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A1_5 Let's Disko para-para-paradise

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Abstract

The idea popularised by Coldplay's recent sustainable concerts is explored to be utilised in the O2 Academy during Let's Disko. By using the conservation of energy and power equations, it is found that by fitting the venue with kinetic dance floors, it would take 11 Let's Disko nights to power the Physics Department for one day. However, if all of the energy exerted by 1500 people dancing for a 5 hour club night was converted into electricity, then only half of a Let's Disko night would be required. The efficiency of the kinetic floors is found to be 5%.

Let's Disko para-para-paradise

This summer, Coldplay highlighted the environmental issues with huge stadium tours, combating this issue by using sustainable energy. They utilised a kinetic floor during their concerts to produce power while people danced along... but could this idea be utilised in our O2 on Wednesday nights to power our beloved Physics department?

Assumptions

Due to the lack of information available about the energy expenditure of the Physics Department, it is assumed that the power used by an average household of 4 people, found to be 3500 kWh per year [1] or 400 J s^{-1} (using equation 1).

$$E(kWh)/(365 \times 24) = kW \tag{1}$$

This can be multiplied by 150, which is used after taking the number of students, staff and equipment into consideration. There are around 500 people in the department, or 125 times the number of people in a 4 person household, but increasing this to 150 times takes into account lab equipment and computers in use. However, this multiplication factor does not involve the use of the supercomputer, ALICE, as it is quite often down due to technical faults.

After this, it is found that the Physics Department uses 6×10^4 J s^{-1}.

Department of Physics Energy

Once the assumptions have been used to find the average power consumption for the Physics Department per day, the energy per day can be found by using equation 2:

$$E = P \times t \tag{2}$$

where E is energy in J , P is power in J s^{-1} or W and t is time in seconds. Due to wanting to find the energy per day, the power is multiplied by the number of seconds in a day, 86,400. This gives an energy used in a day of 5.2×10^9 J.

Kinetic Floor

The surface area of kinetic dance floor that could fit in the O2 Academy was found by multiplying the capacity of 1500 people by a 0.5 m^2

area for dancing, giving an overall surface area of 750 m^2.

The kinetic floor used by Coldplay was from Energy Floors [2] which provide 18 m^2 flooring pieces which produce a maximum of 640 J s^{-1} each. Due to the surface area being 750 m^2, 42 of these floors would be required, meaning that an energy of 26,900 J s^{-1} is produced.

Let's Disko nights run from 2300-0400, meaning that the energy over these 5 hours can be found by using equation 2, giving an energy produced per night of 4.8 $\times 10^8$ J.

The Energy of Dancing

By using data collected by an Apple Watch worn while dancing, data shows that around 900 kcal were burnt in 3 hours, giving an exertion of 300 kcal per hour [3] for an average female. By using the conversion of 1 kcal = 4184 J The energy exerted by 1500 people [4] in the O2 Academy on a Let's Disko night can be calculated as 9.8 $\times 10^9$ J.

Comparisons

If all energy exerted whilst dancing was converted into electricity by the kinetic floors, the Physics Department would be supplied for one day by just over half a night in the O2! However, much of the energy exerted by dancing is used for movement, respiration, digestion, speech and more, so only 5% of the energy produced is able to be used to power the department. Due to this inefficiency, powering the Physics Department for one day would take just under 11 Let's Disko nights, or 5 and a half weeks if Friday nights were included too. Using these kinetic floors alongside other sustainable energy sources like exercise bikes and solar panels becomes a possibility after these results have been found. The success of these techniques for Coldplay's 2022 tour [5] shows that using multiple techniques to reduce environmental impact is effective, so applying a combination is ideal. One study at the University of Jordan [6] found that in a faculty of 500, much like the Physics Department, with each person walking over kinetic tiles twice per day, 1.6 kWh of energy is produced. This means that 38,400 J s^{-1} is produced per tile. The paper proves that the use of these kinetic floors in public places can produce a significant amount of power.

Conclusion

Due to the rising cost of living, using the kinetic floors would be a worthwhile investment both in the O2 Academy, but also in places with high levels of foot traffic. These kinetic floors would have constant use throughout every day, a more constant flow of energy would be maintained and therefore more energy would be available to be used by the University. Alongside this, research into more efficient production of power from humans could be further researched, as kinetic floors are very inefficient, evem compared to the heat energy produced by club-goers in 'Nightclub Energy' (L. Weightman, 2021). For future research, the idea of kinetic floors in busy areas could be looked into in more detail, as well as comparing the kinetic floors with the use of more conventional sustainable energy methods like the use of solar panels.

References

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