

JUNE 2022

2023 ERCOT ELECTRICITY MARKET OUTLOOK



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About this study

As part of an ongoing series, LCG Consulting has produced this study outlining our findings when we model the year 2023 in ERCOT, based on the most likely weather, market, transmission, and generator conditions. The nodal market simulations for this study were performed with LCG's [UPLAN Network Power Model](#) (NPM) and [PLATO-ERCOT Data Model](#) using hourly dispatch. UPLAN-NPM is a full network model designed for electricity market simulation. It replicates the engineering protocols and market procedures of any system operator. It also captures the commercial activities, such as bidding, trading, hedging, and contracting, of all players in a deregulated nodal power market. The model performs coordinated marginal (opportunity) cost-based energy and ancillary service procurement, congestion management, contingency analysis with Security Constrained Unit Commitment (SCUC) and Security Constrained Economic Dispatch (SCED), replicating those used by the ERCOT ISO.

LCG Consulting, based in Los Altos, California, is a widely-recognized leader in electricity industry and a pioneer in modeling energy markets. Since its founding in 1978, LCG has played a leadership role in providing the utility industry with specialized software and consulting services in the areas of electric and gas deregulation. Our clients include a wide range of public and private electric utilities, independent system operators, electricity traders, power marketers, federal and state agencies, and a number of energy research institutes across the United States and abroad. LCG has a long history in modeling Texas and serves many clients in the region, including ERCOT itself.

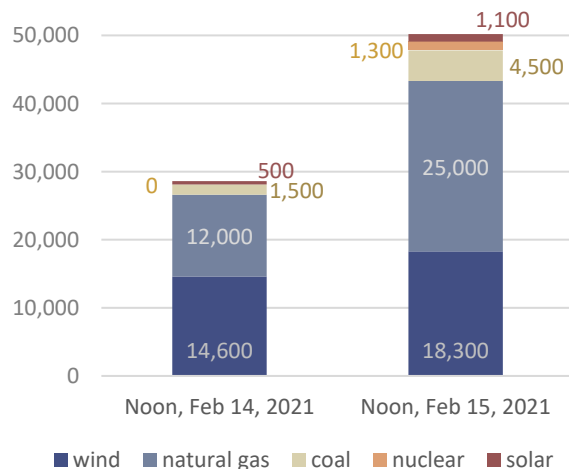
ERCOT Outlook 2023

This outlook for year 2023 is based on best available data. However, compared to the 2022 outlook, it is expected to host more uncertainty as the prediction horizon is extended further by one year.

Texas has incorporated dramatic fuel mix and transmission changes over recent years, breaking its own 2020 record in wind production again in 2021.

Market players had already been actively navigating the balance between incoming renewables, transmission changes, and population growth, when Winter Storm Uri thrust Texas reliability into the national spotlight. The storm precipitated the widespread failure of all sources of electricity, fossil and renewable. Facing record demand, ERCOT implemented blackouts to avoid catastrophic failure. Critical natural gas infrastructure - that should have been exempt from blackouts - lost power, further exacerbating the crisis and thrusting Texas demand-supply management into the public eye and subsequently in front of the legislature. A [300-page federal report](#) was released in November 2021, outlining the events and remedies.

Offline capacity in ERCOT (MW)
Due to Winter Storm Uri



Bills were passed changing requirements for electricity system weatherizing; ERCOT completed a review of winterized plants and transmission facilities in January. The Texas Public Utilities Commission lowered the systemwide offer cap to \$5,000 per MWh, down from \$9,000 per MWh. Additionally, a new gas-electric rule was created to keep power on for critical natural gas infrastructure. However, the natural gas industry is still awaiting the Railroad Commission of Texas to complete weather-related rules, which are not expected until after Sept 2022.

