

# Energy Harvesting Trees

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**Abstract:** Energy harvesting is that the process of capturing and accumulating by product energy because the energy becomes available, storing the energy for a period of your time and conditioning it into a form which will be used later like operating a microprocessor with in its limits. It's also a robust contender for applications that need a back-up battery, especially if the battery is during a remote or difficult location to succeed in. Perhaps the most important promise is that energy harvesting will enable new market applications and products that are currently impossible or maybe thought of yet. The energy are often captured from a spread of sources deemed wasted or otherwise unusable for any practical purpose. The method, also referred to as energy scavenging, captures residual energy as a byproduct of a natural environmental phenomenon or process and is therefore considered "free energy. Other sources are biological, solar power from all sorts of light sources; electromagnetic energy captured via inductors, coils and transformers; wind and fluid energy resulting from air and liquid flow; energy from naturally recurring or biological processes; and large amounts of RF energy within the environment due to ubiquitous radio transmitters and tv broadcasting.

**IndexTerms** –*nano leaf, energy system, photovoltaic, thermo voltaic, piezoelectric.*

**I Introduction** Energy harvesting is defined as capturing minute amounts of energy from one or more of the encompassing energy sources, accumulating them and storing them for later use. Energy harvesting is additionally called as power harvesting or energy scavenging. Within the view point of energy conversion, citizenry have already used energy harvesting technology within the sort of windmill, watermill, geothermal and solar power. [01] The energy came from natural sources, called renewable energy, is emerged as future power source thanks to limited fuel. Since the renewable energy harvesting plants generate kW or MW level power, its called macro energy harvesting technology. Energy harvesting as an alternate technique that has been applied to solved the matter of finite node lifetime and it refers to harnessing of energy from the environment or other energy sources for converting it to electricity. During this process the energy is collected from the environment. Samples of such energy sources include light, thermal gradients, vibrations, electromagnetic radiation, etc. By using this new technology, we will harvest the energy of the sun and wind. Also existing source of renewable energy, solar panels, parabolic sun collectors, wind and tidal turbines are inefficient, expensive and environmentally insensitive. Energy harvesting is defined as capturing minute amounts of energy from one or more of the encompassing energy sources, accumulating them and storing them for later use. Sun light or light, physical body, chemical or biological sources, which may generate mw or  $\mu$ W level power In the world where there'll be scarcity for non-renewable energy sources, The leaves are distributed throughout artificial trees and plants, and when operating at optimum efficiency can supply an entire household with electricity. They're intended to harness energy provided by the wind and sun, thereafter converting it into electricity

**1) Overview of Nano leaves Technology-** One of the emerging Nano technologies associated with renewable energy is Nano leaves and stems of artificially created trees or plants. They're an emerging sort of renewable energy through collecting energy from the sun and wind and converting it to electricity. The leaves are distributed throughout artificial trees and plants, and when operating at optimum efficiency can supply an entire household with electricity. They're intended to harness energy provided by the wind and sun, thereafter converting it into electricity. The elemental of Nano leaves are often understood by a technology called Bio mimicry

**2) Use of Nano Technology-** Nanotechnology is the combination of science, engineering, and technology conducted at the Nano scale, which is about 1 to 100 nanometers at the Nano-scale nanometers. It is the engineering of functional systems at the molecular scale. The science of the miniature nanotechnology, 'Nano' in Greek means dwarf and material, when reduced to Nano dimension (10<sup>-9</sup> meter =1 nanometer) shows drastic changes in physical, chemical, magnetic, optical, mechanical and electrical properties. This promises exiting applications in bioscience, medical science, polymers sector, environment, electronics, cosmetics, security and variety of other fields. Nanotechnology is a molecular manufacturing or more simply building things the size of one atom or molecule with programmed precision. Development of devices modified by Nano-sized materials has become a fundamental goal of modern nanotechnology. enables nanoparticles to transform and revolutionize various fields of technology including aerospace, aviation, homeland security, national defense, energy, environmental improvement, information technology, medicine, transportation, biotechnology, agriculture etc.

## II Solar botanic tree

Solar botanic tree utilizes the Nano-technology which was initially developed to harness the solar power. But, nowadays it's widespread uses. It utilizes various alternative sources of energy like wind, solar and thermal energy. Furthermore, these highly advanced artificial plants and/or trees use tiny cells to capture energy. Construction

the most a part of the solar botanic tree is Nano leaf and so as to construct the Nano leaves we'd like solar array, thermo galvanic cell, piezo galvanic cell and photo galvanic cell . the development of Nano leaves is extremely easy. It consists of two transparent conducting layers of silica which can act because the outer body of the leaf. And one photovoltaic cell is placed in between these two layers which is employed to convert the solar power into electricity then the piezo galvanic cell , thermo galvanic cell and photo galvanic cell are used. of these cells are interconnected to the highly conducted metal film to finish the circuit for the flow of electrons and protons. The piezoelectric generator is placed on rock bottom of the leaf which is employed to convert the strain thanks to rain and wind into the electricity. Now these leaves are connected to the twigs of the synthetic tree. And these small twigs are connected to the stem of the tree with the means of the crystal to covert the strain of the twig also into electricity. The electricity from all the leaves and twigs is stored at rock bottom of the tree by using the storing device. And therefore the solar botanic tree is about 20 feet height..



