



The Renewable Energy Project

FINAL REPORT

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PROBLEM STATEMENT

Which type of renewable energy source is projected to witness the most substantial growth in the next decade in the United States?



OBJECTIVES

- To accurately forecast the growth trajectories of various renewable energy sources in the United States for the next decade using time series analysis.
- To identify the renewable energy source poised for the most significant expansion.



STAKEHOLDERS

- **Policymakers** require this data to craft informed policies and infrastructural plans.
- **Energy Companies** seek this information to align their investment and operational strategies with the anticipated growth.
- **Investors** utilize this information to optimize their investment portfolios in alignment with the forthcoming trends.



Kaggle

1995-2022

17 csv files

DATASET

	count	mean	std	min	25%	50%	75%	max
Year	57.0	1993.000000	16.598193	1965.000000	1979.000000	1993.000000	2007.000000	2021.000000
Geo Biomass Other - TWh	57.0	51.640315	24.831284	13.332232	25.756037	64.815414	73.159860	84.070230
Solar Generation - TWh	57.0	13.143548	34.702751	0.000000	0.000000	0.478253	1.095411	165.356570
Wind Generation - TWh	57.0	52.347070	98.781362	0.000000	0.000000	3.036189	34.797905	383.603270
Hydro Generation - TWh	57.0	274.981598	33.478110	198.974090	256.028530	274.030030	289.822450	355.973100
Electricity from solar (TWh)	57.0	25.374476	68.942213	0.000000	0.000000	0.956506	1.220000	328.840000
Solar Capacity	57.0	7.415070	19.288595	0.000000	0.000000	0.000000	0.974000	93.713016
Geothermal Capacity	57.0	995.899298	1231.805291	0.000000	0.000000	0.000000	2382.000000	3170.960000
Solar (% electricity)	57.0	0.308808	0.836247	0.000000	0.000000	0.012888	0.014777	3.959809
Wind (% electricity)	57.0	1.267605	2.375313	0.000000	0.000000	0.089173	0.831609	9.108380
Hydro (% equivalent primary energy)	57.0	3.557790	0.696467	2.383536	2.967953	3.602766	4.084431	5.202278
Solar (% equivalent primary energy)	57.0	0.135164	0.354995	0.000000	0.000000	0.005903	0.011445	1.675419
Renewables (% equivalent primary energy)	57.0	5.303081	1.705532	3.421371	4.327570	4.614475	5.334361	10.655991
Wind (% equivalent primary energy)	57.0	0.545342	1.016217	0.000000	0.000000	0.038384	0.363568	3.886730
Electricity from hydro (TWh)	57.0	547.594989	67.588075	397.948180	509.400000	544.508000	579.644900	711.946200
Biofuels Production - TWh - Total	57.0	103.151536	151.322025	0.000000	0.000000	22.044724	162.899440	424.440060
Electricity from wind (TWh)	57.0	103.603974	195.393345	0.000000	0.000000	6.072378	68.900000	756.400000
Other renewables including bioenergy (TWh)	57.0	51.265390	24.452388	13.332232	25.756037	64.640000	72.240005	83.070000
Wind Capacity	57.0	19.024343	34.748126	0.000000	0.000000	0.000000	16.515000	132.737600
Hydro (% electricity)	57.0	4.866521	3.775441	0.000000	0.000000	6.506543	7.653214	11.097251
Renewables (% electricity)	57.0	7.606756	6.241404	0.000000	0.000000	9.291262	11.360623	20.749863

