# Energy output calculations of triboelectric system

The output of triboelectric is dependent on force and area. Here we use an equation from alpha labs showing the coulombic production

$$(805J \cdot cm^{-2}) \cdot (1.45x10^{-7}C \cdot J^{-1}) \approx 0.000117\text{C}\cdot\text{cm}^{-2} \qquad \text{eq. 1}$$

The joules given are the approximate average amount of force produced from a person walking. $C \cdot J^{-1}$ is the coulomb value of the two triboelectric materials added together per joule exerted upon them. C is the amount of coulombs (ampere per second) produced from the amount of force in joules.

By taking the value of eq. 1 we can equate the value of watts produced by multiplying the volts produced the area of centimeters squared as shown in eq. 2

$$(2.89V) \cdot (1.17\text{x}10^{-4}\text{C} \cdot \text{cm}^{-2}) \approx 0.00034\ \text{W}\cdot\text{s}^{-1}\cdot\text{cm}^{-2} \qquad \text{eq. 2}$$

Since our generators are in square meters we convert the the area of square centimeters and therefor the output by using eq. 3

$$(3.4x10^{-4}\ W \cdot s^{-1}cm^{-2}) \cdot (10{,}000\ cm^2 \cdot m^{-2}) = 3.4\ \text{W}\cdot\text{s}^{-1}\cdot\text{m}^{-2} \qquad \text{eq. 3}$$

We show the output of our largest generator at 3,000$m^2$ through eq. 4

$$(3.4\ W \cdot s^{-1} \cdot m^{-2}) \cdot (3{,}000\ m^2) = 10{,}200\ W \cdot s^{-1} \cdot m^{-2} \qquad \text{eq. 4}$$

Now we can convert to kilowatts per hour by using eq. 5

$$\left(\frac{(10{,}200\ W\cdot s^{-1}\cdot m^{-2})\cdot(3{,}600\ s\cdot h^{-1})}{1{,}000\ W\cdot kW^{-1}}\right) = 36{,}720\ kW \cdot h^{-1} \qquad \text{eq. 5}$$

We can now show the kilowatts per year produced from our 3,000$m^2$ generator using eq. 6

$$\left((kWh) \cdot h \cdot (BD)\right) = kW \cdot BY^{-1} \qquad \text{eq. 6}$$

Table 1.

| kWh ( kilowatts per hour) | h (hour per day) | BD (business days per year) | $kW \cdot BY^{-1}$ (kilowatts per year) |
|---|---|---|---|
| 36,720 | 6 | 260 | 57,283,200 |

values for eq. 6

Now we can show the kilowatts per business year and the energy savings from the energy produced by our 3,000$m^2$ generator using eq. 7

$$\big((kWh) \cdot h \cdot (\$ \cdot kWh^{-1}) \cdot (BD)\big) - (C) + t = ES \quad \text{eq. 7}$$

Table 2.

| kWh | h (hours used per day) | $\$ \cdot kWh^{-1}$ (cost of kilowatt per hour in USD) | BD ( business days per year) | t (transmission loss cost in USD; consistent with New York state) | C (cost of the 3,000$m^2$ generator in USD) | ES (savings in energy cost per year in USD) |
|---|---|---|---|---|---|---|
| 36,720 | 6 | 0.14 | 260 | $5,337,600 | $500,000 | $12,857,248 |

values for eq. 7