



**Big Blue**  
DATA ACADEMY



## **COMPARATIVE ANALYSIS OF RNN AND SEQ2SEQ MODELS FOR DAY-AHEAD WHOLESALE ELECTRICITY PRICE PREDICTION**

**TIME SERIES FORECASTING FOR ENERGY MARKETS: A SEQ2SEQ APPROACH**

**Presented by:**

**Theodore Karkantelidis**  
**Dimitris Papastavridis**

# Get to Know Us



**Theodore Karkantelidis**

**Work Experience**

- Warehouse Clerk

**Studies**

- BSc Economics
- MSc Data Analytics & Information Systems



**Dimitris Papastavridis**

**Work Experience**

- ECommerce Manager
- Retail Salesperson

**Studies**

- BSc Applied Mathematics

# GOALS AND OBJECTIVES



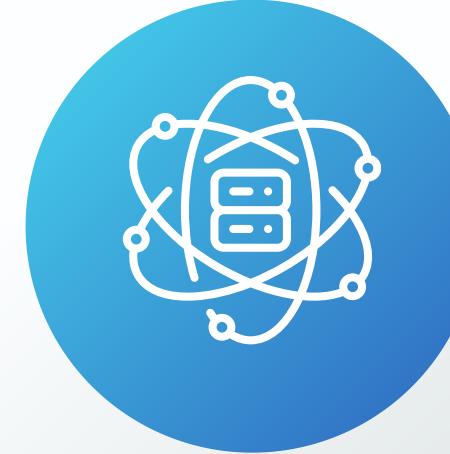
Understanding the  
Business  
Requirement  
and  
PPC's Question



Exploratory  
Data Analysis



Time Series Analysis  
with RNN models



Time Series Analysis  
with  
Sequence to Sequence

# GOALS AND OBJECTIVES



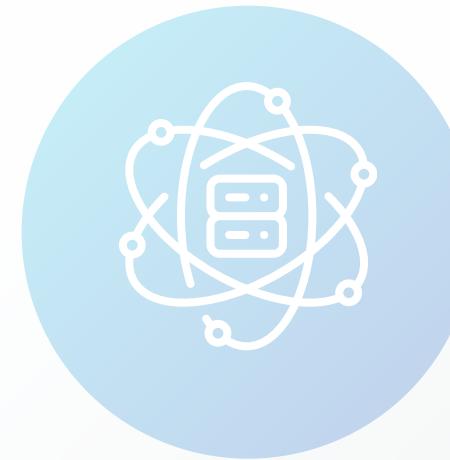
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# Business Requirement

- Use Historical Timeseries Data and Predictions from 3 Providers
- Compare the forecasts from the 3 providers with the actual hourly electricity prices across each country
- Create a forecasting model that makes a sequence of 24 hour window predictions

# GOALS AND OBJECTIVES



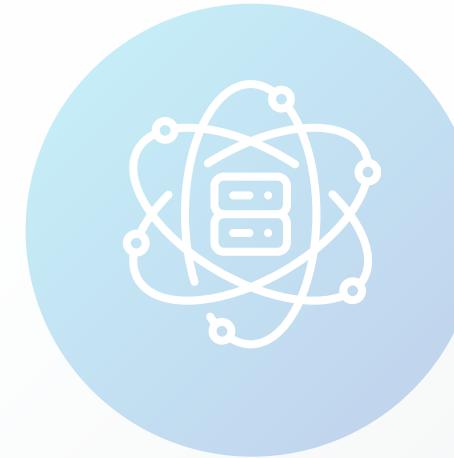
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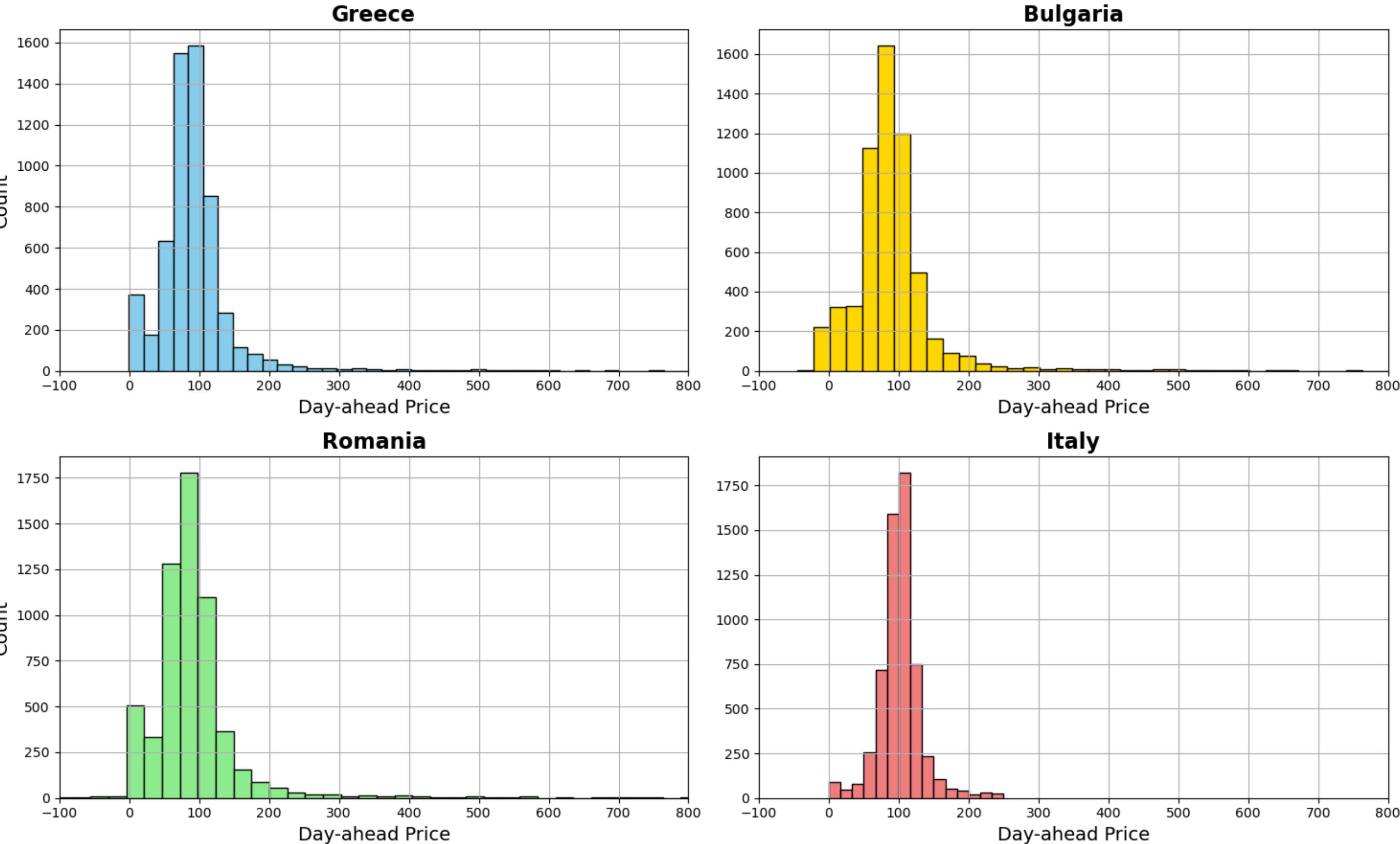


