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Article

STRATEGIC US ENERGY MARKET INSIGHTS: A DATA-DRIVEN ANALYSIS OF U.S. FUEL CONSUMPTION, PRICING TRENDS, AND THE RISE OF ELECTRIC VEHICLES

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ABSTRACT

This project explores the evolving landscape of the U.S. energy market with a focus on identifying strategic growth opportunities within the fuel distribution sector. Due to the limited availability of proprietary or company-specific data and the fragmented nature of regional market operations, a comprehensive analysis based solely on internal business metrics was not feasible. As a result, the study relied extensively on publicly accessible datasets from the U.S. Energy Information Administration (EIA), covering the period from 1983 through September 2024. While these datasets offered significant historical breadth, they also posed challenges such as missing values, inconsistent formatting, and incomplete time series, requiring substantial preprocessing and data transformation using Microsoft Excel. Following the data cleaning process, Python was employed to conduct sector-wise analytics and generate time-series forecasts for the years 2025 and 2026. To enhance interpretability and support insight communication, Tableau was used to create a series of interactive and static visualizations. These visualizations illustrated energy consumption and pricing patterns across key sectors, including residential, commercial, industrial, and transportation. One of the study's central observations was the consistent decline in gasoline and oil consumption in recent years. However, the precise drivers behind these trends could not be fully isolated, as the dataset lacked essential variables such as inflation adjustments, technological innovation indicators, and energy efficiency metrics. This limitation restricted the analysis from reaching definitive conclusions on behavioral or macroeconomic influences. Nevertheless, the study delivered key insights such as the dominant role of the transportation sector in oil consumption, the observable impact of electric vehicle (EV) adoption on traditional fuel demand, and region-specific pricing fluctuations. These findings support strategic initiatives such as expanding infrastructure investment into alternative fuel options, aligning pricing strategies with seasonal demand cycles, and focusing on high-consumption geographic markets. Although constrained by data scope and granularity, the project offers a robust, data-driven perspective on contemporary U.S. energy market dynamics and informs strategic decision-making in an industry facing structural transition.

KEYWORDS

Energy Consumption Trends; Fuel Pricing Analysis; Electric Vehicle Impact; Strategic Forecasting; U.S. Oil Market;

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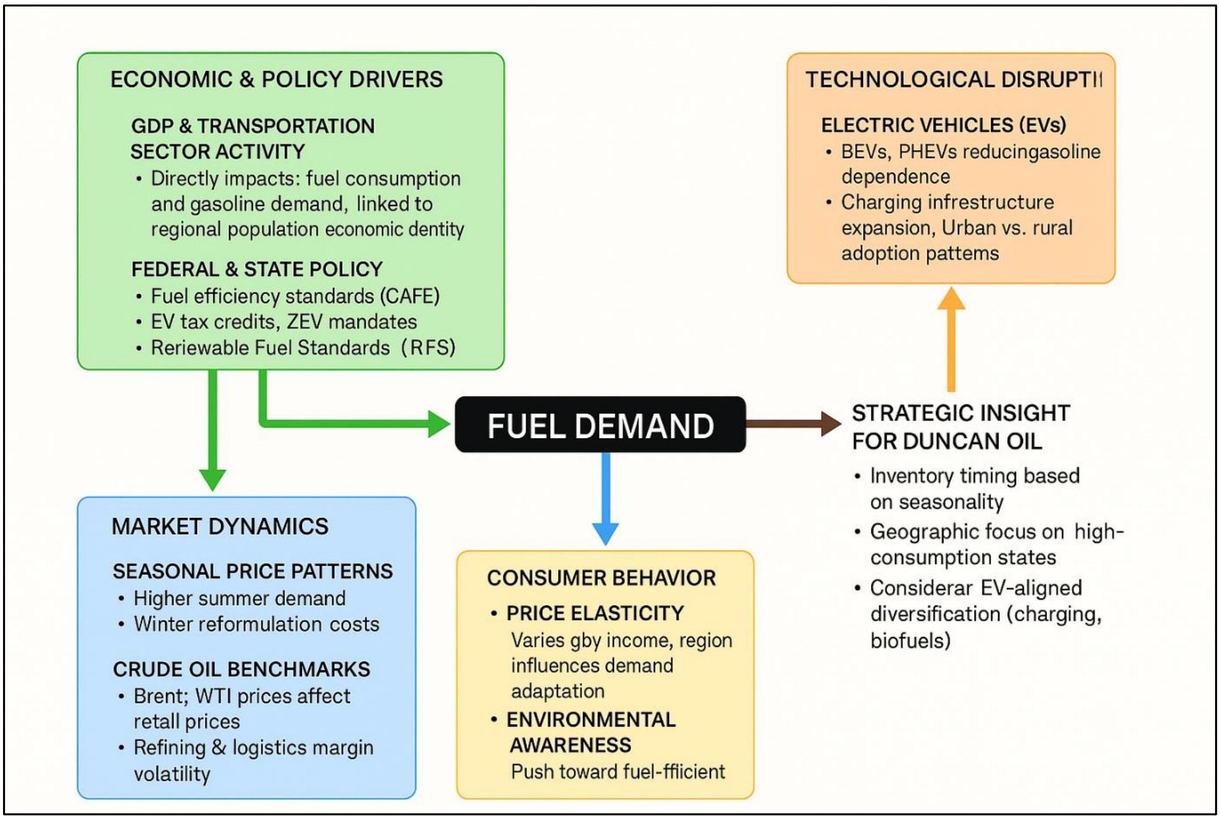
INTRODUCTION

Energy markets are multifaceted systems encompassing the production, distribution, consumption, and pricing mechanisms associated with various forms of energy, including fossil fuels, nuclear power, and renewables (IEA, 2022). At the core of these markets lies the concept of fuel consumption, defined as the volume of energy-bearing substances—particularly petroleum-based products—utilized for residential, commercial, industrial, and transportation purposes (Castillo et al., 2025). In the United States, petroleum products such as gasoline, diesel, and jet fuel constitute a significant share of national energy consumption, accounting for nearly 36% of the total primary energy use as of 2022 (Huo et al., 2024). The global energy landscape's structural evolution reflects a complex interaction of geopolitical dynamics, technological innovations, and policy frameworks aimed at optimizing energy security, affordability, and environmental sustainability (Foroutan et al., 2025). From an international lens, shifts in U.S. fuel demand reverberate through supply chains and financial markets, influencing global oil prices and prompting regulatory recalibrations across both oil-exporting and importing countries (Gohlke et al., 2022). Understanding this dynamic nexus between domestic energy consumption and global market responses is essential for both macroeconomic stability and firm-level strategic planning (Huo et al., 2024).

Figure 1: Conceptual Framework of Key Drivers Influencing Fuel Demand and Strategic Implications



Fuel pricing is another critical determinant within energy markets and is shaped by a blend of upstream production costs, downstream distribution efficiency, international crude benchmarks, and national taxation or subsidy policies (Huang et al., 2022). In the U.S., retail fuel prices are predominantly affected by the global price of crude oil, refining costs, distribution logistics, and federal as well as state-level excise taxes. Price fluctuations bear direct implications for consumer behavior, corporate logistics costs, and inflationary pressures (Wolf & Smeers, 2023). Empirical studies underscore how volatility in fuel prices can alter household expenditure patterns and business investment decisions, with disproportionate effects on low-income demographics and small-to-medium-sized enterprises (SMEs) (Zhu et al., 2022). Internationally, U.S. pricing trends impact global oil markets, influencing production quotas by OPEC and affecting the fiscal stability of oil-dependent economies (Wang et al., 2022). Such price transmission mechanisms highlight the systemic role of U.S. fuel dynamics in orchestrating broader energy supply-demand equilibriums (Sagaria et al., 2021).

The structural transformation of energy demand, particularly in the transportation sector, has garnered attention with the accelerated adoption of electric vehicles (EVs), marking a pivotal transition from conventional internal combustion engine (ICE) vehicles (Huang et al., 2018). EVs are defined as vehicles powered either partially or entirely by electricity, typically stored in batteries, and propelled via electric motors (Hardman et al., 2018). In the U.S., federal incentives, state-level mandates, and corporate decarbonization strategies have collectively contributed to a substantial increase in EV registration and sales, from less than 2% of total vehicle sales in 2016 to over 8% in 2023 (Holechek et al., 2022). Research shows that the rise of EVs has begun to reshape gasoline demand curves, prompting oil refiners and marketers to reassess long-term distribution strategies and infrastructure investments (Castillo et al., 2025). This shift bears global significance, as the U.S. automotive market is among the largest in the world, and transformations within it signal demand-side shifts in crude oil utilization, thereby influencing oil-exporting nations' macroeconomic planning (Wolf & Smeers, 2023).

Fuel consumption patterns in the United States are characterized by sector-specific dependencies, with the transportation sector accounting for approximately 67% of total petroleum usage, followed by industrial, residential, and commercial sectors. The dependency on gasoline and diesel within freight and passenger transport has historically made this sector a prime focus for energy efficiency improvements and carbon reduction policies (Zhu et al., 2022). Urbanization trends, commuting behaviors, fuel economy standards, and fleet electrification all contribute to evolving consumption profiles (Wang et al., 2022). Spatial disparities also play a role, with metropolitan areas exhibiting distinct fuel usage characteristics due to public transit availability and vehicle ownership norms (Sagaria et al., 2021). These multifactorial influences underscore the complexity of modeling and forecasting U.S. fuel demand, which remains a central input into both domestic energy policy and corporate supply chain optimization strategies (Huang et al., 2018).

On the pricing side, the elasticity of fuel demand relative to price remains a focal point in both academic literature and policy debates. While short-term price elasticity tends to be inelastic, long-term elasticity estimates reveal greater responsiveness as consumers adapt through fuel-efficient technologies, behavioral changes, or modal shifts in transportation (Holechek et al., 2022). Real-world data suggest that prolonged periods of elevated fuel prices accelerate the adoption of alternative transportation options, including public transit, carpooling, and EVs (Castillo et al., 2025). Inversely, fuel price declines have been associated with increased vehicle miles traveled (VMT), a critical contributor to urban congestion and environmental degradation (Dodds et al., 2015). Such insights hold critical relevance for petroleum distributors as they navigate pricing strategies, margin management, and investment decisions in fuel infrastructure amidst fluctuating consumer behaviors (Hassan et al., 2023). A further dimension of the energy pricing ecosystem involves the intersection of regulatory policy, technological change, and market liberalization. U.S. energy markets have undergone waves of deregulation, particularly in refining and distribution segments, facilitating price transparency while also exposing markets to speculative pressures (Simons, 2013). Concurrently, technological advances in hydraulic fracturing and horizontal drilling have transformed the U.S. into a major energy exporter, further entwining domestic fuel prices with international events such as geopolitical conflicts and supply disruptions (Huang et al., 2022). This globalization of fuel pricing dynamics has led to increased price volatility, prompting firms and consumers alike to hedge fuel expenses through futures markets and long-term contracts (Wolf & Smeers, 2023). For industry actors, these regulatory and technological interdependencies demand a data-driven understanding of price formation and risk exposure across both regional and national supply chains (Zhu et al., 2022).

In analyzing strategic positioning within the fuel distribution sector, it is essential to integrate both historical consumption trends and current shifts driven by electrification, carbon regulations, and consumer awareness. The analytical frameworks employed by energy economists and market analysts include time-series econometrics, spatial distribution modeling, and scenario-based simulations to quantify the impacts of policy shifts, EV penetration, and technological disruption on fuel demand and pricing (Wang et al., 2022). These models are supported by data repositories from the Energy Information Administration (EIA), U.S. Department of Transportation (USDOT), and private market intelligence firms like Rystad and IHS Markit (Sagaria et al., 2021). Such data-driven strategies allow firms to make informed capital allocation decisions, optimize logistics, and maintain competitiveness in an evolving energy market landscape marked by volatility and sectoral transformation (Huang et al., 2018).

LITERATURE REVIEW

The literature review aims to critically examine and synthesize existing research and empirical evidence related to the dynamics of fuel consumption, pricing behavior, and electric vehicle (EV) adoption in the United States. This foundational assessment supports strategic analysis within the fuel distribution sector and highlights the interconnections between evolving energy market structures, consumer decision-making, and the technological disruption introduced by electric vehicles (EVs). Given the volatility of fossil fuel prices and the increasing relevance of sustainability-driven alternatives, understanding prior research on market demand shifts, policy regulations, and technological transitions is essential for formulating informed business strategies (Holechek et al., 2022). This section presents a thematic review of scholarly and policy literature covering historical fuel demand patterns, pricing mechanisms, energy market regulation, and electric mobility adoption. By organizing the literature into logical categories and tracing the progression of debates over time, the review identifies gaps, areas of consensus, and methodological approaches that are instrumental for data-driven forecasting and strategic planning.

U.S. Fuel Consumption Trends

The trajectory of fuel consumption in the United States has undergone significant structural changes since the 1990s, driven by economic growth, technological innovation, policy shifts, and shifts in consumer behavior. From 1990 to the early 2000s, gasoline and diesel demand steadily increased in alignment with rising vehicle ownership and economic expansion (Bhattacherjee et al., 2024). The transportation sector has consistently been the primary consumer of petroleum products, accounting for over 65% of total fuel use in the U.S., with gasoline dominating light-duty vehicles and diesel fueling heavy-duty freight transport (Bhuiyan et al., 2024). Industrial consumption, although smaller in volume, has been characterized by more stable demand profiles driven by manufacturing and chemical production processes . The residential and commercial sectors, in contrast, have seen a gradual decline in petroleum use due to efficiency standards and electrification of heating systems. Regional consumption variations further demonstrate the heterogeneity in fuel use across the U.S., with higher per capita consumption in suburban and rural areas due to limited public transport infrastructure (Campbell et al., 2018). These spatial disparities are compounded by demographic characteristics, with income, household size, and employment type influencing travel demand and fuel use patterns (Liu & Sheng, 2019). Additionally, policies such as the Corporate Average Fuel Economy (CAFE) standards have influenced fuel efficiency and moderated the growth of fuel demand, particularly after 2007. While consumption peaked around 2007, it declined during the 2008 financial crisis and fluctuated thereafter in response to oil prices and economic recovery patterns. More recently, fuel consumption rebounded after the COVID-19 pandemic dip, reflecting a partial return to pre-pandemic travel behavior (Herrera et al., 2019).

