CAAF/09-IP/10
3/11/09
English only

CONFERENCE ON AVIATION AND ALTERNATIVE FUELS

Rio de Janeiro, Brazil, 16 to 18 November 2009

Agenda Item 3: Measures to support development and use

FUNDING AND TIME ARE DRIVERS FOR SOLUTIONS[1]

(Presented by Brazil)

1. INTRODUCTION

1.1 How to reduce the climate change impact attributable to aviation if airlines will require 29,538 new airplanes valued at US$3.2 trillion, remaining in service 37.774 by 2028? Directive 2008/101/EC goal is to reduce the climate change impact attributable to aviation by including emissions from aviation activities in the European Community Emissions Trade Scheme (EU ETS) beginning January 1st 2012, although European airlines will call for 7,330 new airplanes throughout 2028 and Eurocontrol (AEM) fuel consumption model projects 472.586 (Tg) total Fuel burn and 1.488.175 (Tg) CO2 Emissions by 2025. In these scenarios, how to make possible greenhouse-gas emission adopted goal for limiting global warming to 2°C? Is it reasonable or economically practical to enforce a country such as Great-Britain to dropping a hefty percentage of its carbon-dioxide emissions as means to allow airplanes emission mount?

1.2 Bio-derived jet fuel is a key element in the industry strategy to address these challenges given that it can achieve GHG emissions reduction amid 65 and 80 percent relative to petroleum derived jet fuel[i]. It may as well arrive at sensible reductions *vis-à-vis* other alternative fuels, such as coal or LNG as starting material using the Fischer-Tropsch process.

1.3 Unlike other transport modes, there are no alternatives. Airplanes must be using liquid fuels in the foreseeable future. Airplane industry has three pillars: manufacturers, operators and oil industry: Manufacturers wish for selling 23.000 plus airplanes in a 20 years' timeframe although all at once facing global warming; Airlines operators must purchase jet fuel (No fuel, no flight) to run their flights although having to address the cost exposure from environmental mandates putting a high price on emissions; Refiners, blenders and importers crave to selling jet fuel even though subject to regulatory mandates such as EPA's Renewable Fuel Standard (RFS2) which requires the displacement of petroleum diesel fuel with low carbon fuel beginning January 1st 2010. Corporate ethics and stakeholders as well compel an effective approach that ought to be put in place to ease environmental impacts.

[1] The ideas and propositions expressed in this paper are the result of ongoing research by Coppe – Alberto Luiz Coimbra Institute – Graduate School and Research in Engineering. The information presented in this paper is subject to change pending the final results.

1.4 The US Energy Independence and Security Act of 2007 (Section 202) mandates that 21 billion gallons of advanced bio-fuel plus 16 billion gallons of Biomass-based diesel must be blended to oil fuel by 2022. The European Community Directive 2009/28/EC establish a 10% bio-fuel component in vehicle fuel by 2020. The demand for bio fuel is factual. The offering is the problem. Are the risks unprecedented? Are the stakes therefore high? Is it feasible the required feedstock scale-up?

1.5 **Funding and time are drivers for solutions**. As remind, Boeing put a $2.5 billion price tag on the first three 787s, which was cheered by analysts. In April 1994 it was estimated that final R&D costs for the 777 approached $5.5 billion. The development cost of the A380 had grown to €11 billion when the first aircraft was completed.

1.6 Climate policy necessarily increases the price of energy and goods, either explicitly through taxes or tradable permits or implicitly by mandating the use of diverse fuels from those that a free market would prefer. Notwithstanding, it may provide the funding which is the answer to move forward the bio feedstock R&D, its large-scale production and infrastructure completion. This sort of endowment must be part of the airplanes manufacturers', airlines' and petroleum companies' business-plans through a percentage of the proceeds, as well as an element in the concerned government's strategy to mitigate climate change. This shall turn out to be a win-win situation.

