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# A New Nano-Generator-Photovoltaic Cell Platform for Transforming Motion on Earth to Electrical Energy: Theoretical Study

1<sup>st</sup> Adda Boualem

Department of Computer Science  
Ibn Khaldoun  
University Tiaret, Algeria  
adda.boualem@univ-tiaret.dz

2<sup>nd</sup> Marwane Ayaida

UMR 8520 - IEMN Polytechnique  
Hauts-de-France, CNRS, Univ. Lille  
F-59313 Valenciennes, France  
marwane.ayaida@uphf.fr

3<sup>rd</sup> Cyril de Runz *LIFAT*,

University of Tours,  
Blois, F-41000,  
France  
cyril.derunz@univ-tours.fr

**Abstract**—Given the number of inhabitants of planet Earth, their spontaneous movements, the machines used every second, minute, hour, day, and year, and with a view to accelerated development in electronics, mechanics, computer science, and nanotechnology. The relentless and continuous need for energy in our present life is becoming inevitable, accelerating the search for renewable energy sources to replace exhaustible energy sources.

Our idea is to take advantage of the continuous movements in time and space to generate renewable energy. The design of a generator based on Nanotechnology that transforms movement into electric current, then stored in school panels, large batteries, and in reinforced concrete,...

In this paper, we propose a platform for a nano photovoltaic cell (NPC). A plate is a woven fabric of nano photovoltaic cells that is used in plate fabrication. These plates will be planted at the end of the squares frequented by the great movement such as the rails, the big highways, the big boulevards of the big cities ...

These nano photovoltaic cells are used to transform movement into electric current, which is stored in the photovoltaic plates linked by electricity storage stations.

The platform consists of:

- One Nano-Motor, (1) the first transforms movements into thermal energy, and
- Two other Nano-Motors, (2) the first is to transform thermal energy into electrical energy, the second (3) transforms electrical energy into thermal energy.
- Two storage stations; (a) a station that stores electrical energy and (b) a station that stores thermal energy. The use of thermal energy is diverse:
  - To escape any type of fog.
  - To warm the roads, roads against clouds, ice,..., and any type of sliding.

**Index Terms**—Nano-photovoltaic cells, Kinetic energy, Electrical energy, Thermal energy

## I. INTRODUCTION

The worrying increase in greenhouse gases on our planet with the climatic consequences that we know, the announced shortage of fossil energy, and the signature of the Kyoto Protocol encourage us to use renewable energies for the production of domestic hot water and heating. In this sense, a certain number of possibilities are now available in terms of renewable energy for individuals, both in new construction and

renovation. Scientists, industry leaders, researchers for low-cost energy solutions, and economists have recently become aware of the need to take into account the consumption of fossil fuels in the world. They understood that energy was not inexhaustible; worse, that we were going to run out of it, first oil, then gas, and so... The important growth of the consumption of greenhouse gases in the last decades has contributed to the lasting modification of the climatic conditions on the planet. These energy problems propose temporal solutions, as Insulation (a key point of energy savings): Insulation is undoubtedly the most important factor since it conditions the consumption of heating in winter and even air conditioning in summer. the generation of renewable energy is not just a necessity to combat climate change and environmental degradation; it is a transformational opportunity to create a more sustainable, prosperous, and resilient future for generations to come. By embracing renewable energy, this paper contributes to proposing a solution based on a nano-generator photovoltaic cell platform for transforming motion on Earth into electrical energy.

The rest of the article is structured as follows. Section II, discusses similar work along two main lines; free energy and renewable energy, sources, and transformations. In Section III (free energy), we explain the types and transformations of free energy in nature and their relationship to human use. In Section IV (renewable energy), we explain the sources and mechanisms used to produce this type of energy. Section VI details our proposal (nano-generator-photovoltaic cell platform) and its usefulness and ends with a statement of some benefits and value of our project by a conclusion in Section VII.

## II. RELATED WORK

The world we live in today still uses some types of energy that it has used since antiquity, such as fire to cook food, even, if only at a summer outdoor gathering. There are numerous energy sources in use today that have only been harnessed and come into use in the past two centuries, and some that are much newer than that. Since then major efforts to develop renewable energy technologies have been made.

