

Training

The Nodal Transition Plan calls for ERCOT to develop a comprehensive training program that prepares market participants to operate in the nodal market. The plan also calls for market participants to ensure that appropriate personnel complete applicable training courses.

Market participants may now review a wide curriculum of nodal market courses, including those currently available and those still under development. Training courses are being developed for delivery as instructor-led classroom sessions, web-based self-directed instruction and webcast.

Information on the nodal training curriculum, applicable attendees for training readiness and schedule of course offerings may be found on the nodal website: <http://nodal.ercot.com/training/readiness/index.html/>.

Training readiness will be tracked and reported as one of the readiness criteria items for market participants and ERCOT staff.

Resources

ERCOT and market participants can communicate about the nodal implementation in the following ways:

On the web . . .

Visit the Texas Nodal Market Implementation website (<http://nodal.ercot.com>) for all nodal information, including:

- Documents currently in review by TPTF
- Training schedule, curriculum and access to LMS
- Test environments and APIs
- Nodal Protocols
- Readiness materials

Visit the ERCOT public website (www.ercot.com) to view the TPTF meeting calendar, agendas and meeting materials.

By e-mail . . .

- Subscribe to Texas Nodal News, a biweekly newsletter containing TPTF updates, program updates and links to detailed information on the website. To subscribe, go to <http://lists.ercot.com> and select "texasnodalnews."
- Subscribe to the TPTF exploder list, to receive documents for review. To subscribe, go to <http://lists.ercot.com> and select "tptf."
- Contact the Nodal Transition Service Center with questions, suggestions or feedback at: TexasNodal@ercot.com

By phone . . .

- Contact your account manager or call (512) 248-3900 to speak with a representative from the Nodal Transition Service Center.

In person . . .

ERCOT will host a series of market readiness seminars, beginning in April, to serve as a forum for discussion, feedback and Q and A. Topics will vary from business processes to systems development to overall market readiness.

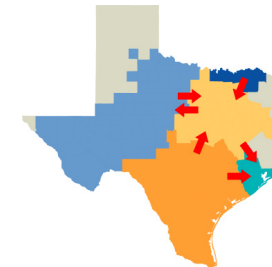


Understanding: Texas Nodal Market Implementation

In September 2003, as part of Project 26376, the Public Utility Commission of Texas (PUC) ordered ERCOT to develop a nodal wholesale market design.

This paper presents an overview of the zonal vs. nodal markets and ERCOT's Texas Nodal program, which will transition ERCOT to the new market design.

Zonal Market



In today's zonal market, the grid is divided into Congestion Management Zones (CMZs), which are defined by the Commercially Significant Constraints (CSCs).

Several limitations have been identified with the current zonal model:

- **Insufficient price transparency** – This results in less efficient power dispatch, less efficient congestion management tools and muted or distorted signals for investment.
- **Resources grouped by portfolio** – QSEs submit schedules for a group of resources (portfolio) in a specific zone, and ERCOT operators have limited options to resolve congestion.
- **Indirect assignment of local congestion** – Participants who contribute to local congestion are not directly assigned the associated costs.

What's Changing?

The transition to the nodal market will require significant changes to processes and systems. And some of ERCOT's business won't change at all.

Processes and systems that won't change significantly include the following:

- Components or structure of the current retail market
- Contracts for black start units
- Renewable Energy Credit (REC) program
- Treatment of transmission and distribution losses
- Unaccounted for energy (UFE)

The major components that will impact ERCOT's current business model include the following:

- Day-ahead market (DAM)
- Reliability unit commitment (RUC)
- Real-time or security constrained economic dispatch (SCED)
- Congestion revenue rights (CRRs)

Each of these components is either new or will replace a current process.

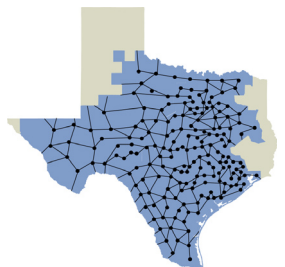
Nodal Market

Moving to a nodal design will satisfy the PUCT order to directly assign local congestion.

In the nodal market, the grid will consist of more than 4,000 nodes, replacing today's CMZs.

The Texas Nodal design is expected to deliver the following benefits:

- **Improved price signals** – More granular pricing will encourage additional generation and/or transmission investment in the proper locations.
- **Improved dispatch efficiencies** – Dispatching at the resource level will yield a lower overall cost of power supply.
- **Direct assignment of local congestion** – Settlement prices are based on locational marginal costs.



