Current Perspectives and Challenges of Biofuel Production and Consumption

Authors:∗

Victor PLATON, Simona FRONE
Andreea CONSTANTINESCU
Sorina JURIST

Abstract*. This is the first article in a series[1] meant to identify secondary effects of fuel production and consumption.The article presents, in synthesis, the main ideas and contributions of the paper "Economic effects of biofuels production and consumption in Romania", written by the authors in 2009 within the research programme of the Institute of National Economy: Economic-social mechanisms and policies of increasing environmental factors in accordance with the European and world programs for diminishing the effects of the world resources crisis. The paper pursues the adjustment process of fossil fuel consumption to the rigors of an economy aiming to diminish carbon-composites emissions in atmosphere. At the same time, it is a warning regarding the secondary effects that might occur from the overblown consumption and production of first-generation biofuel.*

∗ *Victor Platon, Ph.D., senior researcher I, Institute of National Economy, Romanian Academy, e-mail: victor_platon@ien.ince.ro; Simona Frone, Ph.D., senior researcher II, Institute of National Economy, Romanian Academy, e-mail: simona.frone@ hotmail.com; Andreea Constantinescu, Ph.D. Student, researcher, Institute of National Economy, Romanian Academy, e-mail: andreea_constantinescu07@yahoo.com; Sorina Jurist, research assistant, Institute of National Economy, Romanian Academy, e-mail: sorinaj2005@yahoo.com*

[1] *The following article on biofuels shall undertake an in-depth approach to biofuel production, its geographic positioning, as well as details about investments. Also, a comparative analysis will be made about medium-sized countries from Europe and countries having a significant impact on this market. It should be mentioned that these topics were not the subject of the present article.*

Key-words: biofuel, production potential, EU strategy for biofuels, subventions, secondary effects

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1. General Assumptions

In order to attain the objectives established by the Kyoto Protocol with respect to diminishing the greenhouse gas emissions, it is essential to identify methods for reducing emissions resulting from car transports. In this context, the present article[1] is important in view of the efforts of reaching the targets imposed by the European legislation that is the Biofuels and Renewable Energy Directives. The period for achieving the targets is 2007-2020 and involves specific economic policies and significant investments.

From the theoretical viewpoint, biofuels represent a direct substitute for fossil fuels used in transports because they are obtained from biomass, a renewable energy source. These can be integrated into already existing systems for fuel supply preparing thus the way to more performant fuels, such as hydrogen.

Even though the majority of biofuels still are a lot more expensive than fossil fuels, their use is on increase worldwide due to financial incentives both for processing and consumption. Encouraged by various economic measures and instruments (especially subventions), the global production of biofuels is estimated currently at over 35 million tons.

The main biofuels produced and used in the European Union (EU) for transports are biodiesel and bioethanol. To these vegetable oil and biogas (Figure 1) are added.

*Biodiesel is an ecological fuel obtained from vegetable oils (*soybeans, mustard, sun-flower, palm oil) through transesterification and it can be mixed with gasoline, the outcome being a less polluting fuel. Biodiesel represents the equivalent of gasoline, a fuel processed from renewable biological sources, which can be used in all types of Diesel engines.

[1] The article is based on the research paper "Economic Effects of Biofuels Processing and Consumption in Romania", INE, 2009.

Figure 1. First generation of biofuels

First-generation biofuels

Biofuels	Feedstocks	Conversion technology
Straight vegetable oil	Oilseed crops (rapeseed, soybean, sunflower, palm, jatropha, canola, castor oil, etc.)	Extraction by cold pressing
Biodiesel	- Oilseed crops (rapeseed, soybean, sunflower, palm, jatropha, canola, castor oil, etc.) - Waste, burnt oils	- Extraction by cold pressing, purification and esterification - Hydrogenation
Bioethanol	Sugar crops (sugar beet, sugar cane, sweet sorghum), starchy crops	Hidrolysis and fermentation
Biogas	Biomass (wet)	Anaerobic digestion
Bio-ETBE	Bioethanol	Chemical synthesis

Bioethanol is an ecological fuel, the chemical formula being identical to the one of the ethylic alcohol found in alcoholic beverages. The raw material from which bioethanol is obtained is respresented by wood industry waste (timber, wood pieces, recycled paper), sugar cane, sugar beet, corn, etc. Bioethanol is used as an alternative to gasoline, varying percentage blends with gasoline or pure (E100). From the viewpoint of bioethanol characteristics, it has a higher octane than petrol, hence more efficient burning (implicitly also CO_2 emissions lower than in the case of engines operating only with petrol, emissions without sulphurs or hydrocarbons).

