



Forecasting Energy Commodity Prices with Deep Neural Networks: *A Case Study on Crude Oil and Natural Gas*

Team Members:

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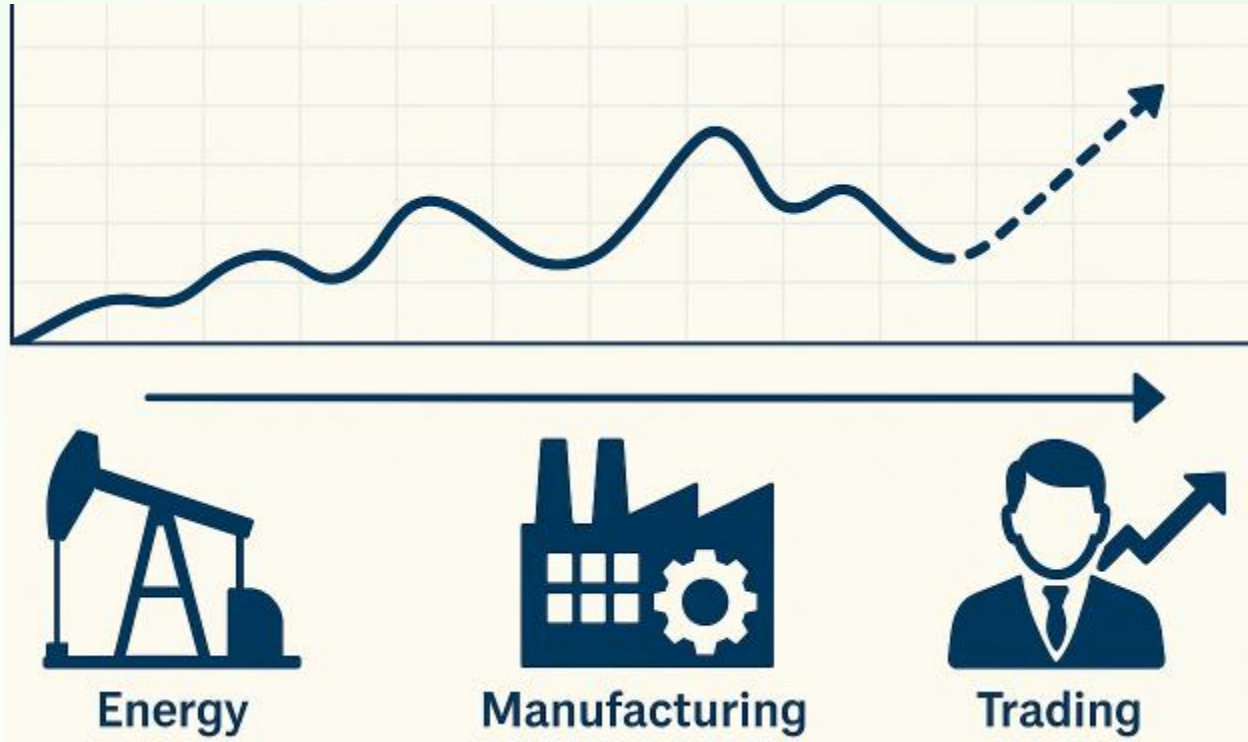
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Content

- Introduction (Problem Statement)
- Dataset Description
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Problem Statement

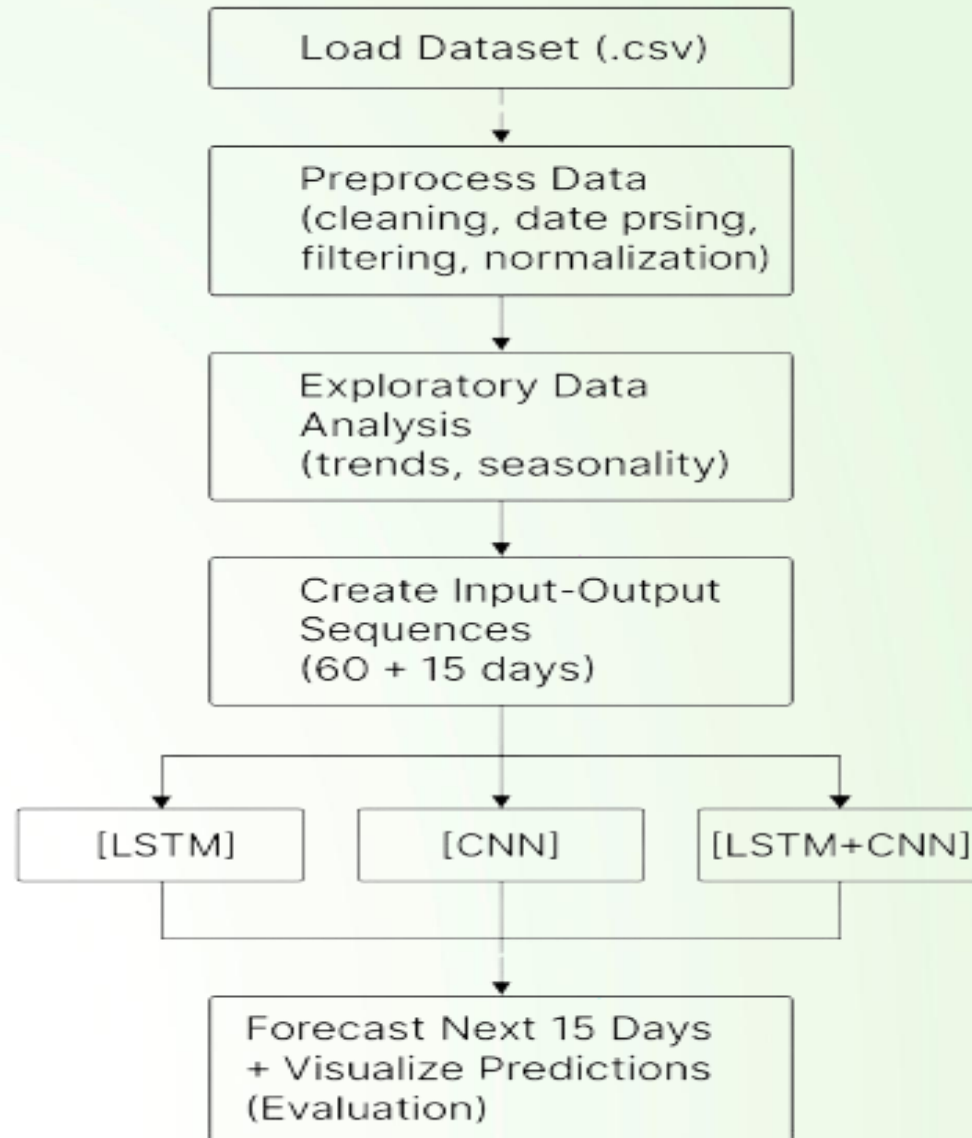


- Natural resource prices, such as crude oil and natural gas, are highly volatile and impact a wide range of stakeholders including businesses, policymakers, and households.
- This project aims to develop a deep learning model to forecast these prices, helping stakeholders make informed and timely decisions.

