

**Production of biofuels in AT & CZ and its impact on the food market**

**Nora Kandler**

**Marta Gryčová**

Co-operating Universities

Financial support by

Prague and Vienna, 2010/2011

Content

[1. Motivation 2](#_Toc294469061)

[2. Methodology 2](#_Toc294469062)

[3. Introduction 2](#_Toc294469063)

[Biofuels around the world 4](#_Toc294469064)

[Advantages and disadvantages of the 1st generation 5](#_Toc294469065)

[Advantages and disadvantages of the 2nd generation 7](#_Toc294469066)

[Production costs and potentials 7](#_Toc294469067)

[Real CO2 emissions reduction 8](#_Toc294469068)

[Efficiency of 2nd generation biofuels 10](#_Toc294469069)

[EU legislation 11](#_Toc294469070)

[Food crisis 11](#_Toc294469071)

[4. Biofuels in Austria and the Czech Republic: production and legislation 12](#_Toc294469072)

[Biofuels in Austria 13](#_Toc294469073)

[Market situation 13](#_Toc294469074)

[Promotion of biofuel production 14](#_Toc294469075)

[How did Austria implement the EU Directive 2003/30/EC? 14](#_Toc294469076)

[National Resources for processing biomass 14](#_Toc294469077)

[Food price vs. biofuels production analysis (econometric analysis) 15](#_Toc294469078)

[Biofuels in the Czech Republic 16](#_Toc294469079)

[Legislation about biofuels 17](#_Toc294469080)

[Biofuels production 17](#_Toc294469081)

[Food price vs. biofuels production (econometric analysis) 21](#_Toc294469082)

[5. Discussion of results and future perspectives 23](#_Toc294469083)

[6. Index of Figures 23](#_Toc294469084)

[7. Index of Tables 24](#_Toc294469085)

[8. References 24](#_Toc294469086)

[9. Appendix 26](#_Toc294469087)

# Motivation

Climate change and its impacts have been discussed thoroughly in the past few years by governments around the world. It is obvious that several actions have to be taken against further CO­­2 emissions. One of these measures are biofuels which in the last years mainly were discussed because of their competition with food production and the resources for biofuel production within the environment of the food crisis. This has drawn our attention to the field of biofuels. During literature research we have found many articles that illustrated an interrelation between food prices and biofuel production, but also many articles that argued with other potential factors for increased food prices and marked the biofuels production as negligible factor. This disagreement in academic literature attracted us to the extent that we want also at least partly contribute to this debate with this paper. Even though we hardly agree that the 1st generation biofuels are an effective solution to the climate change problem because of the very low CO2 emissions reduction, this paper would like to evaluate this issue objectively and to concentrate only on the relation between food prices and the production of biofuels in the analysis section without taking in mind other negative externalities of the production of 1st generation biofuels.

# Methodology

We will use methods of synthesis in the section of literature review about the connection of biofuels and food prices. The method of analyses on econometric basis relating the two variables of food price and biofuels production will be carried out in the second section.

# Introduction

*“Nicolas Sarkozy, France's president, has rightly identified food price volatility as a priority for his country as it chairs the Group of 20 leading economies this year. Figures released on Wednesday by the UN's Food and Agricultural Organisation show that costs for a range of basic commodities have now surpassed their peaks of 2008. With food accounting for a large and volatile share of tight family budgets in the poorest countries, rising prices are re-emerging as a threat to global growth and social stability.“*

(Robert B. Zoellick, president of the World Bank Group, Financial Times, 05/01/2011[[1]](#footnote-2))

*“The latest FAO Food Price Index averaged 231 points in January, up 3.4 per cent from December and the highest level since it started in 1990, above 2008. Another measure, the World Bank’s food price index, rose by 15 per cent between October and January and is now only 3 per cent below its 2008 peak. Whichever measure is used, the result is the same: 44 million more people thrown into extreme poverty.“*

(Article: „UN food experts call for increased agricultural investment to offset soaring prices,” UN News Center[[2]](#footnote-3), 18/02/2011)

Figure 1: FAO Food Price Index[[3]](#footnote-4)

As pictured in media, food prices are reaching the top in recent history, noticed as the Great Food Crisis of 2011. Among many other important factors in some literature sources biofuels are blamed as one factor. It is definitely immoral to burn food crops to gain biofuels instead of feeding hungry children in developing countries. In some countries highly profitable biofuel crops displace the traditional crops for food production purposes in the arable land area. In 2008 the biodiesel production was about 3 million gallons[[4]](#footnote-5) in the European Union, which was 65% of the global biofuel production[[5]](#footnote-6). In 2009 the US bioethanol production peaked at 10.6 billion gallons[[6]](#footnote-7). Brazil and the US produced over 87% of global biofuels production in 2008. The global biofuels’ production with an annual growth rate of 6% and 5% for biodiesel and bioethanol production respectively, counts over 4.4 billion gallons for biodiesel and 19.3 billion gallons for bioethanol in 2009[[7]](#footnote-8). The world final consumption of liquid biofuels was 66.7 million tonnes in 2009. In 2007 the area of energy crops exceeded 42% in the EU.[[8]](#footnote-9) From the figures it can be deduced that biofuels as a new phenomenon are very important to the food prices analysis mainly due to their high growth rate. Even in some developing countries biofuels are profitable to produce thanks to subsidy policies in many countries. However, we have to put into question if the biofuels’ GHG emission reductions are really worthy given privileges by the government, respectively if biofuels are efficient from both economic and environmental point of view and if there are other hidden consequences of huge 1st generation biofuels’ boom.

This paper tries to concentrate on the relation between food prices and biofuels’ production in the Czech Republic and Austria, with respect to their natural resource base for energy production. The evaluation of the usage of 1st and 2nd generation biofuels is carried out and the most striking advantages and disadvantages are stressed in the first section. Also EU targets for biofuels’ content in will be outlined. The main task of this paper is to discover the true relationship between food prices and biofuel production in this two countries. The correlation between increased production, respectively increased arable areas devoted to the production of rapeseed and changes of food prices, mainly the price of bread, is calculated. Finally the results of the price analysis and the danger of food crisis are assessed.

## Biofuels around the world

Biofuels as a relatively new source of energy are a quite new phenomenon in production. Due to the oil crisis in 1970’s developed countries tried to find some alternative fuels to reduce their dependence on fossil fuels, imported from OPEC countries. It was also necessary to find some economically and environmentally sustainable fuels because of the scarcity of fossil oil. The boom of biofuels nowadays is mainly caused by people’s and government interest in greenhouse gas (GHG) mitigation and in rural development. However, biofuels only make about 2% of world fuels consumption in 2008 (UNEP).

Nigam and Singh (2011, p. 54) summarize the most common categories of biofuels: Primary biofuels are, i.e. firewood, wood chips, pellets, animal waste, forest and crop residues, landfill gas, etc., and secondary, i.e. are biofuels themselves. Secondary biofuels can be divided in 1st, 2nd and 3rd generation of biofuels. The 1st and 2nd generation will be explained in the following sections. The 3rd generation contains those biofuels produced from algae and sea weeds, i.e. biodiesel and bioethanol from algae, see weeds and hydrogen from green algae and microbes. World’s main biofuel production is based on bioethanol. In the EU-27 also the increasing importance of biodiesel can be observed. The following graph describes the current situation and recent development:



Figure 2: World biodiesel and ethanol production from 1975 to 2010[[9]](#footnote-10)

## Advantages and disadvantages of the 1st generation

The 1st generation of biofuels is defined as those biofuels that are produced from plants that contain sugar, starch or oil, such as corn, wheat, barley, sugar cane, rape seed, soybean, sunflower or from animal fats, thus competing with agricultural food production. They nowadays dominate the market of biofuels. They include ethanol produced from sugar cane, corn or starch, biodiesel (or fatty acid methyl esters, FAME) from oilseeds, soybean and rapeseed, or PPO (pure plant oil). We distinguish different types of biofuels: e.g. B5 – means 5% share of biofuels and the rest is fossil diesel, etc. The same applies to ethanol (E5, E20…). Around the world the production of bioethanol is higher than biodiesel (21 billion gallons vs. 5 billion gallons). However, in the EU mainly biodiesel is produced. Timilsina et Shrestha (2010) summarize the top bioethanol and top biodiesel countries with their major feedstock used for the biofuel production: For ethanol production the leading country is USA with corn, then Brazil with sugarcane as a major feedstock and far behind these two, China and the EU (wheat – 70%). The number one in biodiesel production is the EU, namely France and Germany, with rapeseed as major feedstock. After them on the second place is the USA with soybean as major feedstock.