Figure 1. Construction of Nano leaf

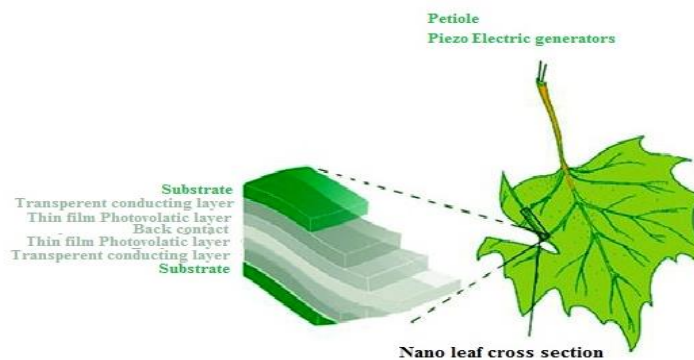


Figure 2. Nano leaf

## 3. Sort of Tree

[1] Broad Leaf trees

these trees can provide between 3500kWh and 7000kWh per annum. They supply shade, cooling the air, green ambiance and far more.

[2] Evergreen trees

these trees can provide between 2500kWh and 7000kWh per annum. They will be placed as single trees or to fence garden properties.

## WORKING

It works supported the principle of Photo synthesis during which, typical plants absorb the sunshine emitted by the sun and CO<sub>2</sub> within the atmosphere. Similarly a man-made tree utilizes light energy from the sun to get the electricity. electricity from the Solar Botanic Nano leaves are often generated by using Thermo voltaic cells, Photovoltaic cells and Piezoelectric cells which are integrated within the tree .When Sun light falls on the Nano-leaf, the photons are absorbed into the Nano-leaf; their energy causes the electrons to become free. The electron moves towards rock bottom of the Nano-leaf and exit through the connecting Nano wires working as trunk. This flow of electrons causes generation of electricity.

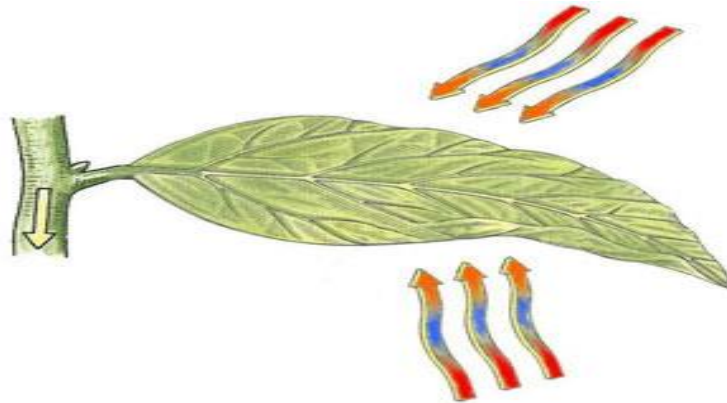


Figure 3. Generation by Solar and Thermal energy

Thermal energy is captured through the utilization of thermo voltaic (TV) cells. It consists of two junctions T<sub>1</sub> and T<sub>2</sub> during which T<sub>2</sub> is kept at constant reference temperature. Hence it's referred as cold junction and therefore the temperature changes to be measured are subjected to the junction T<sub>1</sub>, which is referred as hot junction. When T<sub>1</sub> > T<sub>2</sub>, an EMF is generated thanks to the generator gradient. The magnitude of emf depends on the materials used for wires and temperature difference between T<sub>1</sub> and T<sub>2</sub>. That emf produces electricity. Piezoelectric cell works supported the piezoelectricity i.e. when two opposite faces of a skinny, slice of certain crystals are subjected to a mechanical force, then opposite charges are developed on the 2 faces of the slice. During this technology a crystal is placed in between two metal electrodes and when outside forces like wind pushes the Nano leaf back and forth mechanical stresses appear within the petiole, twigs and branches. When thousands of Nano leaves flap back and forth thanks to wind, millions and many Pico watts are generated by converting K.E. into electricity.

### 4. Methodology

The nanotechnology was initially developed to harness solar energy .Nowadays it's widespread uses. It uses the energy sources like solar, wind and thermal energy to urge the electricity. Furthermore, these highly advanced artificial trees uses tiny cells to capture energy. Solar botanic tree utilizes Light energy, Thermal energy and K.E. .