Much successful research, development, and demonstration work has been accomplished from the design of photovoltaic cells to the development of geothermal drilling techniques. New materials have been developed with the thermal, optical, and physical properties required for lower cost and higher performance. New components have been tested and substituted for less effective ones. Extensive system analysis has been performed with thousands of systems studied under both controlled laboratory conditions and typical field operation conditions. Throughout the world, teams of scientists and engineers in universities, industry, and government laboratories have created a solid technology base and expertise in the extremely broad array of disciplines that make up renewable energy technologies. Renewable energy is a clean energy that does not harm the climate and not the depletion of fossil fuels that commands the global transition to the age of solar and hydrogen.[1]. Renewable energies are one of the solutions in the fight against climate change. The purpose of this book is to show that they can be simple to implement. As I write these lines, one of the oldest French newspapers is publishing an association's tribune warning the government against its recent publication of the multiannual programming of energy, for its taste too favorable to the wind and photovoltaic. This association, probably gathering nostalgia for the *status quo* and of an energy mix certainly sober in  $CO_2$ , but dependent on imports, wishes to engage a citizen debate on the question of wind energy. The establishment of wind farms on the national territory, according to her, is not necessary, it is inefficient, and it devastates our landscapes. She affirms that 8000 pylons have already disfigured our territories and warns against its doubling [2]. Currently, the whole world is concerned about climate change. We are all concerned about the degradation of water and air quality, often due to the overconsumption of our fossil resources for more than a century. The idea of this manuscript is to provide an answer to the problem: "How do we produce energy for our daily domestic uses and to ensure our mobility without continuing to dangerously degrade our planet, our health, and, consequently, our well-being? and, consequently, our well-being?"

Renewable energies have become the cheapest means of energy production in less than 20 years [2].

NPC represents an exciting advancement in the field of renewable energy, offering great potential for enhancing the efficiency and versatility of solar power generation. NPC combines two distinct technologies: photovoltaics and nanogenerators, resulting in a hybrid device capable of harvesting solar energy, as well as mechanical or vibrational energy [3]. The rest of the paper is structured according to the following plan: Section II reviews recent work on free, renewable energy and work on energy storage mechanisms. Section III shows the different types of free energy. Section IV describes the type of renewable energy. Section V presents the energy storage of different types. Section VI describes the Nano-Generator-Photovoltaic Cell Platform proposed in this paper to produce free renewable energy and how to store it, the objectives and motivation of our solution, and we end with a

conclusion summarizing the advantages and disadvantages of our proposed solution in Section VII.

### III. FREE ENERGY

#### A. Geothermal energy

Geothermal energy is the energy of the heart of the Earth. As evidenced by geysers, hot springs, and volcanic eruptions, the Earth is a permanent source of heat. There are two reasons for this: the Sun, which heats the surface of the Earth, but above all the presence at the center of our planet of an external core, made up of molten matter: magma. This magma is none other than the red, burning lava that erupts volcanoes. It was already used 20,000 years ago in these hot springs, which became thermal baths in ancient times. Volcanic regions were very early a pole of attraction, because of the existence of fumaroles and hot springs that could be used for heating, cooking or simply bathing. Already in the 14<sup>th</sup> century, the spring of Chaudes-Aigues was used for industrial purposes such as washing wool and skins. But it was not until the beginning of the 20<sup>th</sup> century that the first geothermal power plant was built, capable of producing electricity from underground heat. The first modern district heating network powered by geothermal energy was installed in Reykjavik (Iceland) in 1930. Since then, geothermal heating networks have been built in Europe, China, Russia, and the United States. The exploitation of this energy source is still not very developed but projects are multiplying all over the world. Its main interest lies in the fact that, unlike wind or solar energy, it does not depend on weather conditions. It is constant and does not suffer from intermittence.

#### B. Aerothemy

Just as there are heat pumps that use the heat from the ground or groundwater, there are also groundwater, and there are also aerothemy heat pumps that use heat from the air. They are an interesting and increasingly popular means of heating. They have no connection with geothermal energy but are associated with it because they use the same technology. Air always contains heat, even at sub-zero temperatures. Aerothemy energy consists in recovering this heat using a heat pump, before transmitting it to the indoor air (heat pump), air (air-to-air heat pump) or to a water circuit (air-to-water heat pump), which supplies (air/water heat pump), for example, to an underfloor heating system or radiators.

#### C. The transformations of free energy

The four forms of free energy can be inter-converted thanks to appropriate devices, called energy converters (Fig. 1)

There is no industrial process that directly converts radiation into mechanical energy although the physical phenomenon exists (radiation pressure engine or solar sail). It is the same for the reciprocal conversion. All free energies do not have the same quality level. Some are indeed more easily, some are indeed more easily converted into other forms and are thus considered nobler. When an object moves, storing mechanical energy, we see that all the molecules move in an orderly