The advantages of the 1st generation biofuels are overwhelmed by its disadvantages. However, among environmental positive impacts the biofuels still have potential to mitigate GHG and other air pollutants. Demirbas (2009) states the differences in emissions from 20%vol. soybean-based biodiesel added to petrodiesel (B20) and petrodiesel. Biodiesel is able to reduce particular matter, hydrocarbons and carbon monoxide, but increases nitrogen oxides (NOx) in unmodified diesel engines. Emission reductions expressed in percentages: NOx +2%, particular matter -10.1%, hydrocarbons -21.1% and carbon monoxide -11.0% in 2007. According to EPA, percentage change in emissions for pure biodiesel (B100) compared to conventional petrodiesel in total: for hydrocarbons (HC) -67%, for CO -48%, PM -47%, NOx +10%, sulfates -100% and for polycyclic aromatic hydrocarbons -80%. Next figure shows the GHG emissions and primary energy savings of biofuels completed by Reinhardt and von Falkenstein (2010).

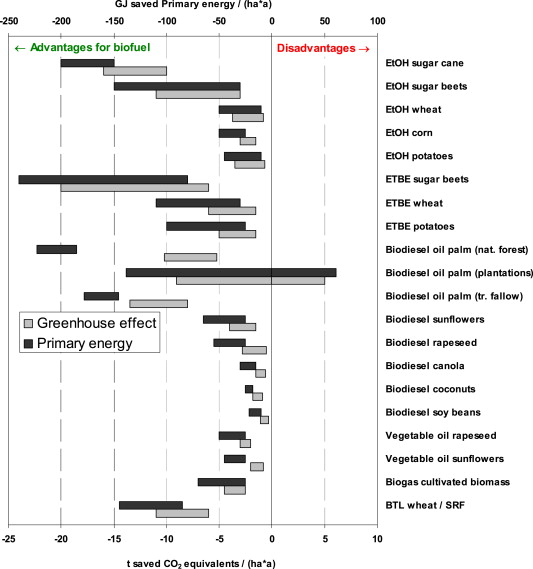


Figure 3: GHG mitigation and primary energy saving potentials of biofuels[[10]](#footnote-11)

From the figure describing life cycle comparisons of biofuels from energy crops and fossil fuels for energy consumption and greenhouse gases it is clear that most of the results are in favor of biofuels except palm oil from palm oil plantations. However, land use effect (e.g. carbon stock changes of soil and vegetation) and indirect land use changes are not taken into consideration in the studies searched by Reinhardt and von Falkenstein (2010). Including this can completely change the total impact of biofuels to even opposite sign. Also efficiency of production must be considered. Brazil is very efficient in producing biofuels, but the devastation of the tropical forests remains an unsolved problem. Other advantages and reasons to produce biofuels are sustainability and renewability, fuel diversity and reduction of use of fossil fuels, increased employment in rural areas, etc. (Demirbas 2009).

The main disadvantage is competition with agriculture food production and land use - also connected with increased food prices (prices of agricultural raw materials), mainly due to financial speculation with biofuels prices, competing biomass, increased use of fertilizers (more intensive agricultural production and therefore increased eutrophication of surface water), water pollution (by pesticides) and water usage (scarce water resources in some regions), energy used, logistics, danger of deforestation (tropical forests), negative impact on biodiversity and local ecosystem, etc. Biofuels are also a very expensive option in terms of total production costs excluding government subsidies providing only low GHG reductions at relatively high costs (IEA 2009).

## Advantages and disadvantages of the 2nd generation

Since first generation biofuels caused a lot of controversies concerning land use, competition with areas for food production, limited GHG saving potential and supply of feedstock, research is now emphasizing on second generation biofuels. Since second generation fuels do not only use parts of the plant (e.g.: starch, sugars and oils) like the first generation biofuels but also use the lingo-cellulosic parts, agricultural residues and waste, hope for a more sustainable production of biofuels has risen again and investments in R&D are promoted. Second generation biofuels are those biofuels produced from cellulose, hemicelluloses or lignin. 2nd generation biofuel can either be blended with petroleum-based fuels combusted in existing internal combustion engines, and distributed through existing infrastructure or is dedicated for the use in slightly adapted vehicles with internal combustion engines (e.g. vehicles for DME). Examples of 2nd generation biofuels are cellulosic ethanol and Fischer-Tropsch fuels. (IEA Bioenergy Task 39, 2009)

2nd generation biofuels can be made available by two different conversion routes (Sims et al. 2009 and IEA):

**Bio-Chemical:** Enzymatic hydrolysis of lingo-cellulosic material into sugars. Then sugars are fermented into alcohol and later destilled into ethanol.

**Thermo-Chemical:** Alsobtl (biomass-to-liquid).Pyrolysis or gasification produces a synthesis gas. The synthesis gas is transformed into (i) liquid (btl-Diesel) or (ii) gaseous fuel (bio-SNG). It is based on the Fischer-Tropsch conversion.

But even second generation biofuels are no universal remedy. Still they cannot compete with conventional fossil fuels in prices without governments subsidies (with Brazil being the only exception) and because of constraints due to logistics problems (supply for year-round availability of feedstocks) and cannot yet be commercially deployed. (Sims et al. 2009) At the moment only demonstration plants are in operation, which are located i.e. in Freiburg (Germany) by Choren (Fischer, Hizsnyik 2009, p.61) and in Canada operated by Iogen[[11]](#footnote-12).

Second generation biofuels have some advantage compared with biofuels of the first generation that make them more sustainable than their forerunner. They don’t need as much arable land because their yield is significantly higher than that of the 1st generation and some plants even can grow on lands that don’t have high demands for quality, although they also need sufficient irrigation and specific nutrients. With the 2nd generation, already available land can be used which was not apt for cultivation of cereals or other plants for food production. Therefore it would not stand in competition for food anymore. According to a study conducted by WWF Brazil, no further deforestation would be necessary in Brazil because of already available land (degraded pastureland) that could be used for cultivation of feedstocks for biofuels. (WWF Brasil 2009) The main drivers of the development of biofuels are (Sims et al. 2009): Energy supply security, wish for independence, encouragement of rural areas, reduction of GHG emissions.

### Production costs and potentials

As 2nd generation biofuels are not yet ready for commercialization, there are no long-time studies, which can prove the full production costs and the development of cost reduction due to economies of scale, feedstock prices, deployment of new technologies and learning and experience. Whereas there are higher expected cost reduction effects for bioethanol produced biochemically than for the BtL process, which is already established (as coal- or biogas-to-liquid process) for many years. At present, investments in second generation biofuels are very risky, as oil and gas prices are not stable. (Sims et al. 2009)

|  |  |
| --- | --- |
| Advantages | Disadvantages |
| * Rely on forest residues and high yielding non-food energy crops * Can be cultivated on lower abundant soil * Are considered to be produced more sustainable (Sims et al. 2009) * Consuming waste residues * Using abandoned land * Promote rural development * Create jobs in rural areas (depending on the feedstock) | * Can barely compete with the prices of crude oil, tar sands, gas-to-liquids and coal-to-liquids * High commercial risks, even with government subsidies (Sims et al. 2009) * Complex logistic system and good infrastructure needed- which makes it more difficult for developing countries to implement these new technologies (Eisentraut 2010) * Competition with food-cultivation |

