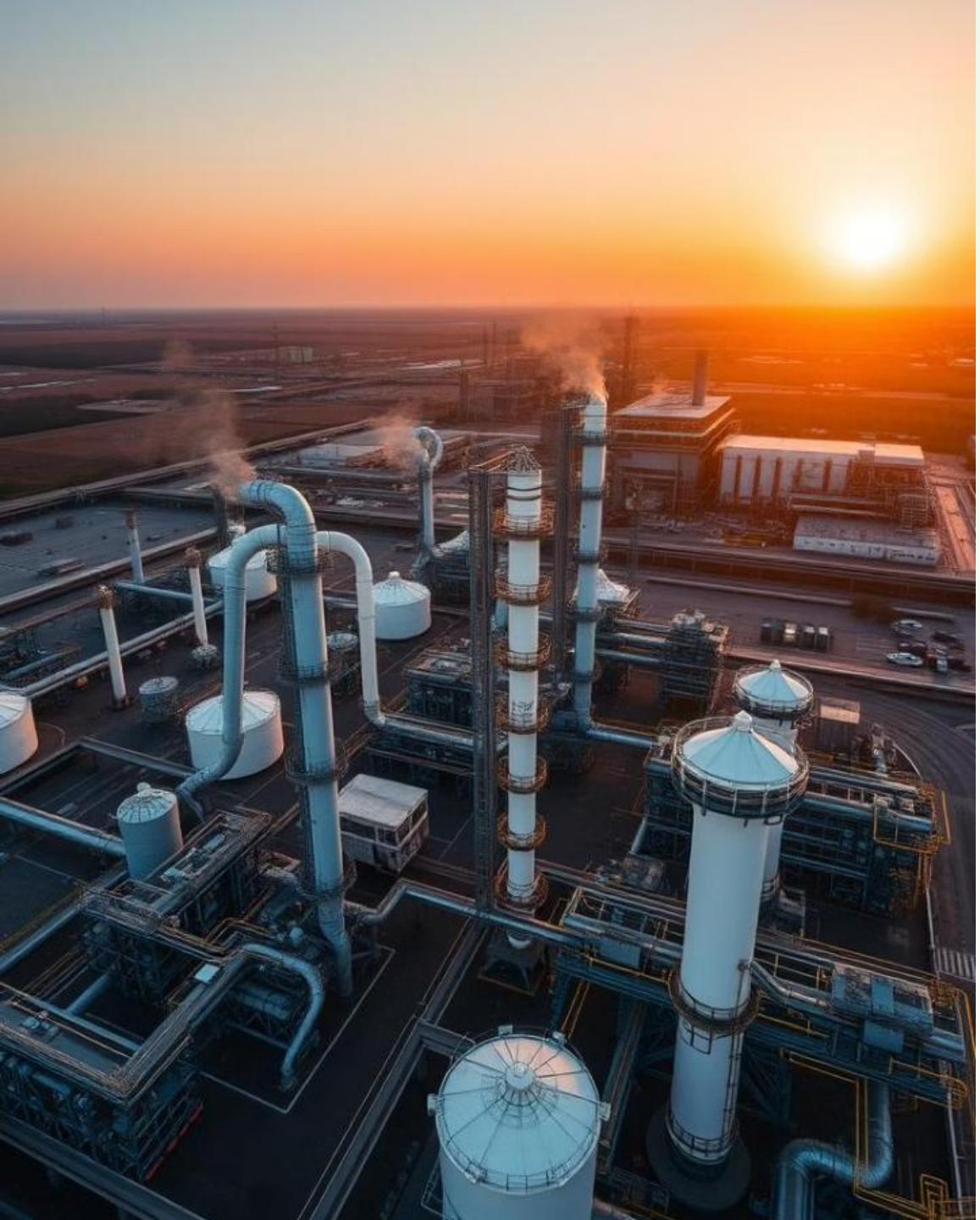

Forecasting Energy Commodity Prices with Deep Neural Networks: *A Case Study on Crude Oil and Natural Gas*

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- Introduction (Problem Statement)
- Dataset Description
- Methodology
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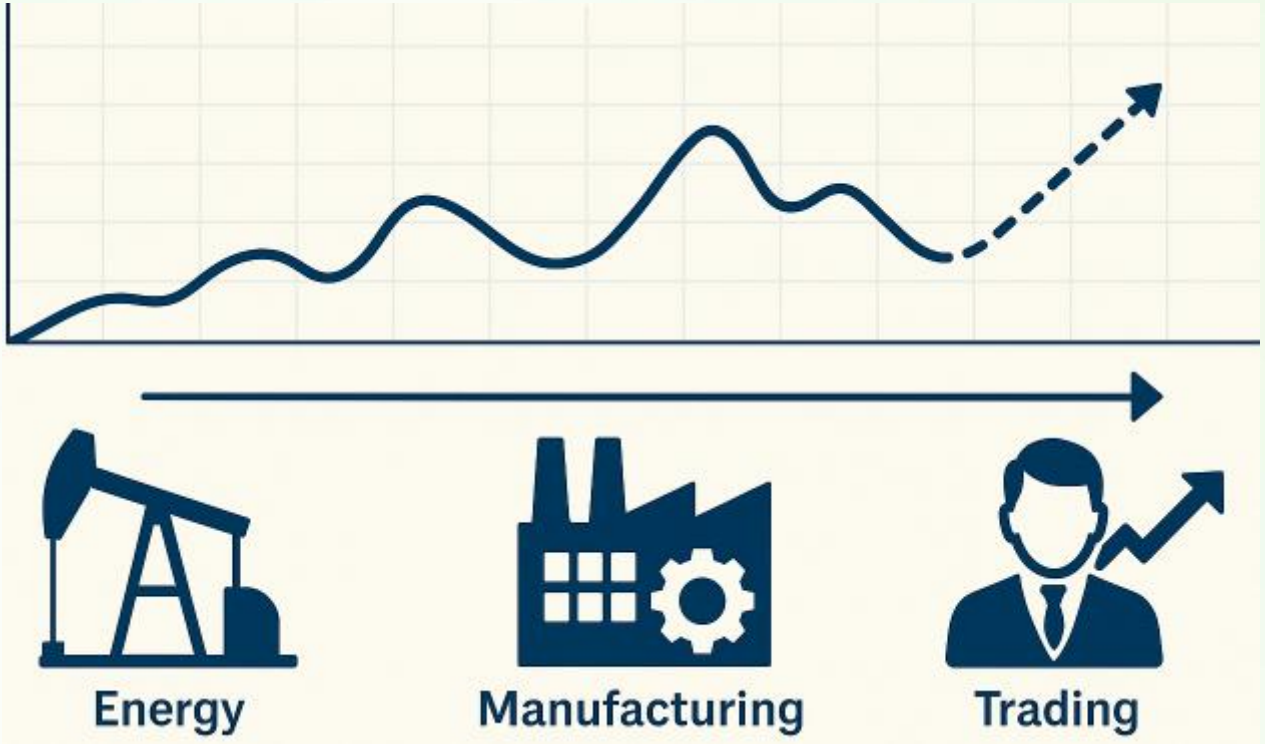
- Conclusion & Future Work

