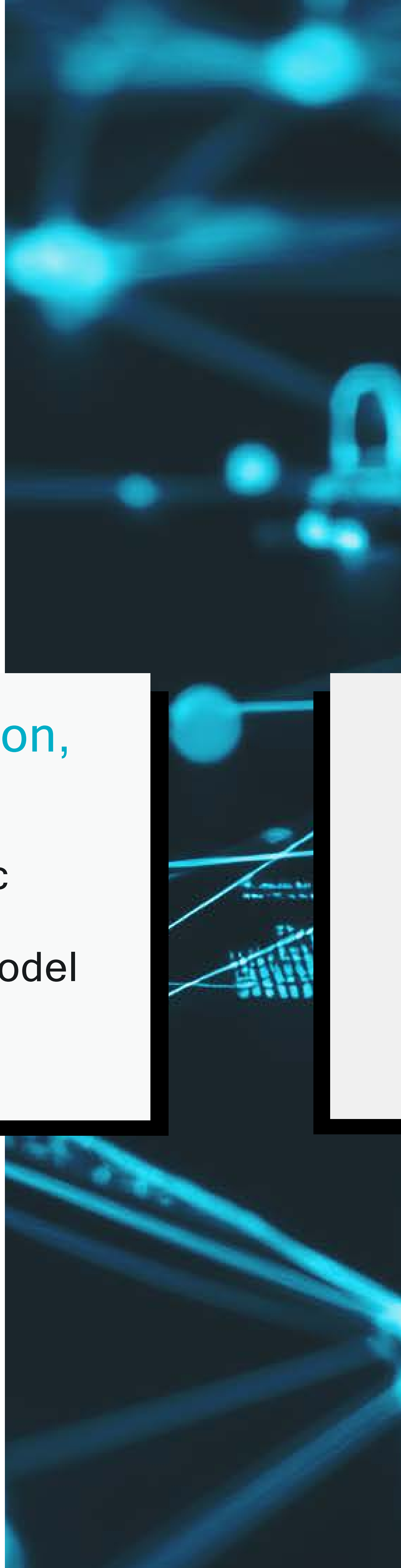
Grid Research, Innovation, and Transformation

The Value of Mapping Electric Service Identifier to Common Information Model Network Model Load

August 2025



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Executive Summary

With increasing grid complexity and load variability, mapping Electric Service Identifier (ESI ID) data to the Common Information Model (CIM) network model for loads is essential for better load management, grid operations, and analytics. This process requires a deep understanding of both the ESI ID data structure and the CIM model structure. By linking ESI IDs to CIM loads, ERCOT can enhance load profiles, improve situational awareness for system operators, and achieve accurate load distribution factors. Additionally, mapped CIM loads are invaluable for outage studies, assessing load shedding during system events, and refining planning models.

1. Introduction

1.1 Electric Service Identifier

Each Transmission and/or Distribution Service Provider (TDSP) Service Delivery Point has a unique number within Texas. This unique number is referred to as the ESI ID.

Each ESI ID has the following format: **10xxxxxyyy..yy**

where:

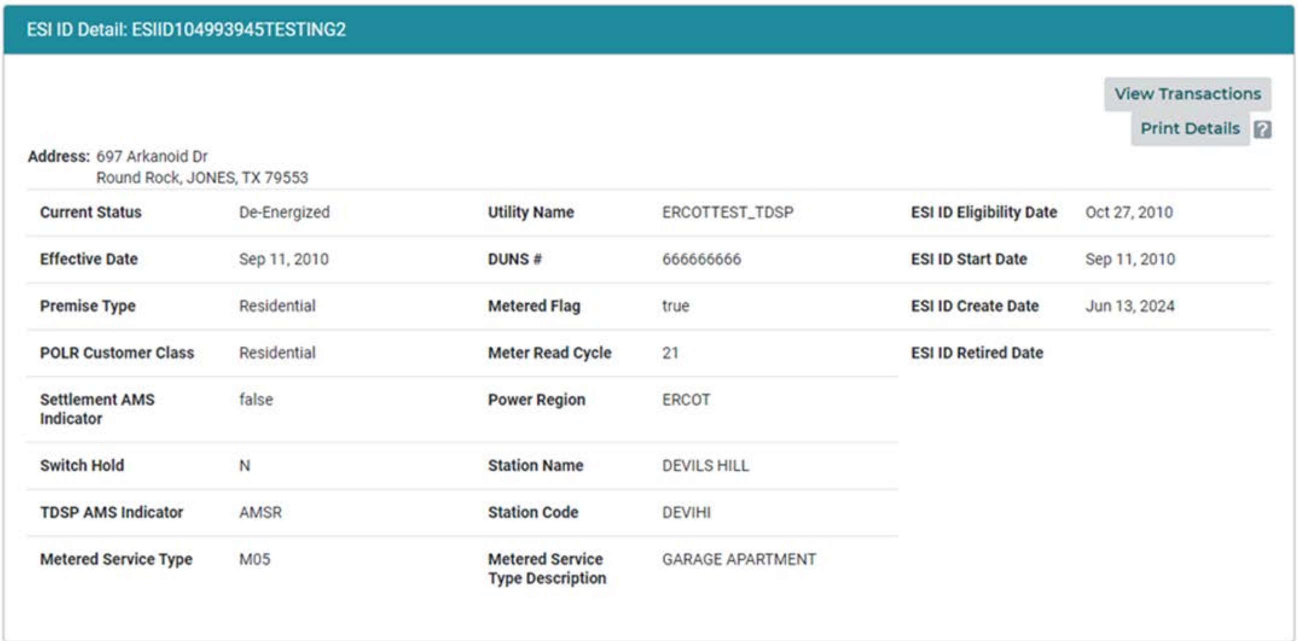
10	Electric Industry Prefix
xxxxx	Five-digit United States Department of Energy identification code for the assigning TDSP
yyy..yy	Up to 29 alphanumeric characters assigned by the TDSP