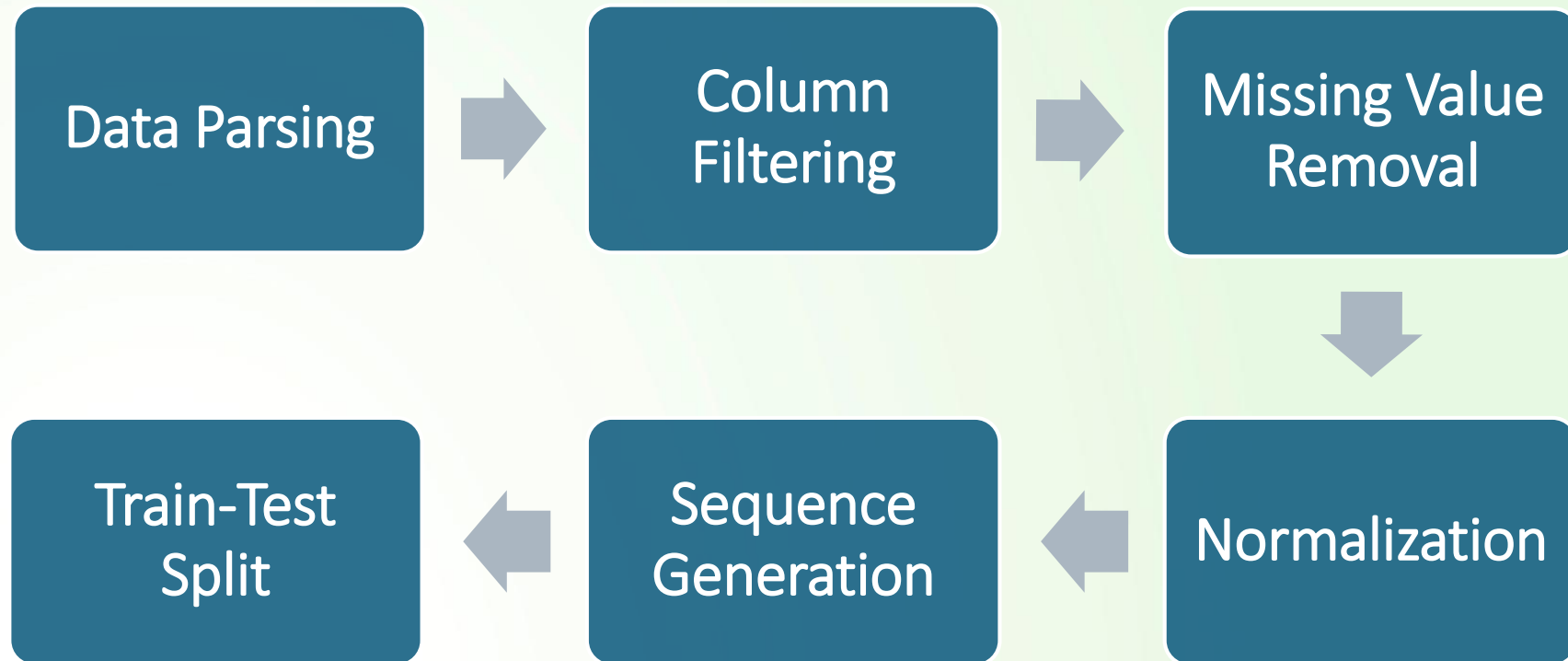
Dataset Description

- **Source:** Historical commodity price data (e.g., natural gas, oil, or minerals)
- **Time Range:** Daily records from January 1997 to early 2023
- **Features**
 - **Date:** Timestamp of each price record
 - **Settle:** Daily settlement price (used as the target variable)
 - Derived features created for modeling include (Moving averages 14-day)

