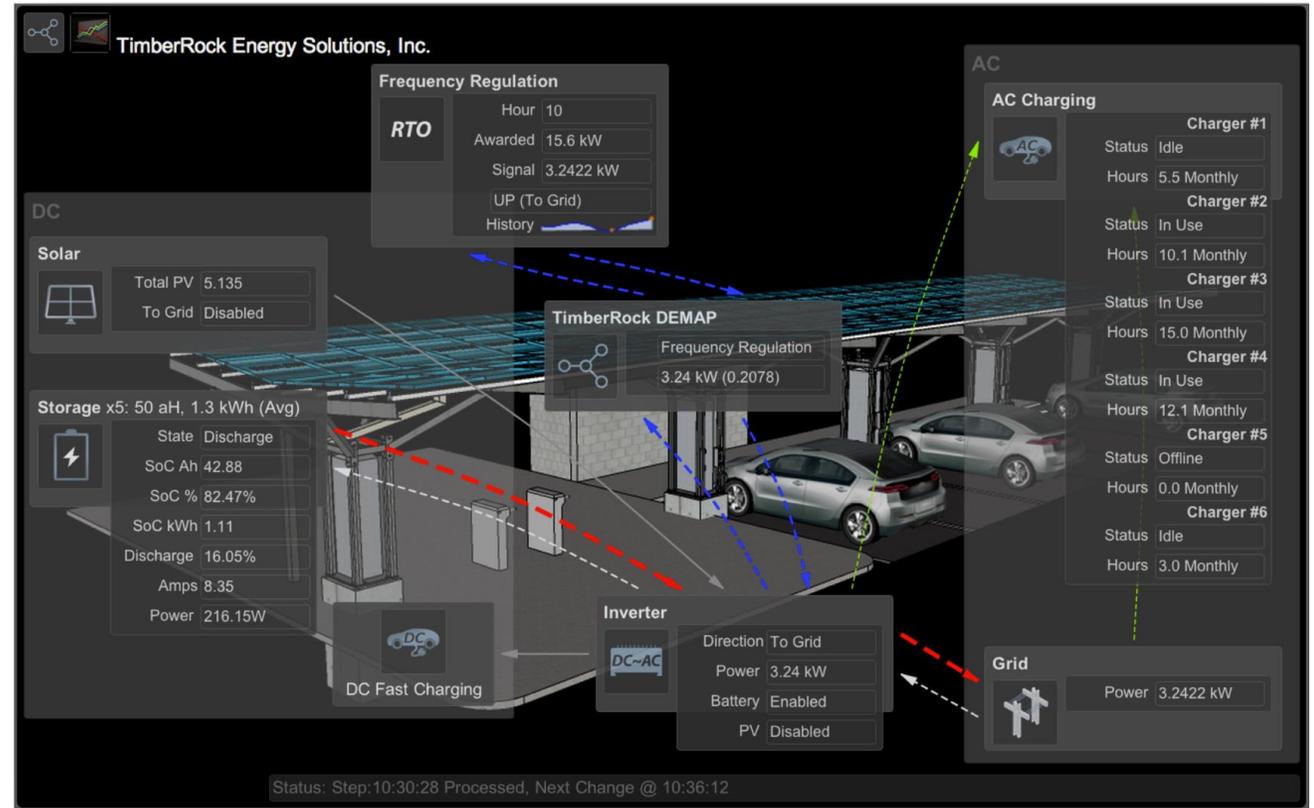


Liquid

# PJM ETF | TimberRock Overview - Aggregation



- Software platform (moving data):
  - Aggregating energy assets
  - Tracking CO<sub>2</sub>
- We've applied this platform in two ways:
- First, advanced, distributed energy projects that tested limits of aggregation**



*Project: RE, BESS, EVs, Bi-Directional Inverters. Tested Concepts: Aggregating Capacity To Provide Ancillary Services, CO<sub>2</sub>-Free Driving, Optimization for \$ or CO<sub>2</sub>*

