

## BIOFUELS AND THE GREENHOUSE EFFECT PUBLIC INFORMANCE - EDUCATION

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### INTRODUCTION

Biofuels were the first kind of fuels that were used on the planet, however nowadays biofuels are closely connected to the greenhouse effect. Greenhouse effect is a complex problem that demands the collaboration of governments, scientists as well as ordinary people in order to face it. It is essential though to understand that it also demands culture and that the commonly referred to as environmental education is not enough.

With the present proposal we aim at enlightening the issue of biofuels and every one who may be concerned, through the educational procedure, by pointing out the exaggerations as well as the inaccuracies that were published from time to time from both supporters and decriers.

### WHAT ARE BIOFUELS

Biofuels are all those fuels that come from biomass. The term biomass refers to all the dead parts of plants and animals, as well as to the waste products of animal's metabolism, like feces mainly from bovines.

Some biofuels are:

**Firewood and charcoal**, known from the prehistoric times.

**Pellets** (Figure1). They derive from drained and fragmented parts of different kind of plants after the appropriate mechanical treatment.



Figure 1.

There can be converted into pellets: the by-products of wood treatment, like sawdust and scrap wooden parts, the materials that are left from the cleaning and sanitation procedures of forests like boles and bushes, the lops that remain from the trees, the shanks of farming after the harvest of fruits like the shanks of corn, or some energy plants that are cultivated for this purpose like cardoon (thistle-Figure2) .



Figure2.

Pellets are used as a substitute of firewood and coal in specific heaters (Figure3). They also have many advantages over coal as far as the quality of the exhaust that is produced is concerned.



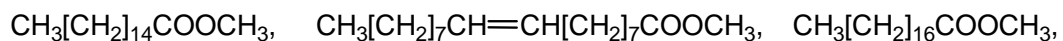
Figure 3.

**Bioethanol.** It concerns the well-known chemical compound ethanol or empirically known as alcohol. The term bio ethanol suggests only its origin.

This fuel is produced in countries that use cheap materials for the production of sugar containing solutions, which afterwards are converted to alcoholic solutions during the process of alcoholic fermentation. The country with the greater production of bioethanol is Brazil due to the appropriate weather conditions.

**Biogas.** Biogas is a gas fuel that is produced from wastes in specific industrial plants. Gas is produced from the wastes of bovines with the methane to be the most abundant component.

**Biodiesel.** Biodiesel is a mixture of fatty acids esters with low molecular mass alcohols, mainly methanol (Figure 4). Usually it is a mixture of the following esters:



It derives from vegetable or vital fat during a specific procedure which is called, transesterification, in chemical terms. The final product behaves in the same way like diesel in internal combustion engines.

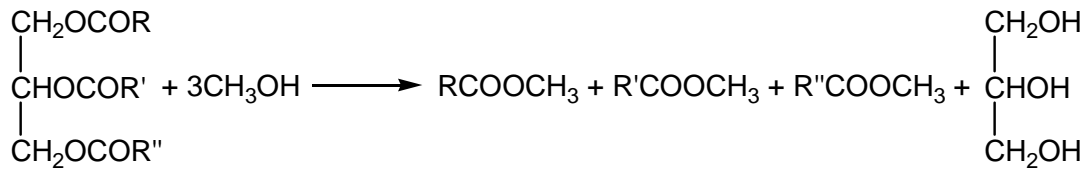


Figure 4.

Biodiesel is mainly produced in countries that spare cheap crude (prior to refinement) seed-oil. In countries that have developed cattle breeding, like Ireland, biodiesel is produced from fat that is rejected from butcheries.

The way to convert oils in bio-diesel is rather simple and it does not demand advanced technology. In Greece there are produced 500,000 tones yearly, according to the data from Greek Industrial Biodiesel Association.

#### WHY USE BIOFUELS (ADVANTAGES)

Using biofuels the following are achieved:

- 1) Not to depend upon mineral fuels, for economical reasons, especially for countries that do not possess them.
- 2) Limitation of emissions of greenhouse gases.

#### BIOFUELS HAVE AN ADVANTAGE OVER MINERAL FUELS AS FAR AS THE EMISSIONS OF GREENHOUSE GASES ARE CONCERNED

The statement that biofuels do not charge the atmosphere with CO<sub>2</sub> emissions, or they slightly charge the atmosphere, seems extravagant to many people, as they wonder how it is possible their combustion (like firewood), during which great quantities of CO<sub>2</sub> are produced, not to contribute to the enhancement of the atmosphere with the particular gas.

