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ENERGY HARVESTING AND TRANSFER: REVIEW

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Abstract

Green communication focuses on investigating and exploring different ways to increase energy efficiency in communication. Energy consumption is ever increasing. And with time it will increase even more. This paper aims to explore various methods of electrical energy harvesting and it's transfer. And to study the works done by other researchers in this field. We will also have a look at the results of a personal survey. And finally observe the conclusion.

Keywords: *Energy, energy transfer, energy harvesting, electricity distribution, wireless power transfer*

INTRODUCTION

Electricity has become an inseparable part of people's daily lives. The rising global energy consumption has increased our dependency on fossil fuels as a source for energy generation. Hence, there is a need to shift to renewable sources like water, wind, sunlight etc.

In this regard, energy harvesters have become an efficient and green alternative for gathering energy from the environment. Energy harvesting systems can obtain energy from sources available in industrial or other environments such as mechanical vibration, temperature gradients, natural or artificial light, elevated levels of noise, pipes with air or water.[3]

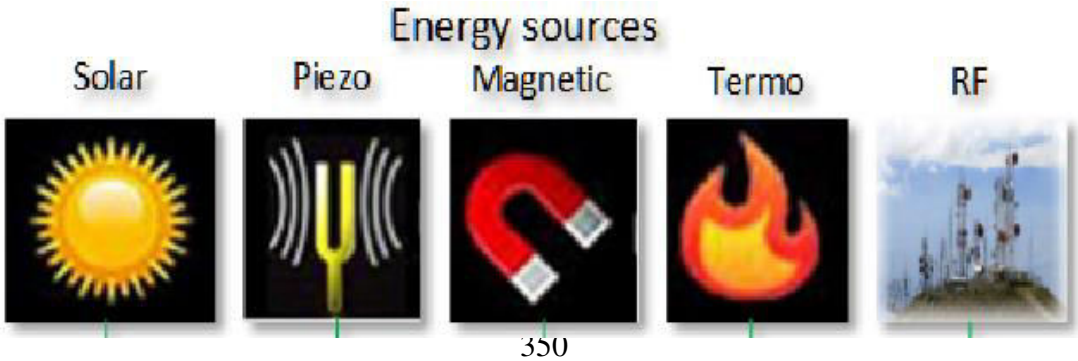
This research work organizes and analyses the different energy harvester technologies and energy transfer method and also provide some application examples.

ENERGY HARVESTING OVERVIEW

Harvesting methods and applications

In most of the cases, energy is wasted in the form of heat. Energy harvesting devices capture energy from various sources and convert it to electricity.

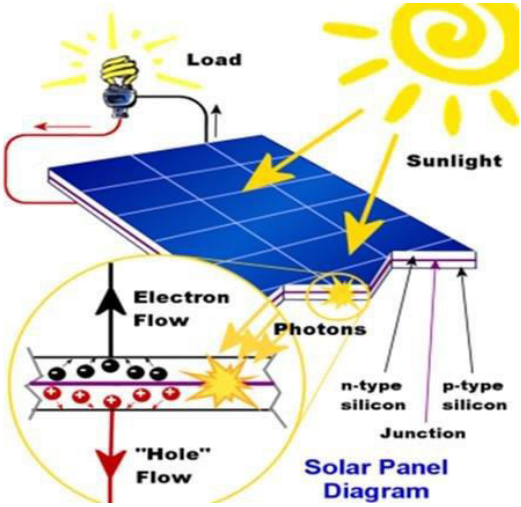
Fig. 1 Different sources of energy



(Image credit: www.semanticscholar.org)
Large solar panels and wind generators are the most efficient energy harvesters. They are fast becoming the next alternative source of energy.
Many forms of energy harvesting technologies are used currently. Some of the common energy sources are light, heat, vibration and RF.

Solar technologies

Photovoltaic (PV) or solar cells use light energy to convert into electricity. Of all the various energy harvesting devices, photovoltaic cells have the highest power output.
Solar cells are commonly found in consumer and industrial applications. Watches, calculators, portable power supplies, toys and satellites are some of the examples. Solar cells are also used to charge batteries.
Fig. 2Solar energy module



(Image credit: www.semanticscholar.org)

Thermoelectric technologies

Thermoelectric technology converts thermal energy into electric. These harvesters are useful in environments with temperature gradients. The temperature gradient between the material terminals provides the potential for efficient energy conversion, while heat flow provides the power [3]. Thermoelectric devices, have limitedcapability, and cannot provide more energy even in case of higher amount of heat flow, because of low material efficiencies.
Thermoelectric harvesters are without any moving parts and are silent, reliable, scalable and easy to install.