### Real CO2 emissions reduction

In lifecycle analyses biofuels are often considered CO2 neutral, because carbon dioxide emissions during combustion will later be absorbed from the air by newly growing feedstock. But it is not sufficient to calculate only CO2 that derives from combustion but the whole lifecycle of each biofuel has to be analyzed thoroughly to be able to make predictions about their impact on air pollution. Most studies neglect for example land-use changes, which in fact have a high impact on the environment and the pollution of our atmosphere. Further impacts of biofuel production are: burning of fields/forests, drainage of peatlands and burning of peatlands. Burning practices have widely been forbidden by ASEAN[[12]](#footnote-13) member countries and RSPO[[13]](#footnote-14) but it is difficult to enforce these policies and due to lacking surveillance, burning continues. (AEA Technology 2008, p.92) But in the special case the lifecycle of the biofuel has to be compared with the lifecycle of its fossil fuel equivalent. If forestry residues are the main feedstock, no additional space for production will be needed and would prevent potential deforestation or degradation of land. (Eisentraut 2010)

In comparison to the first generation, biofuels of the second generation are said to have a considerable higher GHG saving potential. The saving potential can reach up to 91% (for straw) compared to petrol or even 94% (from wood). The following table shows the expected GHG saving potentials of different feedstocks (well-to-wheel):



Table 1: Expected GHG saving potentials of different feedstocks (well-to-wheel)[[14]](#footnote-15)

|  |  |  |
| --- | --- | --- |
| Feedstock | GHG/CO2 saving | Authors (year)/Source of review |
| Wood (poplar) | 51% | GM et al. (2002)/Fulton et al. 2004 |
| Wood | 77% (CO2) | Shaheen (2005) |
| Wood | 107% | Wang (2001)/ Fulton et al. 2004 |
| Grass | 66-71% | GM/ANL (2001)/Fulton et al. 2004 |
| Grass | 73% | Wang (2001)/ Fulton et al. 2004 |
| Grass | 72% (CO2) | Shaheen (2005) |
| Grass | 71% | Levelton (2000)/Fulton et al. 2004 |
| Crop residue (straw) | 82% | GM et al. (2002)/Fulton et al. 2004 |
| Crop residue (stover) | 61% | Levelton (2000)/Fulton et al. 2004 |
| Hay | 68% | Levelton (2000)/Fulton et al. 2004 |
| Wheat straw | 57% | Levelton (2000)/Fulton et al. 2004 |
| Corn stover | 84% (CO2) | Shaheen (2005) |

Table 2: of estimates of GHG mitigation potential of Ethanol[[15]](#footnote-16)

The impact of biofuel-production on the atmosphere varies with the way of conversion, the choice of land (e.g. soil, climate, crop management) and the kind of feedstock used (Eisentraut 2010)



Figure 5: Comparison of well-to-wheel emission changes of different biofuels compared to fossil fuel

### Efficiency of 2nd generation biofuels

For cultivation of feedstocks for fuels of the second generation not each region of the world is equally suitable. In an cooperative assessment of FAO and IIASA[[16]](#footnote-17) it was found out that about 3 billion hectares (or 40% of the world’s combined cultivated land, unprotected grassland, woodland and unprotected forestland) have potential for high yields of lingo-cellulosic feedstock. The assessment was conducted for herbaceous[[17]](#footnote-18) and woody cellulosic[[18]](#footnote-19) feedstock and shows that South America accounts with 76% or almost 1 billion hectares of the world’s total suitable land as most suitable region. Of the unprotected grasslands and woodlands alone world-wide 25% or about 860 million hectares would be suitable for the production of lingo-cellulosic feedstocks. (Fischer, Hizsnyik 2009, p.124)



Figure 6: Global land suitability for second-generation feedstocks (herbaceous and woody lignocellulosic plant species)[[19]](#footnote-20)

Potentials of biofuels concerning economic growth, oil substitution and air pollution are limited due to competing land and water resources for (Sims, Mabee et al. 2009):

* high subsidies by governments as long as the oil price is low – biofuels have much higher processing and production costs
* GHG emission balance, when making land available for cultivation of food crops/ energy crops

## EU legislation

Like in the Czech Rep. and Austria the European Union is confronted with similar problems as its individual member states. In total 98% fossil fuels are imported from countries in politically unstable regions of the world which perils energy and fuel supply. Therefore the EU set targets for its member states for the next years to achieve more energy supply security, reduce CO­2-emissions to meet the Kyoto Protocol goals and to achieve more competitiveness. These targets are demonstrated in three main directives of the EU and several other policies:

EU Directive 2003/30/EC promotes the use of biofuels (1st and 2nd generation) or other renewable fuels (electricity, hydrogen…) for transport. It stipulates substitution of conventional fuels for biofuels until 31.12.2010 of minimum 5.75% (20.7mio t/a) and 31.12.2020 of minimum 10%. (Biofuels Research Advisory Council 2006)

Directive 2003/96/EC regulates the application of tax incentives for biofuels. Each member state can set its individual taxation for biofuels but has to present it to the European Commission for authorization. This provides that distortion of competition prevails on an acceptable level. In Directive 2003/17/EC (amending Directive 98/70/EC) environmental specification for fuels are concerned. The Directive contains a 5% limit on ethanol blending for environmental reasons. The “health check” of the CAP-policy (Common Agricultural Policy) lead to abolition of compulsory set-aside land in 2009 because of the tight situation on the cereal market, which makes more land available for cultivation of food crops and energy crops. 2003 an energy crop premium was introduced but was also abolished in 2009 as a result of the “health check”. It is expected that biofuel production will continue growing, due to high governmental targets even without EU-support.

On 23rd of January 2008 the Renewable Energy Directive (RED) was presented in the Energy Policy Package as a part of the 20-20-20 goals of the European Union. It consists of a binding minimum target of 10% of overall EU consumption in all forms of transport being substituted by renewable energy such as biofuels, electricity and hydrogen from renewable resources. It should also ensure sustainable production, commercialization of 2nd generation biofuels. Biofuels have to save at least 35% of GHG emissions compared to fossil fuels provided that indirect land-use change is not the case. Some support for biofuel production also comes from the rural development policy. (Fischer, Hizsnyik et al. 2009)

## Food crisis

2008 was the year when the first time the inter-linkages of food and energy was noticed in a painful way. In only a few weeks staple food prices rose more than 50% above their usual level in some countries, causing food riots from Mexico to Haiti to Mauritania to Egypt and Bangladesh. It is said that these increases of domestic food prices resulted in a 100 million more people living in food insecure regions of the world. The reasons for this were of different character: adoption of mandatory biofuels policies, high crude oil price volatility, increasing food import demand from major developing countries and below average harvests in some countries and a low level of world food stocks. (Fischer, Hizsnyik et al. 2009, p.29)

The food crisis in 2007/08 was triggered not only by the growing production of biofuels but also by massive losses of crop caused by crop failures like draughts and inundations. Also increasing energy and food demand (especially for meat which makes higher production of animal feed necessary) in China and India amplify the raising of international food prices. Speculations on markets are also price-enhancing. There are diverging studies and assessments, how much influence increased production of biofuels has on world’s food and animal feeds prices. The estimations range from 15-25%, some deny an augmentation and some assume even 75% higher price level, even though land used for energy plants just makes up 2% of world’s arable land. (Sims, Mabee et al. 2009)

A further analysis by Ajanovic also states that the price peak in agricultural commodities 2007/08 was not alone result of biofuel production. Many events lead to the high price level such as higher costs for fertilizers and fuel for farmers, switch from food cultivation to cultivation for biofuel production in the last decades, reduction of food stocks in developing countries, destruction of crops due to bad climatic conditions (draughts, inundations…) in mayor exporting countries, higher demand of developing countries, decline of the US dollar and a high correlation with speculation in the oil market. (Ajanovic 2010)

Statements of biofuel-lobbies, saying that 1.5% of the crops in Austria and the EU can’t be the reason for increasing food prices was rejected by the IMF, who estimates that recent increasing biofuel production had a significant influence on the food prices. According to IMF estimations, biofuel production is responsible for global price increases of 70% for corn and 40% for soy. (IMF 2008, p.8 and Putzer 2010, p.90)