The EU supports the use of biofuels as one of the ways of attaining the objectives regarding the diminution in greenhouse gas emissions. Theoretically, this takes place in the stage of increasing the biomass which absorbs carbon from air. Thereafter, by burning biofuel obtained from biomass, the absorbed carbon quantity is released in the atmosphere and the cycle can be repeated without increasing the carbon quantity in the air. By diversifying the sources of fuel it is aimed to develop some long-term substitutes for fossil fuels. There are a series of signs that the development of biofuel processing shall provide for new opportunities of diversifying incomes and jobs in rural areas.

The 2003 directive on biofuels[1] established a reference value of 2% from total market for biofuels in 2005 and of 5.75% in 2010. For implementing the directive, part of the Member States considered tax exemptions for biofuels. Some of the taxes on fossil fuels have already been redirected to biofuels, and petrol fuels supplying companies were compelled to incorporate a certain percentage of biofuels in the products sold on national markets.

In 2007, the EU processed 75% of the world quantity of biodiesel. Germany is the market leader in the sector with over 50% from the EU biodiesel production that is 2.8 million tons from the total of about 5.7 million tons in the year 2007. Therefore, the arable surface of EU for energy crops increased ten times as of 2004, to up to 2.84 million hectares. Currently, only a small share of the EU cereals production is used for biofuel processing, but **reaching the EU objectives in the field for the year 2020 would require the use of about 15% from the agricultural land of the Member States.**

Building installations for producing alternative fuels, introducing new types of engines and adjusting the fuel distribution system presuppose long-term investments requiring careful analyses of the market demand. This means that the necessary measures in the area of supply need to be accompanied by a subvention system.

Biofuels are classified into three broad categories: first generation biofuels, second and third generation ones.

First generation biofuels are obtained especially from agricultural raw materials: soyabeans, sugar cane, corn, etc. For these biofuels important capacities are operational and they are available in large quantities on the market.

The second generation of biofuels comprises biofuels obtained especially from wood raw materials. These biofuels are still in the laboratory stage.

The third generation of biofuels includes products obtained from sea algae and is in an incipient research stage.

On medium term, very high investments would be required in order to use newly emerged technologies for processing wood raw materials or algae. Wood, algae and biological waste shall play an increasingly important role, if second and third generation of biofuels are to become efficient from the commercial viewpoint.

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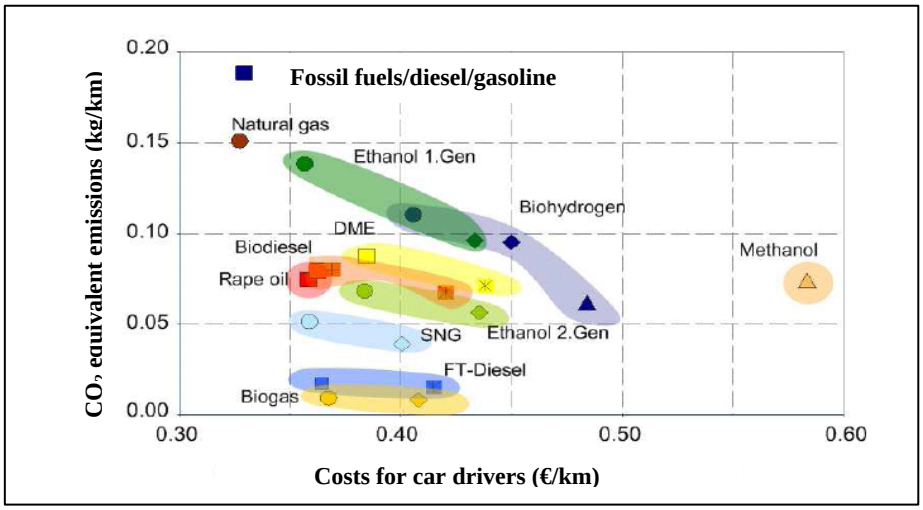
[1] Directive 2003/30/EC of 8 May 2003 on the promotion of the use of biofuels or other renewable fuels for transport (OJ L 124, 17.5.2003).

Figure 2 shows that lowest cost for car drivers (fuel and car maintenance cost) is recorded for fossil fuels, natural gas, and mustard-based biodiesel. For other biofuels higher costs are recorded and this fact explains the reluctance of car drivers in using biofuels.

Figure 2. Comparative scheme of fuels and biofuels from the viewpoint of emissions and costs for car drivers



Source: Background Paper on Biofuel Production Technologies, working document, November 2007, authors: Sergey Zinoviev, Sivasamy Arumugam and Stanislav Miertus.

2. EU strategy on biofuels

In order to obtain the highest benefits from current and future opportunities, the EU Commission decided *to encourage the first generation biofuels market to be completed by new technologies as they are being developed.*

As suggested above, promoting energy crops and introducing biofuels present, at least, the following **theoretical advantages**:

- diminishing the pollution of environment, by decreasing polluting gas emissions;

- energy crops ensure the supply of raw materials for fuels under safety conditions and environmental protection helping to promote renewable energy resources;
- due to the fact that at world level oil fields are progressively decreasing and that very fast, it was necessary to identify an alternative to processing tractor and agricultural machinery fuels (for which even pure vegetable fuels can be used).

