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A1 5 An Electrifying Dance

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Abstract

In August 2026, a new technology in several Japanese cities made furores world-wide with the implementation of a piezoelectric technology, turning some of the busiest stations into electric generators using footsteps [1]. In this paper, we have investigated the feasibility of Kinetic Floor Tiles (KFT) and triboelectrics, 2 alternative technologies, and found that developed nations could generate 0.001-0.008% of their energy needs, with developing nations mostly ranging 0.003-0.025%.

Introduction

There are 3 main ways by which the mechanical energy of a human step is converted to electricity: piezoelectrics, which use the dipole shifts in crystals to generate tiny charges when put under stress [2]; KFTs which use a system of springs and rotational motions to generate a current via electromagnetic induction, in essence a dynamo [3] and triboelectrics which work on electrostatic induction. [4].

In this paper, we will be primarily focusing on kinetic floor and triboelectric systems, because they are more efficient at these scales and piezoelectrics are incredibly complex, well beyond the scope of this paper.

Country	EC per capita kWh
United Kingdom	25,128.77
France	37,612.65
Italy	25,990.92
Luxembourg	50,095.83
China	31,815.43
Cuba	7,673.82
Brazil	14,608.53
Mexico	16,481.28
Haiti	602.28
Dominican Republic	12,252.86

Table 1: EC = Energy Consumption. List of 4 "developed" Nations and 6 "developing" Nations. Where possible 2025 data has been selected, 2024 data where it wasn't [5].

Method

Whenever a person steps on a KFT, about 26% of the energy will be converted to useful electrical energy. This turns out to be anywhere from around 0.5 W [3] at 12V to some upper claims of 6 W [4] for hybrid systems, at 1200V (DC), measured using an open circuit after they had been converted from AC. This is taken under walking conditions, and as such, it is reasonable to assume it is capable of sustaining this performance, with the average person having a frequency of roughly 2 Hz. We have assumed a range of 0.5 - 6 W, generated over a period of an hour for every day of the year. We will also assume an ideally electrified society, with transport and heating using electricity.

A dance such as the Cuban Salsa has 160 -

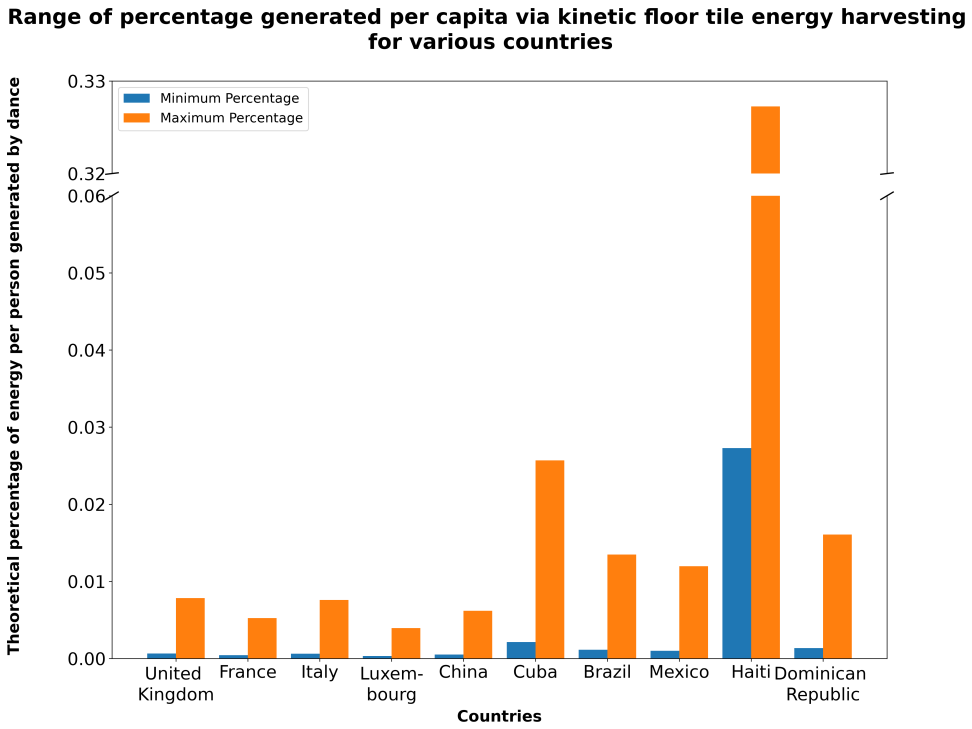

Figure 1: Percentage of the country's energy per capita that could be generated via a daily, one hour dance using KFT and triboelectric technologies.

220 bpm, which is equivalent to a frequency of 2.67 Hz and 3.67 Hz [6], comparable to the referenced walking and running frequencies [7]. As such, one assumption will be that the force applied by the foot when it comes in contact with the tile will be roughly equal between walking/running and dancing, and that the spring stiffness is designed for a resonant frequency of this kind.

The chosen countries and their energy consumption per capita are listed in Table 1.

In this study, we have chosen a simple model of energy, the formula for which, in relation to power is simply [8]:

$$E = \int_0^t P dt, \tag{1}$$

$$E = Pt. \tag{2}$$

Where, E is energy, P is power and t is time over which the power is applied.

As we could not find a reference for DC-AC inverters for our required voltages, we assumed 100% efficiency. For a slightly more accurate model, the generated electrical voltage would have to be converted from 12 V / 1200 V to 240 V mains. For this study, we have taken the efficiency of the transformer to be 90% [9].

Discussion and Conclusion

For most countries, a these system would provide a minuscule proportion of the overall consumption (0.001 - 0.008% for developed nations; 0.003 - 0.025% for developing nations), and this under unrealistic assumptions. The technology is also not feasible for less developed countries either, as it does not generate a substantial enough portion of the energy needs to justify the high cost and maintenance such systems would require.

AI disclosure

Claude 5.5 Sonnet has been used to enlarge the numerical values of the x and y plots and to break up the bar chart for Haiti.

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