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Forecasting annual renewable electricity output in Barbados

A five-year backtest of three forecasting methods

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Abstract

Barbados recorded 44.1 gigawatt-hours (GWh) of renewable electricity in 2018 and 108.4 GWh in 2022 [1]. We tested three ways of predicting the next annual total using only earlier years. Carrying the average annual increase forward gave the lowest mean absolute error, 6.28 GWh. A fitted straight line missed by 7.89 GWh on average. A model proposed for annual planning can be tested against both figures on the same years.

Research question

Which simple model best anticipated the next annual total during 2018–2022?

Data and methods

We transcribed the renewable output series in Chart 4 of the Barbados Energy Bulletin [1]. We converted kilowatt-hours to GWh by dividing by one million and rounded to one decimal before fitting. The ten values cover 2013–2022. Five years formed the first training window.

For each target year, persistence repeats the previous observation. Drift adds the mean annual change since 2013 to the last observation. Linear regression fits an intercept and slope to all earlier annual observations by least squares. After each prediction, we added the observed year to the training set. We averaged the five absolute errors, giving each year equal weight [2].

Results

Persistence missed by 14.14 GWh on average. Drift reduced that to 6.28 GWh. Regression came closest in 2018 and 2019 but fell short by 20.67 GWh in 2022. Drift also underestimated 2022, by 13.89 GWh.

Removing the final test year preserved the ranking. The mean errors for 2018–2021 were 4.38 GWh for drift, 4.70 GWh for regression and 11.73 GWh for persistence, rounded to two decimal places.

Average size of a one-year forecast error

GWh



Mean absolute error over the five targets, 2018–2022. Smaller values indicate closer predictions. Calculated from [1].

Discussion

The straight line gives early observations lasting influence. Drift starts from the most recent output and extends the historical average increase. The difference mattered as generation rose late in the series. Future tests could add capacity scheduled to enter service, using only information available when each forecast would have been issued.

Limitations

The five errors come from overlapping training windows. They cannot establish future accuracy. The bulletin is one historical edition and could include revisions to earlier figures. Annual renewable output combines sources and conceals hourly swings. These results cannot guide dispatch or measure the performance of a solar weather model.

Reproduce the analysis

Enter the ten annual values in order. For 2018, use 2013–2017 for training. Extend the window by one year for each later target.

For drift, add (last value minus first value) divided by (number of training years minus one) to the last value. For regression, fit output against year and predict the next point.

Subtract each forecast from the observation, take its absolute value and average across the five targets. Keep full precision until reporting.

Data table

Year	Renewable output (GWh)
2013	5.3
2014	4.7
2015	16.8
2016	26.5
2017	37.7
2018	44.1
2019	52.5
2020	68.7
2021	84.6
2022	108.4

References

[1] Barbados Energy Bulletin, Volume 8, Issue 2, January–December 2022, Chart 4, p. 14

[2] R. J. Hyndman and G. Athanasopoulos, Forecasting: Principles and Practice, 3rd ed., Chapter 5