# PJM ETF | TimberRock Overview – REC Aggregation/Trading



- **Second**, integration of **thousands of distributed renewable energy projects**,

tracking/aggregation/trading/settlement of REC transactions

- Mostly in PJM GATS. Transaction count: 55,000+ (settlements)

- Across both activities:

- End Customers - Residential, C&I, Municipalities, Federal Gov., Fortune 50

- Energy Companies – “Majors”, REPs, Utilities

- *Beyond RECs* – From RECs to “true” low-CO<sub>2</sub> energy

160GWhs of RECs Aggregated/Delivered\* To  
67 REPs/Utilities/Energy Companies



# PJM ETF | TimberRock Overview – CO<sub>2</sub>-Tracking – Beyond RECs



- While maintaining all REC functionality, platform has evolved to support more precise CO<sub>2</sub> tracking and reduction
- Helps organization navigate their journey toward a **low-CO<sub>2</sub> energy** future. Three phases; Five basic steps
- **Establish a long-term, target curve**
  - 1) *Visualize* - Set goals that allow a target, CO<sub>2</sub>-mitigation glideslope/curve to be visualized. All sites, S2, S3. RE and/or CO<sub>2</sub>
- **Precisely track the current curve**
  - 2) *Digitize* - Integration of all inputs/outputs of the energy system integrated. Automated ingesting of data
  - 3) *Track* - Monitor real-time, location-specific grid emissions, align with energy consumption data and produce detailed CO<sub>2</sub> accounting for electricity usage. Plot the current curve. Debits
- **Align the curves** (i.e., bend the current curve to align with the target curve)
  - 4) *Shift* - Transition energy sources to lower CO<sub>2</sub> sources. Credits
  - 5) *Optimize* - Manage energy assets - EVs, ESS, flexible load - to match load to availability of low CO<sub>2</sub> energy