As mentioned above, production of biofuels cannot alone be made responsible for increasing of staple food prices. It may have some influence but there are remote opinions and estimations about the extent of the effect. Also in the econometric analysis which was conducted in order of this paper, no significant results could be found. For further research on this topic it may be important to examine especially the regional impacts of biofuel production. Because it may not have significant impact on the price level but can be measured as social costs, that cannot be quantified. For example developed countries endowed with arable resources may find it more lucrative to export biofuels feedstocks to developed country markets at the expense of food production for their own consumption and for regional markets. (Fischer, Hizsnyik 2009, p.29)

A similar case is land grabbing which is a new trend in global food market. Some states or multinational companies buy or rent huge areas of arable land to cover their national demand for food production, which shows that in some countries, self-sufficient cultivation of feedstock for biofuels is not possible and therefore leads to indirect land use-changes and furthermore has negative impacts on food security of countries affected by land grabbing. (Putzer 2010, p.38-41)

# Biofuels in Austria and the Czech Republic: production and legislation

This section is devoted to the analyses of biofuels market in the two EU countries, the Czech Republic and Austria, and to the estimation of the correlation between the biofuels production and food prices. Austria is number 14 among the top 25 countries producing bioethanol with its 485 mil. liters (128.14 mil. gallons) produced in 2010 and number 16 among the top countries producing biodiesel with its 982.96 mil. liters (259.7 mil. gallons) according to the Global Biofuels Center. The Czech Republic is number 22 among the top 25 countries producing bioethanol with its 280 mil. liters (73.98 mil. gallons) and number 25 among the top countries producing biodiesel with its 459.77 mil. liters (121.47 mil. gallons)[[20]](#footnote-21). According to the discussion about the biofuels competition with food production and land for food crops we wonder if the biofuels production really pushes up food prices.

## Biofuels in Austria

### Market situation

At present Austria depends on importation of about 95% fossil fuels from abroad. To gain more independence 5% biodiesel (since October 2005) and 5% bioethanol (since October 2007) are added to conventional fuel and Austria also approved the EU commission’s plans of a 10% use of biofuels in the EU until 2020. To make sure that use of biofuels has exclusively positive influence on economy and environment, in the EU only biofuels produced from agro feedstock which comes up to EU sustainability criteria (e.g. cross compliance and availability of 2nd generation fuels), are permitted. Thus, importation of palm oil from Malaysia or sugar cane ethanol from Brazil going along with the deforestation or displacement of original tribes should be avoided. But gained independency on oil exporting countries on will only be shifted to other European countries because Austria is not able to produce the necessary amount of feedstock to fulfill the quota. Again importation of biofuels and feedstock (e.g.: rapeseed-seeds, vegetable oil…) from countries like Hungary, Czech Republic, Romania, Bulgaria and possibly Ukraine, would be necessary. The advantage of negotiations with those countries is, that they are politically more stable than countries Austria currently imports oil from. In most cases long business relations have already existed, which guarantees security of supply. Also CO2 emissions can be saved by the substitution of conventional fuels for biofuels. (Bachlet et al. 2008) Substitution goals according to EU-biofuel Directive 2003/30/EC, Directive 2009/28/EC and Austrian Fuel Edict 2004:

|  |  |  |
| --- | --- | --- |
| Target year | EU | Austria |
| 2005 | 2.00% | 2.50% |
| 2007 |  | 4.30% |
| 2008 |  | 5.75% |
| 2010 | 5.75% | Gasoline 3.40% Diesel 3.60% |
| 2020 | 10.00% |  |

Table 3: Substitution goals of the EU and Austria[[21]](#footnote-22)

### Promotion of biofuel production

Besides the substitution obligations there are tax privileges for fuels (due to a spreading of the petroleum tax (MöSt[[22]](#footnote-23))) that are free of sulfur and which are blended with biofuels. Pure biofuels are completely liberated from any tax, as well as the share of bioethanol in the E85 fuel (of which 85% is bioethanol and 15% is petrol). These splitted petroleum tax rates became effective in October of 2005 for Diesel and in October of 2007 for petrol. Apart from the tax exemptions the “klima:aktiv” program of the Federal Ministry of Agriculture, Forestry, Environment and Water Management supports the switch of vehicle fleets to biofuels (pure or with minimum 40% share of biofuels) or electric drive. This support is addresses cities, municipalities, regional authorities, companies and the tourism sector. (Winter 2010)

### How did Austria implement the EU Directive 2003/30/EC?

According to the EU directive of 2003, all EU member states have to achieve the substitution target of fossil fuels for biofuels of 2% in the year 2005 and 5,75% in the year 2010.

Austria followed the legislation by implementing the “fuel directive” in 2004. After an adaption of the law in 2009 Austria already reached the aim of 5,75% in the same year and even exceeded the target with a 7% rate of substitution. Mainly biofuels like Biodiesel (since October of 2005) and Bioethanol (since 20007) are added to conventional fuels.

In the last reporting year 2009 following amounts of biofuels of the first generation were sold:

|  |  |
| --- | --- |
| Biofuel | Amount |
| Biodiesel | 521,611 t (of which 405.909 t were added to convenient fuels and 115,702 t were used purely) |
| Bioethanol | 99,628 t (of which the whole amount was used in blends) |
| Vegetable oil | 17,784 t (of which only 2,656 t were produced in Austria) |

Table 4: Sold amounts of biofuels in Austria 2009

In 2009 5.952.125 t of Diesel were sold, of which 5.889.649 t (or 99%) were blended with 6,52% vol. on average. In the reporting year 2009, a total of 1,841,863 t of petrol were sold, including 1,841,711 t with a biogenic content averaging 4.95% vol.

Amount of biofuels produced in 2009:

|  |  |
| --- | --- |
| Biofuel | Amount |
| Biodiesel | 323,147 t |
| Bioethanol | 138,073 t |
| Vegetable oil | 2,656 t |

Table 5: Biofuels produced in Austria 2009

### National Resources for processing biomass

**Biodiesel**: in 2009 14 utilities were in use. The whole capacity was 650.500 tonnes and for 2011 an increase to 700.000 tonnes was expected. (Cf. WKO)

**Bioethanol**: There is one bioethanol plant operating in Austria, that was put into operation in 2007. After an extension in 2009 its capacity is 191.000 t/a. As a by-product, each year 190.000 t of DDGS (Distiller’s Dired Grain with Solubles), an animal feed with high content of proteins is produced.

**Biogas:** In February 2010 there were 344 licensed biogas plants in Austria with a capacity of 93.4 MW

Figure 7: Biodiesel production in Austria 2003-2009 in tonnes

### Food price vs. biofuels production analysis (econometric analysis)

This section is devoted to the econometric analysis of the impact of biofuels production on food prices in Austria were used as data sources.

Figure 8: Prices of bread roll, bread and wheat flour in Austria 2003-2009

A simple linear regression model is used in the form: **P(bread) = a1 UV + a2X + ut**

where

P(bread) is the price of bread (or bread roll and wheat flour)

X is the production of biofuels in tonnes,

UV is a unit vector and

ut is a stochastic variable (error term).

The FAO food price index uses a second equation instead of the price of bread (P) and production of biodiesel and biogas instead of X in the first and second equation and variants of them. The tests for our model were not very satisfactory because we do not have long enough data series (Diagonal elements of W'W are very small or very different, so numerical accuracy is endangered). The estimated parameters in our equations are following:

**P(barley) = 62.59 + 0.0005541X,**

where P is the price of barley in US dollars per tonne in the Austrian market and X is the production of biodiesel in Austria in tonnes. The parameter 0.0005541 means that an increase in the production of biodiesel of 1 tonne causes an increase of the price of barley by 0.0005541 USD/t[[23]](#footnote-24). In the equation with the price of wheat in USD/t the parameter a2 was estimated to 0.000673298 and the constant was 67.007.

