

## Predicting the Turbulence Intensity, Excess Energy Available and Potential Power Generated by Building Mounted Wind Turbines over Four Major UK City

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**Abstract :** The future of potentials wind energy applications within suburban/urban areas are currently faced with various problems. These include insufficient assessment of urban wind resource, and the effectiveness of commercial gust control solutions as well as unavailability of effective and cheaper valuable tools for scoping the potentials of urban wind applications within built-up environments. In order to achieve effective assessment of the potentials of urban wind installations, an estimation of the total energy that would be available to them were effective control systems to be used, and evaluating the potential power to be generated by the wind system is required. This paper presents a methodology of predicting the power generated by a wind system operating within an urban wind resource. This method was developed by using high temporal resolution wind measurements from eight potential sites within the urban and suburban environment as inputs to a vertical axis wind turbine multiple stream tube model. A relationship between the unsteady performance coefficient obtained from the stream tube model results and turbulence intensity was demonstrated. Hence, an analytical methodology for estimating the unsteady power coefficient at a potential turbine site is proposed. This is combined with analytical models that were developed to predict the wind speed and the excess energy (EEC) available in estimating the potential power generated by wind systems at different heights within a built environment. Estimates of turbulence intensities, wind speed, EEC and turbine performance based on the current methodology allow a more complete assessment of available wind resource and potential urban wind projects. This methodology is applied to four major UK cities namely Leeds, Manchester, London and Edinburgh and the potential to map the turbine performance at different heights within a typical urban city is demonstrated.

**Keywords :** small-scale wind, turbine power, urban wind energy, turbulence intensity, excess energy content

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