## **Key Enhancements for Crude Oil System:**

### **1.** IBKR-Compatible Data Integration

* Uses CL=F (Crude Oil Futures) as proxy for IBKR data
* Added Gold (GC=F) correlation features for cross-market analysis
* Added Dollar Index (DX-Y.NYB) for currency impact analysis
* All data fetching methods use IBKR-compatible naming conventions

### **2.** Enhanced Commodity-Specific Features

* Extended technical indicators optimized for commodity markets
* Increased prediction range limits to ±15% to accommodate commodity volatility
* Added commodity-specific risk management parameters
* Enhanced correlation analysis with Gold and Dollar Index

### **3.** Improved Model Architecture

* Enhanced deep learning models with more layers and neurons
* Better regularization and dropout rates for commodity data
* Increased sequence length from 20 to 30 for better pattern recognition
* Enhanced transformer architecture with 4 layers instead of 2

### **4.** Advanced Risk Management

* Enhanced risk metrics specifically for commodity markets
* Improved market regime detection with commodity-specific indicators
* Better correlation risk assessment (Crude-Gold-Dollar relationships)
* Enhanced liquidity risk calculation

### **5.** Commodity-Specific Analysis

* Detailed analysis of commodity market conditions
* Enhanced volatility assessment for energy markets
* Better volume analysis for futures contracts
* Improved correlation analysis between commodities and currencies

### **6.** Enhanced Feature Engineering

* Extended technical indicators with multiple timeframes
* Enhanced Ichimoku Cloud components
* Fibonacci retracement levels
* Cross-market correlation features
* Extended lagged features (10 periods instead of 6)

### **7.** Optimized Training Process

* Increased model complexity for better accuracy
* Enhanced hyperparameters for commodity data
* Better early stopping criteria
* Improved model evaluation metrics

This system is now focused exclusively on Crude Oil predictions using IBKR-compatible data structures, with significantly enhanced accuracy and risk management features specifically tailored for the energy commodity markets.