While overshadowing much of the national economic tone of the last two years, the COVID-19 pandemic has not had an outsized impact on ERCOT in terms of peak load and energy demand. Both residential and commercial demand continue to grow. The industrial load growth, along the coast and in West Texas, and the increased oil and gas production activity in the Permian Basin have made a contribution to the above-normal growth. Growth continues in major load centers, such as the Dallas-Fort Worth area and Houston. Texas is the fastest-growing state, according to the U.S. Census. The peak demand is forecasted to be 79,130 MW by ERCOT, and the energy demand 439,847 GWh. Figure 1 Shows the peak load and energy demand from 2018 to 2023 (forecasted). The annual average growth for peak load is 1.5%, and 3.2% for energy demand.

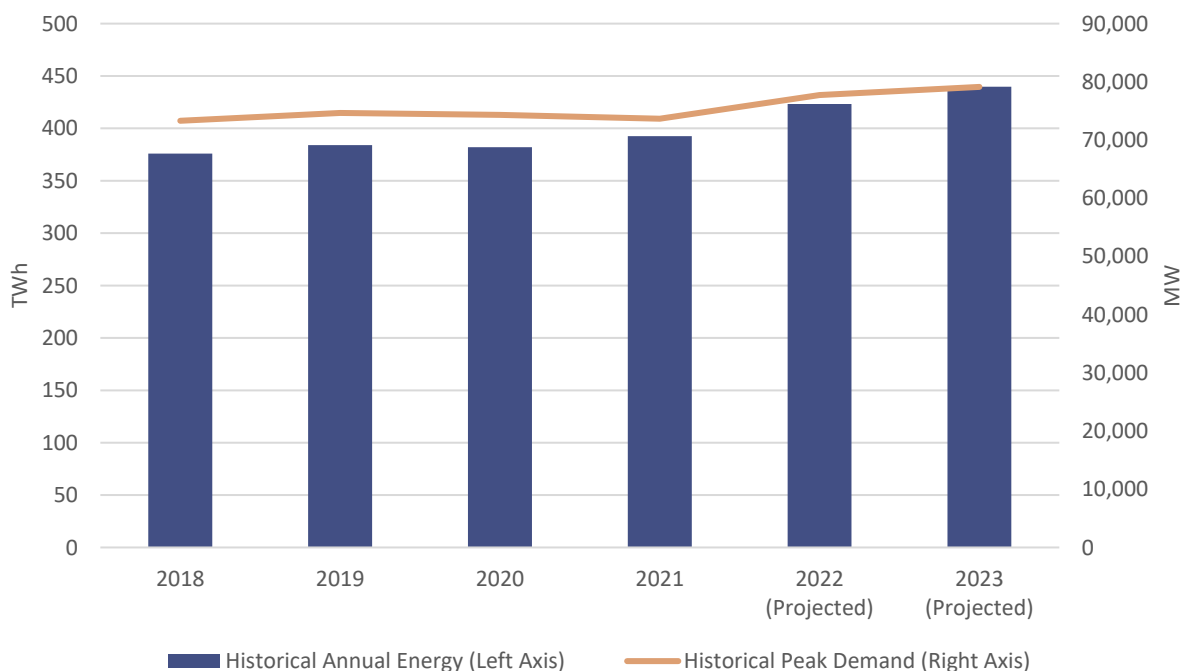


Figure 1 Peak Load and Energy Demand from 2018 to 2023 (Projected)

ERCOT's competitive electricity prices and limited regulation have attracted crypto miners. By mid-2023, ERCOT expects crypto mining activities increase electricity demand by as much as 6 GW, which would account for a considerable portion of peak demand, 7.6% of forecasted 79 GW of peak demand for the entire ERCOT region. The addition of these demand will present challenges to the transmission system and impact prices. However, crypto mining can be flexible and take orders from the grid operator to ramp up or down demand. While maintaining its open and welcoming position to crypto miners, in March 2022 ERCOT began requiring crypto miners to get approval before they can connect to the grid.

