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Future Energy Source: An Introspection

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ABSTRACT—
Approximately 85% of the energy the world consumes is addressed by fossil fuel (coal, oil and gas), which is depleting rapidly and is expected to be run out in the midst of 21st century. What will happen when we will run out of oil, coal and gas?
In this article, we tried to find the alternative energy sources with their potential to become as substitution of fossil fuel. A relative study of several energy sources with respect to their merits and demerit is made. It is found that none of the sources can become as an immediate substation of fossil fuel. So, saving energy as much as possible is the only alternative.

Keywords—Fossil Fuel; Alternative energy; Atomic energy; Ocenaic Energy

I. INTRODUCTION

National Geographic [1] estimated that the world uses 320 billion KWh of energy every day. It roughly equates to 22, 100W light bulbs running 24 hours a day for every single person among 6000000000 of us. Approximately 85% (Fig. 1 and Fig. 2) of this enormous requirement is addressed by fossil fuel (coal, oil and gas), which is depleting rapidly and is expected to be run out in the midst of 21st century[2, 3]. **What will happen when we will run out of oil, coal and gas?**

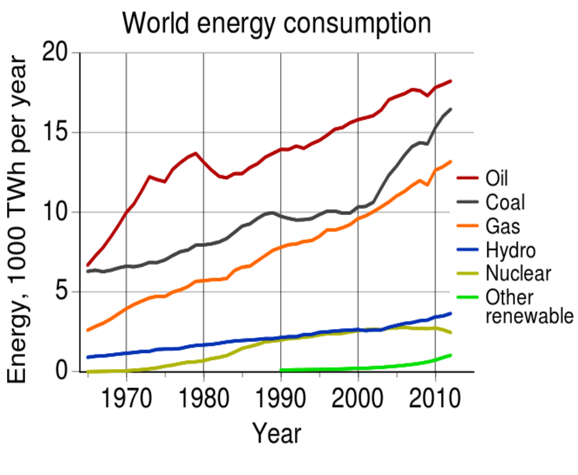

Fig. 1: World energy Consumption chart

Scientists are constantly looking for HIGH energy sources as a substitution of fossil fuel[4, 5]. Some of the promising alternative sources are nuclear, solar, wind, bio-fuel, geothermal, and ocean etc.

		Year 2012	%	
Fossil	Oil	**4130.5**	32.95	84.92%
	Coal	**3730.1**	29.75	
	Gas	**2987.1**	23.83	
	Nuclear	**560.4**	4.47	10.89%
	Hydro	**831.1**	6.63	
	Solar	**21.0**	0.17	4.19%
	Wind	**117.9**	0.94	
	Geothermal	**98.4**	0.79	
	Bio-fuels	**60.2**	0.48	
	Other renewable	**237.4**	1.89	

Fig. 2: World energy sources(in Million tons of oil equivalent)

II. NUCLEAR ENERGY

A. Selecting a Template (Heading 2)

The International Atomic Energy Agency (IAEA) expects the global nuclear power generation capacity to increase from the current 372 gigawatts (GW) to 437–542 GW by 2020 and to 473–748 GW by 2030 [IAEA].

Nuclear energy is harnessed by either splitting (fission) or merging (fusion) the nuclei of two or more atoms. Fission usually uses uranium, which will **last approximately 30 years.** One option is the reprocessing of the spent fuel. This spent fuel is rich in plutonium and when combined with the leftover uranium, it can be reprocessed into a mixture known as MOX, which can be used as fuel. This may help to stretch the available uranium resources by a few more decades.

The biggest drawback to this source of energy is the disposal of radioactive waste and the high cost of building nuclear power plants.

Fusion, on the other hand, utilizes *hydrogen* isotopes, *lithium*, and *boron*. The lithium reserves from the earth, combined with those from the sea, can last us for more than *60 million years.* Deuterium, an isotope of hydrogen, can last another *250 million years*[8].

However, the process of harnessing energy from this isotope is fairly complicated and is still in its infancy [6]. If we can successfully learn how to utilize nuclear fusion for the generation of energy in a viable manner, it could well be the new king of the energy world. Nuclear fusion is a clean process, with low carbon dioxide emissions, and the radioactive waste products also have a relatively short half-life.

