Stakeholder Workshop:
Emissions Estimates

July 18, 2024

Updated: Corrected links to Insights Questionnaire, pages 39-40

This workshop will be recorded.

Stakeholder Workshop Agenda

Agenda Item	Time Allocation
Agenda Review	5 min
Executive Introduction to Workshop	5 min
Overview	15 min / 5 min Q&A
GHG Emissions Landscape Overview (EPRI)	15 min / 5 min Q&A
Poll Questions	5 min
Present Proposed Data Deliverables Real-Time Dashboard Consumed Emissions Locational Marginal Emissions	40 min / 15 min Q&A 10 minutes 15 minutes 10 minutes
Poll Questions	5 min
Present Insights Questionnaire & Next Steps	5 min

Executive Introduction

Mark Wyatt

Executive Director Data and Analytics

Executive Summary

Purpose: To inform stakeholders about MISO's work to create a new data service offering to produce emissions estimates and to gather feedback from stakeholders

- MISO is seeking to provide data for stakeholders to help solve their emissions estimation needs
- MISO's emissions tracking method development has progressed from internal pilot efforts to a public launch of three data services on a staggered calendar
- MISO's primary objective today is create awareness, and obtain feedback on its new emissions data services, planned for launch in 2025

Members and states throughout MISO's footprint have committed to emissions reduction

STATES WITH ENFORCEABLE DECARBONIZATION GOALS

• Illinois • Michigan • Minnesota

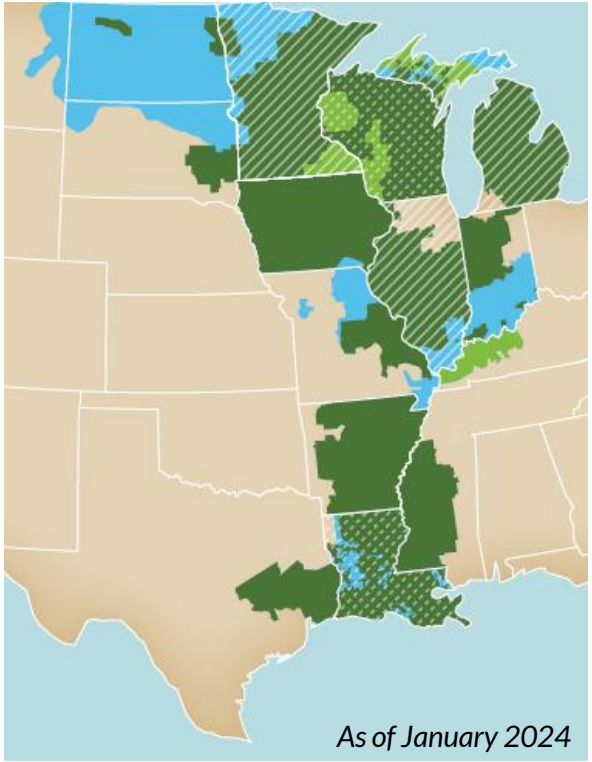
STATES WITH ASPIRATIONAL DECARBONIZATION GOALS

• Louisiana • Wisconsin

MISO Footprint

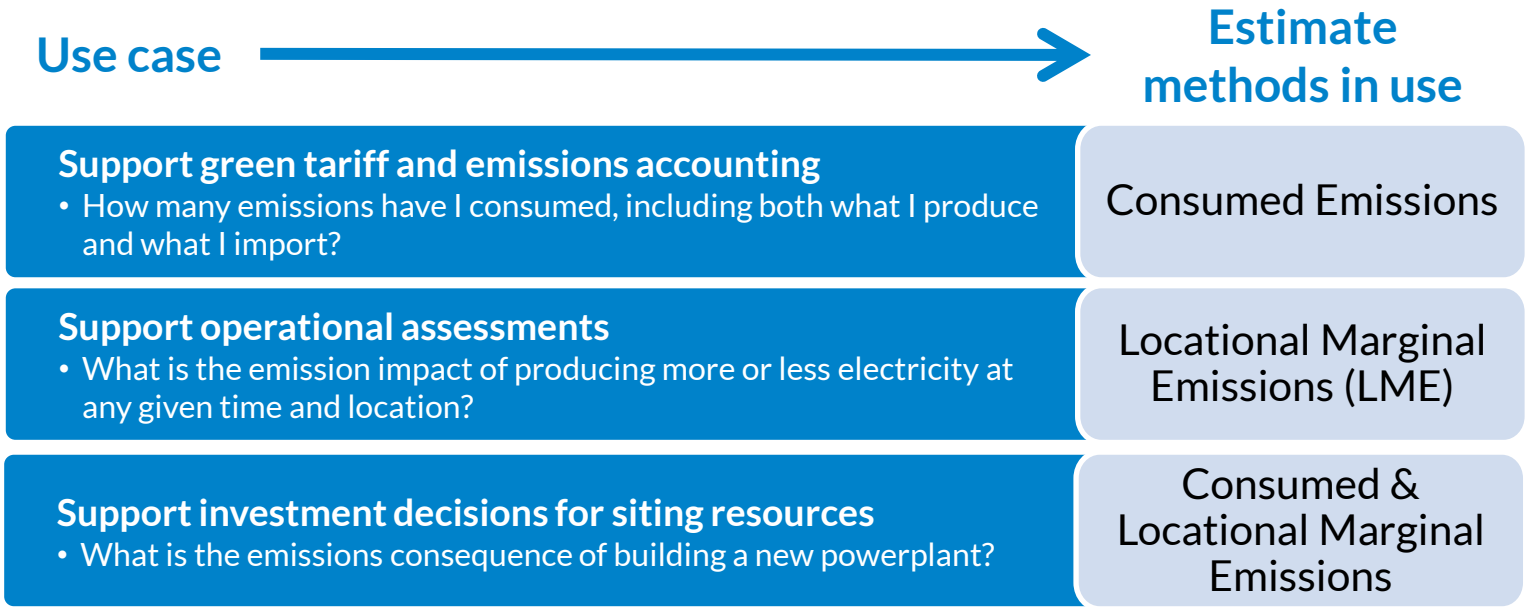
UTILITIES WITH 80%+ TARGETS

UTILITIES WITH 50%+ TARGETS

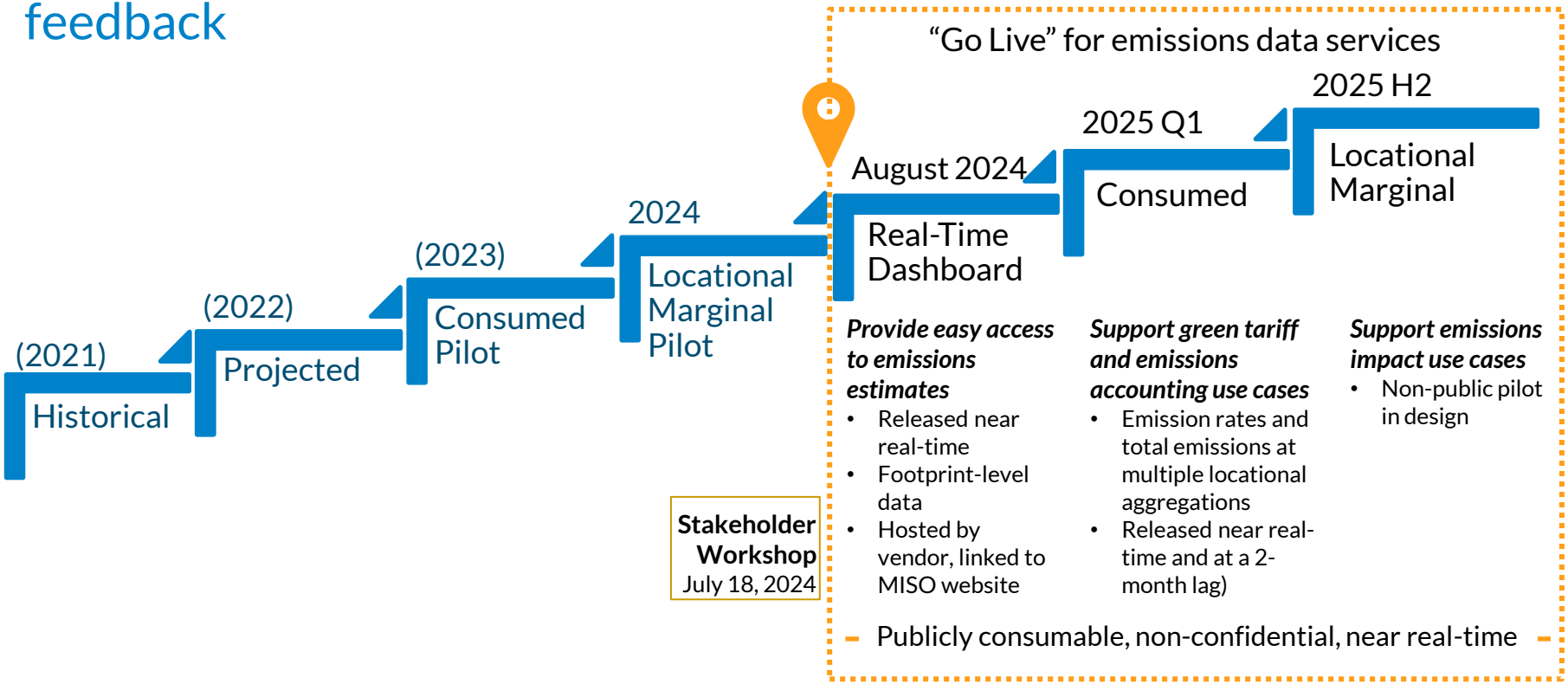


Decarbonization Goals are targets for reducing human-caused carbon dioxide emissions. Clean Energy and / or Renewable Goals comprise Decarbonization Goals.