Transmission continues to be a hot topic in Texas: where and when upgrades happen is essential to predict economic patterns. After roughly seven years of deliberations, Lubbock Power & Light (LP&L) finally joined ERCOT in June 2021, a change that market participants expected would help export renewable generation from the Panhandle region. Transmission upgrades in Far West Texas have been implemented before the start of 2022 and the improvements will continue. The number of Generic Transmission Constraints (GTC) has increased in recent years, especially in West Texas and South Texas, as a temporary measure to address the stability constraints associated with the long-distance transfer of power from these areas to urban centers. In total, 16 GTCs are in effect.

The generation mix change continues trending similarly to 2021, and we don't see a significant difference between 2022 and 2023. In 2023, we expect natural gas-powered generators will continue to be the majority of installed capacity, followed by wind and solar resources. Wind energy plays an important role in the capacity mix, with a total nameplate capacity of 37,555 MW, not adjusted for Effective Load Carrying Capability (ELCC). The planning reserve margin for summer 2023 is forecasted to be 25.91%, based on resource updates provided to ERCOT from generation developers and an updated peak demand forecast. Figure 2 shows installed capacity by fuel type, as modeled in UPLAN.

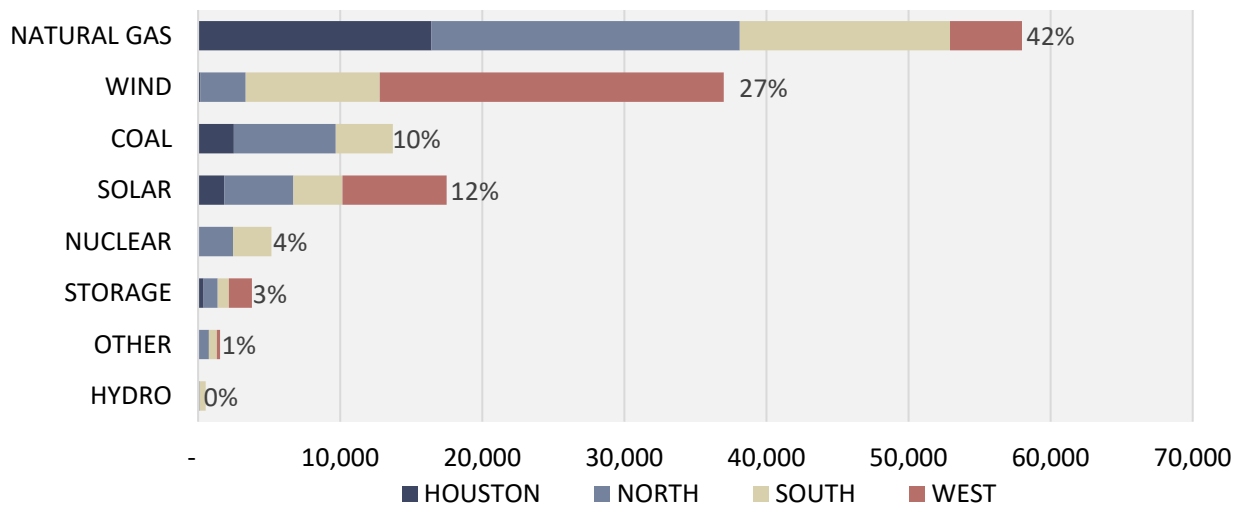


Figure 2 ERCOT Installed Capacity by Fuel Type in 2023 (MW)

Approximately 15.5 GW of new capacity will enter the ERCOT network from 2022 to 2023. New capacity by 2023 is outlined below in Table 1.

Table 1 Capacity Expansion by Fuel Type and Zone by 2023 (MW)

Zone	STORAGE	SOLAR	WIND	NATURAL GAS	TOTAL
HOUSTON	203	1,820	-	826	2,849
NORTH	837	3,675	1,395	-	5,906
SOUTH	387	2,153	1,377	-	3,916
WEST	887	364	1,543	-	2,793
TOTAL	2,314	8,011	4,314	826	15,464

Energy in ERCOT continues to come primarily from fossil fuels, but is increasingly being replaced by wind and solar. Fossil fuels are expected to generate 52% of the electricity, similar to the 2022 outlook. It is a sharp decrease of 8% from 2021. The growth of solar generation has been picking up speed. Solar generation doubled from 1.0% in 2019 to 2.3% in 2020, nearly doubled to 4% in 2021. It is expected to double again to 8.8% in 2023. Wind generation is expected to grow to 29.8% in 2023. Coal generation continues to decline.