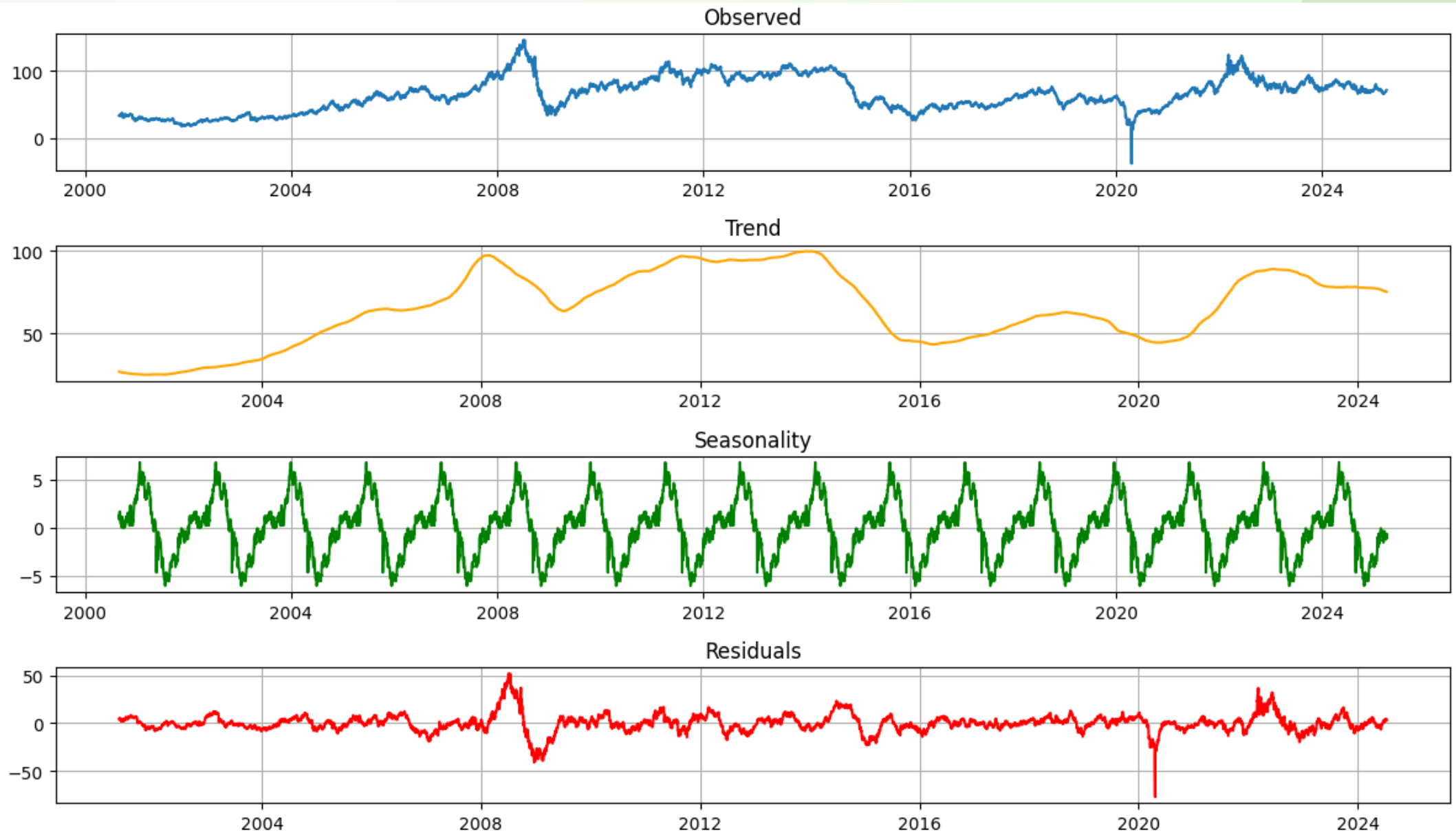
Project Workflow



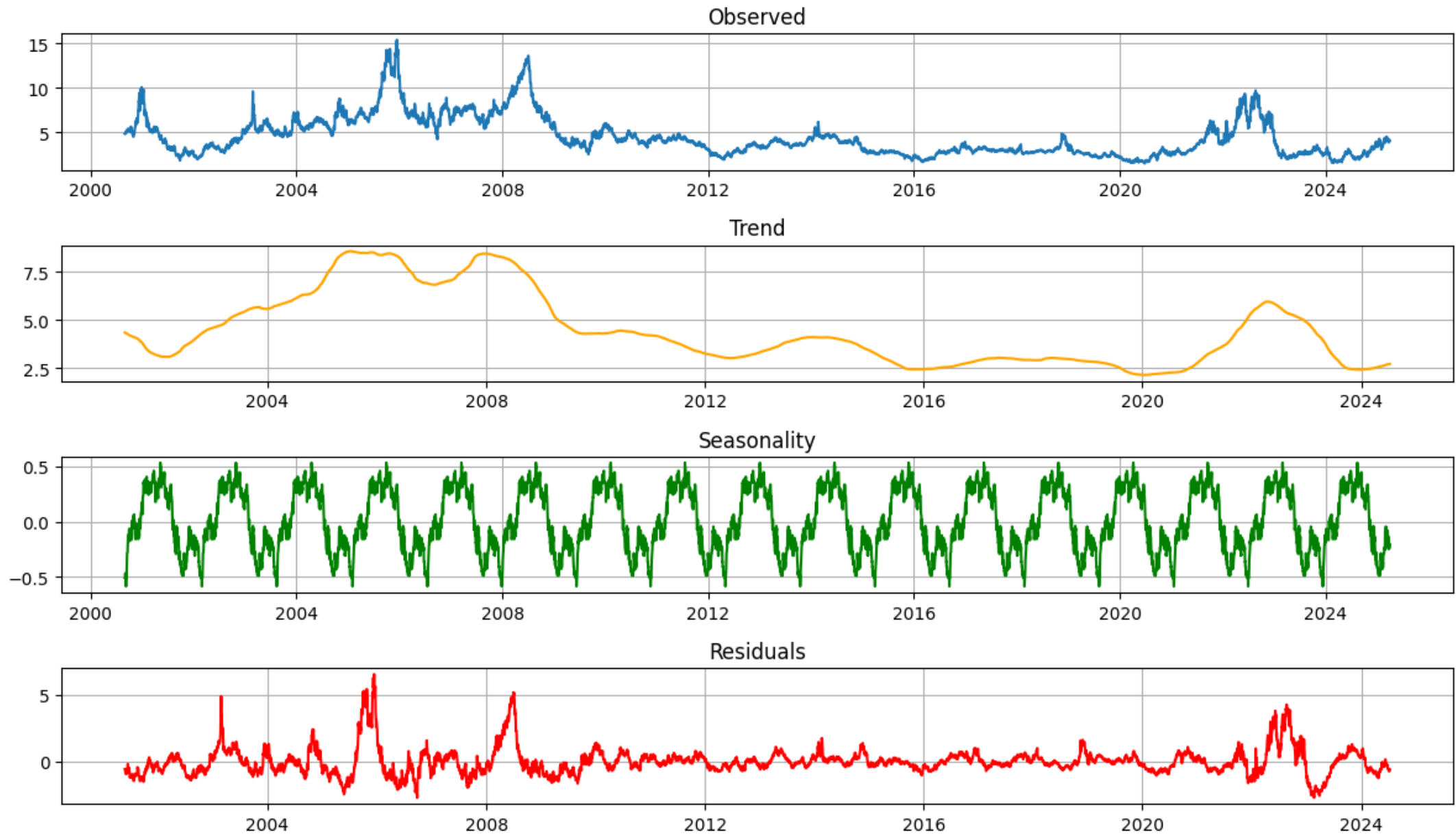
Dataset Preprocessing



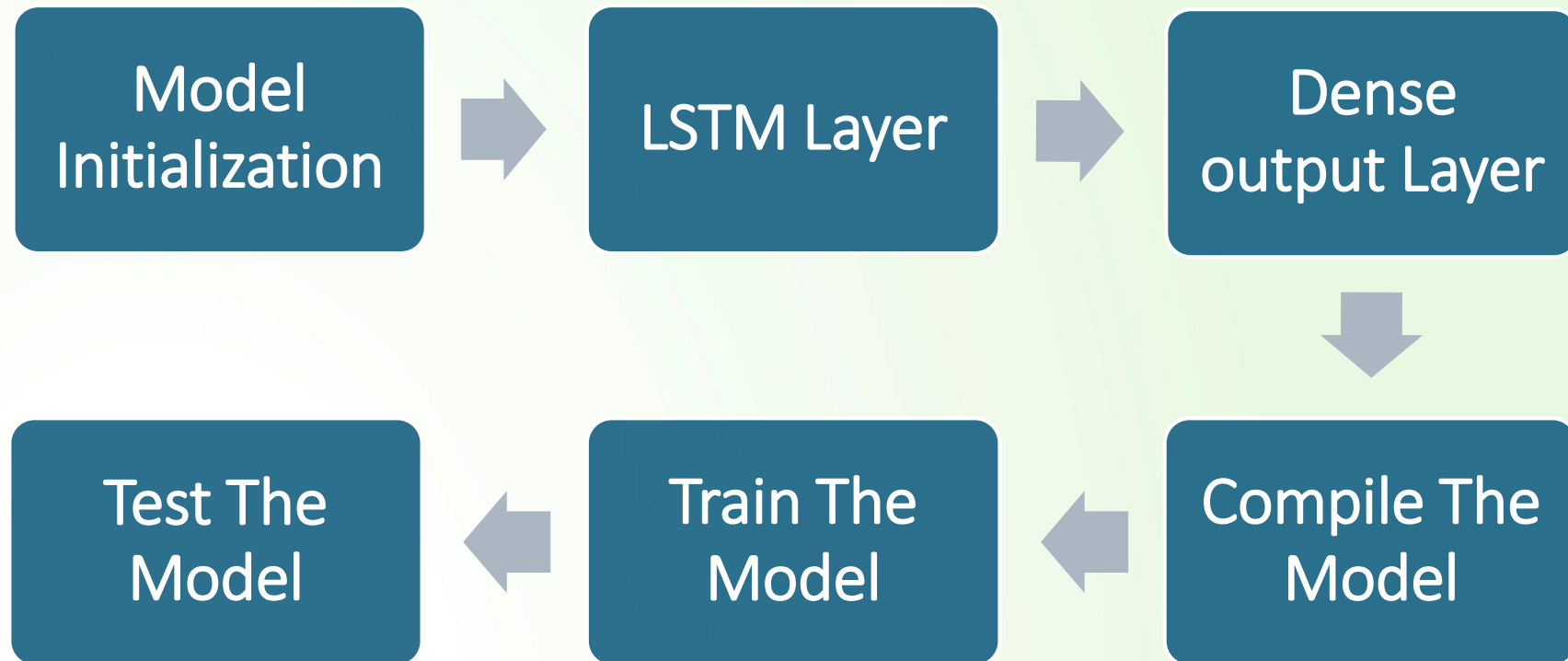
Crude Oil Seasonal Data



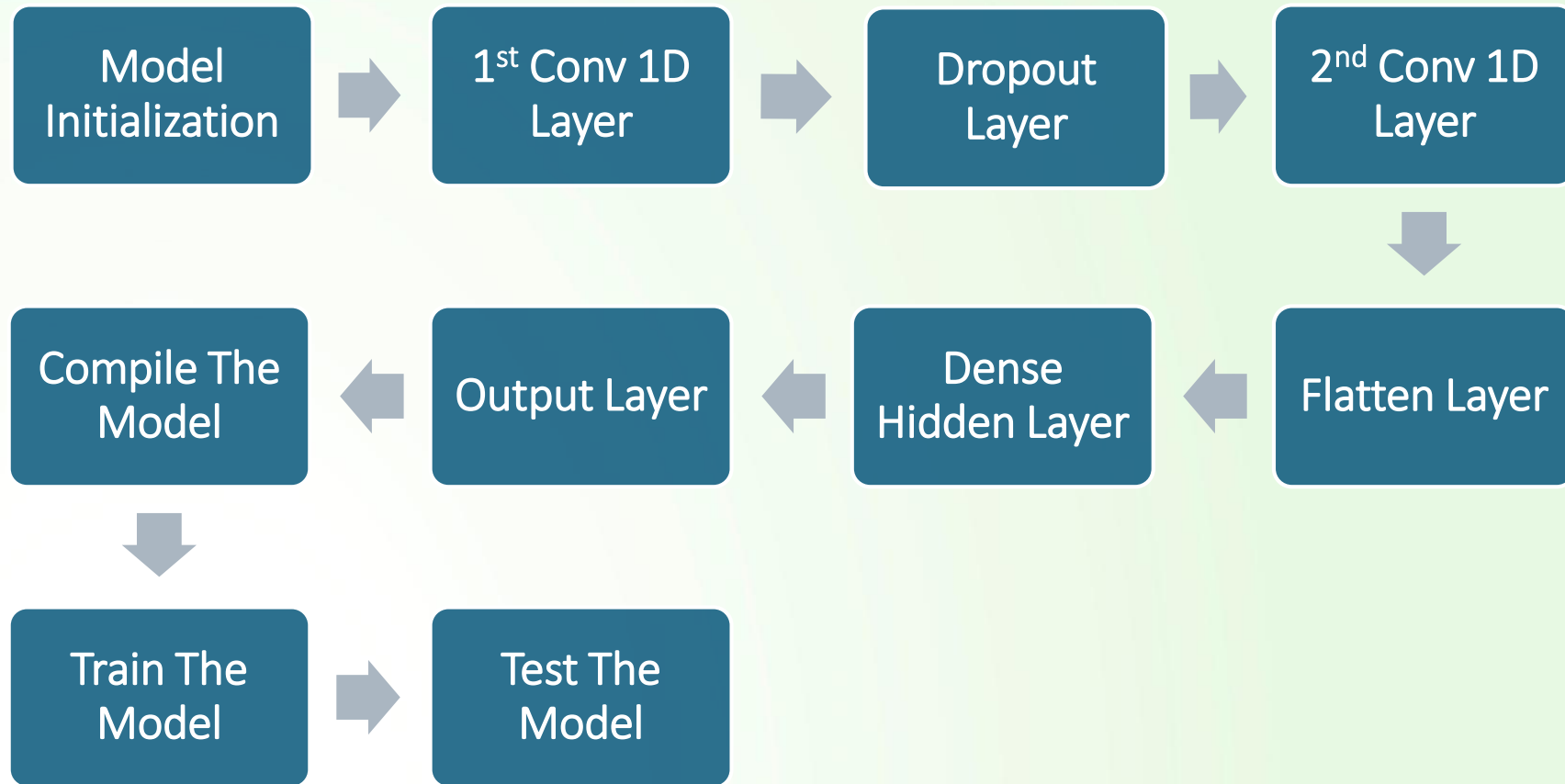
Natural Gas Seasonal



