

Energy and It's Impacts on the Environment

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Abstract

Energy is the most important commodity for a modern society. Therefore, energy is a key ingredient in all sectors of modern economies, and it is a sign of power of a country. In fact, the development of a country is depending on the energy consumption per capita.

The conversion of energy from one form to another (e.g. heat to electricity) often affects the environment in many ways, thus the study of energy is not complete without considering its impact on the environment

Fossil fuels such as coal, oil, and natural gas have been used as the source of energy for centuries. These fossil fuels, however, have adverse effects on environment, namely air pollution, global warming and climate changes. Nowadays, the environmental pollution has reached such high levels that it became a serious threat to plants, wild life, and human health.

Air pollution affects the ozone layer, the oxygen and carbon dioxide cycles. The other serious pollutant in air is carbon monoxide. It is more hazardous than carbon dioxide because it can bind with the red blood cells of the human and affects human organs, especially the brain.

Fossil fuels are mixture of various chemicals, and can carry sulfur and nitrogen compounds as well. These sulfur and nitrogen compounds upon burning produce SO_2 and NO_x which are severe air pollutants. SO_2 and NO_x can be converted to sulfuric acid (H_2SO_4) and nitric acid (HNO_3), respectively, which results in risky acid rains.

Intense research is ongoing on the renewable energy sources (*such as solar, wind, hydro, biomass, geothermal, wave, tide, etc.*) to minimize fossil fuel consumption.

In this paper, adverse effects of fossil fuels on the environmental pollution and the greenhouse effects will be discussed in detail along with hydrogen usage in fuel cells.

Keywords: *Energy, environment, renewable energy, fossil fuels, global warming and climate change.*

1. Introduction

Energy is fundamental demand of our lives and energy is the most important commodity in modern Society. The development of a country is measured in terms of energy consumption per capita.

The conversion of energy from one form to another often affects the environment. Thus the study of energy is not complete without considering its impact on the environment [1,2]

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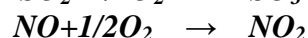
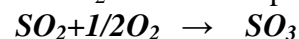
The environmental pollution has reached such high levels that it became a serious threat to plant, wild life, and human health. The largest source of air pollution is the motor vehicles, which have a big part of our lives. Air pollution affects the ozone layer, the oxygen and carbon dioxide cycle.

Today's energy is mostly obtained from fossil fuels (coal, crude oil, natural gas). Only a small fraction is obtained from renewable energy sources (*solar, wind, hydro, geothermal, biomass, waves, tides, etc.*). Renewable energy sources are fairly clean, environmentally friendly and sustainable. Therefore, the efforts to increase the percentages of renewable energy in the total consumption are the main concern in the universities and energy research centers in all over the world.

The main drawbacks of the fossil fuels are:

- 1) They are in limited amount on the globe, and in the next 50 years or so they will be depleted.
- 2) S- and N- heterocompounds in fossil fuels are eventually converted to SO₂ and NO_x acid gases upon burning according to the following simple reactions:

These gases are then converted SO₃ and NO₂ in the atmosphere with the following reactions:



These gases react with H₂O vapor in the atmosphere and are converted to H₂SO₄ and HNO₃, respectively. At the end, these acids precipitate as *so-called* acid rains. Acid rains are not only disaster for human beings, animals and plants they are also disaster for the whole environment.

- 3) Generation of CO₂ upon burning of fossil fuels, which is the main contributor of the greenhouse gases causing global warming, and climate changes [3,4].

It is extremely important that we need clean energy to protect our environment. This could be accomplished by increasing the percent usage of renewable energies. So the focus, today, is on the high efficiencies of energy conversion and on the effect of CO₂ on the global warming with the emphasis of the usage of hydrogen in fuel cells.

2. Global Warming

Any carbon containing organic compound upon burning will generate CO₂. For example, natural gas upon burning will generate CO₂ and H₂O according to the following reaction



This CO₂ in the atmosphere together with other greenhouse gases will form a blanket which will trap the low frequency (high wave length) rays close to the surface of earth, hence will increase the temperature of the earth. CO₂ increase in atmosphere in terms of ppm over the years is given in the **Figure 1**. As can be seen, CO₂ amount is increasing significantly. If no precaution is taken the temperature of atmosphere will rise to a point at which the ice in the poles will melt and most of the islands and seashores will be flooded with water. 78 island countries are under the danger of being submerged. At the same time climate changes will take place as well. In any case, the result is disaster.