Problem Statement

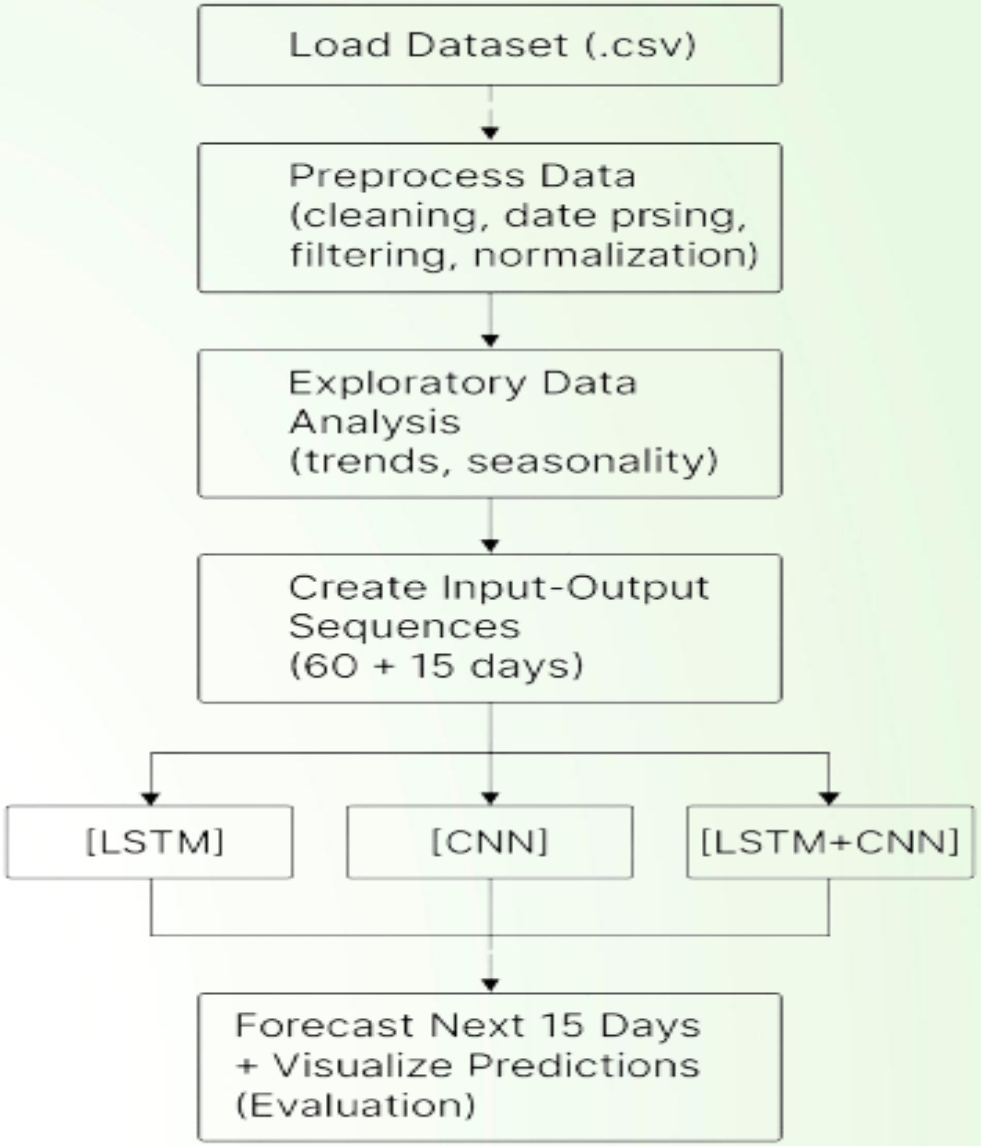


- Natural resource prices, such as crude oil and natural gas, are highly volatile and impact a wide range of stakeholders including businesses, policymakers, and households.
- This project aims to develop a deep learning model to forecast these prices, helping stakeholders make informed and timely decisions.

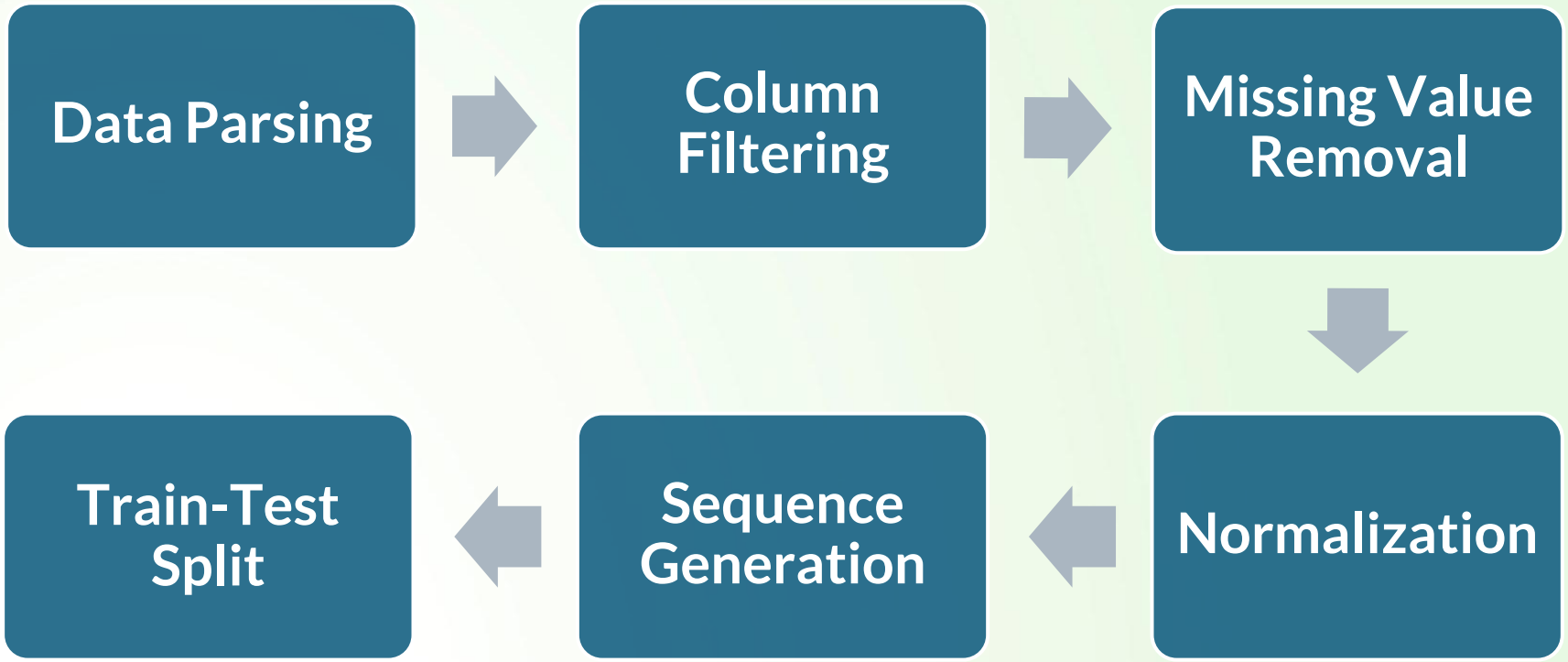
Dataset Description

- **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)