The strategic objective for the year 2005 was to use a fuel blend which contained 2% biofuels. This objective was not reached; a percentage of 1.4% was reached. It is important to mention that, as a result of the analysis regarding the achievement of this objective, the EU Commission launched an action of researching contraventions in seven instances, where certain Member States adopted too low objectives, without adequate substantiation.

The new EU strategy for biofuels has three major objectives:

1. Promoting biofuels[1] in EU and developing countries by ensuring that processing and use is beneficial to environment and contributes to the Lisbon Strategy objectives;
2. Preparing wide-scale use of biofuels through researches dedicated to second generation biofuels and sustaining market promotion by demonstrative projects and removing non-technical obstacles;
3. Exploring opportunities for developing countries – including the ones affected by the EU reform with respect to the sugar regime – by producing biofuels and stocks for biofuels and determining the EU role in promoting production sustainable development of biofuels.

The main motivations, objectives and directions of the EU strategy for biofuels are rendered concrete in the seven intervention axes analysed below.

2.1. Stimulating biofuel demand

In order to stimulate the biofuel demand, the EU Commission aimed to act *by means of subventions and promoting public acquisitions***.** An active market for developing and using biofuels may be represented by the public and private

[1] The action plan for biomass already described various actions that shall be undertaken for encouraging the use of all types of biomass for the generation of renewable energy.

car stock, or by farms and carriers of heavy products, market for which tax exemption and diminution proved to be positive always.

The expected outcome is encouraging the use of fuels with as high percentage of biofuels as possible. At the level of farms there are currently small-scale installations and systems of processing seeds that can contribute to the low-cost production of biodiesel from farm waste and vegetable oil plants. The car stock for public or private transport busses have, usually, own fuel reserves so that the switch to biofuels shall be relatively easy to accomplish. Another potential market for biofuels is the one of sea transport and fishing vessels.

2.2. Obtaining benefits for the environment

In order to have advantages from the possible benefits with respect to the environmental protection, the strategy regarding biofuels must focus on avoiding environmental problems triggered by biofuel processing and of related raw materials. Solving these issues requires focusing attention on the following items: position to be held by "energy" crops within agricultural rotation; avoiding negative effects on bio-diversity; water pollution; land degradation; habitat and various species destruction in areas with high natural value.

The sustainability criteria for the biofuel production within EU should not be restricted to "energy" crops, but should refer to all agricultural crops, as stipulated in interdisciplinary rules established by the Common Agriculural Policy (CAP) reform of 2003. These criteria shall also take into account the advantages of farming "energy" plants in a rotational system and on marginal lands.

2.3. Developing processing and distribution of biofuels

Several of the regions assisted by Structural and Cohesion Funds, particularly rural regions from Central and Eastern Europe have potential for using biomass to generate economic growth and employment opportunities, and the low price of labour force and existing resources in large quantities may provide for these regions a substantial advantage in raw material production for biofuels. Supporting the development of alternative and renewable energy sources (for instance, biomass and biofuels) is, under these circumstances, an important objective for the cohesion policy[1].

[1] As stipulated in the Commission Communication "Cohesion policy in support of growth and jobs", COM (2005)299.

By means of structural funds, the EU Commission shall act for:

- encouraging Member States and regions to take into account the benefits of biofuels and other forms of bio-energy in structuring the national reference framework and operational plans within the cohesion and rural development policies;
- proposing to set-up a specific group for evaluating bio-mass, including opportunites for biofuels within national rural development programmes.

Tax exemptions and other forms of official support for processing and using biofuels must be in accordance with the European provisions regarding the state aid.

2.4. Expanding the raw material sources

By the CAP reform from 2003 a special aid for "energy" crops was introduced. A subvention of 45 Euros per hectare was provided for a maximum surface of 1.5 million hectares. If demands shall exceed the established budgetary ceiling, the subvention will be proportionally diminished. This scheme of energy crops is presented in a report of the Commission published on 31st December 2006 and in corresponding proposals, taking into account the implementation of the biofuel objectives.

Currently, biofuels are processed almost entirely from crops that can be used also as food. There is the risk that as global demand for biofuel increases, the food reserves at reasonable costs would be endangered in developing countries. Biofuels are in competition for raw materials also with other industries. From this viewpoint, a careful monitoring of biofuel demand impact on other markets is considered.