**Immediate  
-Term**



**Near  
-Term**

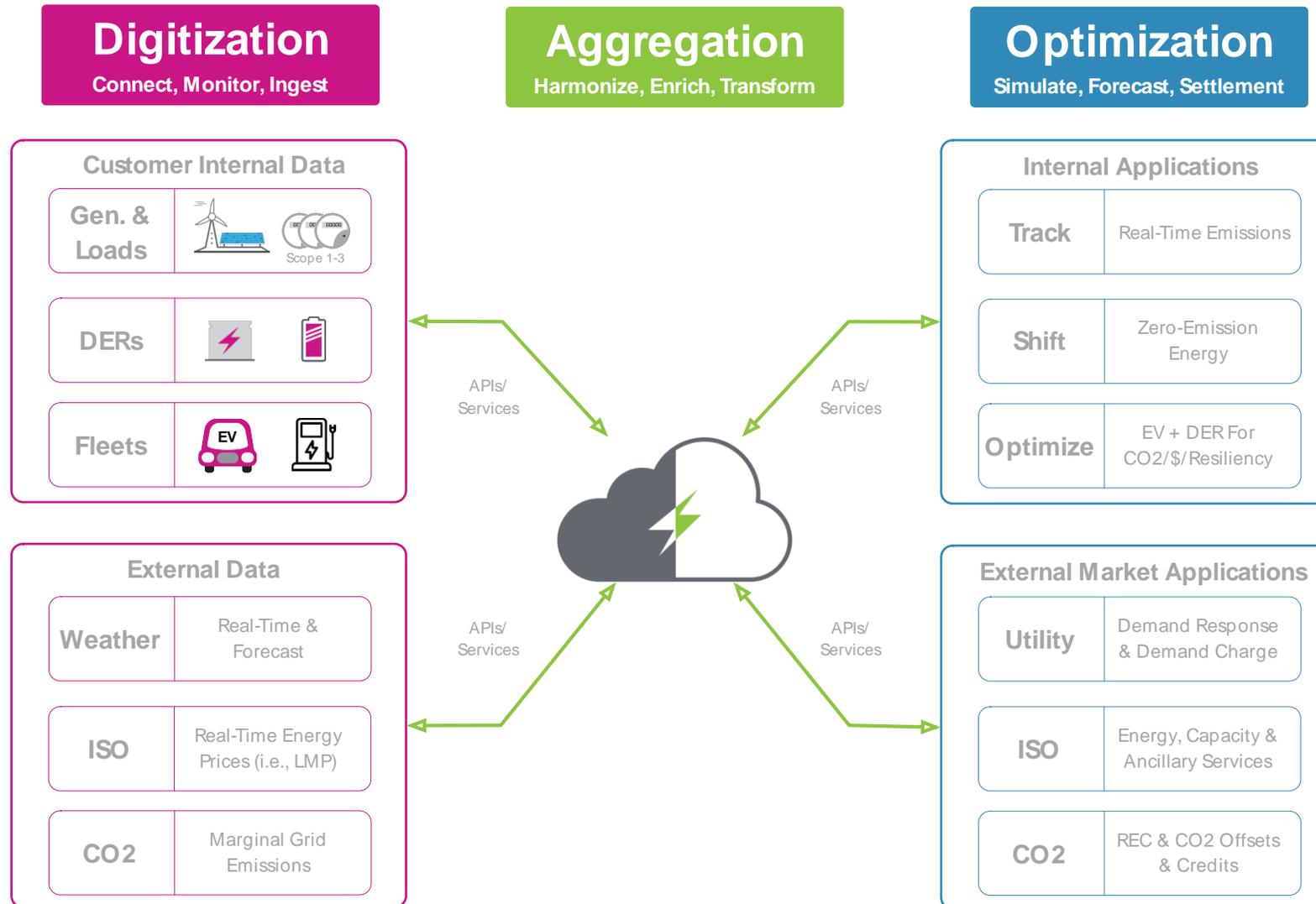


**Long  
-Term**



# Our Tech

# PJM ETF | The Tech – A Simple Architecture Overview





- Supply-Side
  - RE Generator Meters
  - Marginal CO<sub>2</sub> estimates and forecasts – national coverage, various grain, 5-min frequency
  - Marginal CO<sub>2</sub> via PJM. 5-min frequency; p-node grain
- Demand-Side
  - Load Meters – Integrated with major smart meter networks (i.e., ERCOT)
  - Direct DER integrations with any asset class. To date: BESS, EVSE, advanced inverters
  - Technical aggregators: B-T-M fossil and RE generators, switch gear, BMS, EMS, HVAC
- ISO/RTO - Market data. Market Participants (a.k.a., commercial aggregators) – CSPs, QSEs
- Utilities – Open ADR 2.0
- Weather – National coverage. Zip code grain. Hourly frequency

*Data Integration Of  
All Inputs Or Outputs  
Of An Organization's  
Energy Ecosystem*

# PJM ETF | The Tech – Aggregation



- Cross source harmonization – data interoperability
- Temporal harmonization
- Aggregation by load zone or any market boundary
- Monitoring of all data sources for reliability
- Time-series database
- Previously have implemented a Distributed Ledger for testing/assessment. Not currently in production

*Harmonization Of All Data Sources – Temporally & Geographic - As To Allow Optimization & Ultimately Dispatch/Settlement*



- Simulation – Digital twin
- Custom algorithms (a.k.a. Strategies) for CO<sub>2</sub> assessment via API call
- Linear optimization engine
  - LMP
  - CO<sub>2</sub>
- Multivariate forecasting
  - Load
  - Capacity
- Ability to leverage machine learning algorithms

*Ability To Optimize For Both CO<sub>2</sub> & Price Signal*

*Digital Twin Methodology Protects Sensitive Data & Allows Simulation/Optimization To Be Performed Efficiently*

# PJM ETF | Case Study – GM – Scope 3 CO<sub>2</sub>



- GM, Shell and TR collaborated to design/launch a program to help GM's supply chain access low-CO<sub>2</sub> energy solutions
- Launched this summer in ERCOT
- Shell provides retail supply
- TR's role includes
  - Program administration
  - Landing page development/operation
  - CO<sub>2</sub> tracking platform and portal – Visualize, Digitize, Track, Shift, Optimize

**BRINGING YOU A RENEWABLE ENERGY PROGRAM WITH GREAT RATES**

Through an innovative collaboration between GM and Shell,<sup>1</sup> we created a renewable energy program to support our Texas suppliers.

