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Sustainable Development and Renewable Energy: A Crucial Review

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ABSTRACT: ***Achieving answers to environmental issues that we confront now needs long-term prospective activities for sustainable development. In this respect, renewable energy resources seem to be the one of the most efficient and practical alternatives. That is why there is an intimate link between renewable energy and sustainable development. Anticipated patterns of future energy consumption and associated environmental effects (particularly on acid precipitation, stratospheric ozone depletion and the greenhouse effect) are extensively addressed in this article. Also, possible answers to existing environmental issues are highlighted along with renewable energy technology. The connections between renewable energy and sustainable development are explained using practical examples, and an exemplary example is given. Throughout the article various problems related to renewable energy, environment and sustainable development are addressed from both present and future perspectives. It is anticipated that the findings and suggestions made in the current research will be helpful to energy scientists and engineers and policy makers.***

KEYWORDS: Energy Use, Environment, Pollution, Renewable Energy, Sustainable Development,

1. INTRODUCTION

Energy is the convertible currency of technology. Without energy the entire fabric of civilization as we know it would collapse; the impact of a 24-h interruption in electrical supply to a metropolis illustrates how completely reliant we are on that especially valuable type of energy. Computers and elevators fail to work, hospitals fall to a care and maintenance level and the lights go out. As populations expand, often faster than the usual 2 percent, the demand for more and more energy is compounded. Enhanced lifestyle and energy consumption grow together and the affluent industrialized economies which comprise 25 percent of the world's population use 75 percent of the world's energy supply [1].

Ultimately, of course, all energy supplies on Earth derive from the sun and solar energy provides a continuous stream of energy which warms us, causes crops to grow via photosynthesis, heats the land and sea differentially and so causes winds and consequently waves and, of course, rain leading to hydropower. Tidal rise and fall is the consequence of gravitational attraction of moon and sun and geothermal heat the result of radioactive decay deep in the Earth[2]. All are potential sources of energy but while the physics is known, it does not follow that given enough research money is put into the project an engineering solution should be discovered properly. The scientific knowledge of the process is the simple part; it is the engineering that is tough to execute.

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The main objective of this paper is to discuss the environmental problems such as acid precipitation, stratospheric ozone depletion, and greenhouse effect and the anticipated patterns of future energy use and consequent environmental impacts and to identify some solutions to the current environmental problems, focusing on renewable energy sources and technologies and the linkage between renewable energy and sustainable development[3].

1.1. Environmental issues

During the last two decades the danger and reality of environmental deterioration have grown increasingly evident. Growing evidence of environmental issues is due to a mix of many reasons because the environmental effect of human activities has increased significantly because of the sheer growth of global population, consumerism, industrial activity, etc. Aside from advancements in environmental research, changes in industrial processes and structures have led to new environmental concerns[4]. For example, in the energy sector, significant changes to the road transport of industrial products and to individual travel by automobiles has led to a rise in road traffic and therefore a shift in attention given to the impacts and sources of NOx and volatile organic compound (VOC) emissions. A comprehensive information on these gaseous and particulate pollutants and their effects on the environment and human bodies has been recently provided by Dincer [5].

1.2. Acid rain

This is a form of pollution depletion in which pollutants produced by the combustion of fossil fuels, particularly from both stationary and mobile sources such as smelters for nonferrous ores, industrial boilers, and transportation vehicles, are transported over great distances through the atmosphere and deposited via precipitation on the Earth on ecosystems that are exceedingly vulnerable to damage from excessive acidity. This acid rain deposition was shown to be primarily due to emissions of SO2 and NOx and such gases react with water and oxygen in the atmosphere and result in acids such as sulfuric and nitric acids. It is thus apparent that the solution to the problem of acid rain deposition needs an adequate management of SO2 and NOx [6].

1.3. Stratospheric ozone depletion

It is widely known that the ozone present in the stratosphere, approximately between altitudes of 12 and 25 km, performs a natural, equilibrium-maintaining function for the Earth, via absorption of ultraviolet (UV) light (240±320 nm) and absorption of infrared radiation [8]. A worldwide environmental issue is the distortion and regional depletion of the stratospheric ozone layer which has been proven to be caused by the emissions of CFCs, halons (chlorinated and brominated organic compounds) and NOx. Ozone depletion in the stratosphere may lead to higher amounts of harmful UV light reaching the earth, causing increased rates of skin cancer, eye damage and other harm to many biological species.

