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2022 ERCOT ELECTRICITY MARKET OUTLOOK

LCG CONSULTING

4962 El Camino Real, Suite 112
Los Altos, CA 94022
Tel: 650-962-9670
www.EnergyOnline.com

About this study

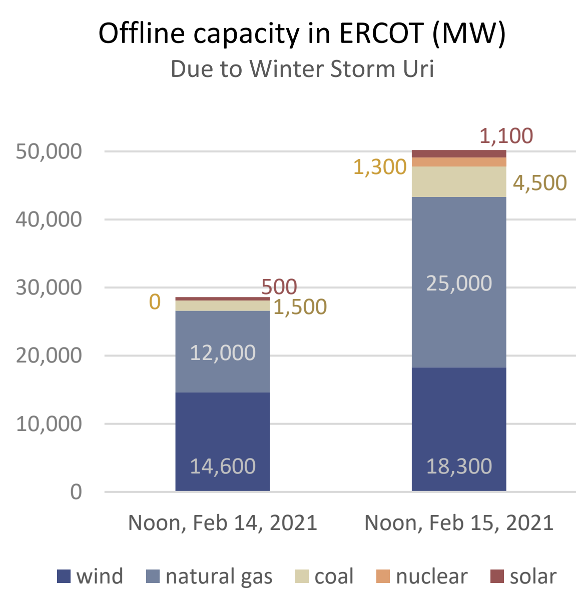
As part of an ongoing series, LCG Consulting has produced this study outlining our findings when we model the year 2022 in ERCOT, based on the most likely weather, market, transmission, and generator conditions. The nodal market simulations for this study were performed with LCG's UPLAN Network Power 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 2022

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 on the storm in November, outlining the events and remedies.



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 in forecasted to be 79,155 MW by ERCOT, and the energy demand 405,431 GWh. Figure 1 Shows the peak load and energy demand from 2017 to 2022 (forecasted). The annual average growth for peak load is 3.5%, and 2.3% for energy demand.

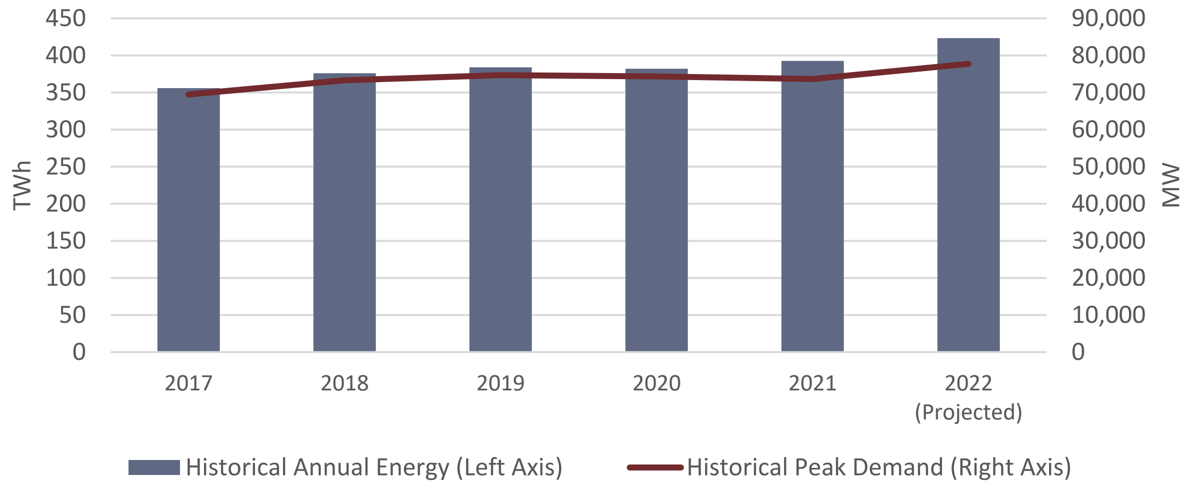


Figure 1 Peak Load and Energy Demand from 2017 to 2022 (Projected)

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.