GM and Shell are proud to introduce the GM Supplier Renewable Energy Solutions Program which provides great rates and flexibility on energy backed by renewable resources. Regardless of where you are on your sustainability journey, the program is designed to fit your company's needs by providing four plan levels which include anywhere from 5% to 100% renewable energy certificate (REC). See program details below.

<sup>1</sup> Electricity supply offers are fulfilled by MP2 Energy LLC, TX PUCT No. 10074, a Shell Energy North America subsidiary. Program administration, CO<sub>2</sub> tracking and program REC management provided by TimberRock.

[Contact Us To Learn More](#)

**THE GM SUPPLIER RENEWABLE ENERGY SOLUTIONS PROGRAM**

Our goal is to give you the energy supply you need, at a budget that works for you, so you can invest more in sustainability.

Through our supplier pricing, program participants receive:

- A range of flexible energy supply offerings
- Broker related services including:
  - REC options to fit your energy strategy
  - Process CO<sub>2</sub> tracking of real emissions
  - Real time grid emissions are calculated and applied to electricity consumption providing a detailed assessment of CO<sub>2</sub> impact. Via secure web portals, this derived CO<sub>2</sub> data is presented and can serve as a pillar of your emissions reporting which aligns with Environmental, Social and Governance (ESG) reporting.

Regardless of where you are on your sustainability journey our GM Supplier Renewable Energy Solutions Program is flexible by nature and designed to fit your needs. GM and Shell will continue to expand the program offerings to ensure you have everything you need to meet the changing energy demands of our business.

<sup>2</sup>CO<sub>2</sub> tracking and program REC management provided by TimberRock.

**CHOOSE FROM FOUR PLAN LEVELS<sup>3</sup> TO SUPPORT YOUR SUSTAINABILITY JOURNEY**

All participants in the program will receive 5% Renewable Energy Credits (RECs) matched to their energy use, and CO<sub>2</sub> tracking. Plus, you have the option to purchase additional RECs to help address your carbon budget efforts.

**Silver**  
Cost-effective energy delivered to your meter with terms that work for you.<sup>4</sup>

**Gold**  
Cover 5% to 100% of your electricity use, at your choosing, with unbundled, non-project specific RECs registered in any available national or regional market.

**Platinum**  
Cover 5% to 100% of your electricity use with RECs sourced to PPAs already executed by Shell or GM PPAs/assets relating to specific renewable energy projects.<sup>5</sup>

**Diamond**  
Cover 5% to 100% of your electricity use with RECs sourced from a newly executed PPA by Shell or GM relating to specific renewable energy projects that would not have been developed without your (and other suppliers' movement) in contracting with Shell - thereby providing possible additional claims for you, in regards to your respective proportionate offtake from such a new project.<sup>6</sup>

[Connect with a Representative](#)

Not ready now? No problem.  
Email us with any questions or if you'd like us to follow-up with you later.  
<sup>7</sup>These offers are available to GM suppliers in deregulated regions of Texas where there is choice regarding retail energy providers.  
<sup>4</sup>The 5% RECs are provided by GM and CO<sub>2</sub> tracking is provided by TimberRock.  
<sup>5</sup>Minimum tenor and volume requirements apply.

**PROGRAM BENEFIT FOR YOUR EMPLOYEES**

As a participant in the GM Supplier Renewable Energy Solutions Program you can also provide attractive pricing to your employees on home energy backed by renewable resources.