The interpretation is obvious in the following examples:

If the dead logs of trees are not utilized, after the lapse of several years, they are converted to inorganic compounds during the process of decomposition and the interference of insects, bacteria and stems. The above procedure is characterised with the biological term: 'degradation'.

During their conversion to inorganic compounds though, the same amount of CO<sub>2</sub> is produced with the amount that would have been produced from the combustion of wood.

This amount of CO<sub>2</sub> corresponds to the quantity of CO<sub>2</sub> that was taken on from the plant during the process of photosynthesis in order to form the specific quantity of wood.

From the above it is clear that the combustion of firewood and charcoal does not charge the atmosphere with CO<sub>2</sub>.

The above applied a few decades ago because: At our time in order to cut trees, machines (band saw) are used that use benzene, a product of crude petroleum. In order to chop up and transfer wood, also machines are used that consume products of crude petroleum. So, firewood as bio-fuel is not quite clear.

The same thing applies to current biofuels, which also contribute to the greenhouse effect, each one with a different percentage. This happens because the procedure of producing pellets, bio-ethanol and bio-diesel demands industrial plants which consume among other things electric power. It has been calculated that for every KWH consumed, the atmosphere is charged with one Kgr of CO<sub>2</sub>.

As far as the other components of biomass are concerned, we have the following conversions: Nitrogen is converted to  $N_2$  if the combustion takes place in low pressure and temperature conditions; oxygen is converted to  $CO_2$  and S to  $SO_2$ , independently of the combustion conditions.

Though, during the function of internal combustion engines, nitrogen oxides are produced from the components of the atmosphere due to the fact that high pressure and temperature are developed.

Also, some types of biofuels produce greater quantities of  $NO_2$  in internal combustion engines than the fuels that come from crude petroleum. Those biofuels originate mainly from plants, in the root system of which nitrogen fixing bacteria are developed. Such plants are legumes. As we know though, the problem of nitrogen oxides emissions is faced using specific catalysts.

**The conclusion from all the above information is that biofuels are not completely 'innocent' as far as the emissions of greenhouse gases are concerned. They do though have great advantages over mineral fuels in that area.**

Contrary to biomass, mineral fuels, coal, petroleum and natural gas, produce  $CO_2$  only since they have been excavated and exploited, thus only with the interference of man.

#### OTHER ADVANTAGES OF BIOFUELS

Biofuels produce  $SO_2$  in much smaller quantities than conventional fuels.  $SO_2$  is the number one factor that contributes to the formation of acid rain. Besides only a few plants contain S in considerable amounts. Some of the known plants that contain S are leek, onion, and garlic. The components of biodiesel are biodegradable, as esters of organic acids. Also bio-diesel does not contain aromatic hydrocarbons which are highly toxic and carcinogenic.

#### DISADVANTAGES OF BIO-FUELS

The main disadvantages of biofuels that are mentioned in the literature (published articles and internet) are the following:

1. They increase the prices of the agricultural products.
2. They contribute to deforestation.
3. They produce larger quantities of  $NO_2$  than conventional fuels.
4. Bioethanol during its combustion produces acetaldehyde which is carcinogenic.

#### COMMENTARY OF THE DISADVANTAGES

The crop of energy plants has as a result the restriction of cultivation of other crops. This also has as a result the increase of the prices of agricultural products and food. In order to cultivate energy plants, forests are being deforested, mainly tropical. Forests contribute to the consumption of  $CO_2$  which is the main greenhouse effect gas. This though, has as a result the confutation of the main advantage of biofuels which is the restriction of the greenhouse effect emissions.

**The last two disadvantages though, are not quite valid**, because they can be easily confronted using the technology of the past decades. Catalytic converters that are used in vehicles convert the oxides of N to  $N_2$  and  $O_2$ , while the substances that contain C, H, and O, like  $CH_3CHO$ , are converted to  $CO_2$  and  $H_2O$ .

This subject is offered for an interdisciplinary as well as an inter-professional approach, mainly in the area of science education since it is an interprofessional issue on its own.