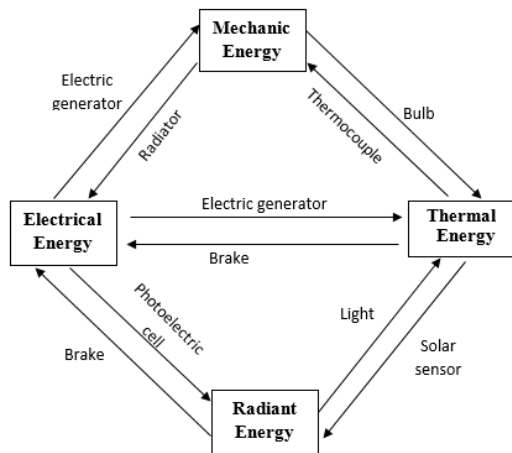


Fig. 1. Transformation of free energy and examples of energy converters.

fashion, contrary to thermal energy which imposes disordered movements on the atoms. The passage from mechanical energy to thermal energy can be done spontaneously (without energy input) while in the opposite direction, it is necessary to have a heat engine that will bring external energy to the system.

Generally speaking, there can only be a spontaneous degradation of energy quality, i.e. a passage from order to disorder. This is a fundamental principle. The level of disorder of a system is measured by its entropy. The greater the disorder, the higher the entropy. If an isolated system is in a non-equilibrium state, it will inevitably undergo a further increase in its entropy. This is the law of entropy increase or second principle of thermodynamics, discovered by **R. Clausius** and highlighted in its statistical approach by **L. Boltzmann**. The entropy of all the isolated systems observable in nature never decreases. It increases or at best remains constant. Moreover, any process involving macroscopic objects can be broken down into reversible and irreversible processes. An irreversible process is always accompanied by an increase of entropy and a reversible process by a conservation of entropy. In short, any spontaneous transformation of free energy into another is an irreversible process that is accompanied by an increase in disorder, i.e. entropy. The quality of energy deteriorates. A living organism is characterized by a very high level of organization, which it maintains by an external supply of energy (food). Its spontaneous evolution leads to an increase in disorder and the destruction of its organization, i.e. death.

On the other hand, the spontaneous transformation of potential energy into kinetic energy is a reversible process. It is accompanied by the maintenance of the order, thus of the entropy. The quality of the energy does not deteriorate. This is the case of the pendulum. During the oscillatory movement, there is a reciprocal conversion of the potential energy, characterized by the height of the pendulum, into kinetic energy characterized by its speed (Fig. 2).

Potential energy is one form of stored energy among others. We will discover them now.

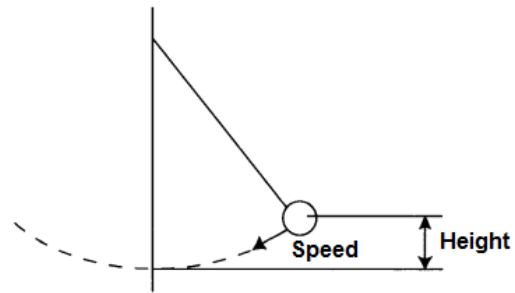


Fig. 2. Energy conversion in the pendulum.[4]

#### IV. RENEWABLE ENERGY

High fossil fuel prices and limited reserves, pollution, and climate change drove a 17% increase in investment in renewable energy solutions to \$270.2 billion in 2014. Hybrid or integrated renewable energy systems are efficient technologies to be explored in terms of resilience, environmental and economic benefits, and sustainability [5] for power generation, heat, or biogas. Local renewable energy includes agricultural and household farming waste, bioenergy crops, crop residues, and animal manure. Increased use of renewable energy can follow technological development, long-term planning, implementation of integration strategies, and appropriate investments. Renewable energy is the collective name for energy, that is produced using the earth's natural resources, like sunlight, wind, water resources (rivers, tides, and waves), heat from the earth's surface, or biomass. According to the European Parliament, "energy from renewable sources (or renewable energy) is energy produced from renewable non-fossil sources, namely [6], [7], [8], [9]:

- **Wind energy**,
- **Solar energy**,
- **Geothermal energy** (energy stored as heat beneath the surface of the solid earth),
- **Ambient energy** (naturally occurring thermal energy stored in a closed environment, which can be stored in ambient air, off-air, surface water or wastewater) wastewater);
- **Tidal energy** (resulting from the movement of the tides), wave energy (coming from the swell) and other marine energies (currents for example);
- **Hydroelectric energy** (water energy converted into electricity in hydroelectric power plants);
- **Biomass** (all organic plant or animal matter from forestry, agriculture, fishing and aquaculture, as well as related industries, and the biodegradable fraction of industrial or household waste)
- **Landfill gas** wastewater treatment plant gas and biogas".