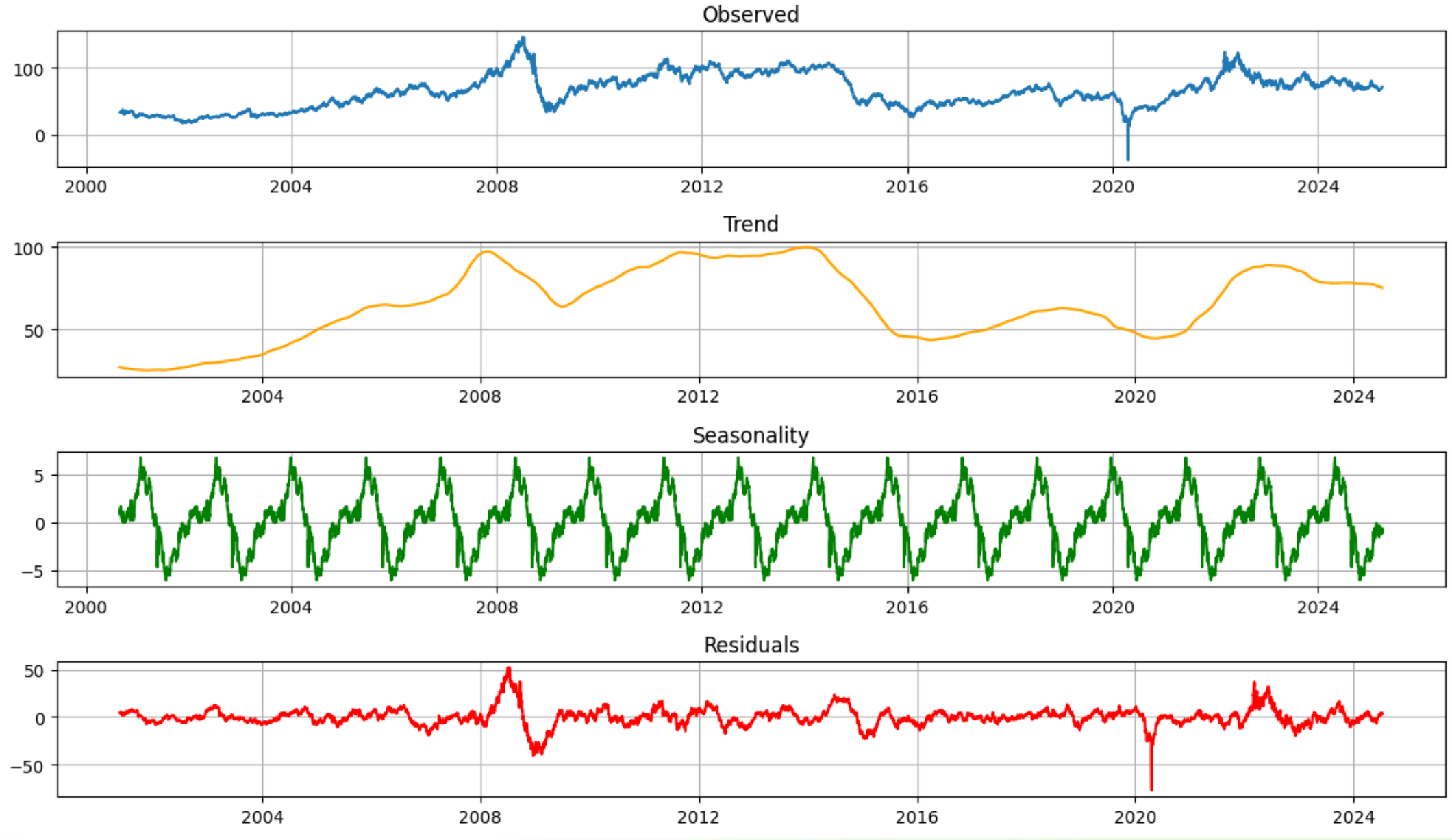
Project Workflow



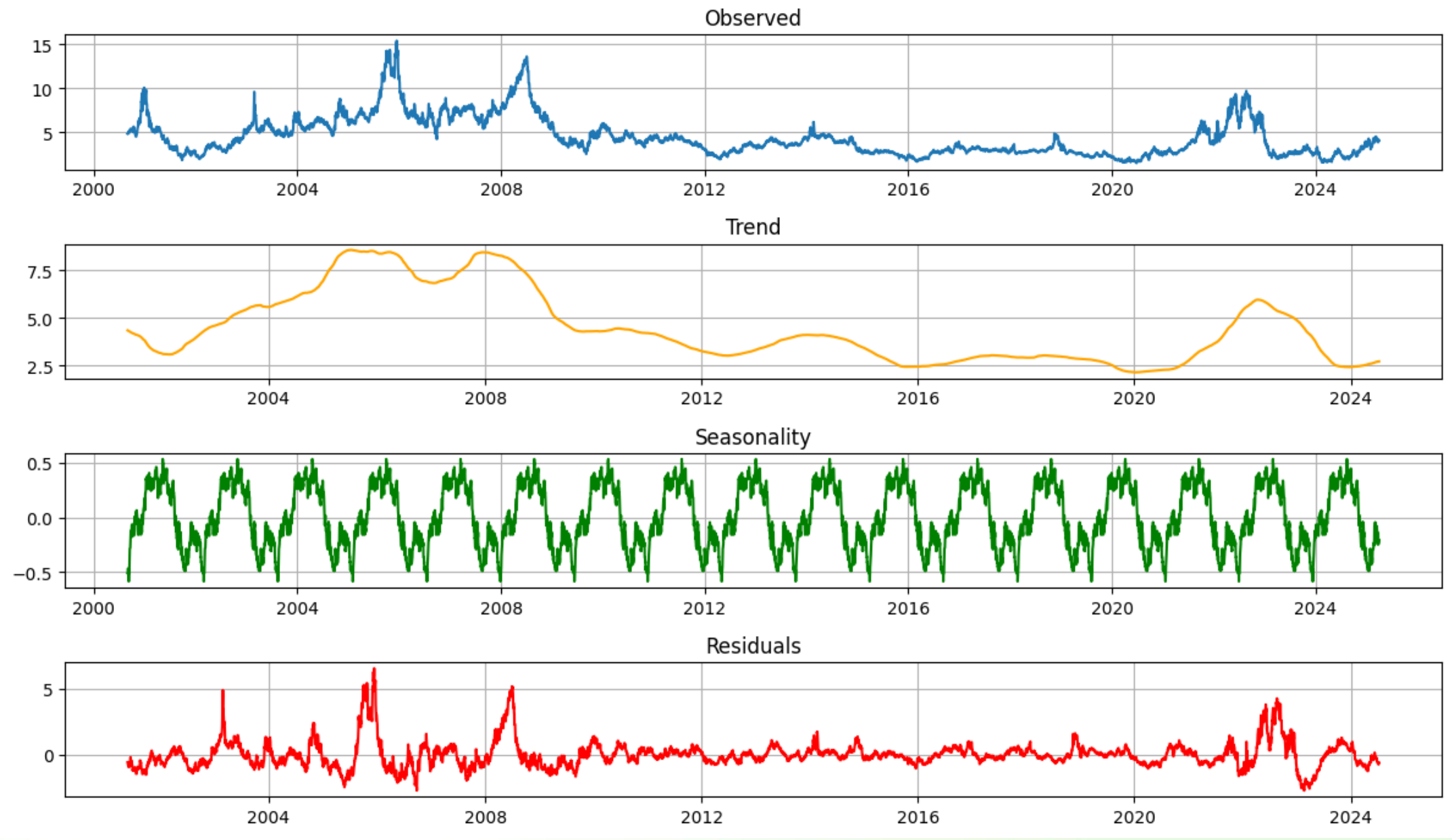
Dataset Preprocessing



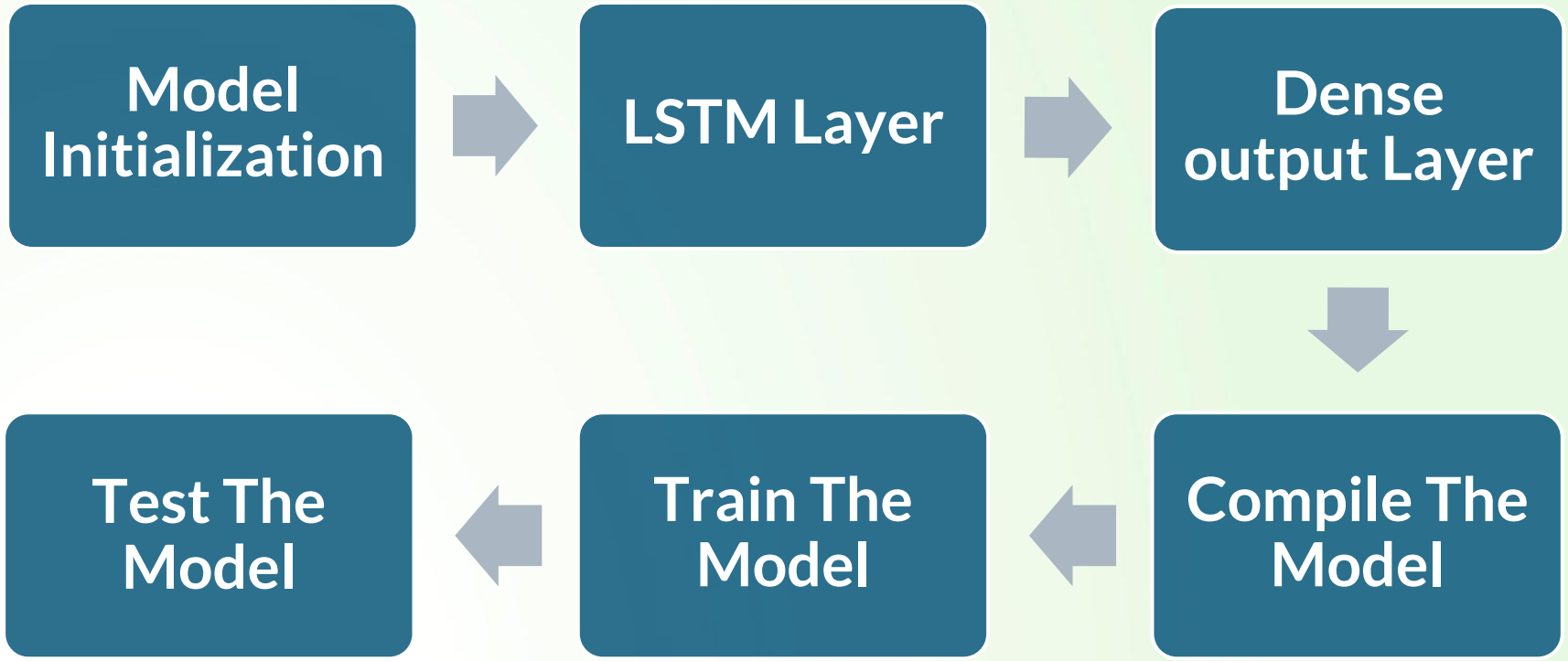
Crude Oil Seasonal Data