**Interdisciplinary approach:** A way of organising the analytical schedule by negating the discrete courses and deal with knowledge as a uniformly wholeness.

**Interprofessional approach:** A way of organising the analytical schedule by preserving the discrete courses and aim at relating their content.

#### **Example of interdisciplinary approach:**

Plants consume  $\text{CO}_2$  from the atmosphere,  $\text{H}_2\text{O}$  from soil, and solar energy in order to form  $\text{C}_6\text{H}_{12}\text{O}_6$ , which is converted to cellulose, from which the log plants are consisted of. When the log plants are converted to inorganic matter, C is converted to  $\text{CO}_2$ , H is converted to  $\text{H}_2\text{O}$  and the solar energy that was absorbed, is aborted as heat. Thus, during the degradation procedure the same amount of  $\text{CO}_2$  is produced, with the amount that was taken on from the plant during the photosynthesis procedure. The solar energy that was absorbed from the plant during the photosynthesis procedure is also expelled as heat during degradation.

Conclusion: It is rather preferable to burn firewood in order to exploit their heat than let them rotten. Besides, the same amount of  $\text{CO}_2$  that will be produced during combustion will also be produced during degradation (decay). The amount of heat that is produced during degradation is not perceived because this procedure takes place during several years.

#### **Example of interprofessional approach:**

If we make a reference in the above example, to the thermo-chemistry law of Lavoisier – Laplace, to the law of Lavoisier about incorruption of matter, to the thermodynamic principles of physics and also if we make a reference to the photosynthesis and degradation procedures as biological procedures, an inter-professional approach arises.

Besides,  $\text{CH}_3\text{CHO}$  is produced in small quantities and only when the engine is defective. The same compound,  $\text{CH}_3\text{CHO}$ , is produced in small quantities during the decay of fruits and it contributes to their characteristic odor.

## BIOFUELS AND EDUCATION INTER-DISCIPLINARY AND INTER-PROFESSIONAL APPROACH

### CONCLUSION – DISCUSSION

Biofuels are able to cover a small percentage of the energetic needs of the planet's population. Suggestively we mention that, if firewood is used in order to cover all the energetic needs of the planet, it will only take two years before all the forests of the earth disappear. Although this small percentage can not be neglected, since for some specific countries, like Brasil, is rather important.

Biofuels do not charge the atmosphere with  $\text{CO}_2$ , not because they don't produce it as they burn, nor because they produce it in small quantities but because the carbon of biomass that lies in the biosphere will, eventually, be converted to inorganic matter without man's interference, thus we have to make it as productive as possible.

Bio-diesel and diesel are two different chemical compounds. Diesel is a mixture of hydrocarbons, while bio-diesel is a mixture of esters, usually palmitic methyl ester, oleic

methyl ester and stearic methyl ester. Contrary, bioethanol is the same chemical compound with ethanol, independently of the production mode.

The use of biofuels could be one efficient proposal, as far as the reduction of the greenhouse effect emissions is concerned and the partial independency of mineral fuels, under the following conditions:

1. Cultivate energetic plants without deforestating the land .
2. Not to cultivate energetic plants in fertile lands where food producing plants could be cultivated.
3. To fully turn to advantage the parts of the plants that they are of no use, after the harvest of fruits or the extraction of their useful parts.
4. To utilize as fuels, the by-products of agricultural and forest exploitation, after the appropriate treatment, as well as the scrap by-products wood treatment plants.

## LITERATURE

1. Chemistry, the Centrale Science. Seventh Edition. Brown, LeMay, Bursten.

Internet:

[http://www.planete-energies.com/contenu/deuxieme\\_generation.html](http://www.planete-energies.com/contenu/deuxieme_generation.html)

[http://www.ecosources.info/dossiers/Biocarburant\\_de\\_premiere\\_generation](http://www.ecosources.info/dossiers/Biocarburant_de_premiere_generation)

[http://www.actu-environnement.com/ae/news/biocarburant\\_uicn\\_4112.php4](http://www.actu-environnement.com/ae/news/biocarburant_uicn_4112.php4)

<http://www.biofuels.gr/links.html>

<http://www.cres.gr>

<http://www.biodiesel.org>

<http://www.alternative-energy-news.info/technology/biofuels/>

<http://journeytoforever.org/biofuel.html>