Figure 3 shows the annual production by fuel in LCG’s 2023 simulation.

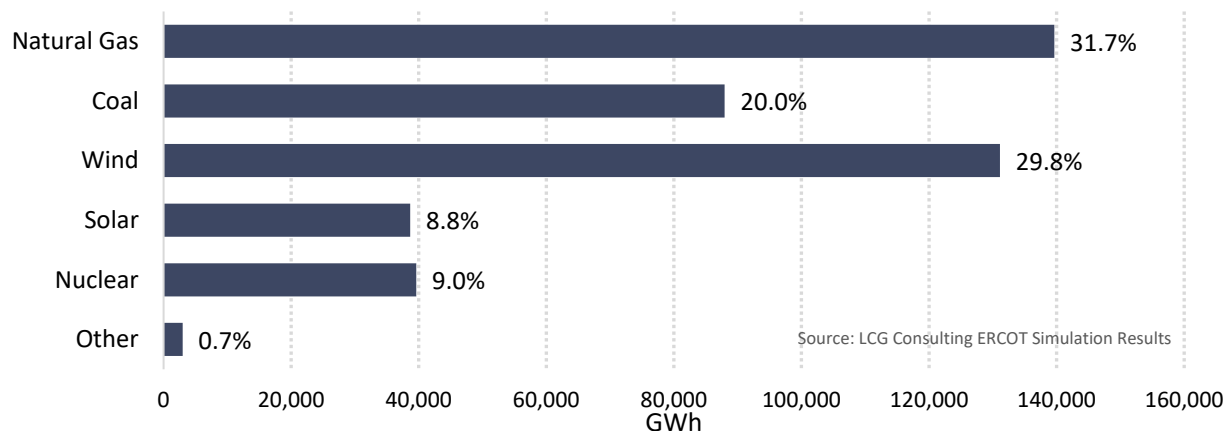


Figure 3 Annual Energy Production by Fuel Type (GWh)¹

Figure 4 below shows a heat map of annual average bus LMPs as well as top constraints in the ERCOT region for 2023. West Texas Export, North to Houston and North Edinburg to Lobo interfaces continue to be among the top constraints. The annual average zonal prices tend to be the highest in the Houston zone, followed by the South, North, and West zones.

¹ Contributions from other fuel types including hydro are considered under “Other” fuel type.