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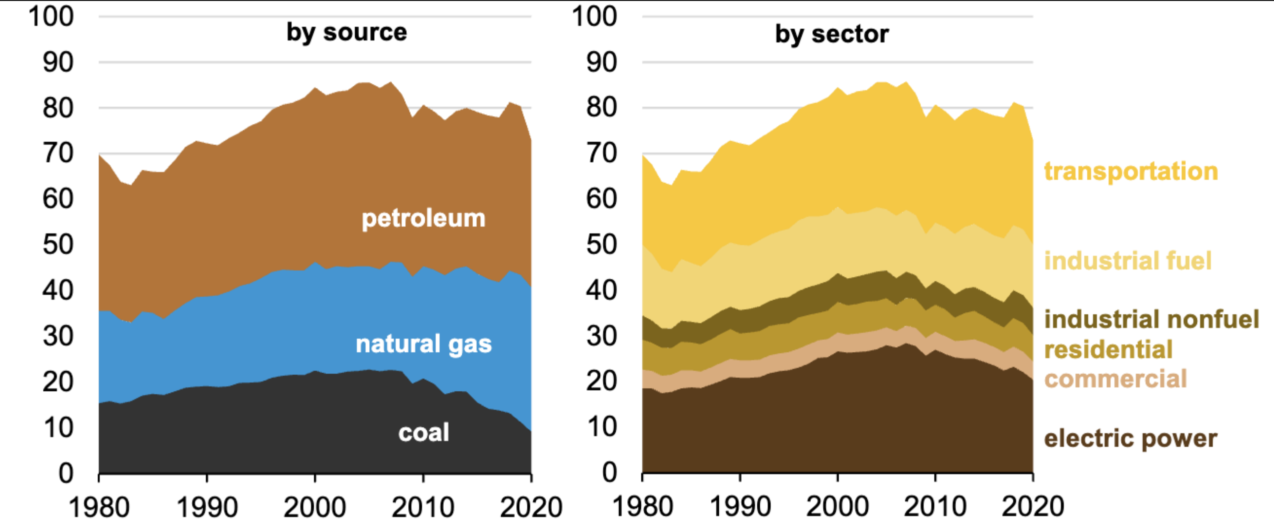
Figure 2: U.S. Energy Consumption by Fuel Source and End-Use Sector (1983–2020)



Source: U.S. Energy Information Administration, *Monthly Energy Review*

Behavioral factors play a critical role in shaping U.S. fuel consumption trends, particularly through travel preferences, vehicle choice, and responsiveness to fuel price changes. The elasticity of gasoline demand has been a focal point in transport economics, with most studies indicating that short-run price elasticity is inelastic, typically ranging between -0.02 and -0.06, whereas long-run elasticity can reach up to -0.4 as consumers adjust through technology adoption and mobility changes (Bhattacherjee et al., 2024). Price sensitivity varies among demographic groups, with lower-income households showing greater behavioral responsiveness due to budget constraints (Bhuiyan et al., 2024). Vehicle miles traveled (VMT) serves as a core metric for evaluating fuel demand, correlating with urban sprawl, commuting patterns, and economic cycles (Campbell et al., 2018). VMT increased steadily during the 1990s and early 2000s, plateaued in the aftermath of the 2008 recession, and then experienced renewed growth prior to the pandemic. Vehicle purchasing behavior is another significant behavioral driver, with a consumer preference for light trucks and SUVs contributing to increased fuel consumption per capita even amidst improvements in engine efficiency. Socioeconomic variables, including urban density, access to mass transit, and regional gasoline taxes, also influence travel decisions and thereby fuel usage (Bhuiyan et al., 2024). Moreover, policies aimed at promoting fuel-efficient vehicles have had mixed effects, as rebound effects—where fuel savings lead to increased travel—can offset some efficiency gains. Psychological dimensions such as driving habits, environmental attitudes, and risk perception have also been explored as indirect contributors to fuel consumption patterns (Campbell et al., 2018). Altogether, these behavioral, economic, and policy factors interact in complex ways to drive fuel demand in the U.S. energy market.

Determinants of Fuel Pricing in the U.S. Market

The structure of retail fuel prices in the U.S. is shaped by a combination of crude oil costs, refining margins, distribution and marketing expenditures, and taxation at both federal and state levels (Conrad & Loch, 2014). Crude oil typically constitutes the largest share of retail fuel prices, accounting for approximately 50% to 60% of the final pump price depending on the global oil market conditions. Refining costs, which include operational expenditures, maintenance, and technology upgrades, also contribute significantly to fuel pricing, particularly during periods of refinery outages or tight capacity. Distribution and marketing expenses include the cost of transporting refined products through pipelines and trucks, as well as retail station overheads, which can vary widely depending on location and business model (Wang & Min, 2006). Taxes, although relatively stable, contribute to the retail price disparity across states; federal excise tax stands at 18.4 cents per gallon for gasoline and 24.4 cents for diesel, with state taxes ranging from under 10 cents to over 60 cents per gallon. Global benchmarks like West Texas Intermediate (WTI) and Brent crude serve as reference points for U.S. oil pricing, with fluctuations in these markets directly influencing the domestic wholesale prices of gasoline and diesel. Supply chain dynamics, including disruptions in global crude transport, refinery shutdowns, or changes in inventory levels, have immediate and measurable impacts on retail fuel prices in both urban and rural regions (Bhattacherjee et al., 2024). The interdependency of each pricing component reflects a vertically complex supply chain in which downstream actors like fuel retailers are highly susceptible to upstream volatility.

Volatility in fuel pricing has been a long-standing feature of U.S. energy markets, with far-reaching macroeconomic implications. Studies consistently demonstrate that sudden increases in oil prices negatively impact consumer confidence, reduce disposable income, and trigger inflationary pressures (Bhuiyan et al., 2024). These effects are particularly pronounced in oil-intensive sectors such as transportation, logistics, and manufacturing, where fuel costs represent a substantial portion of total operating expenses. On a macroeconomic scale, oil price shocks have been associated with recessions in the United States, particularly during the 1970s, 1990s, and the 2008 financial crisis. Research suggests that unanticipated volatility, rather than sustained high prices, has a more severe effect on economic performance due to its impact on uncertainty and investment behavior. The asymmetric transmission of price changes, where price hikes lead to immediate consumer response while price drops have a more subdued effect, has been well-documented in both empirical and behavioral economics literature. Furthermore, energy price volatility is also linked to stock market fluctuations and commodity price correlation, particularly in economies where energy expenditures are substantial (Campbell et al., 2018). In regions with limited public transportation alternatives, consumers face a greater burden from rising fuel costs, intensifying regional economic disparities. Fuel price swings can also disrupt business planning and consumer spending cycles, particularly in lower-income households where gasoline purchases comprise a larger share of the household budget. These wide-ranging economic ripple effects highlight the sensitivity of the U.S. economy to even minor perturbations in fuel pricing, necessitating ongoing monitoring and robust strategic responses across sectors (Liu & Sheng, 2019).

Consumer Behavior and Price Sensitivity

The price elasticity of demand for gasoline and diesel has long been a foundational metric in transport and energy economics, reflecting how responsive consumers are to changes in fuel prices. In the short run, demand tends to be relatively inelastic, typically estimated between -0.02 and -0.06, as consumers have limited immediate alternatives to automobile usage (Herrera et al., 2019). Over the long run, elasticity values increase due to adjustments in vehicle choice, relocation, or commuting habits, with estimates ranging between -0.2 and -0.4 (Forsberg, 2023). This behavior reflects both technological and behavioral lag in substituting gasoline-dependent transport. Fuel prices also directly influence modal decisions; higher fuel costs are associated with increased public transit ridership, bicycle use, and carpooling, especially in urban areas with robust infrastructure (Conrad & Loch, 2014). Mode choice is further affected by urban form and density, as residents in compact cities display greater fuel price responsiveness due to access to non-automotive options (Wang & Min, 2006). Additionally, responses to price changes vary widely by income group, with lower-income households disproportionately affected because a greater share of their expenditure is allocated to transportation fuel (Bhattacherjee et al., 2024). High fuel prices can thus exacerbate social inequities, as wealthier consumers are more likely to own fuel-efficient vehicles or have flexibility in mode choices. Regional differences in elasticity also emerge, with rural residents showing less price sensitivity due to necessity-driven travel and limited access to alternative transport. These patterns underscore the layered and context-specific nature of consumer fuel price responsiveness.

Consumer behavior in fuel purchasing is influenced by psychological heuristics, social norms, and perceived economic trade-offs, as posited by behavioral economics. Traditional rational choice models have been expanded to incorporate cognitive biases such as mental accounting, status quo bias, and hyperbolic discounting in explaining fuel consumption patterns (Bhuiyan et al., 2024). Consumers often underestimate long-term fuel cost savings from fuel-efficient vehicles, opting instead for lower upfront prices, a phenomenon known as the energy paradox. Additionally, framing effects and lack of trust in fuel economy labels influence purchasing decisions (Liu & Sheng, 2019). Subsidies and taxation policies play a critical role in modifying these behaviors. Fuel subsidies, which are prevalent in many developing economies but limited in the U.S., tend to distort market signals and encourage excessive consumption. In contrast, fuel taxes are associated with reduced gasoline demand, especially when taxes are highly visible and perceived as permanent. Tax incidence also matters; for instance, excise taxes are found to be more effective in changing behavior than carbon pricing schemes that are less transparent to consumers. Behavioral responses to subsidies and taxes are often nonlinear, with large changes eliciting stronger reactions due to salience and perceived fairness (Herrera et al., 2019). Moreover, studies have shown that pairing taxes with targeted rebates or mobility subsidies can mitigate regressivity while retaining behavioral effectiveness. These insights from behavioral economics and policy analysis provide a deeper understanding of the mechanisms through which fuel consumption can be shaped by structural and cognitive factors.

Electric Vehicle Adoption and Its Influence on Fuel Markets

Electric vehicles (EVs), particularly battery electric vehicles (BEVs) and plug-in hybrid electric vehicles (PHEVs), have gained increasing market presence in the United States, challenging traditional fossil fuel consumption models. BEVs operate entirely on electric power, while PHEVs combine internal combustion engines with electric propulsion systems, offering flexibility in energy sources (Gohlke et al., 2022). As of 2023, BEVs accounted for over 7% of new light-duty vehicle sales in the U.S., with market penetration concentrated in states like California, where supportive policies and charging infrastructure are more robust. Federal and state-level policies have been instrumental in accelerating EV adoption. Initiatives such as the federal tax credit under the Inflation Reduction Act, state-level Zero Emission Vehicle (ZEV) mandates, and California's Advanced Clean Cars Program have incentivized both manufacturers and consumers. These policies interact with fuel markets by gradually reducing gasoline demand through vehicle stock turnover. Empirical research confirms a negative correlation between EV market share and per capita gasoline consumption in high-adoption states. Moreover, spillover effects are observed when broader EV visibility influences consumer preferences and accelerates the obsolescence of gasoline-dependent technologies (Woo et al., 2022). The transition toward EVs thus directly challenges fuel retailers, particularly those reliant on gasoline sales volume, as declining demand compresses profit margins and necessitates operational adjustments (Alanazi, 2023; Huang et al., 2018). The geographic unevenness of EV adoption also results in spatial variation in fuel demand patterns, with urban corridors experiencing sharper declines in gasoline sales relative to rural regions. This shift underscores a structural evolution in mobility energy demand, driven by regulatory frameworks and consumer preferences.

The environmental and economic implications of EVs extend beyond direct fuel substitution to encompass life-cycle emissions and systemic infrastructure considerations. Life-cycle analyses (LCA) of BEVs and PHEVs consistently show lower greenhouse gas (GHG) emissions relative to internal combustion engine vehicles (ICEVs), even when accounting for battery production and electricity generation from fossil fuels (Castillo et al., 2025). The total emissions benefits are magnified when electricity generation is sourced from renewables, though regional variability in grid carbon intensity affects net outcomes (Karjalainen et al., 2024). From a cost perspective, the total cost of ownership (TCO) for EVs has narrowed due to declining battery costs, federal subsidies, and lower maintenance and fueling expenses (Sanguesa et al., 2021). These factors enhance the attractiveness of EVs and further displace gasoline demand by encouraging adoption among cost-sensitive consumers. However, EV integration imposes new challenges on infrastructure systems, particularly in the development and scalability of charging networks. The availability, speed, and geographic distribution of EV charging stations remain critical constraints to broader adoption (Karjalainen et al., 2024). Public and private investments have targeted Level 2 and DC fast chargers to reduce range anxiety and support long-distance travel. Grid integration also presents technical and regulatory issues, including load balancing, peak demand management, and vehicle-to-grid (V2G) system compatibility. Utility operators and urban planners face coordination demands to align EV charging behavior with grid capacity and renewable energy availability (Sanguesa et al., 2021). These systemic adjustments signify not only a shift in vehicle propulsion technologies but also a transformation in the supporting energy and logistics infrastructures required to accommodate electric mobility at scale.

Fuel Supply Chain Optimization Using Big Data Analytics

Fuel supply chains operate under complex, data-intensive environments where decisions must accommodate fluctuating demand, price volatility, and logistical constraints. Big data analytics has emerged as a pivotal tool for improving supply chain visibility, forecasting accuracy, and decision-making across upstream, midstream, and downstream operations (Gohlke et al., 2022). In the context of petroleum distribution, real-time data from sensors, transactional records, GPS devices, and weather feeds provide granular insights into supply chain activities that were previously obscured (Molderink et al., 2010). Predictive analytics allows firms to anticipate fuel demand variations based on historical consumption trends, seasonal patterns, and socio-economic variables

(Forsberg, 2023). This is particularly critical for demand planning at retail fuel stations and depots, where stockouts and overstocking can lead to financial losses or reputational damage. Machine learning models, including time series analysis and neural networks, have shown higher forecasting accuracy compared to traditional statistical methods, especially when integrated with external data sources such as crude oil prices and mobility patterns (Mohamed & Koivo, 2007). Moreover, supply chain resilience has improved through real-time monitoring and disruption detection enabled by data-driven tools. Enhanced visibility across supplier networks helps identify bottlenecks and facilitates adaptive routing in distribution logistics. The integration of big data analytics into fuel supply chains thus reflects a paradigm shift toward digitalized, responsive, and predictive supply networks that minimize inefficiencies and reduce operational risks (Kabeyi & Olanrewaju, 2022).

Inventory and transportation management constitute critical components of fuel supply chain optimization, where big data analytics enables more efficient allocation of resources and dynamic scheduling of deliveries. In the petroleum industry, inventory management must align with safety regulations, volatile demand, and varying lead times, making static replenishment models inadequate (Bhuiyan et al., 2025; Faria & Rashedul, 2025; Simons, 2013). Big data analytics facilitates the real-time synchronization of inventory levels across refineries, storage terminals, and retail outlets, ensuring lean stockholding while preventing supply disruptions(Helal et al., 2025; Islam et al., 2025; Islam et al., 2025). For instance, the use of IoT-enabled tank monitoring systems provides continuous updates on fuel levels, triggering automated replenishment decisions based on threshold values and consumption forecasts. In logistics, route optimization algorithms powered by big data inputs—such as traffic conditions, weather patterns, and delivery schedules—enhance fleet productivity and reduce fuel consumption (Saiful et al., 2025; Khan, 2025; Md et al., 2025; Santos & Cornford, 2024). Transportation analytics platforms can detect route deviations, driver performance issues, and delivery delays, allowing real-time intervention and cost control (Jakaria et al., 2025; Sarker, 2025; Strielkowski et al., 2021). The complexity of fuel distribution networks, which often involve multimodal transportation and regulatory checkpoints, benefits from simulation-based analytics and decision support systems that model various logistical scenarios. Studies have further emphasized the role of advanced optimization methods such as genetic algorithms, mixed-integer linear programming, and reinforcement learning in refining routing, scheduling, and dispatching decisions (Karjalainen et al., 2024; Siddiqui, 2025; Sohel, 2025). These innovations not only improve delivery reliability but also contribute to environmental sustainability by minimizing emissions and reducing empty runs (Ishtiaque, 2025; Roksana et al., 2024; Strielkowski et al., 2021). As such, big data-driven logistics optimization has become integral to maintaining a cost-effective and environmentally responsible fuel supply chain.

