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A new approach to biofuels – certification of sustainable development according to the RED Directive

The observed changes on the biofuel market are assessed as solution-oriented on economic growth taking account of aspects of social and ecological development with elements of diversification of raw materials and technology. An important factor verifying compliance with those aspects of biofuels are the sustainability criteria described in the Directive 2009/28/EC (called RED Directive). It applies to many areas including agricultural production and conversion of biomass into fuel. This Directive, although planned to be implemented in December 2010, has still not been introduced in several EU (European Union) countries, including Poland. But taking into account the fact that a systemic approach to biofuels is relatively new, it is now necessary to make a correction in the RED regulations. This article presents some issues related to the production of fuels that meet the criteria of sustainable development.

Key words: biofuels, bioliquid, sustainability criteria, certification of biofuel, GHG emission.

Nowe podejście do biopaliw – certyfikacja z zakresu zrównoważonego rozwoju według dyrektywy RED

Obserwowane zmiany na rynku biopaliw ocenia się jako rozwiązania zorientowane na wzrost ekonomiczny z uwzględnieniem aspektów socjologicznego i ekologicznego rozwoju wraz z elementami dywersyfikacji technologii i surowców. Istotnym czynnikiem weryfikującym zgodność biopaliw z tymi aspektami są przyjęte kryteria zrównoważonego rozwoju opisane w Dyrektywie 2009/28/WE (zwanej dyrektywą RED). Dotyczy ona licznych obszarów obejmujących produkcję rolną i konwersję biomasy do produktów paliwowych. Dyrektywa ta, pomimo że miała wejść w życie od 2011 r., to ciągle nie została wprowadzona w kilku krajach UE (Unii Europejskiej), w tym w Polsce. Dlatego biorąc pod uwagę fakt, że systemowe podejście do biopaliw jest stosunkowo nowe, to obecnie konieczne jest dokonanie przeglądu zapisów dyrektywy RED. W niniejszym artykule przedstawiono część zagadnienia związanego z produkcją paliw spełniających kryteria zrównoważonego rozwoju.

Słowa kluczowe: biopaliwa, biopłyny, kryteria zrównoważonego rozwoju, certyfikacja biopaliw, emisja GHG.

Currently, there are numerous discussions in progress around the world concerning the influence of human activity on global warming and climate change. Although opinions on the legitimacy of the limitation of GHG (greenhouse gases) emission vary, on a global-scale actions are being taken which aim at the reduction of greenhouse gases emission. One of many tools, among other things, which are supposed to achieve this goal is the application of biofuels, used for car engines.

In the case of conventional engine fuels, the emission of greenhouse gases occurs not only at the moment of fuel combustion in the engine – it is also generated during oil processing in a refinery as well as during extraction or transport. This is the reason why the LCA method (Life Cycle Assessment, described in the EN ISO 14044:2009 standard) is used for estimating the influence of petrol or diesel fuel on the environment. In view of the necessity for laws which would stimulate the GHG emission reduction, the European

Parliament and Council Directive 2009/30/EC of 23 April 2009, among other things, introduces the requirement of GHG emission (which is counted in the fuel life cycle) reduction by maximum 10% by 31 December 2020. This goal might be achieved also due to the use of biofuels.

Biofuels reduce not only the emission of greenhouse gases, but also the dependence upon fossil fuels and they have an influence – owing to the cultivation of plants which are intended for their production – on rural land activation. The development of this industry branch should contribute to an increase in innovation and economic activity. It is expected then, that apart from achieving goals of an ecological nature, some positive changes of economic-social nature will also be noticeable. However, biofuel production also contributes to generating greenhouse gas emission. Fig. 1 demonstrates schematically the GHG emission generated at particular stages of the life cycle for conventional fuels and biofuels.

Emission of greenhouse gases at the stage of oil extraction is generated mainly by combustion in torches and direct emission of deposit gas into the atmosphere [4], unintentional and uncontrolled emission which occurs on valves, device gaskets and apparatus [4] connected with machine and device work. Crude oil processing in a refinery to produce petrol and other products also requires incurring energy expenditures, and as a consequence – generates greenhouse gas emission, just like transport and ready fuel distribution, though this stage is not that essential.