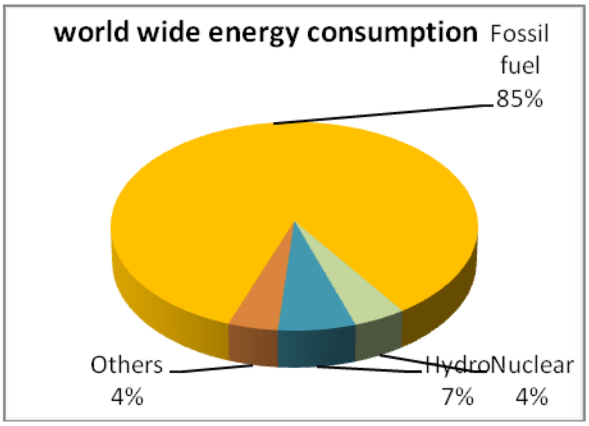

Fig. 3: World energy consumption pie chart

In general, for nuclear power to emerge as a reliable and clean source of energy, several challenges need to be addressed. Some of these include improvement in economic competitiveness, designing safe and reliable nuclear power plants, management of spent fuel and disposal of radioactive waste, developing adequate skilled workforce, ensuring public confidence in nuclear power, and ensuring nuclear non-proliferation and security.

III. SOLAR ENERGY

The earth receives about 174 billion megawatts of power at the upper atmosphere as a result of solar radiation [9]. About 30% of the incident solar radiation is reflected back, while the remaining, which amounts to 3.85 x 1024 Joules every year, is absorbed by the atmosphere, oceans and landmasses. **The amount of solar energy that is available to us during an hour is more than the total amount of energy consumed worldwide in an entire year.** But this is a diffused, rather than concentrated, form of energy and the greatest challenge lies in harnessing it.

Heat and light radiation from the sun can be harnessed through the use of semiconductor solar panels. The energy solar radiation excites electrons on these panels and leads to the production of electrical energy.

One of the biggest hurdles in harnessing the energy from the sun is in building cost-effective solar panels. Proper storage of energy is another major obstacle. Solar energy is not available at night but modern energy systems usually assume continuous availability of energy. Thermal mass systems, thermal storage systems, phase change materials, off-grid photovoltaic systems, and pumped storage hydroelectricity systems are some of the ways in which solar energy can be stored for later use.

Even with all of the technological advancements, solar energy technology is still in its infancy. Until we perfect the technology and are able to harness and store solar energy in a viable and cost-effective manner, it won't become a substitution of fossil fuels.

IV. WIND ENERGY

In 2012, the worldwide wind power generation capacity stood at 219 TWh[10]. Wind farms are constructed to harness mechanical energy from the wind and convert it into electrical energy. These wind farms are then connected to electrical power transmission networks for the distribution of power. On average, only 20 to 40 percent of the total energy capacity of a wind farm can be utilized.

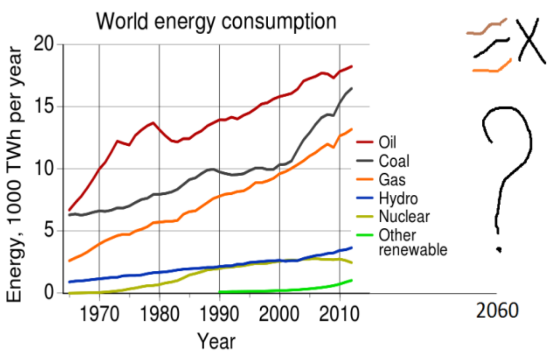

Fig. 4: What will happen after 2060?

The limiting factor in harnessing energy from wind is that wind speed is variable and in most cases the energy from wind can only be effectively harnessed with very high wind speed and consistent heavy winds. These generally occur at higher altitudes. Wind energy also requires large, open expanses of land in order to construct wind farms.

V. BIOFUELS

These include fuel from plant and animal sources. Oil, or ethanol, obtained from plants such as sugarcane, switch grass, algae, poplar, and corn can be used directly or mixed with other fuels such as commercial diesel and gasoline to provide power[20].