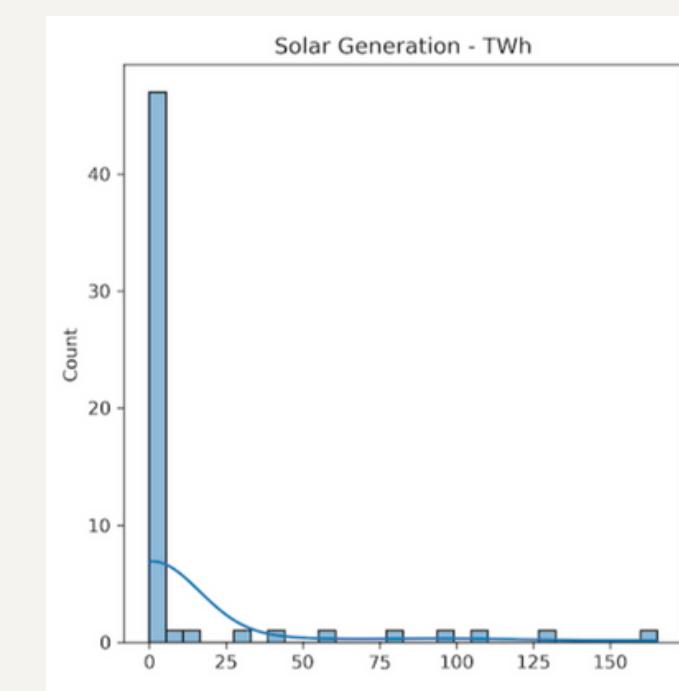
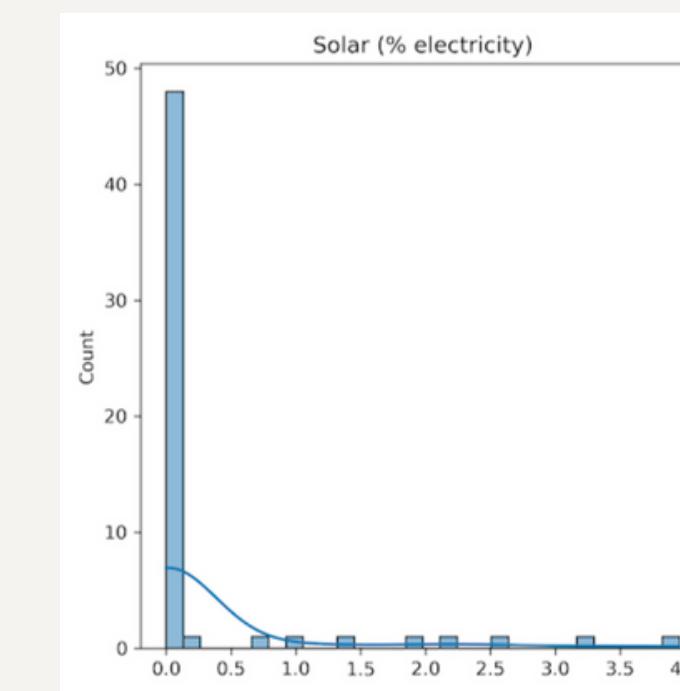
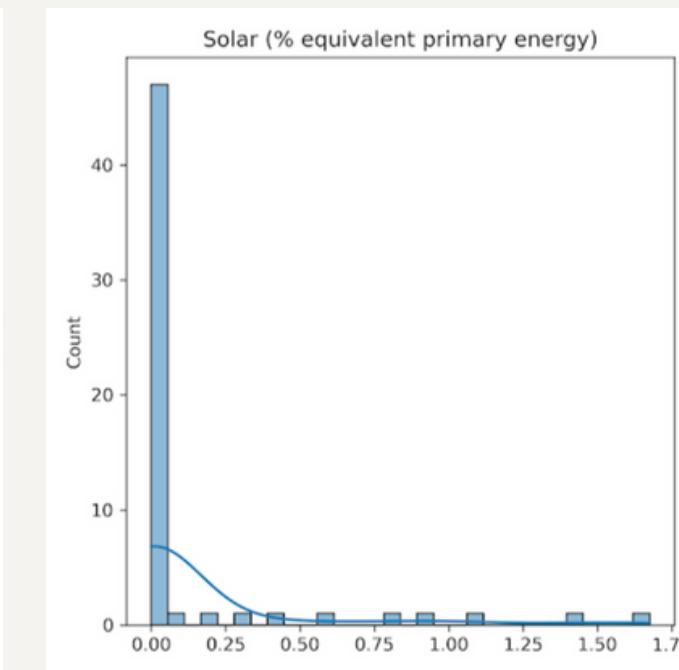
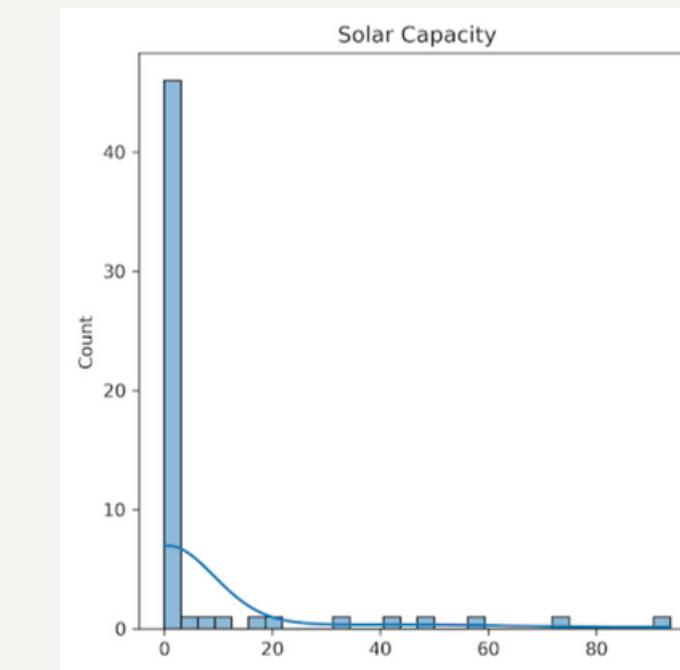