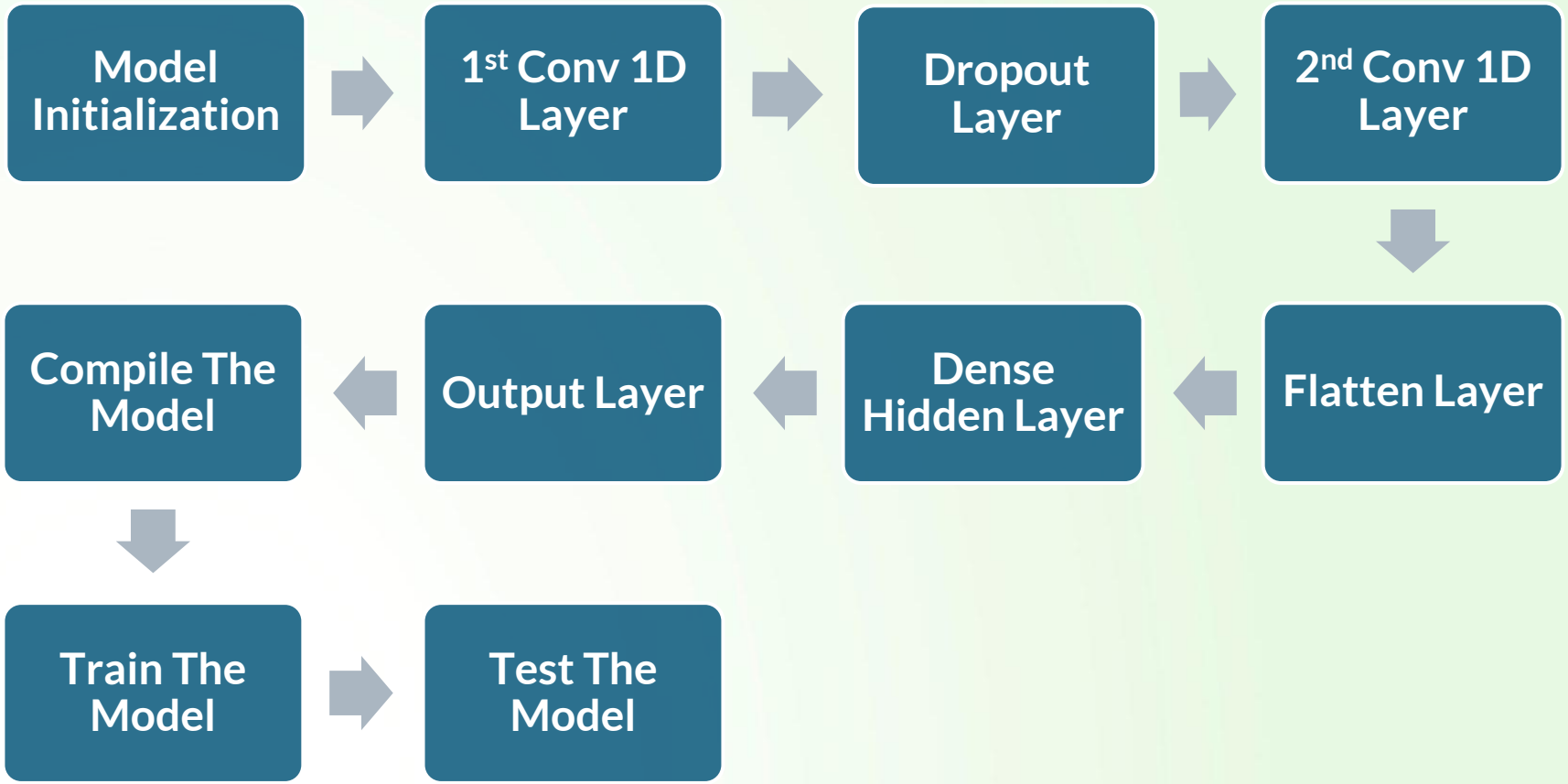
Natural Gas Seasonal Data



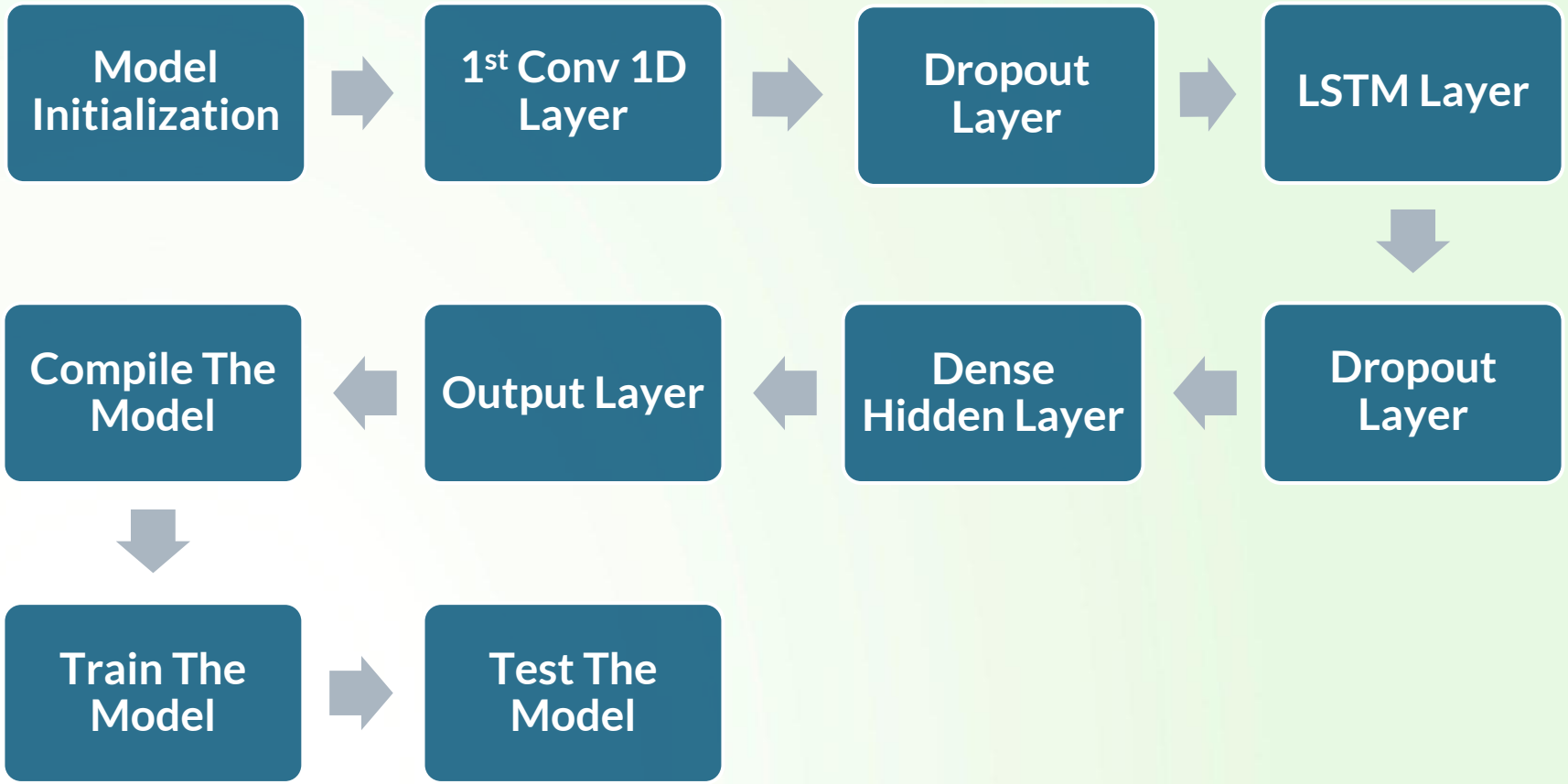
LSTM Model


Model Initialization
LSTM Layer
Dense output Layer
Compile The Model
Train The Model
Test The Model

CNN Model

