LED POWER

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This article is based upon the research that Light Emitting Diodes (LED's), can be used as a power source. LED's can produce more output energy in lumens than electrical energy input. This is due to a chemical reaction within the LED known as doping. Doping silicon atoms with Antimony adds extra electrons, whilst Boron removes electrons leaving holes. The dosage of added impurities dictates the efficiency and lifespan of an LED. A PN-junction is formed when a doped N-type (negative) material is fused together with a P-type (positive) material creating a semiconductor diode junction. electrons in the semiconductor recombine with electron holes releasing energy in the form of a photon using a forward bias approach. (Rooney 2018) (Electronics Tutorials, 2019) (Electronics Weekly, 2009)

LED; Solar Cell; Power Source; Chemistry, Forward Bias

1.Light Emitting Diodes

LED's vary in colour and efficiency, the material used dictates these factors. To harness the maximum efficiency an LED can produce we need to select LED's that reflect the blue spectrum of light. The daylight LED reflects more of the blue spectrum and produces a higher kelvin (K) measurement. Kelvin is the degree measure relating to the colour temperature, the higher the kelvin number, the brighter the visual tone the LED/lamp appears to be. The colour temperature of an LED/Lamp is assigned using the basis of correlated colour temperature (CCT). A Lumen (lm) is also related to the measurement of its brightness level. Kelvin temperatures for commercial and residential lighting have a range that resides somewhere in-between 2000K to 6500K, from a scale of 1000K – 10000K. (Westinghouselighting.com, 2019)

1.1 Wattage

If we purchase two LED lamps and compare the input wattage of a warm white to a daylight, we may find the input wattage to be the same. However, the kelvin measurement of the daylight LED is more than twice that of a warm white producing more lumens. (Westinghouselighting.com, 2019)

1.2 Lumens

The reason daylight LED produces more lumens than a warm white is because of the design material selected and Kelvin factor. Selection of material regarding an LED produces the visual colour requirements. LED's come in a range of colours, and all colours produce different amounts of lumen output given the same power input. (Compound Interest, 2016)

1.3 Daylight

Daylight mimicking LED lamps are considered for clinical uses, for example, hospitals for maximum vision. Warm white LED's would be used in homes environments for a relaxing, less intense lighting solution. Warm white uses more of the red and green spectrum and daylights use more of the blue and yellow spectrum which mimics the natural daylight wavelength better than any other type of lamp. (Socket Store, 2019)

Table 1: Kelvin Range

Source	Colour	Kelvin
LED	Warm White	3000K
LED	Cool White	4000K
LED	Daylight	5000K
Sun	Blue Sky	10000K

1.4 LED Efficiency Advancement

CREE recorded a very significant LED milestone that has a demonstrated ability of producing 303 lumens per watt, 5150 K, 350mA at room temperature, using a high-powered daylight LED. This LED reached the landmark achievement much quicker than to be believed possible. This result surpasses CREE's former research and development industry-best, which was rated at 276 lumens per watt. (Cree.com, 2014)

Figure 1: LED Advancement (CREE.com, 2014)

1.5 Future of LED

Beyond 2020 I believe that the advancement in LED efficiency will continue. LED's of the future will produce 500 lumens per watt. The capability of an LED at present just providing light efficiently will be extended towards powering devices including lighting applications. (Rooney 2020)

1.6 Solar Cell Conventional Method

Photovoltaic cells commonly called solar cells work by converting daylight into electrical energy, transforming photon to electron. Solar cells combined together are known as solar panels, they are found outdoors in fields and on rooftops. They provide homes and business with free electricity. (Theecoexperts.co.uk, 2019)

1.7 Solar Cell

Solar cells are designed to absorb natural daylight; however, they can also convert synthetic light such as LED's. Solar cells vary in efficiency like LED's as both use the same doping technique. The difference is an LED gives off light as an output whilst a solar cell absorbs light as input this is known as reverse bias. The average efficiency rating of a solar cell is between 12-25%. However, a super-efficient solar cell has been developed by the Fraunhofer Institute for Solar Energy Systems in 2014. They have announced the development of a multijunction photovoltaic cell with a 44.7%

efficiency breaking their own record of 43.6% in 2013. Then, in 2020 a 47.1% efficient solar panel using 6 multi junctions was developed by NREL scientists. (Lombardo, 2013) (NREL scientists make six-junction solar cell with 47.1% efficiency, 2020)

1.8 Rechargeable Battery

Direct Current (DC) rechargeable batteries are commonly used to power LED drivers when a mains supply (230V) is not present. An LED torch is a good example of using batteries for remote lighting applications.

1.9 DC-DC LED Driver

LED drivers are used to operate LED's. A DC Driver powered by a DC battery provides the energy required. DC-DC drivers can be up to 95% efficient. (Meanwell-web.com, 2019)

2. State of the Art

Table 2: Light Energy to Watts

Measurement	Distance	Surface Area	Watts
Lux	1000mm	1000mm^2	0.001496
Lumen (lm)	304.8mm	304.8mm^2	0.01609696
Super Lumen	**50.8mm**	**50.8mm^2**	**0.0295**

electrons over time, alongside general breakdown of components. However, a solar cells efficiency loss is based on natural daylight attributes such as infrared heat. My method may be more efficient because the LED's spectrum of light is fully absorbed and the heat an LED produces is very small. (Rooney 2020)

2.3 Lighting Method & Testing

Testing the basic lighting method involves measuring the 50.8mm gap between the LED's and solar cell surface for lumen efficiency, denoted as the light diffusion point. CT scanners, lumen meters and manual electrical test gear will give results to be compared against the theory. However, the materials required are very hard to obtain at present. (Accuenergy, 2019) (Uk.rs-online.com, 2019)