EDA



Circular results

Removing
related
variables

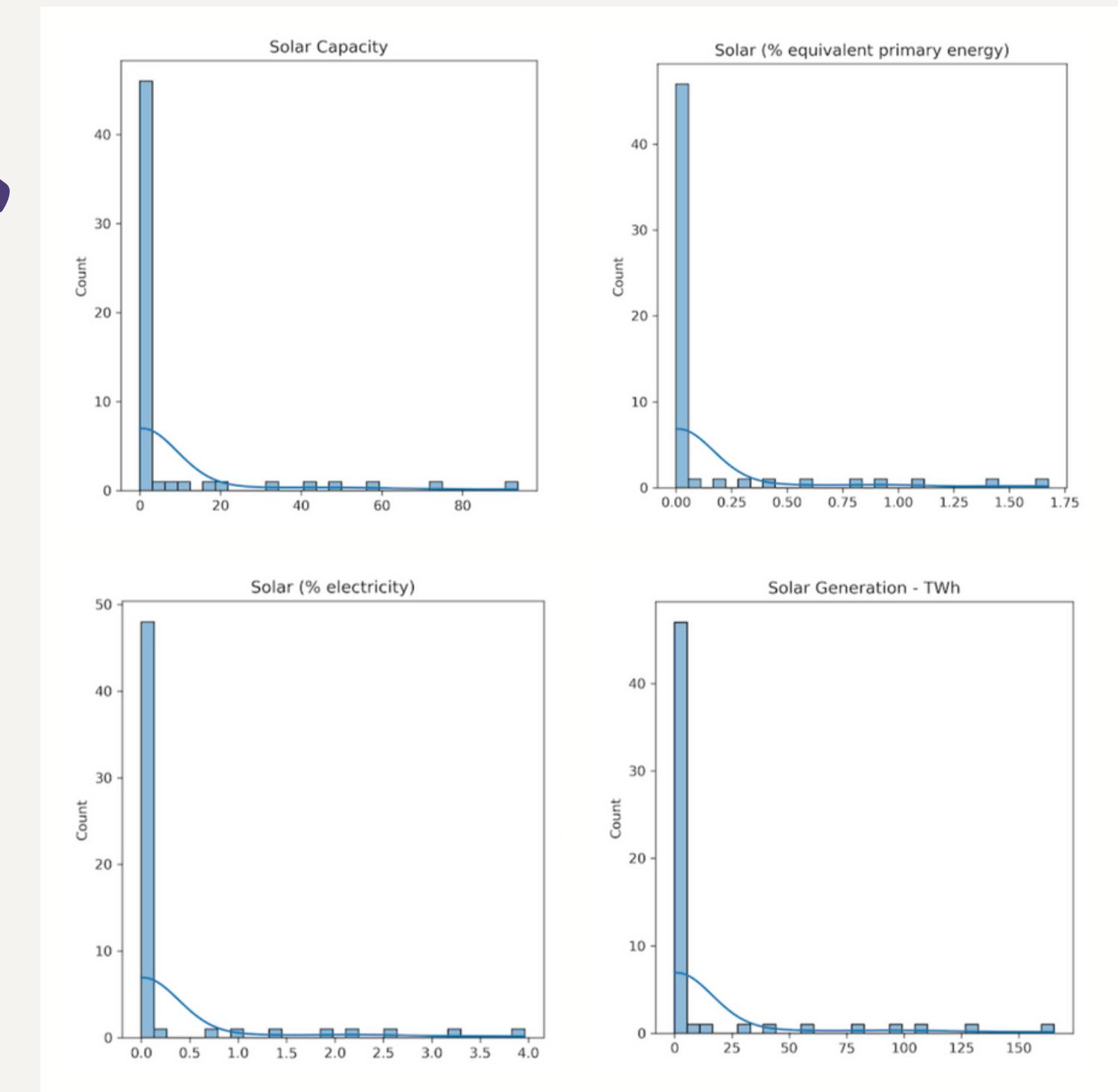




EDA HISTOGRAMS

Circular results

Removing
related
variables

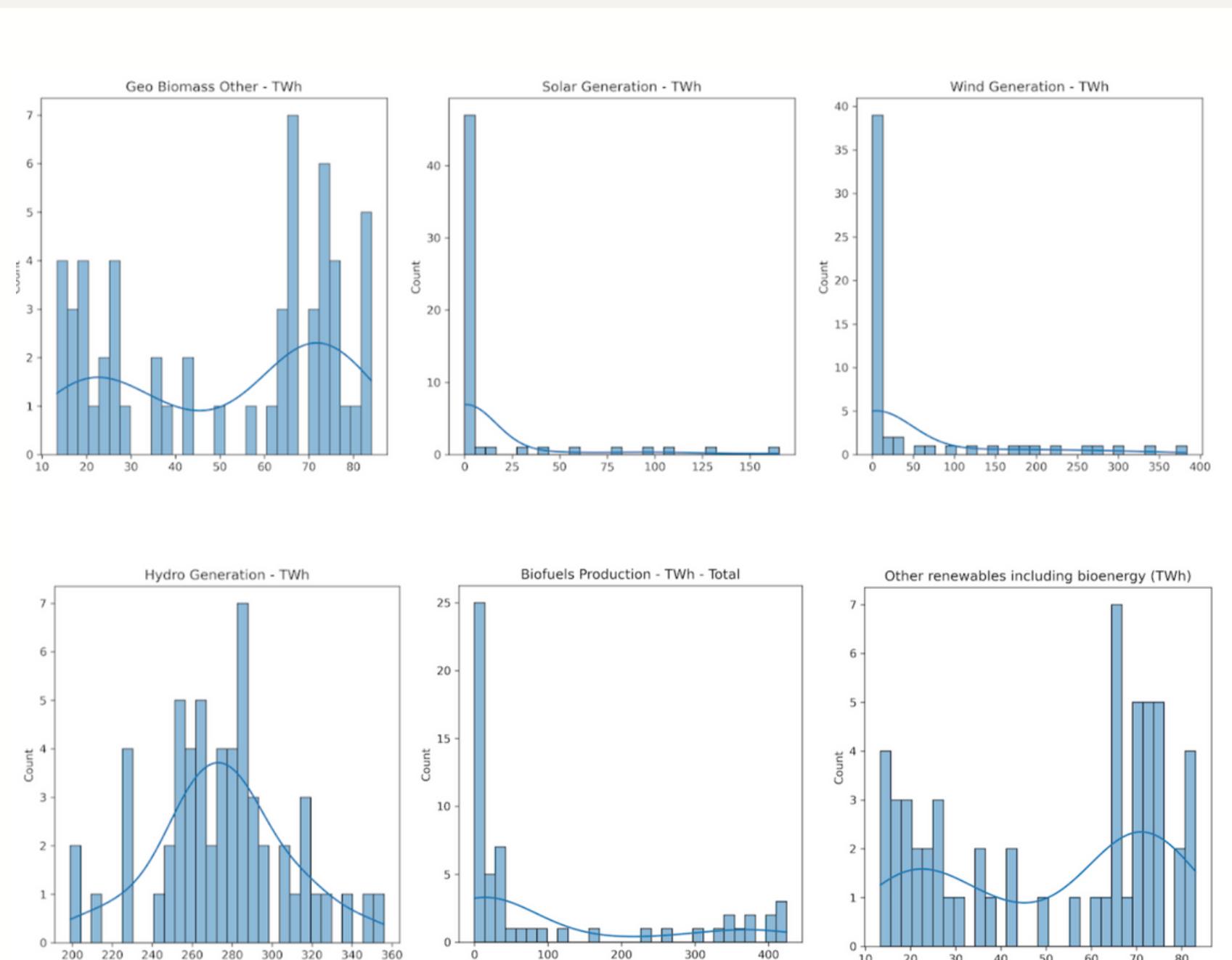