In 2022, we expect natural gas-powered generators will continue to be the majority of installed capacity, followed by wind resources. As a result of a 65% jump in installed capacity, for the first time, solar will surpass coal and become the third largest generation resource in ERCOT. Wind energy plays an important role in the capacity mix, with a total nameplate capacity of 37,191 MW, not adjusted for Effective Load Carrying Capability (ELCC). The planning reserve margin for summer 2022 is forecasted to be 23.9%, 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.

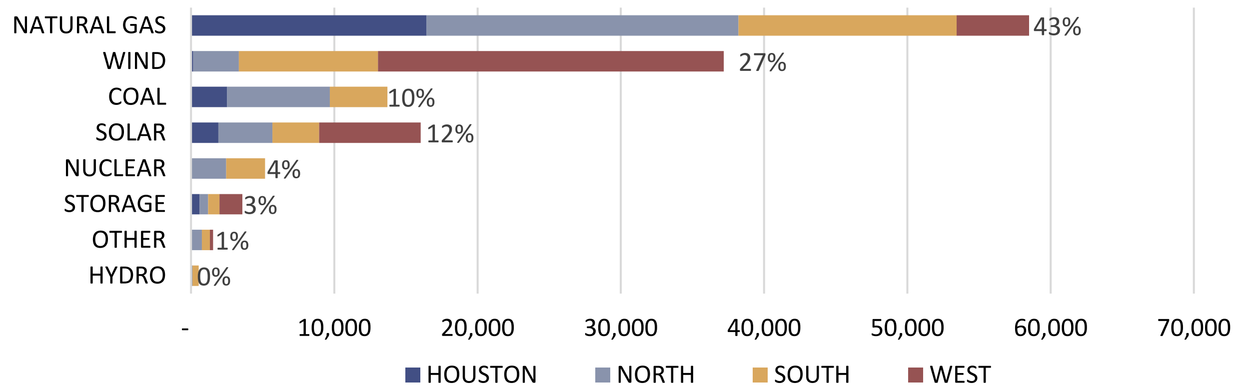


Figure 2 ERCOT Installed Capacity by Fuel Type (MW) – 2022

Approximately 16.7 GW of new capacity will enter the ERCOT network this year, and 506 MW of natural gas has been approved to be retired in 2022. New capacity in 2022 is outlined below in Table 1.

Table 1 Capacity Expansion (MW) by Fuel Type and Zone by 2022

Zone	STORAGE	SOLAR	WIND	NATURAL GAS	TOTAL
HOUSTON	355	1,787	-	837	**2,979**
NORTH	458	3,103	1,212	-	**4,774**
SOUTH	487	2,604	1,214	94	**4,399**
WEST	1,288	472	2,756	-	**4,516**
TOTAL	**2,588**	**7,966**	**5,182**	**931**	**16,667**

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, a sharp 6% decrease from both last year's simulation and actual data. 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, and is expected to grow to 6.5% in 2022. Wind generation is expected to grow from 24.4% in 2021 to 30.7% in 2022. Coal generation continues to decline.

Figure 3 shows the annual production by fuel in LCG's 2022 simulation.

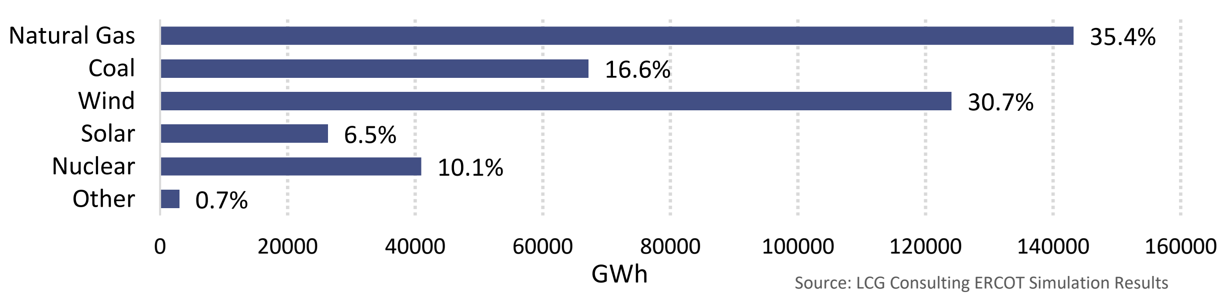


Figure 3 Annual Energy Production by Fuel Type (GWh) [1]

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

Figure 4 below shows a heat map of annual average bus LMPs as well as top constraints in the ERCOT region for 2022. West Texas Export, North to Houston and North Edinburg to Lobo interfaces continue to be among the top constraints. The annual average zonal prices are in general the highest in the Houston zone, followed by the North, South, and West zones.