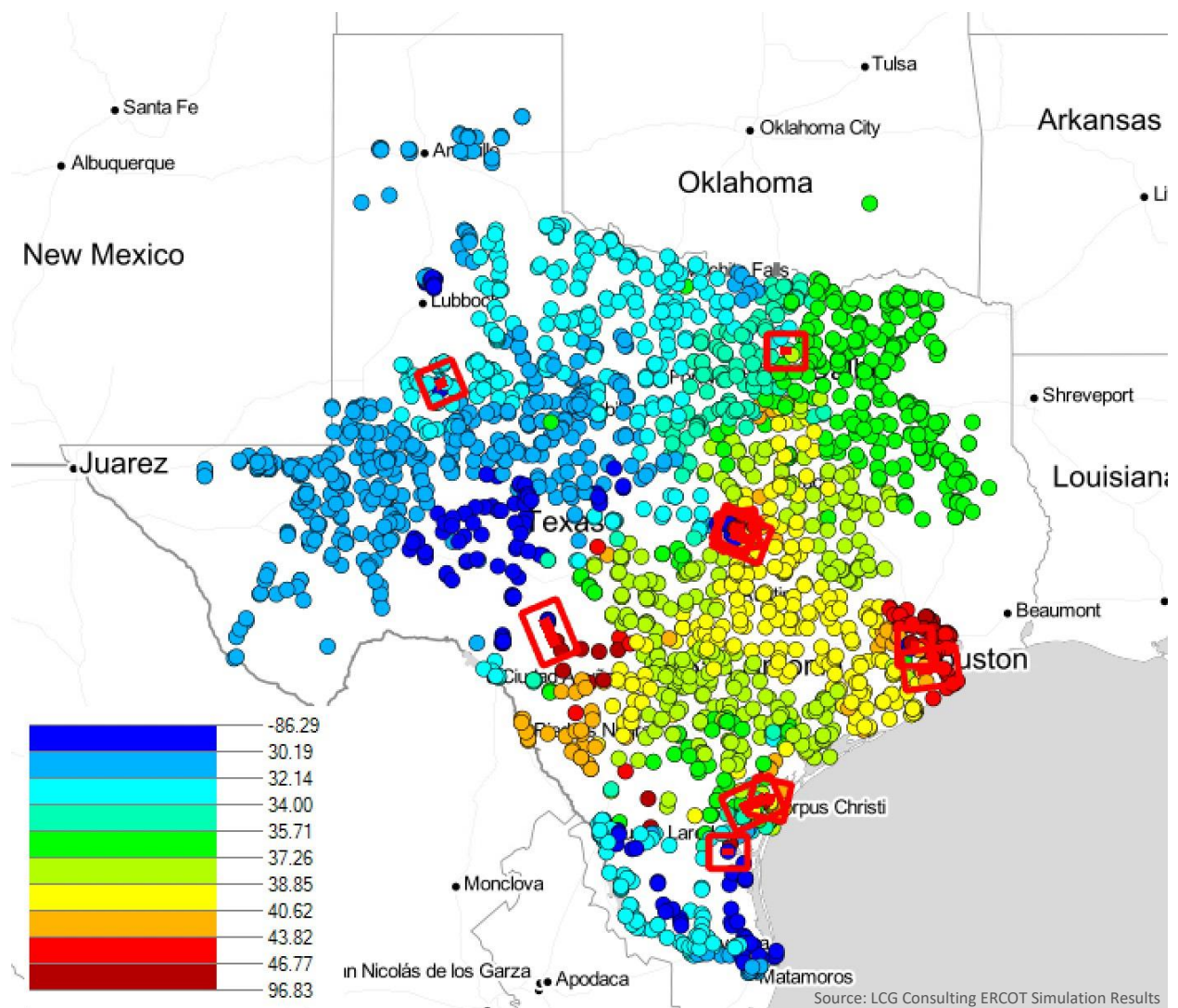


Figure 4 Annual Average Nodal Price Heat Map and Top Constraints

Figure 5 shows the load-weighted, monthly average prices by load zone. Prices are usually higher during summer and winter months. The highest price from the simulation is around \$1,600/MWh, well below the new reduced offer cap of \$5,000/MWh. Average prices in 2023 are higher than those in 2022 by about \$10/MWh, mainly due to higher forecasted fuel prices.