EDA HISTOGRAMS

Final
variables

Geo
Biomass



Solar

Wind

Hydro

Biofuels

Other

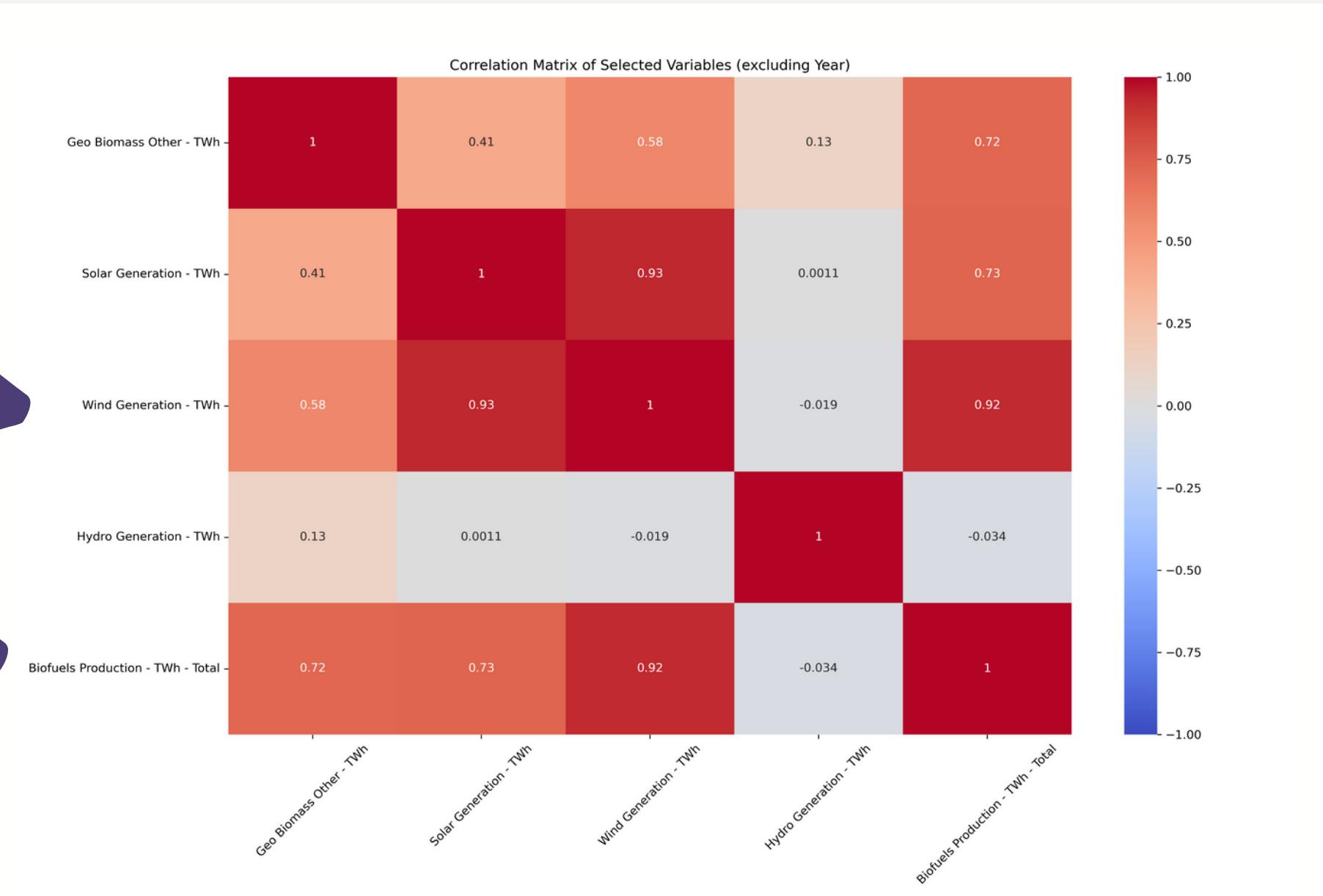


EDA HEATMAP

Wind +
Solar

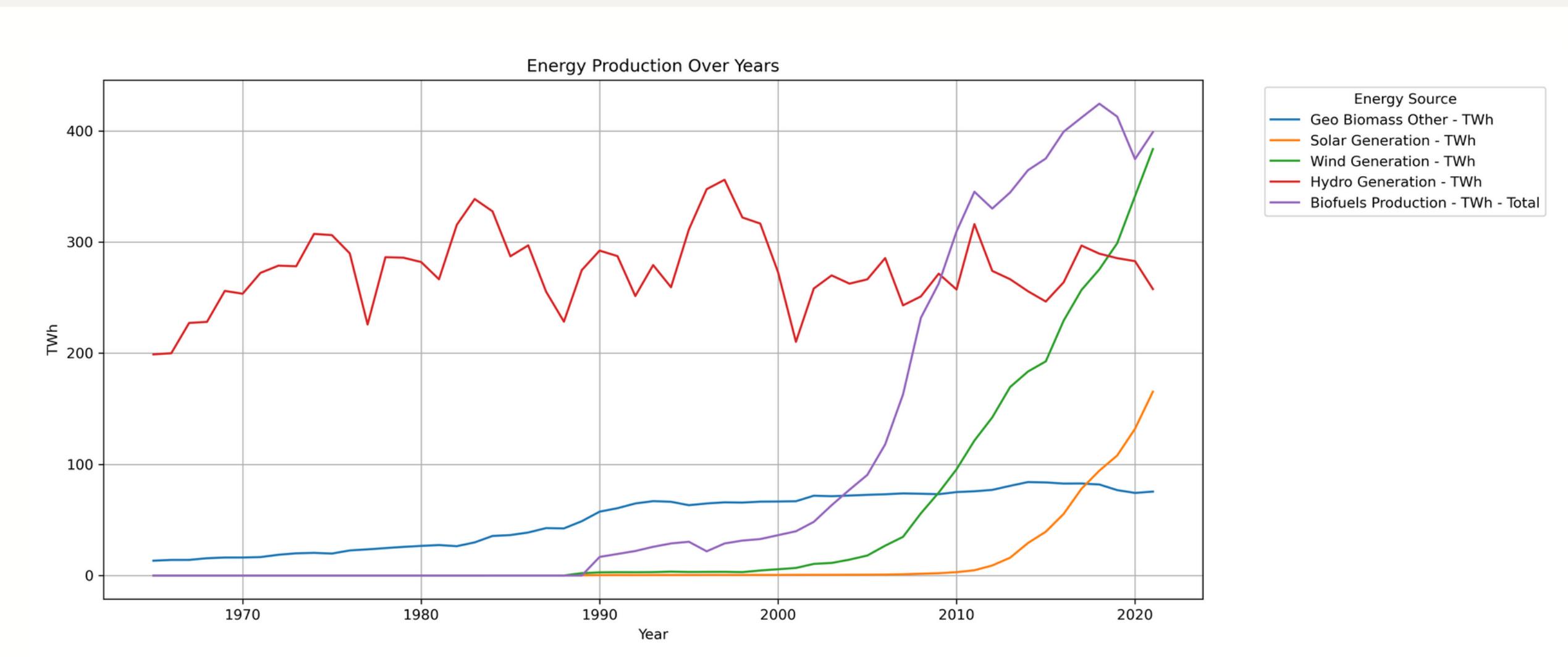