However, the most significant is the last stage in the fuel life cycle – combustion in a car engine.

Biofuels are perceived as a method for reduction of the emission of greenhouse gases generated in production and use of conventional fuels. However, their production also requires energy and it is inevitably connected with greenhouse gas emission. According to the RED, capture of CO₂ in the cultivation of raw materials shall be excluded. It is the reason why emissions from fuel use, shall be taken to be zero for biofuels and bioliquids. The assessment of GHG emission value and determination of other aspects of the influence of increased biofuel production on the natural environment is taken into account when estimating environment-friendly biofuel properties.

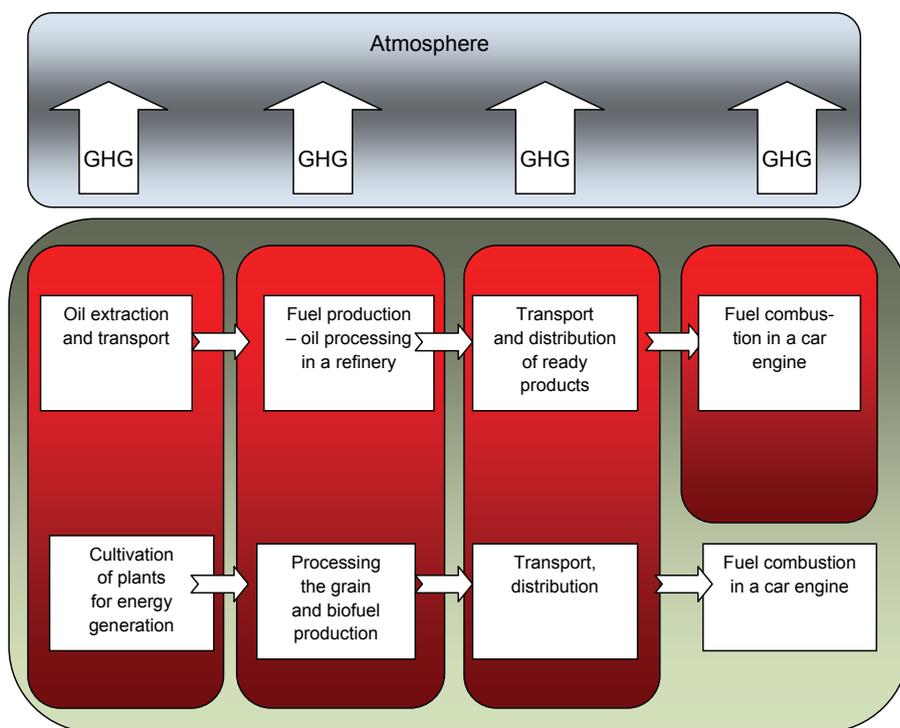


Fig. 1. GHG emission in a life cycle of conventional fuels and biofuels (source: own drawing)