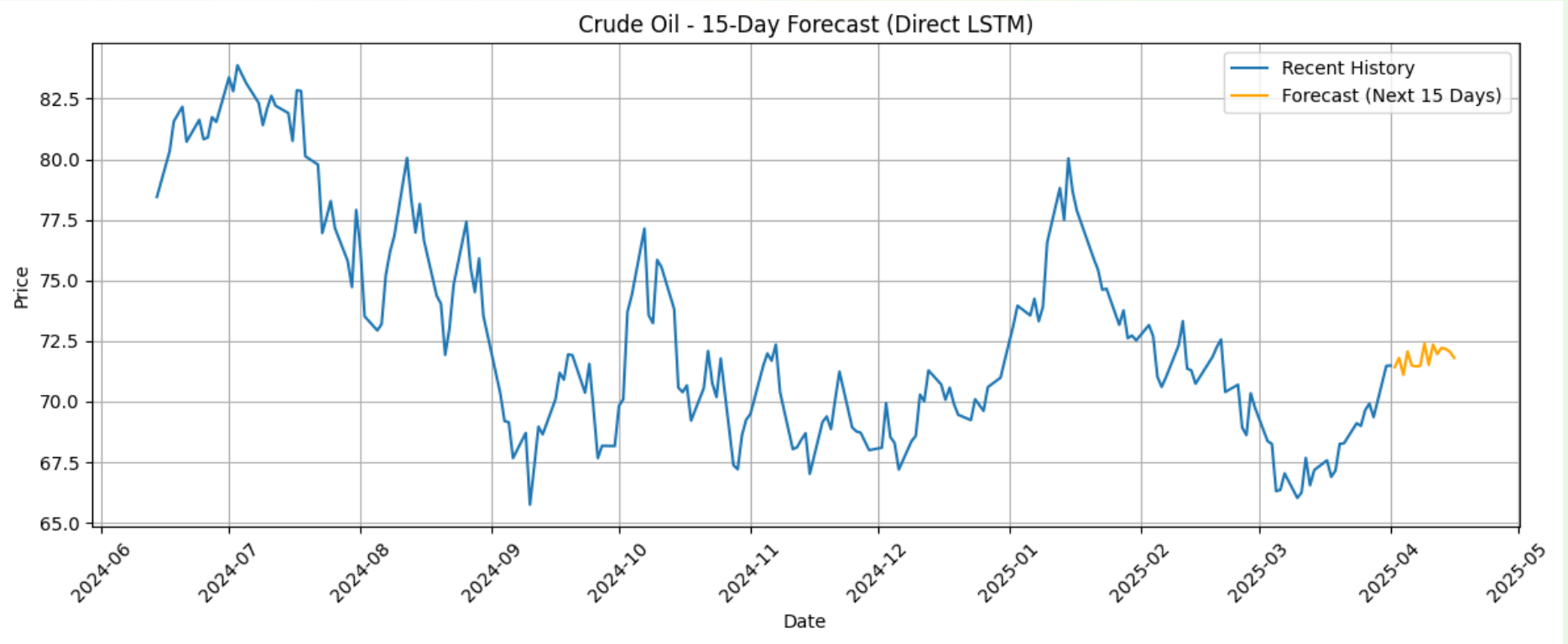

Model Initialization
1st Conv 1D Layer
Dropout Layer
2nd Conv 1D Layer
Flatten Layer
Dense Hidden Layer
Output Layer
Compile The Model
Train The Model
Test The Model

