Artur PAWŁOWSKI, Lucjan PAWŁOWSKI*

CAN BIOFUELS BE SUSTAINABLE SOURCE OF ENERGY

Abstract: Effect of biofuel on sustainable development paradigms is discussed. It was found that biofuels may be often characterized by low energetic efficiency. In some cases the amount of energy used to production of biofuels is higher than energy obtained by its combustion.

Plantation of crops for biofuels causes an increases of food price and has negative impact on the environment and what is more the use of biofuels obtained from crops often does not lead to the reduction in CO_2 emission.

INTRODUCTION

Raising an awareness of the possibility of exhausting the earth resources necessary for the functioning of the human civilization has led to the creation of the sustainable development concept, which was first formulated in the WCED report (1987). Its primary aim was to create such development, which would satisfy the living requirements of today's generations without depriving their future generations of opportunities to meet their needs.

Sustainable development deals with almost all areas of human activities, setting trends for civilization development (Pawłowski 2013, Papuziński 2013). Therefore, in 2000 the United Nations Millennium Development Goals were adopted, which highlighted the need to secure both intergenerational justice and also intragenerational justice. The first relates to the necessity of conservation of resources and the quality of the environment satisfying, at the same time, the needs of future generations. When it comes to intragenerational justice, it is connected with determining the basic living conditions that should to be satisfied for the current generation, including the assurance of equitable access to the Earth's basic resources, especially food and safe water.

The problem is that the dominating political and economic system in today's world favours increasing exploitation of all resources which are exhaustible

* Faculty of Environmental Engineering, Lublin University of Technology, Poland

(Kossecki et al. 2013, Dowbor 2013, Prandecki et al. 2013, Pawłowski 2013) and the most important among them are primary energy resources.

At the present levels of consumption, the amount of oil is estimated to last for about 40–50 years, natural gas for about 60–70 years, and coal for about 140–150 years. The problem of fossil fuel depletion is real and present; however, more attention is paid to global warming, which is caused by the increase in atmospheric CO_2 concentrations resulting from fossil fuel combustion. The IPCC reports predict that if we do not refrain from burning fossil fuels, the climatic consequences will be serious. Although it is widely claimed that climate change is going to occur in the face of enormous costs associated with the introduction of a low-carbon economy (Pieńkowski 2012, Ledo et al. 2011). Moreover, it is worth noting Lindzen's work (Lindzen 2010), which questions the scale of the IPCC's predicted climate change.

Energy supply affects all aspects of human life: social, economic and environmental including access to water, food production, the health of the human population, education and even gender related issues. Therefore, the provision of energy for our civilization is one of the key tasks in the implementation of the sustainable development (Pawłowski 2009, Wall 2013).

Focusing an energy policy only on counteracting CO_2 emissions threatens global sustainable development. One important sustainable development paradigm is intragenerational justice demanding that all people should have equal access to the basic goods, which are essential for living, one of which food is the most important example. Although the production of grain is growing approximately 1% annually it does not keep up with the rapid rate of world population growth 1.1% (USDA 2006, PRD 2007).

It turns out that the commitment to introduce a 10% minimum share for biofuels in transport by 2020, adopted by the EU in 2009, leads to a significant threat to food supply with a questionable impact on reducing CO_2 emissions (Bowyer et. al. 2012, Mandit et. al. 2010) and affect quality of life in some parts of the world, especially developing nations (Krajewski 2013, Sztumski 2013, Venkatesh 2013, Makarewicz-Marcinkiewicz 2013, Cizler 2013).

Renewable energy sources are extremely important for energy supplies. These include solar energy, exploited both as thermal energy as well as electricity generated in photovoltaic cells, wind energy, hydropower and tidal power, geothermal energy and energy derived from biomass. In a number of countries, measures have been taken to increase the use of biomass for energy generation (Dasgupta et al. 2011, Shan et al. 2012, Pimentel 2012, Pieńkowski 2012, Duran et al. 2012, Wall 2013). The use of biomass for energy generation is the most controversial. Extensive use of biomass sourced from agricultural crops is often incompatible with the sustainable development principle, and the aim of the present paper is to demonstrate it.

Biofuels may be often characterized by low energetic effectiveness. Pimentel from Cornel University conducted a research according to which the amount of energy used to production of bioethanol is higher than energy obtained by the combustion of ethanol in car engines.

Therefore, in the process of ethanol production about 29% more energy is used for its production in comparison with energy obtained the combustion of produced ethanol from crop, 45% from grass and 57% from wood.

When it comes to the production of biodiesel the situation is similar. Its production from soy requires 27% more energy than energy obtained from the combustion of produced biodiesel. As for the production of biodiesel from sunflower seeds, it uses up to 118% more energy.

In the following parts of our paper we are going to show the effects of the production of biofuels on the environment having regard to greenhouse effect, and we will characterize threats of agricultural crops used to the production of biofuels in order to provide especially poor countries with food.

1. BIOFUEL AND THE ENVIRONMENT

Biofuel promotion is based on the mistaken assumption that during their combustion only as much CO_2 is released as the plants absorbed earlier. This simplistic reasoning does not take into account the entire biofuel production cycle. What is more, the changes in the land use and the energy expenditure for the cultivation and processing of biomass into biofuels are omitted from these estimates.

In developing countries, tropical forests underwent deforestation and in their place crops designated for biofuels were cultivated. From the research conducted by Danielsen and his colleagues it appears that CO_2 absorption by the tropical forests is significantly greater than the cultivated plants in their place used for the production of biofuels. Converting rainforests and peat lands for the production of biofuels leads to additional CO_2 emission in an amount of about 55 Mg of CO_2 per hectare per year for a period of about 120 years. Thus, the use of biofuels obtained from crops often does not lead to the reduction in CO_2 emissions. The tropical forests are the habitat for more than half of the terrestrial species. The most endangered are forests in south-east Asia.