[Contact Us To Learn More](#)

**LET'S GET STARTED**

Together, we can accelerate the transition to an energy future with zero emissions. Provide us with a bit of information below and we can jointly determine your company's needs and the program plan that is right for you. Once you submit the following info, a representative will be in touch by email. Have questions before submitting your info? [Email Us](#).

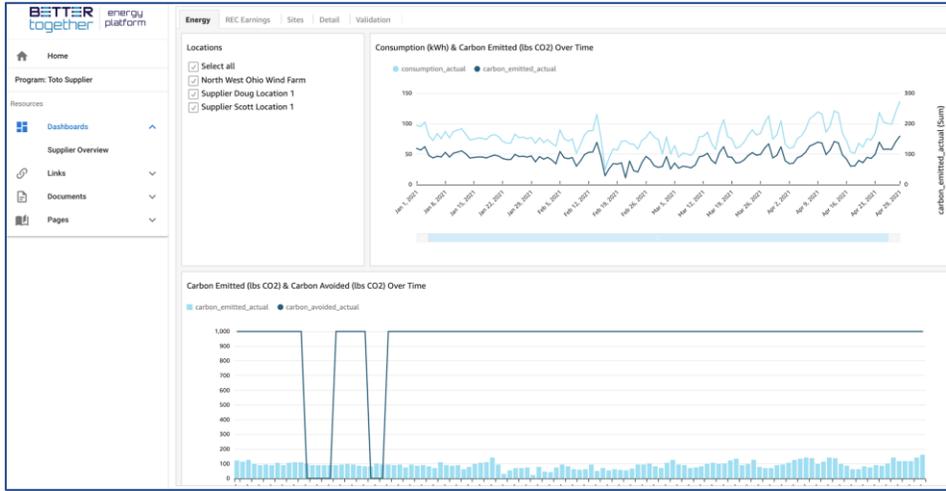
