International Civil Aviation Organization

CAAF/09-WP/20
4/11/09
English only

WORKING PAPER

CONFERENCE ON AVIATION AND ALTERNATIVE FUELS

Rio de Janeiro, Brazil, 16 to 18 November 2009

Agenda Item 1: Environmental sustainability and interdependencies

SUSTAINABILITY AND THE PRODUCTION AND USE OF SUGARCANE ETHANOL IN BRAZIL

(Presented by Brazil)

SUMMARY

The paper discusses briefly the main elements that make up the sugarcane ethanol supply chain from the point of view of environmental sustainability. The analysis shows that both the production and use of this renewable and low carbon fuel do not compete with food production nor cause deforestation and that sugarcane ethanol is an environmentally sustainable product and a feasible alternative to fossil fuels.

The conference is invited to approve the conclusion/recommendation in paragraphs 7 and 8.

1. INTRODUCTION

1.1 Various studies conducted in recent years have evaluated the production and use of sugarcane ethanol from the point of view of sustainability, and the results of these studies indicate an extremely positive and consistent scenario. This paper presents a summary of the key arguments developed by UNICA supporting this point of view, looking at the main elements that make up the ethanol supply chain: agriculture, industrial production, storage and transportation, and final use.

1.2 UNICA, the Brazilian Sugarcane Industry Association, is the largest organization in Brazil representing sugar, ethanol and bioelectricity producers. It was created in 1997, following a consolidation process involving regional organizations in the State of São Paulo after government deregulation of the sugar and ethanol sectors. UNICA members answer for more than 50% of all ethanol produced in Brazil and 60% of overall sugar production.

2. AGRICULTURE

2.1 Brazil has total land area of 850 million hectares. A substantial part of this can support agricultural production, economically speaking, while leaving large areas of forest with different biomes. Sugarcane has been cultivated in Brazil since colonial times and now occupies some eight million hectares, representing less than 1.5% of the country's arable land. Ethanol production currently consumes 55% of the sugarcane crop, while the rest goes to making sugar. Roughly 90% of sugarcane is grown in the Center-South region of the country, with 60% coming from the State of São Paulo alone. The second largest sugarcane area is the Northeast. Together, these two regions account for almost all of national production. These two regions lie more than 2,000 km from the edges of the Amazon region, and information spread internationally that sugarcane is devastating the Amazon is unfounded. Amazon deforestation is a complex problem that involves questions of land holdings, politics and economics, and above all is related to disputes over the ownership of the land, the illegal production and exportation of timber and cattle breeding. The region is home to 20 million people and sadly the forest does not offer them any immediate guarantee of survival. To avoid the spread of false information about sugarcane planting, the federal government in September of 2009 defined a system of agri-ecological zoning that bans sugarcane planting in environmentally sensitive regions including the Amazon, the Pantanal wetlands and the Atlantic Rainforest. This measure follows a similar initiative adopted by the government of São Paulo State in 2008. This last decade has seen a significant expansion of the sugar-energy sector, but over 65% of new plantations occupy areas that were mainly degraded pastures, so helping to restore this land and bring it back into the productive mainstream of Brazilian farming.

2.2 It is generally accepted in Brazil that the cultivation of sugarcane involves relatively low soil loss through erosion, in comparison for example to soy and corn. This is continuing to improve with the increase of mechanized harvesting which avoids crop burning, and with techniques for reduced preparation of the soil. Losses are being brought down to very low levels, comparable to those experienced when using direct drilling in annual crops.

2.3 The consumption of herbicides and pesticides in sugarcane cultivation is lower than that for other traditional crops. It can be reduced still further by using new strains of sugarcane, biological controls and, where possible, the techniques of "organic" farming.

2.4 Sugarcane plantations also use a relatively small amount of fertilizer, compared with other crops. One important element in this process is recycling nutrients by treating the soil with vinasse and filter cake, which are industrial residues from sugarcane processing. This also increases productivity.

2.5 Similarly, sugarcane irrigation is limited to the Northeast region and to some situations that require complementary or "salvation" irrigation. Sugarcane production therefore consumes a reduced amount of water.

2.6 Burning sugarcane in the field has been a traditional practice in the majority of countries where the crop is grown. It takes place prior to harvesting, to facilitate the work of the manual cane cutters. While burning is still frequent in Brazil, it is being phased out with the introduction of mechanized harvesting. Plans call for the elimination of burning by 2014 in areas where mechanized harvesting is possible, and by 2017 in areas of more difficult terrain where mechanization is more difficult. São Paulo State, the leading sugarcane producer in Brazil, is heading this practice change with nearly 50% of total area already mechanically harvested.

2.7 The alleged competition between sugarcane plantations and food production is a myth that has its roots in the competition to use grains as a source for food or energy elsewhere. Brazil is a

major food producer and exporter and official statistics demonstrate that the expansion of sugarcane planting has not affected the production of corn, soy, rice and meat, amongst other products. Moreover, it is important to understand that almost half of the area dedicated to sugarcane plantations is destined to producing sugar, which is a food ingredient. It is also important to note that sugarcane plantations normally operate a crop rotation system: sugarcane is a perennial plant that requires replanting after five years, at which point it is common to rotate the land to a grain crop like corn, soy or peanut.

2.8 The continuous development of programs to restore riparian vegetation serves not only to protect springs and water courses, but also helps restore biodiversity in areas where sugarcane has been grown.