CNN+LSTM (Hybrid) Model



Result for LSTM

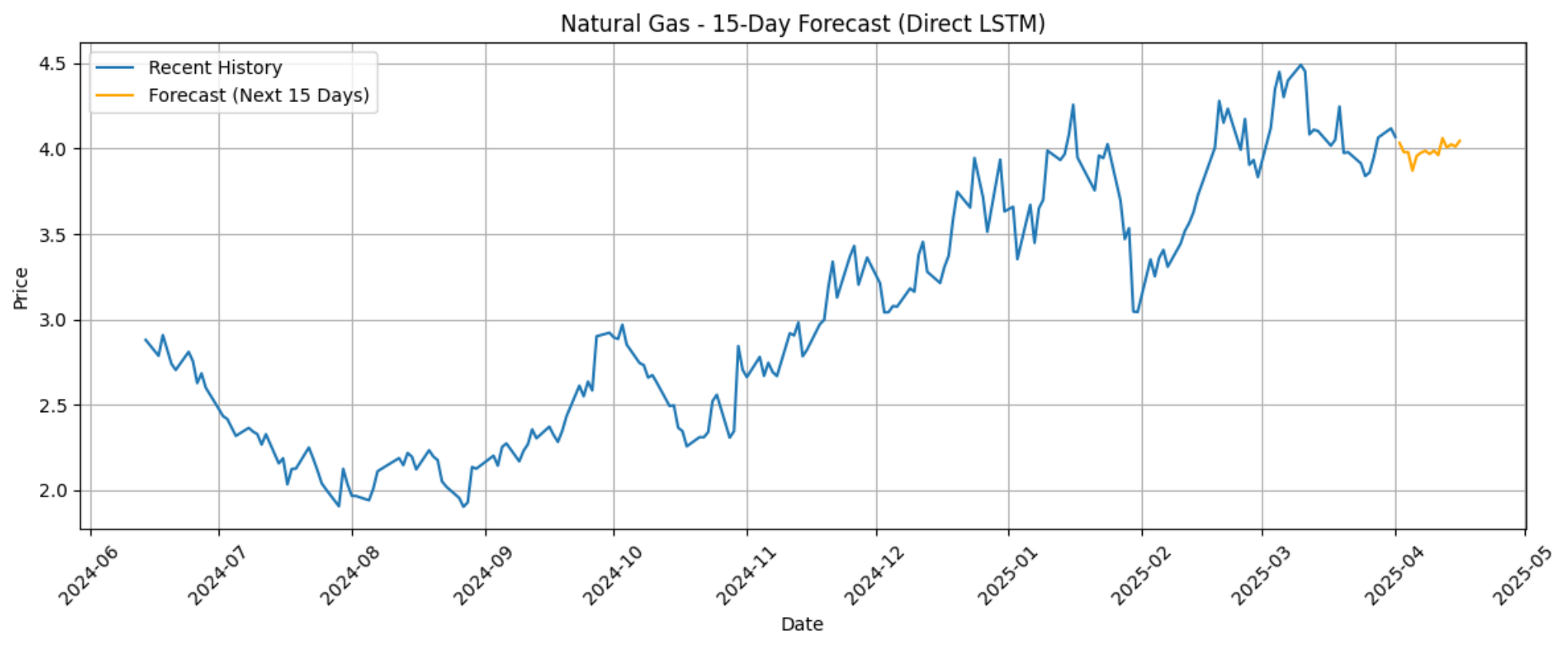
Crude Oil



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

Result for LSTM

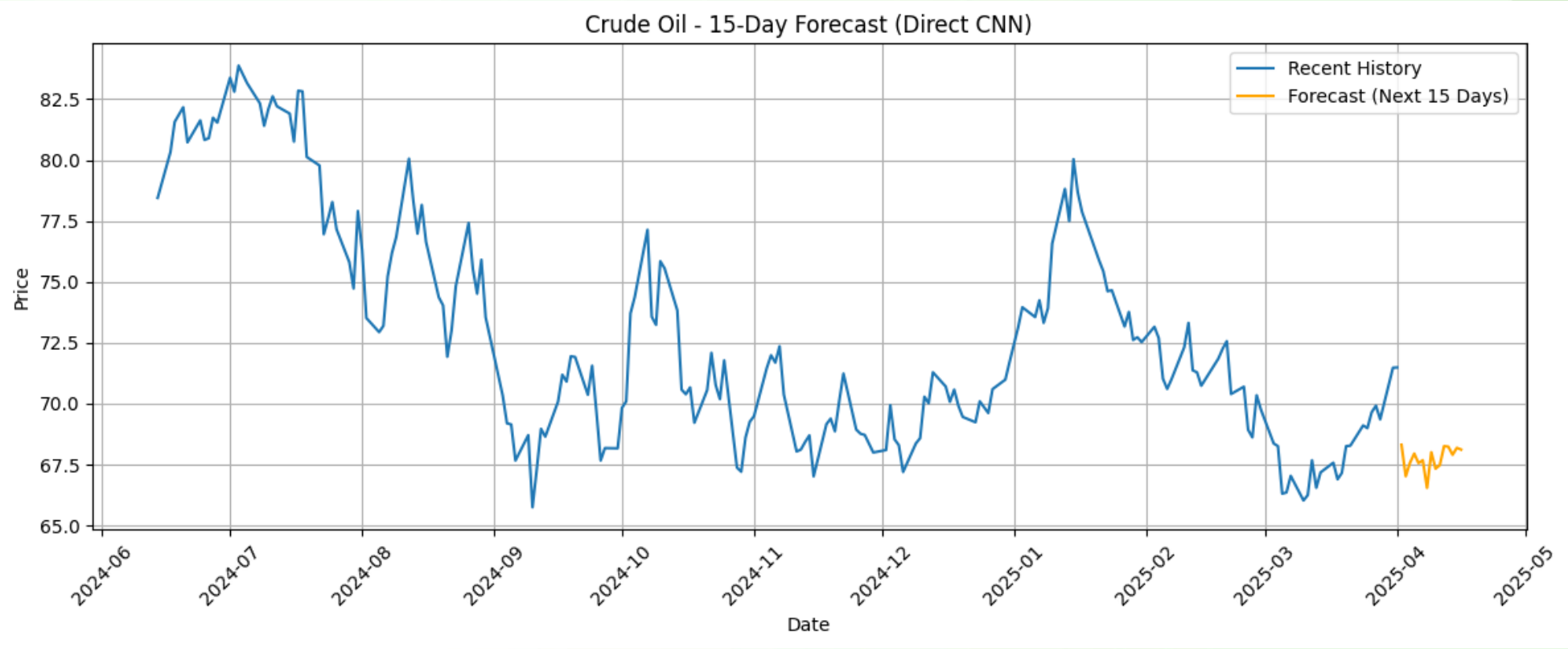
Natural Gas



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

Result for CNN

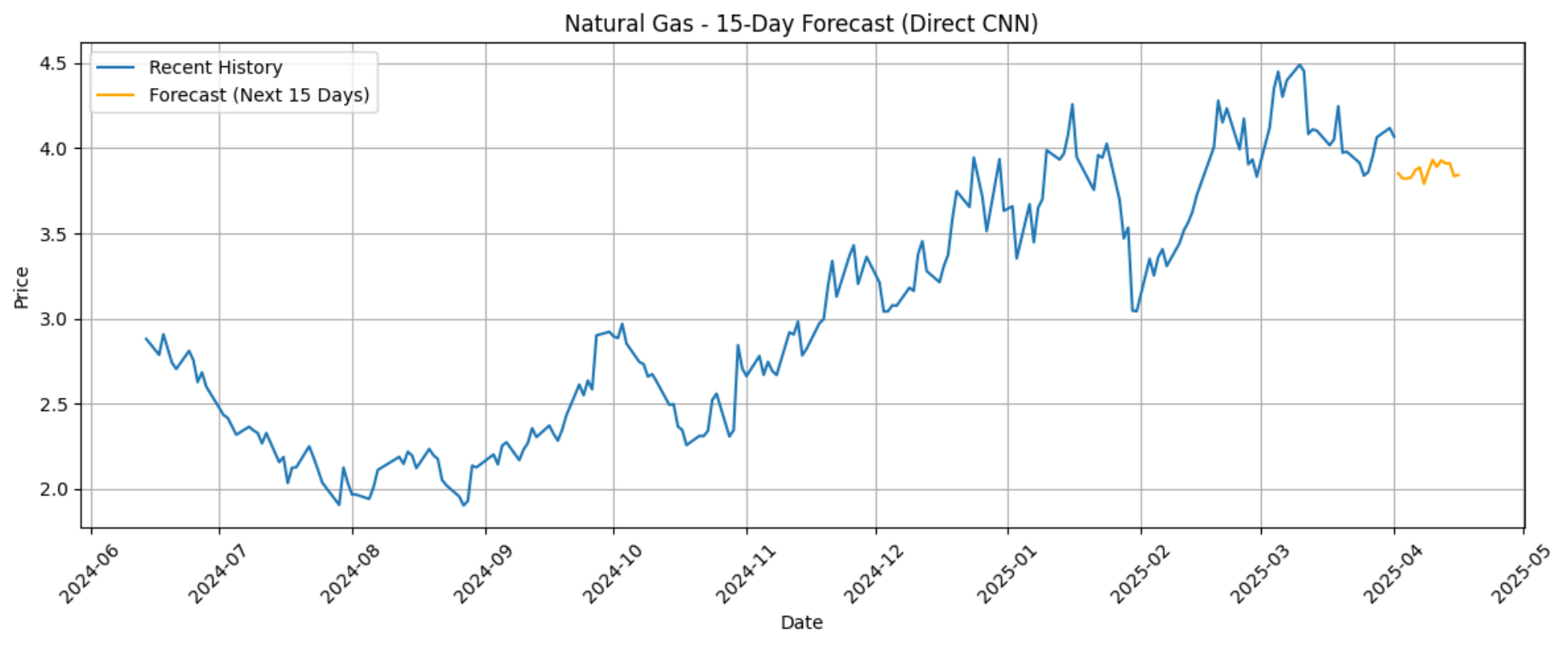
Crude Oil