Forecasting and Modeling Fuel Demand in the Context of EV Growth

Econometric modeling and time-series analysis have traditionally served as foundational tools for forecasting fuel demand, allowing researchers and policymakers to understand long-term consumption patterns, elasticity, and structural shifts in energy use. These models typically utilize autoregressive integrated moving average (ARIMA), vector autoregression (VAR), and cointegration techniques to assess the influence of variables such as income, fuel prices, vehicle stock, and industrial activity on fuel consumption (Bhuiyan et al., 2024). Numerous studies have applied these approaches to national and regional datasets, producing robust forecasts of gasoline and diesel demand in response to exogenous shocks like oil price changes or macroeconomic fluctuations (Liu & Sheng, 2019). However, the emergence of electric vehicles (EVs) as a disruptive force in transportation energy demand has necessitated scenario planning to complement econometric forecasts (Cho et al., 2013). Scenario-based models allow analysts to examine baseline cases versus accelerated electrification pathways, incorporating assumptions about EV adoption rates, policy interventions, and consumer preferences (Karakurt, 2021). These models are especially useful in capturing non-linear transitions and potential inflection points in fuel demand (Tsai et al., 2017). Sun et al.(2019) demonstrate how vehicle turnover rates and fuel efficiency improvements interact with EV penetration to reshape gasoline demand curves. Scenario modeling is also widely employed by public agencies such as the U.S. Energy Information Administration (EIA), which integrates economic and policy variables into its Annual Energy Outlook projections to map possible consumption trajectories. Collectively, econometric and scenario models provide a multi-faceted view of demand forecasting, accounting for both historical dynamics and structural transformations in the transport-energy nexus.

Integrated energy system models, such as the EIA's Short-Term Energy Outlook (STEO), National Energy Modeling System (NEMS), and the Global Change Assessment Model (GCAM), have become essential in capturing the complexity of fuel markets influenced by electrification. These tools are designed to evaluate interactions among energy supply, demand, prices, and emissions across multiple sectors and regions. NEMS, for example, incorporates macroeconomic modules, transportation submodels, and fuel distribution logistics to simulate how changes in consumer behavior or technology adoption affect fuel consumption across different timelines. Similarly, GCAM links fuel use projections to land use, climate policy, and technological development assumptions (Tsai et al., 2017). These integrated models rely heavily on detailed input data, calibrated assumptions, and policy scenario formulations, enabling national-level institutions to anticipate supply chain imbalances or emissions impacts under various electrification scenarios (Karakurt, 2021). However, these models are constrained by the availability and granularity of reliable data. In many cases, the delay in capturing EV fleet composition, real-world charging behavior, or regional variations in electricity carbon intensity limits the resolution of forecasts (Cho et al., 2013). Additionally, long-standing dependency on linear and equilibrium-based assumptions reduces flexibility in modeling emerging trends such as shared mobility or dynamic charging pricing (Suganthi & Samuel, 2012). Temporal resolution is also an issue, as most models operate on annual or quarterly data, which may overlook short-term shifts in consumption patterns due to volatile external events (Baumeister et al., 2022). These limitations suggest that while integrated energy models provide valuable macro-level insights, they may underrepresent micro-level behavioral drivers and emerging technology trends that increasingly shape fuel demand trajectories.

Artificial Intelligence Integration

The integration of Artificial Intelligence (AI) into business and industrial operations has become a transformative strategy for enhancing decision-making, optimizing performance, and driving innovation (Ahmed et al., 2022). AI, broadly defined as the capability of machines to simulate human intelligence processes such as learning, reasoning, and problem-solving(Mahmud et al., 2022), has evolved into a cornerstone of digital transformation across multiple sectors (Majharul et al., 2022). AI systems, particularly those employing machine learning (ML), natural language processing (NLP), and computer vision, are being adopted not only to automate routine tasks but also to provide predictive insights and augment strategic planning (Masud, 2022). The rise of AI integration can be traced to its proven ability to enhance operational efficiency. In manufacturing, for example, predictive maintenance powered by AI algorithms has significantly reduced downtime and increased productivity by analyzing real-time sensor data to predict machine failures (Hossen & Atiqur, 2022). In the energy sector, AI applications are being employed to forecast electricity consumption, optimize energy dispatch, and manage smart grids (Kumar et al., 2022). These advancements allow energy providers to make data-driven decisions that enhance reliability and cost-effectiveness. Similarly, in the transportation industry, AI is being used for route optimization, fuel efficiency tracking, and autonomous driving systems, which collectively contribute to streamlined logistics and enhanced safety (Sohel et al., 2022). Furthermore, AI's impact on data analytics has revolutionized the way organizations extract value from big data. AI-based data processing systems are capable of analyzing unstructured data at scale, revealing patterns and correlations that were previously undetectable through conventional methods (Arafat Bin et al., 2023). This capacity is particularly beneficial for market forecasting, customer behavior analysis, and fraud detection in sectors such as finance and retail (Chowdhury et al., 2023; Jahan, 2023; Maniruzzaman et al., 2023). Additionally, AI-enabled customer relationship management (CRM) systems now use sentiment analysis and behavioral profiling to personalize customer engagement and improve service quality (Hossen et al., 2023; Alam et al., 2023; Roksana, 2023).

Recent literature also emphasizes the challenges associated with AI integration. Concerns include data privacy, algorithmic bias, and a lack of explainability in decision-making (Sarker et al., 2023; Shahan et al., 2023; Siddiqui et al., 2023). For instance, AI models in credit scoring have demonstrated potential biases against minority groups when trained on non-representative datasets (Ammar et al., 2024; Bhowmick & Shipu, 2024; Bhuiyan et al., 2024). Consequently, organizations are encouraged to adopt responsible AI frameworks that prioritize fairness, accountability, and transparency (Dasgupta et al., 2024; Dey et al., 2024; Hasan et al., 2024). Industry standards and regulatory guidelines such as the EU's AI Act and the OECD AI Principles have been proposed to ensure ethical use and governance of AI systems (Hossain et al., 2024; Islam, 2024; Jahan, 2024). Integration success also

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hinges on organizational readiness. Studies suggest that companies with strong digital infrastructure, skilled human capital, and agile leadership are better positioned to realize the full potential of AI technologies (Islam et al., 2024; Hossain et al., 2024; Roksana et al., 2024). The socio-technical nature of AI deployment requires a balance between technical capabilities and change management practices. In this context, cross-functional collaboration between IT departments, business units, and data science teams plays a critical role in achieving alignment between AI initiatives and organizational goals (Sharif et al., 2024; Shofiullah et al., 2024; Shipu et al., 2024).

METHOD

To evaluate trends in fuel consumption and pricing dynamics within the United States, a comprehensive data-driven approach was employed. The initial strategy involved examining internal datasets to uncover insights into regional fuel demand, sales volumes, and customer behavior. However, it became evident that such datasets—typically confined to specific geographic markets or corporate operations—did not adequately reflect broader U.S. gasoline, propane, and oil market trends. The limited regional scope of internal data constrained the ability to draw holistic insights into national consumption patterns, pricing variations, and the growing influence of electric vehicles (EVs) across different states and time periods. In response, external public data sources were identified and incorporated to supplement the internal analysis. A thorough review of national energy databases led to the selection of the U.S. Energy Information Administration (EIA) as a reliable and authoritative provider of extensive historical fuel data. EIA repositories include a wide array of valuable datasets, such as annual and monthly gasoline consumption figures by state, historical price trends in gasoline gallon equivalents (GGEs), and production-consumption trade balances across petroleum products, propane, and natural gas from 1950 through 2024.

Following the identification of suitable data sources, a structured process of data collection, transformation, and visualization was implemented. The EIA's records on Refiner Motor Gasoline Sales Volumes by year and state from 1983 to 2022 served as a longitudinal foundation for identifying demand patterns. Additional datasets, including Average Retail Fuel Prices (converted to GGEs), Average Annual Retail Price of Gasoline from 1950 to 2023, and monthly gasoline consumption from 2022 to 2024, facilitated a multidimensional analysis of consumption behavior. Furthermore, datasets related to propane consumption, residential fuel pricing, and sector-specific oil use in quadrillion Btu enabled disaggregated insights into the distribution of energy demand across residential, industrial, and transportation sectors. Visual tools—including bar and line graphs—were developed to illustrate pricing fluctuations, seasonal demand cycles, and the influence of alternative energy adoption, particularly EV penetration, on gasoline consumption. These analytical efforts formed the basis for actionable strategic insights, aligning historical fuel consumption trends with contemporary market transitions and supporting informed decision-making in an evolving U.S. energy landscape.

FINDINGS

In our first historical dataset, we have found data from January 1983 to March 2022 for the 46 states, where we found Total Gasoline Through Company Outlets Volume by Refiners (Thousand Gallons per Day). After analyzing the first data set, we have found some key aspects of the data set. Between the 46 states in the USA from the year 1983 – 2022. The most selling states are:

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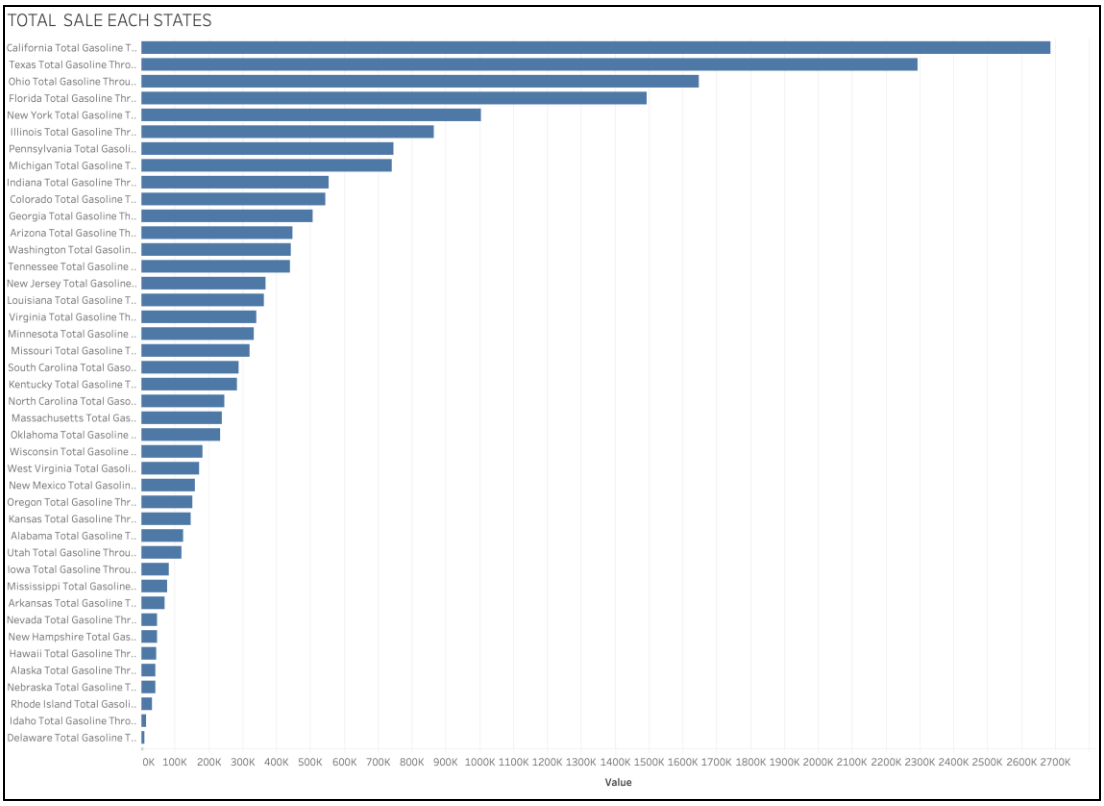
Figure 3: Total Gasoline Sales by State in the U.S. (1983–2022)



So, if we look at the above graph, we can say that California, Texas, Ohio, Florida and New York are the most gasoline-selling states in the last 40 years of oil business. At the same time, if see the last five years of the gasoline business.

Figure 4: Annual Gasoline Sales by Selected U.S. States (2018–2022)

TOTAL SALE EACH STATES

	Date					
	2018	2019	2020	2021	2022	Grand Total
California Total Gasoline Through Company Outlets Volume by Refiners (Thousand Gallons per Day)	53,422	52,747	41,684	17,042		164,895
New York Total Gasoline Through Company Outlets Volume by Refiners (Thousand Gallons per Day)	30,747	33,598	27,088	10,780		102,213
Washington Total Gasoline Through Company Outlets Volume by Refiners (Thousand Gallons per Day)	4,844	5,156	3,721	2,443	508	16,673
Colorado Total Gasoline Through Company Outlets Volume by Refiners (Thousand Gallons per Day)	2,681	2,644	2,388	1,040		8,752
New Mexico Total Gasoline Through Company Outlets Volume by Refiners (Thousand Gallons per Day)	489	1,548	4,283			6,320
Oregon Total Gasoline Through Company Outlets Volume by Refiners (Thousand Gallons per Day)	1,371	1,263	1,037	411		4,081

California and New York are still very good areas of gasoline business. Besides those states, Washington and Colorado are the new areas of the business to expand. But if we see the grand total, California and New York are holding the major portion of gasoline business. If we want to see Total Gasoline Retail Sales by Refiners (Thousand Gallons per Year), we found there the selling of gasoline is declining every year.