#### i. Light Energy

Light energy is captured by the use of photovoltaic cells (PV), which convert the energy inherent in solar light rays into electricity.

#### ii. Thermal Energy

this is often captured through the use of thermo voltaic (TV) cells which convert thermal energy into electricity by using semiconducting materials (a material which is between a metal and an insulator; its conductivity increasing with temperature rise).

#### iii. K.E.

the K.E. contained in wind causes the Nano leaf stems, twigs, and branches to oscillate. This motion is captured by piezovoltaic (PZ) cells employing a semiconductor device embedded in these components, converting the K.E. of the wind to electricity

### 5. Comparison with other sources

Solar botanic tree utilizes renewable sources for the generation of electricity which is abundantly available. This tree is cost effective as compared to other sources also as efficient.

Sr No.	S o u r c e	G e n e r a t i o n	C o s t	A v a i l i b i l i t y
1	W i n d	0 . 3 %	\$35000/house	U n l i m i t e d
2	S o l a r	0 . 5 %	\$25000/house	U n l i m i t e d
3	H y d r o p o w e r	4 %	\$47000/20 houses	U n l i m i t e d
4	B i o f u e l	3 7 %	\$2000/house	L i m i t e d
5	Solar botanic tree	N i l t i l e n o w	\$5000/house	U n l i m i t e d

Table 1. Comparison of Nano tree with other sources

### 6. Energy harvesting in times

Energy harvesting could also be a trending research topic observed within the last decade. Energy harvesting simply means the mechanism to urge derives and store energy from one source and harnessing it with a system to be exploited within the type of another. The scarcity of energy i.e. not having the power to satisfy demands from available resources is because of depletion of fossils and dependence on non-renewable energy resources. To counter that we'd wish to believe sustainable plans for energy production, distribution and composition. Energy scavenging is one of the potential solutions to the matter of limited energy. Fluid driven wind mills and water wheels are the earliest yet efficient samples of energy harvesting techniques. the use of thermal energy for electrical power generation through piezoelectricity is additionally used for energy harvesting models. Piezo electricity converts applied mechanical strain to electrical charge is additionally advancement within the topic . Natural and transmitted radiations also act as a wireless energy source using photovoltaic effect. Models created on bio-energy, geothermal and tidal waves are also seen in working condition lately. Technological advancement has led to the event of Micro-Electro-Mechanical Systems (MEMS) to power small autonomous sensors networks. Electrostatic, magnetic and thermoelectric based energy harvesting devices have also been established. The topic nowadays is combining researchers from fields having mechanics, energy and smart materials background.

### 7. Operation of energy harvesting tree

Sun, wind, water, earth and life touch our living senses immediately always, everywhere and with none intervention of reason. They simply are there in their unmatched variety, moving us, our moods, memories, imaginations, intensions and plans. to maximize the wealth of designs and processes found in nature, engineering and technology gave us the ingredients, creativity, and unique solutions made it possible to bring all this together into a natural looking tree - the Energy Harvesting Tree. to finish the tree for multi energy exploitation, the petiole twigs and branches are incorporated with Nano piezo-electric elements. A Nano leaf is thin kind of a natural leaf, when outside forces, a bit like the wind pushes the Nano leaf back and forth, mechanical stresses appear within the petiole, twig and branches. When thousands of Nano leaves flap back and forth because of wind, millions and lots of Pico watts are generated, the stronger the wind, the more energy is generated. Our Nano leaves only reflect a touch a neighborhood of the daylight that strikes them, mostly the green light, and thus the rest of the spectrum is efficiently converted into electricity. Besides converting the color spectrum of sun shine, our Nano leaves also convert the invisible light, referred to as infrared or radiation, we'll not see it, but we'll feel it - it's warm that's why we call it radiation. because of the unique combination of photovoltaic and thermo voltaic in our Nano leave sit converts this thermal radiation into electricity, even hours after the sun has set.