Supplier Entity Name:<sup>8</sup>

Supplier Contact Email:<sup>8</sup>

Supplier Entity Address:<sup>8</sup>

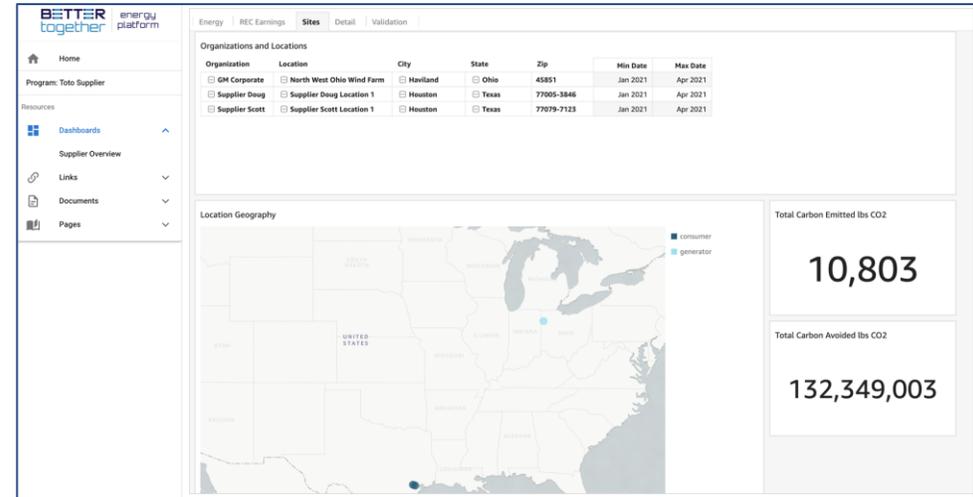
Supplier Contact Phone:<sup>8</sup>

# PJM ETF | Case Study – GM – Scope 3 CO<sub>2</sub>

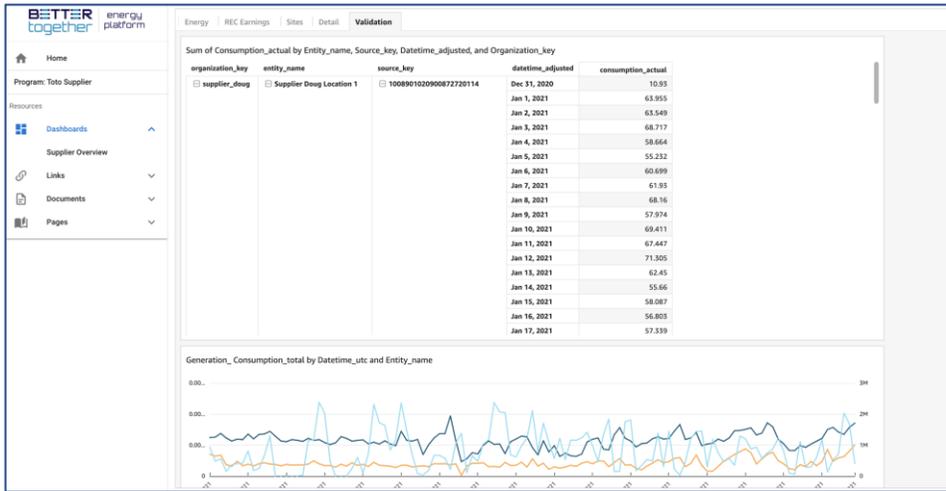


Aggregate Load  
Data & CO<sub>2</sub> Data  
Over time Across  
Multiple Sites

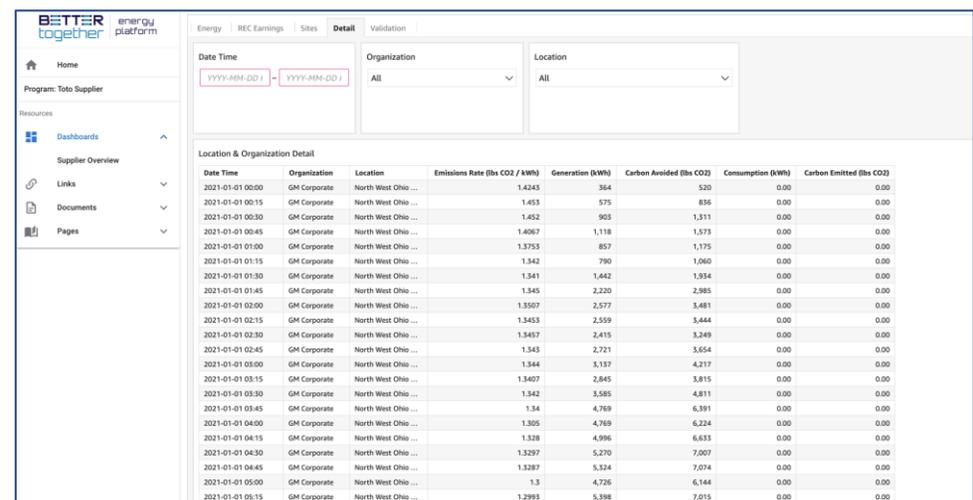
Generation Data  
From Program-  
Specific RE Assets