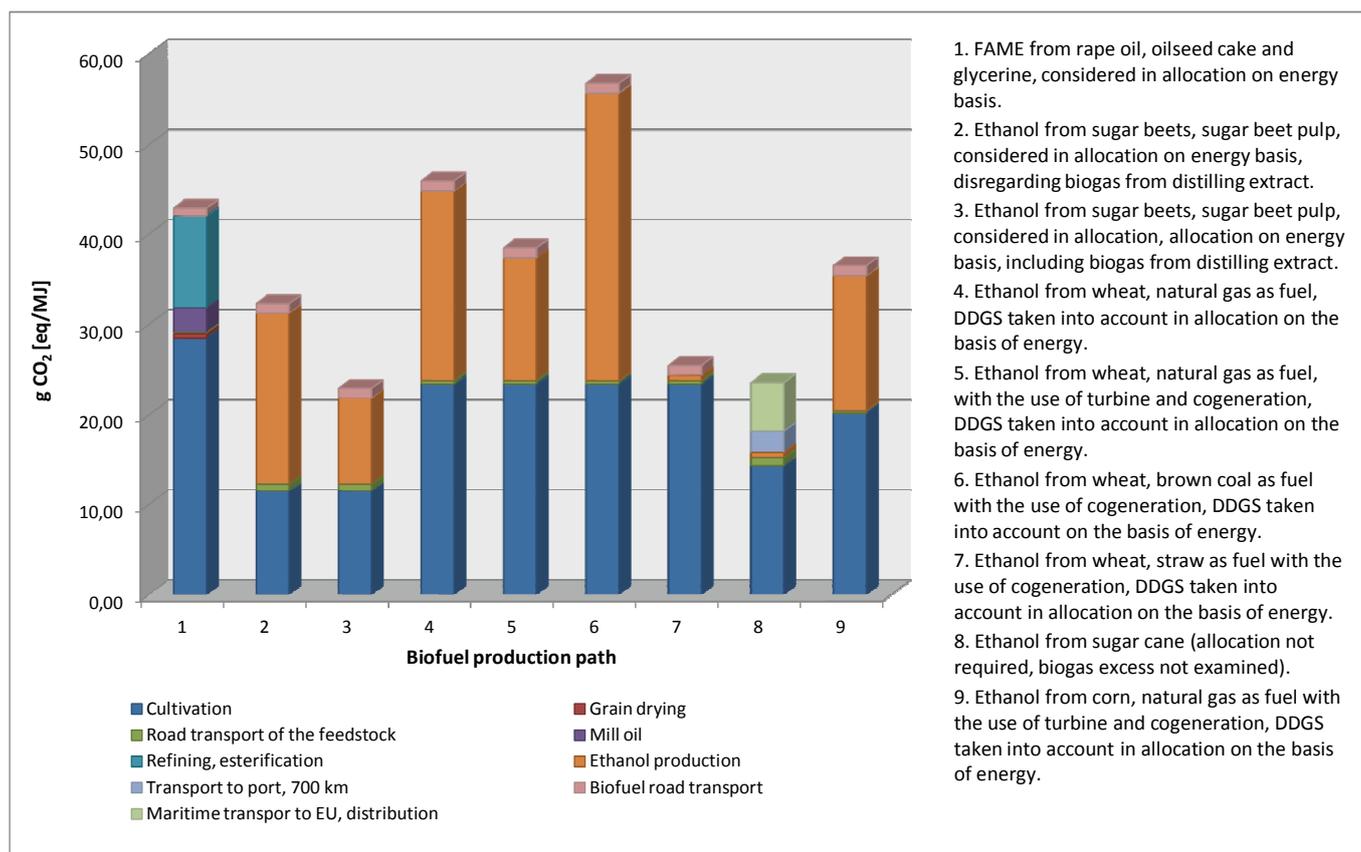
GHG emission in biofuel life cycle

The biofuel production cycle – from the agricultural producer to the final fuel supplier – is often called „the supply chain”. GHG emission distribution amongst particular links is different, depending on the material type and production technology. JEC Consortium on behalf of the European Commission estimated GHG emission at particular stages [10]. On the basis of the achieved [10] values, the diagram (Fig. 2) presents the distribution of the GHG emission in the life cycle of selected paths of biofuel production.

In the case of FAME (Fatty Acid Methyl Esters) obtained from rape oil, ethanol from rye and corn, it has been assumed that the route of grain transport from the agricultural producer

to the processing plant is 50 km, while in the case of ethanol from sugar beets the distance is 30 km. For ethanol produced from sugar cane, the transport to a sea harbour has been taken into account (the distance of 700 km has been assumed) and sea transport and distribution in the EU area (10 186 km to a port in Europe and 150 km to storage reservoirs and 150 km from storage reservoirs to the receiver).

According to Fig. 1, the first link of the chain where the emission of greenhouse gases appears is the cultivation of plants intended for energy purposes; for domestic biofuels these are e.g. rape, rye or corn. The emission arising at this stage results not only from combustion of biofuels which are



1. FAME from rape oil, oilseed cake and glycerine, considered in allocation on energy basis.
2. Ethanol from sugar beets, sugar beet pulp, considered in allocation on energy basis, disregarding biogas from distilling extract.
3. Ethanol from sugar beets, sugar beet pulp, considered in allocation, allocation on energy basis, including biogas from distilling extract.
4. Ethanol from wheat, natural gas as fuel, DDGS taken into account in allocation on the basis of energy.
5. Ethanol from wheat, natural gas as fuel, with the use of turbine and cogeneration, DDGS taken into account in allocation on the basis of energy.
6. Ethanol from wheat, brown coal as fuel with the use of cogeneration, DDGS taken into account on the basis of energy.
7. Ethanol from wheat, straw as fuel with the use of cogeneration, DDGS taken into account in allocation on the basis of energy.
8. Ethanol from sugar cane (allocation not required, biogas excess not examined).
9. Ethanol from corn, natural gas as fuel with the use of turbine and cogeneration, DDGS taken into account in allocation on the basis of energy.

