

Direct Renewable Energy Application to Hybrid Water Filtration and Electricity Generation Facility

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Abstract—Apart from improving our quality of life, knowledge, and our development in general, the Industrial Revolution and the inadequate system of values and priorities that followed disturbed natural and energy balances to the point that it jeopardizes life continuation on Earth. The new direction and the change of the approach in handling our resources were necessary, united under the introduction of renewable and sustainable energy. The transformation of the energy sector requires a very complex analysis, different perspective, and philosophy from the one we currently use.

This article aims to propose a novel understanding of renewable energy and energy in general, by introducing a new technological merger between electricity generation and water filtration technologies, with far better financial, environmental and sustainability benefits from presently known technologies.

Keywords— *Direct renewable energy application, electricity generation, and water filtration, energy storage, sustainability, hybrids.*

I. INTRODUCTION

Control and domination over resources was always the most important factor in geopolitical confrontations. The new sources of energy known as renewable energy, due to its dispersion, are widely available unlike fossil fuels, and are losing dominance over water. The access to usable water, with the rising influences of global warming, is a new seriously destabilizing problem, influencing some countries to the point of being considered as the main reason for the next global war. Both of these strategic resources require some processing and preparation to be used safely and efficiently. A novel technology that can provide the world with a simple, cheap and reliable source of electricity and clean water would be a significant step forward towards a better future for all.

The new sources of energy that are replacing fossil fuels, due to its cyclical nature and dependence on weather patterns, are unstable and, therefore, unreliable. To have a controllable supply of electricity from renewable energy sources, it is necessary to combine several power generation

processes into one system and store a portion of energy. Various hybridizations have been proposed and implemented.

Water pollution, besides biological, has received a significant component of life harmful chemicals, so all modern technologies are based on physical separation and elimination of unwanted water constituents.

Due to the complexity and interconnection of the problems that we are facing, the research is multidisciplinary and includes energy, water, chemistry, climate changes, astronomy, astrophysics, and quantum mechanics, all employed to lead us towards a broader understanding of the world we live in.

A. Defining Energy

Our everyday perception is quite simplified when energy is concerned. If we have to do something, we take a tool/device and plug it in the socket. For traveling, we put petrol in the car. Before start working, we eat. Every change requires some sort of energy, and it seems that there are many shapes and sizes. To be able to utilize it, we have to find an economical and efficient way to transform it into some usable form. This final shape of energy is often treated like any other product, having a raw material that we refine by applying technology and “producing” energy in the process. The term “conversion” seems more suitable, based on Helmholtz Energy Conservation Law, quoting that “Energy cannot be created or destroyed; it can only be changed from one form to another”. Search on defining energy brings many descriptions. The most appropriate is the one saying “Energy is the capacity for doing work, and work requires the use of force to achieve a change in energy”.

Quantum mechanics recognizes four forces that define the universe: gravitational, electromagnetic, weak and strong nuclear, transferred by the invisible particles – waves – which interact with chemical masses of the Earth, creating our world the way it is and us in it. Our current concern is the integration of solar radiation and gravity into the power grid; therefore, we have to consider Max Planck and Isaac Newton’s achievements, partially joined by Milutin Milankovic in defining climate variations that caused Ice Ages. In terms of applying creativity into science of energy, the most important are visions of Nikola Tesla. All this

knowledge, proven by the test of time, create a foundation for building new technical conclusions.

Our world, isolated by the atmosphere, limits our views and understanding. Many terms sound inappropriate when cosmic sciences interact with the Earth's. We have to broaden our perspective to understand the origins, transfers, and the effects of available energies.

1) *Defining Renewable energy*

Renewable energy is a term related to a fundamental change in energy comprehension. The fossil fuels will be replaced with the group of energy sources, which is "renewing" itself in a cyclical manner, as per day/night and the cycles of the tides. The reason for this behavior is explained with astronomy, climatology and quantum physics. This influx of energy has a direct influence, spreading through the different processes, and manifesting by various energy discharges and interactions. This name has a more symbolic than describing function, so because they are coming from space, it is more suitable to explain it as cosmic energies and forces, and there secondary manifestations as cosmic energies and forces conversions.

