Here is the R code;

Load necessary libraries

library(forecast) library(tseries) library(ggplot2)

getwd()

library(readxl) thewinddata2 <- read\_excel("thewinddata2.xlsx") getwd() thewinddata2 <- read\_excel(file.choose())

Extract the "Wind, wave, tidal1 (Mtoe)" column and convert it to a time series

wind\_wave\_tidal\_ts <- ts(thewinddata2$Wind, wave, tidal1 (Mtoe), start = 1990, frequency = 1) # Annual data

Plot the time series to visualize trends

plot.ts(wind\_wave\_tidal\_ts, main = "Wind, Wave, Tidal Energy (Mtoe)", ylab = "Energy (Mtoe)", xlab = "Year")

Step 1: Check stationarity  
adf\_test <- adf.test(wind\_wave\_tidal\_ts) print(adf\_test) If non-stationary, apply differencing

if (adf\_test$p.value > 0.05) { wind\_wave\_tidal\_ts\_diff <- diff(wind\_wave\_tidal\_ts) plot.ts(wind\_wave\_tidal\_ts\_diff, main = "Differenced Time Series", ylab = "Differenced Energy", xlab = "Year") adf\_test\_diff <- adf.test(wind\_wave\_tidal\_ts\_diff) print(adf\_test\_diff) }

Step 2: Identify ARIMA parameters using ACF and PACF

acf(wind\_wave\_tidal\_ts, main = "ACF for Wind, Wave, Tidal Energy") pacf(wind\_wave\_tidal\_ts, main = "PACF for Wind, Wave, Tidal Energy")

Use auto.arima to find the best model  
best\_model <- auto.arima(wind\_wave\_tidal\_ts, seasonal = FALSE) summary(best\_model) Step 3: Check residuals for white noise

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checkresiduals(best\_model)

Step 4: Forecast for 10 years

forecast\_horizon <- 10 forecast\_values <- forecast(best\_model, h = forecast\_horizon)

Plot the forecast

plot(forecast\_values, main = "10-Year Forecast for Wind, Wave, Tidal Energy", xlab = "Year", ylab = "Energy (Mtoe)")

Display forecasted values

print(forecast\_values)

Save forecast results to a CSV file

write.csv(forecast\_values, file = "forecast\_wind\_wave\_tidal.csv")

Load necessary libraries

library(forecast) library(tseries) library(ggplot2)

Assuming you have already loaded your dataset using read\_excel and named it thewinddata2

Extract the "Solar photovoltaic (Mtoe)" column and filter data starting from 2005

solar\_photovoltaic\_filtered <- thewinddata2[thewinddata2$Year >= 2005, ]

Convert the filtered data to a time series

solar\_photovoltaic\_ts <- ts(solar\_photovoltaic\_filtered$Solar photovoltaic (Mtoe), start = 2005, frequency = 1) # Annual data

Plot the time series to visualize trends

plot.ts(solar\_photovoltaic\_ts, main = "Solar Photovoltaic Energy (Mtoe)", ylab = "Energy (Mtoe)", xlab = "Year")

Step 1: Check stationarity  
adf\_test <- adf.test(solar\_photovoltaic\_ts) print(adf\_test)

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If non-stationary, apply differencing

if (adf\_test$p.value > 0.05) { solar\_photovoltaic\_ts\_diff <- diff(solar\_photovoltaic\_ts) plot.ts(solar\_photovoltaic\_ts\_diff, main = "Differenced Time Series", ylab = "Differenced Energy", xlab = "Year") adf\_test\_diff <- adf.test(solar\_photovoltaic\_ts\_diff) print(adf\_test\_diff) } else { solar\_photovoltaic\_ts\_diff <- solar\_photovoltaic\_ts # If stationary, no differencing needed }

Step 2: Identify ARIMA parameters using ACF and PACF

acf(solar\_photovoltaic\_ts\_diff, main = "ACF for Solar Photovoltaic Energy") pacf(solar\_photovoltaic\_ts\_diff, main = "PACF for Solar Photovoltaic Energy")

Use auto.arima to find the best model

best\_model <- auto.arima(solar\_photovoltaic\_ts\_diff, summary(best\_model)

seasonal =

FALSE)

Step 3: Check residuals for white noise  
checkresiduals(best\_model)  
Step 4: Forecast for 10 years  
forecast\_horizon <- 10 forecast\_values <- forecast(best\_model, h = forecast\_horizon) Plot the forecast

plot(forecast\_values, main = "10-Year Forecast for Solar Photovoltaic Energy", xlab = "Year", ylab = "Energy (Mtoe)")

Display forecasted values  
print(forecast\_values)  
Save forecast results to a CSV file  
write.csv(forecast\_values, file = "forecast\_solar\_photovoltaic.csv")