Day-Ahead Market

Today, ERCOT procures ancillary services (AS) during the day before the operating day. This ensures ERCOT will have sufficient available capacity to manage the grid for the next day. Currently, ERCOT does not have a day-ahead energy market. QSEs arrange bilateral energy contracts with each other to cover the anticipated load.

In Texas Nodal, there will be a daily day-ahead market (DAM) to co-optimize the following:

- Energy
- AS capacity
- Certain CRRs

The primary purposes of DAM are as follows:

- Arrange for energy and AS for tomorrow
- Provide price discovery for tomorrow
- Provide price certainty for tomorrow

Day-Ahead Market (continued from page 1)

The DAM provides an opportunity for parties to participate in a centralized market to optimize around their bilateral contracts. (Figure 1)

This centralized market makes it easier for QSEs with load to find other trading partners with generation. It also gives the market a snapshot of what the operating day will look like.

A co-optimized market will gain efficiencies because ERCOT will clear for energy and capacity at the same time in the DAM. (Figure 2)

The DAM is a forward market, which means transactions are delivered in the future – in ERCOT’s case, the next day. After real time, there is a true-up process in which buyers and sellers fulfill their obligations.

Reliability Unit Commitment

RUC is used to ensure there is sufficient generation capacity in the proper locations to reliably serve the forecasted load and forecasted transmission congestion by committing offline resources, if required.

RUC is similar to today’s out-of-merit capacity (OOMC) and replacement reserve service (RPRS).

In today’s market, OOMC and RPRS call on specific offline units to come online but use a different cost allocation than RUC will use. In some cases, the units are not compensated enough to cover their costs. RUC will use “make-whole” payments, which ensures a generator is adequately compensated for its costs.

ERCOT runs the RUC study daily, for the following day (Day-Ahead RUC or DRUC), and hourly (Hourly RUC or HRUC) (Figure 5).

Real-Time Market

Currently, the real-time market is used to “balance” the system. ERCOT uses balancing energy to meet the short-term load forecast and manage congestion between zones.

Today, ERCOT deploys balancing energy every 15 minutes by QSE resource portfolio in each CMZ. The QSEs manage the economic dispatch of individual resources within their portfolio. If there is zonal congestion, portfolios are redispatched in each zone, based on zonal average shift factors. A zonal average shift factor indicates the impact of net zonal generation on the flow over a CSC. Local congestion is relieved through resource-specific deployments (Figure 3).

In Texas Nodal, ERCOT will run the security constrained economic dispatch (SCED) every five minutes, using offers by individual resources and actual shift factors by each resource on each transmission element. As the name implies, SCED determines the most economical dispatch of individual resources across the grid. The distinction between zonal and local congestion disappears as all congestion is managed using individual resources instead of portfolios.

In Texas Nodal, generation will be settled based on the locational marginal price (LMP) of the node where the generator is located. Load will be settled based on a load zone price that is a load weighted average of the LMPs in the load zone.

Day-Ahead Market Comparison

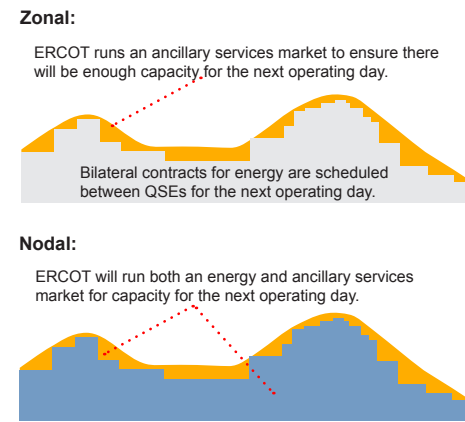
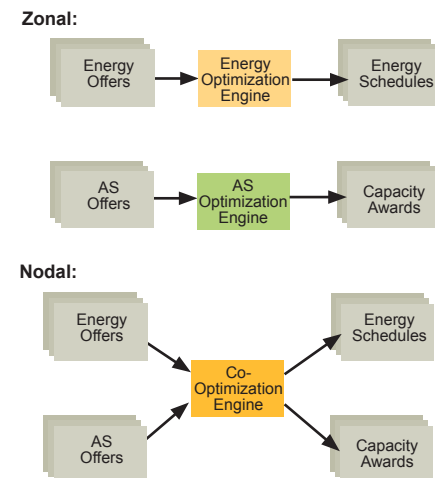