MISO stakeholders are increasingly looking to address emerging use cases related to emissions data



MISO is advancing three new emissions data services to support stakeholder use cases, to be further refined from stakeholder feedback



EPRI | ELECTRIC POWER RESEARCH INSTITUTE

Adam Diamant, Senior Technical Executive

- Leads EPRI's research for corporate greenhouse gas (GHG) emissions accounting, reporting and disclosure, GHG emissions offsets, and 24/7 Carbon-free Energy (24/7 CFE)
  - Current research activities focus on GHG emissions accounting for electric companies and combined electric and gas utilities, including scope 1, 2 and 3 emissions
- Prior experience in the Office of Management and Budget (OMB) in the Executive Office of the President of the United States
- Education from University of California, Berkeley and the Kennedy School of Government at Harvard University

MISO

The Landscape of Greenhouse Gas Emissions Accounting

MISO Emissions Estimates Stakeholder Workshop

Adam Diamant
Senior Technical Executive

July 18, 2024
Via WebEx

Founded in 1972, EPRI is the world's preeminent independent, non-profit energy research and development organization, with offices around the world. EPRI's trusted experts collaborate with more than 450 companies in 45 countries, driving innovation to ensure the public has clean, safe, reliable, affordable, and equitable access to electricity across the globe. Together, we are shaping the future of energy.

Nonprofit

Chartered to serve the public benefit, with guidance from an independent advisory council.

Thought Leadership

Systematically and imaginatively looking ahead to identify issues, technology gaps, and broader needs that can be addressed by the electricity sector.

Independent and Objective

Objective, scientific research leading to progress in reliability, efficiency, affordability, health, safety, and the environment.

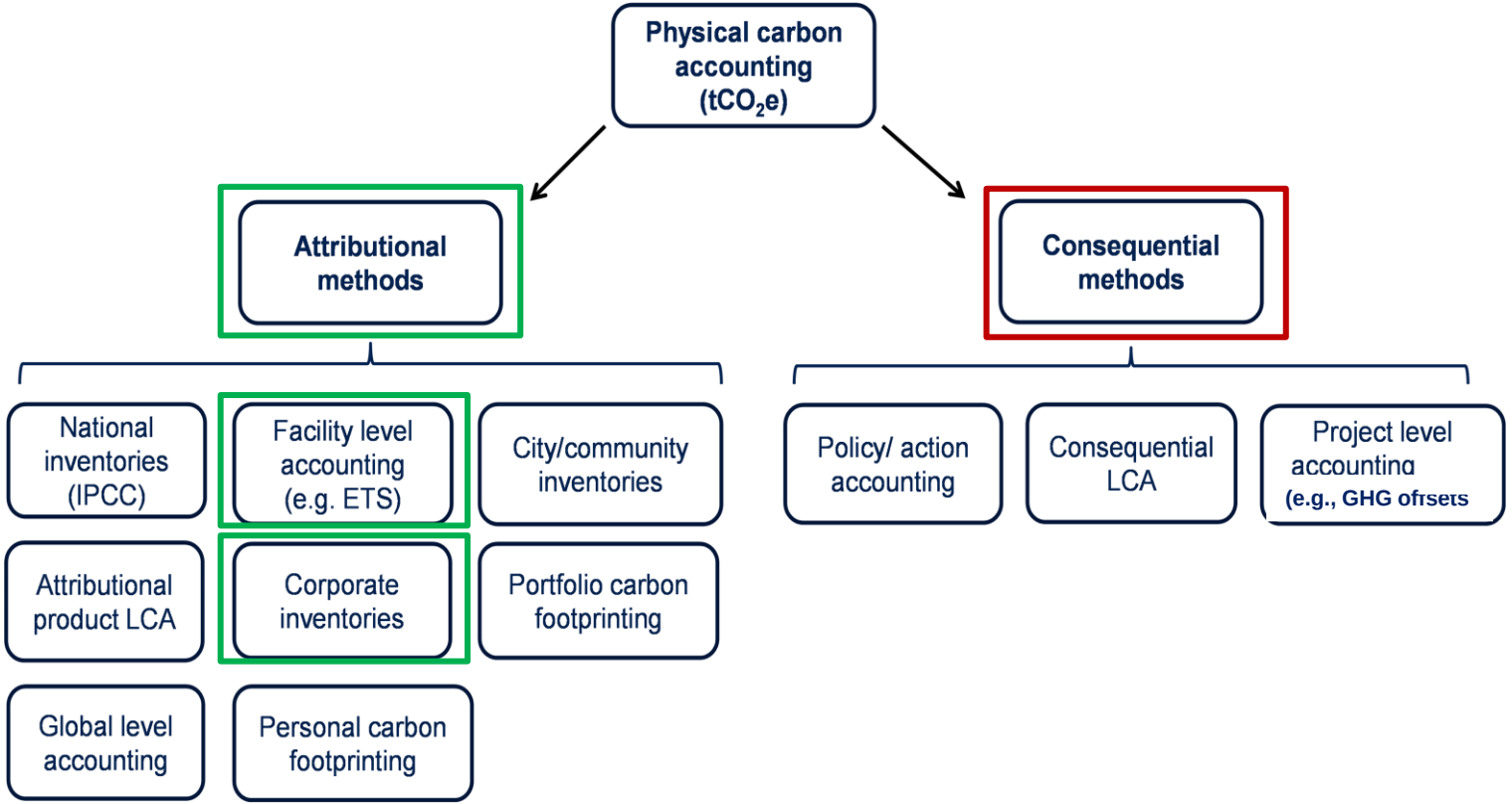
Scientific and Industry Expertise

We provide expertise in technical disciplines that bring answers and solutions to electricity generation, transmission, distribution, and end use.

Collaborative Approach

We bring together our members and diverse scientific and technical sectors to shape and drive research and development in the electricity sector.

Landscape of GHG Accounting Frameworks



Accounting frameworks have specified scopes that limit their applications and the uses of their output.

What is an Organizational GHG Inventory?

- Comprehensive accounting of an organization's annual GHG emissions, including ***Direct*** and ***Indirect:***
  - **Scope 1 – GHGs emitted directly** to the atmosphere by sources a company owns or controls.
  - **Scope 2 – Indirect (energy) emissions** related to electricity, heat, or steam used by a company that is purchased from another party.
  - **Scope 3 – Indirect ("value chain") emissions** includes all other types of "upstream" and "downstream" GHG emission sources

What are Emission Factors (EFs)?

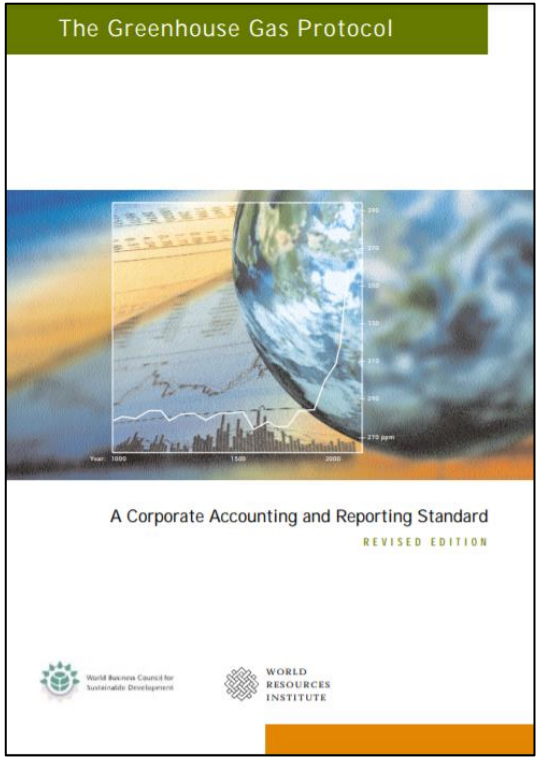
*"[A] representative value that attempts to relate the **quantity of a pollutant released** to the atmosphere **with an activity** associated with the release of that pollutant*."*