According to the organization (The Intergovernmental Panel on Climate Change (IPCC); established in 1988, renewable energy is "any form of energy of solar, geophysical or biological origin that is replenished by natural processes at a rate equal

to or greater than its rate of use. Renewable energy is obtained from continuous or repetitive energy flows that occur in the natural environment and includes low-carbon technologies, such as solar, hydro, wind, tidal, wave, and geothermal energy, as well as renewable fuels, such as biomass.” The scope of renewable energies is sometimes extended to that of renewable and recovered energies: recovered energies include thermal energy from waste incineration or the recovery of waste heat from an industrial process. Fossil energies refer to energies resulting from the combustion of fossilized organic matter contained in the earth’s subsoil. The main sources of fossil fuels are oil, coal, and natural gas. They are present in limited quantities and are not renewable on a human time scale. Nuclear energy is the energy produced as a result of the process known as “nuclear fission”, which involves splitting the nucleus of uranium and plutonium atoms to release energy. This energy is neither a fossil energy (uranium is not a fossil energy) nor a renewable energy (uranium is a limited resource), but it has low  $CO_2$  emissions [10].

## V. STORED ENERGY

Contrary to free energy, stored energy can, by definition, be preserved over long periods of time while maintaining its intrinsic qualities. The different forms of stored energy are :

- Potential energy;
- Chemical energy;
- Nuclear energy.

### A. Potential energy

We have already mentioned it. It is a stored mechanical energy whose associated free form is the Kinetic energy. We accumulate potential energy by making a force work in the opposite direction. By letting this force work in its natural direction, the stored potential energy is released:

- The apple on the tree stores a potential energy due to its height, which is transformed into kinetic energy when it falls from the tree. The force at stake is the weight of the apple. Potential energy is accumulated by making the weight work in the opposite direction, i.e. by making the apple go up the tree;
- A stretched spring, the water retained behind a dam constitute a stock of potential energy (Fig. 9).

### B. Chemical energy

While potential energy uses a force linked to the matter (it is often the weight, as in the example of the apple), chemical energy uses the forces that link the atoms together in the molecules. We are in the field of the physics of the atom, at the level of its electronic procession, or atomic physics. The chemical reaction thus consists of modifying the molecules by acting on the forces of connection between atoms. This will result either in an absorption of heat (endothermic reaction) or in a release of heat (exothermic reaction). In the latter case, energy stored in the material is released through a chemical process. As an illustration, let us quote the reserves

of chemical energy stored in the coal mines or the hydrocarbon reservoirs (oil or gas). By chemical reaction of these fossil fuels with the oxygen in the air, the stored energy is released as heat. The industrial applications are multiple: refined oil for the operation of a car engine (gasoline) or aircraft (kerosene), city gas (methane) for district heating, coal (lignite, coal) for electricity production in a thermal power plant. It is possible to store three of the four forms of free energy in chemical energy :

- photochemistry (e.g. photosynthesis of plants - illustrated by Fig. 10) allows :
- thermolysis is a chemical synthesis that stores the thermal energy of the reactants;
- The fourth free energy, the kinetic energy, cannot be converted into chemical energy, but the reverse is possible (ex.: by means of a muscle in the animal).

### C. Nuclear energy

The nuclear energy puts at stake the forces that bind the nucleons together in the nuclei of atoms. This is the field of nucleus physics, or nuclear physics. The nucleus of an atom is made up of nucleons which are either neutrons (zero electric charge) or protons (positive electric charge). If we separate all the nucleons in a nucleus and weigh them separately, we find that the mass of a nucleus is surprisingly smaller than the sum of the masses of the nucleons that make it up (Fig. 11). The difference is called the mass defect and is equivalent, according to Einstein’s theory of equivalence between mass and energy, to an energy called binding energy. Physicists have measured the average binding energy per nucleon  $AE/A$  for all the atomic nuclei found in nature, and they have come up with surprising results. It is indeed observed that there is an increase in the mass defect, i.e. heat release, during the fission (breakup) of a heavy nucleus (mass number greater than 60, corresponding approximately to nickel) or during the fusion (assembly) of two light nuclei (mass number less than 60). These reactions are exothermic. On the other hand, the fission of a light nucleus and the fusion of a heavy nucleus require energy: they are endothermic reactions ( Fig. 11). In the reactions of fission of a heavy nucleus or fusion of a light nucleus, a part of the mass is transformed into energy: This is the principle of nuclear energy production, either by fission of uranium or plutonium nuclei in the core of a nuclear power plant in operation (e.g. EDF PWR) or in the explosion of an A-bomb (e.g. Hiroshima or Nagasaki), or by fusion of deuterium and tritium nuclei in a controlled fusion reactor or in the explosion of an H-bomb.