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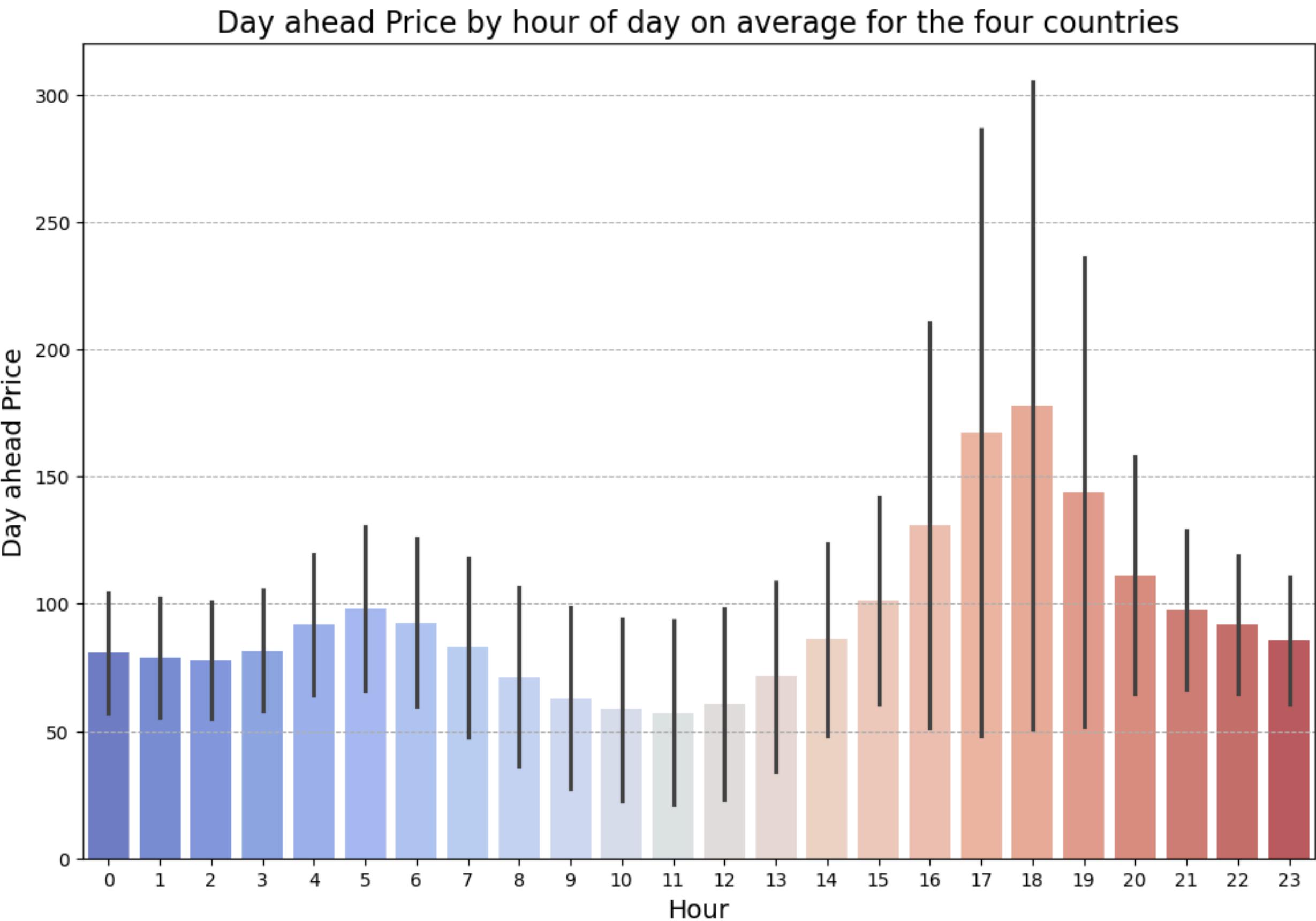


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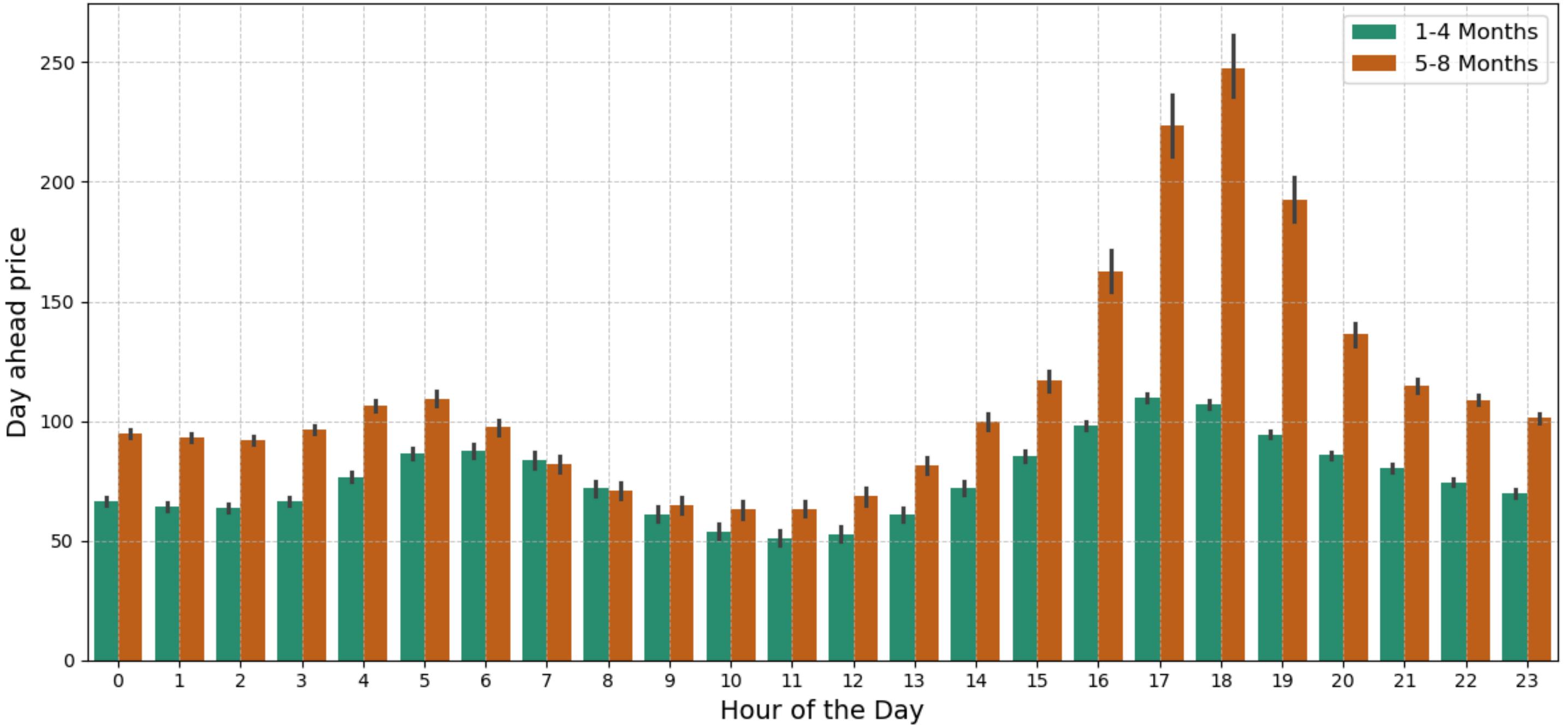
## Day-ahead Price Distribution for Four Countries