Large single crop plantations, which we usually deal with in the case of biofuel crops, require large amounts of herbicides and pesticides, which then penetrate into the groundwater contaminating it. Examples of the negative impact of pesticides are soya bean crops in Brazil. The pesticides and herbicides, used on a large scale, threaten the Pantanal wetland area (WWF, 2003) which is one of the most important areas for hundreds of bird species, mammals and reptiles (Junk and Cunha 2005).

The 20,000 hectare sugar cane plantation intended for ethanol production may constitute one of the examples. It is located in the Tana River Delta in Kenya. With a planned uptake of 1,680 m^3 of water/min, representing about 30% of the river flow rate, it poses a serious threat to the local ecosystem, habitat for 345 species of water birds and marsh birds.

Additionally, in order to produce a biofuel e. g. bioethanol from corn, energy is essential for cultivation, production of fertilizers, plant collection, processing into fuel during fermentation and distillation. Using LCA technique, it was revealed that the amount of CO_2 released per unit of energy obtained from bioethanol produced

from corn is higher by as much as 60% compared to the amount of CO_2 released during the combustion of fuels derived from crude oil (Pimentel 2012). Even in the case of bioethanol production from sugar cane in Brazil, where the biofuel production is in the most developed stage and the remaining biomass is fully used, for instance stalks are used in the production of heat, it has not been possible to reduce CO_2 emissions per unit of output energy below that of the emissions from liquid fuels derived from crude oil.

In the case of Brazil, the development of bioethanol production from sugar cane allowed for the creation of about 700,000 new jobs, which can be regarded as a positive social effect which increases social sustainability. The development of ethanol production has ensured Brazil's independence from imported liquid fuels, and the price of energy from ethanol is competitive with petrol prices. Therefore, it can be said that in the case of Brazil it has succeeded in providing a sustainable supply of liquid fuel for transport; however, without decreasing CO_2 emissions. It should be taken into consideration that this is an exception.

The production of liquid biofuels for transport purposes also has a negative impact on the aquatic environment due to high water consumption used for both crop irrigation and in treatment process of energy crops into biofuels. Furthermore, during the processing, large quantities of waste water harmful to the environment are produced.

2. PROBLEMS WITH FOOD SUPPLY

The population growth from 7.2 billion in 2030 will lead to the 35% increase of food demand. However, today 25,000 people die of hunger, and about 780 million people in developing and 27 million in developed countries suffer from malnutrition each day. In this situation, allocating huge areas for biomass fuel cultivation raises moral concerns; especially it applies to liquid biofuels used in transport. In accordance with the European Commission's decision from 2009, as much as 10% of the energy used for transport should come primarily from biofuels made mainly from food crops. To make biofuels viable, European governments are providing powerful industry and farming lobbies with huge sums of money. For instance, by 2020 biofuels will annually cost each person in Great Britain about £35 (£1–2 billion total) and in Germany about €30 (€1.4–2.2 billion total).

Also, due to subsidies, in the United States ethanol production as a fuel additive rapidly expanded. In the USA, ethanol is produced mainly from corn and in 2011 as much as 127 million tonnes i. e. 40% of annual production was allocated for bioethanol production. Ethanol production for fuel purposes consumed a $6 billion subsidy from the national budget.

In the period 2007–2012, allocation of such a large amount of corn for ethanol production resulted in a twofold rise in the price of corn. Therefore, large imports of food crops for biofuels by the European Union countries led to a dramatic 2.5 fold increase in the FAO food index.

An increase in food prices is particularly severe for the poor, who spend most of their income on food.

Taking into consideration above mentioned statements, it may be concluded that the use of biomass obtained from agricultural crops for energy purposes frequently threatens the implementation of the sustainable development strategy because it violates the intragenerational justice paradigm by limiting the poor's access to food.

CONCLUSIONS

Nowadays, all over the world there is an urgent search for a sustainable supply of primary energy in order to slow down fossil fuel exhaustion and to reduce CO_2 emissions to minimise climate change. However, the majority of the biofuels do not meet the criteria for sustainability. Their application, in most cases, does not lead to the reduction in CO_2 emissions but, in some cases, the output energy from biofuels is even lower than the input energy used in their production. Often, but mostly in tropical areas, biofuel plantations have a very negative influence on the local environment. Biofuel use, mainly by the European Union countries causes an increase in food prices which threatens intragenerational justice, one of the principal paradigms of sustainability. Only biofuels made from waste biomass or from biomass grown on depleted land can somehow reduce the CO_2 emissions and be sustainable. Thus, the European Union's policy related to biofuel use for transport should be re-evaluated from the sustainability standpoint.

It seems that large subsidies for the biofuels promotion are not reasonable. Biofuels which do not meet the sustainability criterion should not be subsidised. According to current knowledge, only biofuels produced from agricultural and forestry waste or from cultivations on depleted land meet the sustainable development criteria. Promotion of such biofuels through subsidies could actually contribute to the reduction of greenhouse gases emissions and the minimisation of the negative impact on food prices. It should be also taken into account that the amount of biofuels possible to produce from this source will be significantly smaller than the amount possible to produce from agricultural cultivation. Only biofuels made from waste biomass or from biomass grown on depleted land can offer some reduction in CO_2 emissions and can be sustainable. Therefore, the European Union's policy related to biofuel use for transport should be re-evaluated from the sustainability standpoint.

Due to rapidly increasing number of vehicles and exhaustion of oil resources, the world is undoubtedly facing the challenge of finding solutions for transport. It appears that the development of the electric vehicle is a promising direction, whose batteries will be recharged from electricity generated by photovoltaic cells.

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