The limiting factor in using bio fuels is that a large number of crops need to be grown to harvest the energy trapped in plants. This requires vast areas of fertile land. Additionally, not all plant sources offer a high yield. Experiments are underway to hybridize and genetically alter these crops to make them more robust and increase their yield. Biofuels are very promising for small-scale use as they are low on greenhouse gas emission, are an effective waste management system, and produce little air pollutants.

VI. GEOTHERMAL ENERGY

The interior of the Earth contains a lot of heat. Shallow regions contain hot water, rock and steam. Deeper inside, the magma is intensely hot. This heat can be harnessed [18, 19,7] to produce electrical energy and drive various applications. Harnessing geothermal energy requires no fuel and minimal land. *It is relatively cheap and a very sustainable source of energy since the amount of heat contained in the earth bed is so vast that even if we harness more energy than we require, it will still suffice for millions of years to come.*

VII. ENERGY FROM ANTIMATTER

One of the most complicated theories of producing energy is the idea of using *matter* and *anti-matter* to generate electric power[11]. Anti-matter is the opposite of matter. If matter is comprised of particles, anti matter is comprised of anti-particles. Scientists propose that if matter and anti matter were to collide, they would annihilate one another and release vast amounts of energy. However, this is still a theoretical source of energy. Whether anti-matter exists in some part of the universe and can be harnessed in some way is still a mystery to humankind.

VIII. LIGHTNING ENERGY

Since the late 1980s, there have been several attempts to investigate the possibility of harvesting energy from lightning. While a single bolt of lightning carries a relatively large amount of energy (approximately 5 billion joules or about the energy stored in 145 liters of petrol), this energy is concentrated in a small location and is passed during an extremely short period of time (milliseconds); therefore, extremely high electrical power is involved. It has been proposed [12, 13, 14] that the energy contained in lightning be used to generate hydrogen from water, or to harness the energy from rapid heating of water due to lightning, or to use inductors spaced far enough away so that a safe fraction of the energy might be captured.

A technology capable of harvesting lightning energy would need to be able to rapidly capture the high power involved in a lightning bolt. Several schemes have been proposed, but the ever-changing energy involved in each lightning bolt render lightning power harvesting from ground based rods impractical. Additionally, lightning is sporadic, and therefore energy would have to be collected and stored; it is difficult to convert high-voltage electrical power to the lower-voltage power that can be stored.

IX. OCEANIC ENERGY

The oceans are vast and contain huge amounts of energy in the water currents, and thermal and salinity gradients. The energy from tides and waves can be harnessed to produce electrical energy [15, 16, 17]. The differences in temperature that occur with varying depths can be used to drive heat engines, which in turn produce electric power. The osmotic pressure difference between salt water and fresh water can also be used to generate electricity. Although most of these methods are still in the experimental stages, if researched properly, they can be a breakthrough for mankind. The oceans may well be able to quench our thirst for energy and bag the crown as the king of fuels.
Among many possibilities, the most important part of oceanic energy is tidal energy. Tidal power is the only technology that draws on energy inherent in the orbital characteristics of the Earth–Moon system, and to a lesser extent in the Earth–Sun system. Other natural energies exploited by human technology originate directly or indirectly with the Sun, including fossil fuel, conventional hydroelectric, wind, biofuel, wave and solar energy.

A tidal generator converts the energy of tidal flows into electricity. Greater tidal variation and higher tidal current velocities can dramatically increase the potential of a site for tidal electricity generation.

Because the Earth's tides are ultimately due to gravitational interaction with the Moon and Sun and the Earth's rotation, tidal power is practically inexhaustible and classified as a perpetual renewable energy resource.

X. CONCLUSION

There are various ways of extracting energy from the earth that humankind has discovered and used to its advantage. As the human race evolves, we will continually search for newer, more efficient forms of energy that have the least amount of impact on the environment. At present day, the most economically efficient fuel has proved to be oil. In the future, when the world’s oil reserves are depleted, we will use another source of energy; possibly one that is mentioned above. However, the fact of the matter is that we must be proactive in researching new forms of energy to continue the advancement of civilization and to ensure a high quality of living that we all have grown accustomed to.

Note that all non-fossil fuel technologies together can only provide us a negligible fraction of energy we require. Save fuel, save energy!

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