- Electricity prices peak in the late afternoon (17:00 - 19:00)
- Lowest prices are observed between 09:00 and 11:00



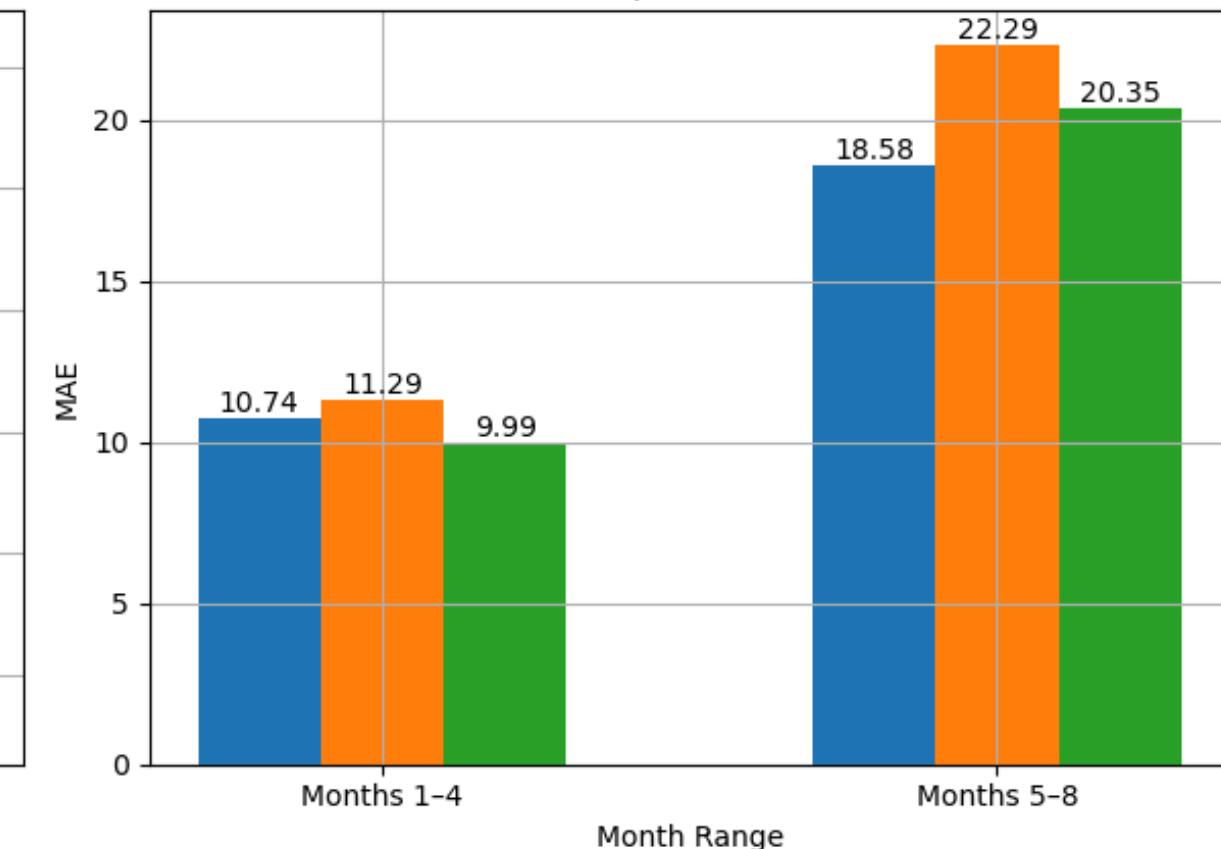
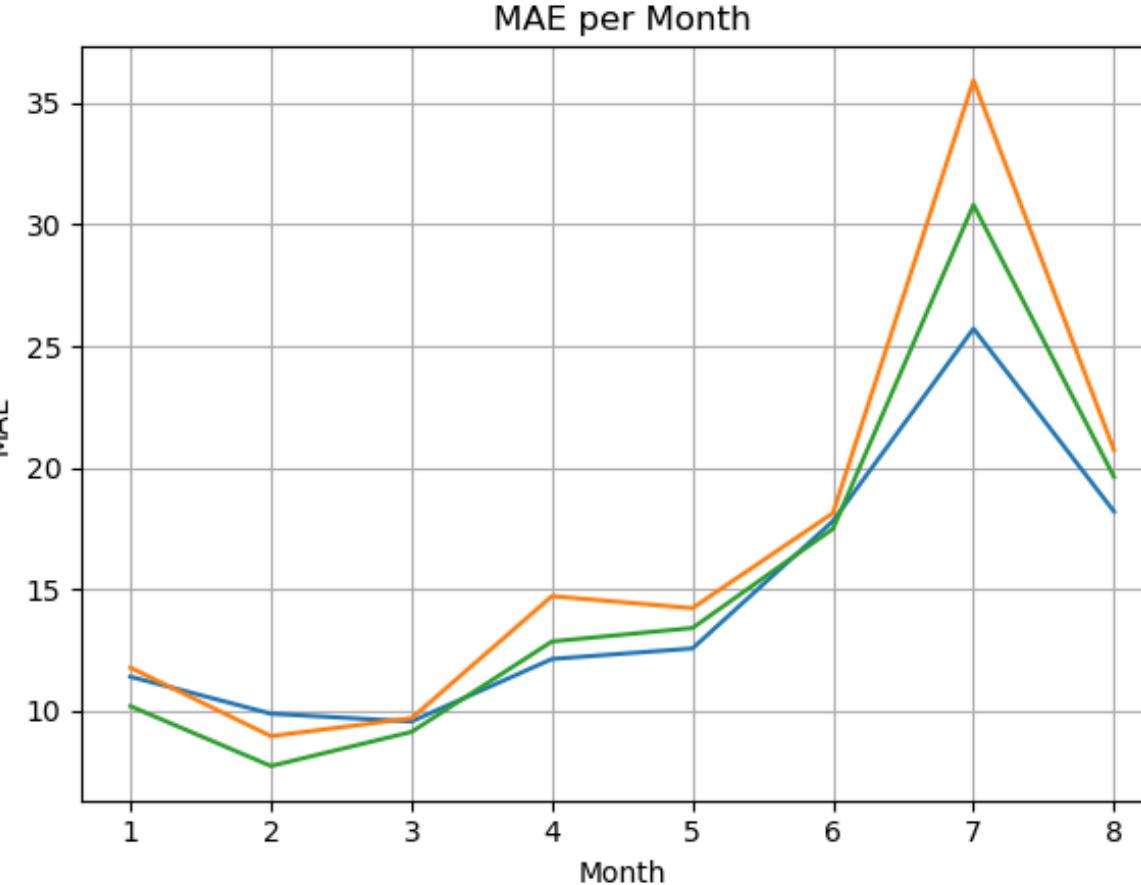
