Mapping FAQs
Mosaic and Panorama

Enverus has automated mapping processes that perform mappings programmatically and a Manual Mapping Team of dedicated specialists that handles the mappings that our algorithms cannot. Maintaining mappings is a very time intensive process in large part because the grid topologies and ISO naming conventions change often. Although we are never going to get to 100% mapping coverage, we are able to map the vast majority of grid elements and are a trusted source of mappings in the industry. If there is a grid element that is unmapped that you would like to have mapped, please reach out to powersupport@enverus.com for the Manual Mapping Team to investigate. Generally, the Manual Mapping Team prioritizes maintaining mappings for more current and higher impact grid elements (e.g. constraints that have bound recently and/or strongly), but the mapping team will investigate all reasonable mapping requests (a request to map all constraints across history cannot be accommodated). Enverus mappings live in RMS (a Panorama API) and flow into Panorama and Mosaic.

Contents

What types of mappings does Enverus perform?

1) **Binding Constraints** - Matching binding constraints from the ISO binding constraint reports with the associated branch names in the state estimator or state estimator-like datasets
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11) **IIR Generators** - Mapping of IIR generator units to buses in the state estimator or state estimator-like datasets
12) **NOAA Weather Stations** - Mapping NOAA stations to ISO zones for every region for use in PJM line ratings.
13) **EIA Mappings** - Mapping of EIA generators to the state estimator case generators. Enverus utilizes the fuel types from EIA in the "Generators" case data tool. In MUSE, the pmax and unit names are used for the MUSE generator clusters.
14) **Enverus Plants** - Mapping of generator and large load substations (from the Enverus PRISM platform and Enverus' Energy Transition Research Team) to Panorama state estimator or state estimator stations.

What is the cadence of the manual mapping process?

The cadence of the mapping process largely varies depending on the ISO and grid element. Please see the ISO-specific sections of this document for more information.

Is the Manual Mapping Team considering adding additional manual mapping sessions?

Although the mapping team is considering adding additional mapping sessions per day, there are currently no definite plans to add additional sessions.

What is the cadence of the automated mapping processes?

The automated mappings generally run on a continuous basis. The automated GIS mapping process kicks off shortly after the state estimator cases are received and is a maximum 30-minute process. For the Enverus Plants mappings, there is an automated process run quarterly.

How long does it take for newly mapped grid elements to show up in Mosaic and Panorama. And what is the cause of the delay?

In Panorama, newly mapped grid elements show in Panorama in approximately 15 minutes. This latency is entirely due to data pipeline processing time. The Mosaic latency of between 2-4 hours is caused by a data backfill process and manual data quality review. Although we would like to reduce the time it takes for newly mapped grid elements to show in our products, there are currently no clear ways to hasten the process.

What are the reasons that a constraint cannot be mapped?

The high-level answer to this is that either we do not have enough information to map the constraint confidently or it is impossible to map for a topological reason. Please see the table below for a more detailed explanation and the ISO-specific sections of this document for even further detail.

Reason	Description
Weak or Inconclusive MCC Spread	Our constraints are defined with a binding direction and MCC spread is a critical component we utilize to determine direction. Common issues include: a lack of nearby pnodes to utilize, weak correlation between the MCC spread and the shadow price during the binding event, and MCC spread flips during binding events.
Circuit Breaker	Circuit breakers are a single piece of equipment inside a substation where a substation contains multiple buses. The state estimator or state estimator-like topologies we rely on are at the bus level. It can be hard to tie a circuit breaker constraint listed in an ISO binding constraint report to a specific bus/branch in the state estimator. Circuit Breaker constraints are mapped manually.
Branch Doesn't Exist in Topology	There are occurrences where the branch associated with the constraint in the ISO binding constraint report does not exist in the current topology therefore there is nothing for us to map the binding constraint in the report to.