The fields of information collected for ESI IDs typically include the following:

Service address	Physical address of the service point, including city, state, zip, county
Premise type	Indication of whether the premise is residential, small non-residential, or large non-residential
Meter information	Details about the meter installed at the service point, such as meter ID and type
Utility/TDSP	TDSP responsible for the area
Service history	Records of previous service activations, deactivations, and changes
Status code	Indication of the ESI ID’s state (active, inactive, or pending)
Load profile	Classification of the service point based on energy consumption characteristics
Rate class	The pricing category assigned to the service point

Station ID	ID of the substation that feeds the ESI ID

These fields help in tracking and managing electric service delivery for customers and ensure compliance with regulatory and operational standards. ERCOT receives meter data from all competitive retailers and some Non Opt-In Entities (NOIEs), which are spread across the vast geographical footprint of Texas. Figure 1 illustrates details of a representative ESI ID:



ESI ID Detail: ESIID104993945TESTING2

View Transactions

Print Details

Address: 697 Arkanoid Dr
Round Rock, JONES, TX 79553

Current Status	De-Energized	**Utility Name**	ERCOTTEST_TDSP	**ESI ID Eligibility Date**	Oct 27, 2010
Effective Date	Sep 11, 2010	**DUNS #**	666666666	**ESI ID Start Date**	Sep 11, 2010
Premise Type	Residential	**Metered Flag**	true	**ESI ID Create Date**	Jun 13, 2024
POLR Customer Class	Residential	**Meter Read Cycle**	21	**ESI ID Retired Date**	
Settlement AMS Indicator	false	**Power Region**	ERCOT		
Switch Hold	N	**Station Name**	DEVILS HILL		
TDSP AMS Indicator	AMSR	**Station Code**	DEVIHI		
Metered Service Type	M05	**Metered Service Type Description**	GARAGE APARTMENT		

Figure 1. Sample ESI ID Data

2. CIM Load Modeling

The CIM is an international standard (IEC 61970/61968) for power system modeling and data exchange. The CIM standard is maintained by CIM Users Group (CIMUG) as a subgroup of the UCA© International Users Group. The CIM is defined across a core set of base profiles that can be adopted according to individual use cases but can also be extended, as needed, if the data requirements are not defined in the core CIM classes. At ERCOT, the CIM standard has been adopted as the data model for managing transmission network data, including all the parameters needed to describe the transmission elements and how they interrelate to one another. It has also been defined as the standard for data exchanges of model data between ERCOT and Transmission Service Providers.

The Network Model Management System (NMMS) that uses the CIM model was implemented as part of the ERCOT Nodal market to enhance the ERCOT model and provide a common model for the market and reliability systems of the Nodal market. It also is the base model for future planning models and for the congestion revenue models used in the ERCOT region. The ERCOT system model represents the transmission grid that is 60 KV and greater. Figure 2 illustrates a graphical representation of loads in the ERCOT model.

