Data-Driven Approach for Urban Wind Harvesting – DATA4WIND

Context

Buildings consume large amounts of energy from the electrical grid that often originates from coal and fossil fuel power plants, increasing greenhouse gas footprint. Moreover, today's buildings use more energy then they produce. On the other hand, buildings are still viewed as shelters, a combination of bricks, steel and concrete. If we could shift this archetype toward a building as a fully independent entity, society would experience tremendous benefits. The realisation of this vision seems to be an urgent matter, for two reasons: acceleration of population growth and urbanisation of the world. Namely, the current world population is expected to increase by 29% by 2050, while at the same time, the projected urban population will increase by 11% according to a recent United Nations report.

Vision

The long-term vision of DATA4WIND project is to reach a point of energy self-sustainable buildings. That would enable each building, each home, to become its clean energy power plant, doing its part to energize world around us.

Aims

The general aim of the DATA4WIND project is to develop a novel hybrid approach (Fig. 1) to evaluate the wind energy harvesting potential in urban areas through data assimilation based on computational and experimental wind engineering techniques.

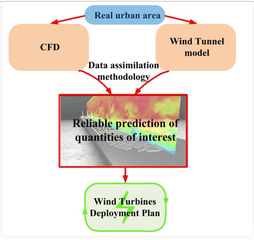

Fig. 1. Urban wind energy harvesting based on the novel data assimilation methodology.

Methods

DATA4WIND proposes a multidisciplinary approach combining computational (Computational Fluid Dynamics – CFD) and experimental (wind tunnel) wind engineering with data assimilation techniques to reliably predict flow patterns within complex urban wind canopies. Based on this prediction, wind energy harvesting potential will be evaluated.

This will be accomplished by fulfilling the next research objectives: designing general data assimilation toolbox (that can be used in other wind engineering fields) and creating a data assimilation strategy for urban wind power utilization. In this way, reliable prediction of aerodynamic information on local wind flow patterns essential for urban wind power utilization is assured. Besides, DATA4WIND project will develop a computationally less demanding methodology allowing multi-directionality of the incoming wind flow using reduced order modelling techniques. As a final outcome, DATA4WIND will consider wind power utilization over existing buildings of Belval area placed in Luxembourg. Besides contributions to scientific knowledge of urban wind energy harvesting, project plans on exploring the benefits of such an approach in the field of urban wind comfort. Thus, the output of DATA4WIND approach will have a wide implication on the urban built environment.

Fig. 2. Real urban area – Belval campus.

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