

ANNEX 1 – REGIONALS OUTREACHES

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Introduction

By reducing the ambition of the agenda in international climate negotiations, as countries have not committed to national goals for overall Greenhouse Gases (GHG) emissions reductions, the idea of “sectoral targets” gains strength. Some sectors of the economy, regardless of the country, have specific goals to set standards of reducing “carbon intensity” per unit of output.

The aviation industry currently generates about 2% of global anthropogenic greenhouse gas (GHG) emissions. While new aircraft and engine technology, fuel conservation and improved airspace traffic management will help reduce aviation GHG emissions, over the longer term, these advances alone may not be sufficient to offset the projected growth in air travel and emissions. Aviation fuel usage increases at an annual rate of 9% in Brazil. Developing alternative and sustainable sources of this fuel is thus an issue of national significance.

Many the different actors, among governments, as well as the investor community and airlines are committed to providing a low carbon and sustainable fuel that can be used in the current and future fleet, with the certainty that this fuel meets the required specifications, at a reasonable price.

The development of new technologies for sustainable aviation biofuel has the potential to offer the most significant long term contribution to reduce emissions of GHG from aviation. Promising technologies to convert biological materials into jet fuels such as biokerosene have been developed and some have been approved for commercial use.

What does this mean for business in Brazil?

Brazil is recognized as a world power in renewable biofuels. The experience of nearly 40 years in the technology of ethanol from sugar cane, accelerated production of biodiesel extracted from crushing oilseeds (soybean, canola, cottonseed, sunflower), and having a large expanse of available land, give the country a relative comparative advantage to meet this new worldwide demand.

New demands, new consumers and international alliances for the production of biofuel for aviation can provide a great opportunity for sustainable economic development and the associated benefits at the regional and local levels. There may be a variety of potential feedstocks that would be appropriate for this new industry, which can be optimized in different regions of Brazil; this is an additional benefit for the industry, which is interested in having diverse options, because their fuel needs are de-centralized.

Brazil is well known as one of the most naturally diverse countries in the world, with ecosystems that vary from Atlantic Forests, Cerrado and Amazon, with different types of

landscapes and climates. With the right policies and research focus, this high biodiversity country could produce a range of regional and sustainable alternative types of biomass for biofuels production.

Biofuel stakeholders and civil society in Brazil are in urgent need to access information about the potential impacts and benefits of the many aspects of the biofuels industry, including jet fuel, and to be recognized as key stakeholders in the process of deciding which are the best options (politically, socially, environmentally and economically) towards a more sustainable development as the industry expands. To better promote an understanding of the challenges and opportunities for the developing Brazilian aviation biofuel sector, 4 Cantos do Mundo and EPFL Energy Center, sponsored by The Boeing Company, delivered three regional outreach workshops, in different parts of Brazil, from September to November 2012, the results of which will be linked with the Sustainable Aviation Biofuels for Brazil roadmap. A separate and more detailed report was prepared for each regional outreach, in Portuguese, which can be available if requested.

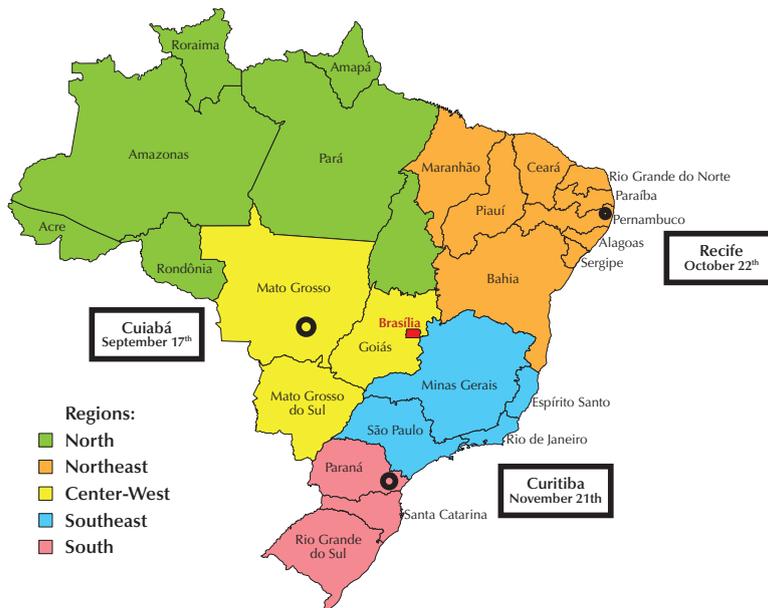


Figure 1 Location and dates of regional outreaches.

