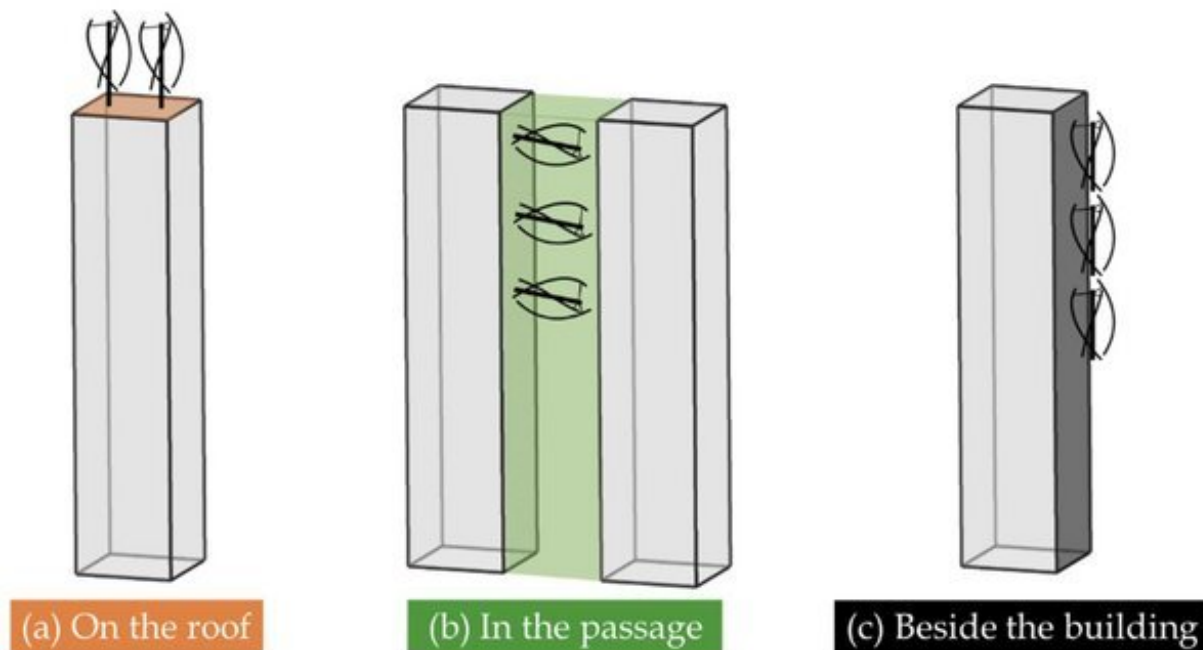


How to make full use of wind energy in a compact city

October 11 2021, by Barry Fitzgerald



Three potential locations for wind energy technologies in a compact city environment. Credit: Yu-Hsuan Juan

Wind can be used as a renewable energy source that is clean, uncontaminated, and inexhaustible. Such characteristics have helped wind energy technologies to a key contributor to sustainable development in society, which is needed given the ever-increasing sizes

and populations of our cities. These urban settings can certainly benefit from the implementation of wind energy strategies and has attracted notable attention in recent years. For her Ph.D. research, Yu-Hsuan Juan investigated how to enhance urban wind energy potential in a compact city environment. Her research reveals that proper design of high-rise buildings could give rise to exciting new possibilities in relation to urban wind energy.

One way to limit [urban sprawl](#) in our cities and to concurrently achieve more sustainable urban development is to employ the concept of the compact city. The compact city refers to the concept of employing good planning to achieve an overall more compact sustainable urban building form or arrangement, not only involving higher densities of high-rise buildings but also linked by an efficient public transport system. With increasing urban densification, the design and sustainability of compact cities with high-rise buildings is becoming more important.

More turbulence

Buildings with a height of 100 meters or more are now quite common in many cities around the world, with these buildings subject to high-altitude winds. It would be a huge waste if we do not exploit such structures for the production of high-altitude wind [energy](#). As the wind passes through the narrow spaces between high-rise buildings, faster-moving wind speeds can result with the potential to be converted into other forms of energy.

However, wind tends to be more turbulent and less predictable in urban areas due to the complexity and heterogeneous roughness of the terrain. Therefore, high-resolution and accurate assessments of urban wind are crucial towards gathering information that could be used in the design of installations to fully exploit wind energy. As an effective tool for early-stage urban design, simulations using [computational fluid dynamics](#)

(CFD) has been recognized as a key tool for analyzing the potential of urban wind energy.

Location, location, location

For her Ph.D. research, Yu-Hsuan Juan explored the potential for urban wind energy generation subject to a number of parameters for high-rise buildings in close proximity such as urban layout, building corner design, and urban density. CFD validation results show reasonable agreement for the mean streamwise velocity and turbulence intensity between the CFD predictions and data from wind tunnel experiments.

Yu-Hsuan noted that the spacing between the buildings, which is usually very small compared to the building height for compact high-rise building areas, can significantly increase the mean wind speed and the wind energy potential because of the well-known concentration effect. Therefore, the impact of [building](#) geometry and their arrangement are of particular interest when it comes to characterization and improving the urban wind energy potential.

Yu-Hsuan's research has revealed that it can be more effective to investigate wider design alternatives through early urban design planning, and thereby devise the optimal configuration of high-rise buildings in the so-called compact [city](#) to realize the feasibility of urban [wind](#) energy harvesting for sustainable urban development.

More information: Analysis of urban wind energy potential around high-rise buildings in close proximity using computational fluid dynamics. [research.tue.nl/en/publication ... d-high-rise-building](https://research.tue.nl/en/publication/.../d-high-rise-building)

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