Emission factor	x	*Activity data*	=	*GHG emissions*
tCO_2e / *MWh*	x	*MWh*	=	tCO_2e

* US EPA Definition

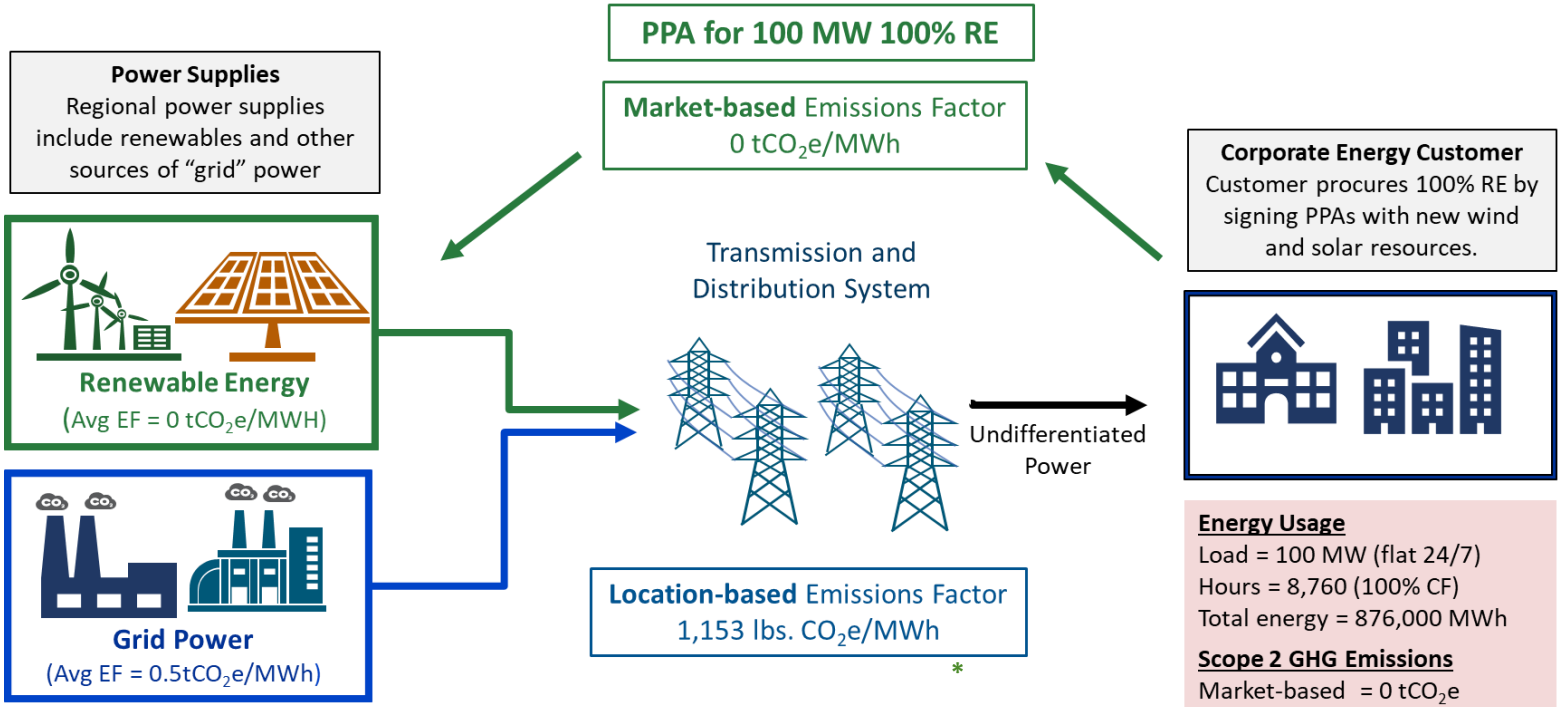
The appropriate GHG emissions factor to use depends on the purpose of using it

ESG Goals and GHG Emissions Accounting Rules are Key Drivers for Corporate RE and 24/7 CFE Demand



- Scope 2 accounting is important to end-use customers, particularly C&I customers that have adopted aggressive ESG / GHG emission reduction goals
  - It is difficult for electricity customers to reduce their Scope 2 emissions because the emission sources are not under their direct control.
  - Existing GHG accounting standards allow companies to use a "market-based" GHG emissions factor of 0.0tCO_2e/MWh when they report emissions associated with procurement of renewable energy and RECs. This has been a key driver of corporate procurement of RE and RECs.
  - Corporate reporting of Scope 2 emissions using market-based EFs is controversial and under review now by WRI and the GHG Protocol.

Scope 2 GHG Accounting: Market-based vs. Location-based

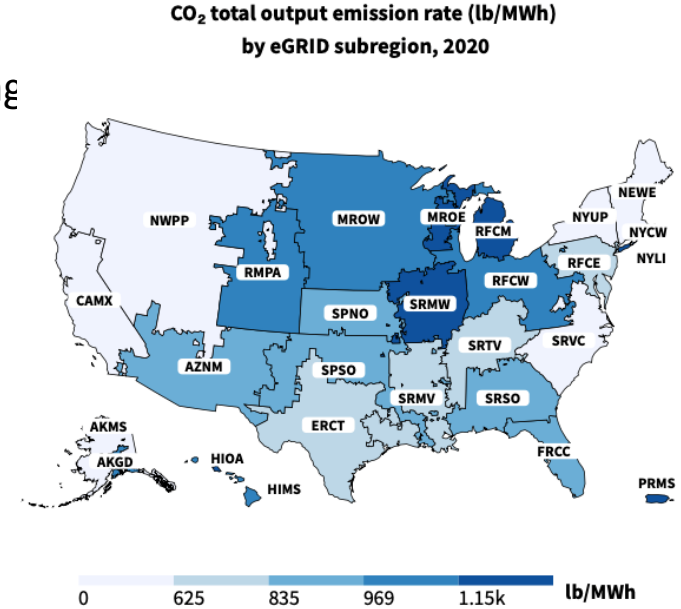


* EF based on Based on EPA eGrid 2020 for RFC Michigan subregion.

Using a Market-based GHG Emissions Factor Can Significantly Reduce Reported Scope 2 Emissions

Location-based Emissions Factors are Used to Estimate GHG Emissions Associated with "Grid" Electricity

- **Types** of emissions factors (EFs):
  - **Average**: Often used for scope 2 accounting and reporting
  - **Marginal**: Used to estimate changes in emissions "caused" or "avoided" by an intervention
  - **Residual**: Less common, but emerging in importance
- **Uses**:
  - Estimating scope 2 emissions associated with electricity consumed by end-use consumers
  - Estimating scope 3 emissions associated with wholesale electricity purchased by electric companies and resold to end-use electricity customers:



Companies have Multiple Uses Cases for Obtaining GHG Emissions Data from ISOs and RTOs

Who — **Electric Generators**

Need — Granular, locational-based average EFs

Use Cases

- GHG accounting & reporting
- Provide data and programs to C&I customers reporting their scope 2 emissions
- Provide data to other electric companies related to power purchased / sold for resale to end-users

Who — **Sustainability-oriented Companies**

Need — Average, marginal (hourly), and residual GHG EFs

Use Cases

- Scope 2 GHG accounting and reporting
- Evaluate potential GHG impacts of new investments
- Evaluate potential GHG impacts of load shifting / DR
- Supports procurement of 24/7 CFE and “CFE Scoring”

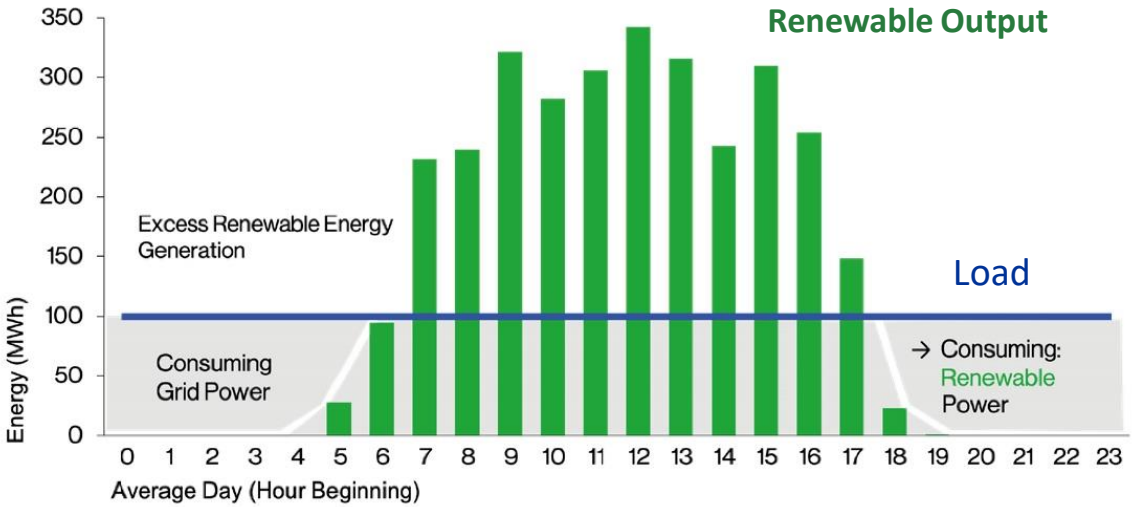
Who — **Power System Planners**

Need — Average, marginal (hourly), and residual GHG EFs

Use Cases

- Evaluate changes in GHG emissions associated with policies, technological change, and new infrastructure
- Help to determine where to invest and site new facilities

Customer Loads Often Do Not Match Renewable Energy Generation



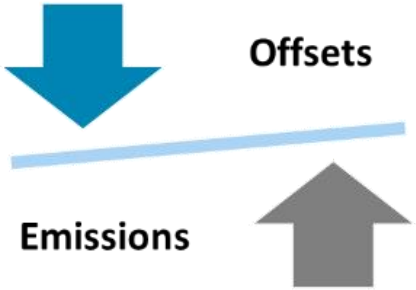
Source: 24/7 Carbon Free Energy Whitepaper, The AES Corporation 2021. Updated October 2022.

