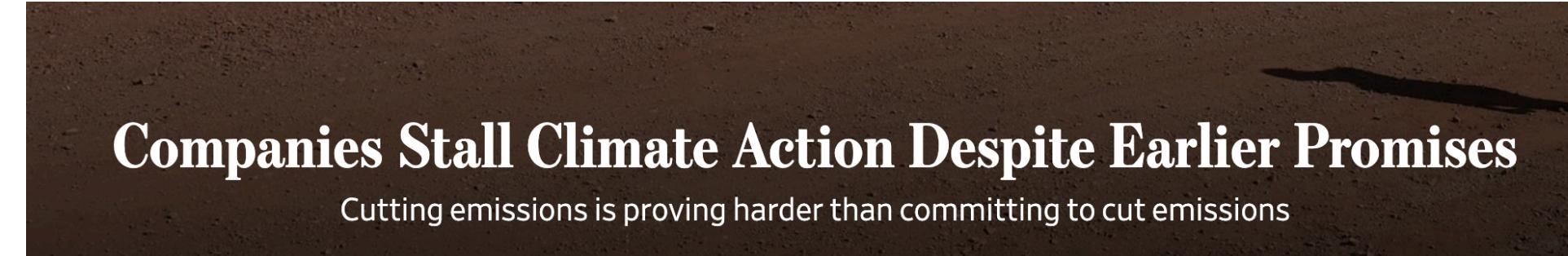


Oil at \$100 Is Too High, Even for Energy Companies

As crude oil prices near triple digits, it isn't just consumers feeling uneasy

By [Jinjoo Lee](#) [Follow](#)

Sept. 23, 2023 10:00 am ET



Companies Stall Climate Action Despite Earlier Promises

Cutting emissions is proving harder than committing to cut emissions

The Fed's Next Challenge: \$100 Oil

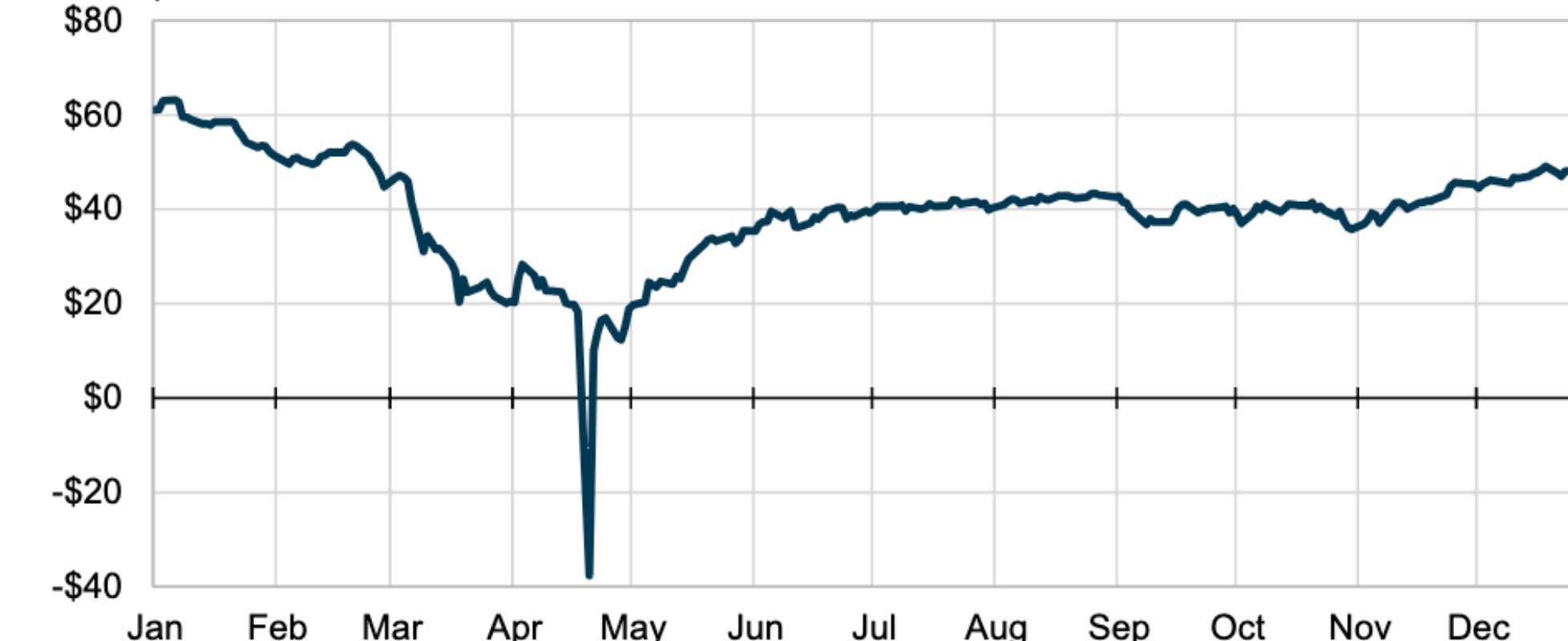
Saudi output cuts and record demand have pushed crude prices 26% higher this quarter