1.7 **The question this paper poses is: How much each manufacturer shall contribute to sell new airplanes? How much each government shall put forward to maintain hundreds of thousands of high paying jobs, huge export revenues by selling to other countries and at the same time uphold the adopted targets for limiting global warming to 2 °C? How much airlines shall concede to keep business operation and simultaneously mitigating GHG emission?**

1.8 International Maritime Organization's (IMO) Marpol Revised Annex IV establishes that every ship must exhibit the International Air Pollution Prevention Certificate (IPPC), also the possible alternative fuels use and that Countries may petition to implement Emissions Control Areas (USA already did) where additional restrict rules may be applied. Since pure vegetable oil (PVO) for Marine Propulsion Engines is cheaper to produce than bio jet fuel, ICAO must counteract in order to assist the airplane industry.

1.9 In this framework, ICAO shall identify a basket of initiatives including but not restricted to market-based measures (MBM). Taxation or MBM shall not be the core method. They impose penalties to passengers, airlines and manufacturers jobs and exports revenue, even though not developing a bio fuel industry. Any proposal shall watch ICAO's bid to promoting national and government-backed infrastructure investments in synthetic and bio-fuel pilot plants and full-scale production facilities and to ensure bio-fuel supply development is coordinated between aviation, agriculture and renewable fuel interest. These innovative schemes shall also be aligned to the Principle 7 of the Rio Declaration, the Common but Differentiated Responsibility (CBDR) as it expresses the need to mitigate airplanes historical contribution to environmental degradation in addition to present and future means.

1.10 The bio feedstock R&D and long-term infrastructure put-up funding may include a mixture of diverse sources, including:

a) I – The Manufacturers could earmark 6% over the 29,538 new airplanes, valued at $3.2 trillion. This would create a US$ 200 Billion bio fuel fund by 2028. Each year circa US$ 5 Billion would be available to R&D and mitigate scale-up risks. This 6% could be supported by Governments, such as US and European Community, through a particular federal income tax credit. This renewable energy tax credit shall sole be

used to sponsor airplanes emission reduction through nonrefundable bio fuel technology development and scale-up grants. This would not be a generosity, but instead an approach to promote the selling of the projected number of planes to the world even as together defending the agreed to targets for limiting global warming to 2°C, while reducing energy dependence. It's meaning remind that European countries and the US seek ways to meet a series of environmental commitments;

b) II - The Airlines, individually or as a group such as Oneworld, may be project financing structure sponsors and lock into direct long-term biding contracts with bio feedstock producers, establishing floor prices and the effective demand;

c) III - In the US, the refiners, blenders, and importers of transportation fuel are subject to a renewable fuel volume requirement and Renewable Identification Numbers (RIN) shall be assigned for their compliance purposes when bio sourced fuel is blended into jet fuel. The party who generates a RIN is accountable for authenticate the feedstock's source and if it meets the RFS2's renewable biomass definition. As outcome, the refiners, blenders, and importers must guarantee long-term bio fuel supply through biding contracts. This approach is a huge driver that could be put in place in other countries; and

d) IV – The US Government must make clear if Algae derived fuel from any country may also qualify for the US $1.01 per gallon tax credit, which shall increase the bio fuel projects internal rate of return (IRR). This act shall trigger European Community to offer comparable incentives as an approach to take delivery of a fraction of the bio fuel production.

1.11 The bio-feedstock producers' integration into the airplane industry depends on pricing incentives and premium rewards for quality, direct long-term binding contracts, floor prices, project finance structure sponsors due to high risks. A public-private collaborative partnership and a forerunner forum establishment should be considered to evaluate risks and promote technical feasibility studies. Environmental and economic benefits derive from bio-feedstock. The latter shall be used to improve the Return on Investment (ROI) and to deliver as much CAPEX as possible (while lowering OPEX). The projected ultimate cost target should not be over US$ 100 per bio jet fuel barrel (in 2008 US dollar).

2. PRODUCTION AND INFRASTRUCTURE SCALE-UP IN BRAZIL

2.1 The first round funding is due to R&D, in-situ prototype I (P-I) completion, workforce training, logistics, et cetera. The preliminary guess is at least US$ 1 Billion, to be used up from 2010 to 2012, corresponding to 6% of the anticipated manufacturers' fund proceeds in the similar period. As comparison, ExxonMobil announced that it will invest more than US$ 600 million in algae genomics research alone during an estimated five to six years project.

2.2 The commercial scale-up shall be based in bio-refineries which shall hold 5.020.000 raceways each one. If efforts to keep each raceway cost (commercial phase) around US$ 7.500,00 happens as expected, the estimated cost to bring the commercial large-scale project production within a 251.000 ha area could amount to US$ 35-40 Billion, pipelines and renewable energy projects included.