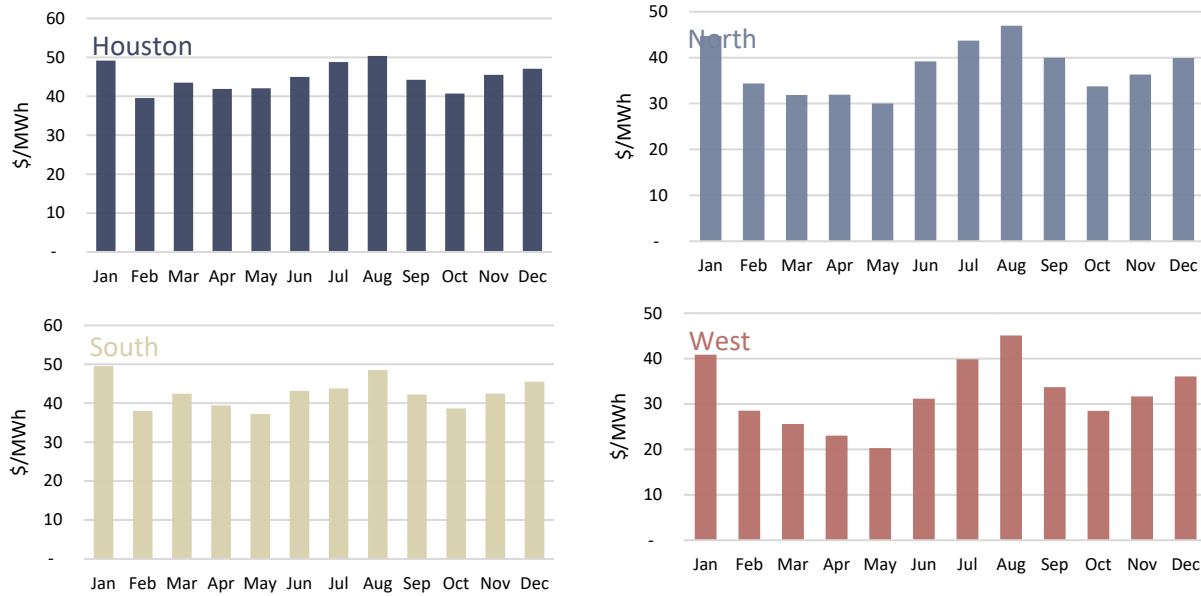


Figure 5 Monthly Load-Weighted Average Prices (\$/MWh) by Load Zone – 2023

Historical monthly load zone prices are shown in Figure 6. Note that the extreme weather events of February 2021 have been removed for better comparison.

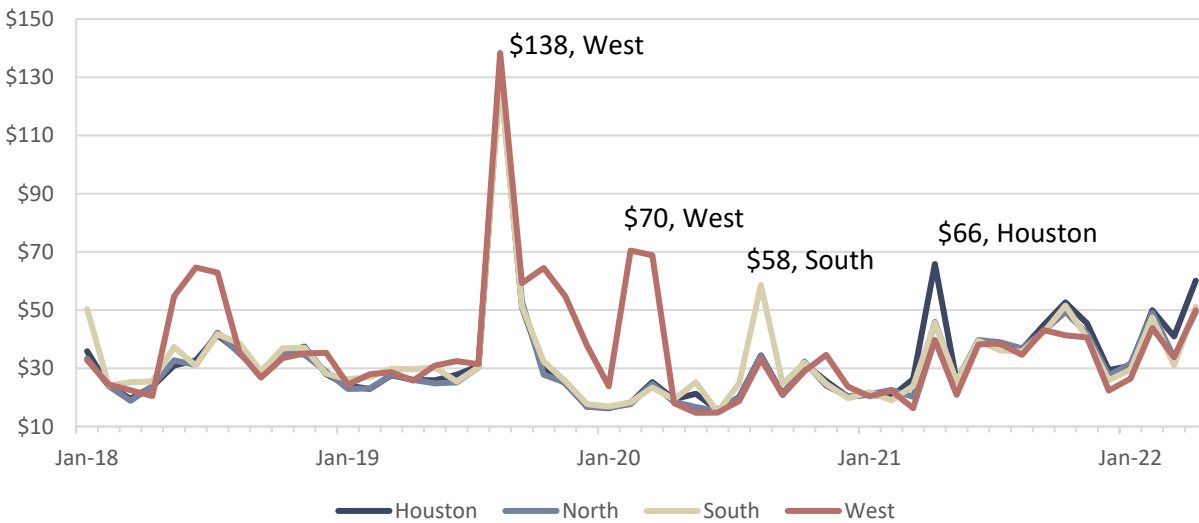


Figure 6 Historical Monthly Load-Weighted Average Prices (\$/MWh) by Load Zone

ERCOT has defined seven hubs for calculating average LMPs and assisting transactions between hubs, zones and individual buses. Houston: 20 buses; North: 75 buses; South: 31 buses; West: 17 buses; ERCOT bus average: 143 buses; and ERCOT hub average: 143 buses. A Panhandle Hub was created in

2019 and has 12 buses. This Panhandle Hub is excluded from the existing ERCOT bus average and hub average.