2) *Defining Electricity*

In the variety of usable forms, it was necessary to find a universal shape of energy that can supply all our machinery and equipment with a single power that is convertible into any shape needed. Electricity is currently the most convenient and transformable form of energy, dominating the market to the point that we do not see any alternative nor the actual energy sources around. So, all available energies have to be converted by the various power generation technologies into it, following certain parameters so that it can be implemented to the existing energy exchange system called The Power Grid. There are many obstacles and complications related to this, especially after fossil fuels and renewable energy mergers. From the perspective of energy, the most important is that each conversion is followed by energy losses that, eventually, manifest as heat. In the case of our car engines where only about 30% of fossil fuels are converted into mechanical energy, the losses are significant, so the negative influence on the surroundings.

B. *Defining the term "fuel"*

With a change in the sense of „energy production", we have to broaden the term „fuel". It was related for a long time with materials used to generate heat and light, then the mechanical energy created by combustion, and finally - the electricity what gave us sense of energy production at the first place. With the introduction of nuclear energy, things became slightly different, but still in the line of previously mentioned energy transformation: the raw material – technology - heat - electricity. The latest technological developments are still having a raw component to transform into electricity, but bring more variety and complexity to understanding. In an attempt to define the term fuel, we can say that it became a word representing any concentration of energy that can be converted into some other shape – with or without our assistance. If we accept the correctness of this definition, we can say that the wind, waves, sea

currents, etc. are fuels for generating electricity, fueled by cosmic forces in the shape of the Sun's radiation and gravity.

1) *Fossil versus Cosmic fuels*

The fundamental difference between the two is that fossil fuels are static, conserved concentrates of energy, while cosmic fuels are dynamic, constantly changing, interacting with each other and different materials to the point of creating new and destroying existing. While the fossil fuels are used and distributed in a controlled and centralized manner (from coal mines and oil/gas wells, transport and pipelines, power plants, transmission, distribution, to the sockets), cosmic fuels are everywhere around and we can feel them with all our senses. Fossil fuels are part of our material value system and refined energy while cosmic can be used raw and are free before integrated into the electricity network. Apart from four cosmic forces identified by quantum mechanics, there are many cosmic forces and energies conversions, which are initiating and conducting various natural processes – all related to the energy exchange aimed to achieve equilibrium. Therefore, the approach in handling and harvesting energy out of them has to be broader. All energy utilized from fossil fuels has to be converted by combustion into heat, light, mechanical or electrical energy and then further, while the cosmic energy influx exist in various forms already, that we convert to electricity, after which we transform it to other shapes, following footsteps enforced by fossil fuels technologies. The cosmic fuels can be looked on through the variety of events, sensations, and forces released during various energy discharges in forms already available and used directly. Advantages of the second possibility are obvious: by employing natural processes and manifestations directly, we utilize renewable energy in the shape and place needed, avoiding losses during accumulation, transformations, transmission, and control. The application of engineering tools and knowledge to the most suitable natural process creates conditions so that it can do the work.

II. RESEARCH

The forces of our interest are gravitational and electromagnetic because they are sources of renewable/cosmic energies. Gravity converts to hydro and tidal energies, while solar gives heat and light, transformed through natural processes into electrical, various forms of mechanical, thermal and chemical energy [1].