Energy- and non-energy related activities are only partly (directly or indirectly) responsible for the emissions which contribute to stratospheric ozone depletion[5]. CFCs, which are used in air

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conditioning and refrigerating equipment as refrigerants and in foam insulation as blowing agents, and NOx emissions which are produced by fossil fuel and biomass combustion processes, natural denitrification, nitrogen fertilizers, and aircrafts play the most significant role in ozone depletion. An significant issue in such a CFC ban is the need to share equitably the economic costs resulting from the prohibition, especially with regard to emerging nations, some of which have invested substantially in CFC-related technology. In order to remove or reduce the effects of the NOx emissions, the solutions stated in the preceding section may be applied appropriately.

1.4. Global climate change (greenhouse effect)

Although the term greenhouse effect has generally been used for the role of the whole atmosphere (mainly water vapor and clouds) in keeping the surface of the Earth warm, it has been increasingly associated with the contribution of CO2 (currently, it is estimated that CO2 contributes about 50 percent to the anthropogenic greenhouse effect). Potentially the most significant environmental issue related to energy consumption is the greenhouse effect, commonly known as global warming[7]. Increasing atmospheric concentrations of greenhouse gases are increasing the way in which these gases trap heat emitted from the Earth's surface, thus raising the surface temperature of the Earth. The effect of such a phenomenon may be severe, including flooding of coastal communities, a shift of fertile zones for agriculture and food production toward higher latitudes, and a diminishing supply of fresh water for irrigation and other important purposes. Such effects may endanger the existence of whole communities[8].

1.5. Potential solutions to environmental issues

Recently, some potential solutions to the current environmental problems associated with the harmful pollutant emissions have evolved, including Renewable energy technologies, Energy conservation (efficient energy utilization), Cogeneration and district heating, Energy storage technologies, Alternative energy dimensions for transport, Energy source switching from fossil fuels to environmentally benign energy forms, Coal cleaning technologies, Optimum monitoring and evaluation of energy indicators, Policy integration, Recycling, Process change as well as sectoral shiftiest, Acceleration of forestation, Carbon or fuel taxes, Materials substitution, Promoting public transit, Changing living patterns, Increasing public awareness, Education and training[9].

1.6. Renewable Energy Resources Technologies

The operating and financial attributes of renewable energy technologies, which include modularity and flexibility, low operating costs, are considerably different than those for traditional, fossil based technologies, whose attributes include large capital investments, long implementation lead times, and operating cost uncertainties, regarding future fuel costs. The total advantages of renewable energy technologies are frequently not fully understood and therefore they are often judged to be not as cost effective as conventional technologies[5]. In order to evaluate fully renewable energy sources, however, certain of their advantages that are frequently not recognized must be accounted for. Renewable energy technologies, in general, are often viewed as direct

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replacements for current technologies such that their benefits and costs are conceptualized in terms of evaluation techniques established for the existing technologies. Such power generating units typically offer greater flexibility in incremental supplies than big, lengthy lead-time units such as nuclear power plants.

1.7. Sustainable Development

A secure supply of energy resources is widely acknowledged to be a necessary but not sufficient condition for growth within a civilization. Furthermore, sustainable development requires a sustainable supply of energy resources that, in the long run, is easily and sustainably accessible at affordable cost and can be used for all necessary activities without creating negative social effects. Supplies of such energy resources as fossil fuels and uranium are widely recognized to be limited; other energy sources such as sunshine, wind and falling water are usually regarded renewable and thus sustainable over the relatively long term. Wastes and biomass fuels are also generally regarded as sustainable energy sources. In general, the consequences of these assertions are diverse, and depend on how sustainable is defined [10].

While not all renewable energy resources are intrinsically clean, there is such a variety of options that a transition to renewables done effectively in the framework of sustainable development may offer a much cleaner system than would be possible by increasing restrictions on conventional energy. Furthermore, being by nature site-specific, they promote a power system decentralization and locally appropriate solutions more or less independent of the national network. It allows people to detect positive and negative externalities of energy use. Consequently, the small size of the equipment typically makes the time needed from original design to operation short, allowing more flexibility in reacting to unexpected growth and/or changes in energy consumption.

2. DISCUSSION

2.1. Importance of Renewable Energy Resources and Technologies for Sustainable Development

The utilization of renewable energy resources and technology is a major component of sustainable development [19]. There are three major causes behind it as follows.

