Journal of Interdisciplinary Science Topics

Watts the amount Eddie Hall could save on his electricity bill?

Sam Seneviratne

The Centre for Interdisciplinary Science, University of Leicester

18/03/2016

Abstract

This paper investigates the amount of electrical energy the deadlift world record holder, Eddie Hall, could produce to aid towards his home electrical power supply. This would be done by deadlifting on a theoretical weights machine which converts mechanical energy into electrical energy. Assuming that Eddie can deadlift 465 kg [1] for a total of 100 repetitions throughout the day, every day for a year, it has been calculated that 21.8kWh of electrical energy could be generated. This amount of energy would save him a total of £4.15 on his electricity bill for the year.

Introduction

Some human energy is produced in the form of mechanical energy when lifting weights at the gym. It is said to be feasible to harvest this energy to produce electrical energy [2]. Facilities that use the work done by people who go to the gym in order to produce electrical energy have already been created [3].

The deadlift is one of the most powerful bodybuilding compound exercises there is and Eddie Hall, one of the world's strongest men, holds the world record for this at 465 kg [1]. By calculating the work done by the record holder one can not only work out the amount of energy Eddie will produce but it's also possible to work out how much money he could save, providing he used his energy for electrical power instead of spending extra money to his electric grid supplier. The cost of electrical energy is given in kWh at 19p per kWh [4]. It's assumed that the gym equipment required for him to deadlift and convert his mechanical energy into electrical energy has been given to him without any personal charge.

By working out the total mechanical energy produced, this value can then be used as the amount of electrical energy produced. Due to the law of conservation of energy, no mechanical energy is lost, however it's important to note that not all energy will be converted into useful output energy as it needs to be take into consideration that some energy will be transformed into other forms of energy such as sound and heat. Electric generators which convert mechanical energy into electric energy have an efficiency of 80-95% [5], in this case for the theoretical energy conversion weight machine, the lower range of efficiency of 80 % will be taken. The value of electrical energy stored by the machine can then be used in conjunction with his normal electrical energy usage at home, therefore making savings on electric energy he would have had to pay for if he had not been converting any of his energy.

How much energy could be produced in a year?

The deadlift movement as shown in figure 1 [6] is a powerlifting exercise in which the weightlifter lifts a loaded barbell from off the ground towards the hips and then back down to the ground.

Figure 1) The correct movement for the deadlift exercise. [6]

This lift moves the mass through a vertical motion as during the movement the weight is lifted vertically from the floor to the mid-thigh area, and then from the mid-thigh back down to the floor. The first assumption in the powerlifting movement is that Eddie will begin the lift 0.42 m from the ground as this is the usual distance the bar would be at during a deadlift due to the radius of weighted Olympic discs on the bar being 0.42 m [7]. This also means that he will finish the lift 0.42 m from the floor. Secondly, Eddie Hall is 1.90 m tall [8] and in this model it's assumed that the length of his legs are half the size of his body [9] and that the middle of the thigh is ¾ of the leg length. Therefore the total vertical distance moved, *h*, comes to ≈ 0.59 m. It has to be taken into account that there is gravity, *g*, acting on the mass, *m*, therefore to calculate the work done (*WD*), the equation below is used:

$$mgh = WD$$

Putting these values into the equation gives:

$$465 \times 9.81 \times 0.59 = 2691\,J$$

To calculate how much mechanical energy is converted into electrical energy the useful energy output has to be calculated by multiplying this value with the machine's efficiency. This gives:

$$2691 \times 80\% = 2153J$$

To work out how much energy is produced in a year this value is multiplied by 100 repetitions and 365 days, giving $7.86 \times 10^7 J$ of energy per year.

How much does this cost?

1 kilowatt-hour (kWh) is equivalent to $3.60 \times 10^6\,J$ of energy and has a cost of as much a 19p per kWh [4]. A whole year of deadlifting 100 repetitions everyday would equate to $21.8\,kWh$ using the equation below:

$$\frac{7.86 \times 10^7}{3.60 \times 10^6} = 21.8\,kWh$$

Therefore at 19p per kilowatt-hour, Eddie would make a small saving of £4.15 per year.

Conclusion

The amount of savings gained from converting his mechanical energy into electrical energy would not leave Eddie with a huge amount of savings, only to afford something with as much worth as a fast food meal. Therefore it's quite likely that Eddie would not feel that one hundred world record deadlifts per day for a year was worth it for such little reward.

References

[1] McMullan, L.M. (2016). *Eddie Hall: Strongman risking death to achieve his dream? - BBC News*. [online] Available at: http://www.bbc.co.uk/news/uk-england-stoke-staffordshire-35726627 [Accessed 10/03/2016].

[2] Zimmerman, L. (2011). *Could we use exercise machines as energy sources? | MIT School of Engineering*. Engineering.mit.edu. [Online] Available at: http://engineering.mit.edu/ask/could-we-use-exercise-machines-energy-sources [Accessed 10/03/2016].

[3] Edmonds, L. (2013). *World's first self-powering gym uses energy from your WORKOUT to keep the lights on (so don't take a break!)*. Mail Online. [Online] Available at: http://www.dailymail.co.uk/news/article-2430771/Worlds-self-powering-gym-uses-energy-WORKOUT-lights-dont-break.html [Accessed 10/03/2016].

[4] Compare My Solar (2013). *Electricity Price per kWh E.ON Energy | CompareMySolar.co.uk Blog*. Blog.comparemysolar.co.uk. [online] Available at: http://blog.comparemysolar.co.uk/electricity-price-per-kwh-eon-energy/ [Accessed 10/03/2016].

[5] Hulscher, W. (2016). *Chapter 1 - Basic energy concepts*. [Online] Fao.org-University of Twente The Netherlands. Available at: http://www.fao.org/docrep/u2246e/u2246e02.htm [Accessed 17/03/2016].

[6] CrossFit Shatter. (2015). *Breaking Down The Deadlift - CrossFit Shatter*. [Online] Available at: http://www.crossfitshatter.com/blog/2015/08/04/breaking-down-the-deadlift/ [Accessed 10/03/2016].

[7] Australian Barbell Company, (2016). [Online] Available at: http://www.australianbarbellco.com/barbellsPublic/dms/Downloads/Brochures/WEIGHT-PLATE-DIMENSIONS/WEIGHT%20PLATE%20DIMENSIONS.pdf [Accessed 16/03/2016].

[8] World's Strongest Man. (2016). *Eddie Hall - World's Strongest Man*. [Online] Available at: http://www.theworldsstrongestman.com/athletes/eddie-hall/ [Accessed 10/03/2016].

[9] Swami, V., Einon, D. & Furnham, A. (2006). *The leg-to-body ratio as a human aesthetic criterion*. Body Image, 3(4), pp.317-323.