- Most customers' loads do not correspond to the output of RE generators.
  - Temporal mismatch
  - Locational mismatch
- Procurement of 24/7 Carbon-free Energy (CFE) is a new approach designed to address these challenges by better aligning load and CFE generation in the "same regional grid."

Corporate Renewable Energy Procurement Continues to Evolve

Google's Energy Journey 2007-2030

Achieve Carbon Neutrality
(Offsetting emissions)



Since 2007
Google has purchased enough high-quality carbon offsets and renewable energy to bring its net operational emissions to zero.

Procure 100% Renewable Energy
(Reducing emissions)

Since 2017
Google has matched its global, Annual electricity use with wind and solar purchases. However, their facilities still rely on carbon-based in some places and times.

100% 24/7 Carbon-free Energy
(Eliminating emissions)

By 2030
Google intends to match its operational electricity u se with nearby (on the same regional grid) carbon-free energy sources in every hour of every year.

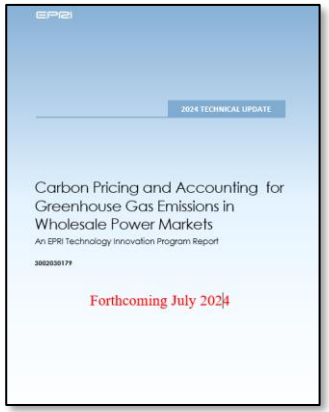
Source: Graphic by EPRI. Based on *24/7 by 2030, Realizing a Carbon-free Future*, Google, September 2020. https://www.gstatic.com/gumdrop/sustainability/247-carbon-free-energy.pdf (accessed 10/17/22)

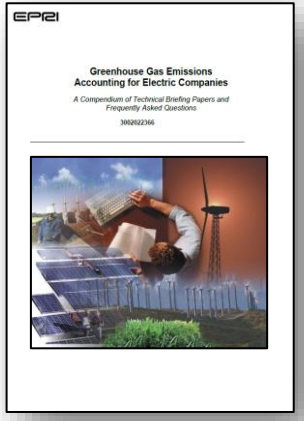
Key Messages and Insights

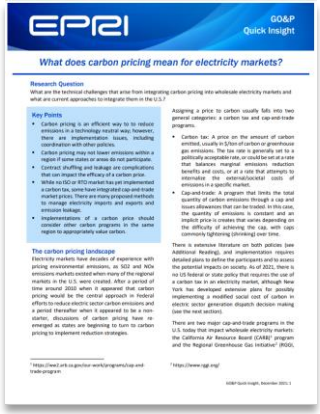
- GHG accounting can be *attributional* or *consequential*.
  - Corporate GHG accounting is attributional
  - "Impact" accounting is consequential
- Many electricity customers want to reduce their scope 2 "consumed" GHG emissions.
  - Corporate GHG accounting is sensitive to use of market- and location-based EFs
  - Customer loads often do not match renewable energy generation
  - Corporate "green" power procurement continues to evolve
- Location-based EFs are used to estimate GHG emissions associated with "grid" electricity.
  - Emissions factors (EFs) can be *average, marginal or residual*.
  - Emissions rate (tCO_2/MWh) x Load (MW) = Emissions (tCO_2).
  - "Generated" emissions are not the same as "Consumed" emissions.
  - ISOs have access to detailed power system data and operations and are in a unique position to provide granular, location-based GHG EFs
- Companies have multiple uses cases for obtaining GHG emissions data from ISOs and RTOs.

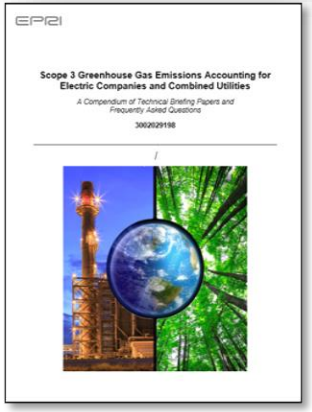
EPRI GHG Emissions Accounting Resources

- **Carbon Pricing and Accounting for Greenhouse Gas Emissions in Wholesale Power Markets**: *An EPRI Technology Innovation Program Report (Forthcoming July 2024; 3002030179)*
- **Scope 3 Greenhouse Gas Emissions Accounting for Electric Companies**: *A Compendium of Technical Briefing Papers and Frequently Asked Questions* (EPRI 2024; 3002029198)
- **Greenhouse Gas Emissions Accounting for Electric Companies**: *A Compendium of Technical Briefing Papers and Frequently Asked Questions* (EPRI 2021; 3002022366)
- **Carbon Pricing in Electricity Markets:** Quick Insight. (EPRI 2021; 3002021815)





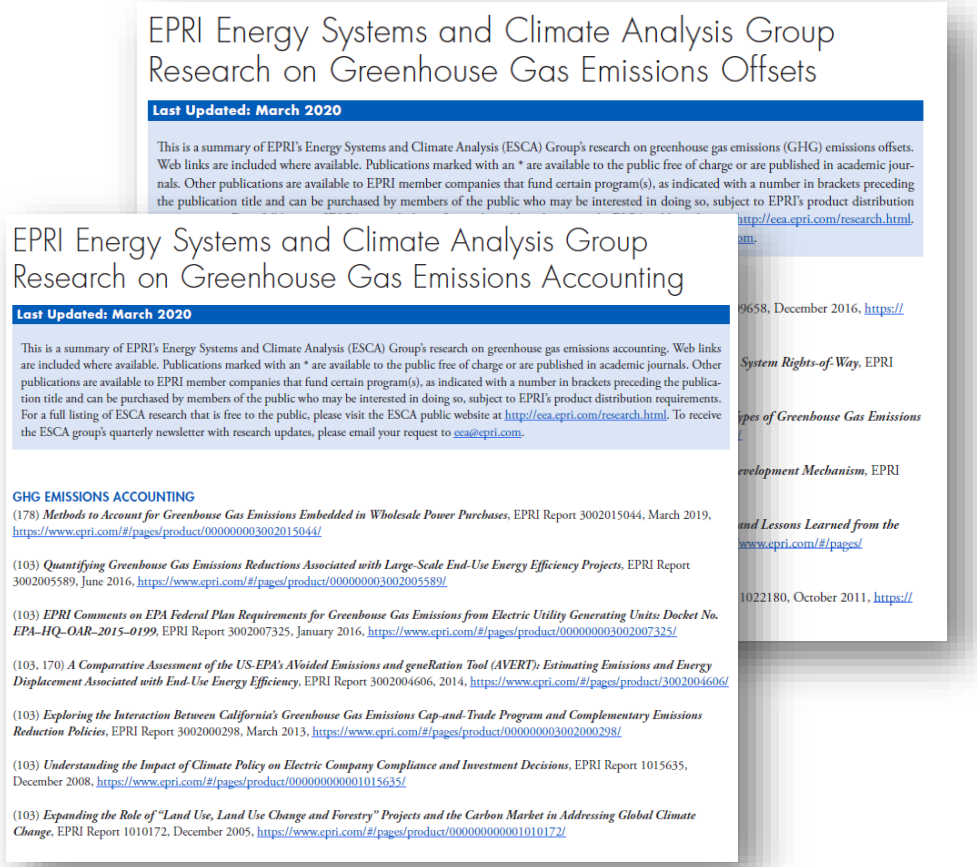




Summaries of Past EPRI R&D on GHG Emissions Offsets and Emissions Accounting

- *EPRI Energy Systems and Climate Analysis Group Research on* ***GHG Emissions Accounting*** *(#3002018261)*
- *EPRI Energy Systems and Climate Analysis Group Research on* ***GHG Emissions Offsets*** *(#3002018263)*

https://esca.epri.com/research-guide.html



EPRI Energy Systems and Climate Analysis Group
Research on Greenhouse Gas Emissions Offsets

Last Updated: March 2020

This is a summary of EPRI's Energy Systems and Climate Analysis (ESCA) Group's research on greenhouse gas emissions (GHG) emissions offsets. Web links are included where available. Publications marked with an * are available to the public free of charge or are published in academic journals. Other publications are available to EPRI member companies that fund certain program(s), as indicated with a number in brackets preceding the publication title and can be purchased by members of the public who may be interested in doing so, subject to EPRI's product distribution

http://eea.epri.com/research.html.

om.

