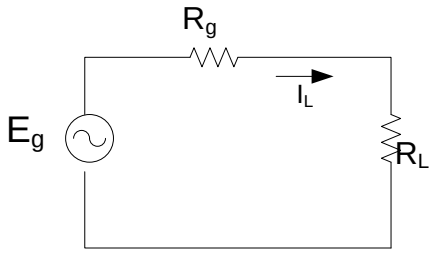
Wind Generator Circuit Power Analysis

The following is the equivalent circuit for a wind turbine.
E_g is the open circuit voltage with R_L open.
R_g = the internal generator resistance



Using Ohms law the current I_L is:

$I_L = E_g / (R_g + R_L)$

The total circuit power is:

$P_T = P_g + P_L = I_L^2 R_g + I_L^2 R_L = I_L^2 (R_g + R_L)$

Substituting for I_L:
$P_T = (E_g / (R_g + R_L))^2 (R_g + R_L) = E_g^2 / (R_g + R_L)$

From the generator equation:

$E_g = 0.707.PBNAZ$

For the 4-Pole generator design with typical parameter values:
P = 4 poles, B = 0.12 T, N = 800 turns, A = 0.001m-sq, Z = rps = rpm/60

$K_E = 0.707.PBNA = 0.005$ volts / rpm

Substitute E_g :

$P_T = K_E^2 / (R_g + R_L) (rpm)^2$

Example:

$R_g = 13$ ohms , $R_L = 15$ ohm, rpm = 600, $K_E = 0.005$

$P_T = (0.005)^2 (600)^2 / (13 + 15) = 0.3214$ watts