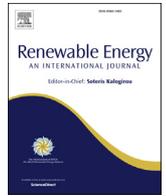




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Sustainable approaches for algae utilisation in bioenergy production

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ABSTRACT

Rapidly increasing global energy consumption has caused depletion of fossil fuels, leading to the search of alternative energy resources. One of the potential solutions is utilizing algae biomass as the source of bioenergy. To fulfil the high biomass demands for biofuel production, it is of pivotal importance to develop feasible technologies to enable economic, efficient and high density cultivation of algae. Algae can be cultivated in either open or closed systems in the presence of nutrients and light intensity. The maximum yield, growth rate and composition of algae can be optimized according to cultivation conditions, such as temperature, pH, light intensity and nutrient concentration. The potential types of algae in contributing carbohydrate and lipids to produce biofuel such as biodiesel, bioethanol and bio-gas are reviewed. Economic feasibilities of algae based fuel production are discussed based on Life Cycle Analysis. Current challenges and future prospective are also presented to realize the use of algae as a feed-stock for commercial and cost effective fuel production.

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1. Introduction

Over decades, the worldwide energy consumption continues to rise, especially in developing countries. Large amount of energy consumed in developed countries is significant, as the emissions increase in case of petroleum derived fuel use. Currently, most of the energy used for daily activities is non-renewable, in other words, they are produced from fossil fuels. Fossil fuels such as carbon, natural gas and petroleum are commonly used in the transportation and energy sector to fulfil the high energy demands of ongoing industrialization, economic growth and rising

populations. It is found that vast amount of greenhouse gases released in processing fossil fuel will trap heat and hasten up the phenomenon of global warming [1]. The greenhouse effect may cause the melting of glaciers and ice sheets, raising the sea level due to thermal expansion and sea surface warming, which affects the ecosystem indirectly.

According to the International Energy Agency (IEA), an estimation of 9500 Million tonnes of oil equivalent (Mtoe) was consumed as fuel from 1971 to 2014. In the year 1971, the total consumption was 4661 Mtoe, where the consumption in the Organisation for Economic Cooperation and Development (OECD) countries stood for 60.3% followed by non-OECD countries like the Europe and Eurasia countries (13.6%) and minor percentages occupied by China (7.8%), Asia (6.3%), non-OECD Americas (3.6%), Africa (3.7%) and Bunkers (4.0%). However, the total amount of consumption had significantly increased to 9425 Mtoe in year 2014. Among the countries, consumption in China and Asia had increased to 21.2%

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