2.5. Improving biofuel trade

For this objective, the Commission shall act by:

- Evaluating advantages, disadvantages and legal implications of submitting a proposal for attributing separate customs nomenclature codes for biofuels.
- Maintaining some market access conditions for imported bioethanol that should not be less favourable than the ones provided by current commercial agreements, maintaining a comparable preferential access level for ACP (African, Caribbean, and Pacific) countries and maintaining "erosion" under observation of preferences.

- Pursuing a balanced approach in current and future negotiations with countries and regions producing ethanol – EU shall provide for equal chances both for local producers and their trading partners, in the context of an increase in biofuel demand.
- Proposing amendments to "biodiesel standards" for facilitating the use of a wider range of vegetable oils for producing biodiesel and replacing methanol with ethanol in the production process.

2.6. Supporting scientific and technological research

The proposal for the Seventh Action Programme (2007-2013) gives priority to research in the field of biofuels, in view of strengthening EU profile industry's competitiveness. Within the cooperation programme, research activities shall focus mainly on two topics:

- "Energy" having as purpose the diminution in the unit cost of fuel, by improving traditional technologies and developing second generation biofuels (Fisher-Tropsch, and others);
- "Food, agriculture and biotechnology", aimed to apply biotechnology for improving biomass production systems.

By the Kyoto Protocol, the 15 older member states of the EU have a common objective of diminishing emissions by 8%, under the levels of 1990, till 2012. In March 2007, EU approved a plan regarding energy and climatic changes for limiting the greenhouse effect gas emissions in UE by at least 20% up to 2020 (from the levels of 1990) and for achieving up to 2020 an objective of 20% from total consumption of primary energy of EU by renewable energy.

In January 2008, the European Commission proposed a new package regarding energy and climate for attaining the objective of diminishing emissions. Various sectors, such as agriculture, transports and constructions and all Member States will have to play a role and contribute to the European objectives depending on their financial capacity. The diminution in greenhouse gas emissions will require an increased consumption of renewable energy, which presupposes also a reserve of more diversified electric power for Europe.

2.7. Evolution of objectives

By analysing the following table, an evolution can be seen towards higher flexibility in attaining the targets. For instance, the Directive 28/2009 provides

that a minimum of 10% of the used fuels in 2020 should come from renewable sources. The previous target was 5.75% up to 2010 and proved to be impossible to achieve.

Table 1: Comparisons regarding the imposed targets regarding limitation of GGE

Directive 77/2001	Directive 30/2003	Directive 28/2009
Objective/purpose		
Promoting the increase in renewable energy sources contribution to electricity generation on the national electricity market and laying the background for a future community framework in the field.	Promoting the use in transports of biofuels or of other renewable fuels for replacing gasoline and petrol in each Member State and contributing to some objectives such as fulfilling the commitments regarding climatic change, and supply safety tat should not damage environment and promote renewable energy sources.	Determining a common framework for promoting energy from renewable sources. Determining compulsory national objectives regarding the compulsory national shares with respect to the global share of energy in renewable sources used in transports.
National objectives		
Global indicative objective: 12% of gross national energy consumption up to 2010.	2% biofuels from the energy contents of all types of petrol and gasolines used in transports, placed on markets before 31st December 2005.	Minimum 20% energy from renewable sources for gross final consumption of energy up to 2020.
Indicative share of 22.1% in electricity generated by renewable energy sources in the total community electricity consumption up to 2010.	5.75% biofuels for the energy content of all types of petrols and gasolines used in transports placed on markets before 31st December 2010.	Minimum 10% energy from renewable sources in all forms of transports up to 2020.
National objectives for Romania		
The reference values in determining the national indicative objectives with respect to electricity generated from renewable energy resources was 33% in 2010, as compared with 14.9% in 1997.	-	The objective regarding the share of energy from renewable sources in gross energy final consumption for 2020 is 24%, against the year 2005, when a share of 17.8% was recorded.

2.8. Biofules in Romania

In 2008 the surface cultivated with plants to produce biodiesel was 150000 ha, representing 1.6% of the total crop area. The main plants for producing biofuels are: corn; rape; sun flower; soybeans. Out of total area cultivated with these plants, rape represents 62%, sun flower 23.9%, corn 10.8 and soybeans 3.3%. The Ministry for Agriculture has registered 760 farmers that cultivate plants for producing biocombustibles.

According to the data from the Minister of Economy and Trade there are 28 small companies that could produce 280-300 thousand tonnes/year of biofuels. In 2008 only 30000 tones were produced by these installations. The total quantity of biofuel used in 2008 was 50000 tones out of which 20000 imported. There are plans for two new capacities of 150000 tones/year of bioetanol from corn. The major issue of the Romanian industrial capacity to produce biofuels is the fragmentation of producers that do not have enough economy of scale. Another issue is related to the quality of biofuel that is not as high as needed. In Romania there are no installations for the second generation of biofuels. The technology for the second generation is very expensive and there is a significant risk assoaciated with biofuel production.