Reason	Description
Monitored Branch Has Same To/From Station and KV	Our mapping system (RMS) uses the station and kV values to determine constraint direction. If the to and from station and kV are the same, it is generally not possible for RMS to distinguish which side is the source side and which side is the sink side of the branch. Therefore, the constraint remains unmapped. We are not able to map constraints that fall into this category with a few exceptions mainly in PJM (see PJM-specific section for more information).

What causes a constraint that was previously mapped to become unmapped?

This can occur for several reasons, including that the names of the grid elements have changed or the grid elements no longer exist in the most current version of the topology. It may or may not be possible to map grid elements that were previously mapped, but currently unmapped.

How does Enverus "effective date" or "case" the mappings across time?

Enverus does not currently have a system for maintaining a history of all the mappings across time via grid element "effective dating" or "casing". Enverus only retains the most current version of the mappings. Here are some examples showing the practical implications of this reality:

- There is a bus in MISO that has existed for 10 years, but last year MISO decided to change the name (specifically the unique identifier) of the bus in the MISO state estimator models. Enverus tools will show this bus as two different buses. If pulling the bus load data from Reflow inter case endpoints, these data will be shown as 2 distinct time series.
- A branch name changes (it is otherwise the same branch) and in the same state estimator that the name change occurs, the branch is on outage. This branch outage will be considered a persistent outage because the branch is treated as a new branch.
- The branch and/or bus and/or bus voltage that comprise the monitored branch component of the constraint definition changes in the most recent case. The constraint will be remapped according to the new component attributes.

Why do GIS coordinates sometimes change slightly depending on the Panorama GIS case?

In Panorama, we have GIS coordinates for sets of substations and the rest of the of the grid element latitudes and longitudes are interpolated. Since the values are interpolated, they can change slightly between cases.

ERCOT-Specific FAQs

What is the cadence of the ERCOT mapping process?

Most of the ERCOT mappings are performed programmatically because ERCOT data are clean. There is one ERCOT DA file released per day that we modify to create 24 distinct cases.

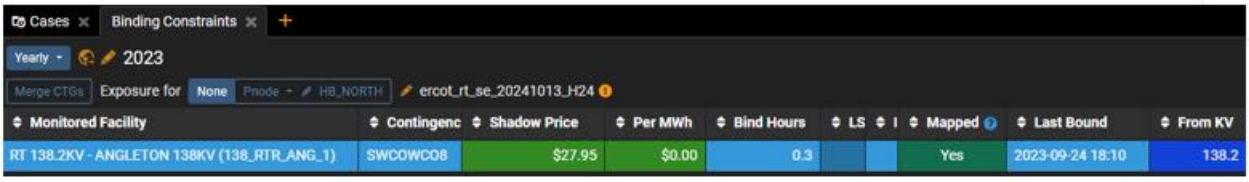
Grid Element	Manual Mapping Cadence
Binding Constraints	N/A
Contingencies	N/A
Interface/Multi-Element Constraints	Monthly – By First Friday
Cross ISO Branch to Branch	N/A
Cross ISO Bus to Bus	N/A
Outages	N/A
Pnodes	N/A
Generators	N/A
GIS	Ad-Hoc (Verification)
Market Participant	Monthly (First Week)
NOAA Weather Stations	Ad-Hoc (Normally When Zone Added)
EIA Mappings	Monthly & Ad-Hoc (Fixes)
Enverus Plants	Ad-Hoc

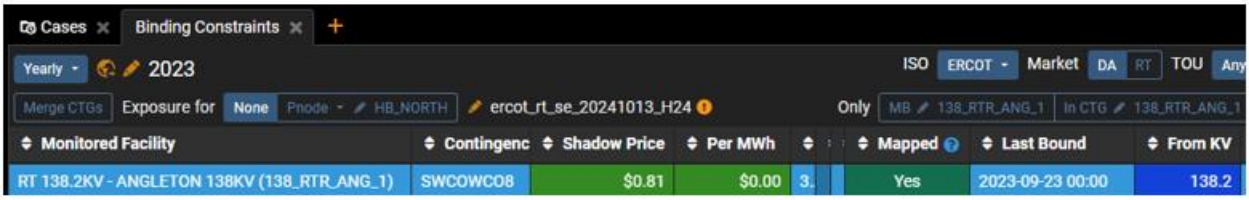
How does Enverus handle occurrences where ERCOT represents the same constraint, but with slight differences in bus voltage?