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

Result for CNN

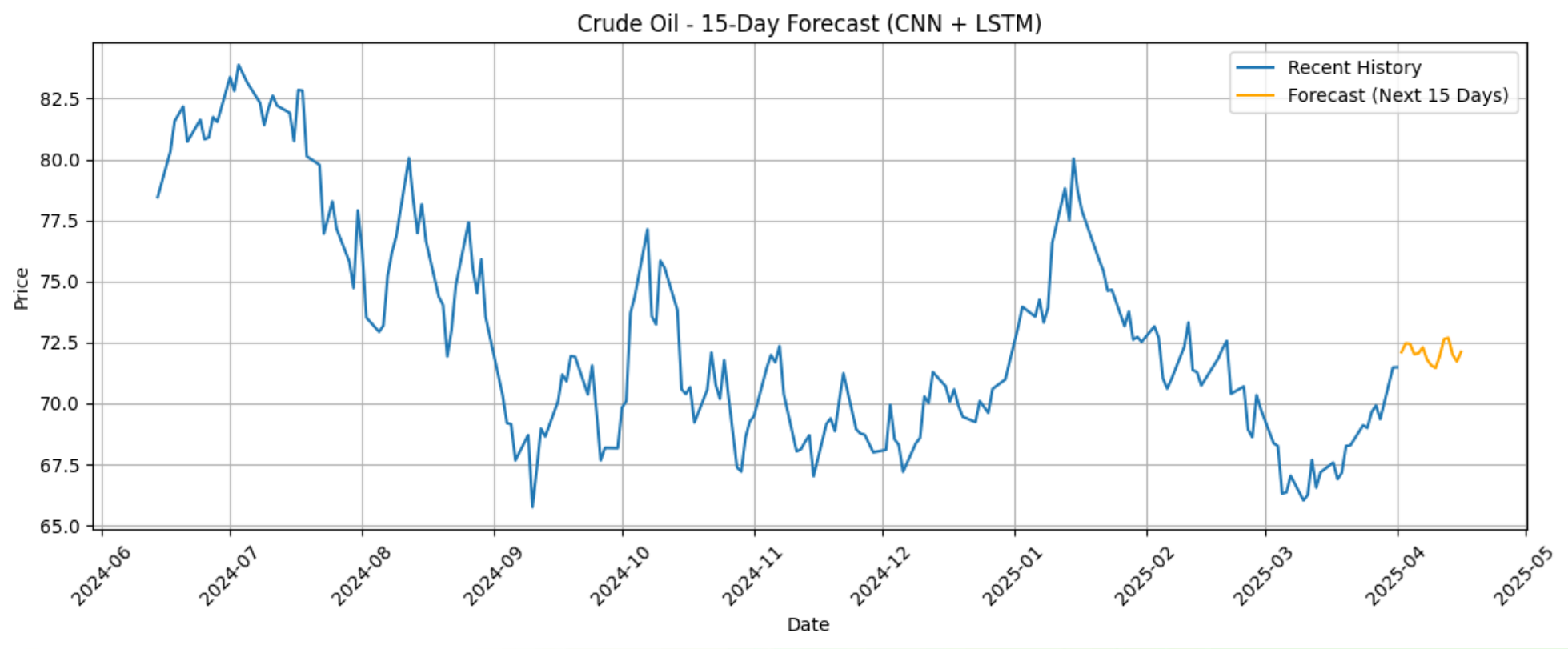
Natural Gas



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

Result for LSTM+CNN

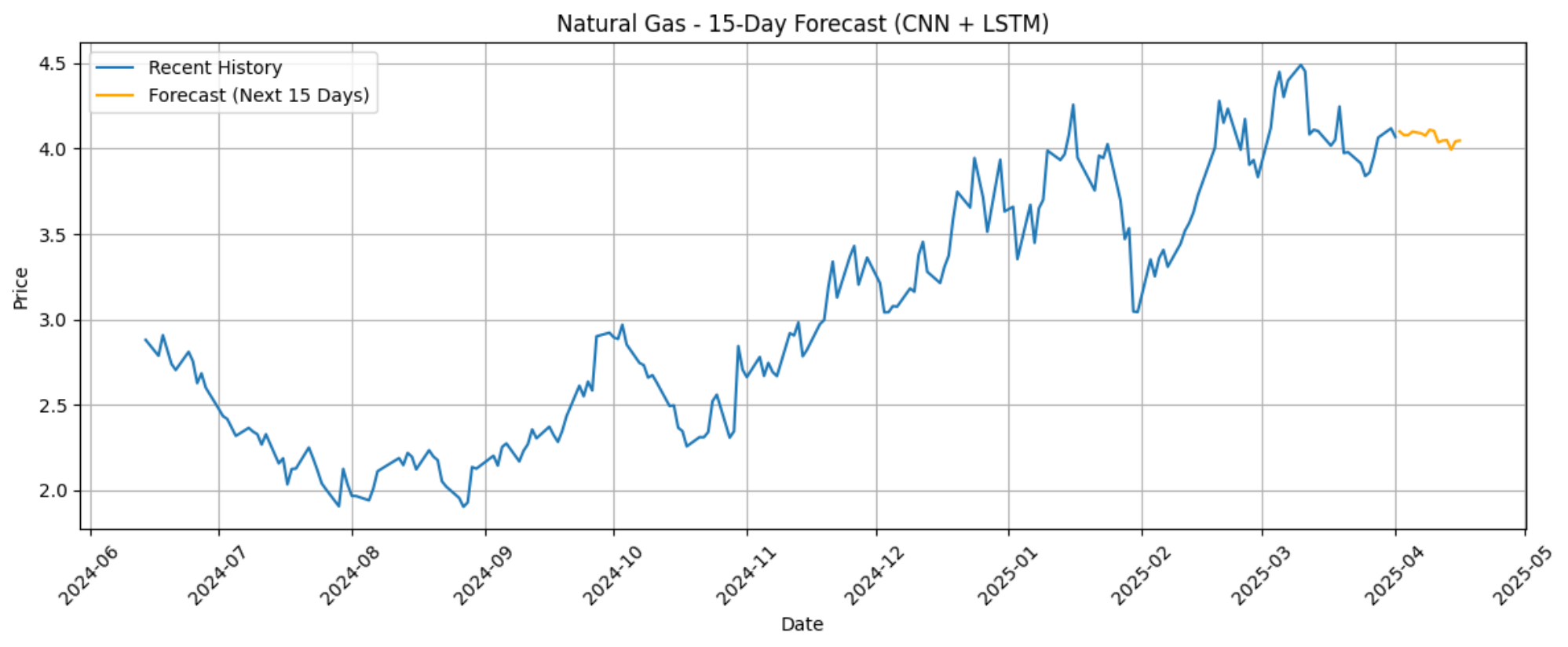
Crude Oil



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

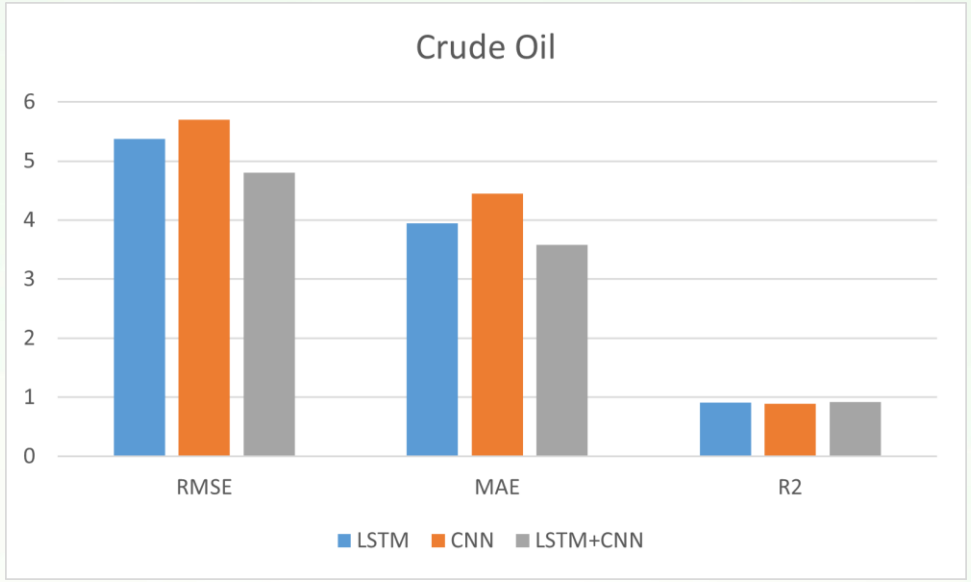
Result for LSTM+CNN