This way the price sensibility of following commodities for different kinds of biofuels were analyzed:

* An increase in the production of biogas of 1 m3 causes an increase in the price of barley by 0.245363 USD/t
* An increase in the production of biodiesel by 1 tonne causes an decrease in the price of bread roll of -0.0014 € per piece
* An increase in the biodiesel production by 1 tonne increases the price of bread by 0.004122 € per kilo.
* An increase in the biodiesel production by 1 tonne increases the price of wheat flour by 0.005757 € per kilo
* An increase in the production of biogas of 1 m3 causes an decrease in the price of bread roll of 0.02877 USD per piece
* An increase of the production of biogas of 1 m3 causes an increase in the price of bread of 0.001033 USD per kilo
* An increase in the production of biogas of 1 m3 causes an increase in the price of wheat flour of 0.000399 USD per kilo
* An increase in the production of bioethanol of 1 tonne causes an increase in the price of bread roll of 0.001446 USD per piece
* An increase in the production of bioethanol of 1 tonne causes an increase in the price of bread of 0.00385 USD per kilo
* An increase in the production of bioethanol of 1 tonne causes an increase in the price of wheat flour of 0.007009 USD per kilo

The main conclusions from our analysis in Austria are:

Biogas production has the highest influence on the price of bread roll, bread and wheat flour, but mainly on the FAO prices of barley and wheat.

* the production of biodiesel has a very low effect on prices (even negative influence on the price of bread)
* the production of bioethanol also has an effect on prices close to zero.
* Why is the production of biogas so important? Because of the consumption in agriculture?

## Biofuels in the Czech Republic

Biofuels in the Czech Republic have a long tradition. From 1992 the production of rapeseed oil methyl ester (FAME) for automotive fuel purposes has been increasing at the higher and higher annual growth rate thanks to financial subsidies, subsidized loans, grants, subsidized price of rapeseed, etc. Big production capacity was build during the early period. Actually, there is any direct subsidy to biofuels industry or to farmers of biofuels’ plants no more. In the following sections the current legislation and situation in the Czech biofuels market will be covered.

### Legislation about biofuels

According to the act No. 172/2010 Coll. of 29 April 2010 (amending the Act No. 86/2002 Coll.) on air protection and amendment of some laws (the Clean Air Act), from the 1st of June the content of biofuel in gasoline, more precisely bioethanol, is set at 4.1% of the total volume of motor gasoline blended with motor fuels; in form of low-percentage blends it must be at maximum of 5% of volume (without exceeding the amount of oxygen content at the maximum of 2.7% by weight); and the content of biofuel in diesel must be 6% of the total volume of diesel fuel blended with diesel oil; by the form of low-percentage additions it shall not exceed the maximum fixed proportion of 7% by volume. The list of all legislation connected to the biofuels can be found in the Appendix. Subsidies directly connected with the energetic plants intended to produce biofuels paid to the farmers was abolished beginning from the year 2010. The only subsidy that the biofuel plant farmers can receive is SAPS. The list of energetic plants that are subjects to subsidies payment according to the Government Regulation No. 333/2007 Coll. amending Decree No. 80/2007 Coll. § 3 par.5 is in the Appendix.

### Biofuels production

In the Czech Republic biodiesel in the form of FAME (fatty acid methyl ester) from rapeseed oil is produced more than bioethanol from sugar cane, because the Czech legislation did not set any priority which type of biofuel the Czech Republic should be produced in the future, therefore producers started with FAME. Also biodiesel is more adequate for European countries. However, bioethanol is much more used worldwide. So in 2006 the Czech producers started also bioethanol production from sugar cane. Emissions from the czech biopetrol (FAME) in large utilities in the Czech Republic are lower than from standard petrol by about 45%. Most emissions in terms of grams of CO2 equivalent per MJ (gCO2eq/MJ) are emitted during the cultivation of rapeseed (29g CO2eq/MJ from total 45,4g CO2eq/MJ), then during the production of FAME (9,9g CO2eq/MJ), during the production of rapeseed oil (5,5 gCO2eq/MJ) and it is emitted 1g CO2eq/MJ during the last phase – transportation and distribution[[24]](#footnote-25). The sewing areas for rape including rapeseed has rather increasing trend with actual 368.824 thousands hectares, but sewing areas of industrial sugar beet record small decreasing trend to actual 56.388 thousands hectares in 2010.

**Figure 9: Sewing areas of rape and sugar beet in the Czech Republic in ha[[25]](#footnote-26)**

The yield per hectare for industrial sugar beet registers an increasing trend to 57.91 t/ha in 2009. However, yield per hectare for rape (including rapeseed) is rather stable with only little improvement to 3.18 t/ha in 2009.

Figure 10: Yield per hectare for rape and sugar beet in the Czech Republic in t

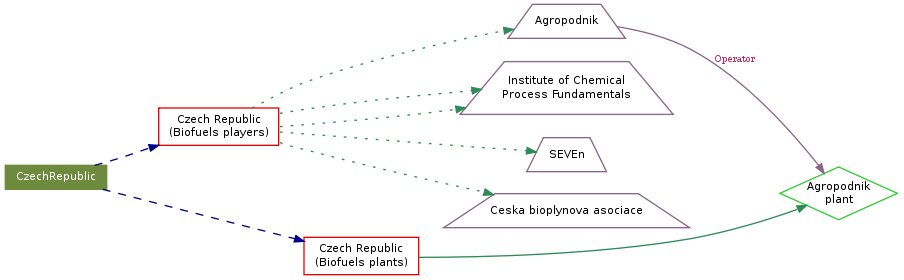
Data source: ČSÚ, Czech Statistical Office

In the Czech Republic there are 14 plants producing biodiesel or bioethanol. The following table lists those firms and their location.

|  |  |
| --- | --- |
| Firm in Czech Republic | Location |
| ADW Bio | Krahulov |
| Agropodnik Domazlice | Domazlice |
| Agropodnik Jihlava | Polna |
| BIOPAL | Kolin |
| Chebio |  |
| Chemopetrol | Litvinov |
| Citronelle |  |
| Cukrovary TTD/Tereos | Dobrovice |
| Ethanol Energy | Vrdy |
| Jihocesky zemedelsky Lihovar | Blatna |
| Moravsky Lihovar | Kojetin |
| PLP | Trmice |
| PREOL, a.s. | Lovosice |
| SWP Trading | Horni Sucha |

Table 6: Firms producing biofuels in the Czech Republic[[26]](#footnote-27)

The Czech biofuels market and the main players on it are described in the following diagram.



**Figure 11: Players on the biofuels market in the Czech Republic[[27]](#footnote-28)**

This production capacity produces 197,988 tonnes of FAME and 94,523 tonnes of bioethanol. The following graphs demonstrate the development in the home production, gross consumption, import and export. The Czech Republic has higher exports than imports (so it is an exporting country), especially during recent years the difference between exports and imports has increased. Also it produces more biofuels than it consumes, it was true for log time since 2000 for FAME. However, the consumption has increased nearly to the level of home production.

**Figure 12: CZ FAME home production, gross consumption, import and export in t, annual[[28]](#footnote-29)**

Figure 13: CZ bioethanol home production, gross consumption, import and export in t, annual[[29]](#footnote-30)

The next figures describe the development of the home production and gross consumption of FAME and bioethanol in the Czech Republic per month.

**Figure 14: CZ FAME home production and gross consumption in t monthly[[30]](#footnote-31)**

Figure 15: CZ bioethanol home production and gross consumption in t monthly[[31]](#footnote-32)

### Food price vs. biofuels production (econometric analysis)

In this section the econometric analysis of the impact of biofuels production on food prices will be conducted. Data sources for production of biofuels (FAME and bioethanol) in Czech Republic are Ministry of Industry and Trade in Czech Republic, Czech Statistical Office and FAOSTAT. The main hypothesis used in the analysis is that an increase in the production of biofuels, resp. in sewing areas, evokes an increase in food prices, i.e. price of bread and inflation rate as a proxy. The following graphs demonstrate the development of the price of bread. The increasing trend was little bit interrupted by the financial and economic crisis in 2007 to 2009.