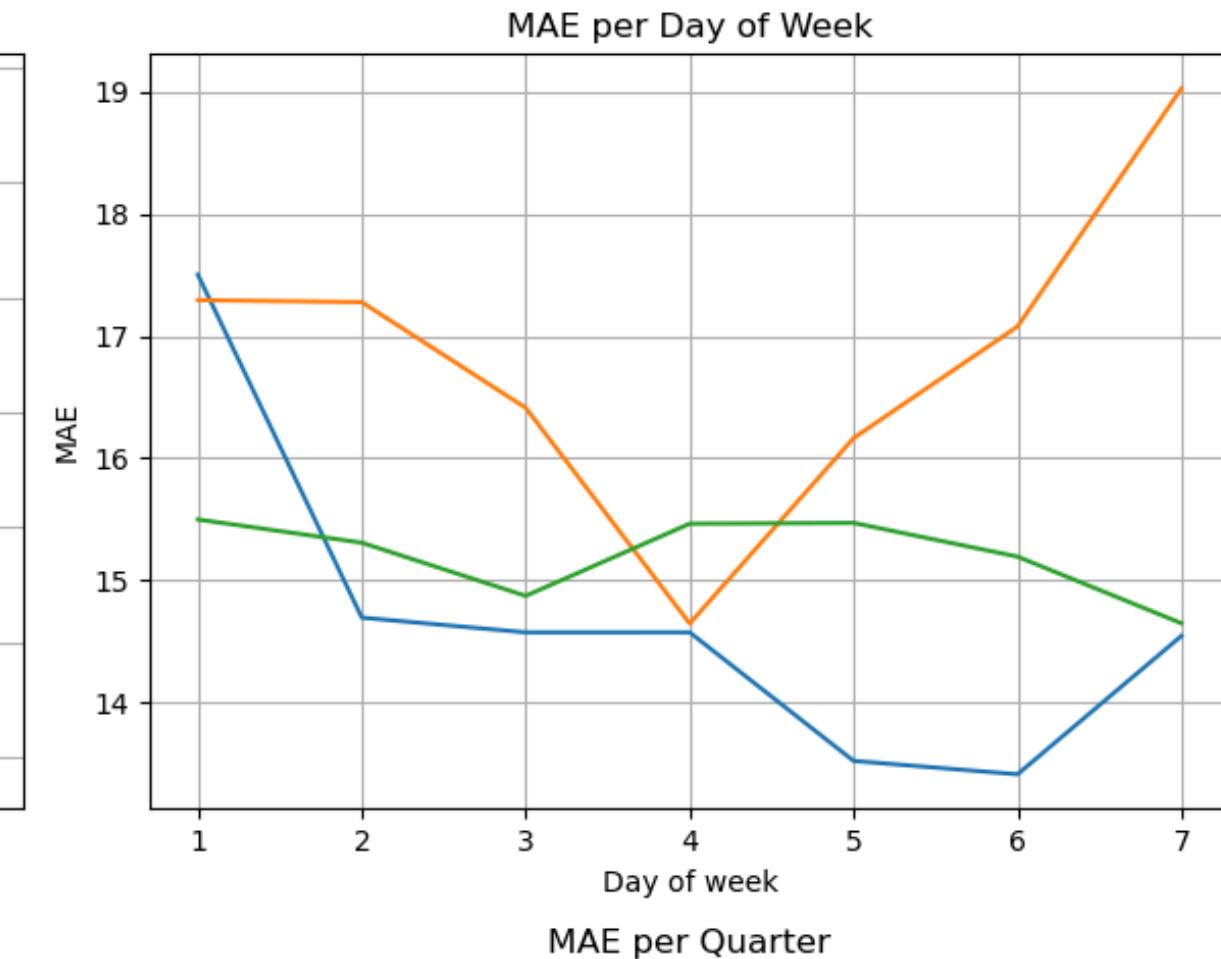
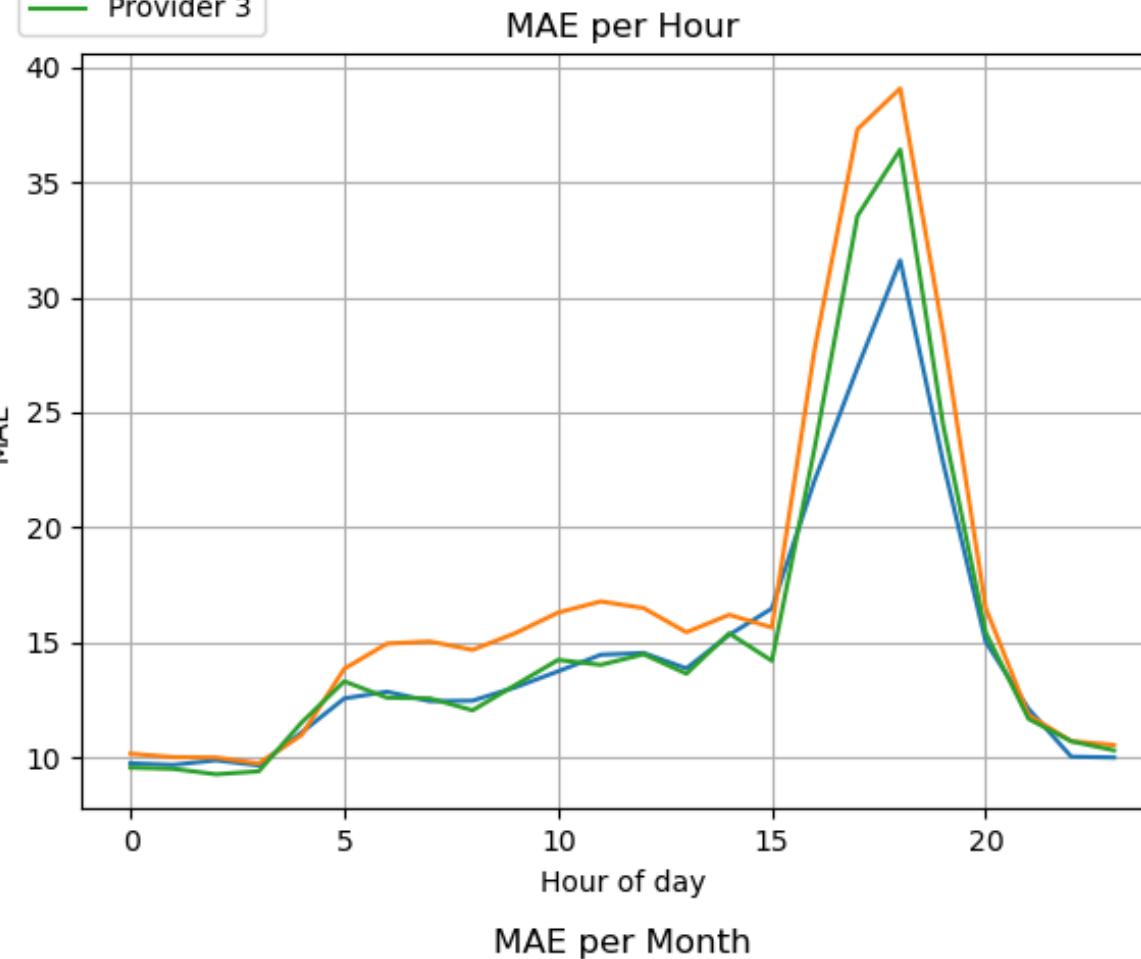
## Comparison of day ahead price by Hour and Quarter on average for the 4 countries