ERCOT constraints within the ERCOT binding constraint reports sometimes exhibit this behavior. Please see below for an example of a constraint where the monitored_uid = **138_RTR_ANG_1** and contingency = **SWCOWCO8** and the from station voltage differs by 0.2 (data pulled from ConstraintDB in uid_mode = "raw" in 2024-12).

from station name	from station voltage	to station name	to station voltage	da shadow price sum	rt shadow price sum	earliest appearance	latest appearance
RT	138	ANGLETON	138	0	27.95	2023-09-24	2023-09-24
RT	138.2	ANGLETON	138	0.81	0	2023-09-22	2023-09-23

These two constraints are effectively the same, but they will be represented as different constraints. The first screenshot below shows RT binding constraints and the second shows DA.





MISO-Specific FAQs

What is the cadence of the MISO mapping process?

MISO provides 4 state estimator cases per day and makes small changes frequently in the intraday and day to day state estimator releases (the table below reports the cadence of the updates made to address the routine changes MISO makes). However, MISO also makes large scale changes to the ISO topology quarterly – on the 1st day of the last month of each quarter (released on the 15th). In response to these changes, the Enverus Mapping Team immediately performs a delta analysis and semi-automated mapping update which takes 1-2 business days to complete where hundreds of mappings are updated. Then the manual mapping effort begins to complete the mapping process – this process can take a maximum of 2 weeks to complete and multiple hundreds of mapping changes are made.

Grid Element	Manual Mapping Cadence (Times are Mapping Completion Deadlines)	Notes
Binding Constraints	2x Daily (8:30 am CT, 4:00 pm CT)	See section below for how Enverus handles MISO RT constraints
Contingencies	2x Daily (8:30 am CT, 4:00 pm CT)	Mostly automated
Interface/Multi-Element Constraints	Monthly – By First Friday	If MISO assigns a constraint ID or lists what equipment is part of the constraint, these will be mapped
Cross ISO Branch to Branch	N/A	
Cross ISO Bus to Bus	N/A	
Outages	N/A	

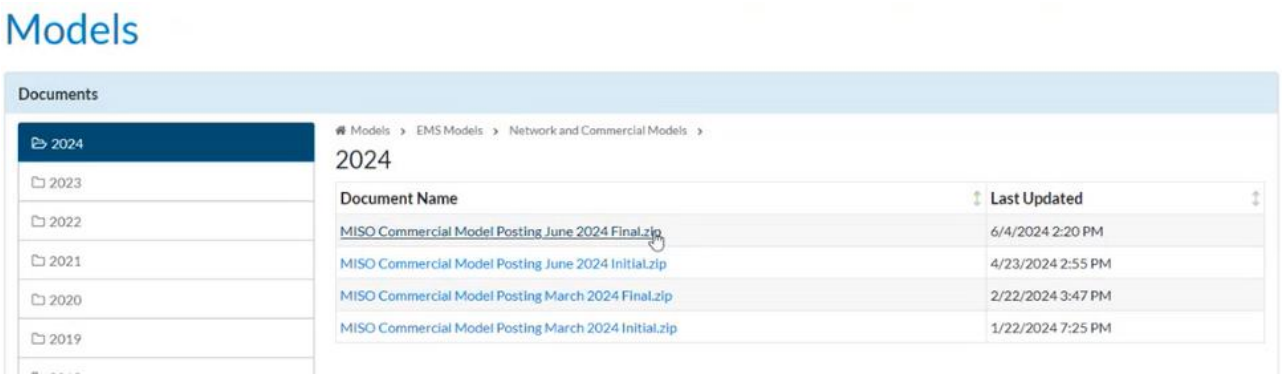
Grid Element	Manual Mapping Cadence (Times are Mapping Completion Deadlines)	Notes
Pnodes	N/A	See section below for how Enverus maps MISO pnodes (and handles weights)
Generators	N/A	
GIS	Ad-Hoc (Verification)	
Market Participant	Monthly (First Week)	
NOAA Weather Stations	Ad-hoc (Normally When Zone Added)	
EIA Mappings	Monthly & Ad-Hoc (Fixes)	
Enverus Plants	Ad-Hoc	

