

# Reaching higher wind measurements in complex terrain

## Case Study



### The client:

Green Trust

### Vaisala solution:

WindCube vertical profiling lidar

## THE CHALLENGE:

### Complex terrain and Bora winds

About 30 kilometers inland from the coast of Croatia lies a developing wind farm that will supply 400 MW of installed capacity. The site has some unique landscape features: Not only is it in complex terrain with a 500m difference between the lowest and highest point, but the area is also hilly, forested, and subject to powerful seasonal Bora winds.

Green Trust, a consultancy active in all parts of the wind farm development chain, had one met mast installed at the site to conduct a Wind Resource Assessment (WRA) campaign. However, the complexity of the site, the met mast's measuring height limitations, and the need for data extrapolation prompted the Green Trust team to add a wind lidar to reduce measurement uncertainty and measure where met masts cannot.

As explained by Jorn Goldenbeld, Senior Wind Specialist and Team Leader of the Solutions department at Green Trust, "There are a lot of height differences between the center points of the met mast and the guywires: The met mast maximum measurement height is 140m and the turbine hub heights we expect to use are 166m or higher. To add a lidar next to the met mast reduces this vertical extrapolation uncertainty."

Bankable data is critical regardless of terrain type, with specific technologies required to provide the best outcomes. Green Trust sought a lidar solution to accurately measure the wind up to the highest possible hub heights.

*"With lidar you can measure up to higher altitudes. For me, it means I can never measure higher than that with a mast, so I need something additional to understand what's going on up there. And of course, lidar is the best solution for that."*

*Jorn Goldenbeld  
Senior Wind Specialist, Green Trust*

## THE APPROACH:

### Trusted lidar with reliable measurements

Green Trust selected the industry-leading WindCube® vertical profiling lidar based on its extensive experience working with the technology. The lidar's measurement capabilities are an asset in complex terrain environments, where landscape features create non-homogeneous wind flow. Jorn pointed out: "With lidar you can measure up to higher altitudes. For me, it means I can never measure higher than that with a mast, so I need something additional to understand what's going on up there. And of course, lidar is the best solution for that."

In this campaign, Green Trust worked with Deutsche WindGuard GmbH (DWG) to integrate the CFD modeling with the WindCube measurements to validate the correction model. "The objective is to get a measurement location within 2km of each turbine position according to complex terrain measurement recommendations," said Jorn.

The organization is also using WindCube to compare the lidar measurements with the met mast at the heights where the sensors are located. "We have discovered the wind profile measured with the met mast does not represent reality. Above 130 meters, we see a sudden change in the wind profile leading to higher average wind speeds at hub height than we previously expected," Jorn added.

## THE RESULTS:

### Proven technology for long-term results

WindCube's extensive measuring heights are ideal for accurately measuring beyond the limits of a met mast, which is a major advantage in complex terrain. Another advantage is reduced uncertainty of wind measurements in this particular climate.

Green Trust is taking advantage of the WindCube's flexibility to take measurements in more than one location for a complete picture of wind conditions throughout the three-year measurement project. "The fact that you can reuse one device on more than one location definitely has a value and is of interest to me."

Green Trust and DWG first measured the wind in a smaller area to calculate the CFD correction factors and translate it exactly above the lidar position, in order to accurately compare the measurements to the met mast. The team then used the resulting flow correction map within the search area of the lidar location to find the best position with the smallest correction and the lowest uncertainty.

## Why Vaisala?

We are innovators, scientists, and discoverers who are helping fundamentally change how the world is powered. Vaisala elevates wind and solar customers around the globe so they can meet the greatest energy challenges of our time. Our pioneering approach reflects our priorities of thoughtful evolution in a time of change and extending our legacy of leadership.

Vaisala is the only company to offer 360° of weather intelligence for smarter renewable energy, nearly anywhere on the planet. Every solution benefits from our 85+ years of experience, deployments in 170+ countries, and unrivaled thought leadership.

Our innovation story, like the renewable energy story, continues.