By [Joe Wallace](#) [Follow](#) and [David Uberti](#) [Follow](#)

Updated Sept. 19, 2023 3:42 pm ET



Daily West Texas Intermediate crude oil futures price (2020)
dollars per barrel



Source: U.S. Energy Information Administration, New York Mercantile Exchange (NYMEX)

Note: Prices reflect front-month (contract with the earliest delivery date) futures prices.

Saudi Arabia and Russia Win Big in Gamble on Oil Cuts

Brent crude is climbing toward \$100 a barrel after the two OPEC+ nations made risky choice to slice production

By [Anna Hirtenstein](#) [Follow](#)

Updated Sept. 28, 2023 4:42 am ET

Fuel Prices Are Soaring. Who Is Feeling the Pinch?

Production cuts by OPEC and its allies push crude oil to 10-month highs

By [Bob Henderson](#) [Follow](#)

Updated Sept. 14, 2023 4:15 pm ET

UAW Strike Hurts Demand for Steel

Lower demand for auto steel adds pressure to tumbling steel prices

By [Bob Tita](#) [Follow](#)

Updated Oct. 2, 2023 10:13 am ET

Crude Oil

Within The Context of Oligopoly Market

Florence Chen Xu

Quick concept

- **Crude Oil WTI:** A specific type of crude oil, West Texas Intermediate (WTI), known for its high quality and a widely traded futures contract in the energy markets.
- **Oligopoly Market:** A market structure with a few dominant firms influencing prices.
- **Futures Contract:** An agreement to buy/sell assets at set prices on future dates, used for risk management and speculation, with crude oil being a popular contract type for trading.

Executive Summary

- **The Problem:** What insights can be gleaned from the variance in crude oil prices within the context of oligopoly market?

- **Data and Methods Used**

- Exploring correlation for crude oil WTI, US automakers & US oil companies
- Building Machine Learning Model for forecasting crude oil WTI thereby to enhance the comprehension of risk exposure
- Analyzing U.S. automakers' financial performance in the context of crude oil WTI fluctuations
- Time Series Analysis of U.S. greenhouse gas emission

- **Data Source**

- United States Environmental Protection Agency
- Federal Reserve Economic Data
- Alpha Vantage API
- US Energy Information Administration
- U.S. Securities and Exchange Commission API

Executive Summary

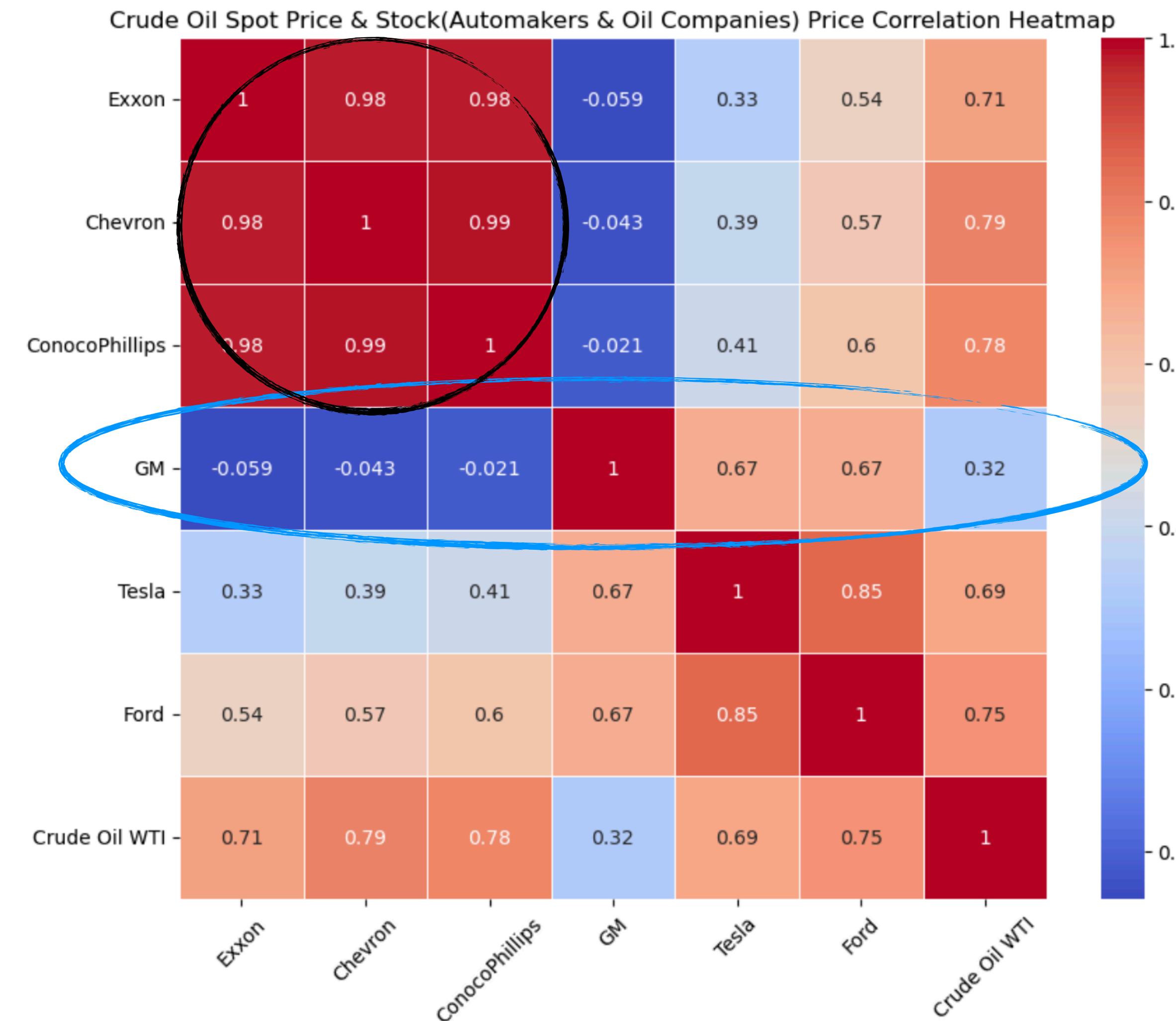
• Key Findings:

- The stock prices of oil companies and automaker is sensitive to the fluctuations in oil price.
- XGBoost model demonstrates strong performance, with R-squared (R²) values exceeding 90%. This indicates that over 90% of the variability in weekly crude oil WTI prices can be accounted for by the model.
- While these statistical metrics are strong indicators that the model fits the data well and captures a significant portion of the price fluctuations, it is crucial to incorporate additional relevant features, such as commodities trading activities, to achieve more meaningful R-squared (R²) scores. This approach will enhance both the statistical robustness and financial significance of the model.
- Cyclical companies face limitations on profit growth tied to broader economic conditions, especially in long-term.
- Balancing environmental objectives with economic stability is paramount. A robust economy and a sustainable environment must coexist, as an imbalance would have long-term repercussions for all stakeholders. Achieving this equilibrium necessitates collaborative efforts among oil companies, automakers, and government entities.
- The sharp rise in crude oil prices can have a cascading impact, resulting in elevated diesel and gasoline prices. This, in turn, can trigger a ripple effect, leading to increased costs for delivery services, higher product prices, reduced consumer spending, and ultimately, a dampening effect on economic growth. Consequently, cyclical industries such as automakers can also be adversely affected.
- To expedite the transition to a hydrogen-based economy, the responsibility for building a robust infrastructure should not fall solely on one party. Collaboration and shared responsibility among stakeholders are essential for achieving this goal efficiently and effectively.
- *Crude oil (oligopoly market) + automaker (cyclical company) + climate change (global issue) = collaboration*