Wind +
Biofuels





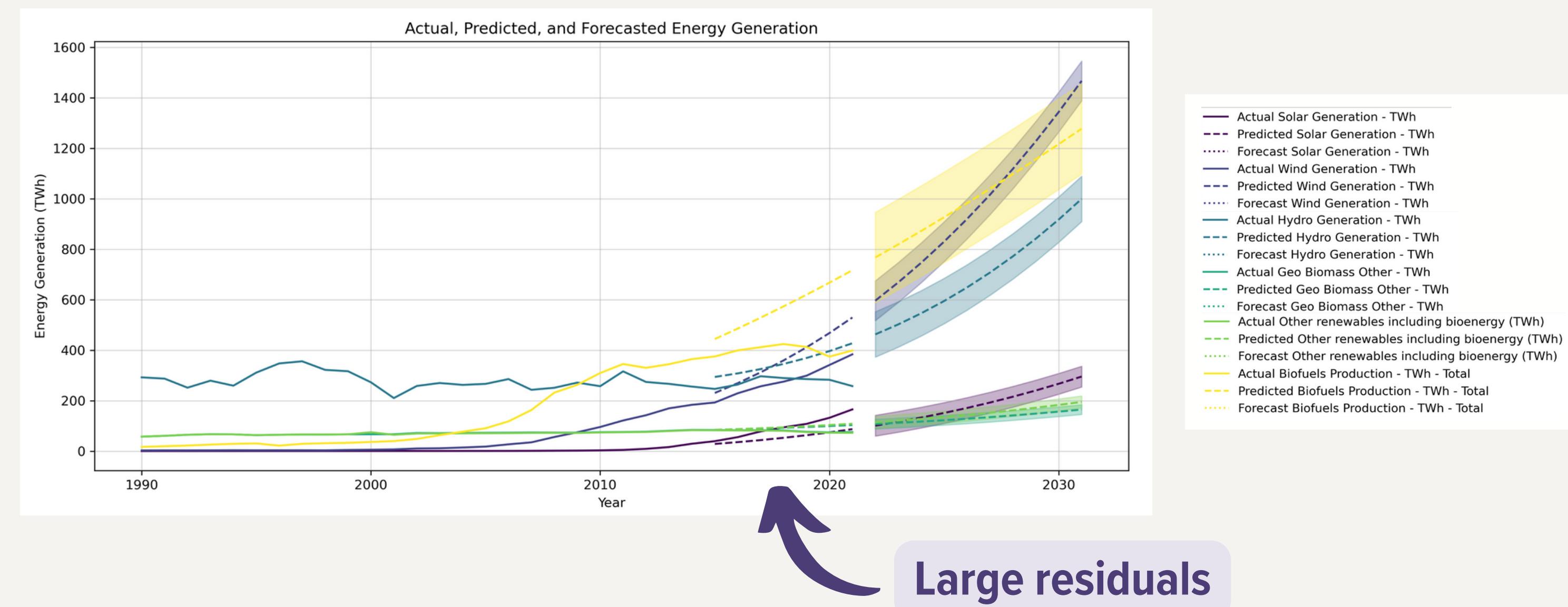
EDA LINEPLOT



Significative increase

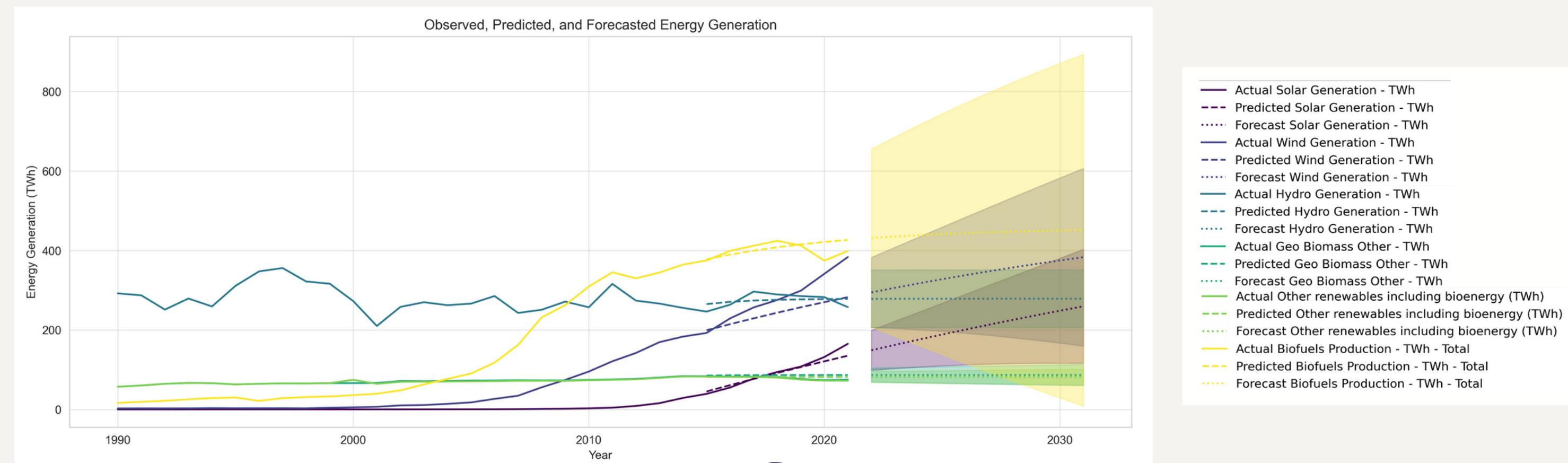


MODELING LINEAR REGRESSION





MODELING ARIMA NON-STATIONARY