Fig. 2. Distribution of GHG emission in the life cycle, for selected paths of biofuel production (source: own drawing based on [10])

used for powering machines and agricultural equipment, but it is also brought about by chemicals and fertilizers, mainly N_2O emission [7]. The share of this amount is significant, sometimes it constitutes more than 50% of total emission in a life cycle. The calculations disregard carbon dioxide which is assimilated by the plants and biofuel combustion which is released to the atmosphere.

In the case of ethanol from sugar cane, the emission generated during transport by sea – also to the harbour, is a significant item. Despite that, this ethanol is characterized by a relatively low GHG emission factor. The highest emission value was found for ethanol produced from wheat, with the use of brown coal as boiler fuel.

For particular biofuels, the GHG emission generated at the stage of biomass processing – biofuel production, is varied depending on the technology applied, boiler fuel and on the method of using other products generated in this process. If they are treated as by-products, their further management is defined and executed, and GHG emission arising in the process is allocated to them as well (by the same, it results in reduced emission attributed to the biofuel) [1]. GHG emission is not ascribed to waste products.

Values obtained in calculations are compared to the emission generated also by conventional fuels in the life cycle. In this way, the **estimation of the degree of ability of biofuels to reduce greenhouse gas** in relation to fossil fuels is possible.

Indirect land use change (ILUC) problem

The view on biofuels presented above, despite relatively high extensiveness, does not give a full image of the influence of biofuels on the natural environment. With the growing demand for biofuels, increased acreage for the cultivation of plants for energy is also needed. Moreover, despite systematic a rise in crop productivity per hectare, it seems essential to map out new areas for cultivation of plants for food purposes, which results in changes in the ecosystem. This phenomenon is called the ILUC (Indirect Land Use Change) and concerns

the changes in the use of lands in any location, as a consequence of actions promoting the development of renewable energy sources (RES). Relocation of agricultural production for food purposes to another area, changing its natural ecosystem to agricultural areas might be an example [2, 11].

Indirect influence of changing the land use on emission is quite difficult for quantitative estimation. According to the authors of report “*Bioenergy, Land Use Change and Climate Change Mitigation*” [2], changes in land use which

accompany mainly deforestation and expanded production for food purposes, make up about 15% of global GHG emission.

Another vital aspect, apart from the land use change, is the degradation of areas of high natural value, protected

areas which are habitats of wild animal and bird species, and areas with high biological diversity. These changes are difficult, or even impossible to determine with measurable values.

Sustainable development criteria – RED directive

Having been introduced to the above mentioned issues, the following reflection appears: it is necessary to find the “golden rule”, something like a compromise between the need for increasing the biofuel contribution and preservation of the air and areas of great natural interest. This task has been undertaken by the European Commonwealth by implementing the European Parliament and Council Directive 2009/28/EC of 23 April 2009 concerning the promotion of energy from renewable sources which changes and – as a consequence – overrules the directives 2001/77/EC [6]. This Directive is often referred to as “RED”, meaning: Renewable Energy Directive. The Directive assumes that the contribution of renewable energy source in the Commonwealth, by the year 2020, will amount to 20% of final gross consumption, including 10% in the transport sector. On the one hand, the directive has great importance for increased energy security, technological and innovative development support and it should contribute to higher employment and the possibility of regional development, especially in rural and isolated areas [6]. On the other hand, by introducing regulations which stimulate biofuel production, it was also necessary to define restrictions for natural environment protection. That is why the 17th article of the RED directive introduces “*the sustainable development criteria*”.