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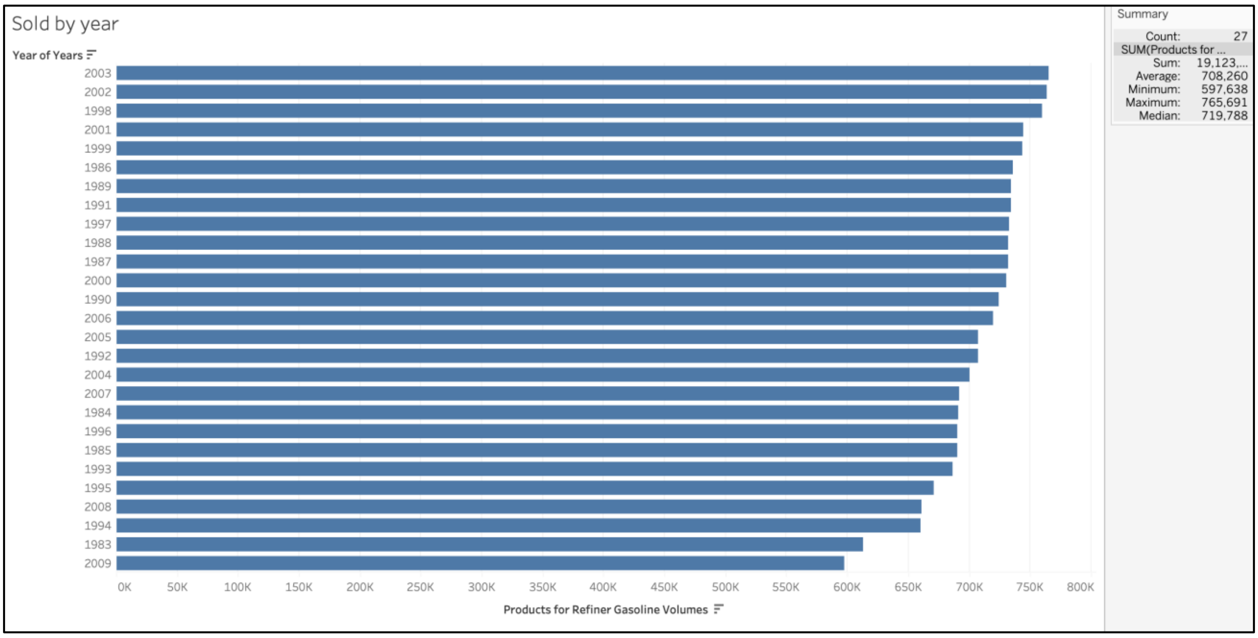
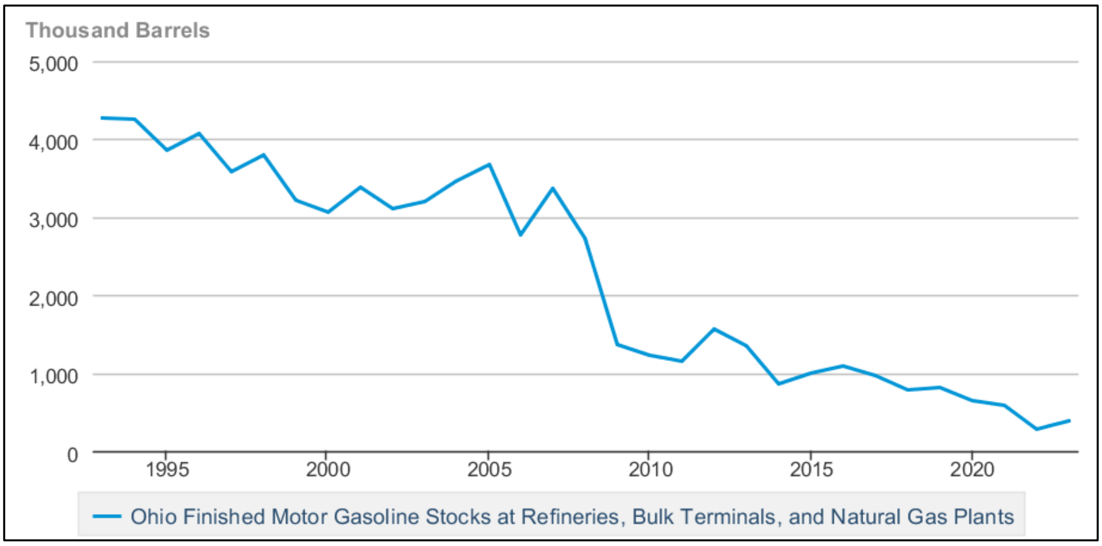
Figure 5: Annual U.S. Gasoline Sales by Year (1983–2009)



This is not only happened because we have a lack of data, but the real senior has told us same story, Motor gasoline, the most consumed petroleum product in the United States, accounted for 44% of U.S. petroleum consumption in 2020. Most gasoline consumption in the United States occurs in the transportation sector (96%), and the industrial and commercial sectors consume the rest. In 2020, U.S. gasoline consumption decreased to 8 million b/d, down 14% from 2019, to the lowest level since 1997.

Figure 6: Ohio Finished Motor Gasoline Stocks at Refineries, Terminals, and Gas Plants (1993–2023)



In the other dataset, we are trying the analysis of which grade of gasoline is popular between the grades. We found the regular gasoline is one, always undoubtedly popular, and lasts more than 3 decades. Here our dataset begins in 1983, but we found midgrade's data from 1986, although this grade introduces at 1983. Mid-grade gasoline was introduced in 1986 as the United States began phasing out leaded gasoline.

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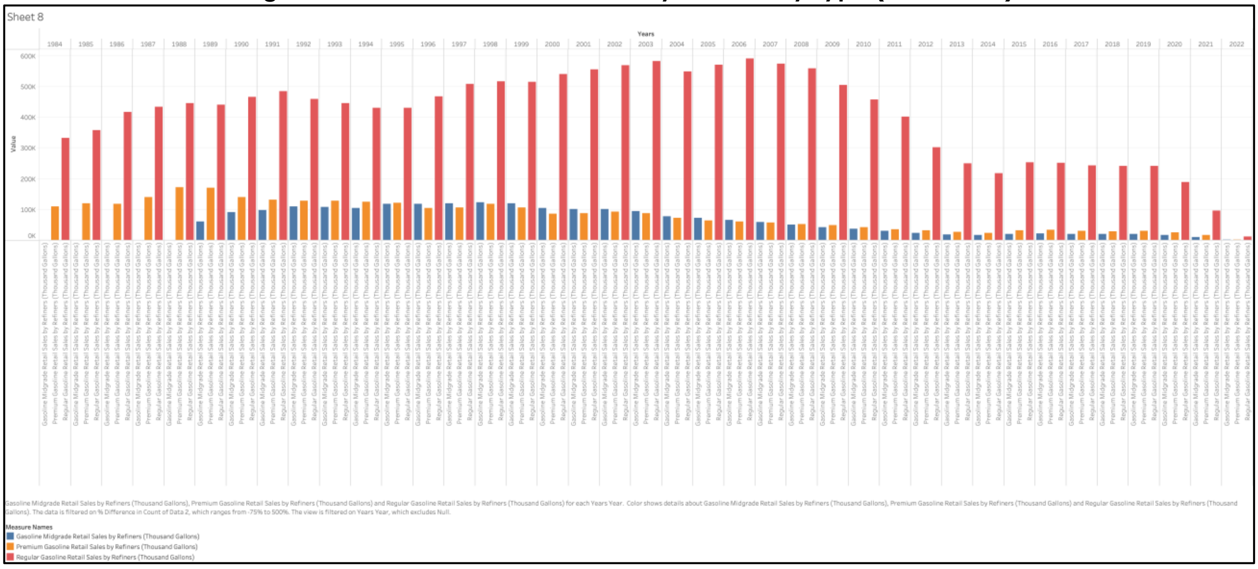
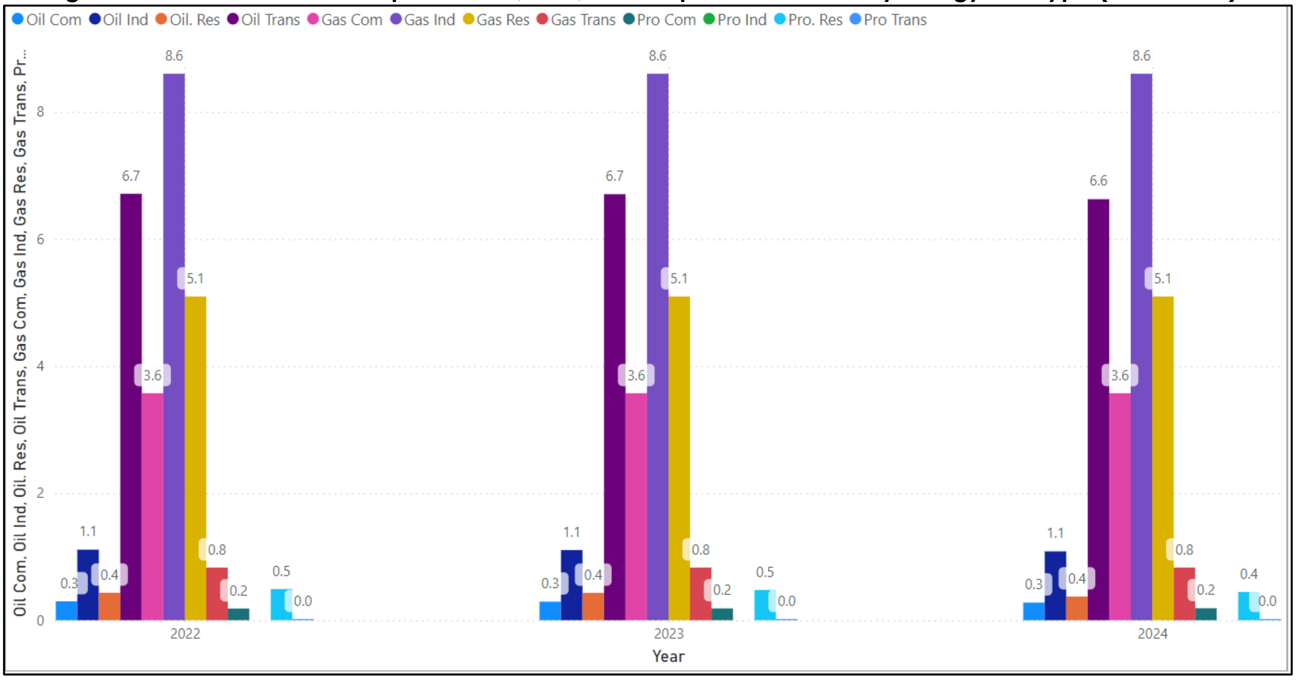
Figure 7: U.S. Gasoline Retail Sales by Refiners by Type (1984–2022)



Oil, Natural Gas, and Propane Consumption in the US: We need to know how energy consumption trends vary by sector and fuel type. The chart below analyzes sector-wise energy consumption trends (quadrillion Btu).

Figure 8: Sector-Wise Consumption of Oil, Gas, and Propane in the U.S. by Energy Use Type (2022–2024)



This chart illustrates the sector-based consumption of oil, gas, and propane across three years: 2022, 2023, and 2024. It breaks down energy usage by different sectors—commercial (Com), industrial (Ind), residential (Res), and transportation (Trans)—for each fuel type. The values are represented in consistent categories, allowing for comparisons between fuels and sectors over time.

Key insights:

- The transportation sector dominates oil consumption across all years, showing consistent usage at 8.6 quadrillion Btu.
- The industrial sector demonstrates significant energy consumption for oil and gas, maintaining steady levels over the years.
- The residential sector exhibits propane as the primary energy source, with minor usage of other fuels.
- Gas and propane show relatively stable but lower levels of consumption across all sectors compared to oil.

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Figure 9: Forecasted energy consumption by sector for the year of 2025 and 2026.

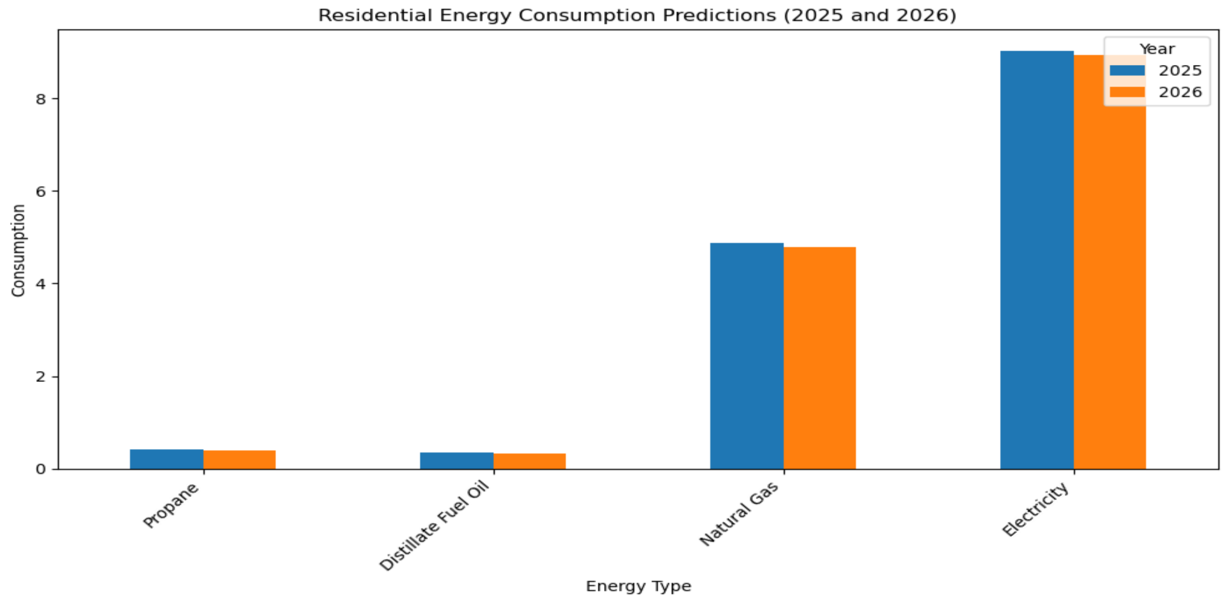
```
Predicted energy consumption for Residential sector (2025 and 2026):
   Year  Propane  Distillate Fuel Oil  Natural Gas  Electricity
0  2025    0.420                 0.35     4.883333     9.026667
1  2026    0.395                 0.32     4.778333     8.921667

Predicted energy consumption for Commercial sector (2025 and 2026):
   Year   Propane  Distillate Fuel Oil  Natural Gas  Electricity
0  2025  0.196667                 0.27         3.47        8.010
1  2026  0.201667                 0.26         3.42        7.895

Predicted energy consumption for Industrial sector (2025 and 2026):
   Year  Propane  Distillate Fuel Oil  Natural Gas  Electricity
0  2025      0.0             1.066667        8.210        6.130
1  2026      0.0             1.051667        8.015        6.065

Predicted energy consumption for Transportation sector (2025 and 2026):
   Year  Propane  Distillate Fuel Oil  Natural Gas  Electricity
0  2025     0.01             6.586667        0.680     0.183333
1  2026     0.01             6.541667        0.605     0.208333
```

Figure 10: Residential and Commercial Energy Consumption Predictions in the U.S. by Energy Type (2025–2026)



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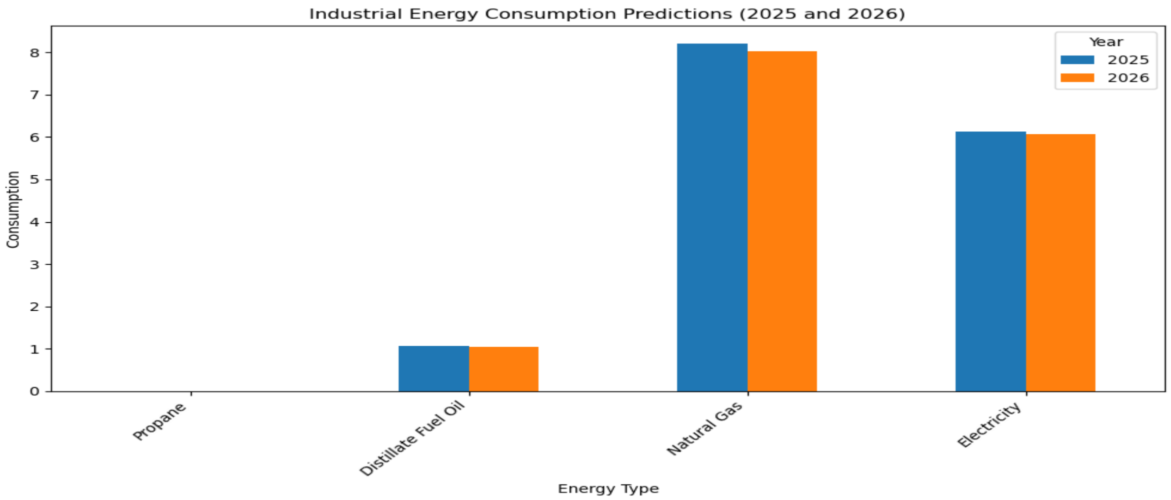