## VI. OUR SOLUTION (NANO CELL MODEL)

The total mechanical energy of an object in a system changes when a force causes energy to leave a system and enter another system by transferring the object’s kinetic energy as heat to the surface on which it slides. The process by which the total mechanical energy in an object changes is called work. If the work is negative, the object has transferred energy to its surroundings. If the work is positive, then an external

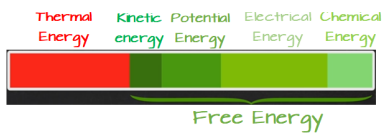


Fig. 3. Energy Types.

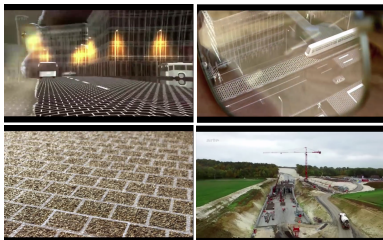


Fig. 5. A Photovoltaic Cell Platform.

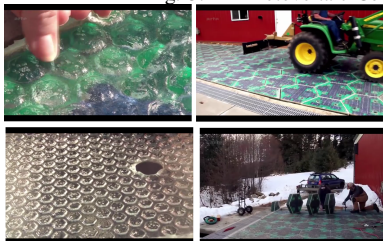


Fig. 7. Nano-Generator-Photovoltaic cell planting.

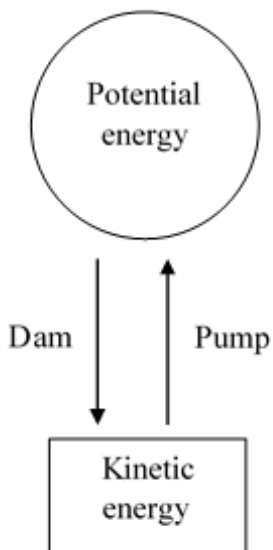


Fig. 9. Inter-conversion of potential energy and kinetic energy. [4]

source has transferred energy into the object, causing it to gain energy. The equation for calculating the work done by a non-conservative force is:

$$W_{nc} = \Delta U + \Delta K \quad (1)$$

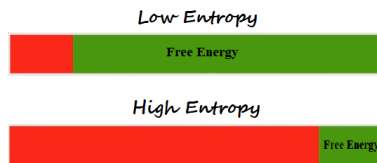


Fig. 4. Entropy Types.



Fig. 6. The uses of the Nano-Generator-Photovoltaic cell.

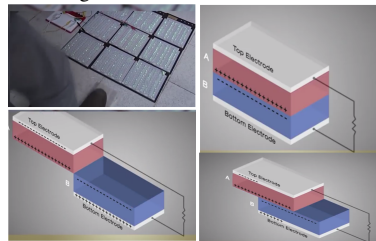


Fig. 8. The working principle of the Nano-Generator-Photovoltaic cell.

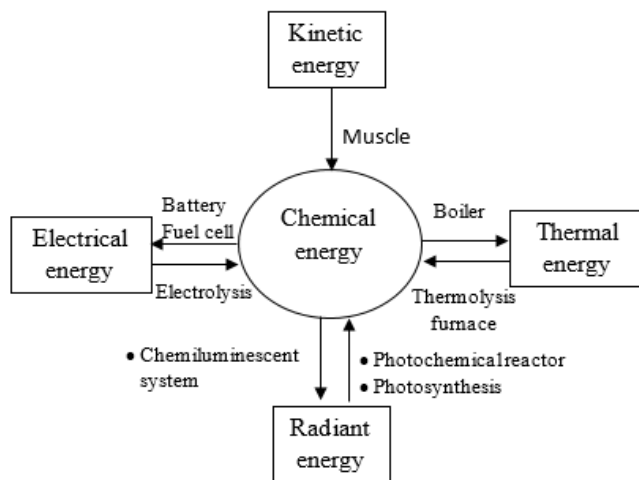


Fig. 10. Transformations between chemical energy and free energy and examples of energy converters. [4]

Work can also be calculated in another way, by finding the value of the non-conservative force  $F$ , and multiply this by the distance  $d$  the object moves under the force [11]:

$$W_{nc} = F * d \quad (2)$$

The platform consists of:



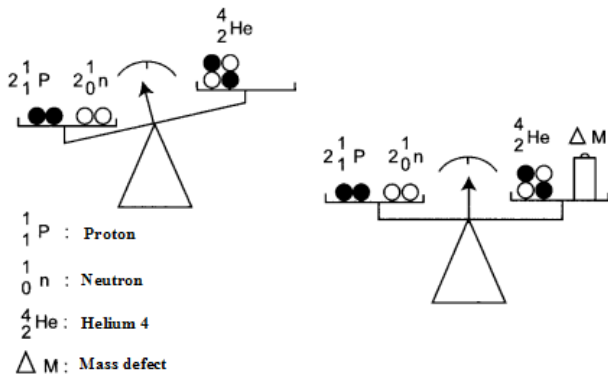


Fig. 11. Binding energy in helium. [4]

- Three Nano-Motors, (1) the first transforms movements (kinetics energy) into electrical energy (Fig.13), (2) the second transforms thermal energy into electrical energy (Fig.15), and (3) the third transforms electrical energy into thermal energy (Fig.14).
- Two storage stations; (a) a station which stores electrical energy, (b) a station which stores thermal energy.