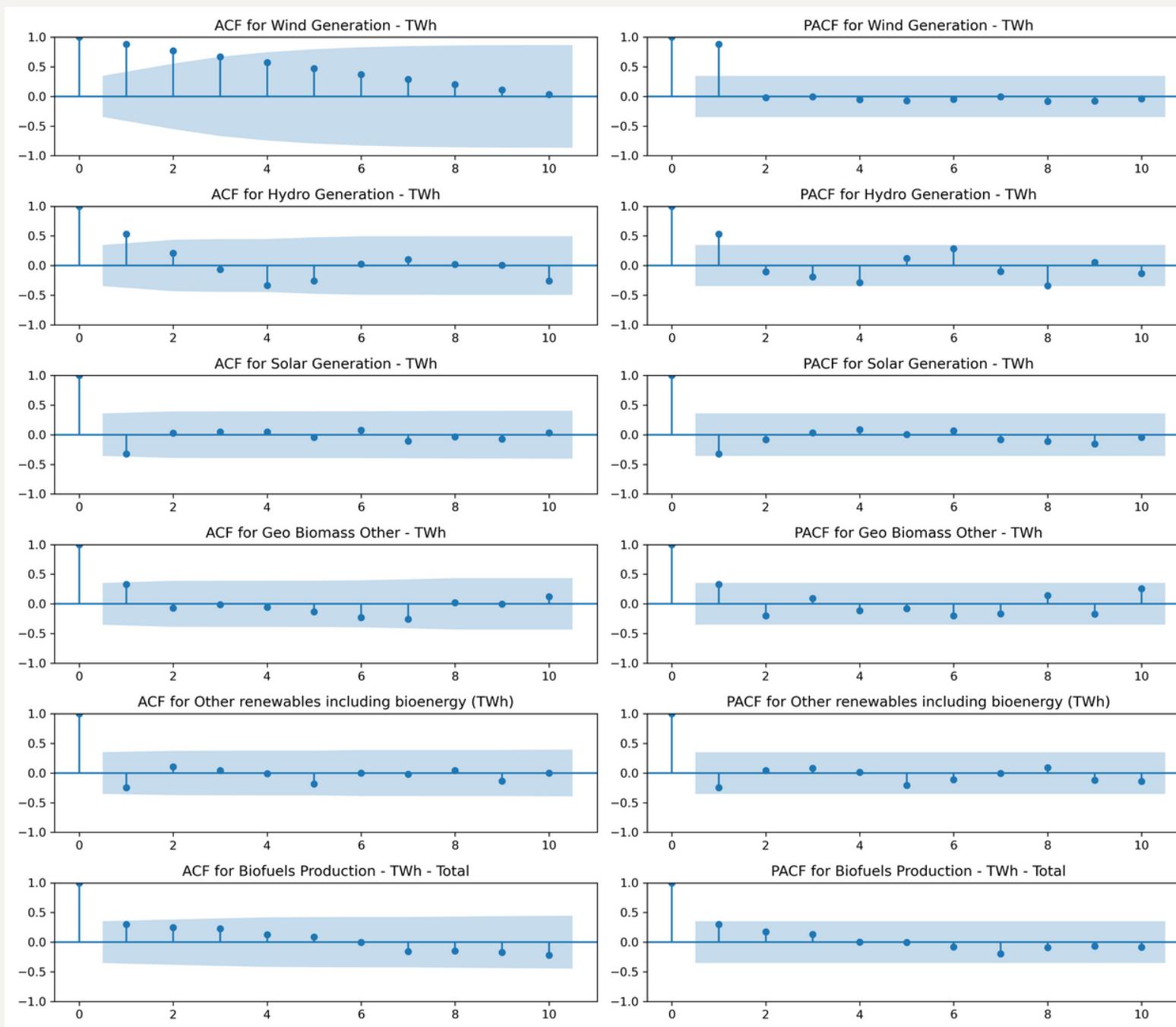


Moderate MAE & RMSE



MODELING

ADF TEST



ARMA model

AR(2) model

AR(2) model

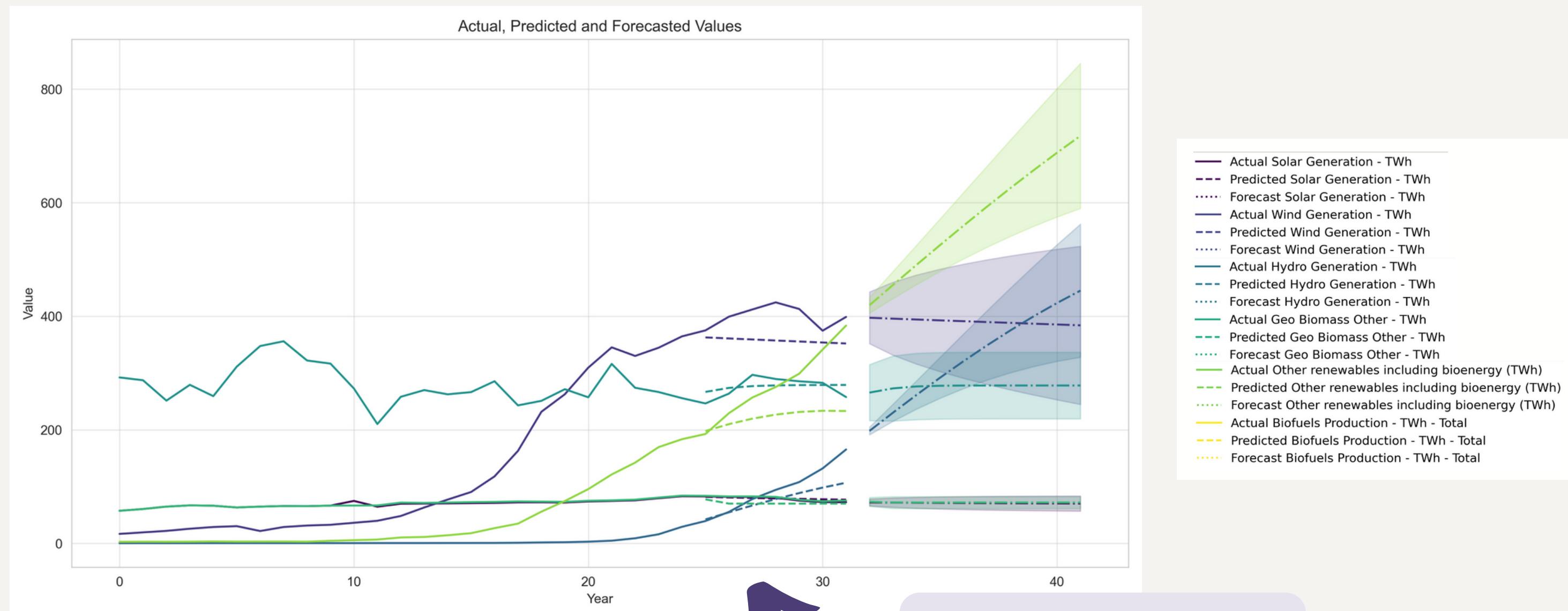
MA(1) model

AR(1) model