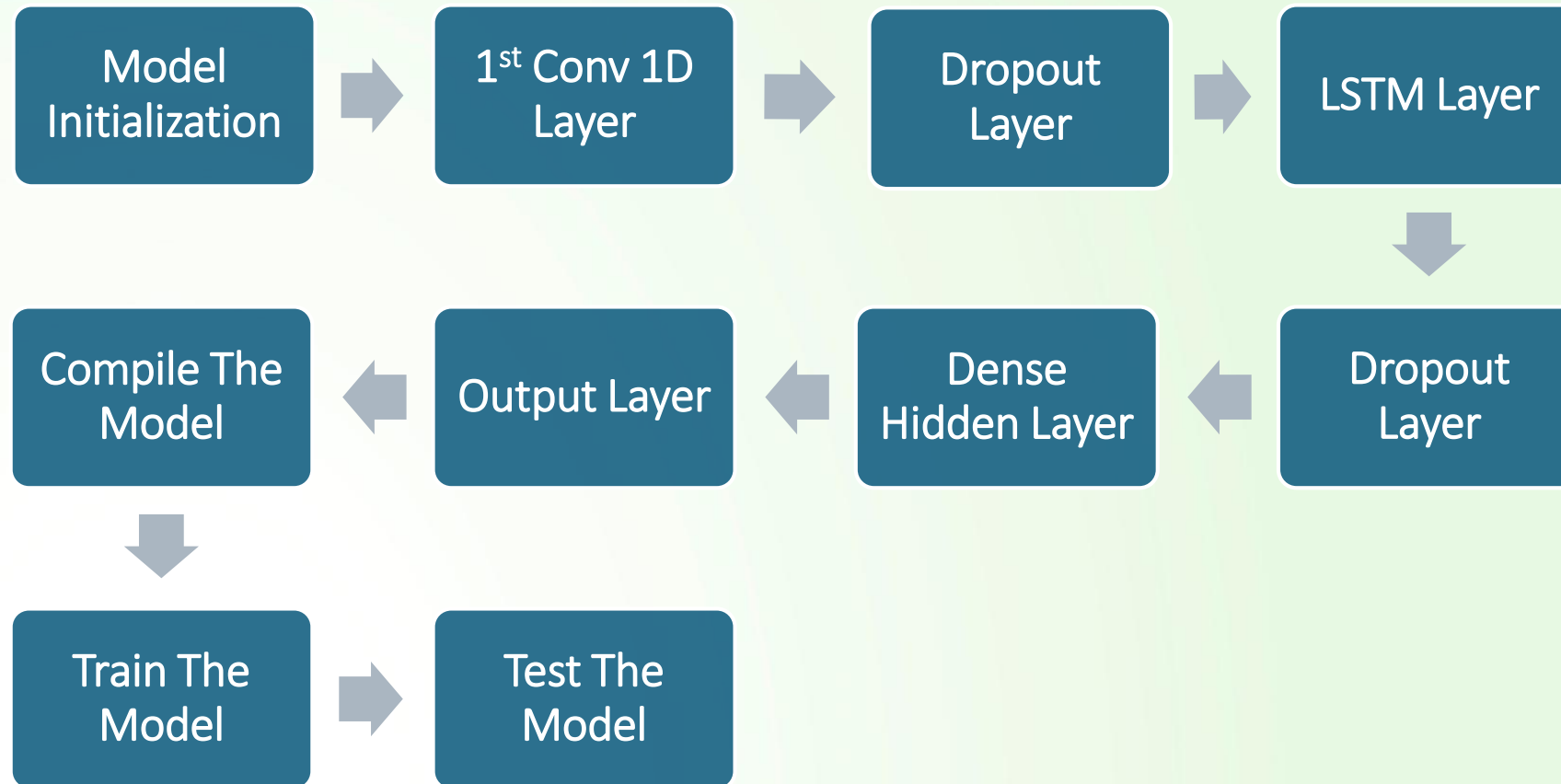
LSTM Model



CNN Model

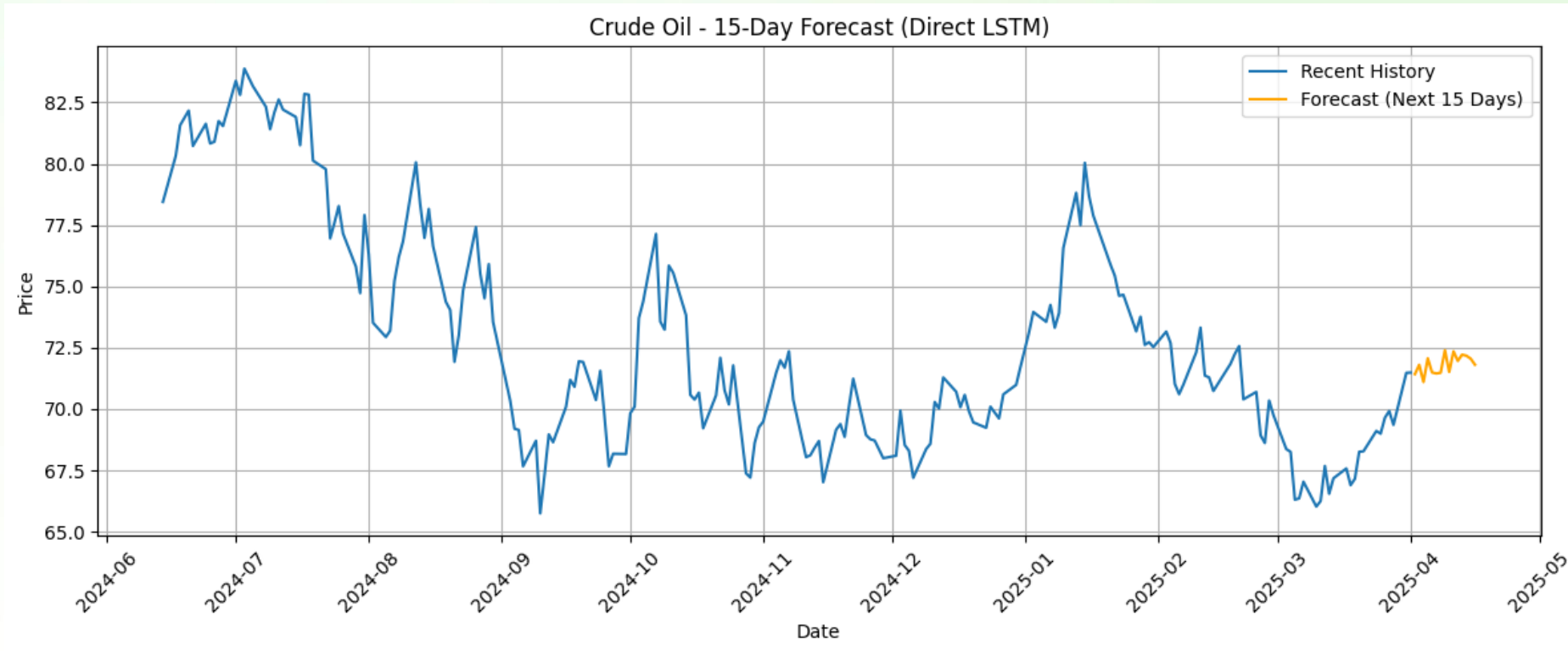


CNN+LSTM (Hybrid) Model



Result for LSTM

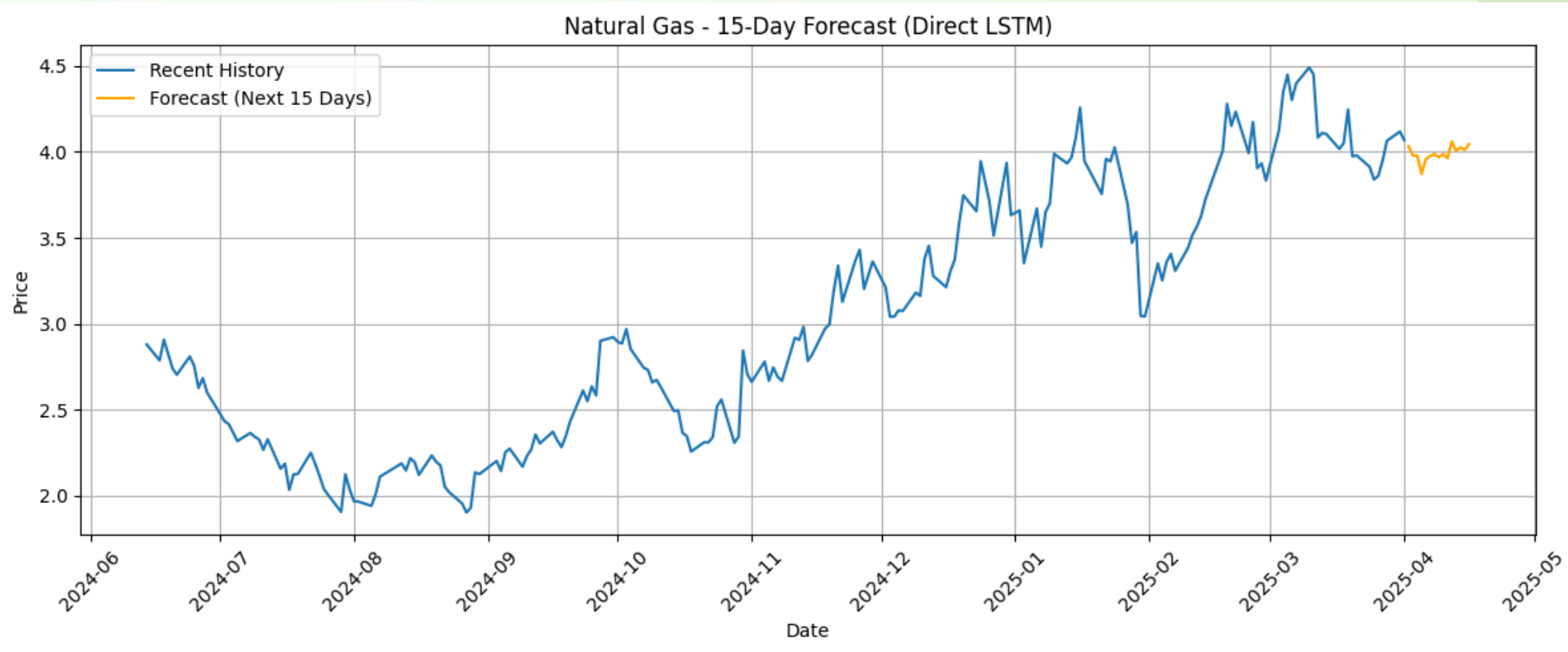
Crude Oil



Metrics for Crude Oil: RMSE: **5.37**, MAE: **3.95**, R^2 Score: **0.9053**

Result for LSTM