9658, December 2016, https://

System Rights-of-Way, EPRI

ypes of Greenhouse Gas Emissions

evelopment Mechanism, EPRI

nd Lessons Learned from the

www.epri.com/#/pages/

1022180, October 2011, https://

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GHG EMISSIONS ACCOUNTING

(178) ***Methods to Account for Greenhouse Gas Emissions Embedded in Wholesale Power Purchases***, EPRI Report 3002015044, March 2019, https://www.epri.com/#/pages/product/000000003002015044/

(103) ***Quantifying Greenhouse Gas Emissions Reductions Associated with Large-Scale End-Use Energy Efficiency Projects***, EPRI Report 3002005589, June 2016, https://www.epri.com/#/pages/product/000000003002005589/

(103) ***EPRI Comments on EPA Federal Plan Requirements for Greenhouse Gas Emissions from Electric Utility Generating Units: Docket No. EPA–HQ–OAR–2015–0199***, EPRI Report 3002007325, January 2016, https://www.epri.com/#/pages/product/000000003002007325/

(103, 170) ***A Comparative Assessment of the US-EPA's AVoided Emissions and geneRation Tool (AVERT): Estimating Emissions and Energy Displacement Associated with End-Use Energy Efficiency***, EPRI Report 3002004606, 2014, https://www.epri.com/#/pages/product/3002004606/

(103) ***Exploring the Interaction Between California's Greenhouse Gas Emissions Cap-and-Trade Program and Complementary Emissions Reduction Policies***, EPRI Report 3002000298, March 2013, https://www.epri.com/#/pages/product/000000003002000298/

(103) ***Understanding the Impact of Climate Policy on Electric Company Compliance and Investment Decisions***, EPRI Report 1015635, December 2008, https://www.epri.com/#/pages/product/000000000001015635/

(103) ***Expanding the Role of "Land Use, Land Use Change and Forestry" Projects and the Carbon Market in Addressing Global Climate Change***, EPRI Report 1010172, December 2005, https://www.epri.com/#/pages/product/000000000001010172/

Additional Resources on GHG Reporting Methods & Protocols

- EPRI's ESCA public website (https://eea.epri.com).
- Greenhouse Gas Management Institute (https://ghginstitute.org/) – Online GHG accounting courses.
- IPCC Guidelines (www.ipcc-nggip.iges.or.jp) – Encompasses all major GHG emitting sectors and provide fundamental technical approaches for estimating emissions.
- ISO Standards (www.iso.org) – Develops and publishes international standards.
- The Climate Registry (www.theclimateregistry.org) – Operates a voluntary reporting program for corporations and other entities including guidance for General Reporting Protocol and Electric Power Sector Protocol.
- U.S. EPA Center for Corporate Climate Leadership (https://www.epa.gov/climateleadership) – A resource for organizations looking to expand their GHG measurement and management.
- WRI/WBCSD Corporate Standard (www.ghgprotocol.org) – Provides requirements and guidance for preparing entity-level GHG inventories. Supplementals: GHG Protocol Scope 2 Guidance and Corporate Value Chain (Scope 3) Standard.

Discussion and Q&A

TOGETHER…SHAPING THE FUTURE OF ENERGY®

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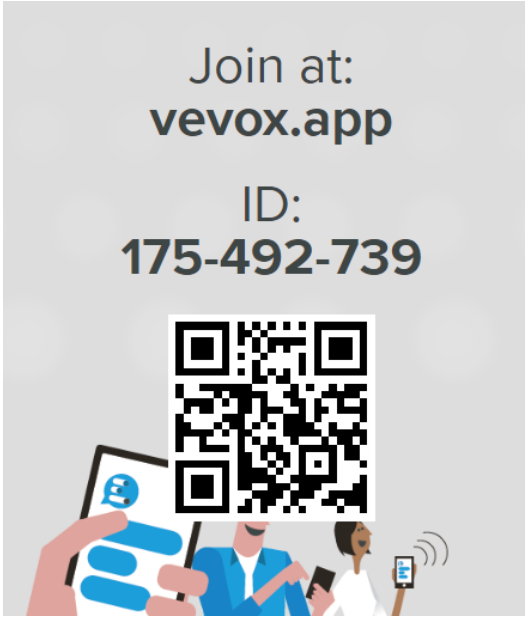
Polling Questions: Your Organization

Please scan the QR code with your cell phone camera to be directed to the Vevox website.

Alternatively, you can click on the link here to Vevox.

You can leave this webpage open for additional poll questions throughout the workshop.



A variety of use cases were combined with a broad set of industry knowledge, resulting in data service offerings that support multiple informational needs

Use case research & targeted outreach

Industry best practices/protocol and external expertise

Internal SME data identification and architecture design

Near real-time operational displays

Consumed emissions

Locational marginal emissions

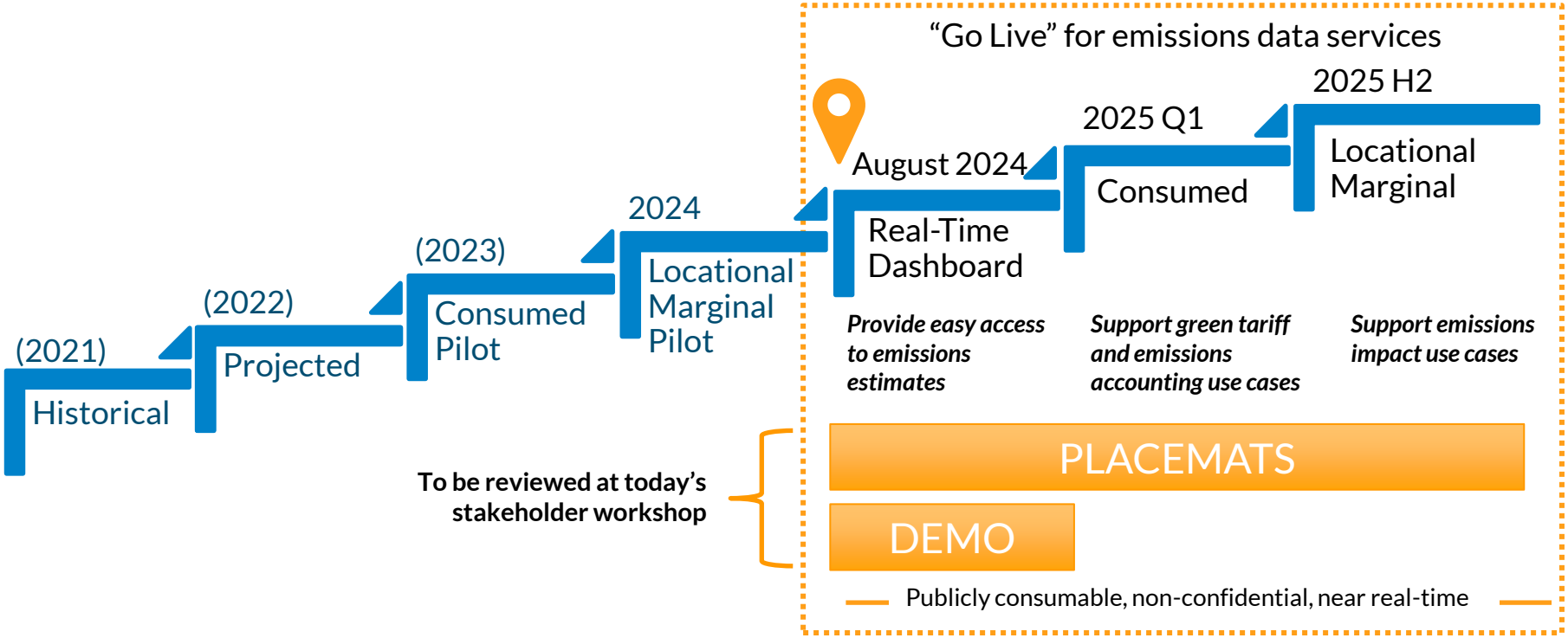
Criteria for developing data service offerings:

- ✓ Publicly consumable
- ✓ Non-confidential/market sensitive
- ✓ Near real-time
- ✓ Supports multiple data requests across member segments
- ✓ High quality and secure data inputs
- ✓ Verifiable methodology
- ✓ Credible emissions data estimates
- ✓ User friendly data consumption and visualization

Key parameters of each data service:

- ✓ Locational granularity
- ✓ Temporal granularity
- ✓ Reporting lag
- ✓ Data retention

Staggering launches will provide increasingly granular, non-confidential data as data services are ready



REAL-TIME EMISSIONS (Release #1): Publish real-time, footprint-level emissions displays with downloadable prompt

DESCRIPTION: Two additional pages on MISO's existing emissions dashboard provide footprint-wide estimates:

1) Real-time **generated emissions**
2) Near real-time **marginal emissions**

VALUE: Provide operational displays of real-time market and operating conditions, akin to services provided by peers.