On account of a high diversification of the biofuel market in Europe, the European Commission in the Announcement [5] elaborated the necessity for meeting the sustainability criteria for biofuels and bioliquids which are:

- 1) counted towards the national general target on the strength of the Directive concerning renewable energy sources¹;
- 2) used in order to fulfill the duty of using energy from renewable sources²;
- 3) covered by financial support promoting the use of biofuels and bioliquids³;

¹Article 17 act 1 letter a). Results from the notion of “final energy use” in accordance with the directive (EC) no. 1099/2008 biofuels used in international air transport are counted in this category (offered for sale in one of the member states), but not used any more in the sea transport.

²Article 17 act 1 letter b) – according to the definition included in article 2 act 1 of the directive concerning renewable energy sources.

³Article 17 act 1 letter c) – usually: as part of the national plan of support.

- 4) counted towards the target specified by the Directive concerning fuel quality, with reference to greenhouse gas emission (only biofuels)⁴;
- 5) covered by investments and/or operational help in accordance with EU directives concerning the country’s support of environment protection (concerns biofuels only);
- 6) considered as a part of regulations which concern vehicles powered with alternative fuel and included in the Directive concerning the reduction of CO₂ emission from passenger cars (concerns bioethanol E85 only)⁵.

Sustainable development criteria according to RED can be divided into two areas: the first concerns the ability of biofuel to reduce greenhouse gas emission in the life cycle when compared to the fossil equivalent, while the other concerns the protection of areas where plants are cultivated for biofuel production. The criteria were defined in five main points, quoted below after RED [6].

- I. Reduction of greenhouse gas emission with the use of biofuels and bioliquids by at least 35%.
Beginning from the 1st of January 2017, the reduction of greenhouse gases emission resulting from the use of biofuels and bioliquids, considered for the purposes described in section 1 letter a), b) and c) of RED directive, is at least 50%. From the 1st of January 2018 the greenhouse gas emission saving shall be at least 60% for biofuels and bioliquids produced in installations in which production started on or after 1 January 2017.
- II. Biofuels and bioliquids do not originate from materials obtained from areas of high biodiversity, i.e. areas that in January 2008 or later had the following status, irrespective of the fact whether they still have it or not:
 - a) primeval forests and other forested soils, i.e. forests and other forested land with native species, with no clearly visible marks of human activity, where the ecological processes have not been significantly disturbed;
 - b) areas designated for:
 - purposes of environment protection, either enacted or ordered by proper authorities; or
 - the protection of rare, endangered or seriously

⁴Article 7a Directive concerning the fuel quality.

⁵Article 6 of (EC) directive no 443/2009.

endangered ecosystems or species acknowledged as such by international agreements or contained in registers prepared by intergovernmental organizations or International Environment Protection Union, on condition that they are acknowledged according to article 18 section 4, second paragraph, unless there is evidence that the production of these materials does not violate the purpose of environment protection;

- c) grass-covered areas of high biodiversity, that is:
- natural – grass areas which remain grass areas if no human intervention occurs and which preserve natural species composition and ecological features and processes; or
 - non-natural – grass areas which cease to be grass areas without human intervention and which are rich in species and are not degraded, unless there is evidence that crops of materials are necessary in order to keep their status of grass-covered areas.
- III. Biofuels and bioliquids do not originate from materials obtained from areas rich in carbon element, that is areas which in January 2008 had one of the following statuses, but do not have it any more:
- a) wetlands, that is areas covered or soaked with water constantly or for a considerable period of time during the year;
 - b) areas constantly forested, i.e. areas of more than one hectare with trees higher than five meters and whose tree crowns cover an area of more than 30%, or trees which can reach the values in situ;
 - c) areas which cover more than one hectare with trees higher than five meters and whose tree crowns cover between 10% and 30%, or trees which can reach the values in situ, unless there is evidence that the area before and after transformation has such an amount of carbon element that having applied the methodology described in part C of annex V of the RED directive,

conditions could be met which concern the reduction of greenhouse gas emission.

Regulations of this section will not be used, if – at the time of obtaining the material, the area had the same status as in January 2008.