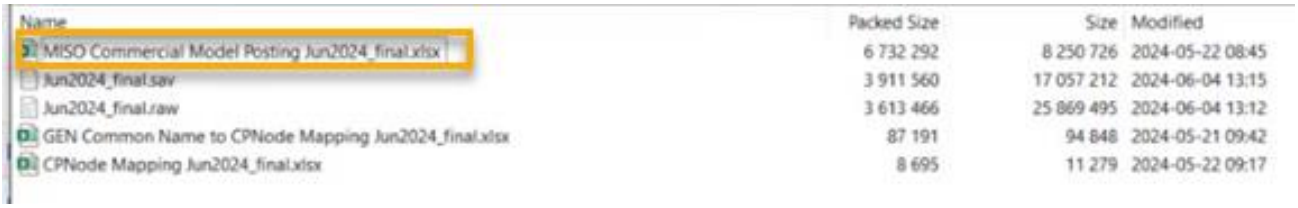
How does Enverus handle mapping MISO RT constraints?

The MISO RT mapping process is complicated because MISO doesn't release a "live" report for their RT constraints, so Enverus scrapes these data from the dashboard on MISO's website. The dashboard provides the constraints in a format that requires manual manipulation and therefore the mapping process is completely manual – the Manual Mapping Team does a preliminary mapping ASAP. Then the next day after MISO releases a final report of all the constraints that have bound in the RT the day prior, the Manual Mapping Team verifies the mappings and makes any necessary adjustments.

How does Enverus handle the bus to pnode mapping for MISO?

The bus to pnode mapping process is the most complicated for MISO. Enverus begins with the MISO commercial model that is released quarterly and contains a CPnode (commercial pricing nodes relevant for FTRs) – EPnode (elemental pricing nodes that correspond roughly to a bus) - commercial model bus mapping. Specifically, Enverus utilizes the most current "final" version of the model as "initial" versions have contained errors in the past (see screenshots below).





However, the MISO commercial model file does not contain all the information necessary to map the pnodes to the MISO state estimator case buses. The file also does not contain bus weights and sometimes the file is missing pnodes. Please see below for how Enverus handles each of these items:

- Bus Mapping – Enverus developed and employs a proprietary mapping algorithm to map the MISO commercial model buses to the MISO state estimator buses. This process is currently entirely automated, and therefore does not allow for manual interventions. Although our algorithm is highly effective, it is not perfect and attempts to improve the algorithm further have proven to be time consuming and ineffective. After the algorithm runs, the mapping team completes the mapping manually.
- Bus Weights – MISO nodes are either uniformly weighted (weight = 1) or bus load-weighted. Enverus utilizes the bus load in the individual state estimator datasets for the bus weights. This procedure delivers a reasonable result though it differs from MISO's methodology which is to use a rolling load window for the weights. Weights apply to MISO ARR Zones (pnodes with names ending in .AZ) and load zones.
- Missing Pnodes – We are considering using MISO's source-sink file to obtain missing pnodes, but there is currently no timeline for that effort.

SPP-Specific FAQs

What is the cadence of the SPP mapping process?

SPP releases 4 state estimator cases per day which Enverus makes available. Enverus utilizes the SPP TCR auction cases as well for operations such as mapping pnodes.