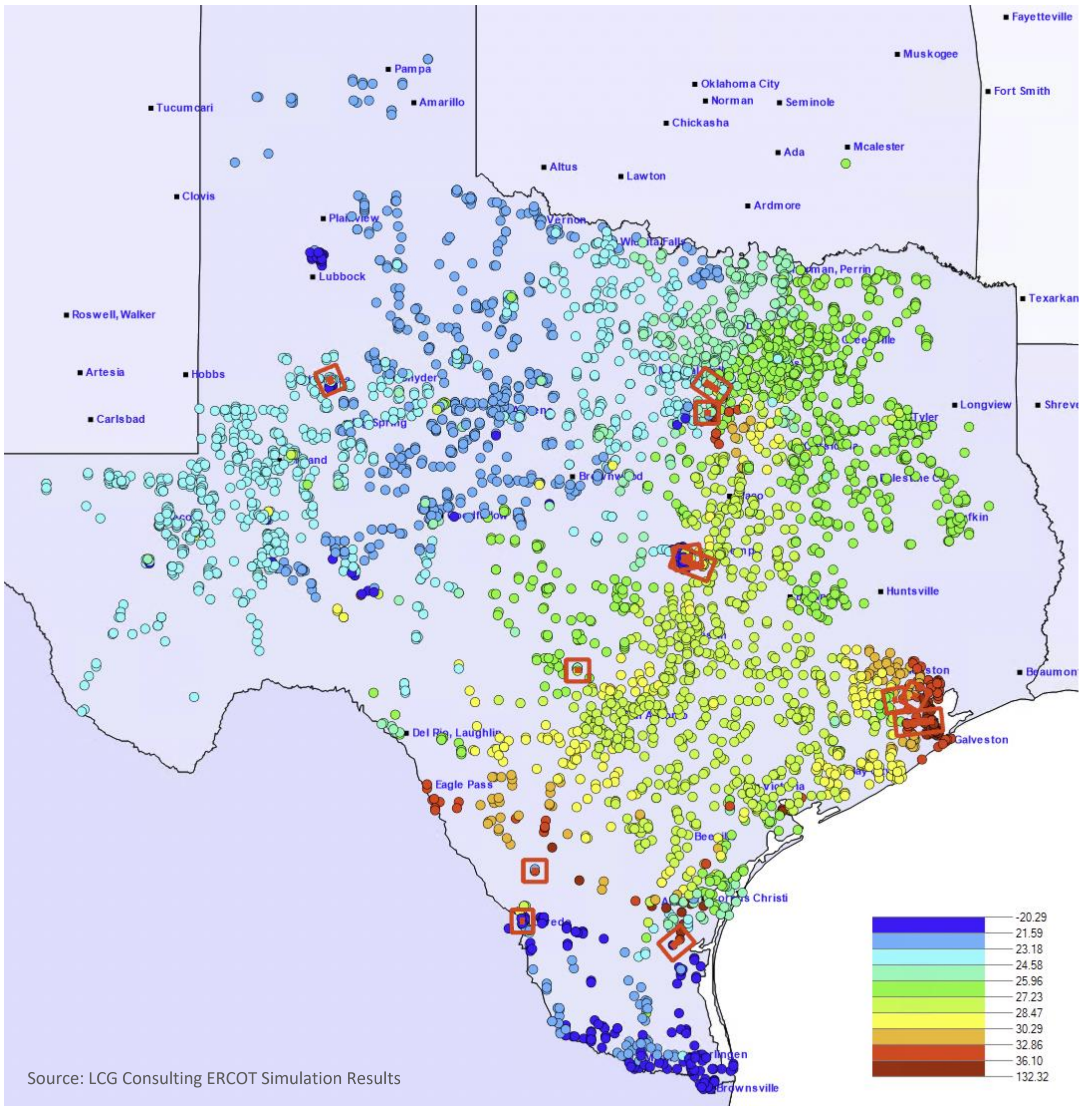


Figure 4 Annual Average Nodal Price Heat Map and Top Constraints

Figure 5 shows the load-weighted, monthly average prices by load zone. Prices are usually higher during summer and winter months. In all four zones, the abnormally-high prices during summer months observed in