3. Indirect (unintentional) effects of first generation biofuel processing and consumption

The effects targeted by the EU strategy for biofuels are well analyzed from a theoretical viewpoint. The issues emerging in reality because of some secondary, unintentional effects may completely cancel the beneficial effects. Because direct effects were exposed in numerous studies, we shall focus only on the indirect (unintentional) ones.

Massive subventions of raw material sources for first generation biofuels have a series of unintentional effects on local economies. The unintentional effects may be either direct or indirect and in some cases exceed in amplitude the direct (intentional) effects. These secondary effects are closely related to the fact that the raw material is used also as food source. Hence the dilemma: more biofuels, higher prices of food.

1) Price increase for primary agricultural products

In the case of first generation biofuels, subvention leads to significant increase in production but also to price[1] increase for some agricultural products such as corn, mustard, vegetable oils, etc.

Price increase for raw materials is the main important indirect consequence, which creates huge problems to those purchasing agricultural products for food or for fishing activities, or poultry. Several categories of beneficiaries of agricultural products are affected, among which:

- population that has to pay more for basic food such as corn flour, mustard oil, palm oil, sunflower oil, etc.;
- small producers, such as poultry farmers, fish farms, etc. must pay more for raw materials produced from corn (in the USA, several poultry farmers and fishery farm owners went bankrupt).
- small beer producers, which go bankrupt because they can no longer purchase the required hop (lands cultivated with hop are replaced by energy plants).

2) Efficiency issues (economic and energy). Influence of raw oil price

The ethanol produced from corn is neither cheaper nor extremely pure from the viewpoint of environmental protection and requires higher energy consumption in order to be processed. For instance, the ethanol production was promoted in the USA by state and federal incentives which are doubtful as economic value, such as subventions and high tariffs for imported ethanol, or by promoting blends of fossil and renewable fuels. The US Government provides for ethanol producers subventions of 13.5 cents per litre and an increasing number of states promote the wide-scale use of the fuel called E85, a fuel that contains 85% ethanol and only 15% petrol. Since the price of raw oil increased to over 30 $ per barrel in 2004 (currently it is more than double that amount), the production capacity for ethanol increased rapidly.

[1] Similarly, subventions for solar energy in Germany (where sunny days are) led to rendering the demand for solar installations dynamic, which had as consequence the price increase for solar installations in Southern countries where solar energy is indeed an alternative.

Even if on the USA experiments are made also on other biofuels of the second generation – from bio-gasoline to ethanol derivatives obtained from pulp (a more efficient technology) – the highest impetus was of the production of ethanol from corn[1]. In Iowa already 28 ethanol refineries with a production of 7.2 mill. tons per year, almost a third of the US production capacity. Several new factories are under construction, but there are also works for expanding already existing factories.

The high price of oil and the subventions granted encourage investments in production capacities for obtained from corn. The corn ethanol production is possible as long as the oil price remains high and subventions are granted.

3) Development of peripheral areas

The production of energy plants, such as ethanol, may begin in remote areas with respect to distribution markets and where the transport cost is a restrictive criterion for traditional agricultural crops. For instance, in the US several farms or agricultural associations and cooperatives of farmers or local investors have built several ethanol processing refineries. Thus, groups of producers and associates have started to build refineries in remote areas, where farmers could not sell corn at good prices due to the high costs related to transport to the market[2]. Same logic applies also in the case of eastern districts of the agricultural states such as North and South Dakota, south-west Minnesota and other parts of the regions with corn crops where crop transport to market is too expensive.

As long as it is possible to build a refinery in an area close to the railway, it is far more efficient to change corn into ethanol and then to transport it to the market than to transport corn as such.

4) Change in land prices and emergence of new activities

The processing activity of agricultural resources benefit rural economy and affiliated industries both at large and small scale. For instance, in Iowa, the price

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[1] California contributed to this development. When at the level of the state it was prohibited to use Methyl Tert-Butyl Ether (MTBE) as additive, in 2003, all producing companies had to use ethanol for reaching the limited air pollution standards and local refineries began to produce massively ethanol, benefiting of the state subvention of 13.5 cents per litre existing at the respective time. Source: "The Craze for Maise"; *The Economist*, May 12-2007.

[2] In north-west Iowa, the corn production is high, and the prices are 25-50 cents lower for the corn bushel because it is too far from the transport barges on the Mississippi.

of agricultural lands increased in 2006 by 10% and continues to grow. New jobs are created around biofuel refineries. In some regions, where some of the most modern refineries were built and progress was made because of the oil price increase and subventions, local population used incomes obtained in this way for arranging their houses, for paying college taxes and purchasing equipment for farms.

Next to the extraction of corn starch, for changing it into fuel, refineries change the rest of the crop into raw material for distilleries. It contains proteins and other nutrients existing in corn are more and more used as food for cows, pigs and poultry in the farms around the refineries.