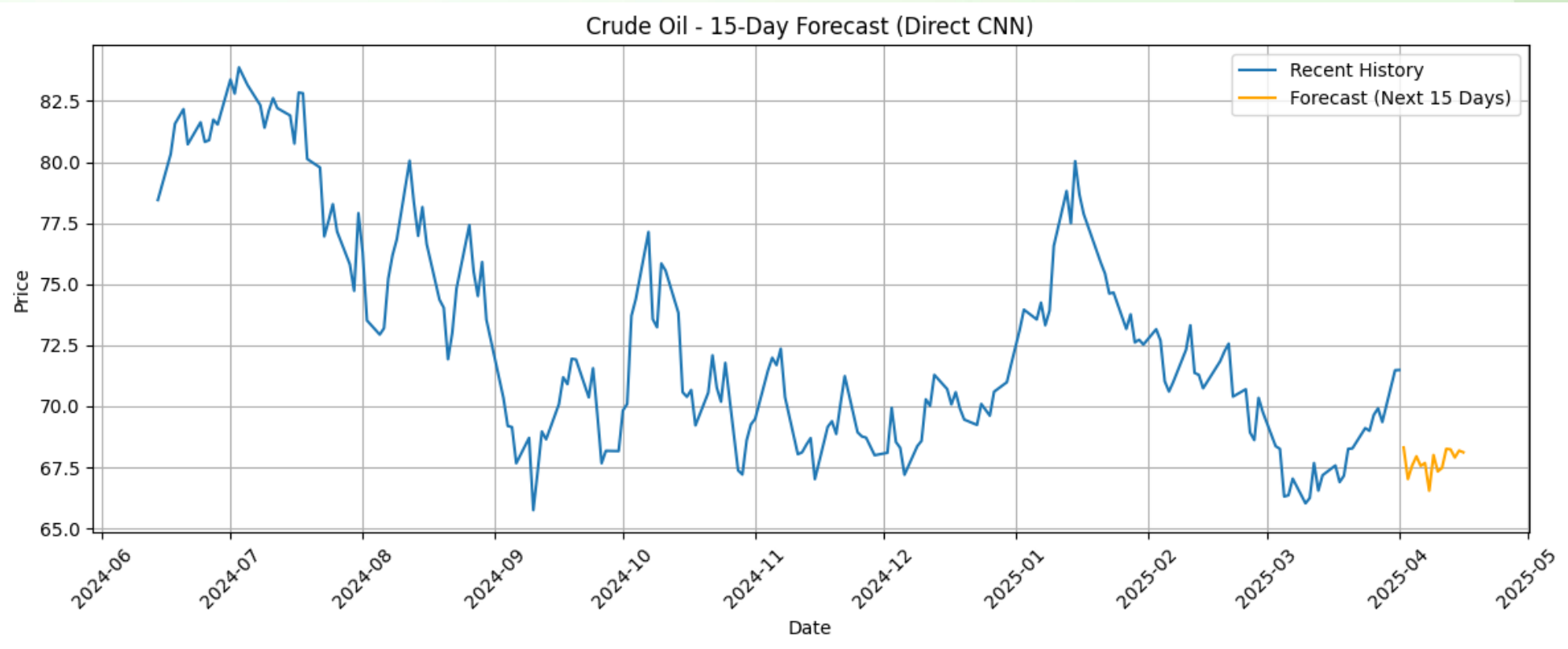
Natural Gas



Metrics for Natural Gas: RMSE: 0.55, MAE: 0.36, R^2 Score: 0.9094

Result for CNN

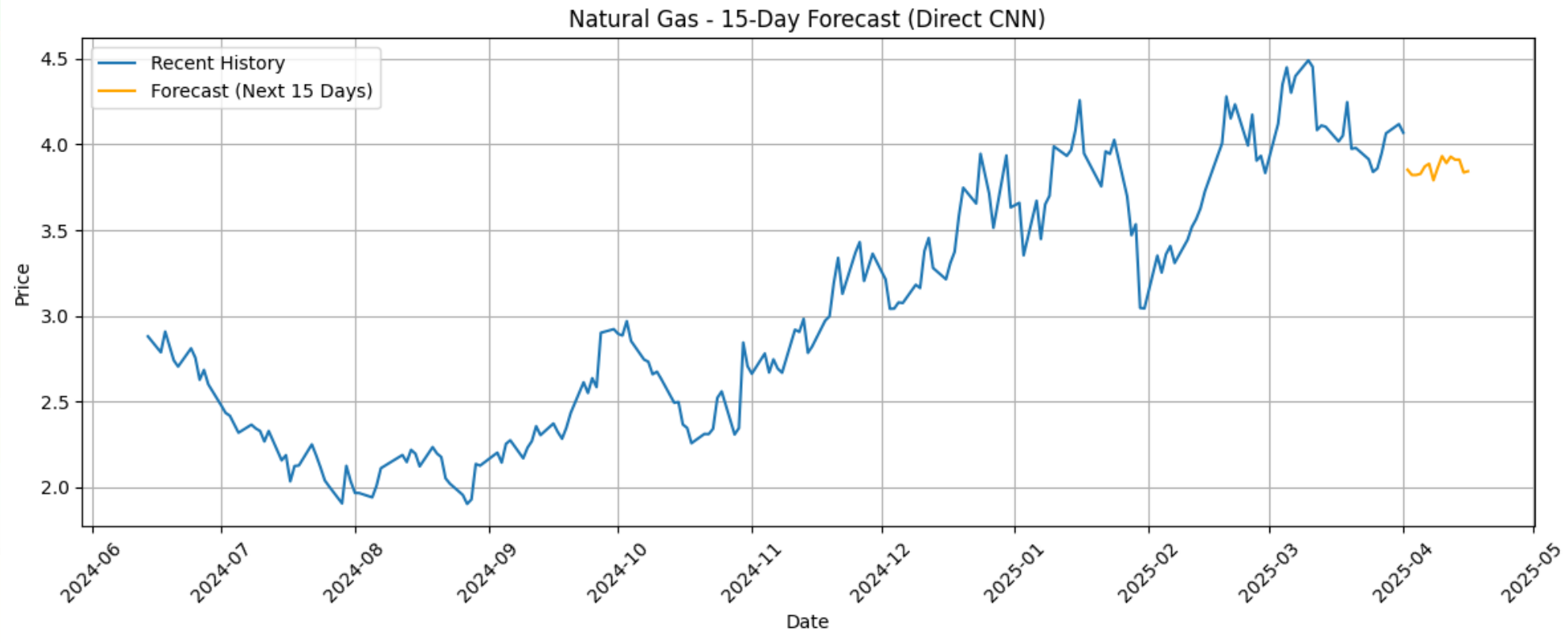
Crude Oil



Metrics for Crude Oil: RMSE: **5.70**, MAE: **4.45**, R^2 Score: **0.8935**