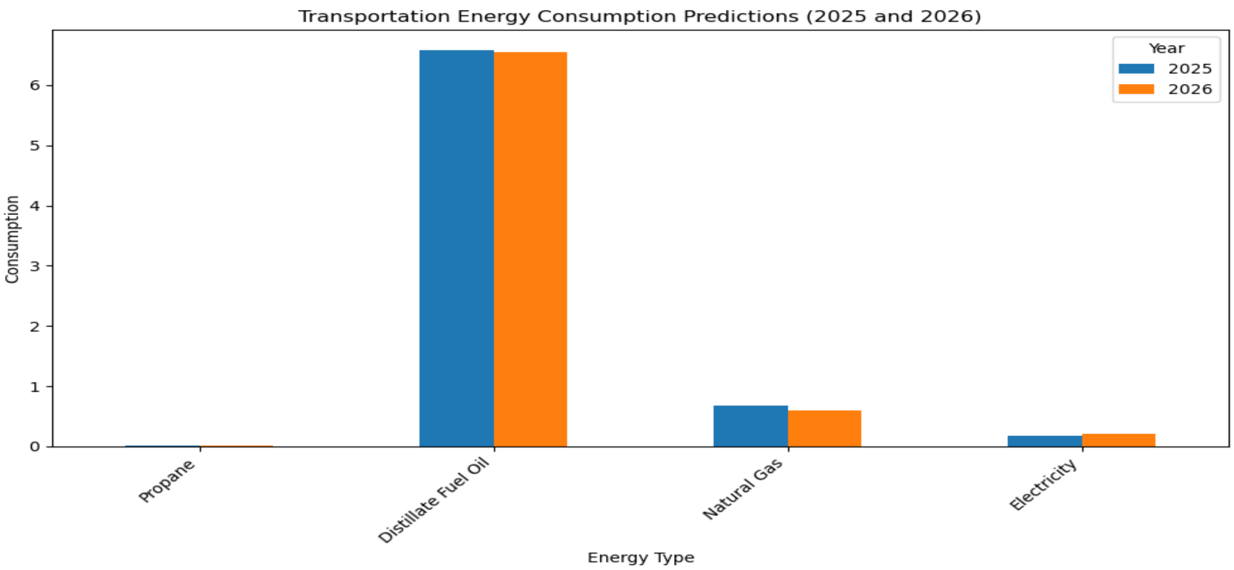

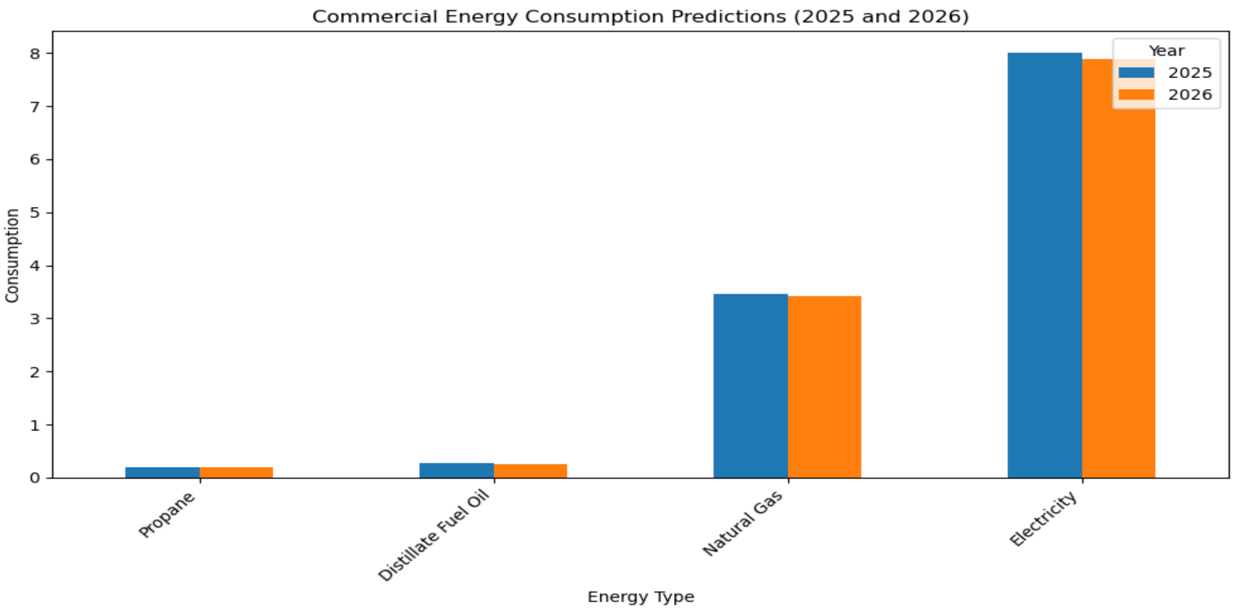

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Table 1: Energy Consumption by Sector and Source (quadrillion Btu)

Year	Residential				Commercial			
	Propane	Distillate Fuel Oil	Natural Gas	Electricity	Propane	Distillate Fuel Oil	Natural Gas	Electricit y
2022	0.49	0.43	5.15	9.43	0.18	0.30	3.60	8.42
2023	0.48	0.43	5.19	9.06	0.19	0.29	3.61	8.11
2024	0.44	0.37	4.94	9.22	0.19	0.28	3.50	8.11
2025 (Forecasted)	0.42	0.35	4.89	9.03	0.20	0.27	3.47	8.01
2026 (Forecasted)	0.40	0.32	4.78	8.92	0.20	0.26	3.42	7.90

Table 2: U.S. Industrial and Transportation Energy Consumption by Fuel Type (2022–2026, Actual and Forecasted)

Year	Industrial				Transportation			
	Propane	Distillate Fuel Oil	Natural Gas	Electricity	Propane	Distillate Fuel Oil	Natural Gas	Electricity
2022	0.00	1.11	8.83	6.34	0.01	6.71	0.91	0.11
2023	0.00	1.10	8.53	6.23	0.01	6.70	0.82	0.13
2024	0.00	1.08	8.44	6.21	0.01	6.62	0.76	0.16
2025 (Forecasted)	0.00	1.07	8.21	6.13	0.01	6.59	0.68	0.18
2026 (Forecasted)	0.00	1.05	8.02	6.07	0.01	6.54	0.61	0.21

Analysis of Sector-Wise Energy Consumption Trends:
Energy Consumption Trends:

- **Residential Sector:**
  - Consumption for natural gas and electricity dominates, while propane and distillate fuel oil show a consistent decline from 2022 to 2026.
  - Electricity consumption remains steady but slightly declines by 2026, indicating potential saturation.
- **Commercial Sector:**
  - Similar to the residential sector, natural gas and electricity lead in consumption. Electricity shows a more significant decline compared to natural gas by 2026.
- **Industrial Sector:**
  - Natural gas is the primary energy source, followed by electricity. Both are forecasted to decrease by 2026.
  - Minimal propane usage persists.
- **Transportation Sector:**
  - Heavy reliance on distillate fuel oil. Its usage declines from 6.71 quadrillion Btu (2022) to 6.54 quadrillion Btu (2026).
  - Natural gas usage decreases more significantly, suggesting limited growth in its adoption.

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Table 3: Forecasted energy prices by sector for the year of 2025 and 2026:

```
Forecasted Prices for 2025 and 2026:
                                                 Residential  \
Propane              [33.00333333333356, 34.183333333333394]
Distillate Fuel Oil  [29.59666666666635, 27.781666666666297]
Natural Gas           [12.25333333333333, 11.518333333333343]
Electricity          [39.43000000000029, 38.370000000000346]

                                                  Commercial  \
Propane              [23.563333333333503, 22.098333333333358]
Distillate Fuel Oil  [28.300000000000182, 25.974999999999454]
Natural Gas            [8.556666666666615, 7.726666666666688]
Electricity            [33.30666666666684, 32.14166666666688]

                                                  Industrial  \
Propane                [17.14333333333343, 15.028333333333274]
Distillate Fuel Oil  [28.113333333333685, 25.758333333333212]
Natural Gas           [4.083333333333485, 2.9983333333334485]
Electricity          [21.269999999999982, 20.144999999999982]

                                              Transportation
Propane              [20.890000000000327, 19.289999999999964]
Distillate Fuel Oil   [27.766666666666424, 24.791666666666606]
Natural Gas           [13.586666666666588, 12.256666666666666]
Electricity           [43.26999999999998, 43.370000000000005]
```

Figure 11: Forecasted Energy Prices by Sector and Fuel Type in the U.S. (2025–2026)

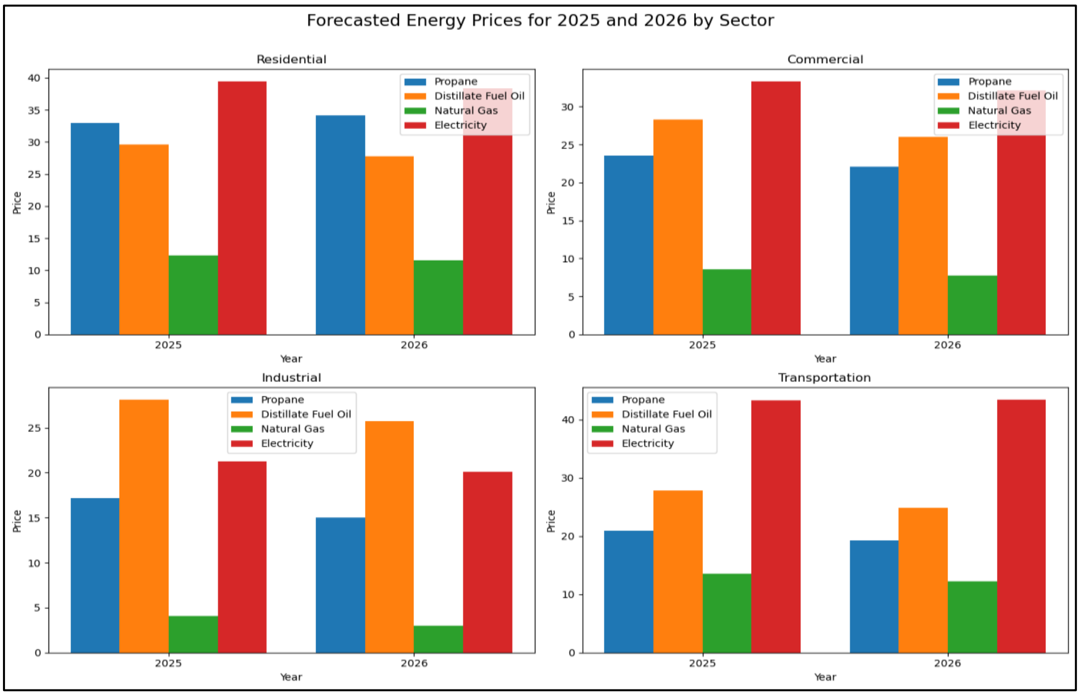

Table 4: Energy Prices by Sector and Source (dollars per million Btu)

Year	Residential				Commercial			
	Propane	Distillate Fuel Oil	Natural Gas	Electricity	Propane	Distillate Fuel Oil	Natural Gas	Electricity
2022	29.13	35.24	14.29	42.67	27.83	35.26	10.99	36.67
2023	31.31	32.83	14.06	41.43	26.75	32.98	10.33	35.90
2024	31.49	31.61	12.82	40.55	24.90	30.61	9.33	34.34
2025 (Forecasted)	33.00	29.60	12.25	39.43	23.56	28.30	8.56	33.31
2026 (Forecasted)	34.18	27.78	11.52	38.37	22.10	25.97	7.73	32.14

Table 5: Energy Prices by Sector and Source (dollars per million Btu)

Year	Industrial				Transportation			
	Propane	Distillate Fuel Oil	Natural Gas	Electricity	Propane	Distillate Fuel Oil	Natural Gas	Electricity
2022	23.44	35.19	7.33	24.42	25.67	37.12	17.55	42.50
2023	21.47	32.80	6.27	23.97	24.13	32.86	16.30	44.01
2024	19.21	30.48	5.16	22.17	22.47	31.17	14.89	42.70
2025 (Forecasted)	17.14	28.11	4.08	21.67	20.90	27.77	13.59	43.27
2026 (Forecasted)	15.03	25.76	3.00	20.15	19.29	24.79	12.26	43.37

Analysis of Sector-Wise Energy Price Trends:
Energy Price Trends:

- **Residential and Commercial Sectors:**
  - Prices for electricity decrease but remain the highest among all energy sources. Natural gas and propane prices drop moderately, with propane exhibiting the sharpest decline.
- **Industrial Sector:**
  - Electricity is costly compared to natural gas. Prices for natural gas decline sharply, making it a more attractive option.
- **Transportation Sector:**
  - Distillate fuel oil remains the dominant cost factor, although its price shows a steady decline.

Key Observations for Oil Company

- **Sector Dependence:**
  - The transportation and industrial sectors heavily rely on distillate fuel oil and natural gas, presenting opportunities for expanded market engagement within these energy segments.
  - Residential and commercial sectors show a declining trend in fuel oil consumption, signaling lower growth potential in these markets.
- **Pricing Trends:**
  - Declining prices of natural gas across all sectors present an opportunity to promote it as a cost-effective energy source.

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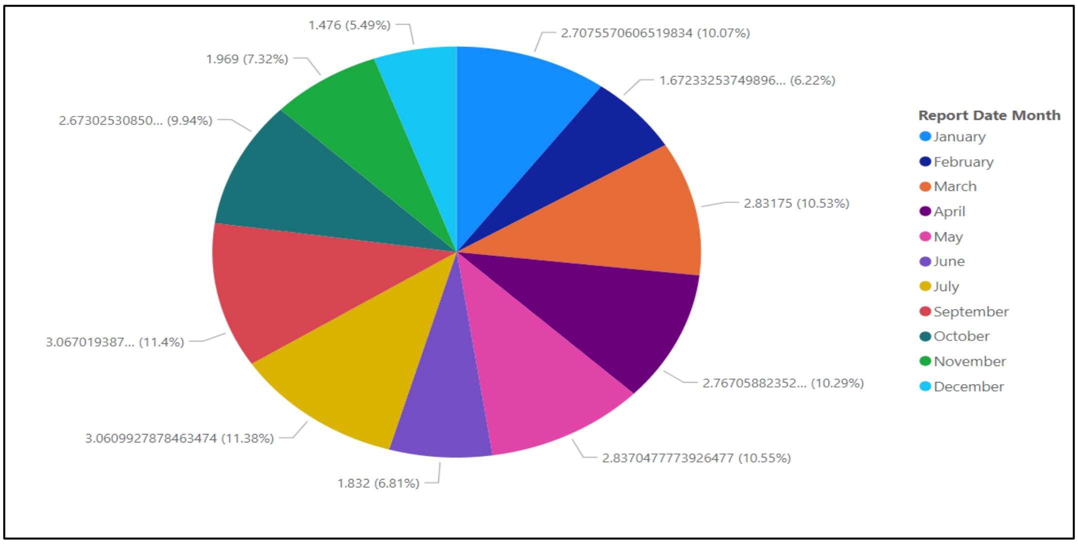
Oil Consumption by Sector in average in month of last three years (quadrillion Btu):
This chart breaks down oil consumption across various sectors (e.g., transportation, industry) over the past three years. It illustrates how different parts of the economy contribute to total oil usage and reflects shifts in sector-based energy needs, potentially influenced by factors such as increased electric vehicle adoption. This type of sector-based analysis can be used to tailor fuel and service offerings to specific industries. A focus on the transportation sector, for instance, may encourage partnerships with logistics companies or promote eco-friendly fuel options in response to growing sustainability initiatives. To identify the average monthly gas price within a year, a visualization will be created to analyze seasonal fluctuations—providing insight into pricing trends across different months and enabling more informed planning and decision-making.