**Correlation Exploration
For
Crude Oil WTI,
U.S. Automakers & U.S. Oil Companies**

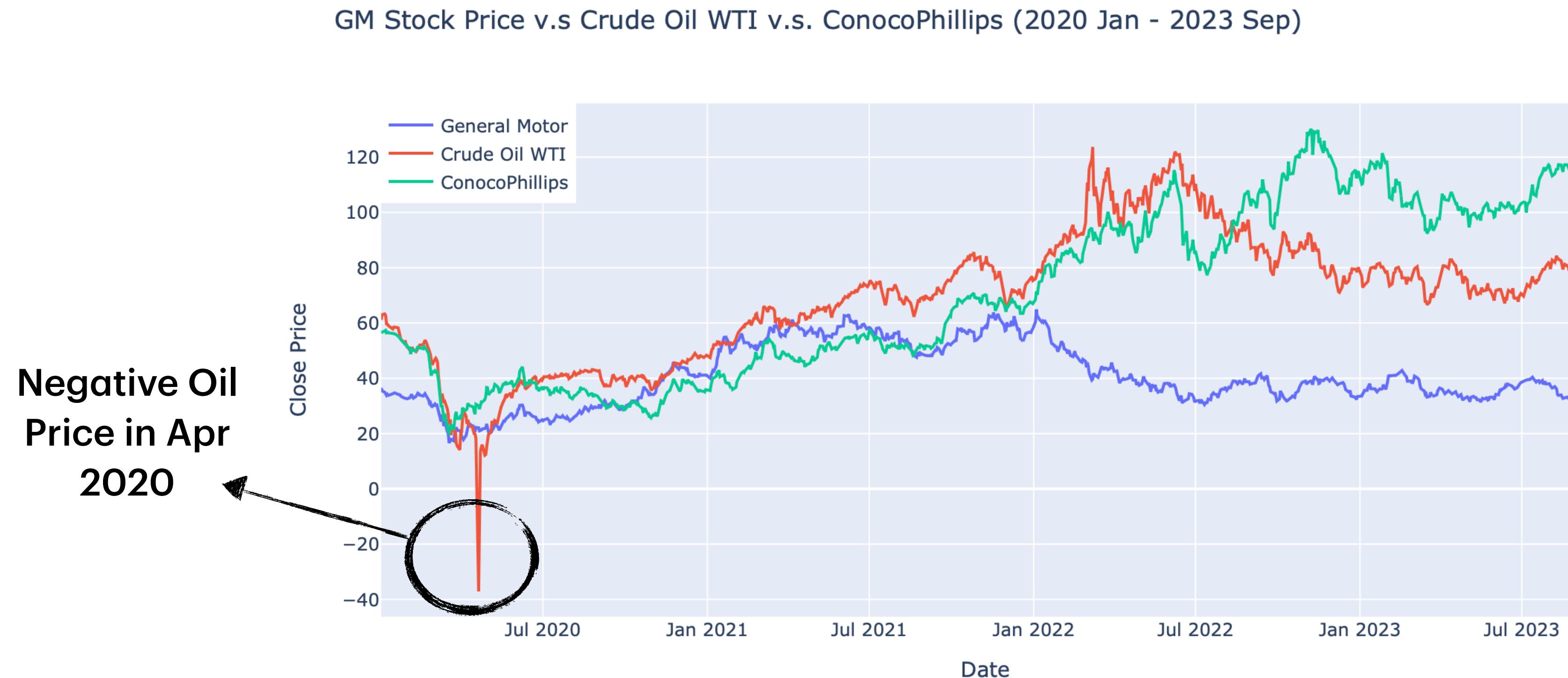
Correlation Heatmap

The stock prices of oil companies and automaker is sensitive to the fluctuations in oil price.



Time Series Analysis

The stock prices of oil companies and automaker is sensitive to the fluctuations in oil price.



- After the removal of the outlier and focusing on data from January 2021 onward, the correlation between General Motors' stock price and the Crude Oil WTI spot price is approximately -0.457. Furthermore, the correlation between General Motors' stock price and ConocoPhillips' stock price stands at -0.805 during this period.

Crude Oil WTI Spot Price Prediction Model

Introduction of Model

- **Main purpose:**
 - forecast Crude Oil WTI futures contract spot prices, thereby enhancing the comprehension of risk exposure.
 - attain a holistic comprehension of the features exerting the most pronounced influence on crude oil WTI
- **Model Selection:** XGBoost
- **Methods for Model Optimization**
 - Applying different date range
 - Different features selection
 - Correlation analysis

Model I

—monthly basis (2020 Jan - 2023 May)

- **Data Selection**

- **Target Variable:** monthly Crude Oil WTI spot price

- **Features**

- US crude oil export/import/stock
 - Henry Hub Natural Gas Spot Price, Crude Oil Brent
 - Export/Import Price Index (North American Industry Classification System): Petroleum and Coal Products Manufacturing
 - Consumer Price Index for all items, Federal funds effective interest rate
 - US Vehicle monthly sales, Personal income

- **Data selection considerations:**

- Data Availability
 - Ended ban on export in 2015
 - Feature Analysis

Model I

Performance Evaluation

• Statistical Analysis

- Mean Squared Error (MSE) : 33.014

- Root Mean Squared Error (RMSE) : 5.746

- After checking both MSE AND RMSE, a lower RMSE indicates that, on average, the model's predictions are off by approximately 5.746 units from the actual monthly crude oil prices.

- R-squared (R2) : 0.946

- An R-squared value of 0.946 suggests that the model explains approximately 94.6% of the variance in crude oil prices.

• Features & Correlation Analysis

- CPI emerges as the most influential feature, boasting an importance score of approximately 0.433. In addition, it exhibits a substantial correlation of 0.803 with monthly crude oil WTI prices.

- Both the Export Price Index and Import Price Index within the NAICS category of Petroleum and Coal Products Manufacturing demonstrate significant correlations of 0.95 and 0.93, respectively, with monthly crude oil WTI prices.

- Brent crude oil price, primarily sourced from the North Sea in Europe, exhibits the highest correlation among all features, standing at an impressive 0.997.