- Higher prices observed in months 5-8, especially during peak hours (17:00 - 19:00)
- Largest price difference between the two periods occurs in the afternoon

## Comparison of MAE across Different Time Periods on average for the 4 countries

— Provider 1  
— Provider 2  
— Provider 3



- **Provider 2 has the highest MAE during peak hours (17:00 - 19:00)**
- **Provider 1 performs better on weekends (Day 6-7), with the lowest MAE**
- **Quarter 2 shows the highest MAE for all providers, with Provider 2 being the least accurate**

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## Calendar for Year 2024

January						
S	M	T	W	T	F	S
1	2	3	4	5	6	
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

February						
S	M	T	W	T	F	S
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29		

March						
S	M	T	W	T	F	S
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
						31

April						
S	M	T	W	T	F	S
1	2	3	4	5	6	
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30				

May						
S	M	T	W	T	F	S
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

June						
S	M	T	W	T	F	S
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
						30

July						
S	M	T	W	T	F	S
1	2	3	4	5	6	
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

August						
S	M	T	W	T	F	S
					1	2
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

Train

01-01-2024 : 31-07-2024 (7 Months)

Validation

01-08-2024 : 15-08-2024 (15 Days)

Test

16-08-2024 : 31-08-2024 (16 Days)

## LSTM - GRU

**LSTM-GRU** are neural networks for time series data, ideal for long-term dependencies and accurate predictions.

## MAE

**MAE** measures the average error between predicted and actual values. Lower MAE means better accuracy.

# PREDICTING 31 AUGUST

	Provider 1	Provider 2	Provider 3	LSTM	GRU
Greece	14.5	47.3	15.1	15	<b>12.8</b>
Italy-Sud	4.5	4.7	4.4	7.5	8.7

## PREDICTING 31 AUGUST

	Provider 1	Provider 2	Provider 3	LSTM	GRU
Bulgaria	13.6	16.8	12.1	17.4	15.2
Romania	15.6	16.8	12.1	21.4	18.5

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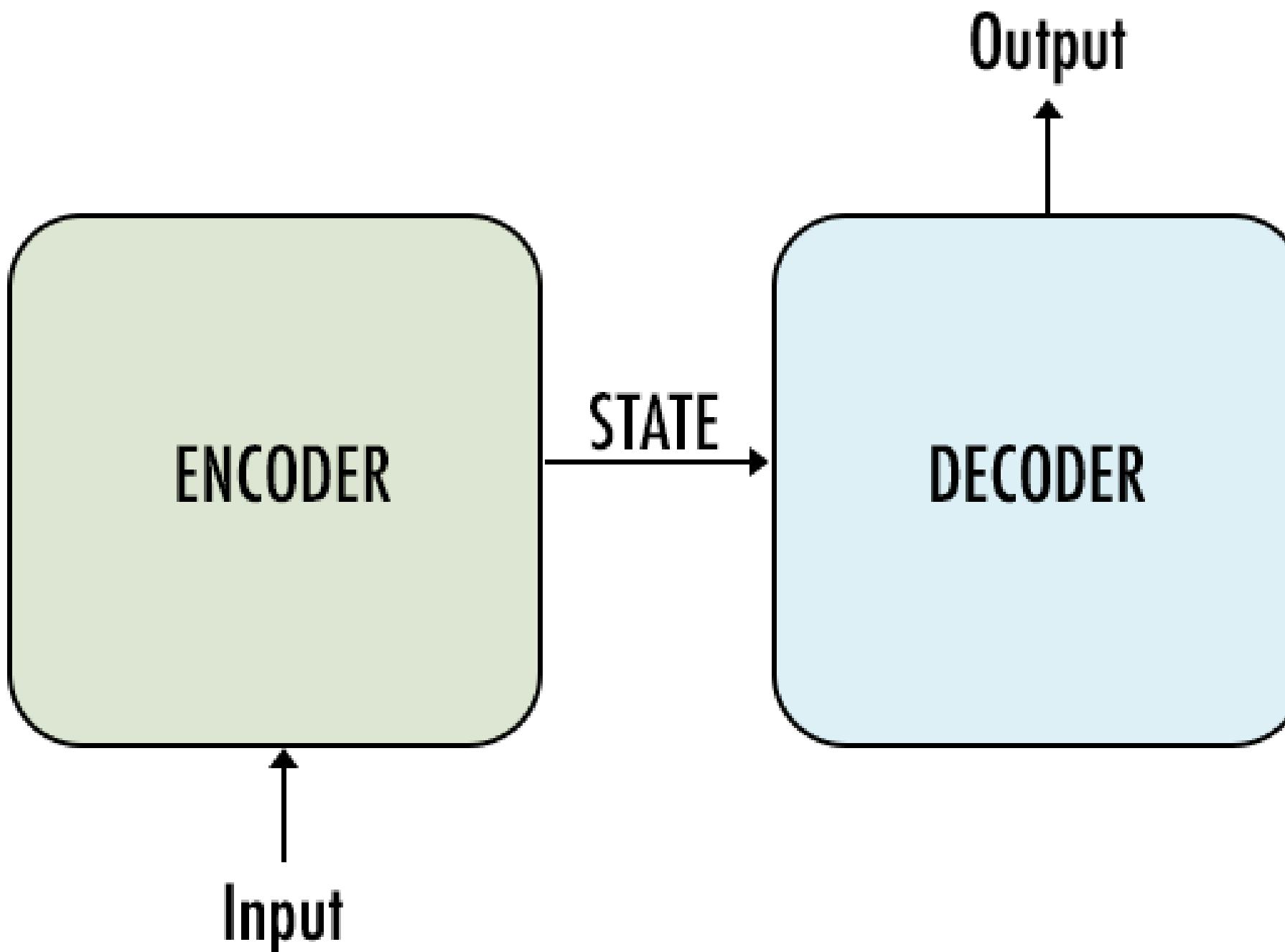