Figure 12: Monthly Distribution of Average Gas Selling Prices in the U.S. (2020–2023)



This pie chart visualizes the distribution of average gas selling prices across the months of the year, using data from 2020 to 2023. Each segment represents a month, showing its share of the overall gas selling price trends during this period. The chart helps identify months with higher or lower average gas prices, indicating seasonal price variations.
Key observations: July has the largest segment, indicating that gas prices tend to peak in midsummer, likely due to increased demand for travel and transportation.

- January and February have smaller segments, reflecting lower gas prices during winter months, possibly due to reduced demand or seasonal pricing trends.
- Variability between months highlights seasonal effects on pricing caused by demand, supply, and external factors like market disruptions or geopolitical events.

Monthly gasoline consumption in the United States 2022-2024: The consumption of gasoline in the United States amounted to some 8.98 million barrels per day in September 2024. In the period of consideration, gasoline consumption reached its highest four-week average in July 2024.

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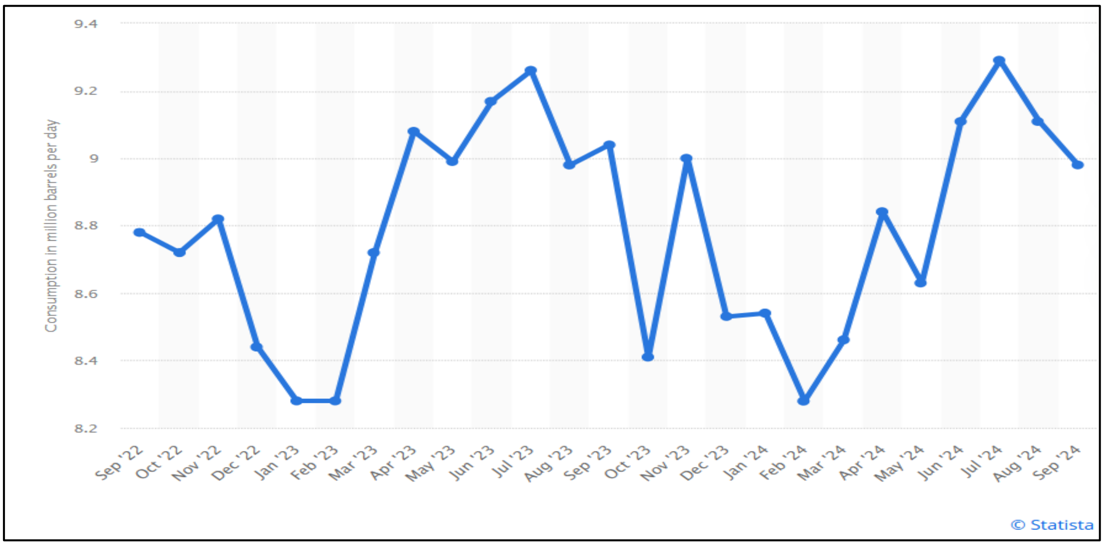
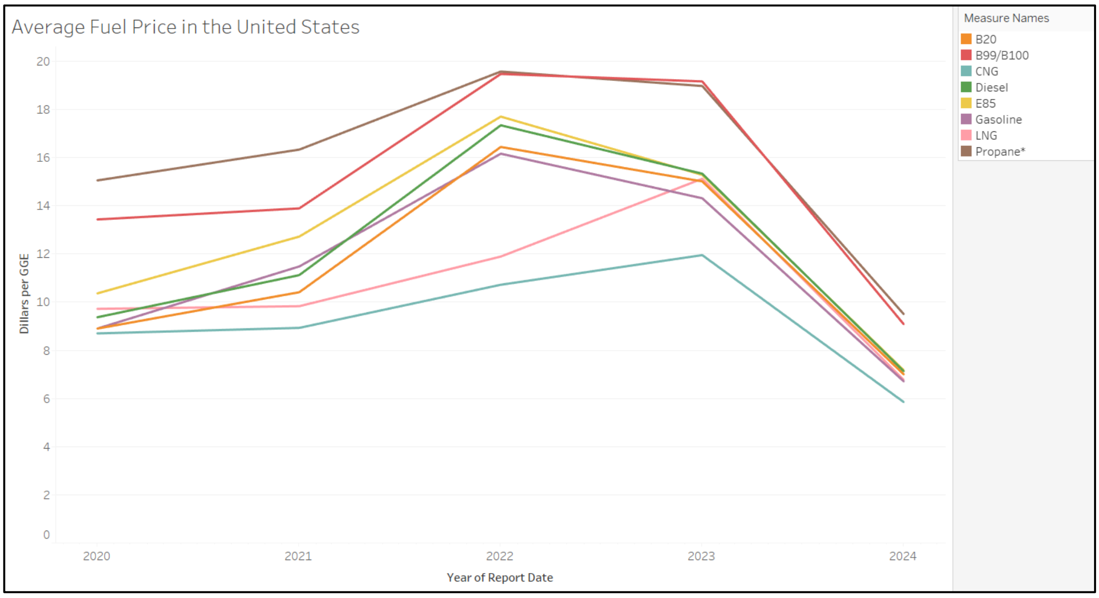
Figure 13: U.S. Monthly Gasoline Consumption Trends (Sep 2022 – Sep 2024) in Million Barrels per Day



- **Gasoline production and sales:** Despite the U.S. reporting a decrease in domestic motor gasoline refinery production in recent years, the gasoline market has been thriving, with gasoline sales across various stations in the country totaling 654 billion U.S. dollars in 2023. Meanwhile, real gasoline prices for end users climbed to around 1.4 real U.S. dollars per gallon.
- **Gasoline vs diesel:** Both diesel and gasoline are derived from crude oil. Gasoline, however, undergoes a more extensive refining process, resulting in a more volatile compound compared to diesel. This characteristic accelerates the combustion of gasoline, yielding greater horsepower in practical applications. However, diesel is still extensively used in the U.S. The average consumption of diesel fuel in the United States stood at 3.74 million barrels per day in September 2024. Utilize these insights to implement seasonal fuel promotions (e.g., discounts in early spring) to build customer loyalty and stimulate sales during off-peak periods.

Average Retail Fuel Prices in the United States: Understanding historical fuel price trends is critical for making informed decisions in the energy industry. Tracking these trends helps identify pricing patterns, evaluate market dynamics, and anticipate future fluctuations. To support this objective, the "Average Fuel Price in the United States" graph was created, visualizing the annual average prices of various fuel types—including gasoline, propane, diesel, and alternative fuels—from 2020 to 2024.

Figure 14: Annual Trends in Average Retail Fuel Prices in the United States by Fuel Type (2020–2024)



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In this chart, we tried to illustrate the annual trends in average retail fuel prices for various fuel types, including gasoline, propane, diesel, B20, E85, CNG, and LNG, from 2020 to 2024. Below is our key observations from this chart.

Key Observations:

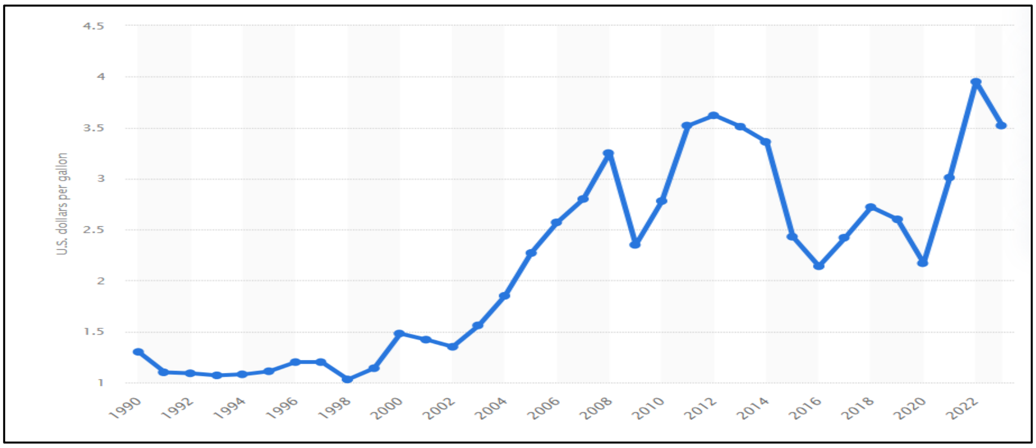
- Peak Prices in 2022: Across all fuel types, a significant rise in average prices was observed in 2022, likely reflecting global supply chain disruptions and increased demand.
- Decline Post-2022: Starting in 2023, fuel prices showed a marked decline, stabilizing further by 2024. This may indicate recovery in supply chains and adjustments in global oil markets.
- Gasoline: Gasoline, being the most commonly used fuel, showed moderate price fluctuations but remained among the mid-priced fuels on the chart.
- Propane: Propane prices exhibited a similar trend to other fuel types, peaking in 2022 but with relatively sharper price declines by 2024.

Here we tried to highlight the trends in fuel pricing and offer insights into market fluctuations during the specified period.

Retail price of regular gasoline in the United States from 1990 to 2023

The retail price of regular gasoline in the United States from 1990 to 2023 has demonstrated significant fluctuations. Here's an overview of the key trends during this period:

Figure 15: U.S. Average Annual Gasoline Prices (1990–2023) – Dollars per Gallon

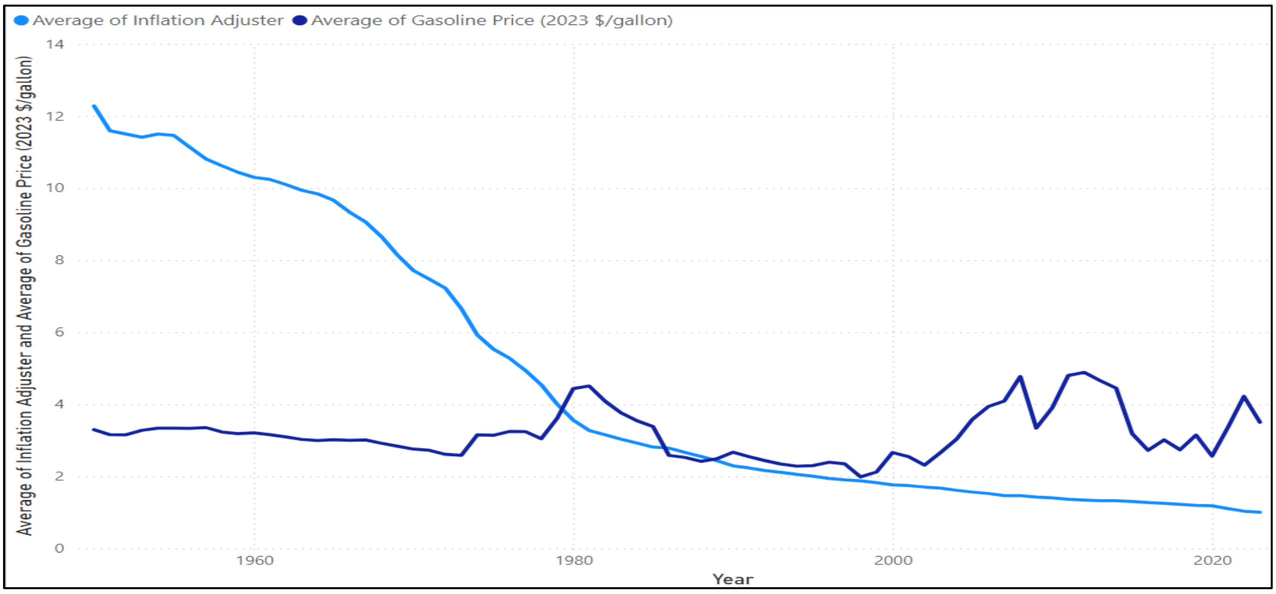


Gasoline prices were relatively stable during the 1990s, with an average price ranging between $1.00 and $1.50 per gallon (adjusted for inflation). By 2005, prices surpassed $2.00 per gallon, reflecting tightening oil supply and rising crude oil prices. In 2023, customers at U.S. gas stations were charged on average 3.52 U.S. dollars per gallon, down almost 10.89 percent from 3.95 U.S. dollars in 2022. The price of gasoline is significantly lower in the U.S. than in many other countries.

Retail Price of Gasoline with inflation adjustment:

For long-term gasoline price trends in the United States, we collect the data adjusted for inflation. This helps us to understand how gasoline prices have evolved over the decades and how external factors such as economic shifts, geopolitical events, and market dynamics have influenced pricing.

Figure 16: Inflation-Adjusted vs. Nominal U.S. Gasoline Prices (1949–2023)



The chart depicts the average gasoline price in 2023 dollars per gallon (adjusted for inflation) alongside an inflation adjustment trend, spanning from the 1940s to 2023. Two distinct lines represent these variables:

- Dark Blue Line – Average Gasoline Price (2023 $/gallon): This line reflects the historical trends in gasoline prices adjusted for inflation. Where we see Gasoline prices relative stability from the 1940s to the 1970s, followed by sharp increases in the late 1970s and early 1980s, coinciding with the oil crises. Prices generally stabilize again from the mid-1980s to the early 2000s, with noticeable peaks after 2005, likely driven by market volatility, geopolitical events, and increased demand. Recent trends indicate fluctuations, with a significant rise around 2008 (global financial crisis) and more recent peaks in the 2020s, reflecting post-pandemic recovery and global supply chain disruptions.
- Light Blue Line – Inflation Adjustment (General Price Trend): This line tracks the adjustment factor used to convert historical gasoline prices to 2023 dollars. It shows a steep decline from the 1940s to the 1970s, reflecting significant inflationary impacts over this period. The line flattens in the later years, indicating that inflation rates have become more stable.