The use of thermal energy is diverse, among them:

- To escape any type of fog.
- Chauvin roads, highways against clouds, ice,... and any type of sliding.

The Fig.12 illustrates the behavior of the generator platform. The initial energy is introduced into the system. It could come from mechanical vibrations, motion, or any form of kinetic energy. The Nano-Motor component converts the kinetic energy into electrical energy. The electrical energy generated by the Nano-motor is collected as an electrical output. This output can be used to power electronic devices, charge batteries, or feed into an electrical grid. The Fig.13 illustrates the General diagram of the Nano-Motor to transform kinetic energy into electrical energy. This electrical Nano-Motor essentially consists of a moving part: the rotor, and a fixed part: the stator.

- The stator is the machine's inductor. The inductor (a DC-powered winding or permanent magnet) creates a magnetic field magnetic field in the air gap (the space between stator and rotor).
- The rotor is called the armature. It consists of a winding, the seat of electrical/mechanical conversion. The vast majority of an MCC's electrical power is therefore concentrated in the rotating part of the Nano-Motor. The currents flowing in the armature are supplied via a commutator brush. The armature currents change direction on either side of the neutral line, producing forces that contribute to the electromagnetic torque in the same direction. The commutator is a mechanical switch that reverses the direction of current in conductors crossing the neutral line. A current  $I$  flows through the armature windings (because the armature is supplied by a voltage source). A conductor through which a current  $I$  flows and which

is placed in an induction  $B$  receives, on each element of length  $dl$  element of length  $dl$  a force  $d\vec{F} = I \cdot dl \wedge \vec{B}$  (Laplace force). This force will therefore be at the origin of the motion of the Nano-Motor shaft.

Nano-Generator-Photovoltaic Cell combines principles from thermodynamics, materials science, and nanotechnology to create efficient devices for converting waste heat into usable energy. Nano-Motor (thermal - electric energy) appears to involve the use of mechanical motion generated by temperature changes to produce electricity. The Fig.15 illustrates the General diagram of the Nano-Motor (thermal to electric energy). The electric energy is provided to the system. It could come from a power source such as a battery or an electrical grid. A control electronic manage the conversion process, controlling the flow of electric current and optimizing the efficiency of the conversion. A thermoelectric material is designed to exhibit the thermoelectric effect, which is the phenomenon where a temperature difference between two sides of the material creates an electric voltage. This effect allows the device to convert heat into electricity or vice versa. A load or device process that receives the thermal energy generated by the conversion process. It could be a heating element, a thermal storage system, or any application that requires heat. During the conversion process, there will be some waste heat produced. This is the thermal energy that is not effectively converted into electricity and is typically released into the environment. The Fig.14 illustrates the General diagram of the Nano-Motor transforms (Electric to Thermal) energy. In the following sections, illustrations of the operation of each Nano-Motor are presented.

#### A. Nano-Motor to transform Kinetic to Thermal energy

In this Nano-Motor (Fig. 14), the conversion of kinetic energy into thermal energy occurs due to friction and other sources of mechanical energy loss. The main equation of this transformation is based on the law of conservation of energy [12] as defined by the formula (3):

$$E_{initial} = E_{final} \quad (3)$$

Where:

- $E_{initial}$  is the initial kinetic energy of the Nano-Motor's moving parts.
- $E_{final}$  is the final thermal energy produced due to the conversion of kinetic energy. The equation can be written more explicitly with formula 4 as :

$$E_{kinetic} = E_{thermal} \quad (4)$$

Where:

- $E_{kinetic}$  is the initial kinetic energy of motion and can be calculated using the formula 5:

$$E_{kinetic} = \frac{1}{2} * m * v^2 \quad (5)$$

Where:

- $m$  is the mass of the moving parts (in kilograms).