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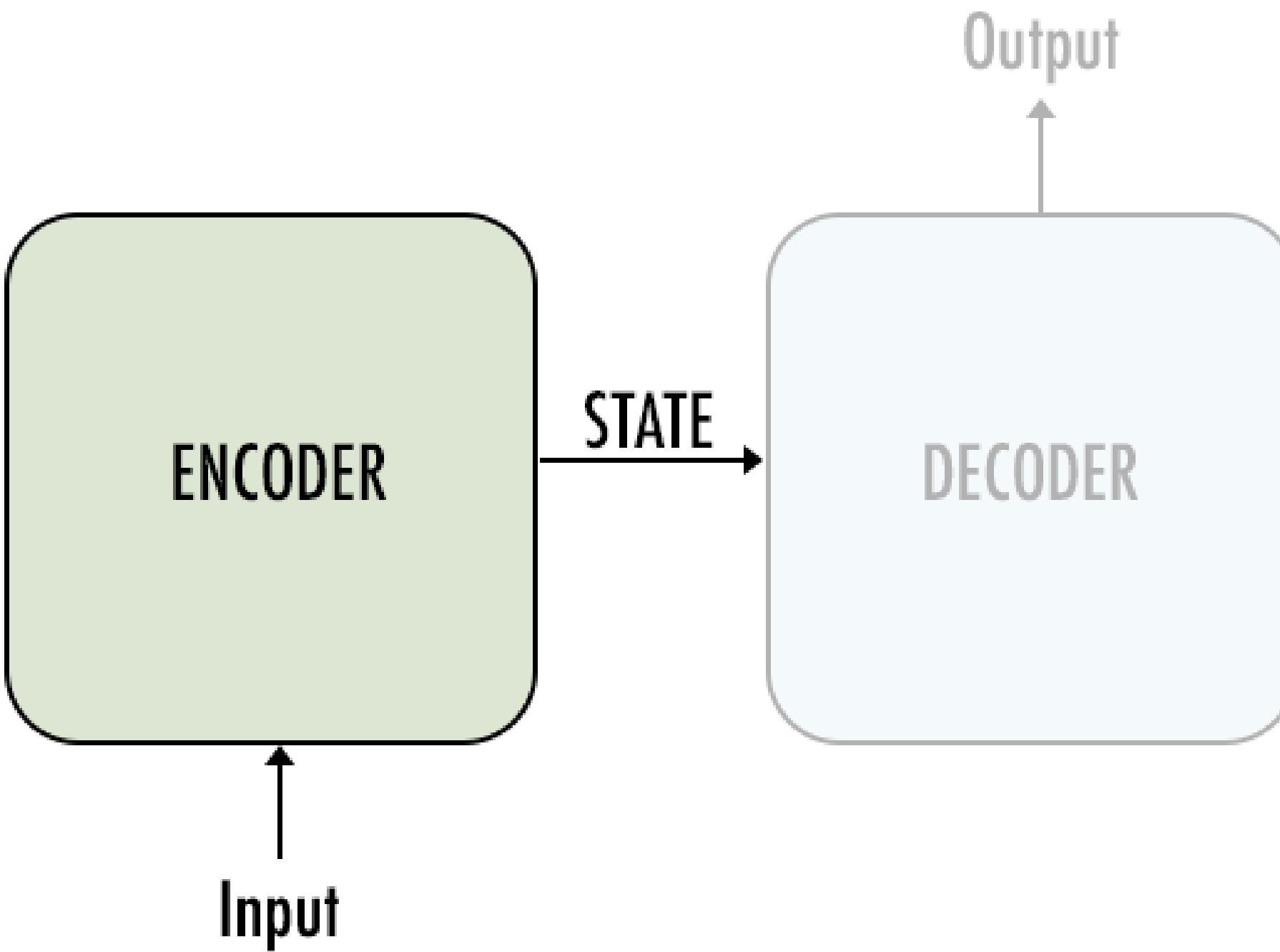


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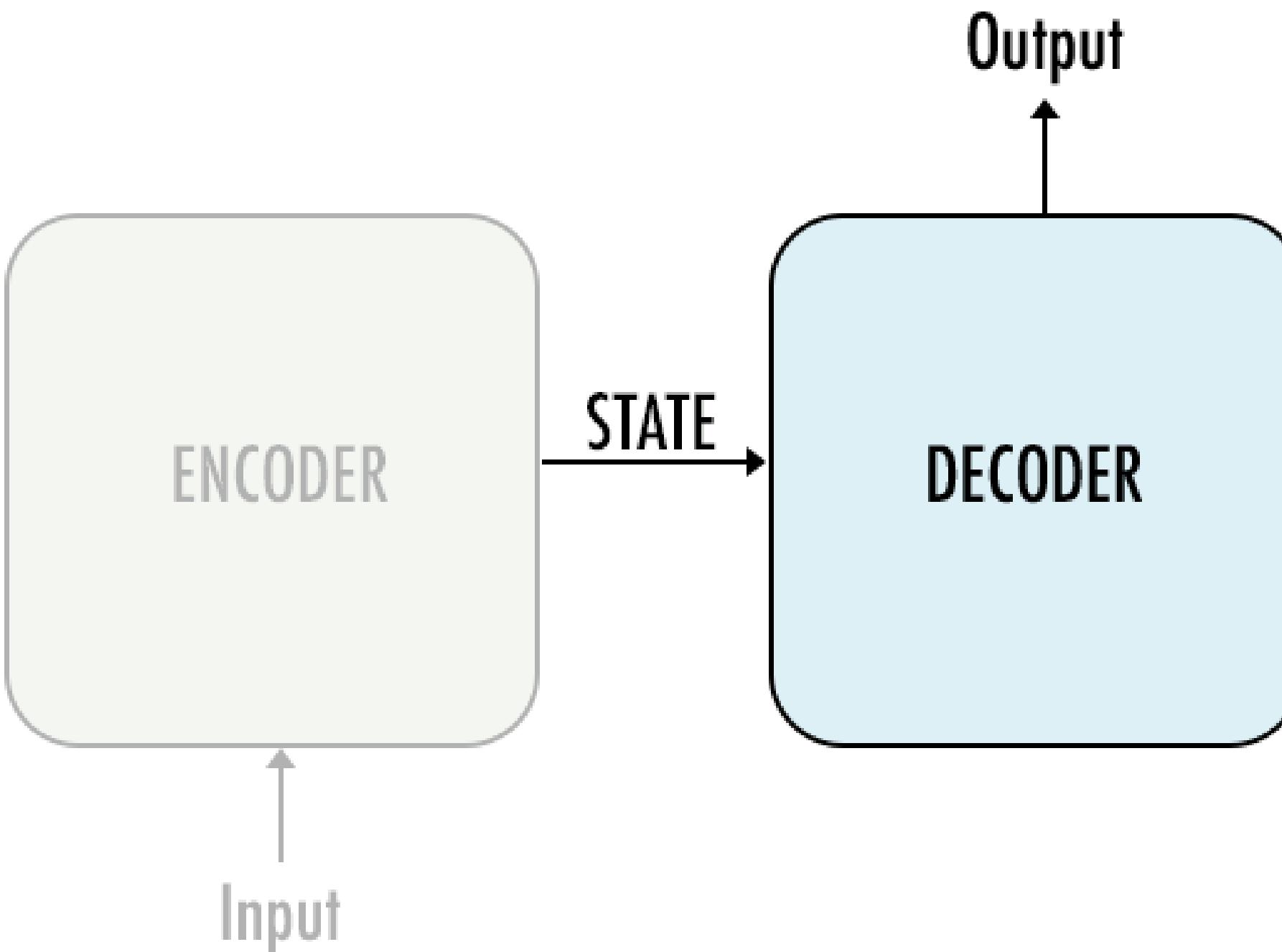
# Sequence to Sequence (seq2seq)