previous years are not seen in 2022. The highest price from the simulation is around $2000/MWh, well below the new reduced offer cap of $5000/MWh.

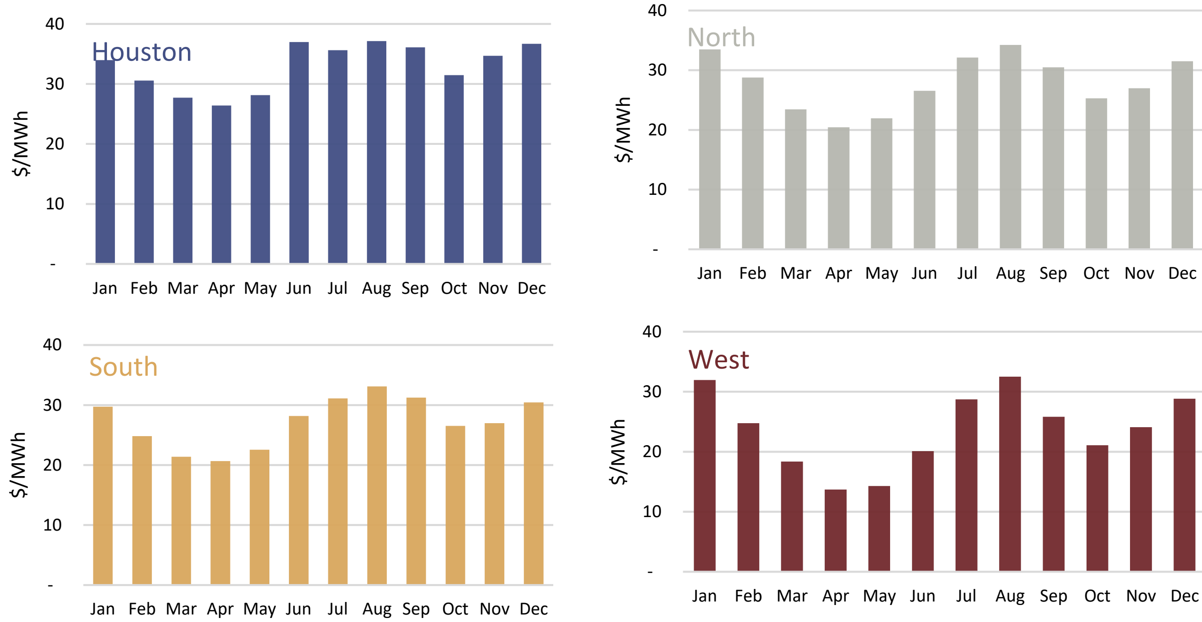


Figure 5 Monthly Load-Weighted Average Prices ($/MWh) by Load Zone – 2022

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.