Due to this global warming and climate changes, the emission of greenhouse gases must be minimized if we are going to leave a livable environment for the coming generations.

3. What Can Be Done?

Since CO₂ is the end product of all the fossil fuels, the usage of them must be minimized. Hence, alternative energy sources must be sought. The most important remedy is to switch to hydrogen (H₂) energy. Today, H₂ energy usage is not at the desired level due to some technical and economic difficulties. It is believed that very soon these difficulties will be overcome. The main usage of H₂ will be in the fuel cells

4. H₂ Energy and Fuel Cells

Hydrogen is universally accepted as a clean energy because of its high energy density. Usage of H₂ in fuel cells or directly in the combustion engines will reduce the emission of greenhouse gases.

Technically, using hydrogen as a fuel, it is necessary either to compress the gas to a small volume or to liquefy it. Both processes are difficult and costly owing to the chemical and physical properties of hydrogen. Compared with these traditional hydrogen storage processes, metallic and nonmetallic hydrides have also received considerable research interest in recent years. NaBH₄ is the one of the most prospective hydrogen storage materials as it stores 10.8 % hydrogen. In addition to its high hydrogen storage capability, it is also nonflammable, non-toxic in nature and stable in alkaline solution [1].

Hydrogen is generated by the following hydrolysis reaction of NaBH₄ in the presence of a suitable catalyst:



As can be seen, half of the hydrogen produced comes from the water which is a great advantage and make it effective on-board hydrogen generation method for portable PEM fuel cells applications. The reaction product, borate, is environmentally clean and can be recycled for the further production of NaBH₄.

If we use H₂ in fuel cell, we can bypass the 2nd law of thermodynamics where the efficiency is limited by *Sadi Carnot Cycle* [5]. With that, not only we will have a clean environment, the efficiency is much higher as compared to conventional mode. That is, in conventional mode

Chemical Energy → Heat energy → Mechanical Energy → Electrical Energy

As can be seen there are some intermediate steps, hence lower efficiencies.

By using fuel cell, however, it is possible to convert the chemical energy directly into electrical energy without intermediate steps as follows:

Chemical Energy → Electrical Energy

In this case, **Carnot Cycle Limitations** are by-passed, and the final product is water only. For this reason, the future of fuel cells is very bright and H₂-economy will probably dominate in near future.

Lastly we must emphasize that the cleanest energy is the **saved** energy

5. Conclusions

- a. We must focus on energy *savings for a clean environment*.
- b. Increasing the efficiencies of energy conversion must be prime importance.
- c. Usage of renewable energies should be increased in order have a clean environment.
- d. One should understand that the climate changes is not local, but a global problem.
- e. Recently, intensive studies have been carried out on hydrogen energy. If some problems in hydrogen technology overcome, many things will change in our life. Hydrogen will replace petroleum. By using hydrogen in fuel cells, electrical energy can be produced with high efficiency of more than 65 %

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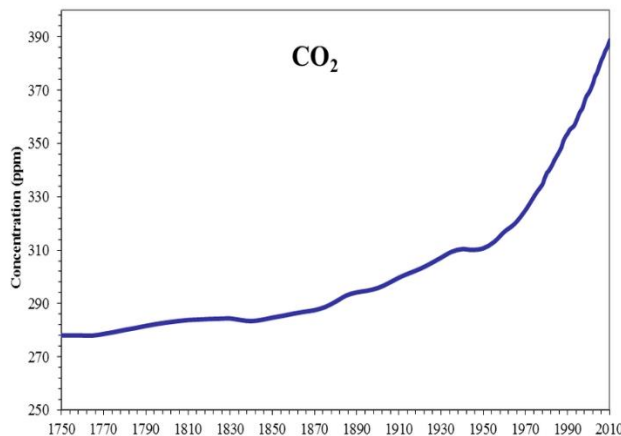


Figure 1-. CO₂ increase in atmosphere in terms of ppm over the years