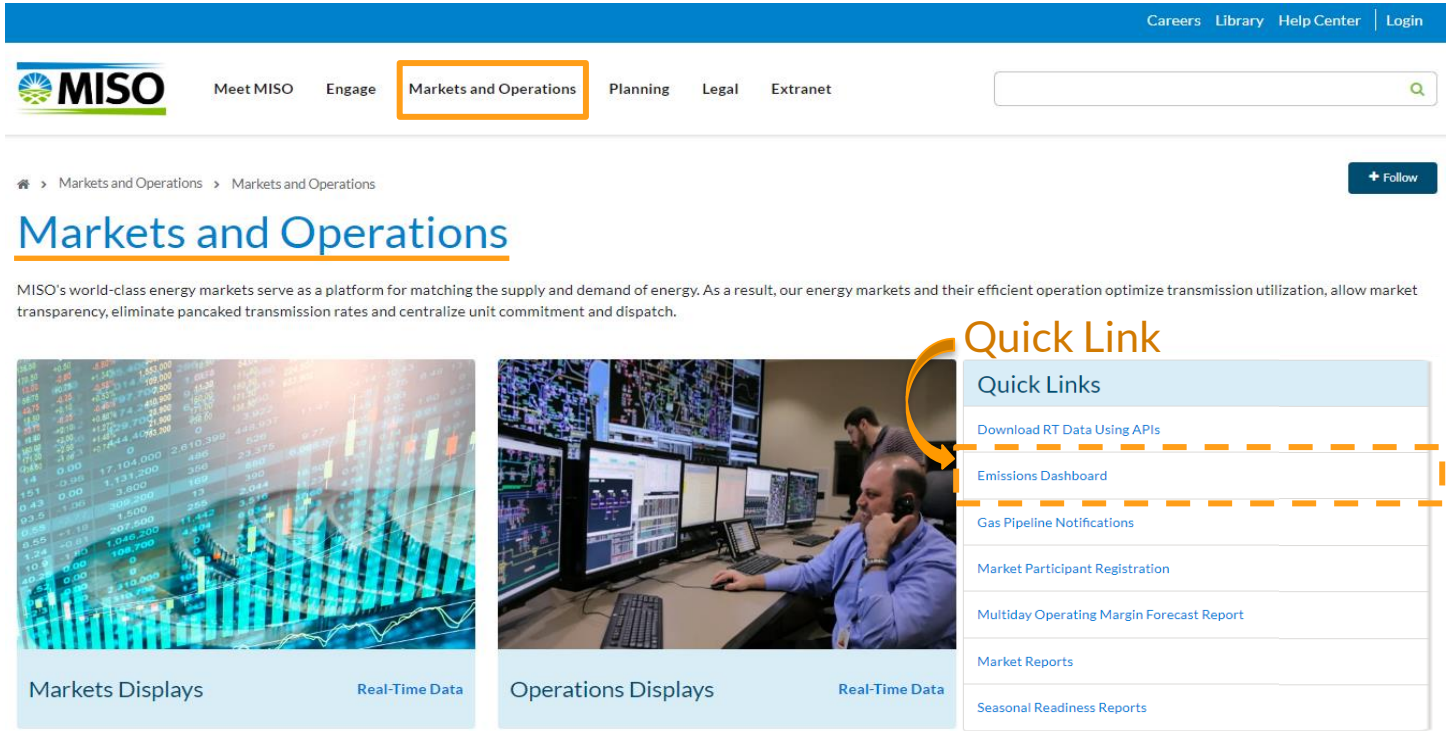
ROLLOUT TIMING: **August 2024**

DATA PARAMETERS and REASONING:

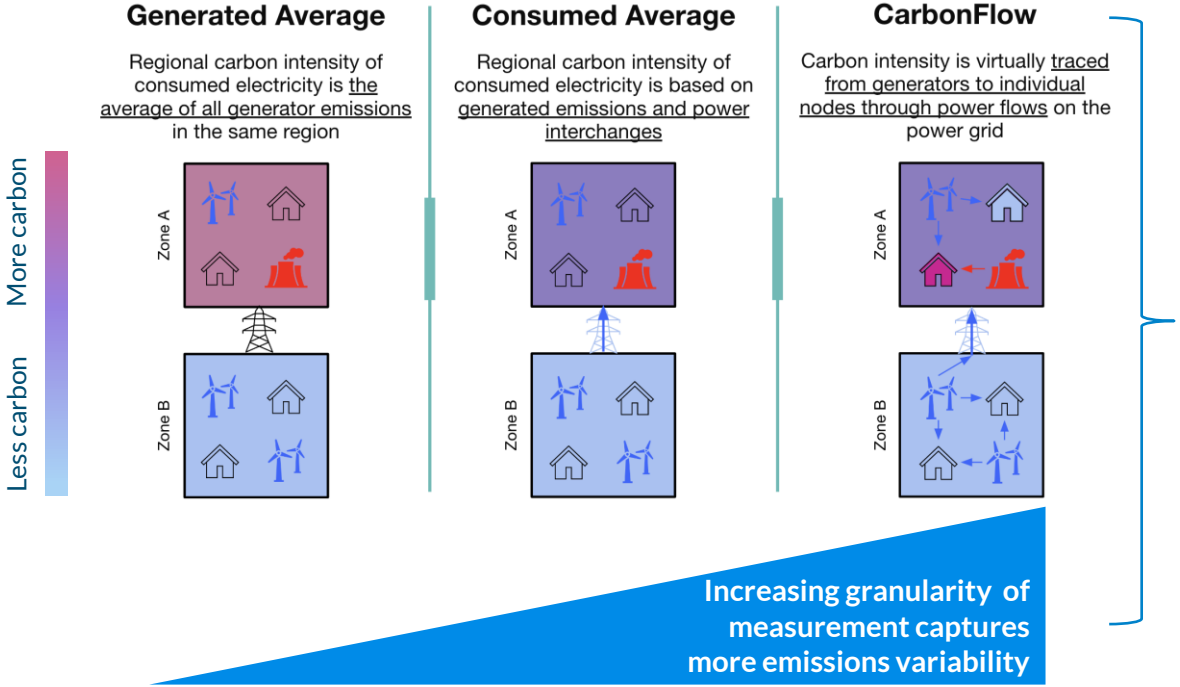
Locational Granularity	MISO Footprint	Input data is from MISO's existing reports: real-time fuel mix and the daily fuel on the margin.
Temporal Granularity	5 minutes	Underlying data is available at 5-minute granularity.
Reporting Lag	Near Real-Time: For 1) 5-minutes For 2) 1-day	Lag is primarily due to MISO's publication timing of data inputs. 1) Real-time fuel mix lags 1 minute for each 5-minute period. 2) Fuel on the Margin report is published on a 1-day lag.
Data availability	2-years	2 years provides time for downloading data history while accounting for different annual reporting cycles. Accumulation of history will begin with the 2024 launch.

MISO's existing Emissions Dashboard, hosted by Singularity: [linked here]

New Quick Links will make the Emissions Dashboard easy to access via MISO's website



MISO's consumed emissions estimates utilizes CarbonFlow™ a peer-reviewed, location-based method



- More temporal and locational granularity drives higher accuracy of emissions attribution
- Using MISO State Estimator and topographical data enables virtual tracing on all MISO-modeled data
- MISO executed a proof of concept with this method in 2023

Implemented by Singularity

CONSUMED EMISSIONS (Release #2): Rollout near real-time and lagged consumed emissions estimates with multiple aggregations

DESCRIPTION: An additional dashboard tab and API provides **consumed emission rates** and **total consumed emissions, as well as non-CFE (carbon free energy) emission rates**.

VALUE: Provide a first-of-its-kind, quality data service inclusive of imports and exports to enable member service offerings (e.g., green tariffs, 24/7 Carbon Free Energy (CFE)) and Scope 2 reporting requirements.

