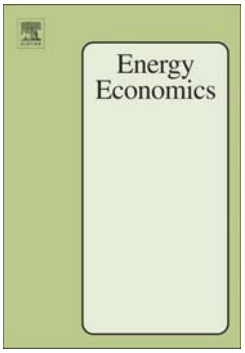

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An improved global wind resource estimate for integrated assessment models

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Abstract

This paper summarizes initial steps to improving the robustness and accuracy of global renewable resource and techno-economic assessments for use in integrated assessment models. We outline a method to construct country-level wind resource supply curves, delineated by resource quality and other parameters. Using mesoscale reanalysis data, we generate estimates for wind quality, both terrestrial and offshore, across the globe. Because not all land or water area is suitable for development, appropriate database layers provide exclusions to reduce the total resource to its technical potential. We expand upon estimates from related studies by: using a globally consistent data source of uniquely detailed wind speed characterizations; assuming a non-constant coefficient of performance for adjusting power curves for altitude; categorizing the distance from resource sites to the electric power grid; and characterizing offshore exclusions on the basis of sea ice concentrations. The product, then, is technical potential by country, classified by resource quality as determined by net capacity factor. Additional classifications dimensions are available, including distance to transmission networks for terrestrial wind and distance to shore and water depth for offshore. We estimate the total global wind generation potential of 560 PWh for terrestrial wind with 90% of resource classified as low-to-mid quality, and 315 PWh for offshore wind with 67% classified as mid-to-high quality. These estimates are based on 3.5 MW composite wind turbines with 90 meter hub heights, 0.95 availability, 90% array efficiency, and 5 MW/km^2 deployment density in non-excluded areas. We compare the underlying technical assumption and results with other global assessments.

Keywords

wind, supply curve, resource assessment, technical potential, integrated assessment model, global

Highlights

- We develop global supply curves for wind-based electric power generation.

[1] The author's contributions to this work were done at the National Renewable Energy Laboratory.