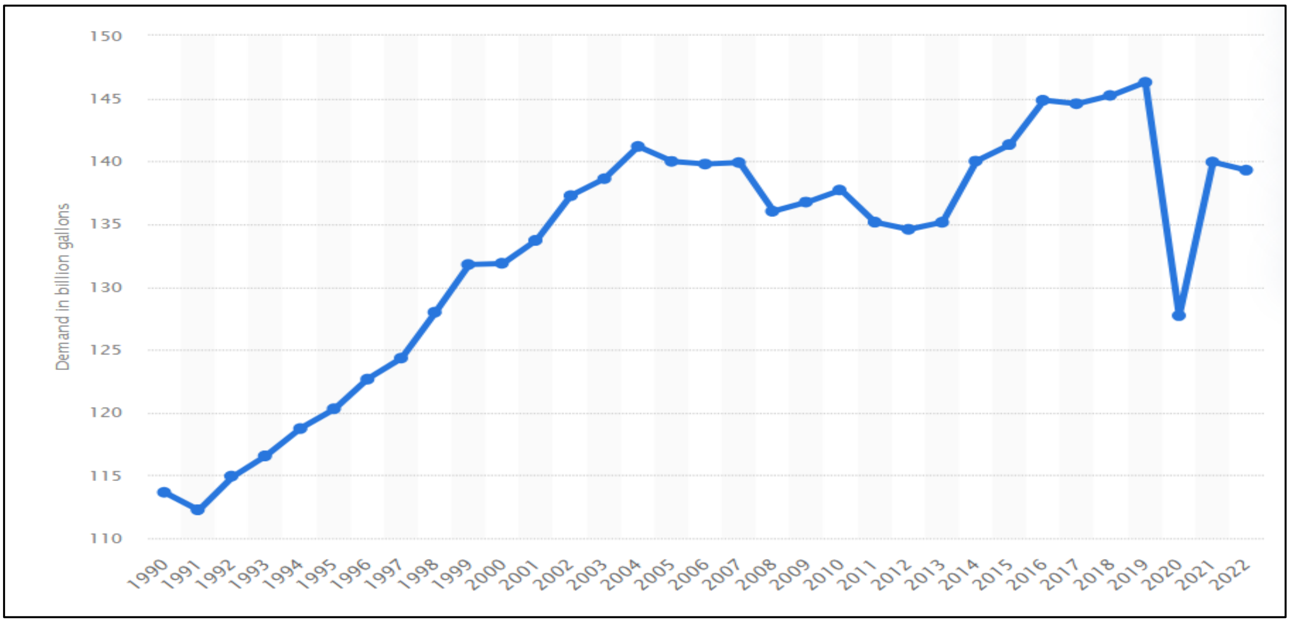
Key Observations:

- Gasoline prices tend to mirror major economic, political, and supply chain events.
- Despite inflationary pressures, gasoline prices have not consistently risen but instead show periods of stabilization and decline, particularly in the late 20th century.
- The 2020s exhibit heightened volatility, likely due to disruptions like the COVID-19 pandemic and geopolitical tensions.

This chart provides a comprehensive view of the relationship between inflation-adjusted gasoline prices and economic conditions, helping to contextualize historical trends in fuel pricing and market behavior.

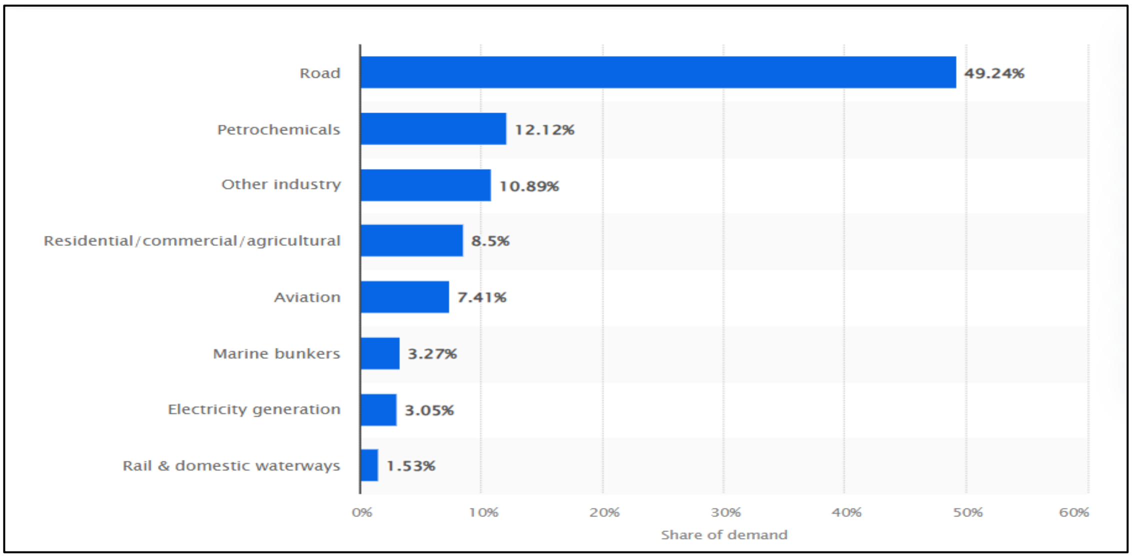
Domestic gasoline demand in the U.S. 1990-2022: Analyzing long-term trends in U.S. oil demand is essential to identify key patterns, disruptions, and recovery periods. Understanding these trends supports the alignment of marketing and operational strategies with historical demand drivers and enhances the ability to anticipate potential challenges or opportunities.

Figure 17: U.S. Annual Oil Demand (1990–2022) – Measured in Billion Gallons



This line chart illustrates the demand for oil (in billions of gallons) in the U.S. from 1990 to 2022. The chart shows a steady increase in oil demand from 1990 to the early 2000s, followed by fluctuations around a relatively stable range. A notable sharp decline occurred around 2020, likely reflecting the impact of the COVID-19 pandemic, after which demand began to recover. Domestic gasoline demand in the United States reached 139.29 billion gallons in 2022. This was a slight decrease compared to the previous year and still below pre-pandemic levels.
In the chart below, we see that Gasoline consumption is largely related to highway travel, with smaller amounts spent by the agricultural and marine sectors.

Figure 18: Sectoral Breakdown of Gasoline Demand in the United States – Percentage Share by Industry



This bar chart shares gasoline demand by sector. It highlights how different industries contribute to overall energy consumption, emphasizing their proportional demand. The sectors and their respective shares are as follows:

- Road Transport: Accounts for the largest share, with 49.24%, reflecting the dominance of fuel consumption for vehicles such as cars, trucks, and buses.
- Petrochemicals: Contributes 12.12%, showing the significant energy needs of chemical production processes.

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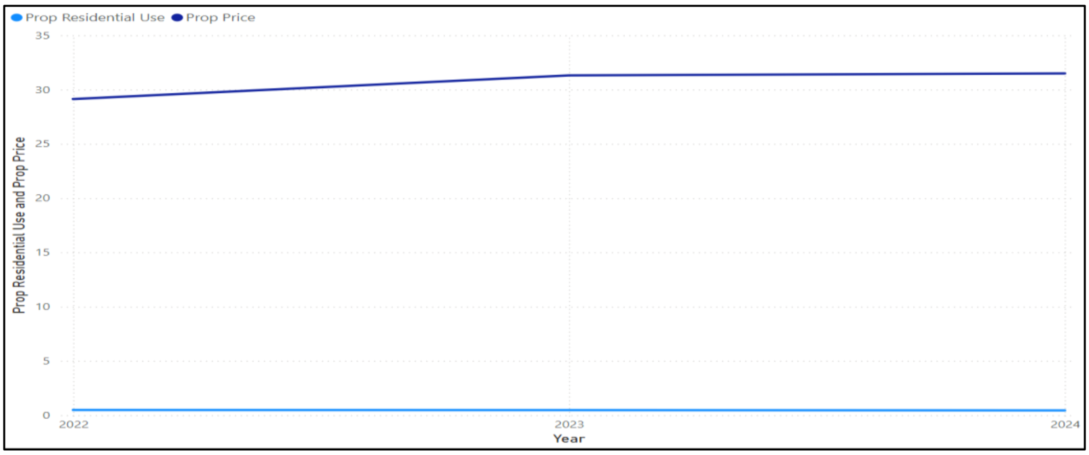
- Other Industry: Represents 10.89%, encompassing manufacturing, construction, and other industrial activities.
- Residential/Commercial/Agricultural: Accounts for 8.5%, reflecting the energy required for heating, cooling, and agricultural operations.
- Aviation: Has a 7.41% share, indicating fuel usage for both passenger and cargo air travel.
- Marine Bunkers: Represents 3.27%, covering fuel consumption for maritime transport.
- Electricity Generation: Contributes 3.05%, reflecting energy use for power plants reliant on oil or related fuels.
- Rail & Domestic Waterways: Holds the smallest share, at 1.53%, indicating fuel use for trains and inland water transport.
-

Figure 19: Propane consumption and price for residential use (quadrillion Btu):



Focusing on propane's residential market, this visualization shows both consumption levels and price trends. By comparing these two metrics, the visualization sheds light on how residential demand for propane correlates with price changes, relevant for understanding consumer behavior and budget impact. Monitoring propane demand in residential sectors enables the planning of localized marketing efforts, such as promoting propane services during colder months or in areas with high residential heating needs. Targeted campaigns emphasizing stable, competitive pricing can also attract customers seeking affordable residential energy solutions.

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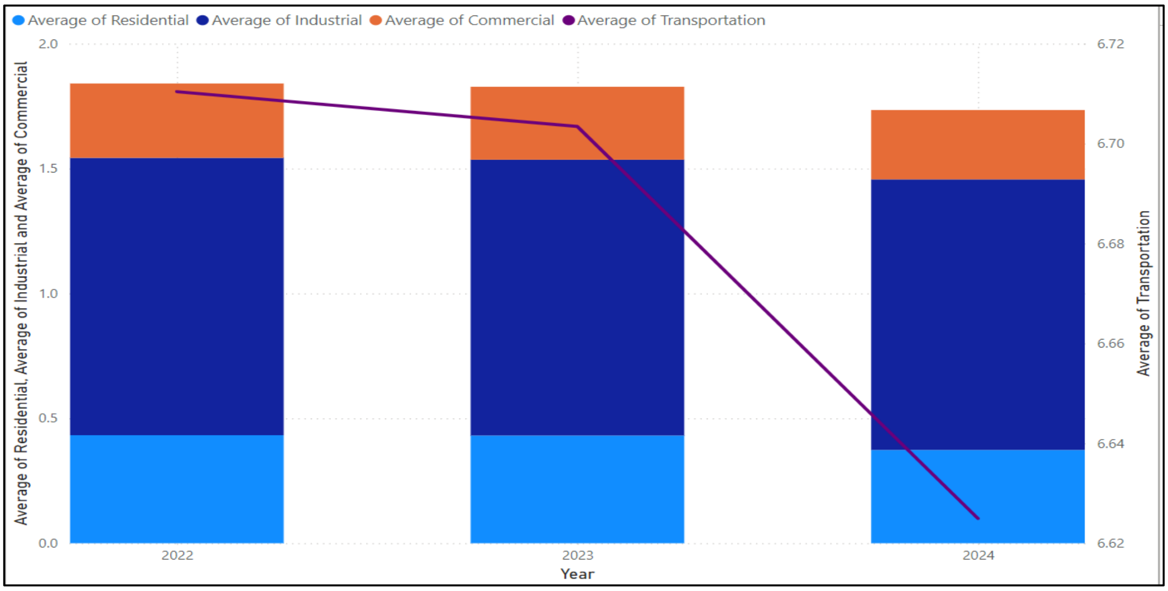
Figure 20: How oil consumption is decreasing in Transportation due to different energy use such as electric cars (quadrillion Btu):

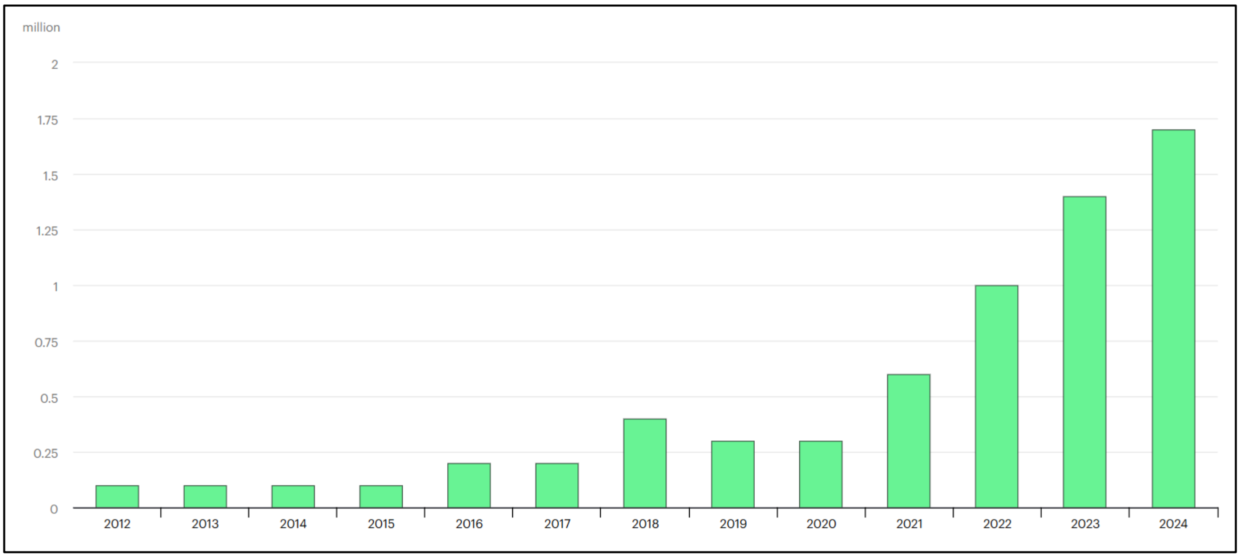


This visualization highlights the reduction in oil consumption within the transportation sector, potentially attributed to the rise of alternative energy sources like electric vehicles. The chart provides a clear view of how changing technology and policy might be steering the sector away from traditional oil-based fuel.

Electric Vehicle Use of USA:

As transportation shows a gradual shift from oil to alternative energies, The U.S. has seen a sharp increase in EV sales, with a significant portion of new car buyers opting for electric models. This trend is supported by the growing availability of EV models, ranging from affordable compact cars to luxury SUVs.

Figure 21: Electric Car Growth in the USA



Electric Vehicle use increasing day by day in the USA. In this chart, we see the growth of electric vehicle (EV) adoption in the USA from 2012 to 2024, measured in millions. It shows a steady increase in EV adoption, with notable acceleration starting around 2018. The growth becomes exponential from 2021 onwards, reaching its highest point in 2024. The rapid rise in EV adoption indicates a shift in consumer preferences toward sustainable energy solutions.

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From the above analysis we can summarize below the findings for Oil Company:

Pricing Trends: Gasoline pricing trends over the years have shown significant variability influenced by seasonal demand, global oil markets, and macroeconomic factors:

Historical Trends (1983-2023): An analysis of the dataset from January 1983 to March 2022 revealed California, Texas, Ohio, Florida, and New York as the top gasoline-consuming states. While California and New York consistently hold the largest shares, emerging markets like Washington and Colorado have shown growth in recent years.

Seasonal Variations: Gasoline prices typically peak in the summer months (e.g., July) due to increased travel demand and decline in winter months (e.g., January and February) owing to reduced usage.

Declining Consumption: Total gasoline retail sales by refiners have declined annually, reflecting broader trends such as increased vehicle fuel efficiency, alternative fuel adoption, and shifts to public transportation.