Correlation Table	
	monthly_value
monthly_value	1.000000
crude_brent	0.997987
export_index	0.952818
import_index	0.933143
cpi	0.803724
gas_Henry	0.795831
year	0.765163
sum_import	0.632127
personal_income	0.566913
sum_export	0.397303
sum_production	0.315089
interest	0.310392
month	-0.014865
vehicle_sales	-0.034934
sum_stock	-0.768133

Model II

— weekly basis (2020 Jan - 2023 May)

- **Data Selection**

- **Target Variable:** weekly Crude Oil WTI spot price

- **Features**

- Weekly Refiner Production
 - Weekly Blender Production
 - Weekly Imports and Exports
 - Weekly Stock

- **Model Optimization**

- the removal of the Crude Oil Brent price variable
 - Increase the dataset by expanding date range

Model II

Performance Evaluation

• Statistical Analysis

- Model (Scenario A: with all features)

- Mean Squared Error (MSE) : 8.845
 - Root Mean Squared Error (RMSE) : 2.974
 - R-squared (R2) : 0.983

- Model (Scenario B: with one highly correlated feature removed - Crude Oil Brent)

- Mean Squared Error (MSE) : 25.638
 - Root Mean Squared Error (RMSE) : 5.063
 - R-squared (R2) : 0.952

- Features & Correlation Analysis

- Both feature importance selected by the XGBoost and correlation values consistently emphasize the significance of natural gas spot prices, which exhibit a strong correlation value of 0.560 with crude oil Brent.
 - It's essential to note that the ban on crude oil exports was lifted only in December 2015. Consequently, the inclusion of data from the restricted export period could explain the relatively low correlation value of -0.270.

Correlation Table	
	oil_spot_price_weekly
oil_spot_price_weekly	1.000000
brent_spot	0.981112
natural_gas_spot	0.559950
sum_refiner	0.466260
sum_import	0.274031
day	-0.005704
month	-0.017867
sum_stock	-0.164682
sum_export	-0.270880
year	-0.338376
sum_blender	-0.390470