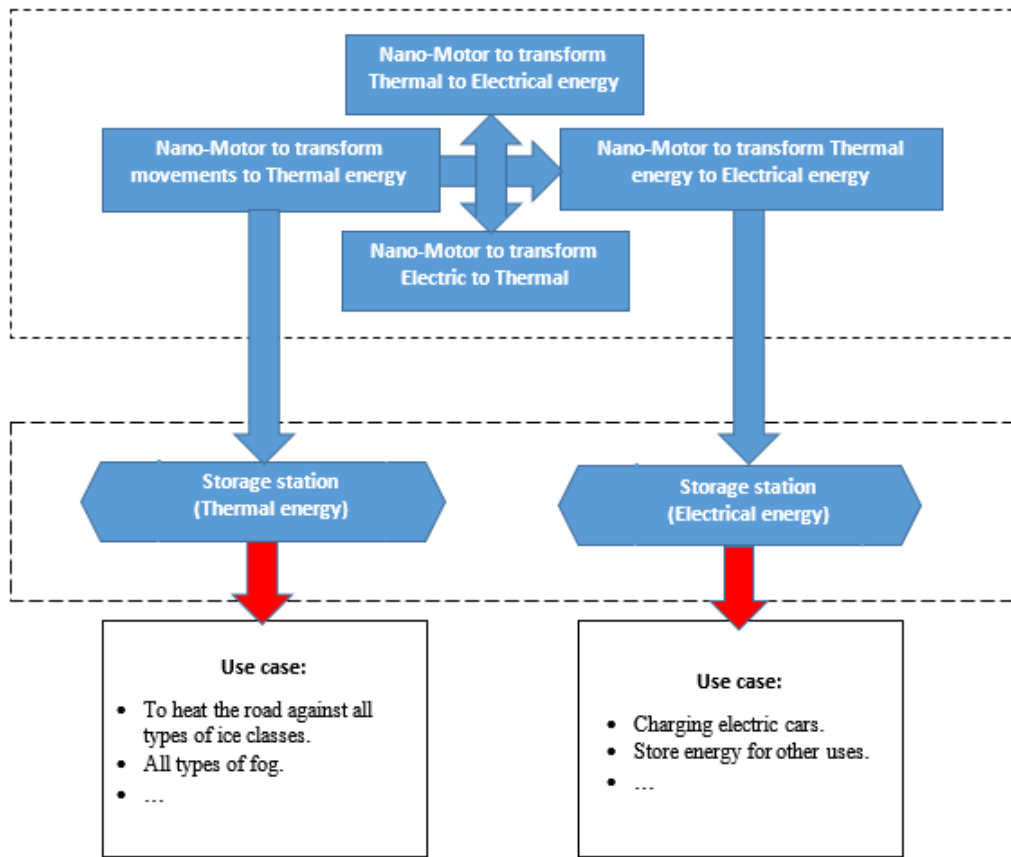


Fig. 12. Nano-Generator-Photovoltaic Cell Platform.

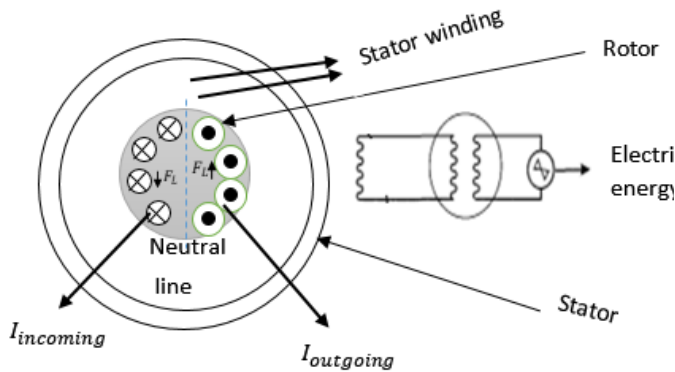


Fig. 13. General diagram of the Nano-Motor to transform kinetic energy into electrical energy.

- $v$  is the velocity of the moving parts (in meters per second ( $m/s$ )).
- $E_{thermal}$  is the thermal energy generated by the conversion of kinetic energy. This energy is generated by friction and other dissipative forces within the

### Nano-Motor.

#### B. Nano-Motor to transform Electric to Mechanical energy

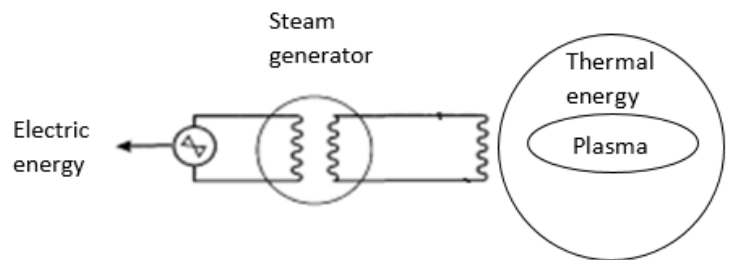


Fig. 14. General diagram of the Nano-Motor to transform Electric energy into Thermal energy.