Economic Impacts: Major events, such as the COVID-19 pandemic, led to steep declines in demand and pricing, with partial recovery post-2020. Supply chain disruptions and geopolitical events have also influenced price surges, notably in 2022.

Inflation-Adjusted Trends: A historical review of inflation-adjusted prices (1940s-2023) shows relative stability until the 1970s, followed by sharp increases during oil crises and fluctuations due to financial and geopolitical instability in later decades.

Fuel Type Insights: Regular gasoline remains the dominant grade, maintaining popularity for over three decades, while midgrade options introduced in the 1980s have experienced relatively lower uptake. This detailed view highlights the importance of understanding seasonal and regional pricing dynamics to craft effective fuel distribution and marketing strategies.

Demand Analysis: Gasoline demand trends in the United States have exhibited significant changes over the decades, influenced by technological advancements, economic factors, and shifting consumer preferences:

- **Historical Trends:** A comprehensive line graph analysis of U.S. gasoline demand (1990-2023) revealed steady growth until 2007, driven by population increase and reliance on private vehicles. However, this was followed by fluctuations, particularly during economic downturns and global crises.
- **Impact of the COVID-19 Pandemic:** Demand sharply declined in 2020 due to travel restrictions and reduced economic activity. Though partial recovery occurred in subsequent years, levels have not yet returned to pre-pandemic norms, reflecting lasting behavioral shifts such as remote work.
- **Sector Contributions:**
    - Road Transportation: Dominates demand with 49.24%, underscoring the heavy reliance on gasoline for personal and commercial vehicles.
    - Petrochemicals: Accounts for 12.12%, reflecting its critical role in manufacturing and industrial processes.
    - Other Industrial Uses: Represent 10.89%, encompassing diverse applications like construction machinery and small-scale generators.
- **Regional Variations:** California, Texas, Ohio, Florida, and New York consistently lead gasoline consumption, highlighting regional economic activity and infrastructure reliance on motor fuels.
- **Declining Growth Rates:** The growth in gasoline demand has slowed in recent years due to improvements in fuel efficiency, adoption of alternative energy vehicles, and increased environmental awareness.

Electric Vehicle Market Insights: The electric vehicle (EV) market in the United States has experienced significant growth over the last decade, driven by technological advancements, policy incentives, and consumer interest in sustainability:

- **Price Trends and Parity:**
    - Between 2018 and 2022, the sales-weighted average price of EVs declined, primarily due to Tesla's competitive pricing and market dominance.
    - EV SUVs are projected to achieve price parity with internal combustion engine (ICE) counterparts by 2030, though smaller EV models may take longer due to production costs and limited availability.

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- **Market Competitiveness (2023-2024):**
    - EV models like Tesla's Model 3 (USD 39,000-42,000) and Model Y (under USD 50,000) are nearing the cost of ICE vehicles, improving accessibility.
    - However, only 5% of EVs sold in 2022 were cheaper than ICE equivalents, and affordable EV options remain limited.
- **Adoption Growth:**
    - EV adoption has risen exponentially, with the fastest growth occurring post-2021. By 2024, EV market penetration reached record levels, signaling a shift in consumer preferences.
- **Challenges to Widespread Adoption:**
    - Charging infrastructure expansion is critical to support continued growth.
    - Affordable small EV models remain rare, limiting accessibility for price-sensitive consumers.

These insights emphasize the transformative impact of EVs on traditional fuel demand and present opportunities to diversify offerings, invest in EV-related infrastructure, and align business strategies with evolving market trends.

DISCUSSION

Despite growing diversification in the energy sector, gasoline remains a dominant transportation fuel in the United States, particularly in highly populated and economically active states like California, Texas, and New York. This finding aligns with long-standing evidence from the U.S. Energy Information Administration, which shows that gasoline consumption continues to account for over 40% of total petroleum product use in the country. While recent years have seen modest reductions in overall demand, the fundamental reliance on internal combustion engine (ICE) vehicles persists, especially in regions with expansive road networks and low public transportation coverage (Luo et al., 2022). Previous research by Bhuiyan et al. (2024) confirms that despite efficiency improvements, the elasticity of gasoline demand remains inelastic in the short run due to limited alternative mobility options. This sustained dependence is further supported by Cho et al. (2013), who observed that vehicle miles traveled (VMT) continued to increase in several major states, reinforcing ongoing gasoline consumption even during periods of fluctuating prices. This continued demand indicates a stable, though gradually diminishing, core market for traditional fuel products.However, it also reinforces the need to monitor geographical disparities in gasoline use, as urban and suburban trends may diverge, impacting supply chain logistics and retail strategies.

The rise of electric vehicles (EVs) has emerged as a significant disruptive force in the U.S. energy market, with clear implications for long-term gasoline demand. Findings from this report show that EV adoption is gaining momentum, particularly in urban, affluent, and environmentally conscious regions. This trend corroborates earlier studies by Tsai et al. (2017) and Sun et al.(2019), which identified rapid EV growth in California and other ZEV-mandated states. The displacement of gasoline demand by EVs is also documented in research by Park et al. (2020), who found that each 1% increase in EV market share corresponds to a measurable decline in per capita gasoline consumption. The IEA further supports this trend, indicating that the United States surpassed two million EVs in circulation, with adoption curves steepening as charging infrastructure improves and battery costs decline. It is important to consider how this transition erodes gasoline sales volume while opening pathways for diversification into EV-related services, such as charging station partnerships or alternative fuel offerings Burke and Stephens (2018) emphasized the significance of early adaptation in response to fuel substitution trends, noting that firms slow to adjust to electrification risk long-term competitiveness. Therefore, while the transition to EVs currently represents a niche shift, its accelerating pace demands strategic attention and investment planning.

The analysis revealed clear seasonal patterns in fuel pricing, with noticeable price increases during the spring and summer months. This aligns with historical pricing behavior identified by Karjalainen et al. (2024), who linked seasonal reformulated gasoline mandates and increased travel demand with mid-year price hikes. The EIA confirms that seasonal fluctuations are driven by both regulatory factors—such as summer-blend gasoline requirements—and demand surges tied to vacation travel. Simons (2013) demonstrated that these fluctuations offer opportunities for strategic inventory and pricing management, allowing fuel distributors to optimize profits by timing purchases and sales relative to expected seasonal peaks. Leveraging seasonal pricing data could improve revenue predictability through adjusted procurement cycles and targeted promotional campaigns. Previous

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findings by Mohamed and Koivo (2007) also highlight the importance of tracking global and domestic price drivers, including refinery capacity constraints and geopolitical events, which often coincide with seasonal variations. This reinforces the recommendation that companies implement predictive pricing models using historical seasonal indices, combined with short-term market signals. Optimizing fuel storage and marketing strategies around these predictable cycles can enhance margin control and reduce the risk of unsold inventory during price downturns.

A major insight from the study is the evolving behavior of fuel consumers, characterized by increased preference for fuel-efficient vehicles, alternative fuel options, and environmentally conscious decisions. This trend is substantiated by earlier research from Santos and Cornford (2024), who identified a growing awareness among consumers about the long-term cost and environmental impact of their transportation choices. Mohamed and Koivo (2007) further found that consumers increasingly consider fuel economy and life-cycle cost rather than just upfront vehicle prices. The U.S. EPA reported rising average fuel economy across new vehicles sold in the last decade, supporting this shift. Additionally, behavioral economics literature suggests that the adoption of hybrid and EV models is not solely driven by cost considerations but also by perceived identity, social norms, and environmental values. This change in consumer orientation may signal declining demand in core gasoline markets. Moreover, Forsberg (2023) noted that information asymmetry regarding fuel savings and technological skepticism may delay—but not halt—these behavioral shifts. Therefore, aligning branding and marketing strategies to reflect environmental stewardship and energy diversification could improve consumer retention and build reputational equity in a transitioning market.

The decision to supplement internal operational data with national-level datasets from the U.S. Energy Information Administration (EIA) proved essential for identifying broader trends. Internal company data lacked the temporal and geographical coverage necessary for analyzing national gasoline, propane, and oil demand. This finding aligns with recommendations from Avtar et al. (2019), who stressed the importance of integrating public datasets into firm-level energy forecasting models. The EIA provides consistent, longitudinal data on refiner sales, retail prices, and state-level consumption patterns, which enable a more holistic analysis. Nnabuife et al. (2023) emphasized that strategic decision-making in energy logistics requires triangulating firm-specific data with macroeconomic and sectoral insights. The inability to project regional demand shifts based on a single company's data highlights the limitations of small-to-mid-sized operators in engaging in national-level market forecasting. As previously noted by Simons (2013), firms that adopt multi-source data environments achieve greater resilience in demand planning and scenario analysis. Incorporating publicly available energy market data enables improved alignment of business strategies with nationwide shifts in fuel demand and pricing.

The insights obtained through market analysis support the development of forecasting models that incorporate electrification trends, consumer shifts, and pricing volatility. These findings echo earlier studies by Kabeyi and Olanrewaju (2022), who argued that dynamic energy markets require adaptive scenario planning rather than linear forecasting. The presence of multiple concurrent transitions—including EV adoption, climate policy enforcement, and carbon-conscious investment—necessitates complex modeling frameworks capable of simulating multiple pathways. The use of data from EIA's Short-Term Energy Outlook (STEO) and the National Energy Modeling System (NEMS) allows for more accurate scenario planning, as documented by Mohamed and Koivo (2007). Incorporating such models into strategic planning enables firms to assess how various demand scenarios—such as EV-dominant futures or policy-induced demand suppression—may impact revenue streams and infrastructure needs. Forsberg (2023) confirmed the utility of such models for private sector energy decision-making. Therefore, developing internal capacity for scenario planning, using both econometric and machine learning tools, supports more agile operational strategies and capital investments based on shifting demand trajectories.

The combination of persistent gasoline dependence, emerging EV disruptions, seasonal pricing patterns, and shifting consumer behavior presents both risks and opportunities for fuel distributors. Earlier strategic management studies, such as those by Kabeyi and Olanrewaju (2022), emphasize the role of adaptability and resource reconfiguration in maintaining competitive advantage amid industry change. The current findings reinforce the necessity of diversifying product offerings, such as investing in EV infrastructure, biofuels, or mobile fueling technologies, to hedge against declining gasoline demand. Avtar et al.(2019) emphasized that logistics agility and data-driven operations are crucial for downstream energy firms facing technological disruption. Additionally, Karjalainen et al. (2024) argued that firms with advanced fuel price forecasting and inventory optimization systems demonstrate superior performance during price volatility. As a regional distributor, a strategic response must also consider geographic segmentation and demographic targeting to preserve core revenues while expanding into adjacent markets. The literature thus supports a proactive and informed transformation agenda that aligns closely with evolving market dynamics and ensures operational resilience within an increasingly electrified and sustainability-conscious energy landscape.

RECOMMENDATIONS

A company operating in the fuel distribution sector can enhance its market position and ensure long-term profitability by implementing several strategic recommendations. First, diversifying product offerings is crucial. Investing in the development of a network of electric vehicle (EV) charging stations at key locations, including existing fuel stations, can help meet the growing demand for EV-friendly infrastructure. Additionally, offering renewable energy solutions such as biofuels, hydrogen, and renewable propane can attract eco-conscious customers and align with environmental goals. Partnering with logistics companies to provide hybrid fueling solutions that combine gasoline with EV charging services can address the evolving needs of fleet operators. Optimizing pricing strategies is another critical area. By introducing dynamic pricing models that adjust in real-time based on seasonal trends, regional demand, and market conditions, profitability can be maximized during peak periods while maintaining competitiveness during off-peak times through strategic pricing and demand-responsive initiatives. Promotional campaigns, such as targeted discounts and loyalty programs during low gasoline demand periods, can boost customer engagement and sales. Moreover, competitive pricing for industrial and commercial sectors, where natural gas and propane demand remains steady, can ensure long-term customer retention.

Strengthening marketing efforts will further solidify market presence and enhance brand visibility within the competitive energy sector. Positioning the company as a sustainable energy leader through eco-friendly branding, highlighting investments in clean energy and alternative fuels, and leveraging strategic advertisements and community initiatives can boost its reputation. Localized marketing campaigns tailored to regional energy needs—such as promoting propane in colder areas for heating and renewable energy in regions with high EV adoption—can enhance effectiveness. Collaborating with government and private entities to co-sponsor clean energy initiatives will also improve visibility and credibility. Leveraging advanced analytics can provide valuable insights to refine strategies. By analyzing customer behavior, marketing efforts and product offerings can be tailored to meet specific preferences and enhance customer engagement. Predictive demand modeling can help anticipate energy consumption trends, enabling proactive inventory and service adjustments. Real-time monitoring tools for tracking energy market fluctuations and customer preferences will ensure agility in decision-making. Lastly, expanding infrastructure is vital for growth. Emerging markets such as Washington and Colorado should be targeted, while maintaining a strong presence in established markets like California and New York. Establishing dedicated refueling hubs for commercial fleets, which integrate traditional fuel options with EV charging capabilities, can cater to diverse energy needs. By adopting these strategies, organizations can diversify their offerings, retain customer loyalty, and adapt to evolving market trends, ensuring resilience and sustained profitability.

LIMITATIONS

This report encountered several limitations due to data constraints. As internal data from smaller, regionally focused energy distributors is often proprietary and not publicly accessible, the analysis relied heavily on external sources to assess broader market trends. As a result, it was not possible to assess the overall oil market scenario specifically from their perspective. To address this, we relied on data from the U.S. Energy Information Administration (EIA), which provided a large dataset spanning from 1983 to September 2024. However, these datasets were incomplete and required significant cleaning to address gaps and inconsistencies. Additionally, while the data revealed a decline in oil consumption over recent years, understanding the exact reasons for this trend was challenging due to the absence of contextual factors like inflation, improvements in energy efficiency, and advancements in technology. These missing details limit the ability to fully analyze the underlying causes of changing consumption patterns. Therefore, The findings and suggestions provided in this report are primarily based on historical data and trends in the U.S. energy market, which may not capture all nuances necessary for developing a fully customized strategy for a specific regional fuel distributor.

CONCLUSION

The current energy market presents a dynamic and continuously evolving landscape, shaped by technological advancements, regulatory shifts, and changing consumer behaviors. Navigating this environment requires fuel distributors to move beyond traditional business models. By embracing diversification, adopting innovative pricing strategies, and investing in emerging technologies such as electric vehicle (EV) infrastructure and renewable fuel options, companies can position themselves for long-term sustainability and competitiveness. These strategic approaches not only mitigate risks associated with declining gasoline demand and volatile market conditions but also open pathways to capture growth in high-potential sectors. Implementing data-driven pricing models enables more responsive and profitable operations, while infrastructure investments in alternative energy sources align with the ongoing transition to cleaner transportation and heating solutions. Furthermore, targeted marketing efforts and geographic expansion into both established and emerging markets support customer retention and revenue growth. The recommendations provided in this report are designed to serve as a roadmap for energy distributors seeking to adapt to the structural shifts within the U.S. energy economy. With a proactive and flexible strategic approach, organizations can seize new opportunities, maintain operational resilience, and ensure long-term relevance in an increasingly diversified energy marketplace.

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