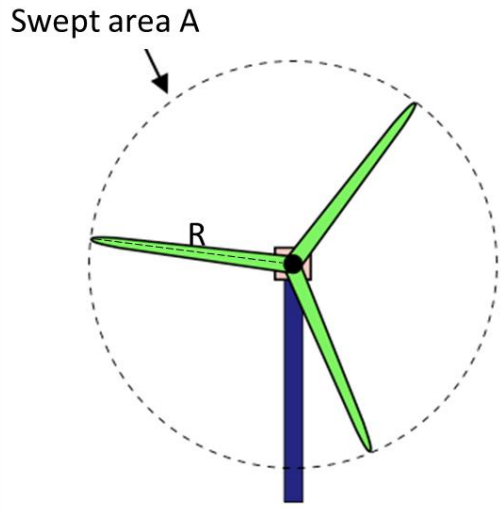
Wind Energy Calculation worksheet:

The power in the wind

Wind Power, which is measured in *Watts*, is the power we can extract from the wind to drive our turbine. Wind power is determined by the size of the rotor blades, the wind velocity and the air density. Then the theoretical power in moving air is the flow rate of kinetic energy per second by a wind turbine and is given by the equation:

$$P = 0.5\ x\ \rho\ x\ A\ x\ V^3 x\ Cp\ (Watts)$$



Where:

P is the Wind Power,
ρ (rho) is the air density in Kg/m^3
A is the circular area in m^2 swept by the rotors
V is the air velocity in m/s or kmph
Cp is the power coefficient (efficiency) which is the percentage of power in the wind that is converted into mechanical energy (35-45%)

1. Calculate the output power in Watts from a wind turbine which has a rotor blade radius of 6 metres with an efficiency of 40% in an area where the air density is 1.225Kg/m3 and where there is a wind speed of 8 m/s. Show your work below…

2. What is the power output in Watts for this turbine if wind speed increases to 16 m/s?

3. What can you say about the impact of wind speed on power output?

The turbine: Taking the example of a 1.75m diameter turbine. It was calculated, given generous parameters, that the turbine could be expected to provide around 80 kWh per month at an average windspeed of 5 m/s.

The location: According to the weather station at Claremorris in Ireland, the average windspeed for Galway was 3 m/s in April and the average outdoor temperature was 8°C.

The school: If the average monthly heat and electricity consumption for a school in Galway was 3379 kWh. The average cost per kWh in Ireland is 0.26 c. The average cost to purchase and install a domestic wind turbine is € 3000.

Are the purchase of small wind turbines for this school justified? Justify your answer…