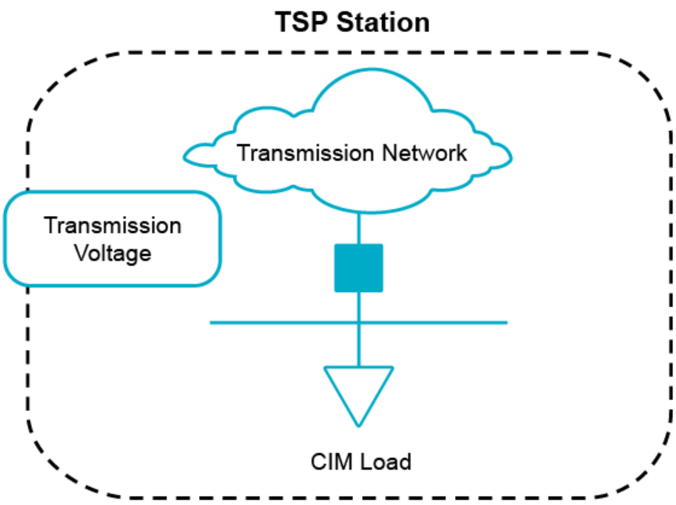


Figure 2. Typical Load Representation in the ERCOT Model

In the CIM, The CustomerLoad class is used to model the location in which power is being removed from the transmission grid. Each CustomerLoad class represents a single transformer in the field. The amount of power consumed by the Customer Load is dictated by an associated hourly schedule. In the physical grid, each transformer typically serves multiple feeders, each with many customers identified by a unique ESI ID. The distribution system is not modeled in the ERCOT network model.

3. The Challenge for ERCOT

The network model shown in the dotted red block in Figure 3 that ERCOT uses is more simplified than the complexity seen in the cyan dotted blocks, on the distribution side. The picture also illustrates the visibility gap for ERCOT. The lack of mapping of ESI IDs to CIM loads does not allow ERCOT to understand the different customers and the impact of them on the actual load distribution. ERCOT does not have the ability to aggregate Distributed Energy Resources (DERs) at the CIM load point. Because of that, ERCOT lacks the situational awareness and has limited understanding of the impact of DERs on load forecasts. As the penetration of DERs and flexible loads at the consumer level keep growing, the lack of visibility hamstrings ERCOT. The ability to map these ESI IDs to CIM load points is fundamental for dispatching, settling, and managing increasingly complex DERs.

As the penetration of DERs increases, it becomes crucial to improve the forecast of DERs in planning models. Without collecting DER information at the load point, the impacts of DERs on existing loads cannot be accurately accounted for. This can be achieved in planning by mapping the existing DERs to CIM loads. Additionally, this approach aids operations, as load forecasts will become increasingly inaccurate unless the impacts of DERs are monitored at the individual load level.

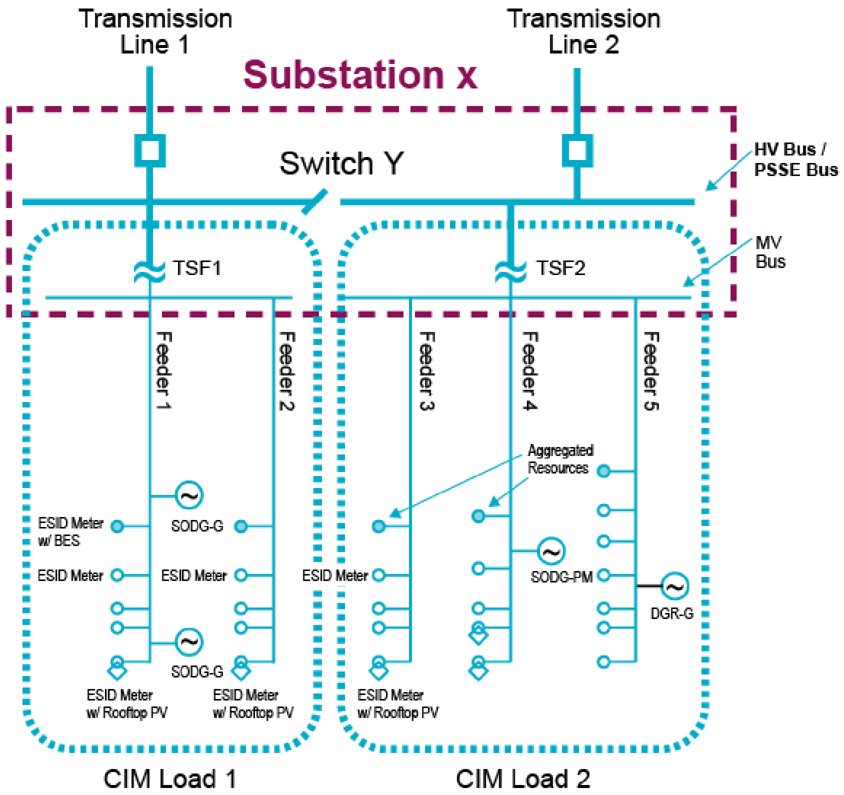


Figure 3. Simplified Distribution Model in the ERCOT Network Model

ERCOT can accurately forecast load at the system and load zone levels; however, the lack of better situational awareness and detailed mapping of DERs leads to reduced forecast accuracy at more granular geographic levels.