Result for CNN

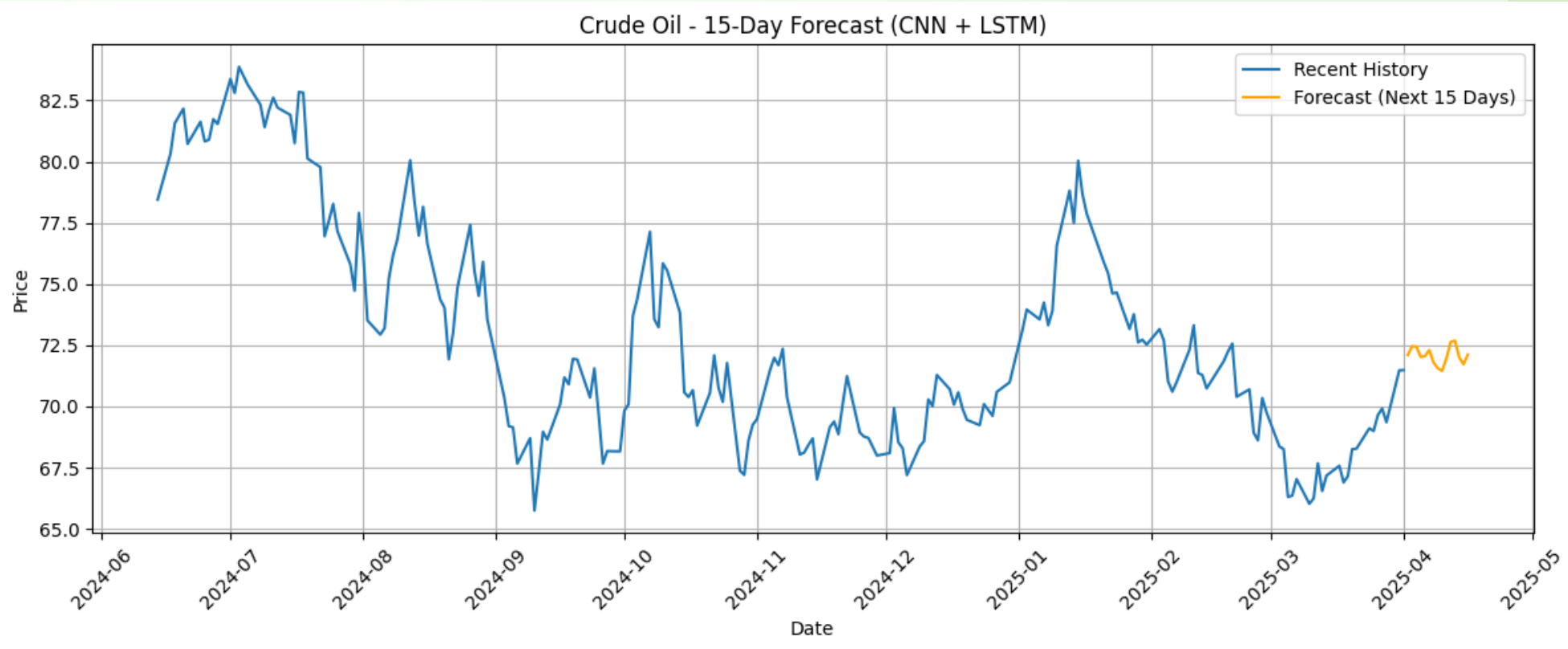
Natural Gas



Metrics for Natural Gas: RMSE: **0.58**, MAE: **0.39**, R^2 Score: **0.9005**

Result for LSTM+CNN

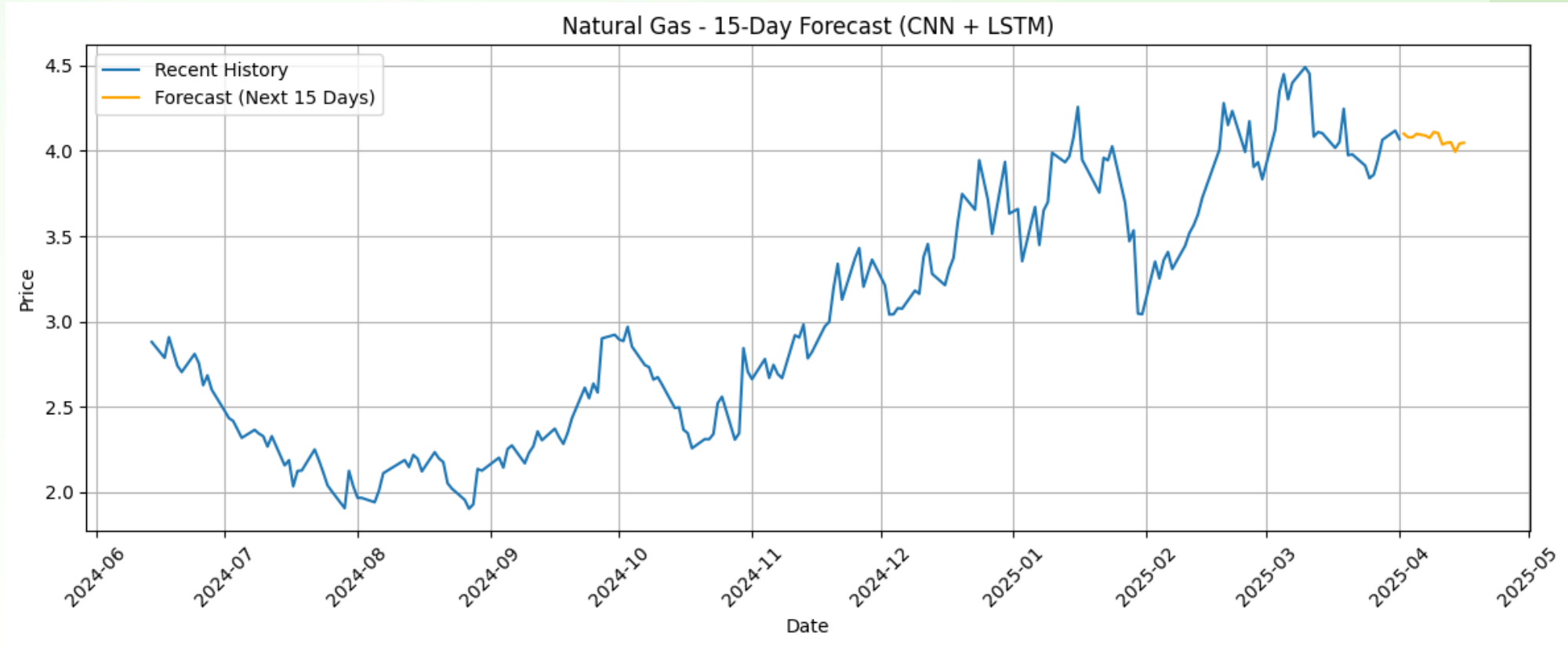
Crude Oil



Metrics for Crude Oil: RMSE: **4.80**, MAE: **3.58**, R^2 Score: **0.9246**