Figure 16: Price of bread in CZK/kg[[32]](#footnote-33)

As for the analysis of Austrian prices the same model is used for Czech Republic:

**P(bread) = a1 UV + a2X + ut ,**

Inflation rate and FAO food price index are utilized in the next equations instead of price of bread (P) and production of FAME and bioethanol instead of X in the first and second equation and variants of them. The data for biofuels production is taken from the website of the Ministry of Trade and Industry, the data for food prices are from the Czech Statistical Office. Again for Czech Republic tests for our model were not very satisfactory because we have too short data series.

**P(barley) = 2875.92 + 0.00852748X,**

where P is the price of barley in CZK per tonne in the Czech market and X is the production of biodiesel (FAME) in the Czech Republic in tonnes. The parameter 0.00852748 means that an increase in the production of FAME of 1 tonne causes an increase in the price of barley by 0.00852748 CZK/t[[33]](#footnote-34). In the equation with price of wheat in CZK/t the parameter a2 was estimated to 0.000364147 and the constant was 105.483 (not statistically significant estimations).

Further results were:

* An increase in the area of rapeseed of 1 ha causes an increase in the price of barley by 0.00768267 CZK/t
* An increase in the production of biodiesel (FAME) of 1 tonne causes an increase in the price of bread roll of 0.03131 CZK per kilo
* An increase in the FAME production by 1 tonne decreases the price of wheat flour by 0.0126 CZK per kilo
* An increase in the FAME production by 1 tonne increases the price of wheat flour by 0.00010813 CZK per kilo
* An increase in the area of rape of 1 ha causes an increase in the price of bread roll of 0.030277 CZK per kilo
* An increase in the area of rape of 1 ha causes an increase in the price of wheat flour of 0.004324 CZK per kilo
* An an increase in the area of rape of 1 ha causes an increase in the price of wheat flour of 0.000399 USD per kilo
* An increase in the production of bioethanol of 1 tonne causes an decrease in the inflation rate of 0.02568 percentage points
* An increase in the production of biodiesel FAME of 1 tonne causes an decrease in the inflation rate of 0.000212542 percentage point

The main conclusions from our analysis in the Czech Republic are:

* Recent monthly data of biofuels production (2006-2010) shows even negative relation to the rate of inflation, but still very close to zero
* FAME production has bigger effect on prices than the area of rape, but both very close to zero and even negative relation between the FAME production and the price of wheat flour.

# Discussion of results and future perspectives

It is very hard to prove the relationship between the biofuels production and food prices on the available data. Too short time series is one of the main reasons of the low reliability of the results. The results show little positive relationship between the biofuels production and the food prices, but very close to zero. In some cases we found even negative relationship that was against our hypothesis. Further research is needed to find out true relationship between the biofuels production and food prices, i.e. the probability of the positive effect of biofuels production on food prices. The problems of biofuels, especially 1st generation biofuels must be given further attention, to find out their possible role in our future energy policy. Future might belong to 2nd generation biofuels, waste oils, Jatropha-based fuels and algae-based biofuels with much bigger GHG emissions reductions. Many studies show that with more advanced and cheaper technology the algae might be the right way to go, because it has a potential for huge production levels. However, this depends on new technological development and further research.

“*A pullout of fossil fuels can’t be achieved if we don’t think about our mobility needs. It will just replace one unsuitable solution for another. We need to reduce our overall consumption and use of fuels if we want to pursue a sustainable strategy*.” (Putzer 2010, p. 85/86)

# Index of Figures

[Figure 1: FAO Food Price Index 3](#_Toc294469003)

[Figure 2: World biodiesel and ethanol production from 1975 to 2010 5](#_Toc294469004)

[Figure 3: GHG mitigation and primary energy saving potentials of biofuels 6](#_Toc294469005)

[Figure 5: Comparison of well-to-wheel emission changes of different biofuels compared to fossil fuel 10](#_Toc294469006)

[Figure 6: Global land suitability for second-generation feedstocks (herbaceous and woody lignocellulosic plant species) 10](#_Toc294469007)

[Figure 7: Biodiesel production in Austria 2003-2009 in tonnes 15](#_Toc294469008)

[Figure 8: Prices of bread roll, bread and wheat flour in Austria 2003-2009 15](#_Toc294469009)

[Figure 9: Sewing areas of rape and sugar beet in the Czech Republic in ha 18](#_Toc294469010)

[Figure 10: Yield per hectare for rape and sugar beet in the Czech Republic in t 18](#_Toc294469011)

[Figure 11: Players on the biofuels market in the Czech Republic 19](#_Toc294469012)

[Figure 12: CZ FAME home production, gross consumption, import and export in t, annual 20](#_Toc294469013)

[Figure 13: CZ bioethanol home production, gross consumption, import and export in t, annual 20](#_Toc294469014)

[Figure 14: CZ FAME home production and gross consumption in t monthly 20](#_Toc294469015)

[Figure 15: CZ bioethanol home production and gross consumption in t monthly 21](#_Toc294469016)

[Figure 16: Price of bread in CZK/kg 21](#_Toc294469017)

# Index of Tables

[Table 1: Expected GHG saving potentials of different feedstocks (well-to-wheel) 9](#_Toc294468952)

[Table 2: of estimates of GHG mitigation potential of Ethanol 9](#_Toc294468953)

[Table 3: Substitution goals of the EU and Austria 13](#_Toc294468954)

[Table 4: Sold amounts of biofuels in Austria 2009 14](#_Toc294468955)

[Table 5: Biofuels produced in Austria 2009 14](#_Toc294468956)

[Table 6: Firms producing biofuels in the Czech Republic 19](#_Toc294468957)

# References

**AEA Technology** (2008): Review of work on the environmental sustainability of international biofuels production and use, Department for Environment, Food and Rural Affairs, London.

**AGRANA Beteiligungs-Aktiengesellschaft (2009):** AGRANA Bioethanol – Jetzt tankt die Umwelt auf, Nachhaltigkeitsbroschüre, Vienna. Available at: <http://www.raiffeisen-klimaschutz.at/eBusiness/rzb_template1/430016439953223678-430016439953223679_431416516093628114-610651226001952542-NA-NA-DE.html> [cit. 23.05.2011]

**Ajanovic A**. (2010): Biofuels versus food production: Does biofuels production increase food prices ?, Energy (2010), doi: 10.1016/j.energy.2010.05.019.

**Allianz Brasil/ WWF-Brasil** (2009): O impacto do Mercado mundial de biocombustíveis na expansão da agricultura brasileira e suas consequências para as mudanças climáticas, Documento para consulta e debate, Brasília.

**Bachlet Alexander/ Baumeister Maria et al**. (2008): Brennpunkt Biotreibstoffe, Broschüre der Landwirtschaftskammer Österreich, des Österreichischen Biomasse-Verbands und des Ökosozialen Forums. Available at: <http://www.oekosozial.at/index.php?id=12951> [cit. 23.05.2011]

**Börjesson P., Tufvesson L. M.** (2011): „Agricultural crop-based biofuels – resource efficiency and environmental performance including direct land use changes,“Journal of Cleaner Production, Volume 19, Issues 2-3, January-February 2011, Pages 108-120.

**Demirbas, A. (2009): “**Biofuels securing the planet’s future energy needs,” Energy Conversion and Management, Volume 50, Issue 9, September 2009, Pages 2239-2249, http://www.sciencedirect.com/scidirimg/clear.gifdoi:10.1016/j.enconman.2009.05.010.

**Eisentraut A**. (2010): Sustainable Production of Second-Generation Biofuels – Potential and perspectives in major economies and developing countries, Information Paper, IEA, Paris.

**European Commission/Community Research** (2006):Biofuels in the European Union- A vision for 2030 and beyond, Final report of the Biofuels Research Advisory Council, Paris.

**European Parliament and –Counsil** (2003):DIRECTIVE 2003/30/EC, Official Journal of the European Union.

**Fischer G., Hizsnyik E.** (2009): Biofuels and food security - Land Use Change and Agriculture Program, International Institute for Applied Systems Analysis, OPEC Fund for Internat. Development (OFID), Vienna.