For instance[1], in some regions, growing livestock is the main concern of farmers, but the raw material resulting from ethanol distilling is better as fodder for cows (milk or meat cows). According to the studies, in the refineries of the state a quantity of fodder is already produced by ethanol distilling that is five times more than the existing traditional low number of milk cows could consume. Therefore, many refineries use large quantities of energy to dry fodder and send it for consumption in other regions where cows are grown.

Redirecting secondary products to local cow ranches would lead both to saving energy by the refineries and also to decreasing transport costs of fodder. Hence, a sustained development shall follow for meat and dairy products industry in areas where corn is processed for ethanol. Yet, many investors see a chance of building production installations for ethanol where there are already many cow ranches.

5) Change in trading flows

In the case in which subventions for biofuels shall be increased, a major incentive will materialize so that these can be produced by countries in tropical areas, such as Brasil. Currently, there are large ethanol production capacities at lower costs than in Europe and it is to be expected that a higher flow of biofuels from these countries shall emerge.

The emerging issue is whether transport at remote distances eliminates the biofuels advantage by GGE emissions generated by the use of some

[1] The “Craze for Maise”; *The Economist*, May 12 2007.

conventional fuels for sea transport. These transports at long distances would not take place if there were no subventions.

6) Negative effects on natural eco-systems

The majority of used biofuels currently have more greenhouse gas emissions than conventional fuels if the emissions are taken into account from the production of biofuels. The benefits of biofuels are increasingly contested in the last time after the evaluation of global environmental costs which are involved in their processing.

Currently, emphasis is laid on a new approach which takes into account the effect of CO_2 emissions resulting from changing large land surfaces in crops for the biofuel production. The destruction of natural eco-systems, whether equatorial or tropical forests in South-America or Asia, leads to the increase in greenhouse gases that are accumulated in the air because the eco-systems are natural reservoirs for these emissions. In initial evaluations a primary mistake was made: the change of land destination was not taken into account. It was considered that fuel from plants would be better than fossil fuels, because the emissions generated in their production would be compensated by the CO_2 quantity absorbed by plants in the growth process. This assumption proved to be erroneous and by far too simple, the change of plants into fuels being a major source of emissions on the entire production, refining, transport chain, etc.

The change of land destination causes several imbalances in nature. The reclamation of the savannas leads to emissions that are 93 times higher than the ones that could be reduced by using biofuel produced on the respective land (Joseph Fargione, for the magazine *Nature Conservancy*, 2009).

UNIPCC (United Nations Intergovernmental Panel on Climate Change) suggested that mankind must diminish the increase in greenhouse gas by 2020 for avoiding a disaster regarding environment. The conclusion of the studies was that the type of vegetation removed for crops does not matter, as the biofuels produced in this manner do not replace in either form the lack of this natural reservoir of CO_2.

The single acceptable solution from the viewpoint of changing the land destination seems to be the one of sugar cane crops in Brazil. They consume extremely few energy against what they have to offer and are much more efficient in producing biofuels than any of the solutions identified in Europe up to date. One of the few acceptable alternatives is the use as source of biofuel of

materials resulting from processing various cultivated plants, a source that would not require the destination change for additional lands.

This controversy related to the use of land emerged in the Netherlands, in 2006, when researchers from the International Organization for Wet Areas (Wetlands International) have discovered that palm oil imported to the Netherlands and used for generating "clean" energy was produced in South-Eastern Asia on plantations created by burning the tropical forest. By these practices CO_2 emissions are released in the air, tens of times higher than envisaged savings. After these analyses, the Dutch Government cancelled subventions for palm oil and prohibited fuel import, in the attempt to indentify more sustainable sources of biofuels[1]. Therefore, a new investment in biofuel production of 7 million Euros had to be cancelled, because it made use exclusively of imported palm oil.

4. Proposals for suspending the 10% objective

In the year 2009, the Scientific Committee[2] of the European Environment Agency (EEA) made public an opinion[3] about the impact of using biofuels on the environment in Europe. This opinion recommended the realisation of a study on the environmental risks and benefits in using biofuels, and the suspension of the EU objective of replacing 10% of the currently used fuel with biofuels up to 2010.

Despite the fact that the first objective regarding biofuels was not accomplished, the biofuel processing in EU, as well as the import from third-world countries are on continuing increase. These led to an increased concern of the Scientific Council of EEA with respect to the additional pressure exerted on the environment both within and outside the EU, therefore issuing an opinion according to which:

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[1] Source: *International Herald Tribune,* "Studies conclude that biofuels are not so green", by Elisabeth Rosenthal, Thursday, February 7, 2008.