Under expected conditions, the most competitive average hub price is observed in the West Hub, with progressively more expensive prices experienced in North, South and Houston Hubs. The hub price averages are higher during the summer and winter months, a trend similar to load zone prices. Monthly average prices in 2023 at Houston, North, South and West Hubs are shown below in Figure 7.

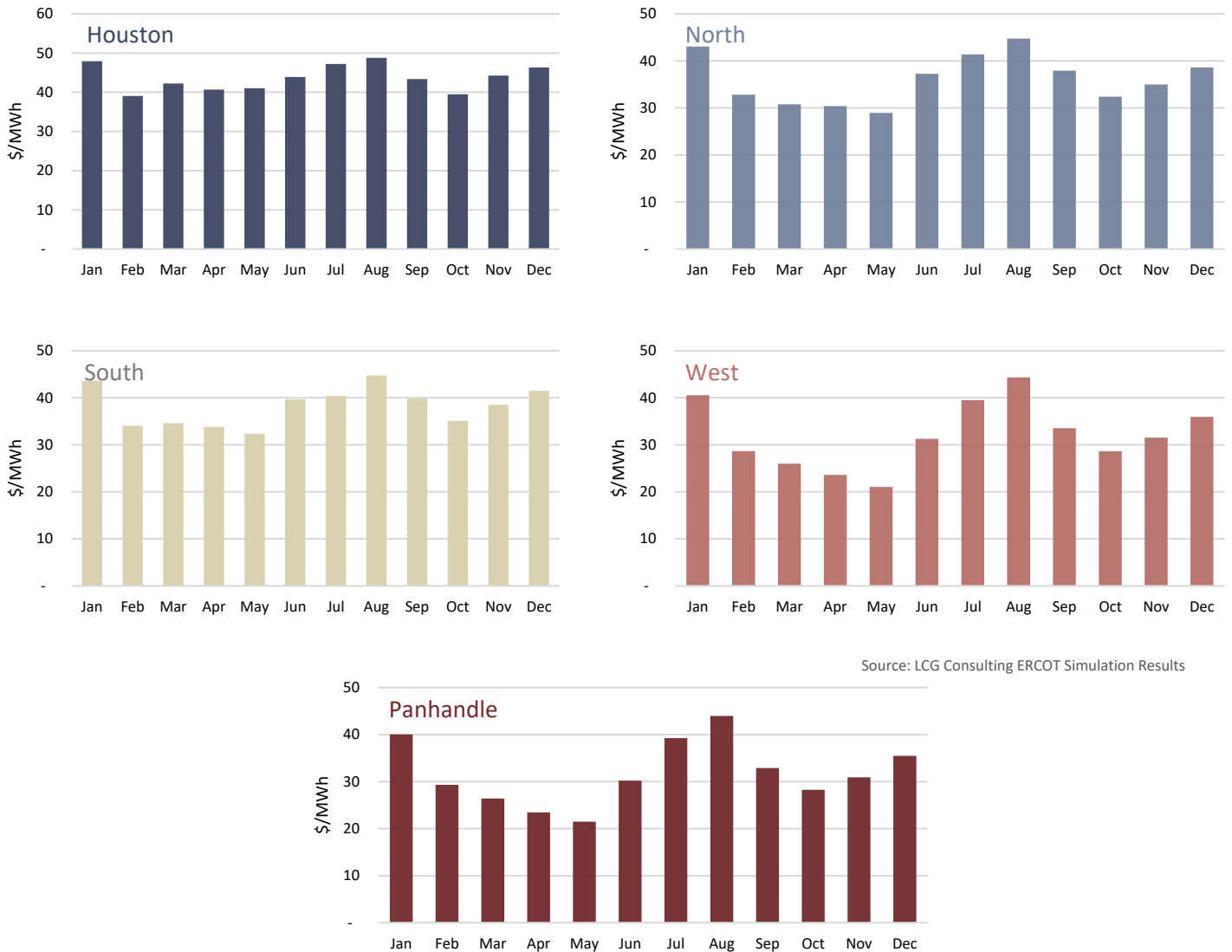


Figure 7 Monthly Average Prices (\$/MWh) by Trading Hub – 2023

Implied heat rate is the electric price divided by the natural gas price. Only a natural gas generator with an operating heat rate, a measure of unit efficiency, below the implied heat rate value can be profitable. In-house natural gas price predictions show that the average natural gas price ranges from \$3.56/MMBTU to \$3.91/MMBTU among load zones. The lowest implied heat rate occurs in May in the

West load zone. During non-summer months, the implied heat rate averages around 10 MMBtu/MWh. Monthly implied heat rate is shown in Figure 8.