- They have significantly less environmental effect compared to other sources of energy because there are no other energy sources with zero environmental impact. There are a number of options available in practice that a move to renewables may offer a much cleaner energy system than would be possible by increasing restrictions on conventional energy.
- Renewable energy resources cannot be exhausted unlike fossil fuel and uranium resources. If utilized properly in suitable and efficient applications, they may offer a dependable and sustainable supply energy nearly forever. In contrast, fossil fuel and uranium supplies are limited and may be reduced by extraction and use.
- They support power system decentralization and locally applicable solutions moreor less independent of the national network, thereby increasing the flexibility of the system and the economic power supply to tiny isolated settlements. That is why several different

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renewable energy technologies are potentially accessible for application in metropolitan settings.

2.2. Essential Criteria for Sustainable Developments

There are many important factors that may assist in establishing a successful sustainable development in a community. Such parameters may be described as follows:

- Public awareness: This is the first stage and extremely important in making the sustainable energy program effective. This should be carried out via the media and by public and/or professional groups.
- Information: Necessary informational input on energy consumption, environmental effects, renewable energy resources, etc. should be given to public via public and government channels.
- Environmental education and training: This may be done as a complete element of the information. Any method which does not have an integrated education and training is likely to fail. That is why this may be regarded as the main requirement for a sustainable energy program. For this reason, a broad spectrum of specialist agencies and training facilities should be made accessible to the public.
- Innovative energy strategies: These should be given for a successful sustainable energy program and, therefore, need the efficient distribution of information, based on innovative techniques and consisting of public relations, training and counseling.
- Promoting renewable energy resources: At order to accomplish ecologically benign sustainable energy programs, renewable energy sources should be encouraged in every step. This will provide a solid foundation for the short- and long-term plans.
- Financing: This is a very significant instrument that can be utilized for achieving the primary objective and will expedite the deployment of renewable energy systems and technologies for sustainable energy development of the nation. Some nations, e.g., Germany, use the assistance a different manner and simply exempt the individuals who use such systems and technology from some part of their taxes.
- Monitoring and evaluation tools: In order to assess how effectively the program has been executed, it is of significant significance to monitor each stage and analyze the data and results collected. In this respect, suitable monitoring and assessment techniques should be utilized.

3. CONCLUSION

Renewable energy resources and their use are closely linked to sustainable development. For society to achieve or attempt to obtain sustainable development, considerable effort should be dedicated to finding sustainable energy supplies in terms of renewables. In addition, environmental issues should be addressed. The following concluding comments may be made from this study:

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- There are a lot of environmental issues that we face today. These issues cover a constantly increasing spectrum of pollutants, dangers and ecological degradation across ever larger regions. The most important ones are acid precipitation, stratospheric ozone depletion, and global climate change.
- Potentially the most significant environmental issue related to energy use is the greenhouse effect. Increasing atmospheric concentrations of greenhouse gases are increasing the way in which these gases trap heat emitted from the Earth's surface, thus boosting the surface temperature of the Earth and as a result raised sea levels.
- Recently, a range of possible remedies to the present environmental issues connected with the hazardous pollutant emissions has emerged. However, renewable energy seems to be one of the most significant answers.
- Renewable energy technologies, in general, are often viewed as direct replacements for current technologies such that their benefits and costs are conceptualized in terms of evaluation techniques established for the existing technologies. For example, solar and other renewable energy technologies may offer modest incremental capacity increases to the current energy systems with short lead times. Such power generating units typically offer greater flexibility in incremental supplies than big, lengthy lead-time units such as nuclear power plants.
- Development of innovative renewable energy technologies that serve as cost-effective and ecologically responsible alternatives to traditional energy production. Technical and commercial potential exists to substantially enhance the present contribution of renewable energy sources to country's energy needs by the year 2000, resulting in employment and economic benefits many times the R&D expenditure. Many government energy organizations and agencies realize this possibility and assist their renewable energy industry's attempts to harness near-term economic potential.
- In order to achieve the energy, economic and environmental advantages that renewable energy sources provide, an integrated set of activities such as R&D, technology evaluation, standards creation and technology transfer should be performed as needed.
- Sustainable development requires a sustainable supply of energy resources that, in the long run, is easily and sustainably accessible at affordable cost and can be used for all necessary activities without creating negative social effects. Supplies of such energy resources as fossil fuels (coal, oil, and natural gas) and uranium are widely recognized to be limited; other energy sources such as sunshine, wind and falling water are usually regarded renewable and thus sustainable over the relatively long term.
- The exploitation of renewable energy resources and technology is a crucial component of sustainable development owing to the facts:
    a. considerably less environmental effect,
    b. greater flexibility,
    c. being undeleted, and
    d. decentralization potential.

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- Increasing global population demands the concept and effective implementation of sustainable development.

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