Figure 1

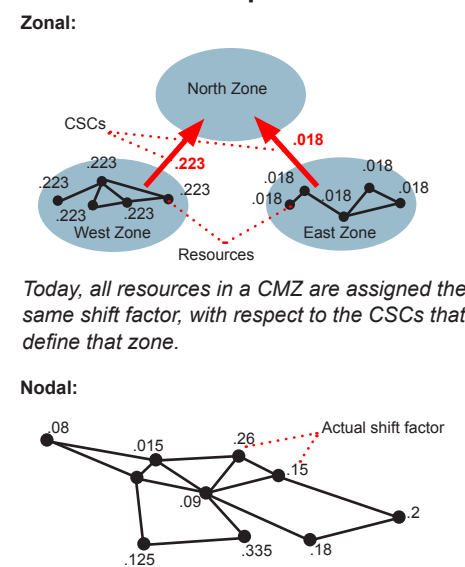
Day-Ahead Co-Optimization



The co-optimization engine will enable more cost-effective and efficient operations.

Figure 2

Shift Factors Comparison



In Texas Nodal, we will calculate an actual shift factor for each resource.

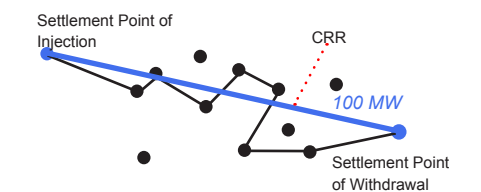
Congestion Revenue Rights

A congestion revenue right (CRR) is a financial instrument. Owning a CRR does not provide any special rights for physical operation. CRRs are defined by a MW amount, settlement point of injection and settlement point of withdrawal. Conceptually, a CRR owner gets paid or pays the LMP difference between the CRR injection and withdrawal settlement points for each CRR MW owned. (Figure 4)

CRRs are auctioned by ERCOT monthly and annually, and auction revenues are returned to loads.

Today, transmission congestion rights (TCRs) are offered for CSC congestion between CMZs.

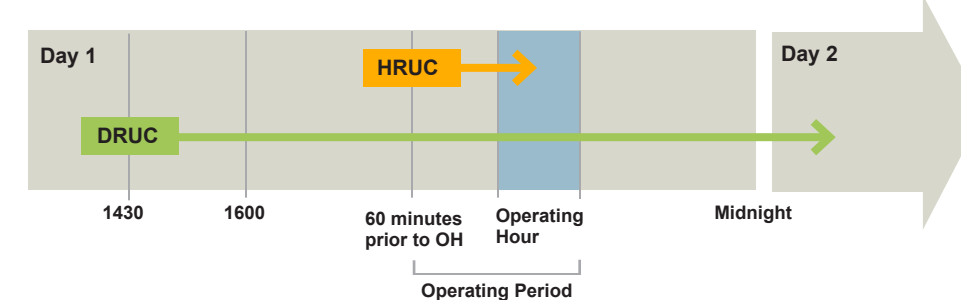
Congestion Revenue Rights



CRRs may be procured for a MW amount, from a point of injection to a point of withdrawal. Regardless of how the generation is dispatched, the holder of this CRR would be paid (or pay) the LMP difference between the injection and withdrawal settlement points x 100 MW.

Figure 4

Reliability Unit Commitment



DRUC is executed after the close of the DAM and evaluates the generation needs for the next operating day. HRUC is executed hourly and evaluates generation needs for the current day. If DRUC has already been executed, the HRUC will evaluate generation needs for the balance of the current day and the next day.

Figure 5

Summary

The following chart sums up the changes between the zonal and nodal markets.

Today's Zonal Market	Tomorrow's Nodal Market
Transmission congestion rights (TCR)	Congestion revenue rights (CRR)
No day-ahead energy market Day-ahead market for ancillary services procured for capacity	Day-ahead energy and ancillary services co-optimized market (DAM)
Replacement reserve service (RPRS) and out-of-merit capacity (OOMC)	Day-ahead reliability unit commitment (DRUC)
Hour-ahead studies	Hourly reliability unit commitment (HRUC)
Portfolio-based offers by zone	Resource-specific offers
Balancing energy service (BES) every 15 minutes Zonal congestion management by portfolio for CSCs Resource-specific for local congestion	Security constrained economic dispatch (SCED) generally every five minutes (still 15-minute settlement) All congestion management will be resource-specific Enhanced load frequency control
Zonal average shift factors for resources	Actual shift factors for resources
Zonal market clearing prices for BES for generation and loads	Nodal locational marginal pricing (LMP) for generation. Zonal weighted LMP for loads