University of Belgrade
Technical Faculty in Bor

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and Industry of Serbia

XV International Mineral Processing & Recycling Conference

IMPRC
INTERNATIONAL MINERAL PROCESSING & RECYCLING CONFERENCE

Proceedings

Editors:
Jovica Sokolović
Milan Trumić

17-19 May 2023 | Belgrade SERBIA

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THE IMPACT OF EXPLOITATION OF PRIMARY AND ALTERNATIVE ENERGY SOURCES ON THE ENVIRONMENT

A. Stojić[1#], D. Tanikić[1], E. Požega[2]
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ABSTRACT – Primary sources of energy are the foundation of all industrial processes, and their exploitation is crucial for the functioning and maintenance of the modern world. However, the majority of primary energy sources come from non-renewable sources, such as coal, oil, and gas, whose exploitation can have negative consequences for the environment. This paper will investigate how the exploitation of primary energy sources affects the environment and which are the negative consequences for the air, water, soil, and animal life. Additionally, measures that can be taken to reduce the impact of primary energy source exploitation on the environment will be presented, and alternatives that can be used as a replacement for traditional energy sources will be considered. The aim of this paper is to assess the impact of the exploitation of primary energy sources on the environment, in order to gain a better understanding of the importance of sustainable development and environmental protection for the future.

Keywords: Energy, Environment, Exploitation, Sustainability, Modern World.

INTRODUCTION

During industrialization and with the increase in population on Earth, as well as the increase in transportation, the demand for energy has also increased. This has led to an increased use of fossil fuels, and the world economy currently relies on them. Energy and environmental problems are closely related, since it is nearly impossible to produce, transport, or consume energy without significant environmental impact.

The environmental problems directly related to energy production and consumption include air pollution, climate change, water pollution, thermal pollution, and solid waste disposal. The emission of air pollutants from fossil fuel combustion is the major cause of urban air pollution. Fossil fuels burning is also the main contributor to the emission of greenhouse gases. Diverse water pollution problems are associated with energy usage. One of the main problems are oil spills. In all petroleum-handling operations, there is a finite probability of spilling oil either on the earth or in a body of water. Coal mining can also pollute water.

Changes in groundwater flow produced by mining operations often bring otherwise unpolluted waters into contact with certain mineral materials which are leached from the soil and produce an acid mine drainage. Solid waste is also a by-product of some forms of energy usage. Coal mining requires the removal of large quantities of earth as well as coal.

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PRIMARY AND ALTERNATIVE SOURCES OF ENERGY

Scientists define energy as the ability to do work. People use energy to walk and ride a bicycle, to move cars along roads and boats through water, to cook food on stoves, to make ice in freezers, to light our homes and offices, to manufacture products, and to send astronauts into space… [1] Energy can be converted from one form to another. For example, the food you we eat contains chemical energy, and our body stores this energy until we use it as kinetic energy during work or play. The stored chemical energy in coal or natural gases and the kinetic energy of water flowing in rivers can be converted to electrical energy, which can be converted into the light and heat. There are many different sources of energy, but they can all be divided into two categories. Renewable energy sources and nonrenewable energy sources. Renewable and nonrenewable energy sources can be used as primary energy sources to produce useful energy such as heat, or they can be used to produce secondary energy sources such as electricity and hydrogen. Energy transition from one fuel source to another are accompanied with each phase of economic development. The current energy mix is dominated by fossil fuels (coal, oil, and natural gas). However, the beginning of a new energy era in the twenty-first century is already in progress as there is a noticeable transition of energy sources away from fossil fuels towards renewable energy. The major factors driving this transition include but are not limited to environmental concerns on climate change, limited nature of fossil fuel and supplies, prices, and advancement in technology. Society will sooner or later adopt renewable energy since fossil fuels have limited supply and are only formed over a long period of geological time. [1] Fossil fuel reserves may be extended by developing new methods and technologies for extraction, but the need to decrease the negative effects of fossil fuel on climate change is a more immediate problem than the depletion of fossil fuel. However, it has been argued that renewable energy (i.e., solar power, hydro power etc.) is fairly developed majorly because the most of its application is in areas of electricity generation. Although renewable energy is a cleaner form of energy, the dark sides of renewable energy sources have not received considerable attention yet. This study analyses the negative impacts of the exploitation of renewable energy sources on the environment, society and the global economy.