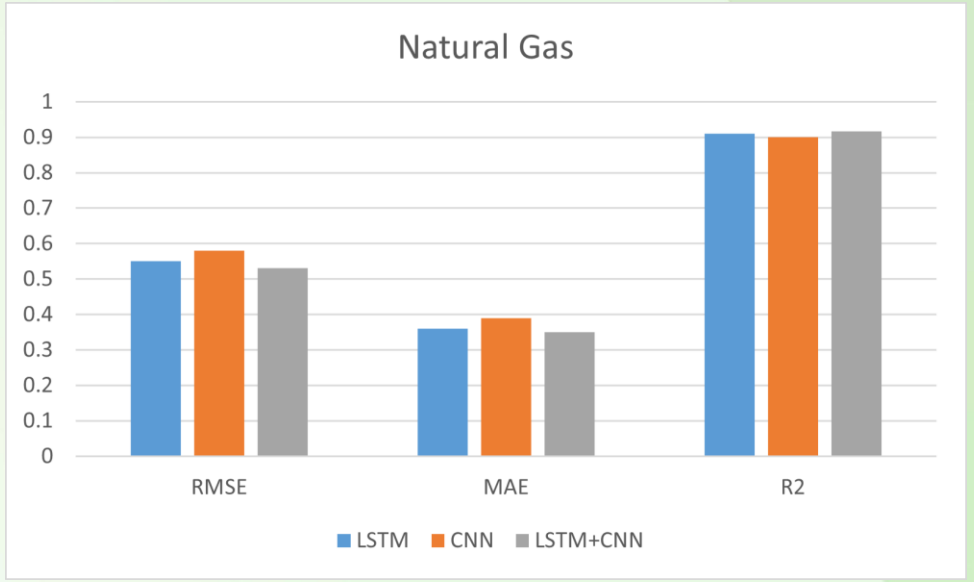
Natural Gas



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

Result Analysis





	Crude Oil			Natural Gas		
Metric / Model	RMSE	MAE	R^2	RMSE	MAE	R^2
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
LSTM+CNN	4.80	3.58	0.9246	0.53	0.35	0.9161

Conclusion & Future Work

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