Geospatial  
Representation  
Of Multiple  
Sites, Load  
and Generator

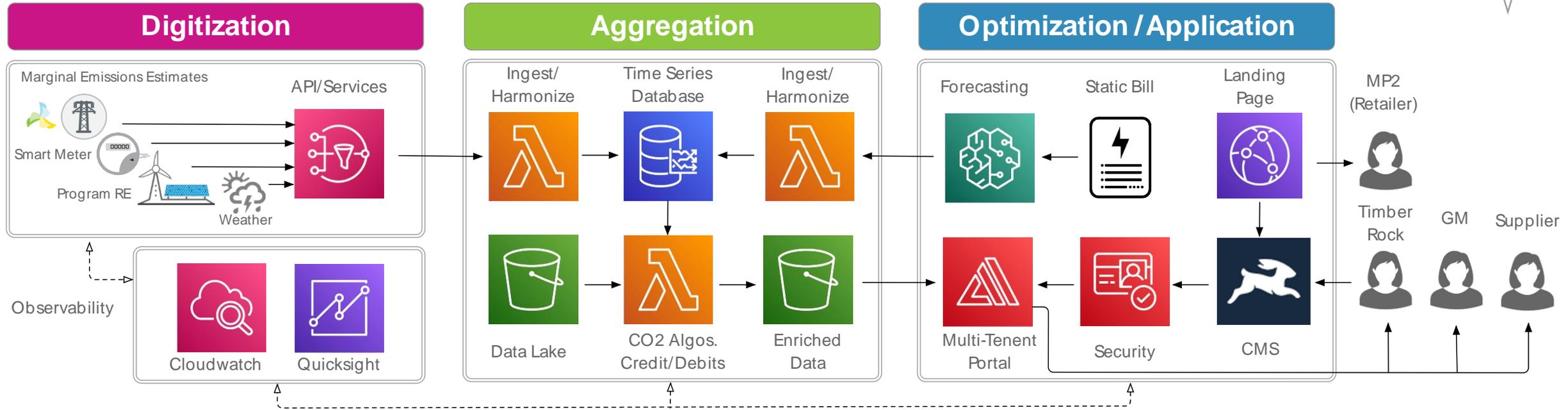


High Granularity  
Data For All  
Data Sources  
Maintained For  
Audit Purposes



High Granularity  
Data Can Be  
Reviewed Or  
Exported For  
ESG Reporting  
Purposes

# PJM ETF | Case Study - GM – Scope 3 CO<sub>2</sub> – Tech Building Blocks



Lambda

Processes are serverless, having no reliance on infrastructure, providing scalability of components with low operational and technical overhead.



SNS



SQS

Decoupled architecture leveraging notification and queue services. Smaller components that are interconnected. Allows applications to scale while maintaining performance and reliability.



Cloudwatch Quicksight

Observability for process monitoring, performance and alerts to detect and notify upon external outages and technical failures. Continuously monitor for data completeness and quality.



Timestream

Time normalization using a timeseries database. Data is arriving at different rates and granularity, various timeseries calculations such as smoothing, approximation, and interpolation help align events across data streams.



S3

Source and enriched data is persisted to a data lake for usage as ingested and historically.



Directus

Content Management System - Characterization data gathered during onboarding are maintained along side of configuration details in a content / data management system.



Sagemaker

Forecasting and resource optimization models are developed in machine learning notebooks, then operationalized and deployed.



Cloudfront

Portal capabilities allowing users secure access to interact and visualize data. Content delivery caches content for high traffic periods on landing pages.