Alternative energy sources have become a popular topic of discussion in recent times, as the world looks for ways to reduce its carbon footprint and combat climate change. The use of solar, wind, and hydropower is on the rise, with many countries investing heavily in renewable energy infrastructure. These sources of energy are not only environmentally friendly but also have the potential to provide a sustainable source of energy for the future. However, their implementation also presents challenges such as high upfront costs, intermittency, and limited scalability. Despite these challenges, the growing demand for renewable energy makes it clear that alternative energy sources will play a significant role in the energy mix of the future. The benefits of alternative energy sources go beyond environmental considerations. They can also lead to energy independence, job creation, and economic development in local communities. In addition, the use of alternative energy sources can reduce the dependence on finite resources and volatile global energy markets.

IMPACT OF PRIMARY AND ALTERNATIVE ENERGY SOURCES EXPLOITATION ON THE ENVIRONMENT

The exploitation of primary energy sources, including fossil fuels, hydroelectric power, nuclear energy, and others, has a significant impact on the environment. The process of energy exploitation and production often leads to air, water, and soil pollution, which can have harmful consequences for human health and animal species.[2] For example, burning of fossil fuels such as coal, oil, and gas releases large amounts of carbon dioxide into the atmosphere, which can lead to global warming and climate change. Nuclear energy exploitation can also have dangerous consequences for the environment, such as possible nuclear accidents and nuclear waste that can be harmful to humans and animals. Hydroelectric power can have a significant impact on ecosystems, including changes to river flows and the impact on animal species that live in those river systems. The installation of hydroelectric power can also have a serious impact on the environment, including the destruction of animal habitats and migration routes. In this sense, there is a growing need to switch to renewable energy sources, such as solar energy, wind energy, and geothermal energy. However, although these energy sources are clean and renewable, their exploitation can have negative consequences on the environment, including the impact on wildlife, the local economy, and communities living near these energy sources. Therefore, it is important to consider the impact of primary energy source exploitation on the environment and to develop sustainable ways of energy production and use that minimizes their impact on the environment.

The dark sides of renewable energy refer to the negative impacts from the exploitation of renewable energy sources. These negative impacts can be broadly categorized into environmental and socio-economic impacts. In order to harness energy from renewable energy sources, a lot of metals and materials are required. A car battery weighs about 1,000 pounds. Fabricating one requires digging up, moving and processing about 500,000 pounds of raw materials. [2] All the mineral products and metals needed to make wind turbines and solar panels rely on mining and these mining activities, from the processing stage to the finishing of the final products, are powered by fuels derived from crude oil. To meet the goals to go “green” may likely cause a rare earth emergency as increase in demand for green energy requires a corresponding increase in mining for rare solid minerals. These minerals are used for the manufacturing of components required for wind turbines, solar panels, batteries, etc. Most of these minerals are harmful and may cause respiratory problems and irritation when contacted, ingested or inhaled. A spike in demand for metals could drain the planet’s reserves. About 60% of cobalt comes from the Democratic Republic of Congo, whose which has been charged for using child labour in unsafe mines. The production level of lithium and nickel would increase to about 280% and 136% respectively if renewable energy was to contribute 100% of the energy mix [2]. Recycling is recommended but also expensive. Recycled cobalt cost 5 times more than newly mined cobalt. In 2019, two dams collapsed in Vale’s Brumadinho mine, Brazil, killing 247 workers and local residents, with 23 still missing. This increase in the exploitation of rare solid minerals and the accidents that occur therefrom are directly or indirectly linked to the drive to increase renewable energy utilization.

Huge wastes are left during decommissioning of renewable energy plants. The average lifespan of a wind turbine is 20 to 25 years. Researchers estimate the U.S. will

have more than 720,000 tons of blade material to dispose of over the next 20 years. Solar panels generally last about 20-30 years. When solar panels are damaged due to storms or hurricanes, they leave a large amount of waste. There will be an estimated 60 million tons of cumulative solar photovoltaic waste by 2050. Added to the waste footprint left on the environment are issues of noise pollution, aesthetic and visual impact, air and water quality reduction and natural resource depletion which renewable energy mix share in common with the fossil fuel family. [2]