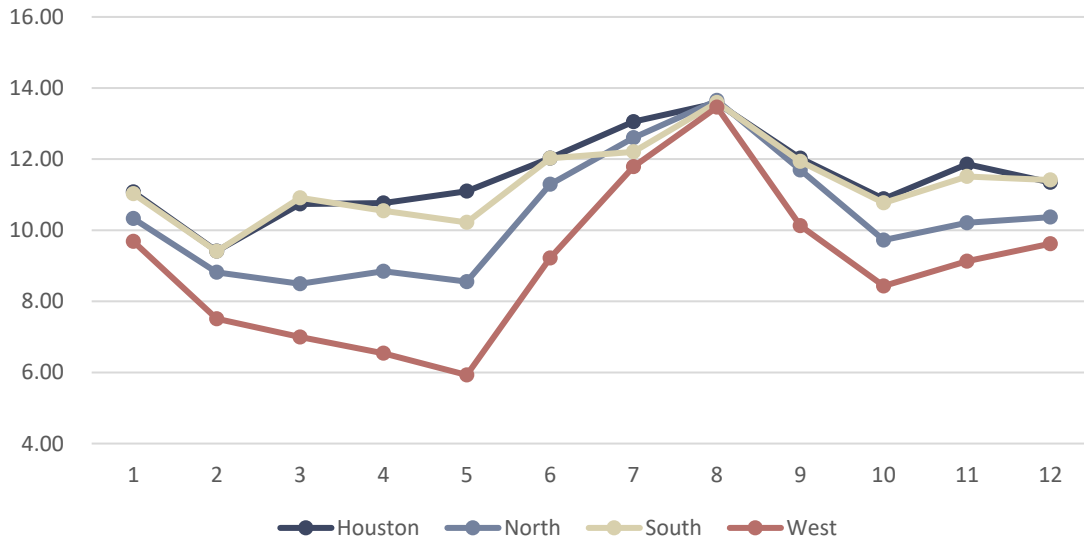


Figure 8 Monthly Implied Heat Rate by load zone - 2023 (MMBtu/MWh)

A comparison between actual 2022 data and simulated 2023 data of prices and implied heat rates during the date range of 5/23-6/5 shows that the ranking of price and implied heat rates among load zones is consistent, with the Houston load zone having the highest price and implied heat rate and West the lowest. Implied heat rates in all zones are 2-3 MMBtu/MWh higher than the actual in 2022. The natural gas price in 2022 for this comparison is assumed to be \$8.5/MMBtu based on Henry Hub spot prices. The comparison is

Overall, our outlook shows that the ERCOT region is undergoing an accelerated transition towards more renewable energy resources, while facing challenges such as maintaining grid resilience during extreme weather events and resource adequacy with high renewable penetration. Regulatory and market design innovations are needed as ERCOT pioneers a market that hosts non-conventional loads such as crypto miners and growing energy storage.