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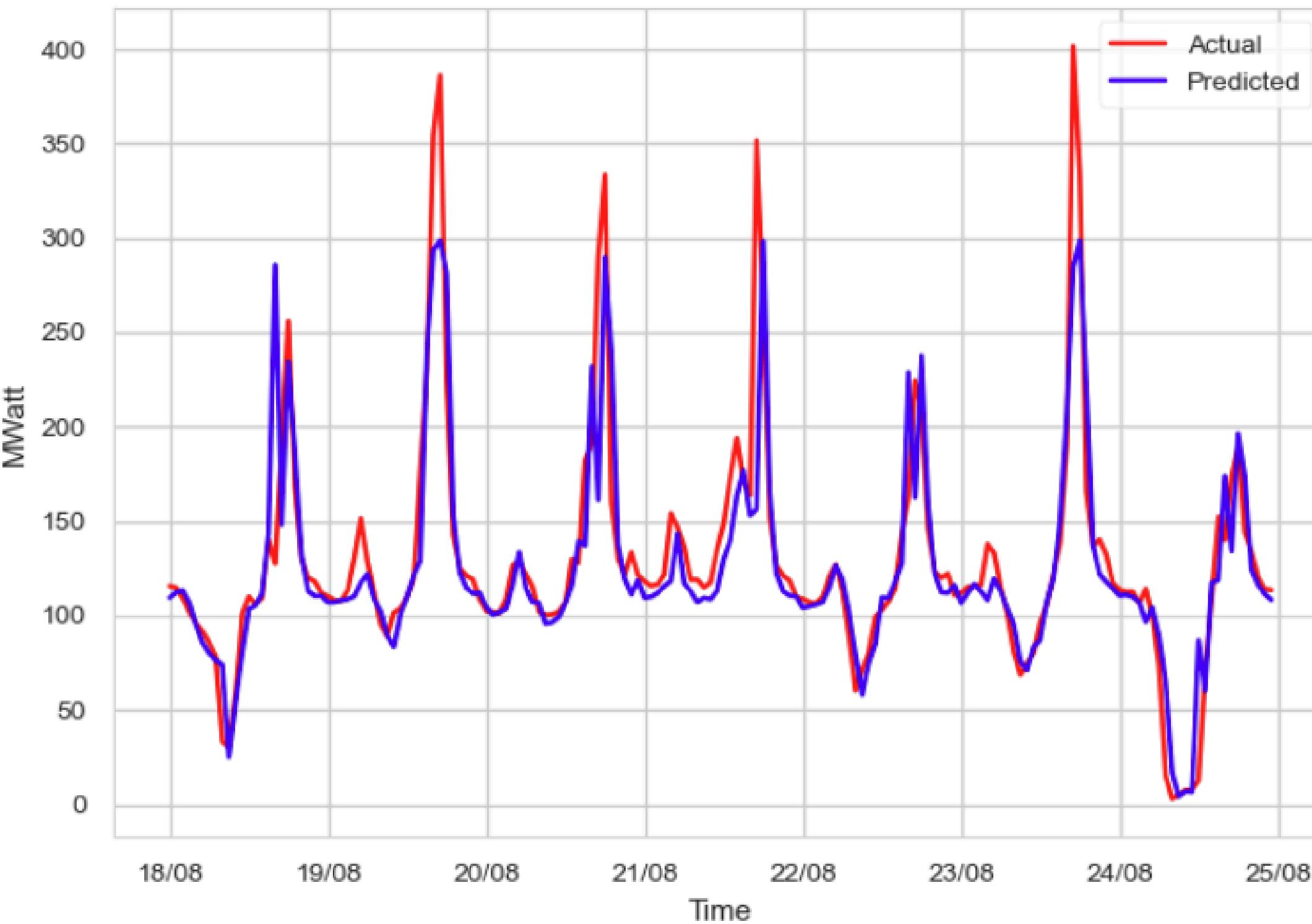