ROLLOUT TIMING: By Q1 2025

DATA PARAMETERS and REASONING:

Locational Granularity	Footprint, subregion, LRZ, ***LBA*, total state (not limited to MISO operating area), county***	Dashboard filter capability enables varying levels of granularity for different footprints and use cases.
Temporal Granularity	*NRT*: Hourly	5-minute reporting contains occasional data gaps.
	2-months: Hourly, ***Daily***, Monthly	
Reporting Lag	*NRT:* Emissions rates/mix For county: rate / mix only†	Processing time is less than 1 hour, and NRT data helps maximize decision-making value. Rates are not traceable back to individual members/units.
	*2- months**: Total emissions	A 2-month lag eases concerns about confidentiality and market manipulation, but in many cases is more prompt than governmentally-reported data.
Data availability	2 years	2 years provides time for downloading data history while accounting for different annual reporting cycles. Accumulation of history will begin in late 2024 / early 2025.

NRT: Near Real Time

Focus of stakeholder feedback

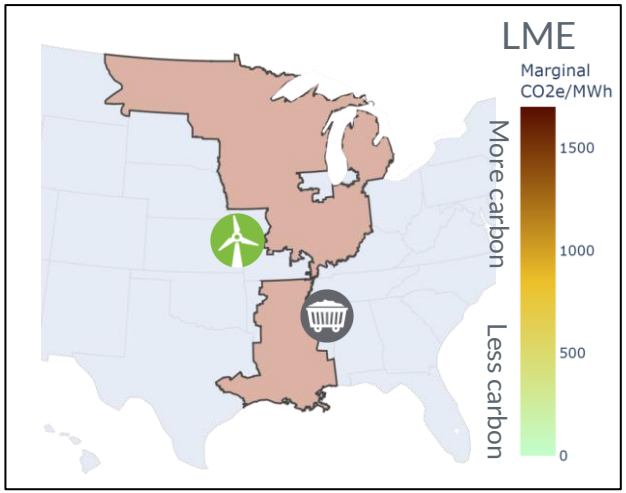
* LBA-level data release aligned with EIA data publication (approximately 2-month lag)

† Only emissions rates and fuel mix will be reported for county aggregations: some counties have only one CPnode, and nodal load is confidential.

Locational Marginal Emissions (LME) will be estimated at multiple levels of locational granularity

MISO-Wide Marginal Fuels

LME is estimated for all of MISO from the list of marginal fuel types

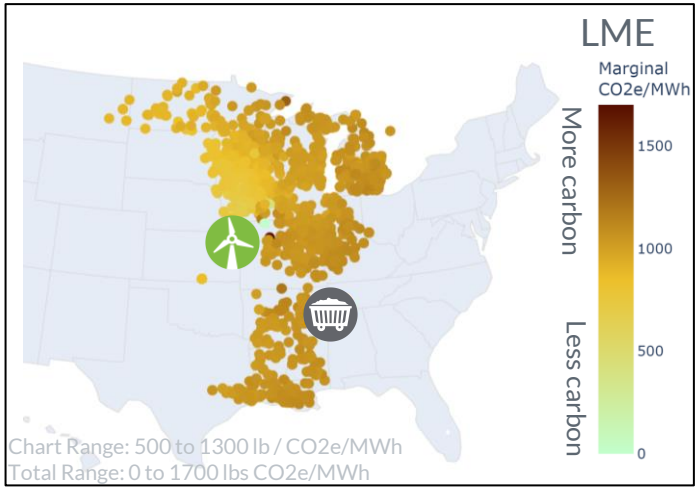


August 2024

Marginal fuel icons are added to illustrate conditions at a particular time interval.

Nodal LME†

LMEs are calculated for each load node based on responses of marginal generators and binding constraints to those nodes



2024 Pilot; Launch Planned Late 2025

At the footprint level, the number of resources on the margin at any interval is limited.

† This visual representation represents a method similar to that of PJM's locational marginal emission estimates

For each interval, locational marginal emissions (LME) estimates reflect marginal conditions of a single solution

This LME approach is appropriate for estimating the impact of small load changes

Marginal system conditions are described by the marginal generators, LMPs, binding constraints, and other data. These conditions change with each market interval.

Marginal Generator 1:
Fuel: Wind
Generation: 30 MW
LMP: $5

Binding Constraint 1:
Location: …
Impact on loads: …

Marginal Generator 2:
Fuel: Natural gas
Generation: 50 MW
LMP: $20

LME calculation

Load changes large enough to cause a non-marginal generator to respond, or to cause an additional constraint to become binding, would not be accurately reflected by the LME estimate.

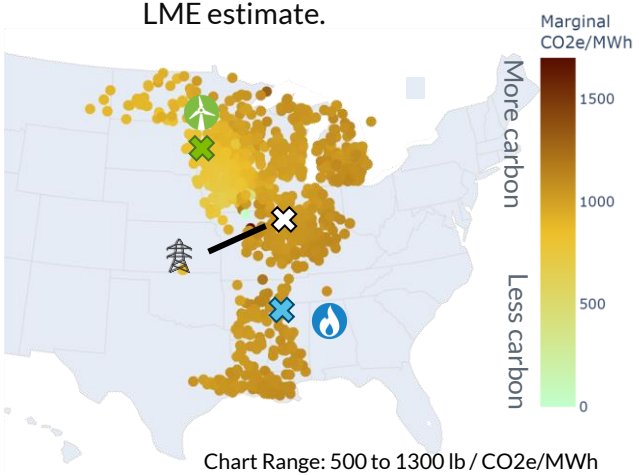


Chart Range: 500 to 1300 lb / CO2e/MWh
Total Range: 0 to 1700 lbs CO2e/MWh

LOCATIONAL MARGINAL EMISSIONS (Release #3): Rollout near real-time LME estimates by year-end 2025, pending a successful pilot

DESCRIPTION: An additional tab on the dashboard that displays **Locational Marginal Emissions (LME)** in near real-time at the nodal level

VALUE: To provide high quality marginal emissions rates for operational intelligence. Inclusion of real-time security constrained economic dispatch data (SCED) would align with PJM reporting

ROLLOUT TIMING: Estimated late 2025

DATA PARAMETERS and REASONING:

Locational Granularity	Load Nodal	Load nodal marginal rates are non-confidential and are the required granularity for end-use customers to make localized decisions.
Temporal Granularity	***RT: 5 minutes***†	RT SCED underlying data is 5 minutes.,
	DA: Hourly†	DA SCED underlying data is hourly.
Reporting Lag	Less than 1 hour	The speed of data transfer and analysis will depend on the methodology chosen.
Data availability	2-years	2 years provides time for downloading data history while accounting for different annual reporting cycles. Accumulation of history will begin in 2025. This aligns with PJM's retention of locational marginal emission rates.

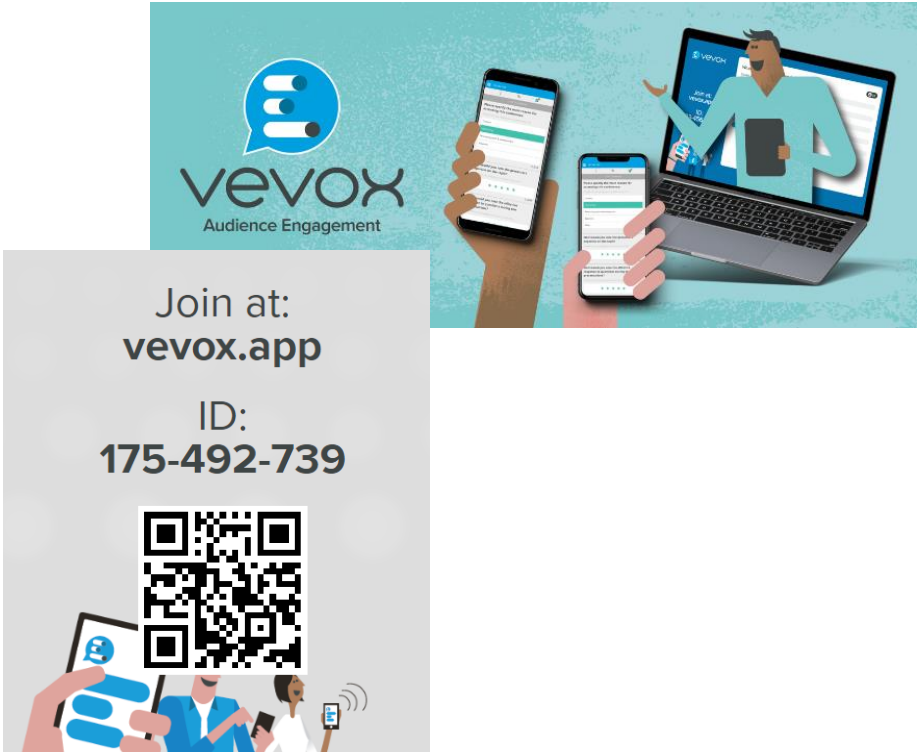
Focus of stakeholder feedback

†2024 LME pilot project will evaluate signals from both data sources, with the objective of reporting one. Nodal load is confidential data and will not be reported.