3. INDUSTRIAL PRODUCTION

3.1 Water consumption in the industrial production of ethanol has been significantly cut in the last 10 years, with the reduction reaching 80% or more in various production plants.

3.2 Discharge of waste products is controlled by environmental legislation and can be done only after the effluents have been properly treated. The efficiency of effluent treatment systems is normally greater than 98%.

3.3 Vinasse is a liquid waste rich in organic material that is produced in large quantities during ethanol distillation, and it used to be a serious environmental problem. However, with the development of fertirrigation practices vinasse has become a valuable byproduct and even reduces the need to use chemical fertilizers.

3.4 The great majority of ethanol and sugar production plants in Brazil are integrated within single industrial units. These produce their own energy by burning sugarcane bagasse – the fibrous residue left after cane has been crushed to extract the juice, which is rich in sucrose. The bagasse is used as boiler fuel, so offering a significant environmental advantage through the substitution of fossil fuels. These boilers generate thermal energy and electricity (dubbed bio-electricity) needed for the industrial processes and other uses. In addition to providing an appropriate use for the bagasse, this process helps reduce the emission of carbonic gas, eliminates emission of sulfur oxides and reduces the emission of nitrous oxides. The only significant emission from the boilers is particulate matter, but this can be reduced by using scrubbers and other emission control systems.

3.5 Using sugarcane bagasse as a boiler fuel produces solid residues, principally in the form of fly ash and cinders. These residues are frequently used to treat the soil, together with the residues from sugar production, so resulting in a compost of great agricultural value. This also avoids the uncontrolled dumping of these products into the environment.

4. STORAGE AND TRANSPORTATION

4.1 The operations for storing and transporting ethanol are equivalent to those used for traditional fossil liquid fuels, and result in similar environmental impacts. Brazil is building a system of ethanol pipelines – work is currently at the design or early building stage. This should reduce the need for motorized transportation systems, and as a result bring down the emission of conventional pollutants and greenhouse gases.

5. FINAL USE

5.1 Ethanol is widely used in Brazil in light vehicles and Otto cycle engines, and its use has contributed to a reduction in the environmental impact of motorized transportation. All the gasoline sold for vehicular or nautical use, or for use in stationary and small motors, currently contains 25% of anhydrous ethanol (E25). Hydrous ethanol (E100) is also sold regularly at almost all fuel stations in the country for use in vehicles that are equipped with ethanol-only engines, which were produced between 1979 and 2005, and vehicles fitted with Flex-fuel engines which have been produced since 2003. These Flex-fuel vehicles can operate exclusively on E100 or E25 and any blend of both fuels. Hydrous ethanol is already being used in agricultural airplanes fitted with piston engines and produced by Embraer. Adding together hydrous and anhydrous ethanol, consumption exceeds that of pure gasoline, so making Brazil the first country in the world where a renewable fuel has surpassed a fossil fuel in terms of volume. This implies environmental benefits of various kinds – elimination and reduction of pollutants associated with the quality of the gasoline, such as lead compounds, sulfur oxides and particulate matter, plus reduction of products of combustion such as carbon monoxide, organic compounds and nitrous oxides. One point that always draws attention with respect to the use of ethanol is the increase in the emission of aldehydes, compared with gasoline. However, this needs to be clarified: in terms of aldehydes, the two main products to be taken into consideration are acetaldehyde – produced mainly during the combustion of ethanol – and formaldehyde, which is produced mainly during the combustion of gasoline, diesel, aviation kerosene and natural gas. However, acetaldehyde is significantly less toxic than formaldehyde, and it is also less reactive in the atmosphere in the formation of photochemical smog. Moreover, the efficient consumption of ethanol and the use of catalytic converters in vehicle exhausts reduces aldehyde emissions by over 90%. Studies about the presence of aldehydes in the atmosphere of the City of São Paulo and other Brazilian cities indicate that ambient concentrations of total aldehydes are equivalent to what is usually found in other large cities in the world although the acetaldehyde to formaldehyde ratio varies with predominance of the former.

5.2 The use of ethanol in internal combustion engines also generates an enormous benefit in terms of reducing emissions of carbon dioxide (CO_2), which is the principal greenhouse gas. International studies[1] show that throughout the ethanol life cycle, taking into account the generation of energy from bagasse and the substitution of gasoline by ethanol, the avoided emissions of CO_2 are around 90%, compared with the life cycle emissions of gasoline. This benefit occurs because the CO_2 generated is in great part neutralized by the sugarcane, via the process of photosynthesis.

6. ENERGY BALANCE

6.1 Production of sugarcane ethanol in Brazil enjoys an extremely favorable energy balance. For each unit of fossil energy consumed during production, more than nine units of renewable energy are produced[1].

7. CONCLUSION

7.1 The conference is invited to conclude that:

[1] Zuurbier, Peter, and Jos Van de Vooren, eds. *Sugarcane Ethanol: Contributions to Climate Change Mitigation and the Environment*. Wageningen, The Netherlands: Wageningen Academic, 2008

a) The supply chain that involves the life cycle of sugarcane ethanol produced in Brazil, and the inherent characteristics of the product – renewability and low carbon content – make sugarcane ethanol an environmentally sustainable product.

8. RECOMMENDATION

8.1 This conference is invited to:

a) Acknowledge the potential for use of sugarcane as biomass for the development of other second generation biofuels, which start from the premise of being sustainable.

b) Encourage efforts must be made for (a) research, (b) technological development, and (c) public policies for the use of ethanol in general aviation in Brazil and around the world, as a means to offer alternatives to fossil fuels.

— END —