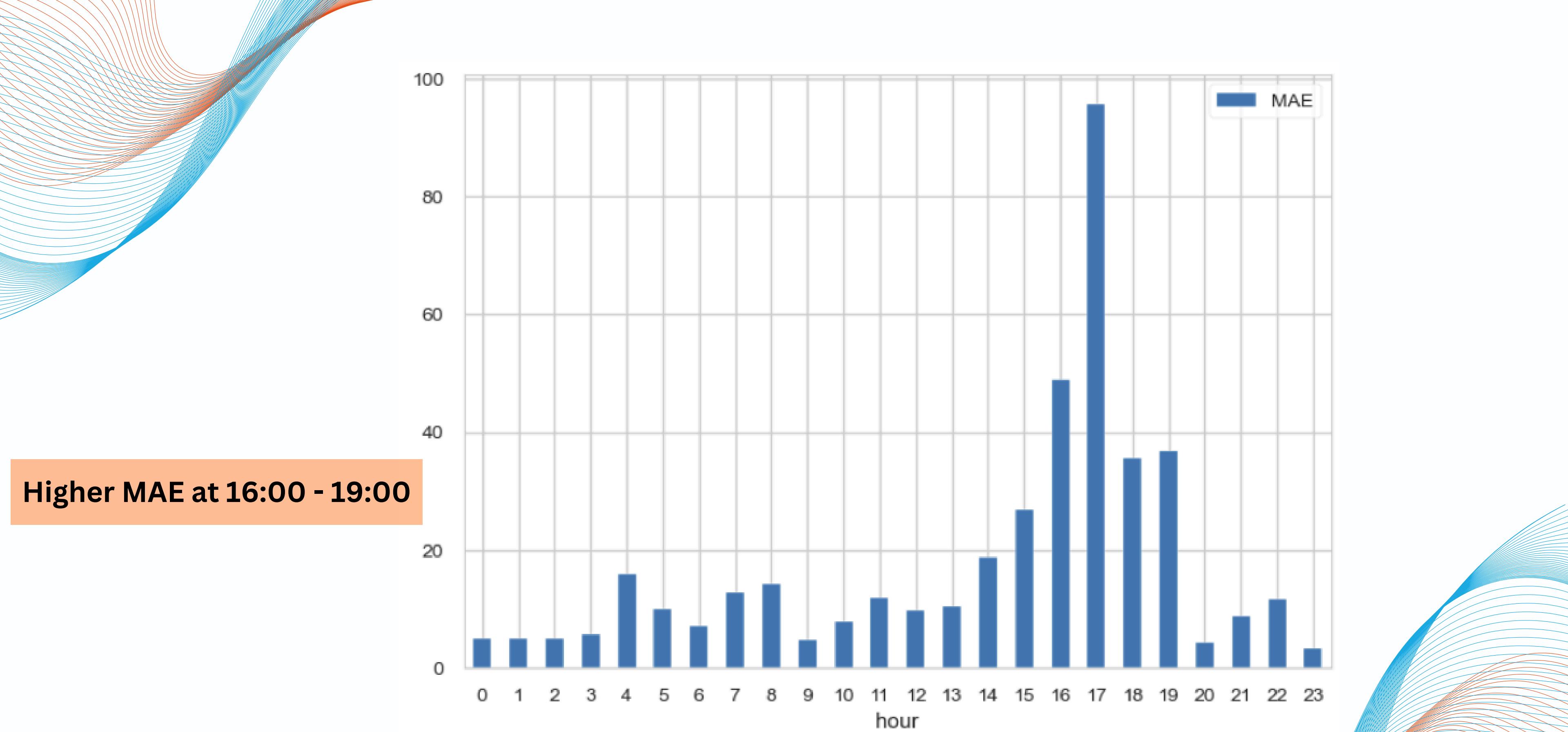
# Sequence to Sequence (seq2seq)



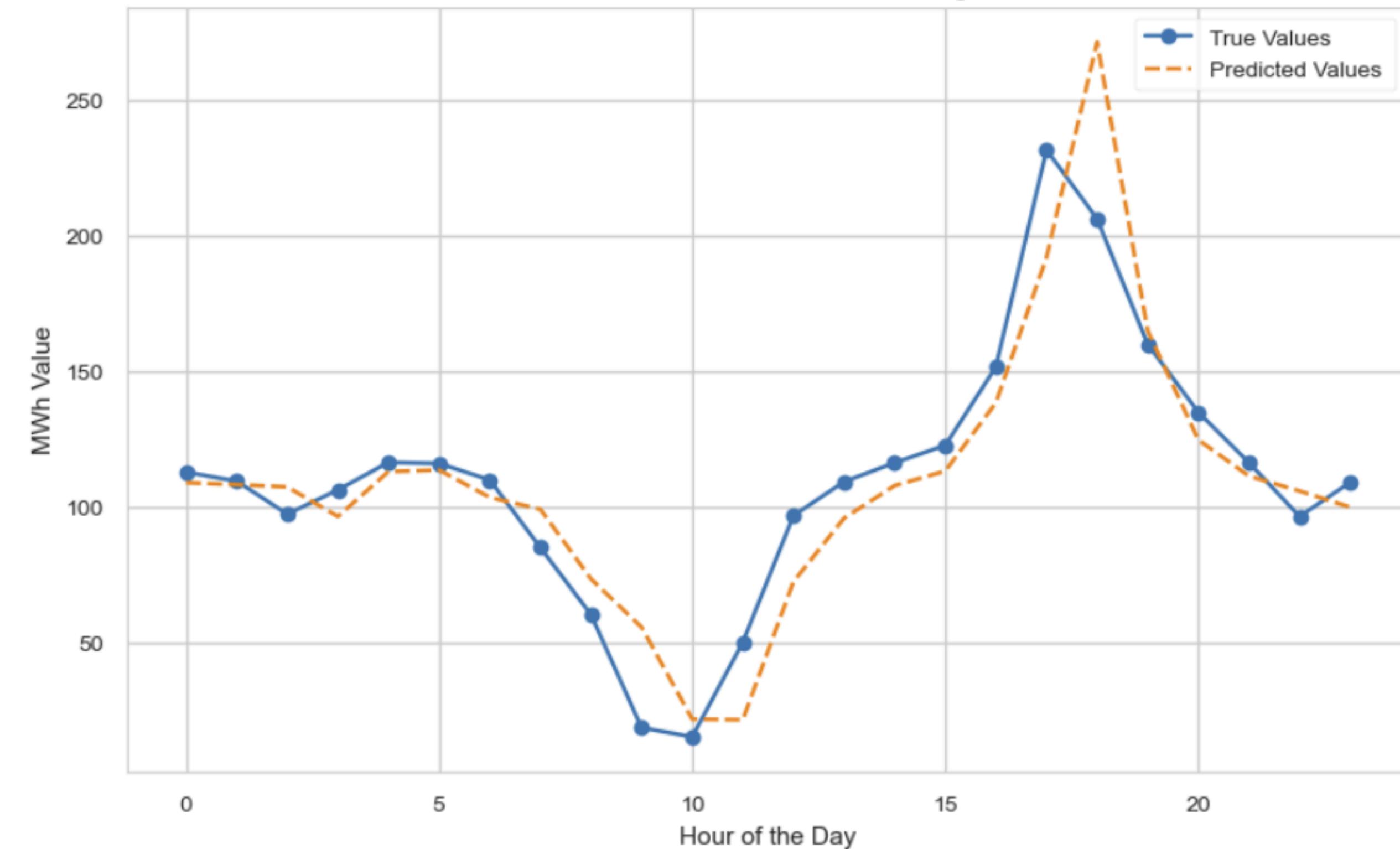
**MAE: 16.5**

Seq-to-Seq with 24 lags for the period 2024-08-18 & 2024-08-24





True vs Predicted Values for 31 August



MAE: 14.5

# PREDICTING 31 AUGUST

	Provider 1	Provider 2	Provider 3	LSTM	GRU	Seq2Seq
Greece	14.5	47.3	15.1	15	12.8	13.1
Bulgaria	13.6	16.8	12.1	17.4	15.2	13.8
Romania	15.6	16.8	12.1	21.4	18.5	13.5
Italy-Sud	4.5	4.7	4.4	7.5	7.7	5.0

# PREDICTING 31 AUGUST

	Provider 1	Provider 2	Provider 3	LSTM	GRU	Seq2Seq
Greece	14.5	47.3	15.1	15	12.8	13.1
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Italy-Sud	4.5	4.7	4.4	7.5	7.7	5.0

# CONCLUSIONS

- We successfully developed a model that outperforms the LSTM and GRU models, in 3 out of 4 countries.
- Incorporating additional features and expanding the range of values would enhance optimization and enable deeper analysis in this seq2seq approach.



# Thank you !

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