- IV. Biofuels and bioliquids are not produced from materials obtained from areas which were peatlands in January 2008, unless there is evidence that at the time of cultivation and harvesting of these materials there was no reclamation of the previously non-reclaimed soils.
- V. Agricultural materials cultivated in the Commonwealth and used for biofuel and bioliquid production, are obtained in accordance with requirements and standards described in regulations specified in the “Natural environment” in part A and in item 9 of annex II to the Council directive (EC) no. 73/2009 of 19th January 2009 which enacts common regulations for direct support systems for farmers as part of common agricultural policy and enacting specific direct support systems for farmers (Journal of Laws L 30 of 31.1.2009, page 16) and also, in accordance with minimum requirements concerning good agricultural culture principles in keeping with environmental protection, as defined in article 6 section 1 of this directive.

The above mentioned regulations mean that in practice only those biofuels will be used which demonstrate the ability to reduce the emission of greenhouse gases at accordingly high levels and those produced from plant materials, the cultivation of which was not harmful for the natural environment. Directive 2009/28/EC, apart from a set of requirements, imposed on economic entities the requirement of submitting appropriate information and conducting its independent audit. Thus the necessity for the certification of biofuel appeared, which would confirm the sustainable development criteria according to the RED requirements. These issues are currently being carried out by the Comité Européen de Normalisation (CEN) and by the Polish Committee for Standardization (PKN) [3].

Biofuel certification

The RED Directive, among other things, requires certification systems which would confirm the compliance of material origin, technology and goals with the sustainable development criteria. Detailed regulations concerning biofuel certification were published in the European Commission announcement which appeared in June 2010 [13]. According to the present legislation, it is the duty of economic entities to prove that the particular biocomponent/biofuel meets the sustainable development criteria. There are three ways to meet the criteria:

- by providing data to the proper national authority in accordance with the requirements which were established by the member state (as a part of the “national system”);
- by utilizing a “voluntary scheme” recognised by the European Commission;
- in accordance with conditions of bilateral or multilateral agreement signed by the Union with third countries, accepted by the Commission for this purpose.

The Polish “national system” is in the progress of drawing up; the requirements of the RED directive which will

be implemented when the amendment to the act concerning biocomponents and liquid biofuels comes into force. However, the last year noted a significant development of voluntary certification schemes recognised by the European Commission.

Voluntary schemes

The essence of every recognised system is the emphasis on the compliance with requirements related to the natural environment and good agricultural practice in agricultural production for energy purposes and preservation of biological diversity.

The equivalence of compliance with requirements may be executed by means of a certification process by entities which approve of the system in which system procedures had been implemented. The basic element of such procedures is the requirement of action transparency and flow of information, considering the basic group of interested parties. Also, the qualifications of auditors have been defined, usually confirmed, among other things, by completed courses with regard to standard EN ISO19011: Guidelines concerning auditing of management systems [8]. The certification bodies and auditors play one of the most important roles in implementation of the RED directive and certification of companies by analyzing the evidence presented by the businessman stating that the biofuel fulfills the sustainability criteria. The audit is carried out on the principles of: impartiality, independence, competence and granting the certificate is based on the audit report.

The auditors accepted and appointed, in the certification procedure estimate the compliance level of the future system participant. The level of non-conformities with sustainable development criteria leads to refusal to issue the certificate. The indicator for such conduct are defined non-conformities categories (serious, small).

Certification bodies are not participants of the voluntary schemes. Their task is to evaluate data delivered by economic operators, documenting compliance with the requirements of the given voluntary scheme. Certification bodies are impartial, independent organizations with the freedom of economic activities, who operates within the framework of a certification system selected by and recognized by that body.

In audit procedures it is required to estimate a part of the system participants' activity which is directly contained in the sustainable development criteria; procedures being drawn up constitute guidelines for each party (system participants) on how to obtain and estimate the conditions for producing biofuel in accordance with requirements of proper country regulations. In Poland such regulations are presently at the developmental stage by the Ministry of Economy and are currently available in the form of "*The project of the act on*

Also the Oil and Gas Institute developed his own certification scheme called "KZR INiG System", which is currently the subject of recognition procedures. This scheme will be perceived as a part of the Polish "national certification system".

biocomponents and liquid biofuels and some other acts". It especially concerns the estimation of risk in case the requirements are not fulfilled, and consequently, the possibility of cases of inconsistency which prevent the granting or retaining of the certificate. The preferred method of granting certification is an audit by a third party. Additionally, it is also indicated that this process should be carried out on the principles of confidentiality, objectivity and impartiality, in accordance with the standard EN ISO45011: General requirements concerning units which deal with product certification systems [9]. In the case of this requirement, the key issue is referring to the established statistic test as part of the certification procedure and identification of the chain flow of materials, products, waste and other streams, crucial for the estimation of compliance with the said criteria.