Cognito



Amplify



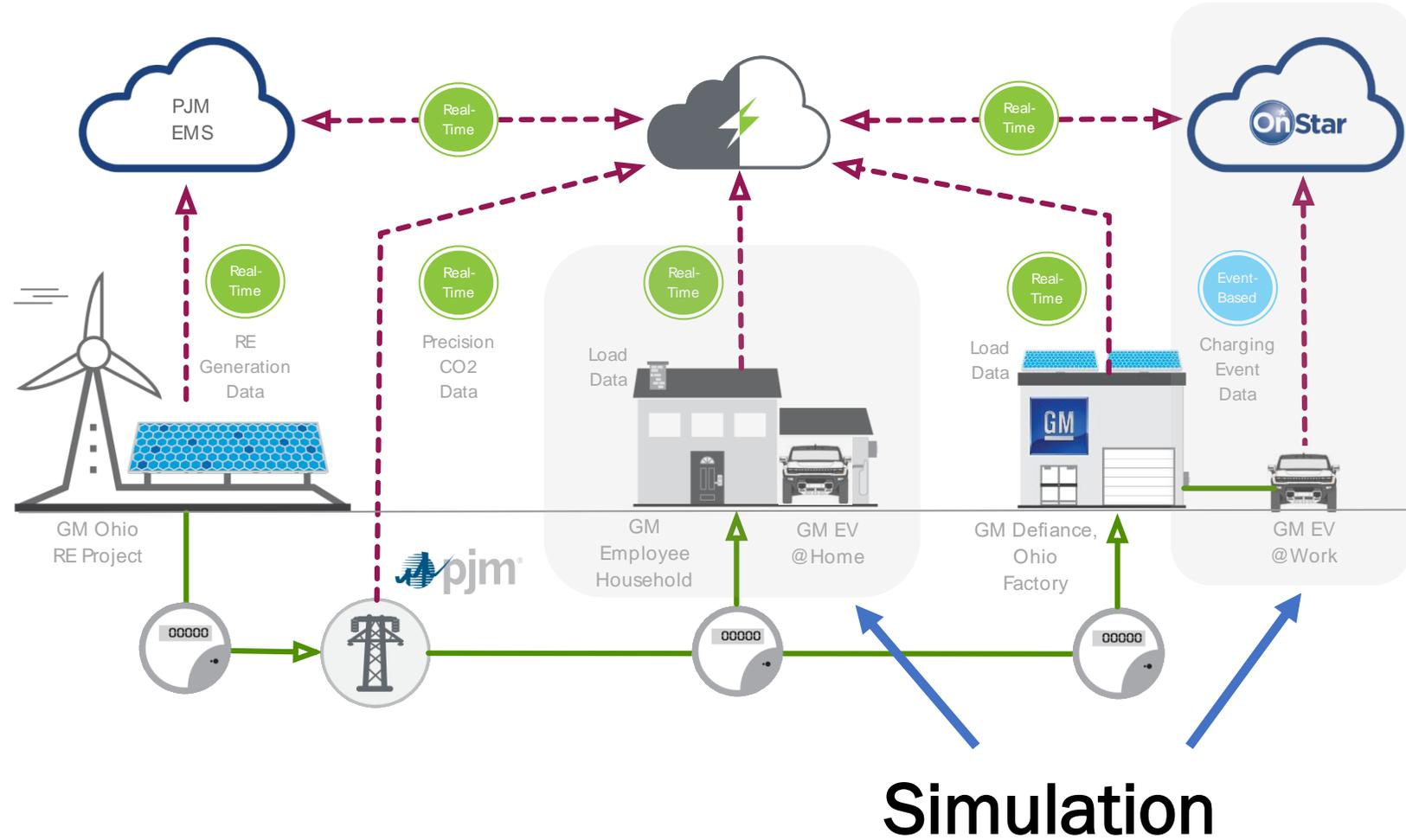
## PJM ETF | PJM Margin Emissions Signal

- TR has a long-standing collaboration with WattTime and leverages WT's marginal emissions estimates in ERCOT and other markets
- Over the last few years, TR has discussed the utility of this data with PJM and the possibility of PJM publishing additional data signals that support precise CO<sub>2</sub> accounting
- TR view is that PJM's decision to publish a marginal CO<sub>2</sub> emissions signal is significant
  - Benefits across PJM for entities seeking precise CO<sub>2</sub> tracking and accounting
  - Will hopefully encourage other ISO/RTOs to do the same

# PJM ETF | PJM Marginal Emissions Signal – Future Testing/Simulation



- A prototype of a fully integrated GM ecosystem...
  - Achieving “true” zero-emissions
  - Delivery of energy services
- Requires simulation of the EV Fleet





# Q&A, Discussion



# Backup

# PJM ETF | The Tech – Features



- Features
  - Native scalability - serverless
  - Robust security. Cloud environment meets requirements for NERC-CIP
  - Interoperability – APIs
- Performance
  - Cost; Efficiency
  - Geospatial- Ability to track mobile assets as they cross geo-boundaries
  - Temporal – Ability to temporally align data source down to 5-min intervals
- Specs
  - Multi- Tenant environment
  - Portal with permissioned access
  - Content Management System (CMS)