AR(1) model



MODELING ARIMA STATIONARY

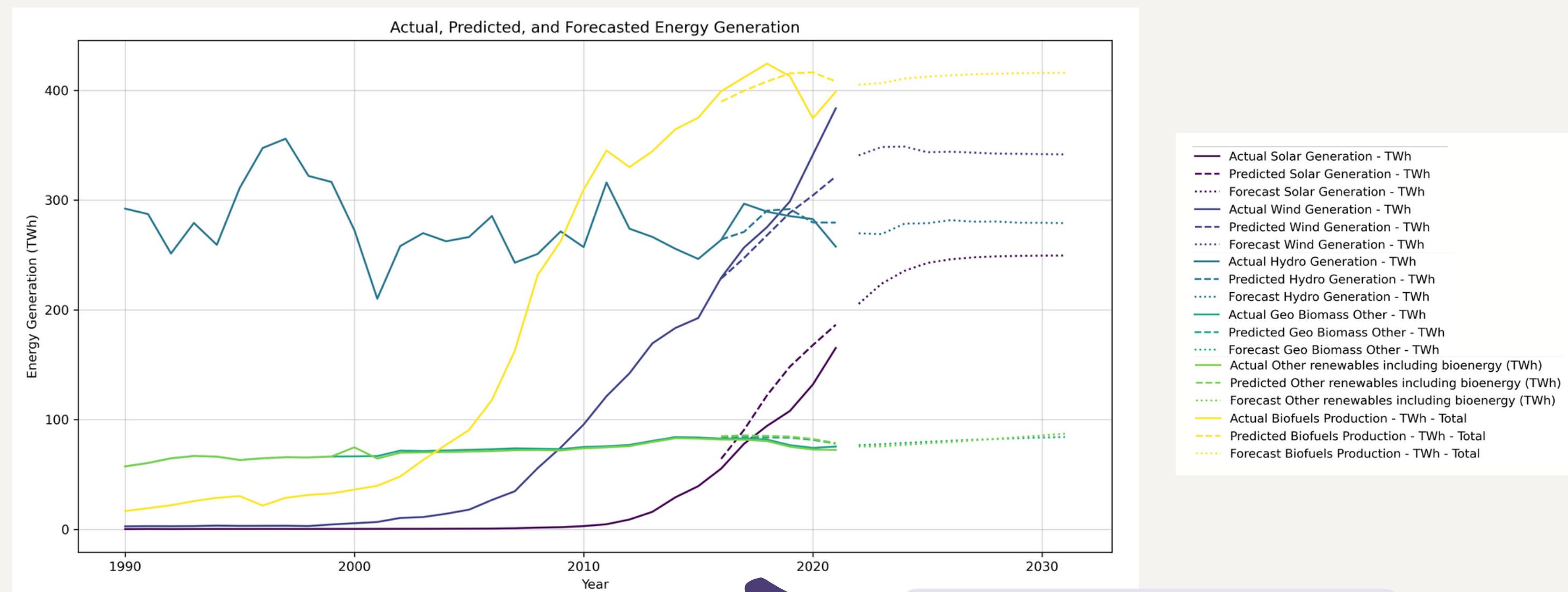


High MAE & RMSE



MODELING

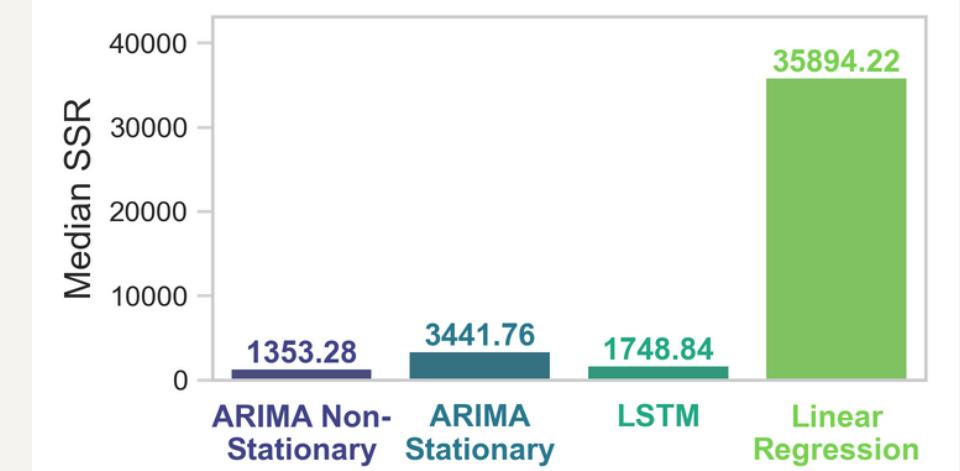
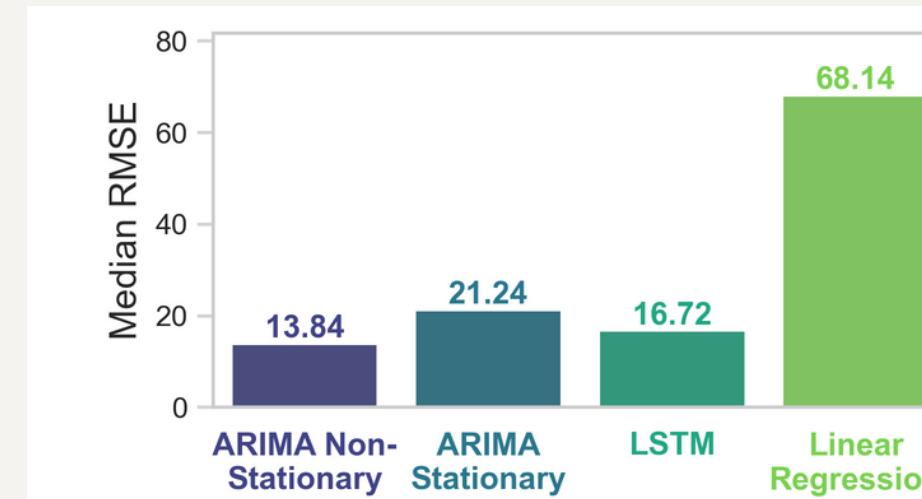
LSMT