All the entities which appear in the biofuel supply chain are subject to compliance with the sustainability criteria requirements. The first link of this chain is, as already mentioned, the agricultural producer. Depending on accepted specific solutions and in particular the voluntary certification schemes, the farmer can be audited individually or as a part of a group. In the second case, audit can be performed when grain storage is certified (the first collecting point) – the next link in the chain.

It is acceptable to make estimations according to three methods. The first involves making the audit mainly with smallholders and organization of producers and cooperatives. Certification is the only way of including many smallholders into the system and their participation on the market covered by certification the system, which can considerably reduce certification costs.

The second method is multilateral certification which covers the whole chain and which begins from the agricultural producer; including also middlemen, manufacturers, subjects who buy and store and producers, to the last in the chain – the final fuel supplier. It is worth noting that such a chain must be managed centrally and needs to have implemented rules and procedures of internal audit. In such a case, the certificate is granted to one of the entities and covers all the defined participants registered in different locations. The certificate might be owned by a company which purchases and stores the material and which has signed contracts with the remaining participants of the system.

The decision concerning the entitlement for using the

certificate should be made public. The last requirement for biofuel certification is obligatory acceptance of certificates issued by other recognized EU systems, which would speed up the procedure, especially with a wide geographical range of the flow of certified materials and products.

It is essential that the above issues: of biofuel certification, requirements for collecting evidence during the audit and the verification level, consultations with the interested parties, procedures of submitting remarks, are not mentioned in the RED Directive or have been marked as potential solutions. Many of these issues have been specified in announcements and decisions which accompany the Directive [12, 13, 14]. The analysis of documents makes one aware of the complexity of biofuel certification problems in accordance with the sustainability criteria.

Introducing the requirements of a selected certification

system to a company and the necessity to carry out certification generates additional costs. It is worth pointing out that in the scope and content of the above mentioned aspects, the market character of the requirements can be found in accordance with the sustainable development criteria and these aspects can be perceived in categories of influence on the competitiveness of certified materials and products. The significance of biofuel certification is vital for the internal organization of the company which is the system participant, but should also be easily market identifiable. Introducing a certification system externally ought to make the product distinct because of meeting the market requirements or compliance with the binding law. On the other hand, it is expected that the system will be associated with receiving a price bonus whose main beneficiaries are the first entities in the product life chain, i.e. agricultural producers.

Summary

The biofuel market development creates opportunities for activation, especially in the rural areas, it should be the stimulus for innovation, it should create a new sector with many new jobs. Also, the fact of reduced dependence upon fossil fuels cannot be ignored. On the other hand, it is necessary to avoid excessive exploitation of the natural environment.

The definition of the sustainable development criteria has been formed in order to avoid the natural environment degradation with the assumed increase in biofuel production. Is it possible to achieve? Each EU member country implements the RED decisions and as a result, it requires that all biocomponents used for fuel production should meet the relevant requirements. It gives the Directive a global range because it imposes on the providers even from outside Europe the duty to prove they meet the sustainability criteria. The Directive was published four years ago and is systematically implemented in all the countries, in Poland as well. It covers numerous areas comprising agricultu-

ral production and biomass conversion to fuel products. Considering the fact that such an approach to biofuels is relatively new, it cannot be ruled out that as a result of experience gained it will be necessary to make corrections in the RED regulations.

The sustainable development criteria do not cover all the issues connected with biofuels. Those concerning the quality or compatibility with car engine elements and powering systems have been omitted.

Essential for biofuel success in Europe are also economic and social aspects. High manufacturing costs, increased due to the certification process make biofuels less competitive in relation to conventional fuels.

To sum up, the chance of development of the biofuel market cannot be explicitly denied, whether in Poland or in Europe. The activities carried out at present should stimulate the development and the search for new, more environment-friendly paths for biofuel production.

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