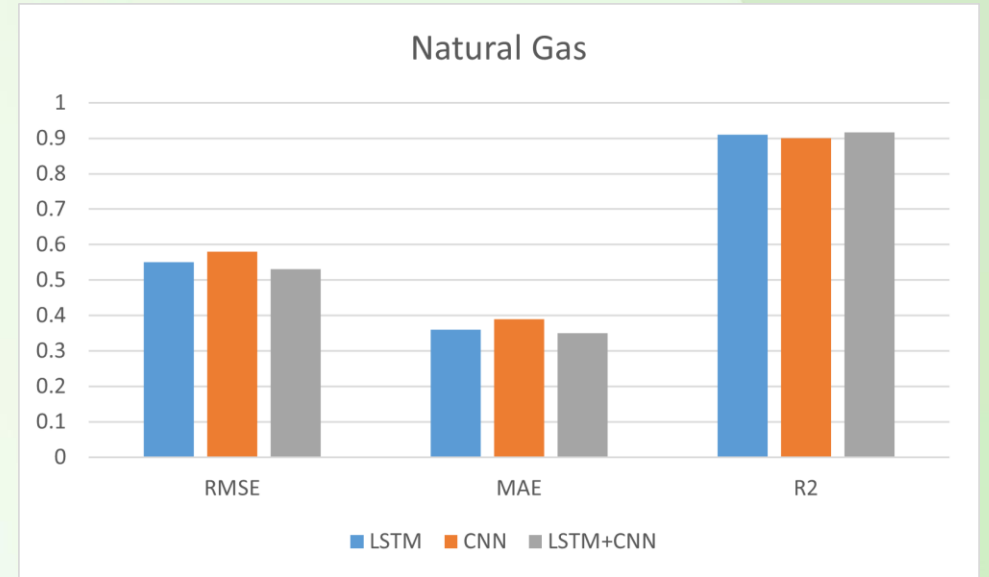
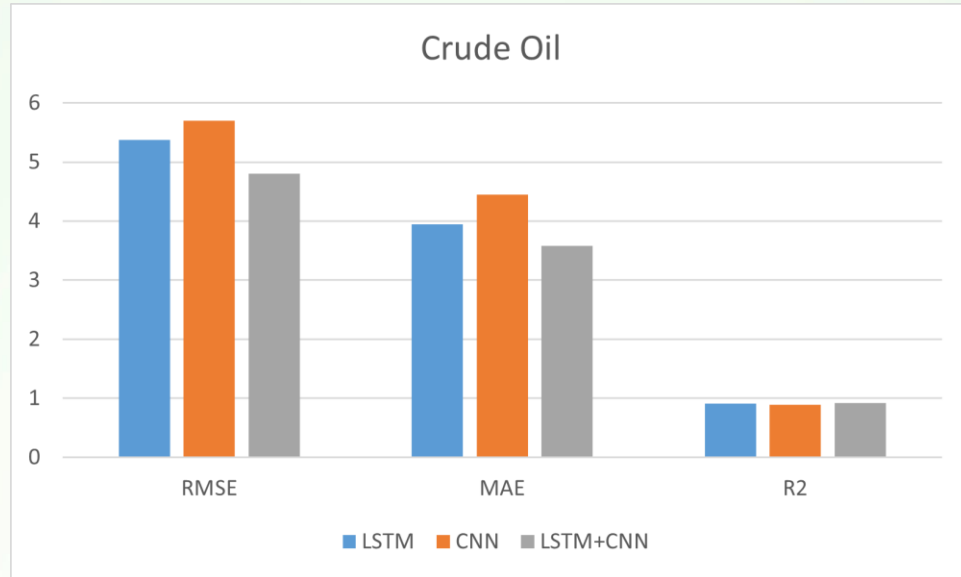
Result for LSTM+CNN

Natural Gas



Metrics for Natural Gas: RMSE: **0.53**, MAE:
0.35, R^2 Score: **0.9161**

Result Analysis



	Crude Oil			Natural Gas		
Metric	RMSE	MAE	R ²	RMSE	MAE	R ²
Model						
LSTM	5.37	3.95	0.9053	0.55	0.36	0.9094
CNN	5.70	4.45	0.8935	0.58	0.39	0.9005

Conclusion & Future Work

- Use Attention-Based or Transformer Models
- Probabilistic Forecasting / Uncertainty Quantification
- Incorporate External Influencing Factors