A. *Gravity*

The quantum mechanics defines gravity as the weakest force of the four mentioned [2], characterized by the mass and the energy, act over large distances, always attractive and is carried by the particle called the graviton. The interaction between all space objects is defined by Newton's laws [3], which are used as a base for complex mathematical models creation of multi-planetary cosmic systems like Solar [4]. Earth is not a solid object. Its liquid content – water and magma – attracted dominantly by the Moon and the Sun – is changing density and position causing mass redistribution [5] which, with other factors influences Earth rotation deviations (precession, obliquity and eccentricity – M. Milankovic), and with its variations in many natural

processes related to insolation. Another aspect of gravity is that each space object attracts and holds its contents together. With it, each particle/group of particles receives characteristic called weight [6], which is different for the same object measured on – for example - Earth and the Moon, causing proportional pressure towards the planet's center. One specific Earth's content – the water – change its shape from liquid, solid to gas with the temperature variations, always circulating, and represent the major barrier and absorber in electromagnetic energy influx. With all mentioned before, we can say that gravity with the temperature creates and controls the hydrological cycle [7] and provide us with all aspects of water-related energies.

B. Electromagnetic forces

The Sun's gravitational force creates pressure that generates nuclear fusion, turning hydrogen into helium, and it converts a portion of mass into electromagnetic radiation [8]. All bodies above absolute zero in temperature emit energy as electromagnetic radiation [9], where the Sun is acting as a blackbody with some cyclic variations in radiation. Various monitoring and analysis methods have been developed to understand the complexity of the Sun's behavior and its influence on our planet [10], classified as radiative, chemical, dynamical, and electrical. Radiative characteristics have been defined by the Planck's law and calculated for the perfect black body, emitting [11] from gamma to radio waves. The nature of electromagnetic radiation is explained by quantum theory, [12] introducing photon. It is a collection of elementary light particles (oscillations), characterized by the frequency and the wavelength that differs with the quantity of energy that the wave is carrying. The electromagnetic characteristics are the consequences of the electrical charge in motion or change in time, attracting different and repulsing the same electrically charged particles. The effects of radiation on the matter, including biologic materials, can be excitation (electron rise to higher electron shell) or ionization (ejection of one or more electrons from the atom) [13]. So, while Infra-Red cause electron vibrations and heat emission, visible and near Ultra Violet brings the energy that stimulates chemical reactions (molecule creations) by interacting with outer (valence) electrons, and larger photons – Gamma, X and the rest of Ultra Violet - are breaking the molecular bonds and destroying biological and other molecules [14].

The atmosphere (it's content) depletes - absorbs and reflect - more than half of total Sun's radiation [15] and protect us from harmful gamma, X and the majority of UV rays, leaving us with the rest of the electromagnetic spectrum that we know and feel as a Sun's energy. In this process, a part of the electromagnetic force is converted into energy of the atmosphere – by breaking gas molecules and creating new ones (chemical energy), the temperature increase and electrical charge. Another part that reaches the surface is converted as follows:

- Infrared provides us with a sufficient temperature. When above 0°C , water flows with the gravity and induce all kinds of hydro energy [16], metabolic energy exchange [17], wind [18], OTEC (Ocean Thermal Energy Conversion) [19] and CSP (Concentrated Solar Power) [20] power generation technologies,

- Visible and near Ultra Violet - into chemical energy like creating sugar with photosynthesis [21], feeding all living organisms with the famous conversion from the past called "the fossil fuels" [22], and PV (Photovoltaic) technologies [23].

C. Research on water

Another convenience of the modern world, apart from the electricity – is water. Average person does not know much about it, except that it is available from taps. However, behind it, there is a huge distribution network, complex operational and maintenance system and the variety of technologies involved that consumes a vast amount of energy. Current world crisis initiated by the global warming and growth of human population is carrying many concerns regarding its present and future availability, quality, and suitability of the purification technologies that are currently in use. If we keep water clean and available, we control pollution in general, but also the quality of life, food supply, industry, microclimate, global warming, life reproduction, and development.