[2] The Scientific Council provides assitance to the Management of the European Environment Agency and to the Executive Director of this institution by providing scientific counseling and issuing specialised opinions on the scientific issues entering the interest area of the Agency. The Committee consists of 20 independent scientists from 15 member countries of the EU, individuals from various relevant fields of activity for the activity of the Agency.

[3] http://www.eea.europa.eu/highlights/suspend 10 percent biofuels target

1. Biofuel processing with the assistance from first generation technologies does not use efficiently the biomass resources and does not give particular attention to diminishing emissions and consumption of fossil fuels. The use of technologies for direct generation of thermal and electric power should be encouraged, because they impact more on the environment than the processing of biofuels for cars;
2. Use of biomass involves burning a considerable part of valuable and finite resources from the environment. These resources should be preserved as much as possible, and the use of biomass should be done in conditions of maximum energy efficiency. The situation is not yet functional in the largest part of the residential sector and of transport;
3. EEA estimated the arable land surface of EU that can be used for the production for bio-energy without causing environment disturbances (EEA Report no.7/2006). According to the Scientific Council of EEA, the necessary land for achieving the 10% objective for biofuel exceeds the available land, even if significant contributions of second generation biofuels are considered. The consequence of expanding energy crops is an increased pressure on land, water and biodiversity;
4. The 10% objective for biofuel will require significant imports. In certain developing countries already damaging consequences can be noticed, which resulted from the expansion of energy crops to the detriment of equatorial forests. The production under conditions of sustainability is hard to achieve and to monitor outside EU.

The extremely ambitious objective of 10% biofuel is, in fact, an experiment and the consequences are hard to estimate and even harder to control. Therefore, the Scientific Council of EEA recommends its suspension, the realisation of a new research and more comprehensive study with respect to environmental risks but also potential benefits to the environment resulting from biofuel processing, as well as determining a new objective on long term, more balanced, as long as the sustainability of the process cannot be guaranteed.

5. Perspectives regarding new generation biofuels

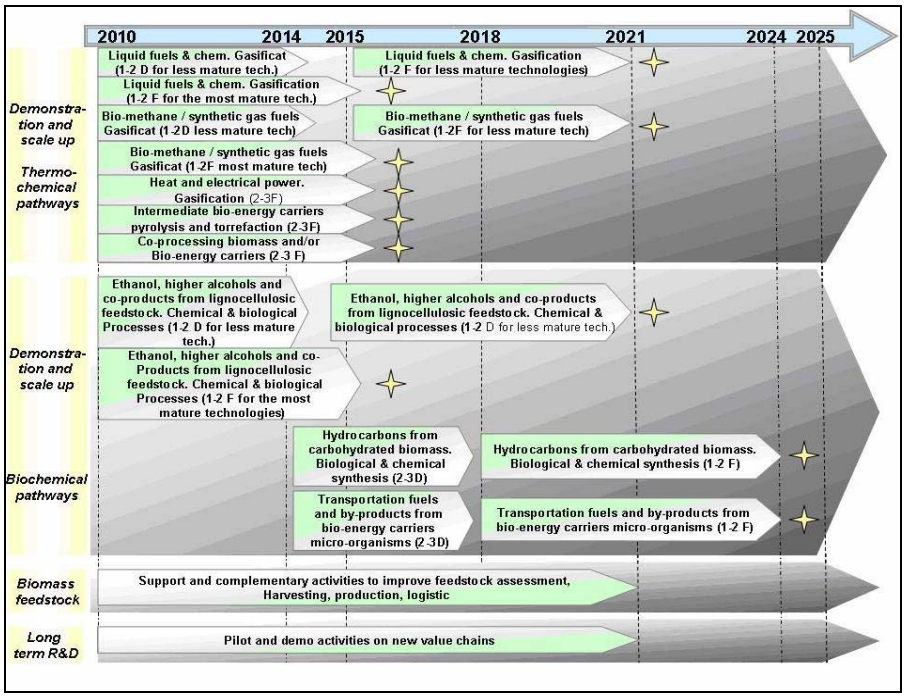
As the first generation biodiesel, processed from oil originating from plants or corn do not satisfy the requirements for a sustainable economy, there is already talk about a second generation biofuel that would generate synthetic fuel.

Currently, the most promising technology of generating biofuels is based on wood residues. Several procedures are tested, but only one of them can generate clean gas. The gas can be used as such or can be changed into synthetical diesel fuel with a production cost of approximately 1 Euro/litre.

The process by which residues are changed is based on gasification of biomass and is a top technology involving several technical and financial risks. Recent studies show that biofuels processed from wood or wood waste might be processed on large scale around the middle of the next decade, even though they required an investment of about 500 million Euros, or 10 times the cost of the first generation technologies (bioethanol or biodiesel).

The development on commercial scale of industrial plants for the second generation biofuels (pulp bioethanol, biogas and bio-hydrogen) (Figure 3) require high capital investments, as well as the support of authorities for determining on long-term future demand. Not to mention the huge effort needed for the third generation biofuels.