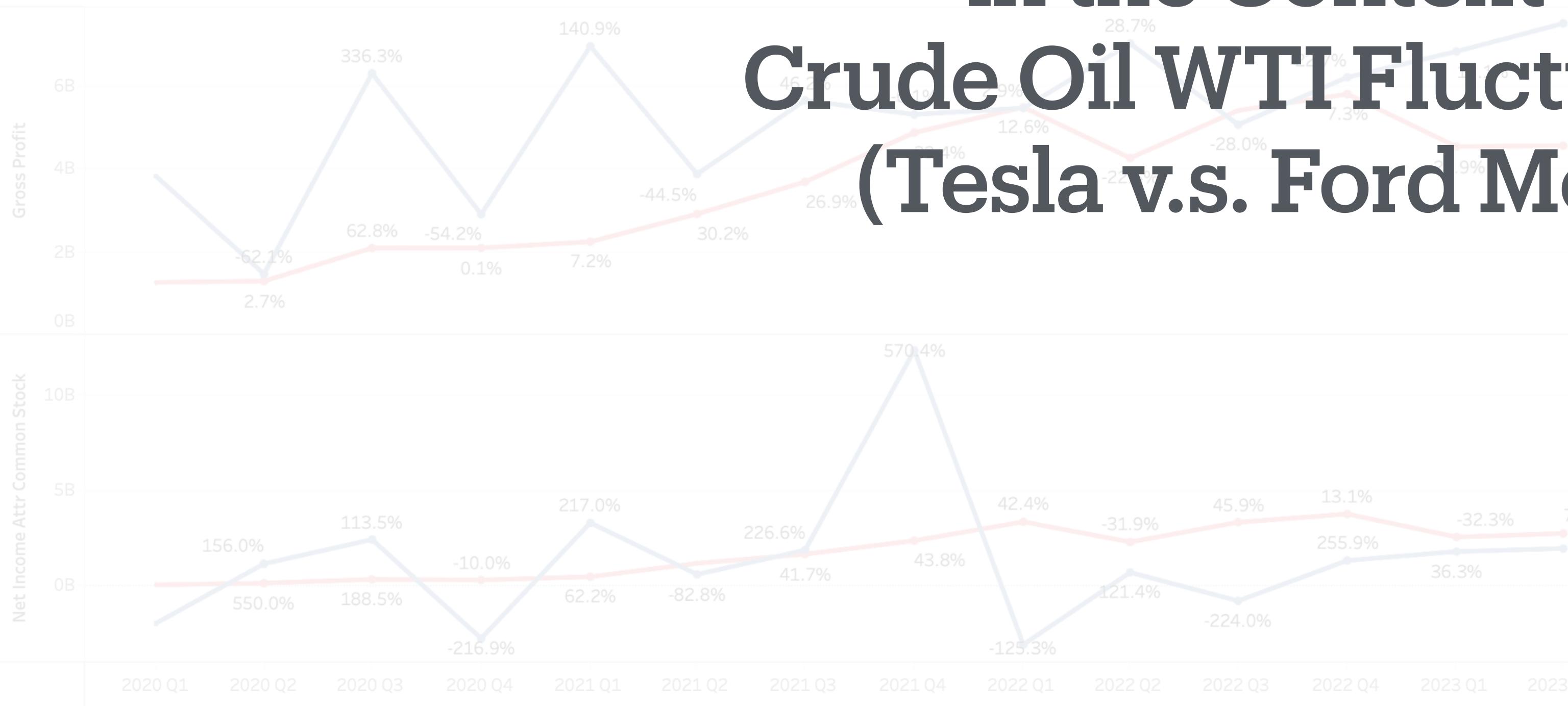
Recommendation of Model

- **Different Features Selection**

- Daily trading volume
- Open/High/Low/Close prices
- Natural gas import/export/production/demand
- CPI per item (e.g. vehicle, energy)

- **Different Model Suggestion**

- Neural network(LSTM) 's “black box” v.s. oligopoly market's “black box”



Financial Measures

Cyclical companies face limitations on profit growth tied to broader economic conditions, especially in long-term.

- **Approaches**

- Common size analysis balance sheet as of Jun 30th,2023
- Cross-sectional company financial ratio analysis

- **Key Findings**

- **Different operational strategies in response to the crude oil market**

- *Fotor Motor*, with over a century of operations, adheres to a conventional operational model. Ford Credit, being its subsidiaries which specializes in providing financial services and flexibilities to the clients and help to facilitate its total vehicles' sales, maintains a significant leverage in its operations.
 - *Tesla*, established two decades ago, focuses on continuous exploration of new technologies, diversifying its capital structure to navigate the challenges of the current oil market.

- **Different profitability strategies in response to the crude oil market**

- *Ford Motor* has sought external investments and collaborations to strengthen its presence in the new energy vehicle sector, albeit with varying results. Both companies face limitations on profit growth tied to broader economic conditions.
 - *Tesla* has pursued continuing cost reduction and product differentiation strategies to bolster profitability.

Climate Change

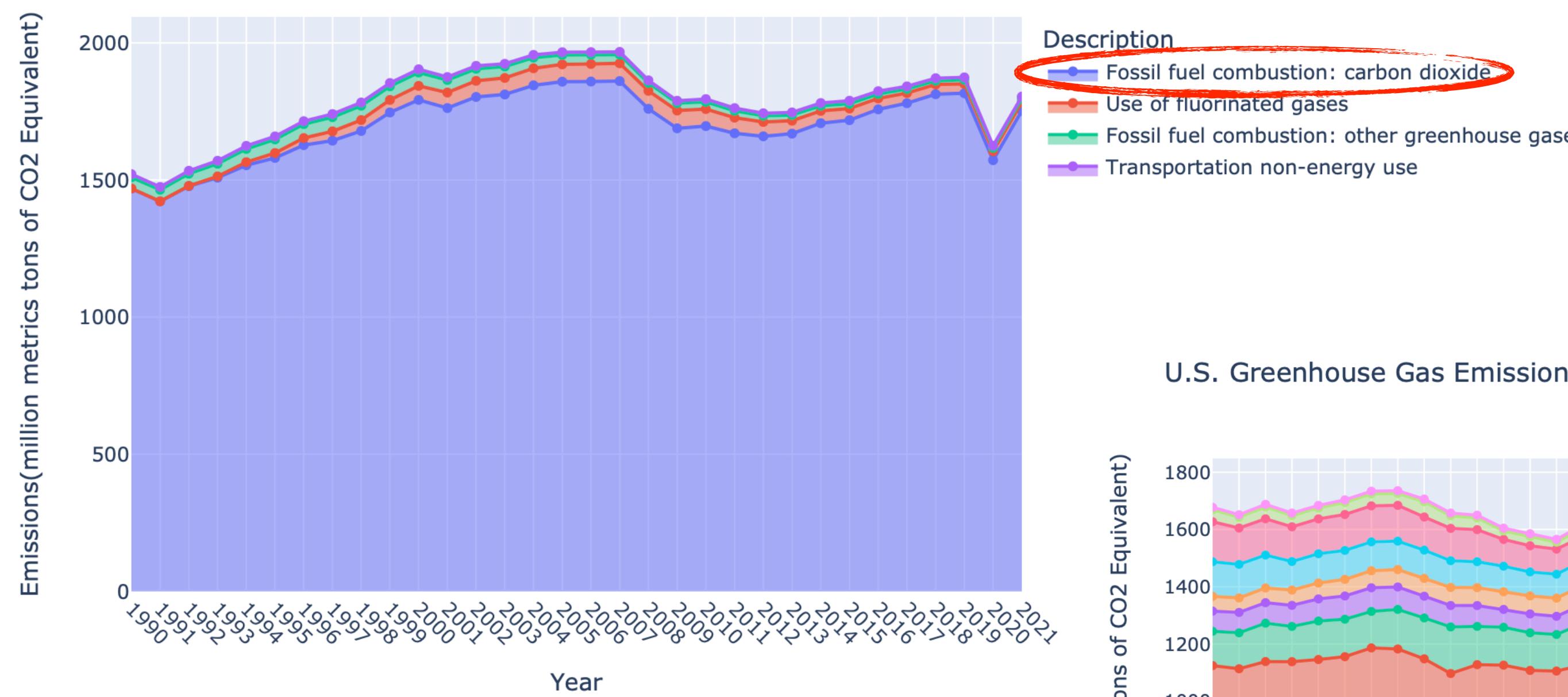
v.s.

