Aplinkos tyrimai, inžinerija ir vadyba, 2011. Nr. 3(57), P. 3-5 *ISSN 1392-1649 (print)*
Environmental Research, Engineering and Management, 2011. No. 3(57), P. 3-5 *ISSN 2029-2139 (online)*
http://erem.ktu.lt

Editorial

Biofuels: Future Prospects

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Recently, the humankind has been placing particular emphasis on resolving environmental problems. A number of treaties and agreements have been signed, and the Kyoto Protocol, which imposes obligations to reduce emissions of greenhouse gases into the atmosphere, is the most important of them. The combustion of fossil fuels in stationary and mobile sources results in emissions of huge amounts of carbon dioxide and other greenhouse gases including nitrogen oxides, methane, and hydrocarbons, whose amounts are recalculated correspondingly into CO2 equivalents, into the atmosphere. The transport sector is one of the major emitters of greenhouse gases into the atmosphere. An overwhelming majority of transport-related pollutants is produced by road motor transport, and only 2 per cent of them are generated by other means of transport (ships, trains, and aircraft). After Lithuania restored her independence, the impact of other industries decreased, while the number of motor vehicles has been constantly growing As a result of this situation, the transport sector generates around 70 per cent of all emissions of greenhouse gases into the atmosphere. Transport-caused pollution is more difficult to control, and it is also difficult to apply effective treatment technologies. Therefore, with the number of motor vehicles growing, it can be forecasted that the negative impact of the transport sector will continue to build up. This is why increasingly growing attention has been recently paid to biofuels produced from renewable energy sources. It is dictated not only by a worsening environmental pollution situation, but also by the fact that reserves of mineral energy sources exhaust rapidly, prices of energy produced from them constantly increase, and countries which do not have their own mineral energy sources, including Lithuania, are energy-dependent on countries exporting such resources.

The expansion of the use of alternative energy is promoted by the European Union, which back in 2003 adopted Directive 2003/30/EC of the European Parliament and of the Council of 8 May 2003 on the promotion of the use of biofuels or other renewable fuels for transport, whereby Europe established the goal of reaching a 5.75 per cent share of renewable energy in the transport sector by 2010. On the basis of summarising reports of Member States regarding the expansion of the production and use of biofuels, in 2009 the European Parliament and the Council adopted the new Directive 2009/28/EC envisaging the reference targets, according to which the share of energy from renewable sources is to rise to a minimum 10 per cent of all fuel consumption in 2020. In terms of current fuel consumption, it would amount to around 140 000 t per year.

In some old Member States, the production and use of biofuels started as early as in the last decade of the past century and gained momentum before the issuance of the Directives. Among such leader Member States, one should mention Germany (installed biodiesel production capacities of more than 5 million tons per year), France (more than 2.5 million tons per year), and Italy (around 2 million tons per year). Fatty acid methyl esters (biodiesel) produced of vegetable oil (most frequently, rapeseed oil) account for the biggest portion of biofuels in EU Member States. Like other EU Member States, Lithuania has implemented the provisions for the expansion

of the use of biofuels. The expansion of the production of biofuels boosted in 2004, when the Programme for the Promotion of the Production and Use of Biofuels for 2004-2010 was approved and the support of the Ministry of Agriculture for biofuel producers purchasing agricultural products for industrial processing entered into legal force. Currently, two types of biofuels are produced in the country: biodiesel and bioethanol. The production capacities for biodiesel amount to 150 000 tons per year, and those for bioethanol amount to 60 000 tons per year. Rapeseed and triticale are used as raw materials for the production of biodiesel and bioethanol, correspondingly. In the country, there are 4 biodiesel producers, while bioethanol is produced by 2 enterprises.

A considerable portion of biofuel production is exported. For example, in 2009 the production volume of biodiesel amounted to 104 000 t, while just 42 700 t were consumed within Lithuania. In accordance with the effective legal and regulatory acts, in the European Union, biofuels are to be blended with mineral fuels, where the share of biofuels accounts for up to 7 per cent. Although pure biodiesel could also be used as fuel, there are just a few countries where it is placed on the market because not all motor vehicles are adjusted to using it directly due to operating problems. The same attributes to bioethanol, which has been recently launched on the country's market in blends with gasoline containing 85 per cent of bioethanol.

From the environmental point of view, the main advantages of biofuels are as follows: they are produced of renewable sources, and smaller amounts of greenhouse gases, solid particles, and other pollutants are emitted into the environment when using them in motor vehicles. Although a significant amount of carbon dioxide is emitted when combusting biofuels in an engine, the use of biofuels eventually does not result in an increase of the concentration of carbon dioxide in the atmosphere owing to a rapid carbon cycle of vegetation from which they are derived and biosynthesis processes occurring in vegetation. Tests of concentrations of other pollutants in exhaust gases have shown that when using pure biodiesel, their relative amounts in exhaust gases decrease as follows: hydrocarbons – by as much as up to 93 per cent, carbon monoxide – by up to 50 per cent, solid particles – by up to 30 per cent, and that of carcinogenic polycyclic hydrocarbons – by up to 80 per cent. Compared to mineral diesel fuel, sulphur oxides emissions are extremely low. When using blends of biodiesel with mineral diesel, concentrations of hazardous components in exhaust gases decrease almost in proportion to the content of biodiesel in the blends.