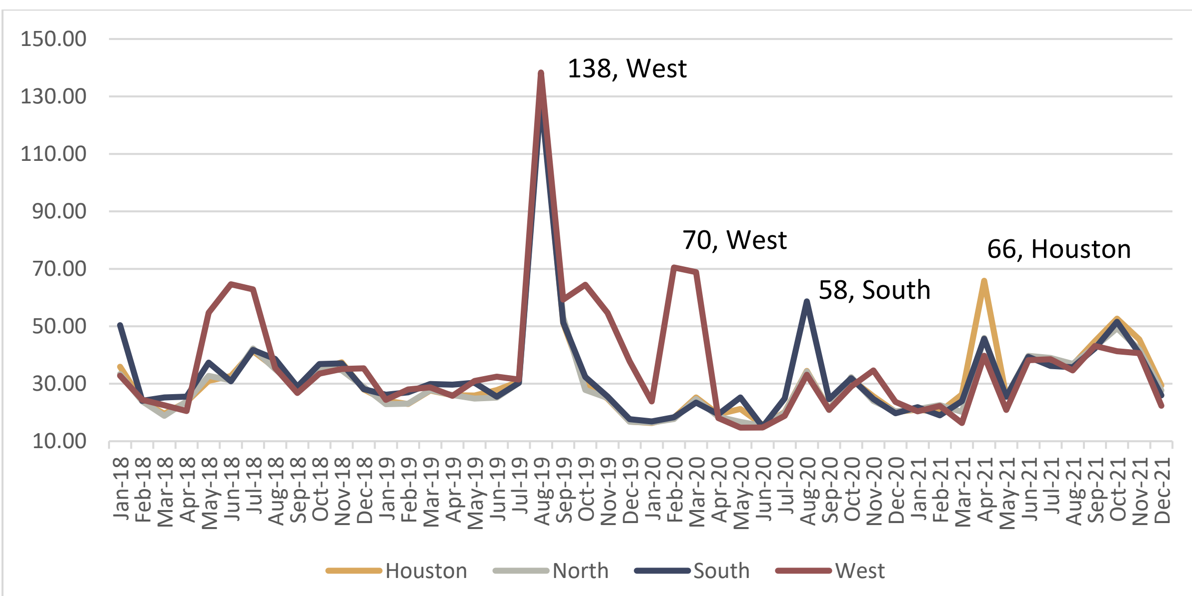


Figure 6 Historical Monthly Load-Weighted Average Prices ($/MWh) by Load Zone

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 on

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 2022 at Houston, North, South and West hubs are shown below in Figure 7.