Crude Oil

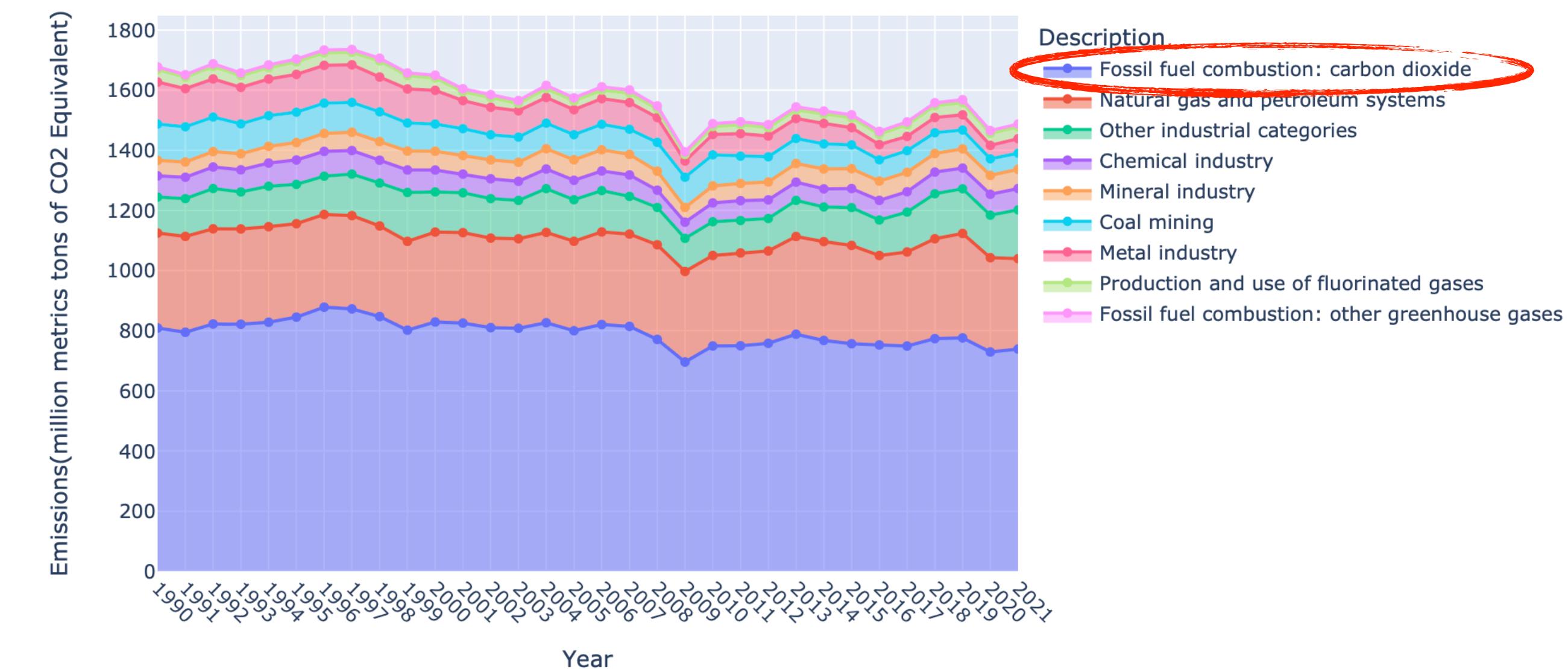
U.S. Greenhouse Gas Emission

From 1990 to 2021 reveals that the predominant source of emissions is fossil fuel combustion.