1) Water properties

Apart from being one of the main components in creation and life existence on Earth, water is a chemical with unique and complex characteristics.

a) Water chemistry

Everything we know is composed of a “building blocks” called atom [24], characterized by the mass and electrical charge. Its center, the nucleus, containing almost an entire atom's mass, consists of protons (positive) and neutrons (neutral), that is orbited by the electrons (negative). The differences between the atoms are formed by the quantity and structural arrangement of these fundamental subatomic particles. A stable atom of every element is electrically neutral, indicating that the positive charges from the protons are balanced by the negative charges from the electrons. If out of balance, it is called an ion. Atoms of the same element can differ in weight due to variable numbers of neutrons and then are called isotopes.

The most abundant hydrogen atom has one proton and electron, while the oxygen contains eight protons and neutrons in its nucleus, balanced electrically by eight electrons, each existing in the shape of three isotopes.

Water molecule is a structure of two hydrogen atoms bonded to one oxygen atom [25], which is formed by a pair of electrons unequally shared between the two atoms. The oxygen atom has a greater positive attraction than the hydrogen, and the unequal sharing in the O–H bond electrons results in oxygen acquiring a partial negative charge and hydrogen a partial positive charge, bending the structure. Molecules with negative and positive regions are called polar molecules.

Polar molecules are attracted to each other - the negative region of one molecule, the oxygen atom, is drawn to the positive region of another molecule, the hydrogen atom. This attraction is called a hydrogen bonding, and due to its unusual strength, water has many unique properties.

b) Water and temperature

Water exists in three aggregate states: vapor, liquid and ice, the last of which has at least nine known forms. For biological phenomena – life creation and existence - the most important is the liquid phase. Its shape is related to heat absorption that causes physical vibrations of atoms and molecules, creating kinetic energy. Every water molecule can form four hydrogen bonds with four neighboring molecules. When the temperature is below 0°C, an extension of this hydrogen bonding in three dimensions produces interconnected hexagon structure cages of water molecules in ice, with space within the crystalline structure, making it lighter than water. This is an exclusive water molecule structure - all other molecules and ions are eliminated. From 0°C upwards, the angular separation between hydrogen atoms change, increasing density. The back-and-forth motion of the molecules are so vigorous that they exceed the strength of the electrical bonds in the crystal, and the crystal structure disintegrates (melts), allowing molecules to form snug clusters. Above 4°C [26], the space between molecules starts expanding, influencing water density. Liquids are loose aggregates of molecules that are in contact, but are free to move relative to one another. As more heat is added to the liquid water, some of these molecules gain so much kinetic energy that they escape from the liquid surface and become a gas. This process is called evaporation. The whole process is reversed with the cooling of water vapor within the atmosphere, resulting in condensation, freezing, and forming a hydrologic cycle. The majority of energy in the process explained is consumed by the maintenance or breaking of hydrogen bonds, giving water unusually high boiling and melting point and specific heat capacity. Hydrogen bonding is also responsible for the six-fold symmetry of snowflakes, important interactions with biological molecules in living organisms, surface tension, to name a few of many characteristics.

Nature purifies the water with freezing and evaporation.

c) Water interactions with other substances

A solvent with polar molecules like water tends to dissolve other substances having polar molecules, as well as substances that form ions when dissolved. This happens because the charges or partial charges of the solvent molecules and solute molecules attract one another. The molecules of the solvent surround molecules or ions of the solute in an arrangement called solvation. This solvation holds the solute in the solution.

Sodium, a positively charged atom (Na⁺) called a cation, and chloride, a negatively charged (Cl⁻) called an anion, are the most common elements dissolved in water. Seawater also contains dissolved metals, nutrients, gases, and various organic compounds. Salt content changes properties of water, like reduce temperature of maximum density, freezing point, specific heat, isothermal compressibility, but increase conductivity, density, viscosity, vapor pressure, surface tension, velocity of sound [27].

On the other hand, substances with nonpolar molecules, such as hydrocarbons, fats, and oils, are not soluble in water, but they are relatively soluble in solvents that have nonpolar molecules, and solvents like those are used for dry cleaning clothing.

