# Assessing Urban Wind Energy by Integrating Mesoscale Weather and Microscale Computational Fluid Dynamics Models

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Renewable energy has become essential in addressing the growing energy demands while mitigating the environmental impact of conventional energy sources. Among the common renewable energy sources, wind energy is a popular choice utilizing wind turbines. Many researches have focused on large wind turbines which are usually built on open terrains with higher wind velocity and energy production. However, for urban areas, the obstacles of complex building geometries decrease the wind velocity and cause more turbulences, which are not a suitable place for large wind turbines. In this case, small wind turbines may be more appropriate due to less space demands for installation and being easier to be driven. Therefore, this research focuses on the assessment of small wind turbine performance in urban areas. The challenge of this research is that the traditional weather models are mainly mesoscale and cannot capture the turbulences and intermittencies in urban areas in microscale. Hence, this research applies the computational fluid dynamics (CFD) model to perform microscale wind field simulation. As the CFD model can simulate the air flow in a very high resolution, the boundary condition settings could significantly affect the simulation. Therefore, to address this issue, this research aims at combining mesoscale weather research and forecast (WRF) model and CFD model to analyze microscale urban wind fields. Finally, the wind fields are visualized in a 3D application built with Unity, where users can specify the location of installing wind turbines and assess the potential annual energy production.

**Keywords:** roof-mounted wind turbine, urban wind field, computational fluid dynamics, wind resource assessment