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Integrating Wind Power: An Investigation using Weibull Parameters for Electricity Generation at Coastline of Pakistan

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Abstract—Currently facing a power crisis, Pakistan is one of the countries much reliant on fossil fuels for power generation, which causes relentless climate change. Even though alternate energy sources, such as wind, are abundantly available, they are not entirely exploited. In this context, this study comprehensively elaborates the wind power potential for electricity generation of a location situated on the south-eastern coastline of Pakistan. Weibull parameters were computed for the site through six numerical approaches. Wind power density and specific wind speed characteristics were calculated at different heights using the Weibull parameters. The power density and seasonal wind characteristics parameters were also calculated. The goodness fit test results showed that the calculations for all methods are valid. However, the best fitting approach is also determined for the wind profile representation of the selected area. Besides, annual energy production, capacity factor, and economic analysis at the site were estimated using different wind turbine (WTs) models. Almost all selected WTs are predicted to produce sufficient energy with an adequate capacity factor and cost of energy generation. Based on computed results, it is found that candidate location has good wind profile and power potential for wind power generation.

Keywords—Energy production, Weibull Parameters, Wind Power, Wind Resource Assessment, Wind Speed Characteristics, Wind Turbine