2022Q9 LIDAR

QUESTIONS

One Energy's wind turbines reach 124 meters into the air, and the wind behaves very differently at that height – usually, it is faster than it is on the ground. Wind speeds are measured at "hub height" to create appropriate estimates of the turbine's energy production. The hub is the center of the rotor's rotation, and for One Energy's turbines, is 80 meters high. One Energy uses a LiDAR (Light Detection and Ranging) unit to measure wind speeds at hub height. These units emit an invisible laser, which bounces off tiny particles in the air and returns to the unit. The LiDAR can then calculate wind speed and wind direction. OE employees can connect to the unit remotely and begin using the LiDAR's wind data to create energy production estimates.

Level 1: The LiDAR can take measurements at 11 different heights. All these heights are measured from the top of the LiDAR instead of the ground. One Energy sets its LiDARs to measure at 39 meters all the time, but the other 10 heights can be adjusted. Usually, specific heights like the hub height and maximum tip height of the turbine are included. These heights allow us to calculate different variables needed in the analysis of a potential project.

Calculate the 11 heights that fit the following criteria:

- The lowest height is 39 meters.
- Standard heights: Hub height (80 meters) and maximum tip height (124 meters) must be included.
- Every height is 10 meters apart. If one of the standard heights is less than 10 meters from the previous height, the standard height is used.
- We do not need to measure over 150 meters.

Level 2: The LiDAR takes measurements by creating a cone with its laser. The point of the cone is the LiDAR, and the base is the highest height that One Energy sets.

The height of the LiDAR is one meter, and the maximum height that it measures is 139 meters. If the angle of the laser's cone at the LiDAR is 4° (measuring from one side of the cone to the other side), what is the radius of the base of the cone?

A close-up of a One Energy LiDAR near our office. The unit comes with a windshield wiper and washer fluid to keep the laser transmitting cleanly.