

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

$$(805J \cdot cm^{-2}) \cdot (1.45 \times 10^{-7} C \cdot J^{-1}) \approx 0.000117 C \cdot cm^{-2} \quad \text{eq. 1}$$

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

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

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

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

We show the output of our largest generator at 3,000m² through eq. 4

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

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

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

We can now show the kilowatts per year produced from our 3,000m² generator using eq. 6

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

Table 1.

kWh (kilowatts per hour)	h (hour per day)	BD (business days per year)	kW·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 3,000m² generator using eq. 7

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

Table 2.

kWh	h (hours used per day)	\$·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 3,000m 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