Presently, the ESI ID-to-station code mapping is established by TDSPs. One of the challenges with mapping is that TDSP switching and new construction require an improved process to keep the mapping up to date. ERCOT expects the same challenge to exist for ESI ID mapping.

4. Benefits of ESI ID-to-CIM Load Mapping

Mapping links the granular retail customer data, ESI IDs, to the aggregated points of demand, CIM loads, and provides customer-to-grid traceability. Grid visibility provides a clearer picture of who and what is connected and where. The following are potential benefits for ERCOT.

Increased awareness

ERCOT can gain a better understanding of the types of loads (e.g., residential, commercial, industrial, data centers, crypto mines) connected to specific transmission buses and their composition. This granular insight helps in assessing the impact of new loads or load shifts. The granular load data allows for better load model validation and disaggregation. More accurate load data tied to specific locations helps transmission planners make better investment decisions for new lines, substations, and upgrades.

Better load forecasting

Understanding the types of loads connected to the transmission buses and their composition also helps with better forecasting. With the growth of DERs in the ERCOT region, especially rooftop solar and battery energy storage, and a lot of that happening behind the meter, mapping helps ERCOT to better understand DERs, access their locations relative to the transmission systems, and improve accuracy of load forecasting. DERs can significantly impact net load at a substation. Knowing their location and characteristics improves the accuracy of load forecasts. The granular load data can be aggregated geographically and can help improve forecasting. Improved load forecasting helps long-term planning, resource adequacy, and operations. Mapping can also help with generating EV charging behavior profiles. Mapping can also support tracking solar PV installations in competitive regions to create regional profiles, which can be scaled up to weather zones using aggregated data from non-competitive areas.

Better real-time grid operations

Another potential benefit would be to identify telemetry errors, such as discrepancies between aggregate ESI ID load and telemetered load, that can be used to correct telemetered data. Better inputs for the state estimator can lead to a more precise real-time view of the grid, which is vital for reliable operations. Knowing the presence of DERs can help identify areas where DERs might affect voltage stability. Understanding DER impact helps manage transmission line congestion more effectively. Better operational control via real-time decisions can be based on actual location/load.

Better Load Distribution Factors (LDFs) and outage studies

Outages studies and forecasts used in forward studies need this mapping to have a better account for load distribution in these cases. If the mapping to CIM load is used to improve LDFs, then outage studies in the Energy Management System will be better in representing the load at those stations and the congestion management studies will be more accurate. Mapping allows for more intelligent parameter adaptation of load models, making them more responsive to real-world conditions.

Better support for new market mechanisms

ERCOT is implementing pilot programs for Aggregate Distributed Energy Resource (ADERs), which involve aggregating smaller loads and behind-the-meter generation from multiple ESI IDs to participate in the wholesale market. The ability to map these ESI IDs to CIM load points is fundamental for dispatching, settling, and managing these aggregated resources. Understanding of the ESI IDs and where they are in the network model leads to better ADER participation and residential demand response (DR) program targeting. Entities can do precision strategies for DR, DER dispatch, and Virtual Power Plants (VPPs) management. Planning accuracy improves as we forecast, and contingency and investment models improve.

Help with resilience and restoration planning

In emergency situations like load shedding, having a clearer picture of what types of loads are associated with certain which transmission points can help in making more strategic and equitable decisions.

Accurate settlement and market operations

While ESI IDs are central to retail settlement, their aggregation to CIM loads helps ensure the accurate allocation of wholesale energy and ancillary service costs to different load zones and, ultimately, to retail providers. Better load modeling and forecasting, informed by the ESI ID-to-CIM load mapping, contributes to a more efficient wholesale electricity market where supply and demand are better balanced.

5. Conclusion

Mapping ESI ID data to the CIM model offers substantial benefits that enhance the efficiency, reliability, and scalability of load management and grid operations. This process facilitates advanced analytics and the seamless integration of emerging technologies, resulting in a more robust and resilient power system. As the penetration of DERs increases, this mapping will provide ERCOT with the visibility needed for informed decision-making. Specifically, it will improve load analytics, enabling a better understanding of load distribution and behavior changes as the grid transforms in the coming years, including increased preparedness during abnormal weather.

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