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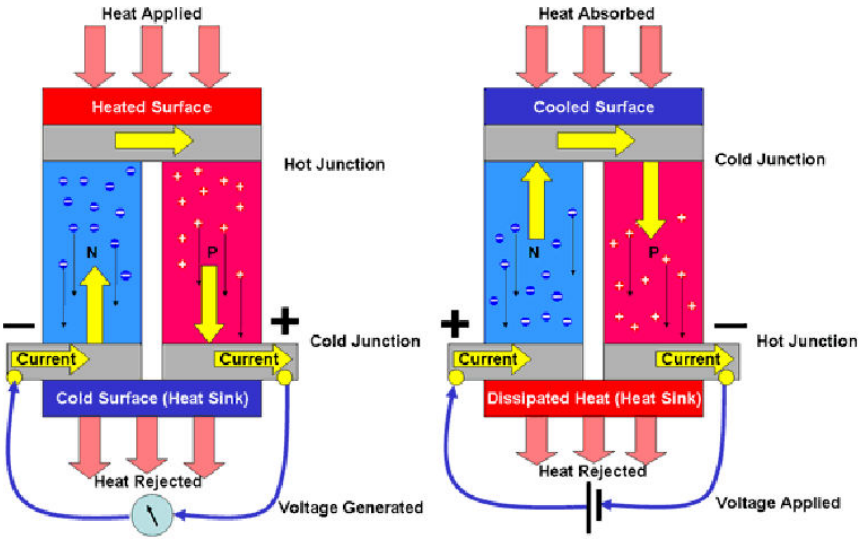
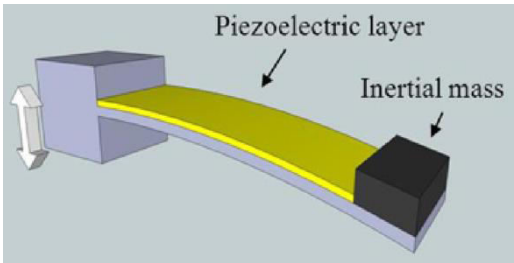


Fig. 3Thermoelectric harvester
(Image credit: www.semanticscholar.org)

Piezoelectric technologies

The piezoelectric effect converts kinetic energy in the form of vibrations or shocks into electrical energy. Piezoelectric harvesters are useful in converting normally wasted vibration energy in the environment to usable electrical energy. They are ideal in applications like charging a battery, super capacitor, or directly powering remote sensor systems.

Fig. 4Piezoelectric harvester
(Image credit: www.researchgate.net)



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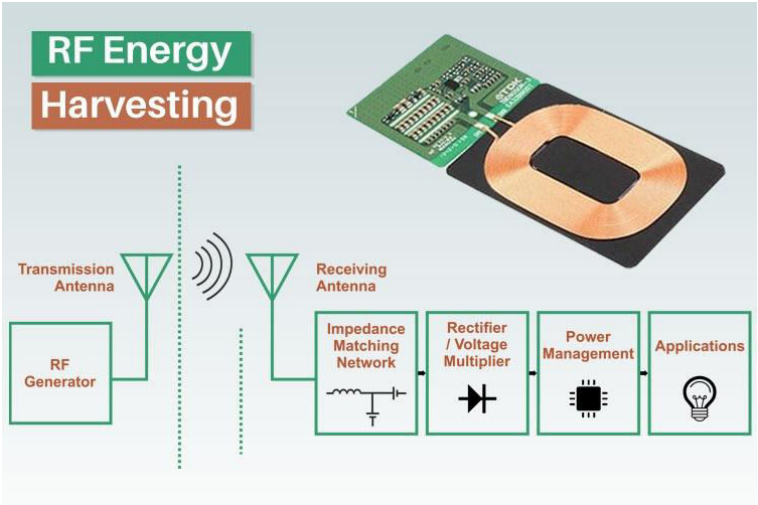
Radio frequency - RF
Radio frequency (RF) harvesters obtain energy from RF and wireless microwave power. The background RF radiation emitted by broadcast transmitters, cell phone towers, Wi-Fi nets or low power wireless networks, are good sources of energy harvesting.
Fig. 5 Radio frequency energy harvester



(Image credit: www.iotdesignpro.com)
The harvested power depends on the incident power density, the distance between the transmitter and receiver, the power conversion efficiency and the harvester antenna dimension. Thus, the intercepted power directly depends on the size of the antenna aperture.