U.S. Greenhouse Gas Emission from the Transportation Sector, 1990-2021



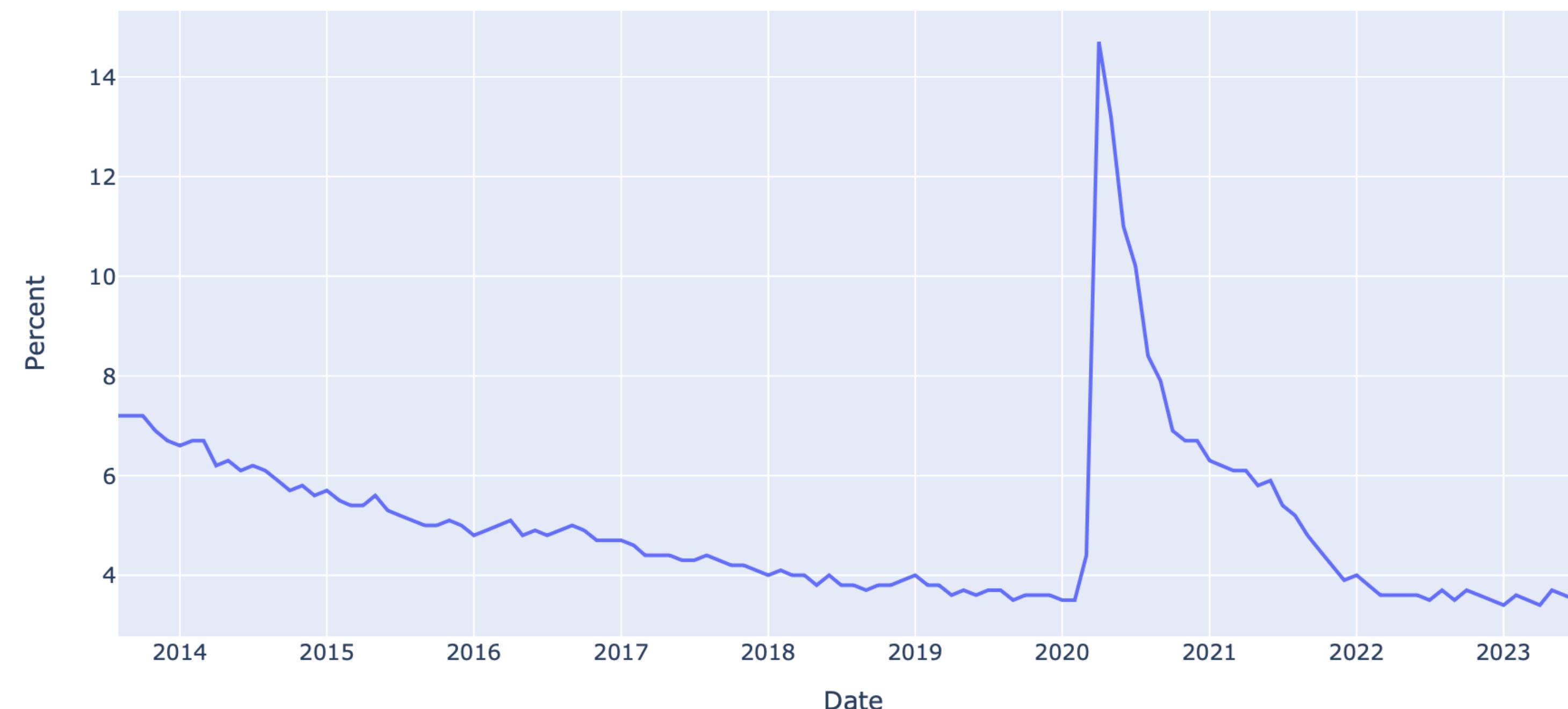
U.S. Greenhouse Gas Emission from the Industry Sector, 1990-2021



U.S. Unemployment Rate

- An efficient transition process to alternative energy sources, such as hydrogen, is imperative to mitigate potential impacts on employment rates within the energy sector.
- Balancing environmental objectives with economic stability is paramount.

US Unemployment Rate (from 2013 Aug to 2023 Aug)



Crude Oil
(Oligopoly Market)

+

Automaker
(Cyclical Company)

+

Climate Change
(Global Issue)

=

COLLABORATION

Recommendations

- **Different Model Suggestion**
 - Neural network's "black box" v.s. oligopoly market's "black box"
- **Risk Mitigation Strategies in short-term**
 - Utilize Candlestick Charts for Seasonal Data Analysis.
- **Cross-Sectional Analysis:**
 - Compare automaker's performance with S&P 500 statistics grouped by S&P/MSCI Global Industrial Classification System
- **Different Marketing Strategies within the context of oligopoly market**
 - Evaluate Sales vs. Leasing of Electric Vehicles.

THANK YOU :)