## 8. Nano tree

The more wind there's, the more Nano leaves are moved. Wind that's moving thousands of Nano leaves during a tree canopy are causing mechanical strain within the petiole, twigs and branches. Nano piezo -electric elements incorporated within the petiole twigs and .It is a man-made tree which makes use of renewable energy from sun, wind and collecting solar and wind energy. Generally artificial trees cannot perform Photosynthesis naturally .To reduces the utilization of fossil-based energy and substituting an equivalent with renewable sources like solar and wind energy etc. The artificial tree will produce the electricity by using both Energy harvesting refers to energy or converting energy from one form to the opposite. Applied to sensor nodes, energy from external sources are often harvested to power the nodes and successively, increase their lifetime and capability. Widespread and popular technique of energy harvesting is converting solar power to electricity. Solar power is uncontrollable—the intensity of direct sunlight can't be controlled but it's predictable energy source with daily and seasonal patterns. Other techniques of energy harvesting convert energy or wind energy to electricity. The synthesis of semiconductor Nano wires is currently a really active field producing an outsized sort of results and potential technological applications. Controlled growth of branched Nano tree structures by sequential seeding of multiple generations of Nano wires has also been reported recently, introducing many new opportunities for the appliance of Nano wire structures. A photo electrochemical cell (PEC) utilizes solar power to directly split water and generate hydrogen, which is clean and freed from carbon emission. However, it's broadly recognized by the PEC community that there's no single material which will be the right photo electrode candidate for solar water splitting with reference to light absorption, water reduction, chemical stability, etc. The high efficiency “nano tree” photo electrode research enables practical HE production or Volatile organic compounds (Voss) remediation using PEC with high efficiency by using earth abundant materials and low-cost fabrication. this may have long-term, ongoing, positive impact on the foremost imminent energy and environmental issue clean energy and energy sustainability, environmental remediation, and thus , have great benefits to our humanity today and tomorrow.

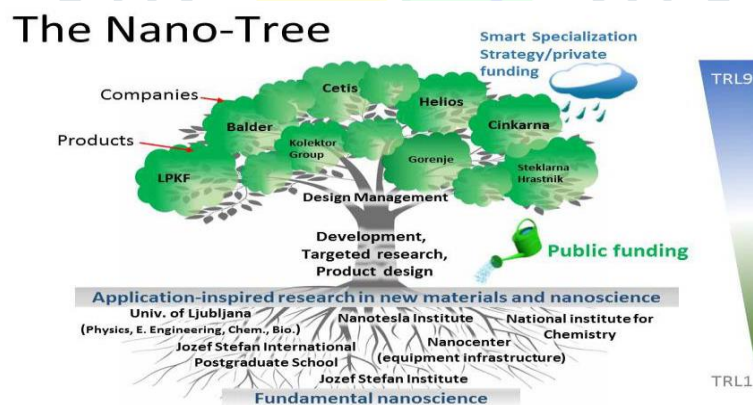


Fig: - Nano tree

## 9. Applications

The photovoltaic, piezo voltaic and thermo voltaic energy harvesters are linked to individual junction boxes, from where they're amalgamated and fed collectively into an inverter. This converts the electricity from DC (DC) into AC (AC) the electric power now being suitable For domestic or industrial use. There are many places were the synthetic trees and shrubs are often positioned as noted below

### i. Deserts

The power supplied by these trees “planted” within the desert are often wont to power desalination plants to supply water from seawater and brackish water aquifers. This water can then be used for drinking and land irrigation, with



none environmental damage to the delicate desert environment. Trees are often planted alongside oases and over water aquifers, with the electricity produced went to power down-hole pumps, enabling water to be piped to other locations. When planted along the desert roadways, trees will supply shade also as protection from the sun, wind, and sandstorms.

#### ii. Golf courses

The electricity produced are often went to charge electrically powered ground maintenance vehicles like grass cutters also as electrically powered hand tools like grass trimmers and shear . When planted on golf courses the facility produced are often went to charge golf buggies also as electrically powered ground maintenance vehicles.

#### iii. Office car parks and Industrial Units

Trees planted in these locations will not only supply electrical power for the office and industrial units, but add aesthetic qualities to an otherwise drab area, whilst providing shade from the wind and sun.

#### iv. Charging Purposes

Solar powered tree to charge mobile devices and it can also be used for charging laptops. Solar powered tree can be used during night time to lights up the street lights.

### 10. Future scope

Energy Harvesting Tree has many scopes, like the electricity produced by these Nano trees are often went to drive the cars, to enlighten the house , for business purposes and it are often used because the balancing factor between power prediction and environment. the most advantage is that it's utilized in efficient and green energy production which may restrict heating . To Use this electricity in driving the car.

- By increasing the size of leaves to extend the assembly of electricity.
- To use within the heavy transport systems
- to form efficient the nana-tree for Photosynthesis

### Conclusion

These super eco-friendly synthetic trees will make use of renewable energy from the sun alongside wind generation, which is an efficient clean and environmentally sound medium of gathering radiation and wind energy. Solar Nano technology as wide ranging potential. Using such technology, power producing solar products might be applied to only about any surface downtown or anywhere. These artificial trees not only will make the planet stable within the field of energy but also will reduce the utilization of fuel which is that the main cause for the world's largest problem heating. And by this Nano leaves we definitely try solve our future upcoming problems thanks to the scarcity of the electricity, and also we product our surroundings with none pollutions. We shall light on how precisely the Nano leaves are often achieved.

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