2) Water purification technologies

Scientists are stating that the future of water supply will rely on the recycling of existing freshwater reserves with the addition of seawater desalinated with the most suitable technology [28]. The mechanism of water interaction with the chemicals has been explained in the previous chapter. To make water usable, we have to apply some energy or force to break bonds and eliminate unwanted substances. Because of the increase in chemical pollution, technologies based on ion/molecule level separation has been dominant, grouped into Thermal (freezing and evaporation) and Membrane Processes (Reverse Osmosis, Electrodialysis, Electro-Deionization and Forward Osmosis). All these processes are electricity-dependent with high electricity consumption. The introduction of renewable energy in the water filtration process was limited – so far - to heat and electricity when thermal technologies are concerned, and electricity only in membrane processes [29].

3) Water energy storing properties

When the water flows - energy is released. Water movement depends on altitude difference, water influx, gravity/the mass in freshwaters, and temperature, density (salinity), winds and Moon gravity in the seas. The advantages of hydro energy against other energy sources are that is clean, controllable and reliable. Water energy storing properties are an increasingly important stabilizing factor in electricity supply based on variable solar and wind generation [30].

Hydropower is generated at facilities called hydroelectric power plants [31]. Many hydropower plant designs are available, depending on conditions related to rivers, streams, and canals but, for any reliable water supply, dams are needed. Dams accumulate water for controllable release in irrigation, domestic and industrial use, and power generation. The reservoir acts like a battery, storing energy to be released as needed. The volume of water released and the vertical distance from which the waterfalls (head) determines the actual output of energy at a dam.

A variation in water mechanical energy utilization is a pumped storage hydro energy [32]. By connecting two water accumulations from different altitudes, we stabilize the power system with releasing upper accumulation through a turbine when short of, and by pumping the water back when having too much electricity. Some energy loss/the waist is necessary and accepted when power system stabilization, transformation, and transmission are concerned, but in the case of pumped storage hydropower plants, it is compensated by the difference in the electricity price/tariffs that makes this process profitable. Seas, due to its size, store energy in shape of wave [33], sea currents [34], tidal [35] from which we can generate electricity, as well.

Second, a very important water property is the ability to accumulate thermal energy. The power generation technologies developed to harvest this kind of energy are OTEC (Ocean Thermal Energy Conversion) [36] and geothermal [37].

III. CONCLUSIONS AND RESULTS

The invention related to Direct RE application to hybrid water filtration and electricity generation facility is protected under patent application П-2020/0933, dated 03.08.2020. Conclusions about energy and water are as follows:

- The cosmic energies and forces influx cause changes on atomic/molecular structures from stimulations to creation and destruction, depending of quantity of energy absorbed/released.
- These energy discharges are happening in cycles, following the rules of cosmic motion, creating a variable energy mix which interact differently with the matter, and causing fluctuations of many energy conversion/exchange processes.
- Fossil fuels are, by its nature, a stored energy, and it is easy to control its output. To have a processes that run continuously on cosmic energies, we need a right mix of non destructive energies and the energy storage that balances between periods with too much and too little/no energy. This is a general rule that is relevant to a creation and existence of life and every process that supports it, including current energy market transition.
- Water plays the most important role in the materials and energy absorption, transport and storage on our planet.
- A hydrologic cycle provides a natural way to purify the water and the environment, but currently is spreading pollution, accumulating it at the static waters.
- The only way to eliminate it is water filtration on a big scale. New water treatment technologies separate macro, micro and Nano sizes of unwanted water contents.
- The biggest problems with new water treatments are the cost/amount of energy consumed and full dependence on electricity supply. A ways to solve this are:
 - To simplify and optimize it, minimizing energy consumption/losses, or
 - Use of the renewable energy directly if/where possible, instead of the electricity.