Grid Element	Manual Mapping Cadence (Times are Mapping Completion Deadlines)	Notes
Binding Constraints	2x Daily (8:30 am CT, 4:00 pm CT)	Constraint definitions located in SPP OASIS Temp Flowgate file
Contingencies	2x Daily (8:30 am CT, 4:00 pm CT)	
Interface/Multi-Element Constraints	Monthly – By First Friday	
Cross ISO Branch to Branch	Ad-hoc	For cross ISO outages
Cross ISO Bus to Bus	N/A	

Grid Element	Manual Mapping Cadence (Times are Mapping Completion Deadlines)	Notes
Outages	2x Daily (8:30 am CT, 4:00 pm CT)	
Pnodes	Ad-hoc	See section below for how Enverus maps SPP pnodes (and handles weights)
Generators	Same as ISOs	
GIS	Ad-Hoc (Verification)	
Market Participant	Monthly (First Week)	
NOAA Weather Stations	Ad-hoc (Normally When Zone Added)	
EIA Mappings	Monthly & Ad-Hoc (Fixes)	
Enverus Plants	Ad-Hoc	

How does Enverus handle the bus to pnode mapping for SPP?

SPP pnode mappings are made programmatically based on a "SOURCE_SINK" file that SPP publishes along with their TCR case, which includes weights. The Enverus team does not manipulate the pnode weights provided by SPP and does not know the methodology SPP utilizes to create the weights.

PJM-Specific FAQs

What is the cadence of the PJM mapping process?

PJM releases auction cases ad-hoc. However, please note that the PJM Panorama collection “miso-se.xt” is also affected by the large scale topology changes that MISO makes quarterly (as well as the intraday and daily changes MISO makes to the models).

Grid Element	Manual Mapping Cadence (Times are Mapping Completion Deadlines)	Notes
Binding Constraints	3x Daily (8:30 am CT, 12:00 pm CT, 4:00 pm CT)	
Contingencies	3x Daily (8:30 am CT, 12:00 pm CT, 4:00 pm CT)	
Interface/Multi-Element Constraints	Each Auction Case Release – By Time of Auction Case in Pano these will be mapped	
Cross ISO Branch to Branch	2x Daily (8:30 am CT, 4:00 pm CT)	PJM to MISO for miso-se.xt – impacted heavily by the large scale MISO quarterly update

Grid Element	Manual Mapping Cadence (Times are Mapping Completion Deadlines)	Notes
Cross ISO Bus to Bus	2x Daily (8:30 am CT, 4:00 pm CT)	PJM to MISO for miso-se.xt – impacted heavily by the large scale MISO quarterly update
Outages	2x Daily (8:30 am CT, 4:00 pm CT)	
Pnodes	N/A	
Generators	N/A	
GIS	Ad-Hoc (Verification)	
Market Participant	Monthly (First Week)	
NOAA Weather Stations	Ad-hoc (Normally When Zone Added)	
EIA Mappings	Monthly & Ad-Hoc (Fixes)	
Enverus Plants	Ad-Hoc	

What makes it possible to map constraints in PJM where the branch has the same to and from station name and kV?

There is an additional data source available - a fallback file that allows us to use the bus uid instead of the station/kv for the mapping.

CAISO -Specific FAQs

What is the cadence of the CAISO mapping process?

CAISO releases monthly and annual auction cases.

Grid Element	Manual Mapping Cadence
Binding Constraints	2x Daily (8:30 am CT, 4:00 pm CT)
Contingencies	N/A
Interface/Multi-Element Constraints	Monthly - Each Auction Case Release
Cross ISO Branch to Branch	N/A
Cross ISO Bus to Bus	N/A
Outages	N/A

Grid Element	Manual Mapping Cadence
Pnodes	N/A
Generators	N/A
GIS	Ad-Hoc (Verification)
Market Participant	Monthly (First Week)
NOAA Weather Stations	Ad-hoc (Normally When Zone Added)
EIA Mappings	Monthly & Ad-Hoc (Fixes)
Enverus Plants	Ad-Hoc