The Nano-Motor converts some of the electrical energy into mechanical energy (Fig. 14), typically in the form of rotational kinetic energy. The mechanical energy output can be calculated as in (formula 6) [13]:

$$E_{out} = \frac{1}{2} * I * \omega^2 \quad (6)$$

Where:



- $E_{out}$  is the mechanical energy output (in joules).
- $I$  is the moment of inertia of the rotating components (in  $\text{kg}\cdot\text{m}^2$ ).
- $\omega$  is the angular velocity of the Nano-Motor shaft (in radians per second).

### C. Nano-Motor to transform Electric to Thermal energy

Nano-Motors proposed is theoretical, and are not perfectly efficient, Where some of the electrical energy is converted into thermal energy due to resistive losses and friction [14]. The thermal energy dissipation can be calculated as (formula 7):

$$E_{thermal} = E_{in} - E_{out} \quad (7)$$

Where:  $E_{thermal}$  is the thermal energy dissipated (in joules). It's important to note that Nano-Motor efficiency plays a significant role in determining how much electrical energy is converted into mechanical energy and how much is lost as heat. The efficiency ( $\mu$ ) of a Nano-Motor can be calculated as (formula 8):

$$\mu = \frac{E_{in}}{E_{out}} \quad (8)$$

This efficiency value is usually less than 100% due to energy losses in the form of heat and other factors. These equations provide a simplified model of energy transformation in a Nano-Motor. In practice, Nano-Motors can have more complex behavior depending on their design and operating conditions.

### D. Transformation of Thermal to Electrical Energy

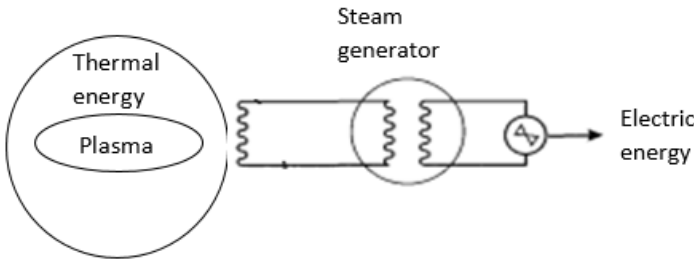


Fig. 15. General diagram of the Nano-Motor to transform thermal energy into electric energy.

The thermoelectric generator (TEG) is a device that can directly convert a temperature gradient into electrical energy [15]. It operates based on the Seebeck effect, which generates a voltage when there is a temperature difference between two sides of the TEG module. The basic equation for the Seebeck effect is (Formula 9):

$$V = S \cdot \Delta T \quad (9)$$

Where:

- $V$  is the voltage generated (in volts).
- $S$  is the Seebeck coefficient (a material-dependent constant).

- $\Delta T$  is the temperature difference between the hot and cold sides of the TEG module (in degrees Celsius or Kelvin).

By placing one side of the TEG module in contact with a heat source (where thermal energy is available) and the other side in contact with a heat sink (at a lower temperature), you can generate electrical energy.

### E. The Motivations behind this Nano Cell model

Among motivations, there are:

- NPC can generate electricity from sunlight through the photovoltaic effect, just like traditional solar cells. Additionally, it can capture mechanical or vibrational energy from its surroundings using nanogenerators, converting ambient kinetic energy into electrical energy.
- NPC's ability to harness both solar and mechanical energy enables it to operate under varying conditions and produce electricity even in low-light or shaded environments.
- The small size and flexible nature of NPC make it suitable for integration into various devices and systems, opening up possibilities for wearable energy harvesting.
- As nanotechnology and materials science continue to advance, the production of NPC is expected to become more scalable and cost-effective. This could lead to wider adoption and integration of NPC technology in renewable energy solutions.

### F. The Objectives behind this Nano Cell model

The use of electrical energy is diverse too; such as:

- The electric charge of cars, machines, etc.
- The storage of electrical energy for other uses, such as lighting of houses, factories, ...
- A significant reduction in greenhouse gas emissions, improved air quality, and decreased reliance on finite and environmentally harmful resources.
- It fosters economic growth by creating new job opportunities and stimulating innovation in clean energy technologies, , ...

## VII. CONCLUSION

Renewable energy offers numerous benefits, including a significant reduction in greenhouse gas emissions, improved air quality, and decreased reliance on finite and environmentally harmful resources. Moreover, it fosters economic growth by creating new job opportunities and stimulating innovation in clean energy technologies. The generation of renewable energy is a concern for researchers to find solutions firstly theoretical and secondly tested in the laboratory, then generalized in reality. This solution is useful to generate energy from the kinetic energy produced from the great movements of the large boulevards, the moving spaces like, highways and railroads. Despite the many advantages, NPC technology is still in the research and development phase. There are ongoing research and innovation in the field hold the potential to address these challenges and pave the way for a more sustainable and efficient future in renewable energy.

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