Figure 3. Perspectives for second and third generation biofuels



6. Conclusions

Replacing fossil fuels with biofuels was proposed within the European Union as part of the strategy to diminish greenhouse gas emissions resulting from transports. Also, it is pursued to reduce energy consumption and support the development of rural communities. The first generations biofuels are usually products of food industry, such as wheat, corn, sugar cane or vegetable oils. These crops need intensive entries of energy, water, fertilizers, pesticide which makes difficult the diminution of gas emissions contributing to climate change. The global demand for these fuels pushed upwards the price of food.

At first sight, the theory of using biofuels is easy: due to their origin, i.e. plants, these absorb CO_2 while the plant grows and then releases it back into the air while burning biofuels. Theoretically, this is a cycle that neutralises the greenhouse gas emissions effect. However, these theories were issued without fully knowing the sustainability and deterioration degree of the environment by means of intensive farming of bio-energy plants such as corn, palms, soya beans or sugar cane, as well as of other crops used as raw material in generating biofuels.

In order to solve the deficiencies of the first directive regarding biofuels, in 2009 a new directive with more realistic objectives was promulgated. Nevertheless, a series of studies and analyses have shown that the extremely ambitious objective of 10% biofuel is, in fact, an experiment, the outcomes of which is difficult to estimate and even harder to control. Therefore, the Scientific Committee of the European Environmental Agency recommends its suspension, the realization of a new and more comprehensive study with respect to environmental risks, but also the potential benefits on the environment resulting from biofuels processing, and the set-up of a new long-term objective, more balanced, as long as the sustainability of the process cannot be guaranteed.

As shown in numerous other papers, in the EU the production costs of biofuels are higher than the ones of fossil fuels. Currently, the use of biofuels is viable from the economic viewpoint only when they originate from import (for instance, Brazil), or are accordingly subsidised.

In many places of the world, chain reactions take place in response to economic incentives introduced by developed states. A first reaction is to expand the crops of energy plants to the detriment of other crops or by reclaiming tropical forests. The effects of extending energy crops have positive effects, such as the use of abandoned lands, but also replacing traditional crops, which has as effect the increase in prices for basic food (flour, maize, oil, etc.).

For instance, in the last period, detailed studies have shown that a defining element for the CO_2 quantity released by burning biofuels is the land on which crops were grown to produce the latter. The change of interior lands, from USE in corn crops led to the increases in CO_2 emissions by over 134 tons per hectare – a difference which requires 93 years of using ethanol obtained from corn, instead of petrol to keep the balance. The change of the jungle in palm crops or of the tropical forest into soya beans crops would require centuries for re-establishing the CO_2 balance in nature.

The production of any type of biofuel requires deforestration which would lead surely to increases in global warming. Centuries are necessary for re-balancing CO_2 in nature after massive deforestration.

The negative unintentional effects are aggravated by the fact that changes into the agricultural structure in one country influence the agricultural production in another country. For instance, the change in food crop destination of biofuel source also causes the multiplication of deforestration. For instance, the high demand for ethanol in the USA determined local farmers to plant more corn (to process ethanol) and less soya. Therefore, the price for soya increased and Brazilian farmers reacted by accelerating deforestration in the Amazon forests for planting soya. Because soya crops retain less CO_2 than the equatorial forest of a corresponding size, initial benefits aimed for using ethanol instead of petrol are quite small.

Moreover, the price of fodder in EU doubled in the last years, thus decreasing even more the viability of indigenous biofuel processing.

In the last period, bigger subventions were proposed for the EU production of energy crops (more than 45 Euros/ha) or exempting biofuels from excises, but these solutions presuppose important financial resources.

As a conclusion, a simple cost-benefit analysis is not enough because biofuels are agricultural products and their wide-scale use presents numerous risks, particularly with respect to uncontrolled expansion of mono-crops, as well as the increase of using chemical products for plant treatment. On the other hand, biofuels are different from all other agricultural products, their final destination being not ensuring food for population, but energy generation.

It should be mentioned that in Romania in-depth studies have to be made about the effect of biofuels. At first sight, it results that Romania would have enough land to cover the objectives of the biofuel directive without resorting to massive deforestation. It is not clear at what costs biofuels would be processed and how high the subvention to be paid. Also, the time horizon for subvention is still

unclear. It is possible that the biofuel industry shall not reach maturity on medium term and the subvention would be paid on long run with uncertain outcomes.

The main issues regarding massive subventions for first generation biofuels are:

- increasing prices of food;
- the effect of diminishing greenhouse gas emissions is very low, or even opposite;
- loss of biodiversity and virgin forests.

Under these conditions, it is necessary to determine a new objective on long term, more balanced and developing second and third generation biofuels.

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