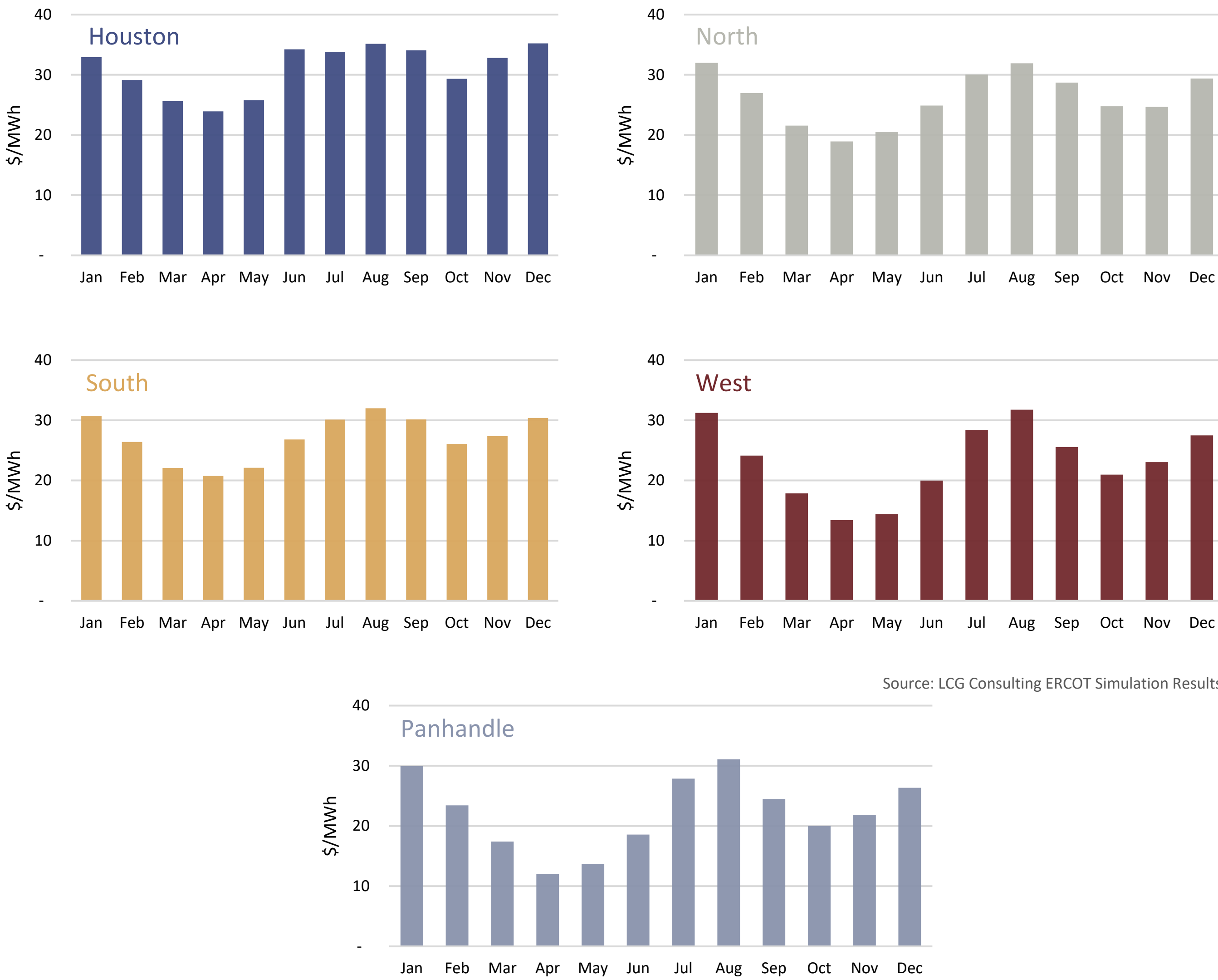


Figure 7 Monthly Average Prices ($/MWh) by Trading Hub – 2022

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 heat rate ranges from $3.16/MMBTU to $3.59/MMBTU among load zones. The lowest implied heat rate occurs in April in the West load zone.

During non-summer months, the implied heat rate averages around 9 MMBtu/MWh. Monthly implied heat rate is shown in Figure 8.

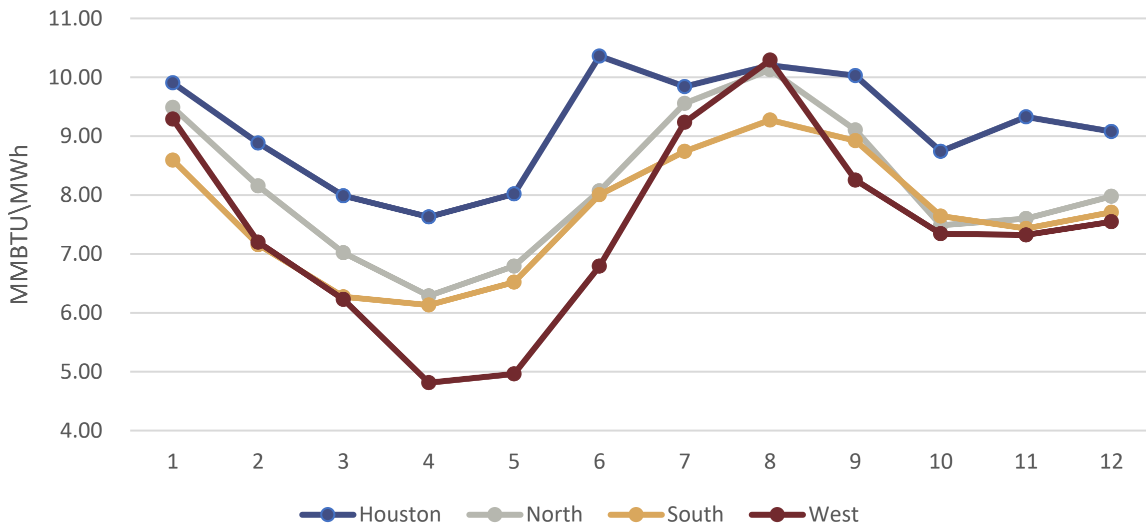


Figure 8 Monthly Implied Heat Rate (IHR) by load zone