ENERGY TRANSFER
Electricity is distributed to the homes in the following way:
1) Electricity is made at a generating station by huge generators. Wind, coal, natural gas, or water are used as source of energy.
2) The current is passed on to transformers that increase the voltage to push the power to long distances.
3) The electrical charge travels through high-voltage transmission lines that are installed all across the country.
4) Inside a substation, the voltage is lowered so it can be transferredthrough smaller power lines.
5) It travels through distribution lines to the local neighborhood. Smaller transformers reduce the voltage again to make the power safe to use in homes.
6) It connects to the house and passes through a meter that measures how much the family uses.
7) The electricity goes to the service panel in a basement or garage, where breakers or fuses protect the wires inside the house from being overloaded.
8) The electricity travels through wires inside the walls to the outlets and switches all over the house.

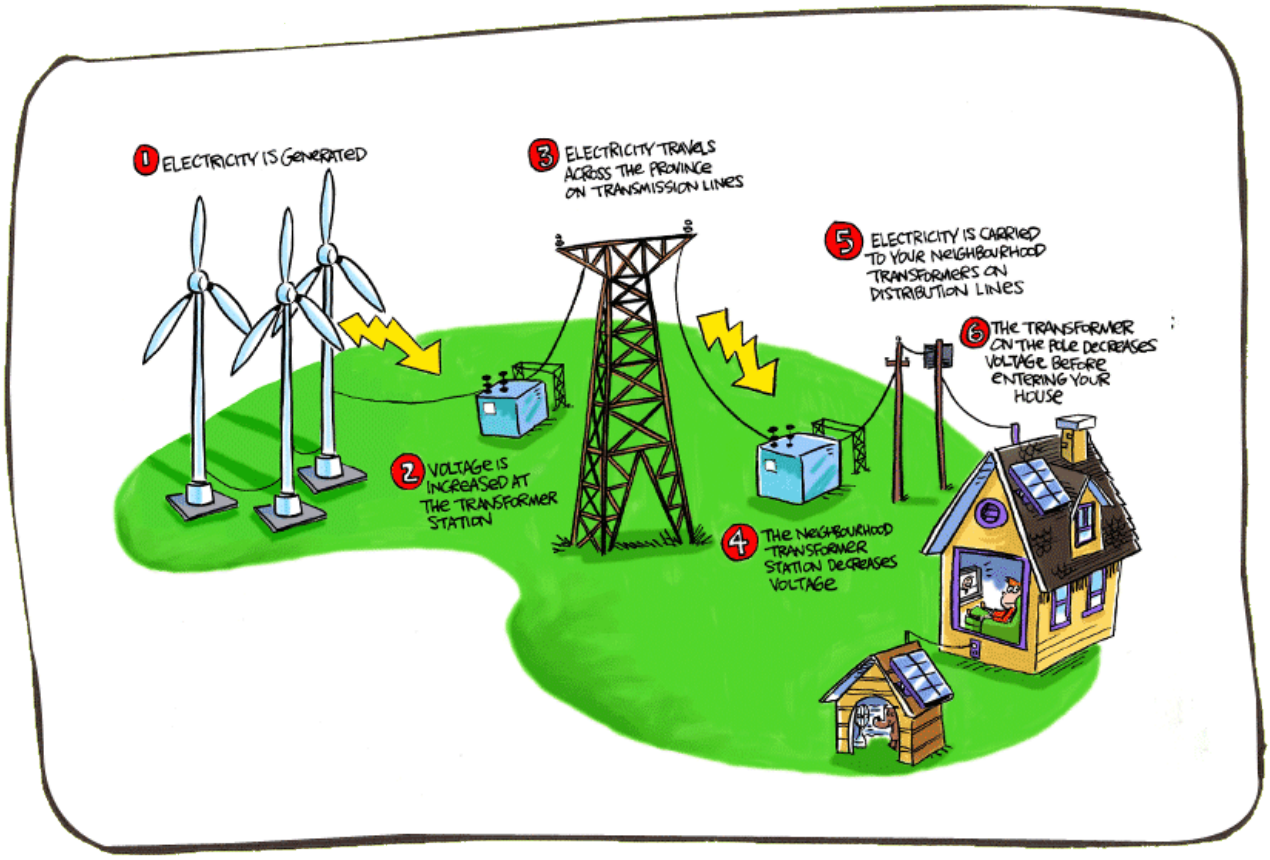


Fig. 6 Transfer of electricity to our homes
(Image credit: www.thinglink.com)

Wireless power transfer

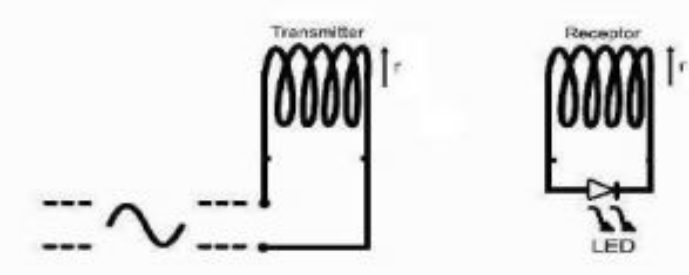


Fig. 7Basic Concept of WPT
(Image credit: www.irjet.net)