Moderate MAE & RMSE



MODEL SELECTION



2nd best
(small margin)

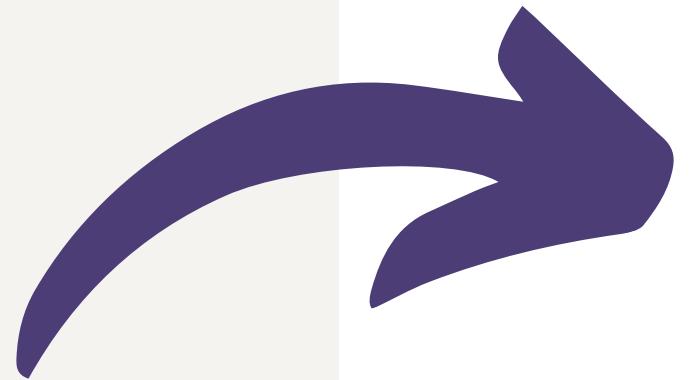
Best

Best

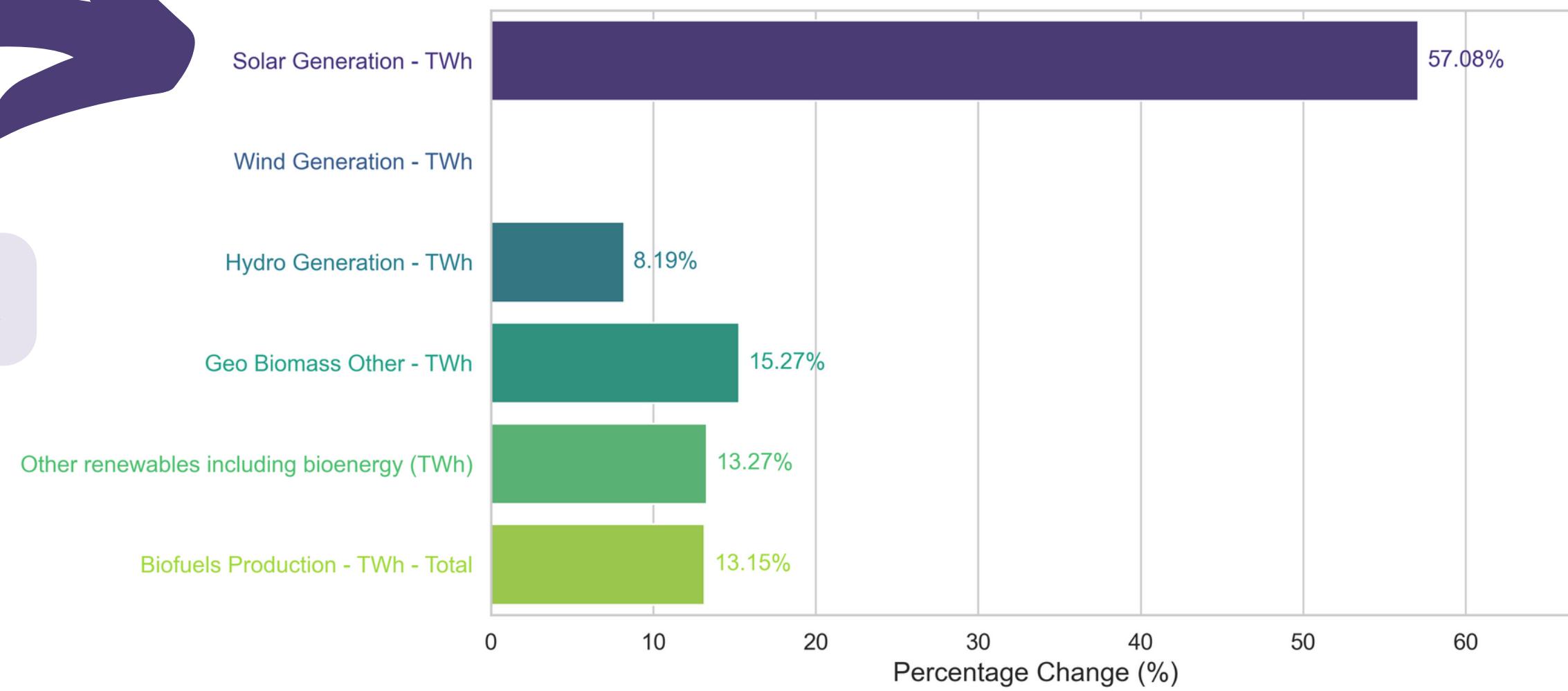


MODEL SELECTION

Increasing the most!



Percentage Change in Different Renewable Energy Sources
ARIMA Non-Stationary Model





TAKEAWAYS

- Optimal Predictive Model: The **ARIMA Non-Stationary**
- **Solar energy** is forecasted to witness the most substantial growth in the next decade.
- Upward trend in several renewable sources, which may be indicative of periods where **policies** or **incentives** were introduced to promote renewable energies.
- **Technological advancements** and diminishing production costs, are likely driving factors in their increased adoption and development.