Raw materials for wind and solar energy equipment are mined in more than 60 countries. Mineral's extraction already exact significant cost on people and the environment, fueling conflict and human rights violations, massive water pollution, and wildlife and forest destruction. Wind farms kill birds and bats, and affect fishing activities when they are built offshore, while solar power plants ignite birds killing about 1,000 birds per year [3]. According to office of Energy Efficiency and Renewable Energy, a US Department of Energy Agency, wind energy can have adverse environmental impacts, including the potential to reduce, fragment or degrade habitat for wildlife, fish, and plants [4]. Land use estimate for solar plants is averagely 3.5 to 10 acres per megawatt for utility-scale PV systems, while the estimate is between 4 and 16.5 acres per megawatt for Concentrated Solar Plant (CSP). A report published by Union of Concerned Scientists in the United States, on the Environmental Impact of Solar Power shows that CSP plants that use wet-recirculating technology with cooling towers withdraw between 600 and 650 gallons of water per megawatt-hour of electricity produced [5]. Hydro energy sources cause environmental and social threats such as damage to wildlife habitat and water quality, obstruction of fish migration pathways and cause limitations to the recreational benefits of rivers. Dams constructed for hydro energy can also create division between nations, an example being the current tension between Egypt and Ethiopia regarding the dam constructed by Ethiopia on the Nile river for generation of electricity.

Time is not on the side of fossil industries and this represents a significant threat to the global economy. The city of Berkeley, California, U.S. has banned new natural gas hookups in new buildings, and there are dozens of other cities exploring similar prohibitions. There would be a big challenge if financial institutions stop funding fossil fuel companies or projects. According to John Fullerton in his article "Big Choice", some of the wealthiest companies and some countries with the biggest sovereign wealth funds in the world have huge fossil fuel assets on their balance sheets [4]. A shift from these fossil assets would imply at least 20 trillion dollars in stranded assets which would trigger a financial collapse. Such financial collapse would be greater than the 2008 financial collapse caused by the stranding of 2.7 trillion USD mortgage assets. If this occurs, it will possibly lead to the complete loss of the oil, gas and coal industries, power producers, insurance companies and banks that hold loans for these industries.

The dark sides of renewable energy utilization come with significant cost implications. For instance, as stated above, windmills and photovoltaic (PV) installations result in huge wastes during decommissioning, at the end of their useful life. There are significant costs associated with managing the resultant wastes, either through recycling or complete disposal. The economic impacts arising from the damage to the ecosystem (fish, birds, bats, impact on land and water, etc.) are huge if reversible, and may sometimes be

irreversible. The depletion of the rare solid minerals exerts pressures on other sectors of the economy that compete for these minerals. In terms of human health, coming in contact with some of these minerals and the collapse of renewable energy facilities are hazards that could lead to illness, accidents and/or deaths, with significant cost implications.

MEASURES TO REDUCE THE NEGATIVE IMPACT OF PRIMARY AND ALTERNATIVE ENERGY SOURCES EXPLOITATION ON THE ENVINROMENT

There are several measures that can be taken to reduce the negative impact of primary energy source exploitation on the environment. [5] One of the most effective measures is to shift towards renewable energy sources such as solar, wind, and geothermal power. This will not only reduce the emissions of greenhouse gases but also reduce the dependence on non-renewable sources of energy. Another measure is to improve energy efficiency by using energy-saving technologies and practices. This includes using energy-efficient appliances, buildings, and transportation systems, as well as implementing energy management systems in industries and businesses. Regulations and policies can also play a crucial role in reducing the negative impact of primary energy source exploitation on the environment. Governments can implement measures such as carbon taxes and emissions trading schemes, as well as regulations to limit the environmental impact of industries and energy producers. Finally, public awareness and education are essential in reducing the negative impact of primary energy source exploitation on the environment. By promoting sustainable lifestyles and educating the public on the importance of reducing energy consumption, we can collectively contribute to reducing the environmental impact of primary energy source exploitation.

CONCLUSION

Renewable energy has the potential to minimize the overall impact that the energy industry has on the environment, especially its contribution to climate change. However, the renewable energy industry causes reasonable negative impacts on people and the environment. Such impacts, arising from the activities in the industry, have significant financial implications. The technology to harness energy from renewable sources have only been well developed for the electricity market. There is currently a strong drive to increase renewable energy electricity generation capacity and to expand the scope beyond electricity generation. Such increase in capacity and increase in scope will place an increasing demand for rare solid minerals and invariably impact negatively on the environment, society and affect the economics of production. Mitigating these impacts will require a proper plan and policy to control supply, regulate decommissioning and encourage recycling of renewable energy products which may also affect the cost of supply in the long run.

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