Wireless power transfer has been present for a long time, the most common method of wireless transfer being inductive coupling, invented by Nikola Tesla more than a century. It has many applications[1], including:

1) Charging mobile and wearable devices - Some mobile devices, like smart phones, wearables and electric toothbrushes have a charging pad or bench on which the devices are placed.
2) Charging and operating devices and implants in the medical field - Wireless power transfer, especially with high power, allows convenient continual charging and operation of under the

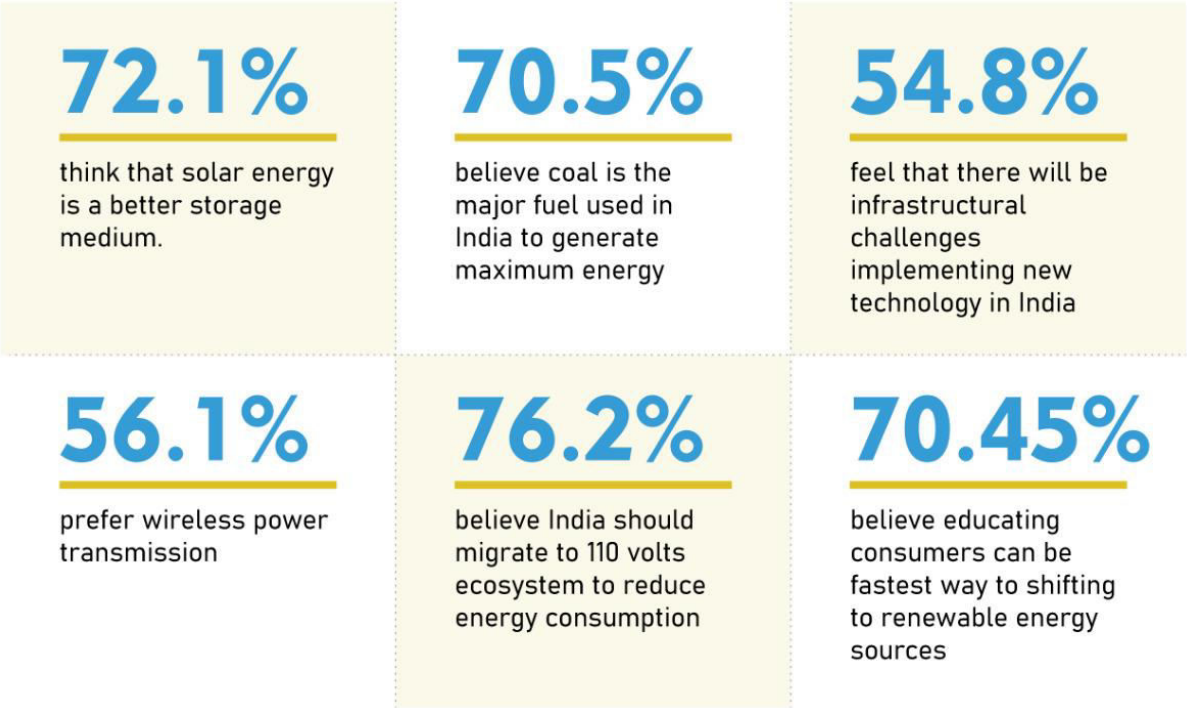
skin drug supplies, pacemakers and similar implants.

3) Electric charging roads - Over 3 years ago, the first electric road opened in Sweden, recharging the batteries of cars and trucks driving on it. According to The Guardian, this system reduces carbon dioxide emissions by 90%.[2]

Wireless power transfer is proving to be an effective energy source for indoor application. There have been some experiments in outdoor application as well. More studies is needed to scale up this technology to larger area coverage.

PERSONAL SURVEY

A survey conducted online, provided insights and suggestions for the current state of energy harvesting and transfer systems. According to the survey, participants were aware of the various renewable energy sources. Most of them believed use of coal for energy production must be reduced. Although most participants wished for newer and better tech for energy transfer, they also anticipated challenges in its implementation like availability of skilled personnel and affordability. The participants believe wireless power transmission is better and safe than wired technology.



CONCLUSION

The research work presented in this article explains some of the energy harvesting technologies that can convert various types of energy present in environment into electric energy. Thus not only do these harvesting models provide energy, but also reduce the environmental footprint at the same time.

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