Feasibility and effectiveness of urban rooftop wind turbines studied through modelling

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Wind turbines at Bunnings Warehouse in Port Kennedy, WA.

Murdoch University researchers hope new three-dimensional modelling of urban wind flows will improve the design and efficiency of small wind turbines in city settings.

Undertaken as part of the International Energy Agency's (IEA) Task 27 global project, the work uses data from Western Australia, Japan and Sweden.

PhD student Amir Tabrizi said the project would look at wind data from open spaces, rural areas and urban settings to get a better idea of differences such as wind shear and turbulence.

Mr Tabrizi said this would help improve the current design standard for small wind turbines.

"The current design standard – IEC61400-2 – lists design turbulence intensity as 18 per cent across a range of sites, but this result is appropriate for open-site testing only. While it is very early days, our on-site testing has shown turbulence intensity of up to 24 per cent at an urban site in Port Kennedy and 30 per cent at another urban site in Melville," Mr Tabrizi said.

"A knowledge of turbulence intensity helps predict the load on the machine, so it informs the required design strength of turbine components, including the tower and blades. We need accurate data to ensure turbines are strong enough for all conditions."

Mr Tabrizi is currently working on adapting a two-dimensional model into a three-dimension computational fluid dynamics model built with OpenFOAM software.

This modelling will incorporate the dynamics of various wind environments, taking into account variations by height, prevailing wind directions and the effects of different building shapes.

Initial findings suggest both rooftop sites and forest sites face turbulence intensity values much greater than those predicted in the current design standard.

"Ultimately we want to establish better guidelines for design and installation of urban wind turbines to maximise efficiency and guarantee safety," Mr Tabrizi said.

"For a small wind turbine, mounted on a rooftop, for instance, we need to determine what part of the roof catches the most energy, how far the

turbine should be above the roofline and how far back it should be from the edge of the roof."

Provided by Murdoch University