Blends containing 20-30 per cent of biodiesel are especially promising: in this case, emissions of nitrogen oxides decrease by up to 7 percent unlike a case of pure biodiesel, when emissions of nitrogen oxide are higher than when using mineral fuels. The biodegradability (ability to degrade under the impact of bacteria of the environment) is another important characteristic of biodiesel. It completely meets the requirements established for biofuels and degrades by up to 98 per cent within 21 days when analysing in accordance with the methodology CEC L-33-T-82 recommended by the EU.

However, if one evaluates only direct emissions of hazardous components into the atmosphere, it is impossible to accurately evaluate the impact of biofuels on the greenhouse effect. Therefore, when biofuels are started to be produced and used, the requirement for them was established taking into account their life cycle, and the amount of the energy of mineral fuels used for the production of biofuels should be less than that generated when consuming the biofuels. Otherwise, fuels derived from biomass were not to be regarded as biofuels. This relation (energy efficiency indicator) depends much on the technologies applied to agriculture and industry. Biggest energy consumption rates fall on agriculture in the course of the cultivation of raw materials for biofuel. They are more than twice as much as energy costs falling on the industrial processing of those raw materials.

Certainly, the energy efficiency indicator also directly depends on the agricultural productivity and agricultural crops fertility. Until 2010, the European Commission did not require the provision of information on energy costs of biofuel production, and all products derived from biomass in the EU were regarded as biofuels. The Directive issued in 2009 already provided for stricter criteria for the evaluation of biofuels. The Directive required that EU Member States should present reports on the compliance of the produced biofuels with the sustainability criteria.

Particular attention is paid to agriculture. The reports had to contain information on the emissions attributable to biofuels in relation to the cultivation of raw materials in separate regions of Member States in accordance with the NUTS nomenclature. In Lithuania, a NUTS unit equals to a county. The Directive provides that when cultivating raw materials for the production of biodiesel, not more than 29 g CO2eq may be emitted in agriculture for 1 MJ of biodiesel; and when cultivating raw materials for bioethanol, the corresponding number may not be higher than 23 CO2eq/ MJ of bioethanol. In Lithuania, in the conditions of law yields of rapes and triticale, these requirements are merely achieved.

The Directive also provides for general requirements for the amount of the total emission of greenhouse gases emitted in the course of the production of biofuels as well as the methodology for the calculation thereof. Besides, it is required that biofuels should comply with the following sustainability criteria: until 2017, the emissions of greenhouse gases should be by 35 per cent, and thereafter, at least by 50 per cent lower compared to those emitted in the case of using fossil fuels. In the understanding that biofuels produced currently, or so-called first-generation biofuels, do not have a good outlook for the reduction of greenhouse gas emissions, the European Commission recommends searching for new, more cost-effective raw materials for the production of ordinary biofuels.

The discussion on the alleged negative impact of the production of biofuels on the foodstuffs sector, which does not subside recently, has also encouraged the search for non-food raw materials for the production of biofuels. According to some statements, competition between the food and non-food sectors has been becoming more rigid as a result of the growing use of food raw materials for the production of biofuels, which causes foodstuffs and biofuels produced from such raw materials to grow. In order to resolve these problems, the European Commission initiated the ERA-ARD Programme, which involves Lithuanian scientists searching for possibilities of using new raw materials for the production of biofuels. Such raw materials which could be used for the production of biodiesel include oil produced from oil crops of new types, which can grow on lands with lower fertility or as undercrop with cereal crops (camelina, crambe, tiger nuts, etc), or various oil wastes.

Microalgae, whose oil is currently the focus of interest for US scientists as a raw material for the production of biodiesel, also have quite a good outlook. Algae grow faster than other vegetation and accumulate 20-40 per cent of oil (on a dry-weight basis), and up to 46 to of algae oil can be produced from 1 ha per year (to compare, about 0.7-0.8 t of rapeseed oil in the conditions of Lithuania). Algae can be cultivated in special tanks, thus saving areas of agricultural land. From an environmental point of view, another advantageous factor is that carbon dioxide emitted into the environment by industrial facilities can be utilised for the cultivation of algae, while de-oiled algae biomass can be used for biogas production. Scientists of our country have already taken an interest in the possibilities of using algae for biofuel production, and one should anticipate that research and obtained results will open better prospects for using new types of raw materials for the synthesis of biodiesel.

The Commission sees even better prospects, from an environmental point of view, in the production and use of second-generation biofuels. Among them, one should mention Fischer-Tropsch diesel, biodimethylether, and biomethanol. Research in the area of second-generation biofuel production is promoted and supported by the programmes BP 7 and Intelligent Energy. The documents of the European Commission provide for the guidelines to carry out intensive scientific studies in 2010-2020 and to start commercial production of second-generation biofuels by 2030. Already now, it is forecasted that owing to the use of second-generation biofuels, emissions of greenhouse gases will be by 91-95 per cent lower than those when using mineral fuels. However, such fuels have not been started to be produced commercially so far. Lithuanian scientists should become deeper involved in the scientific studies currently underway because the potential of the country in terms of raw materials (biomass) is greater than that of other countries.