

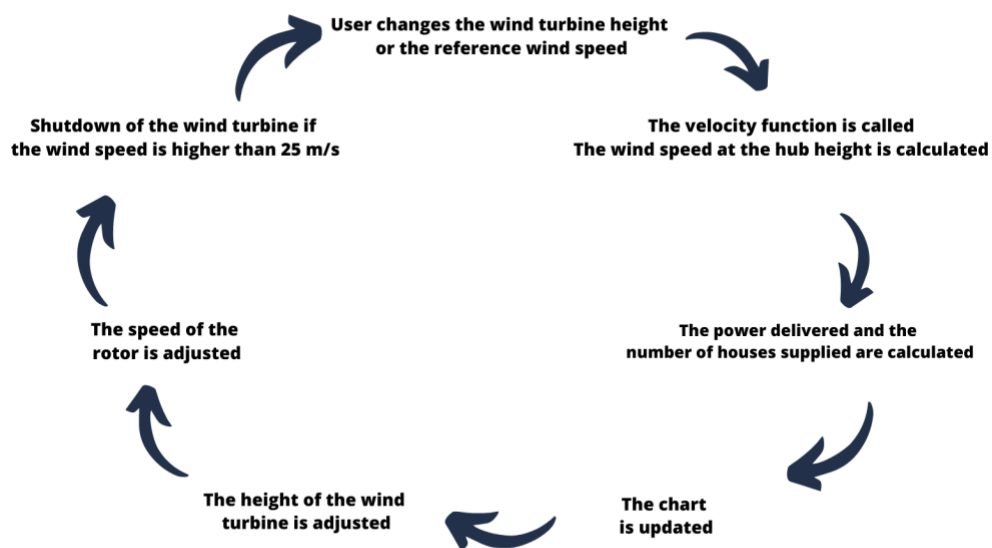
An interactive visualization of the power generated by wind turbines depending on various parameters

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Introduction

This visualization focuses on complementing the learning module “Renewable energies from sun and wind – understanding made easy”. With this visualization, the user can see the dependencies between the roughness, wind speed and height of the turbine.

Program Sequence



The program waits for the user to change. As soon as the user changes the reference wind speed or the height of the wind turbine, the wind speed, the power and the number of homes served are recalculated. The chart is updated accordingly. The height of the turbine and the speed of the rotor are adjusted. If the wind speed is over 25 m/s, the wind turbine will be shut down.

Technical details and formulas used

A wind turbine with the following specifications is used for the visualization:

Nennleistung	3050 kW
Rotordurchmesser	100m
Einschaltwindgeschwindigkeit	2 m/s
Nennwindgeschwindigkeit	13 m/s
Abschaltwindgeschwindigkeit	25 m/s
Nabenhöhe (einstellbar)	60-100 m

The logarithmic height formula is used to calculate the wind speed at the selected height:

$$v_2 = v_1 * \left(\frac{\frac{\ln(h_1)}{z_0}}{\frac{\ln(h_2)}{z_0}} \right)$$

with:

h1 = reference speed

h2 = height at which wind speed is calculated

z0 = roughness length

v1 = reference speed

v2 = desired wind speed

ln = natural logarithm

The following formula is used to calculate the wind power:

$$P = \frac{1}{2} * \rho * \pi * r^2 * v^3 * c$$

with:

P = wind power

ρ = density of air

v = wind speed

r = length of the rotor blade from the center of the rotor hub

c = power coefficient

The following formula is used to calculate the number of houses supplied:

$$Anzahl = \frac{P * 8760}{3196}$$

with:

P = power of the wind turbine in the visualization

It is assumed that the wind turbine will supply the same amount of energy, resulting from the parameters selected by the user, all year round.