Polling Questions: Resources & Challenges

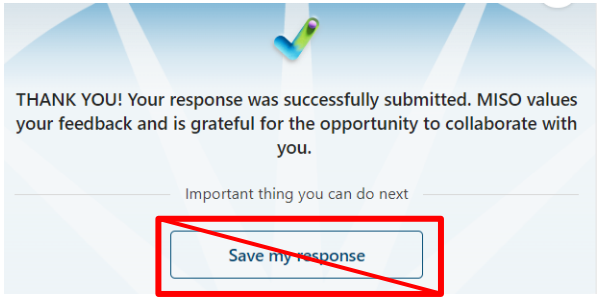
Please scan the QR code with your cell phone camera to be directed to the Vevox website.

Alternatively, you can click on the link here to Vevox.



Please take this opportunity to provide additional feedback about the planned emissions data services

- In place of a Stakeholder Feedback Request, MISO will field an ***Insights Questionnaire*** online using Microsoft Forms
  - Stakeholder perspectives will further inform MISO's decisions on the planned data services through written feedback.
  - Results will be kept confidential, and information will not be publicly reported.
  - Responses will be accepted between July 18 and August 1.
  - "Save my response" box after submitting the questionnaire does not affect recording of responses (see right)



Next Steps

- Stakeholder Responses to Insights Questionnaire between 7/18/2024 – 8/1/2024
- Real-Time Dashboard Launch Timing – 8/1/2024

Appendix

Placemats outline data parameters for each data service and focus discussion on key areas for feedback

- **Data parameters in bold** indicate focus areas for stakeholder feedback.
- All data to be released will be non-confidential and not market-sensitive.
- Multiple locational and temporal granularities are proposed for consideration and feedback.

EMISSIONS DASHBOARD (Release #X): Description

DESCRIPTION: More detail here

VALUE: Benefit described here

ROLLOUT TIMING: Month / Quarter / Year

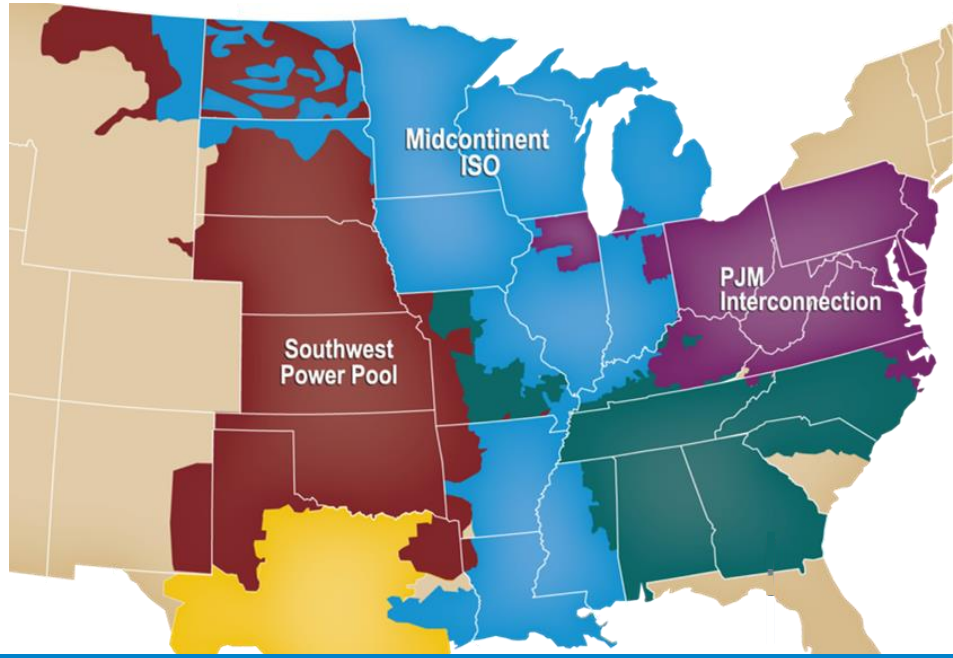
DATA PARAMETERS and REASONING:

Locational Granularity	Level(s) 1, 2, 3	Explanation / Rationale
Temporal Granularity	Level(s) 1, 2, 3	Explanation / Rationale
Reporting Lag	Timing	Explanation / Rationale
Data availability	Timing	Explanation / Rationale

MISO's existing Emissions Dashboard, hosted by Singularity: [linked here]

Operating the grid generates data uniquely suitable for producing emissions estimates to support MISO members' plans and goals

- Load balancing coordination within and across regions necessitates network visibility and data security
- MISO maintains a network model that covers most of the Eastern Interconnection
- Operations maintains visibility into electrical flows, generation output and load levels every 5 minutes



No other entity has better data across MISO's footprint

Definitions

- **24/7 CFE (Carbon Free Energy)**. "Carbon-free" energy 24 hours a day, seven days per week.
- **Attributional Accounting**. Assigning responsibility for the creation of GHG emissions to activities based upon pre-specified use cases.
- **AR (Assessment Report - from IPCC)**. Each version has a corresponding number.
- **CarbonFlowTM**. Consumed emissions estimate methodology. provides locationally granular, temporally granular data about the fuel mix and emissions estimates associated with electricity consumed by loads, based on power flows of the transmission network.
- **CFE (Carbon Free Energy)**. Energy generated by a resource that emits no direct GHG emissions from fuel combustion. This includes hydro, geothermal, nuclear, solar, and wind.
- **CO_2e (Carbon Dioxide equivalent)**. The amount of carbon dioxide that when emitted into the atmosphere would produce the same estimated GWP as a given weight of another radiatively active gas.
- **Consequential Accounting**. Estimating the change in emissions caused by an action. This can be forward looking "what happens if.." or backward looking "What would have happened if…"
- **Consumed Emissions**. Refers to emissions associated with the consumption of electricity at load.
- **CP (Commercial Pricing) Node**. Financial settlement points for the market participant and the most granular load data available in MISO's commercial model.
- **EIA (Energy Information Administration)**. This agency collects, analyzes, and disseminates energy information to inform policy making, efficient markets, and public understanding of energy and its interaction with the economy and the environment.
- **Generated Emissions**. Refers to emissions associated with the generation of electricity at its source.
- **GHG (Greenhouse Gas(es))**. Those gases that trap absorbed radiation that end to warm the planet's surface
  - CO_2: Carbon dioxide (AR6 100 CO_2e = 1)
  - CH4: Methane (AR6 100 CO_2e = 27)
  - N2O: Nitrous oxide (AR6 100 CO_2e = 273)
  - lbCO2/MWh: emission rate measurement increment
- **GWP (Global Warming Potential)**.Measure of how much infrared thermal radiation a greenhouse gas added to the atmosphere would absorb over a given time frame, as a multiple of the radiation that would be absorbed by the same mass of added carbon dioxide. GWP is 1 for CO2.
- **IPCC (Intergovernmental Panel on Climate Change)**. This group is the United Nations body for assessing the science related to climate change.

Definitions

- **LBA (Local Balancing Authority)**. The responsible entity that integrates resource plans ahead of time, maintains load-interchange-generation balance within a MISO Balancing Authority Area (MBAA) and supports Interconnection Frequency in real time. It is also known as Control Area.
- **Location-Based Emissions Accounting**. Emissions estimated based on physical consumption of electricity. See Consumed Emissions
- **LME (Locational Marginal Emissions).** Represents the incremental GHG emissions effect of increasing or decreasing a specified amount of energy into the grid at a give location
- **Mapping**: Process of assigning specific resources to nodal identifiers and geographic locations
- **Marginal Unit**. Represents the generating unit modeled as responding to increasing or decreasing a specified amount of energy into the grid at a give location.
- **Marginal Energy**. Represents the energy produced by the marginal unit.
- **Market-Based Emissions Accounting**. Emissions estimated based on contractual agreements to buy and sell power with specific GHG attributes, including Renewable Energy Contracts (RECs), direct contracts, supplier-specific emission rates, residual mix.
- **non-CFE (Carbon Free Energy)**. Energy generated by a resource that emits GHG emissions from fuel combustion. This includes biomass/gas, natural gas, coal, petroleum, and waste to energy.
- **OGE: Singularity Energy's Open Grid Emissions**. Open Grid Emissions is a peer-reviewed open-source initiative that seeks to fill a critical need for high-quality, easily-accessible, hourly grid estimated emissions data for GHG accounting, policymaking, energy attribute certificate markets, and academic research.
- **Residual mix**: unclaimed energy delivered on the electricity grid which prevents / limits double counting of clean energy as part of GHG emission calculations
- **Residual mix emission rate**. The emissions rate of energy that is unallocated or unclaimed through market accounting that is delivered to customers on the electricity grid.
- **SCED (Security Constrained Economic Dispatch)**. An algorithm capable of clearing, dispatching, and pricing Energy, Operating Reserve, Up Ramp Capability, Down Ramp Capability, and Short-Term Reserve in a simultaneously co-optimized basis that minimizes Production Costs and Operating Reserve Costs while enforcing multiple security constraints. The algorithm keeps the commitment of Resources fixed in the dispatch.