A. *The proposed technology characteristics*

- This technology utilize energy from static and semi static waters,
- Both electricity generation and water filtration on molecule/ion level technologies has been carefully chosen to complement each other and directly consume the energy in the shape available,
- The concept can be applied to fresh water accumulations, but also to seas and oceans, revealing mega potentials in electricity and usable water supply,
- The electricity can be generated continuously or in cycles, enabling us not only to improve power of the grid, but more importantly – its stability,
- The water filtered to the molecule/ion level is released out of the process,
- Possible a simple gradual increase of capacity,
- A water purification system generates high concentration of water unwanted content up to nano sizes, allowing us to add a technology that eliminates and process it, creating new set of benefits.

B. *The advantages over the existing solutions*

- The integration of technologies provides two strategically important resources out of one process,
- Offers high flexibility and the variety of practical solutions,
- Simplified design and functionality,
- The energy is used directly, minimizing transformations, losses and with it heat emission, what makes this technology more sustainable and efficient than the others,
- Has more positive impact on the environment,
- It is much more economical,
- Has much broader base for social acceptance of new technologies, related to socioeconomic and livelihood issues.

1) *Positive impact on the environment*

- Water treatment does not have any negative impact to the environment,
- Electricity generation is based on clean energy, not causing any pollution nor disturbance in the process,
- It provides conditions for general pollution elimination of water, land, and air from macro to molecule/ion level, and prevents further dispersal, creating a healthier living conditions for all living creatures,
- By minimizing energy conversion losses, we reduce the heat emission to the environment,
- Introduction of technologies independent of electricity consumption represents an entirely new direction in the technological drive, providing the benefit of green house gasses emission reduction.

2) *The financial benefits*

- Replacement of the electricity with the renewable energy direct application generate significant cost savings since the energy supplied for water filtration is not a part of our system of financial values and reduce losses from energy transformations,
- The water of the highest purity is sold to the market,
- By processing, recycling and selling the water unwanted content we are creating extra income,
- We sell electricity to the market if designed as permanent power generation facility, and with the energy-storing capabilities, we profit on the tariff difference,
- The physical merger of power generation and water filtration installations saves on material, design, construction and the future operation and maintenance cost,
- Savings on connecting to local electricity, water distribution and sewage network to the cities located on rivers, lakes, and seas.

3) *Social acceptance to new technologies, related socioeconomic and livelihood issues*

- It provides solution for electricity and water supply, creating conditions for up to nano levels pollution

- elimination – all powered by the renewable energy directly,
- The energy storage potentials from small water accumulations to a big capacities at the oceans, allow us to remove quicker all hazardous technologies from the power sector and with it help reversing a climate changes effect,
 - Supply of large volume of water of the highest purity will end water shortage, water transmitted diseases, boost agriculture, return life to the deserts,
 - The removal of unwanted water content – from plastic bottles to molecules and ions - will initiate a new, clean industrial development with job and products creation to the local communities,
 - The concept is particularly beneficial to urban coastal areas because it is almost invisible, stabilize distributed energy resources, provide fresh water from the accumulation and polluted water filtration, creating conditions for elimination of unwanted water content,
 - It will give more independence to the off shore activities from the shore supply, providing fresh water, micro grid stability, sea and fresh polluted water filtration to the islands, concentrate unwanted water content for easy elimination and processing, and security in exploration, exploitation, and colonization of the seas,
 - By connecting it to the on/offshore renewable energy generation facilities, we can get stable and controllable energy output and big quantities of clear water which can turn deserts into populated, industry, agriculture and sea farming rich areas,
 - Provide the fossil fuels industry with the unique opportunity to join the energy transition from renewable power generation side, beneficial to everybody,
 - OVERALL - It gives a new perspective towards the future technical solutions for human habitat resources supply, motivates everybody involved on a way that there work contribution is beneficial to the whole planet, securing a healthier, more stable and sustainable future for our kids and that every minute counts.

As per NASA tech readiness levels [38], this idea is at level TRL 3, requiring analytical and laboratory studies. All further developments are related to the fund's availability.

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