**Hellmann, F., Verburg, P. H.** (2010): „Impact assessment of the European biofuel directive on land use and biodiversity,“Original Research Article, *Journal of Environmental Management*, Volume 91, Issue 6, June 2010, Pages 1389-1396.

**Gauder M., Graeff-Hönninger S. et al.** (2001): The impact of a growing bioethanol industry on food production in Brazil, Applied Energy, Volume 88, Issue 3, Pages 672-679.

**Gartlgruber D.** (2009): Potentiale und Kontroversen bei biogenen Treibstoffen, Master thesis, Graz.

**Havlík P., Schneider A., et al.**: „Global land-use implications of first and second generation biofuel targets,“ Energy Policy, Article in press.

<http://www.biofuel.org.uk/history-of-biofuels.html> [23.5.2010]

<http://www.biofuelstp.eu/global_overview.html> [23.5.2010]

**Chakravorty U., Hubert M.H.** (2011): "Will Biofuel Mandates Raise Food Prices?," Working Papers 2011-1, University of Alberta, Department of Economics, available at: http://ideas.repec.org/p/ris/albaec/2011\_001.html [cit. 13-12-2010]

**IEA/OECD** (2009): “From 1st- to 2nd-Generation Biofuel Technologies - Full Report- An Overview of Current Industry and RD&D Activities,” IEA, 2009, available online at: http://www.iea.org/papers/2008/2nd\_Biofuel\_Gen.pdf [cit. 13-12-2010]

**Lebensministerium Öffentlichkeitsarbeit**: available at: http://land.lebensministerium.at/article/articleview/71373/1/4961 [23.05.2011]

**Singh N., Anoop S. (2011): “**Production of liquid biofuels from renewable resources,” [Progress in Energy and Combustion Science](http://www.sciencedirect.com/science/journal/03601285), [Volume 37, Issue 1](http://www.sciencedirect.com/science?_ob=PublicationURL&_tockey=%23TOC%235741%232011%23999629998%232636744%23FLA%23&_cdi=5741&_pubType=J&view=c&_auth=y&_acct=C000059211&_version=1&_urlVersion=0&_userid=2930208&md5=9c704a7d4ddf52857591be83c77d56c0), February 2011, Pages 52-68, http://www.sciencedirect.com/scidirimg/clear.gif[doi:10.1016/j.pecs.2010.01.003](http://dx.doi.org/10.1016/j.pecs.2010.01.003).

**Pittman Jon K., Dean Andrew P. et al.** (2011): „The potential of sustainable algal biofuel production using wastewater resources“, *Bioresource Technology,*Volume 102, Issue 1, Pages 17-25, Special Issue: Biofuels - II: Algal Biofuels and Microbial Fuel Cells.

**Reinhardt G., and von Falkenstein E.** (2010): “Environmental assessment of biofuels for transport and the aspects of land use Competition“, Biomass and Bioenergy (2010), doi:10.1016/j.biombioe.2010.10.036, article in press.

**Silva Lora EE, et al.** (2010): Issues to consider, existing tools and constraints in biofuels sustainability assessments, Energy (2010), doi:10.1016/j.energy.2010.06.012 (str.6) – article in press [cit. 13-12-2010]

**Sims R., Mabee W. et al**. (2010): An overview of second generation biofuel technologies, Bioresource Technology 101, p. 1570-1580.

**Sorda G., Banse M. et al**. (2010): „An overview of biofuel policies across the world,“Energy Policy, Volume 38, Issue 11, November 2010, Pages 6977-6988.

**Timilsina G., Shrestha A.** (2010): How much hope should we have for biofuels?, Energy (2010), doi:10.1016/j.energy.2010.08.023 [cit. 13-12-2010]

**Winter R.** (2010): Biokraftstoffe im Verkehrssektor 2010, Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft, Vienna.

**World Bioplants**: www.worldbioplants.com online available at: http://worldbioplants.com/country/CZECH\_REPUBLIC [cit. 13-4-2011]

**Putzer H.** (2010): Hungerkriege: das Schicksal unserer Kinder?, Leykam, Graz.

**International Monetary Fund** (IMF) (2008): Food and Fuel Prices—Recent Developments, Macroeconomic Impact, and Policy Responses.

Data sources:

**ČSÚ** (Czech statistical office): Czech Republic from 1989 in figures: available online at: http://www.czso.cz/csu/redakce.nsf/i/cr\_od\_roku\_1989#03 [cit. 13-5-2011]

**ČSÚ** (Czech statistical office): Public database: available online at: http://vdb.czso.cz/vdbvo/maklist.jsp?kapitola\_id=30& [cit. 13-5-2011]

**ČSÚ** (Czech statistical office): Prices, Inflation; Inflation, Consumer prices; Inflation rate available online at: http://www.czso.cz/eng/redakce.nsf/i/inflation\_rate [cit. 13-5-2011]

**FAO**: FAOSTAT: PriceSTAT: available online at: http://faostat.fao.org/site/570/default.aspx#ancor [cit. 13-5-2011]

**Ministry of Agriculture**, Austria: Statistics: available online at: http://www.agrarnet.info/?id=2500%2C%2C900200%2C%2CeF9LRVlXT1JEX0FbMF09MTIw [cit. 23.05.2011]

**MPO**, Statistics, Liquid biofuels, available online at: http://www.mpo.cz/en/energy-and-raw-materials/statistics/default.html [cit. 13-5-2011]

# Appendix

Legislation that covers biofuels in the Czech Republic:

* Decree of Ministry of Industry and Trade No. **227/2001 Coll**. of 22 June 2001 laying down requirements for fuel to operate vehicles on the road and way of monitoring their quality (Source: State Gazette Year 2001, No. 84, dated June 29, 2001).
* Decree of Ministry of Environment No. **482/2005 Coll**. of 2 December 2005 on determining the types, uses and parameters of biomass for the promotion of electricity from biomass (Source: State Gazette Year 2005, No. 168, dated 13.12.2005).
* Decree of Ministry of Environment No**. 5/2007** **Coll**. of 21 December 2006 amending the Decree No. 482/2005 Coll. determining the types, uses and parameters of biomass for the promotion of electricity from biomass (Source: State Gazette Year 2007, No. 2, dated May 1, 2007).
* Act No. **180/2007 Coll.** of 7 June 2007 amending the Act No. 86/2002 Coll. on air protection and amendment of some laws (the Clean Air Act), as amended (Source: State Gazette Year 2007, No. 59, dated July 12, 2007).
* Act No. **180/2005 Coll**. of 31 March 2005 on the promotion of electricity from renewable energy sources and amending some laws (Act on the promotion of renewable sources), (Source: State Gazette Year 2005, No. 66 of 5. 5. 2005).
* Government Regulation No. **333/2007 Coll**. of 12 December 2007 amending Decree No. 80/2007 Coll. setting certain conditions for payment subsidies for energy crops (Source: State Gazette Year 2007, No. 106, dated December 14, 2007).
* Act No. **172/2010 Coll**. of 29 April 2010 amending Act No. 86/2002 Coll. on air protection and amendment of some laws (the Clean Air Act), as amended (Source: State Gazette Year 2010, No. 60, dated May 31, 2010).
* Decree of Ministry of Industry and Trade No. **48/2003 Coll**. of 11 February 2003 amending Decree No. 227/2001 Coll. laying down requirements for fuel to operate vehicles on the road and way of monitoring their quality (Source: State Gazette Year 2003, No. 18, dated 28.2.2003).
* Decree of Ministry of Industry and Trade No. **133/2010 Coll**. of 5 May 2010 on requirements for fuel, a method of monitoring the composition and quality of fuels and their registration (Decree on the quality of fuel and registration), (Source: State Gazette Year 2010, No. 48, dated May 13, 2010).
* Air Protection Act No. **472/2005 Coll**.   
  Prime Minister announces the full wording of the Act No. 86/2002 Coll., on the air and amending some laws (the Clean Air Act), as subsequently amended by Act No. 521/2002 Coll., Act No. 92/2004 Coll ., Act No. 186/2004 Coll., Act No. 695/2004 Coll., Act No. 180/2005 Coll. and Act No. 385/2005 Coll. (Source: State Gazette Year 2005, No. 165, dated May 12, 2005).
* Act No. **37/2008 Coll**. of 17 January 2008 amending Act No. 353/2003 Coll. on excise taxes, as amended, Act No. 86/2002 Coll. on air protection and amendment of some laws (the Clean Air Act), as amended, and Act No. 61/1997 Coll. on alcohol and on amending and supplementing Act No. 455/1991 Coll. Trades (Trade Act), as amended, and the Czech National Council No. 587 / 1992 Coll. on excise taxes, as amended (the Act on alcohol), as amended, (Source: State Gazette Year 2008, No. 11, dated February 12, 2008).