2.4 Thermodynamics

At this point people are sceptical and say, "you cannot do that; it defeats thermodynamic laws". However, CREE's 303 lm per 1-watt LED = 303 x 0.01609696 = 4.877 watts. It is hard to argue with facts. All I have done is altered the factors of lumen which is denoted as 1 candle projecting light over a distance of 304.8 mm and covering a surface area of 304.8mm^2. Lux is denoted as 1 candle, projecting light over 1000mm covering a surface area of 1000mm^2. The 10.76 ratio factor is based on lux distance to lumen using a lux/lumen meter, (1000-695.2 = 304.8mm). I call this the compression and concentration of light. (Rooney 2020)

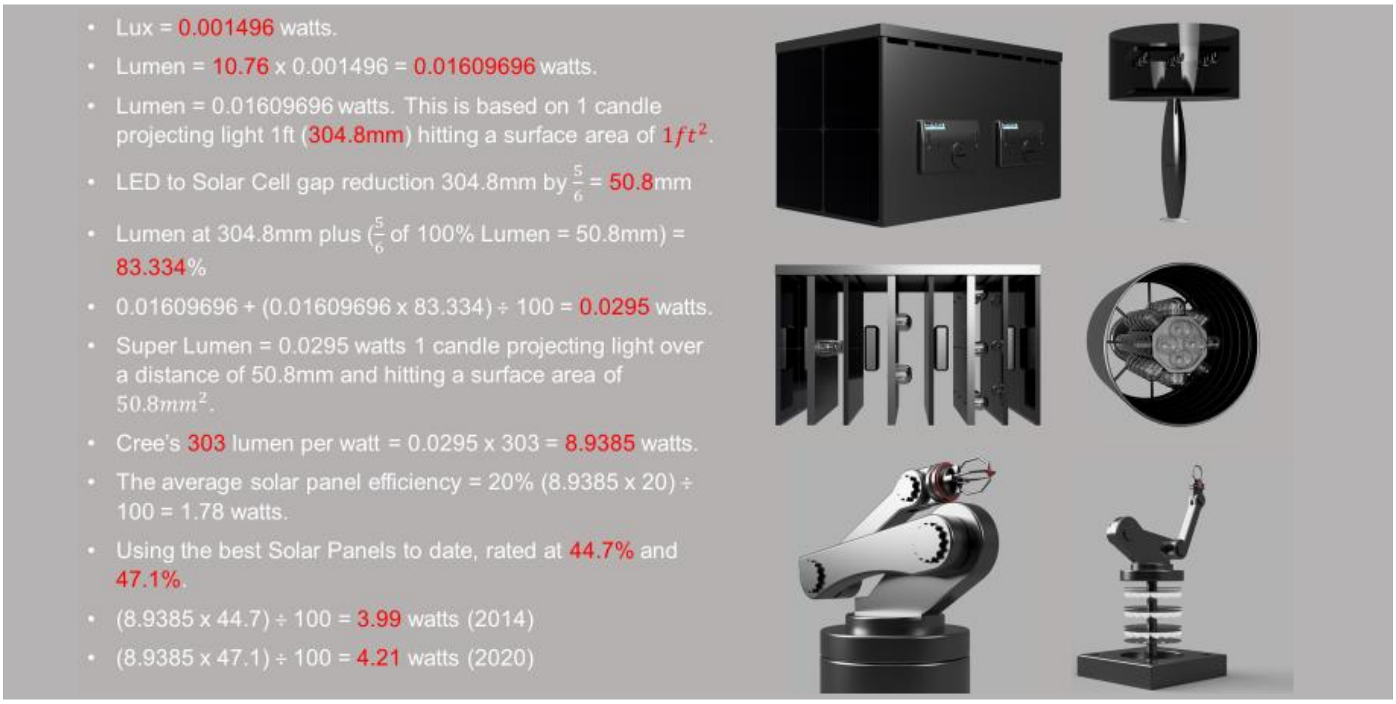

Figure 2: Super Lumen Calculation & Potential Devices (Rooney, 2020)

2.1 Methodology

The methodology is to closely position LED's towards solar cells and not allow the light to escape for maximum efficiency. Initial power will be provided by a rechargeable battery that supplies electricity direct to the first or only DC driver. The driver powers the LED, the light energy absorbed by the solar cell is converted back into electron which is then sent back to power the LED driver, completing the cycle. (Rooney 2020)

2.2 Efficiency

Input 1 watt, output including efficiency loss due to solar cells is 4.21 watts using CREE 303 lm LED's. This is the base foundation of powering small devices such as Lighting and Power Packs. I am aware losses may occur regarding an LED due to heat and loss of

2.5 Conclusion

The daylight LED is a significant power source for tomorrow's world. It is a sustainable and efficient method for powering small independent devices. A free energy concept that has an ability to ramp up power from a single LED because a CREE 303 lm LED using the Super Lumen factor (0.0295slm) gives a ratio of 1:9. Even with a 47.1% efficiency loss due to the solar cell we still get a 1:4.2 ratio, give or take efficiency loss. Free energy lighting is the simplest method using a battery, driver, solar cell and row of LED's. Power ramping packs can start with one LED, and through stages of drivers, LED's and solar cells deliver x amount of energy. Sending power from the last to the first stage means the unit self-powers whilst producing energy. This concept could change many lighting and power applications, bringing solar panels indoor and fully utilising solar cell capabilities 24/7/365. (Rooney 2020)

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