2.3 At least 80% of this amount shall be non-paid back resources supported by the manufacturers' fund, which is aligned with 17-20% of the takings by 2028. Circa 10% of the long-term infrastructure needs shall be based upon a financial project financing structure involving a syndicate of banks to provide non-recourse loans secured by the revenue-producing contracts as sole project asset and paid by entirely from the project cash flow as earlier offered.

2.4 The additional 10% shall be subsidized by Brazilian Government, in order to create jobs in the Brazilian Northeastern Semi-Arid Region, to promote large-scale bio fuel export and participate in the endeavor to fight climate change. The Brazilian government shall offer guarantees concerning the project finance private side high risk

2.5 As the output may reach 3,7 billion gallons of oil equivalent a year by 2020, the forecasted annual revenue would be US$ 6 Billion (US$ 100 per barrel plus US $1.01 per gallon tax credit).The commercial scale-up in Brazil shall as well benefit from opportunities regarding the International Emissions Markets, such as the proposed American Clean Energy and Security Act (ACES 2009) International Offsets and Kyoto's Protocol Clean Development financial mechanisms, such as the Certified Emissions Reductions (CERs), that can help put into operation the related renewable energy projects.

2.6 The non-refundable bio fuel technology development and scale-up grants are essential to scale-up the production regarding the high risk involved; the long-term biding contracts are due to assure and prioritize bio jet fuel offer instead of developing the feedstock as precursor to other bio fuel to be used by diverse transportation systems, such as PVO.

3. ALFA CONSORTIUM & COPPE-UFRJ

3.1 The technology aggregator and main institution will be COPPE-UFRJ, leading other Brazilian and International bodies in a consortium (alfa consortium). These institutions shall be invited or already have been, such as INT (National Institute of Technology), IME (Military Engineering Institute), ITA (Aeronautics Technology Institute). Alfa consortium shall provide the R&D and implementation strategies, microalgae bio-prospection/development, raceways proprietary technologies, conversion technologies development, knowledge management and coordination; The Brazilian Army Command's Trompowsky Foundation may be responsible to implement the P-I engineering work and logistics; The States of Maranhao and Piaui shall be part of the project (Piaui's Environmental Department is already working). The roles and responsibilities as well as a timeline of actions shall eventually be identified.

3.2 Coppe and Centroclima proposed in September 2008 to establish the Brazilian National Institute of Microalgae Technology as a Source of Renewable Energy-IMA (Tender No. 15/2008 - MCT / CNPq / FNDCT / CAPES / FAPEMIG / FAPERJ /). It aims to develop new strategies and products to mitigate the GHGs emission, included the semi-arid region development in partnership with the PAN-Brazil - National Action Program of the Combating Desertification and Mitigating the Effects of Drought (MMA), the INT (National Institute of Technology - MCT), with several laboratories and / or departments of UFRJ, UERJ, UFMA, UFPI, FURG,UNESP, FIPERJ, and researchers from other institutions, such as IME, ITA, UCB, UnB, UFBA, UNICAMP, Agro Embrapa, Embrapa Genetic Resources, IOC-FIOCRUZ, MIT, Harvard Medical School, etc. The General Coordinator was Emilio Lebre La Rovere and Executive Coordinator M. Azevedo. The advisory board suggested was Ignacy Sachs (Ecole des Hautes Etudes en Science Sociales ") and Jean Charles Hourcade (CIRED - Centre International de Recherche sur l'Environnement et le Développement).

3.3 **Coppe – Instituto Alberto Luiz Coimbra de Pós-graduação e Pesquisa de Engenharia** - Over four decades, Coppe has become the largest education and engineering research center in Latin America. It has 12 programs for post-graduate programs (MSc and PhD), has trained more than 11,500 teachers and doctors and now has 320 professors in exclusive dedication, 2,600 students and 350 employees, among researchers and technical and administrative staff. To meet the demands of its growing scientific research projects development it has 116 modern laboratories, which makes up the Brazilian largest engineering complex.

[i] Evaluation of Bio-Derived Synthetic Paraffinic Kerosene (Bio-SPK), Boeing, GE Aviation and others, June 2009.

— END —