List of energy plants that are subjects to subsidies payment according to the Government Regulation No. **333/2007 Coll**. amending Decree No. 80/2007 Coll. § 3 par.5:

|  |  |  |
| --- | --- | --- |
| Name of plant in Latin | Name of plant in English | Name of plant in Czech |
| Amaranthus | Amaranth | Laskavec |
| Cannabis sativa L. | Hemp | Konopí seté |
| Carthamus tinctorius L. | Safflower (False saffron) | Světlice barvířská – saflor (including seeds) |
| Malva L. spp. | Mallow | Slézy |
| Melilotus alba | Hemp (white?) | Konopice bílá |
| Brassica juncea | Brown mustard ? | Hořčice sareptská |
| Sorghum spp. | Sorghum | Čirok |
| Raphanus sativus L. var. oleiformis Pers. | Radish Planut (common garden radish) | Ředkev olejná |
| Silphium perfoliatum | Rosin-weed | Mužák prorostlý |
| Galega orientalis | East rowan | Jeřabina východní |
| Coronilla varia | Crown vetch | Čičorka pestrá |
| Rumex tianshanicus x Rumex patientia | Sorrell feed | Šťovík krmný |
| Kitaibelia vitifolia | Hardy mallow | Sléz vytrvalý |
| Bromus inermis | Brome grass | Sveřep bezbranný |
| Bromus cartharticus | Brome … | Sveřep horský (samužníkovitý) |
| Agrostis gigantea | Deer’s-foot (bent grass) | Psineček veliký |
| Phalaris arundinacea | Reed canary grass | Lesknice (chrastice) rákosovitá |
| Festuca arundinacea | Fescue grass | Kostřava rákosovitá |
| Arrehenatherum elatius | Oat-grass | Ovsík vyvýšený |
| Dactilis glomerata L. | Orchard grass (cocksfoot) | Srha laločnatá |
| Panicum virgatum | Hardy millet (sorgho) (or panic grass) | Proso vytrvalé |
| Miscanthus | miscanthus | Ozdobnice |
| Beta vulgaris L. | Sugar beet | Řepa cukrová (cukrovka) |
| Solanum tuberosum | Common potato | Lilek brambor |
| Brassica rapa subsp. oleifera (DC.) Metzg | Oilseed rape (Swedish turnip) | Řepice olejná |
| Poaceae Barnhart | Other grass | Ostatní trávy |
| Fabaceae Lindl. | Other clovers | Ostatní jeteloviny |

1. Available at: <http://web.worldbank.org/WBSITE/EXTERNAL/NEWS/0,,contentMDK:22802799~pagePK:64257043~piPK:437376~theSitePK:4607,00.html> [cit. 22-02-2011] [↑](#footnote-ref-2)
2. Available at: <http://www.un.org/apps/news/story.asp?NewsID=37570&Cr=food+prices&Cr1>=[cit. 22-02-2011] [↑](#footnote-ref-3)
3. Data source: FAOSTAT [↑](#footnote-ref-4)
4. 1 US gallon = 3.78541178 liters [↑](#footnote-ref-5)
5. <http://www.biofuelstp.eu/global_overview.html> [↑](#footnote-ref-6)
6. <http://www.ethanolrfa.org/pages/ethanol-facts> [↑](#footnote-ref-7)
7. That means that global biofuels’ industry produces around 85% of bioethanol and about 15% of biodiesel. For more information see: <http://www.earth-policy.org/data_center/C23>. In 2003 an estimation of agricultural land for biomass sources was about 1.6 million ha in the EU-15. [↑](#footnote-ref-8)
8. <https://wcd.coe.int/wcd/com.instranet.InstraServlet?command=com.instranet.CmdBlobGet&InstranetImage=1647916&SecMode=1&DocId=1614426&Usage=2> [↑](#footnote-ref-9)
9. Data source: compiled by Earth Policy Institute with data for 1975-1998 from F.O. Licht, World Ethanol and Biofuels Report, vol. 6, no. 4 (23 October 2007), p. 63; 1999-2005 from F.O. Licht, World Ethanol and Biofuels Report, vol. 7, no. 18 (26 May 2009), p. 3; 2006-2010 from F.O. Licht, World Ethanol and Biofuels Report, vol. 8, no. 16 (28 April 2010), p. 328.; 2010 is an estimation) [↑](#footnote-ref-10)
10. Source: Reinhardt and von Falkenstein (2010, p. 4) [↑](#footnote-ref-11)
11. Available at: <http://www.iogen.ca/company/demo_plant/index.html> [cit. 23.05.2011] [↑](#footnote-ref-12)
12. Association of Southeast Asian Nations [↑](#footnote-ref-13)
13. Roundtable of Sustainable Palm oil [↑](#footnote-ref-14)
14. Gartelgruber 2009, p.87 [↑](#footnote-ref-15)
15. Gartelgruber 2009, p. 87 [↑](#footnote-ref-16)
16. *International Institute for Applied Systems Analysis*, Laxenburg Austria [↑](#footnote-ref-17)
17. Miscanthus, switchgrass and reed carnary grass [↑](#footnote-ref-18)
18. Poplar, willow and eucalypt [↑](#footnote-ref-19)
19. Fischer, Hizsnyik et al. 2009, p. 127 [↑](#footnote-ref-20)
20. See http://www.globalbiofuelscenter.com/NM\_Top5.aspx [cit. 13-12-2010] [↑](#footnote-ref-21)
21. Source: Agrana Ethanol, Jetzt tankt die Umwelt auf [↑](#footnote-ref-22)
22. Mineralölsteuer (petroleum tax) [↑](#footnote-ref-23)
23. It has the statistical significance at 1% probability level and R-squared was 0.952819. [↑](#footnote-ref-24)
24. PREOL websites: http://www.preol.cz/info-pro-verejnost/bilance-sklenikovych-plynu/ [cit. 13-12-2010], in terms of gCO2eq/kg: it is in total 1680 gCO2eq/kg, from which 1073 gCO2eq/kg counts for the cultivation of rapeseed, 203 gCO2eq/kg for the production of rapeseed oil, 367 gCO2eq/kg for the production of FAME and 37 gCO2eq/kg for the transportation and distribution. [↑](#footnote-ref-25)
25. Data source: ČSÚ, Czech Statistical Office) [↑](#footnote-ref-26)
26. Source: WorldBioplant [↑](#footnote-ref-27)
27. BIOMAP: http://biomap.kcl.ac.uk/#800003 [cit. 13-12-2010] [↑](#footnote-ref-28)
28. Data source: Ministry of Industry and Trade statistics, Liquid Biofuels [↑](#footnote-ref-29)
29. Data source: Ministry of Industry and Trade statistics, Liquid Biofuels [↑](#footnote-ref-30)
30. Data source: Ministry of Industry and Trade statistics, Liquid Biofuels [↑](#footnote-ref-31)
31. Data source: Ministry of Industry and Trade statistics, Liquid Biofuels [↑](#footnote-ref-32)
32. Data source: ČSÚ, Czech Statistical Office [↑](#footnote-ref-33)
33. It has the statistical significance at 8% probability level and R-squared was 0.205255. [↑](#footnote-ref-34)