Methodology

The one-day workshops had a roundtable format where the participants could feel free to present their concerns and ideas addressing the main themes related to the production of aviation biofuels in Brazil (Feedstocks, Refining technologies, Sustainability, Policies and incentives, Logistics and support, R&D Gaps), but with a regional perspective.

The agenda usually had 4 sessions, two in the morning (Innovation in Biofuels in Brazil and The Challenges of Sustainability and Logistics) and two in the afternoon (Feedstocks for Regional Production of Biofuels and the Challenges for the Industry: Policies and Incentives), allowing time for discussion between presentations.

The participants were local stakeholders, including farmers associations, biofuel producers, NGOs, workers union, academic experts, government agencies, local environmental experts and community organizers, among others.

The main goals were: to discuss with regional stakeholders the challenges and opportunities that the aviation biojet-fuel industry can bring to regional development; understand the challenges related to the implementation of sustainability standards, at the local and regional levels, and provide suggestions on how to best tackle these challenges; knowledge transfer and exchange between different stakeholders on the sustainable production of biofuels, which can use any raw materials and various technological routes for their production; to gather information on the regional potential for a path to sustainable aviation biojet-fuel production in Brazil, and connect these results with the national SABB outreach process, in order provide a full range of recommendations to policy makers.

To facilitate correlating these results with the reports of the national SABB roadmap, the regional outreach findings will be present here divided into separate themes.

Results

1. Feedstocks

As is well known, Brazil has a great variety of feedstocks due to its large production area with good availability of water, different types of micro-climates and multiple regional capacities to promote adaptation of crops.

The feedstocks were the main focus of the regional outreaches, since it's not clear yet which crops will be most promising in the near future for the production of biokerosene; in addition, maintaining a variety of feedstock sources could reduce risks to availability.

The speakers at each outreach session were asked to present their information about which feedstock could create a better interface with both regional development and the demand of the aviation industry; most of them also addressed what is needed to scale up the production of regional crops.

Center-West: The state of Mato Grosso, in the Center-West region of Brazil, is now the largest producer of soybeans in the country – in 2012 alone it produced an estimated 21.4 million tonnes. It is also the first in production of cotton, sunflower and livestock. The state is the 4th largest producer and 2nd largest consumer of biodiesel in the country, producing 206 million liters of biodiesel in the 1st half of 2012.

Although the Center-West region has a lead role in oil seed production, other crops were also presented during the workshop as very interesting alternatives to combine regional development, family farming and biofuels production.

For example, the production of biofuels from a new variety of non-edible sweet potato (*Ipomoea batatas* (L.) Lam.), studied and genetically improved by the University of Tocantins, appears to be a successful option. It can be produced with a proposed “ethanol social seal”, and there is already some experience with the whole production chain. It is a rotational crop, which, with simple logistics, can be produced together with other crops such as corn and soy, and therefore scale up the biofuels production capacity of an area. (See BOX – Sweet potato).

BOX – Sweet Potato (*Ipomoea batatas* (L.) Lam.)

This sweet potato is a genetically improved non-edible type, researched for more than 12 years by the Renewable Energy Department of the University of Tocantins.

One project demonstrated a production per hectare of 65 tons, generating up to 10,500 liters of ethanol, more than the 7000 liters generally produced by cane sugar. The starch per hectare is around 24.4.

The processing plant installed in the city of Tangara da Serra/MT in Mato Grosso, handles the production of nine local growers, currently producing 30,000 liters of ethanol per month with standard features and high profitability. Moreover, the plant also includes a parallel bio-diesel facility, which processes cooking oil collected in the city and region by adapted bicycles called “bio-bikes”. Each bike carries a volume of 50 liters and each liter of oil produces 1 liter of biodiesel and about 20% of this volume is glycerin.

The processor produces parallel fuel streams, utilizing a “zig zag” system that allows the execution of two processes simultaneously: one for biodiesel and glycerin from the cooking oil, and another for ethanol and animal feed from the sweet potato.

Each ton of sweet potatoes produces 160 liters of ethanol, 150 kg of dry weight of cattle feed, 300 kg of wet waste and 0.8 kg of beta-glucan (used in the pharmaceutical industry).

Furthermore, the wet [and dry] residue produced has 28.5% protein, which is excellent for feeding livestock. This could lead to a densification of the number of head per hectare, reduction of GHG emissions and releasing livestock production areas without reducing yield or causing deforestation.

This variety of sweet potato under study is more resistant to pests and plant diseases than corn and soybeans, is adapted to poor soils and sandy areas (low productivity), has a storage tolerance up to 2 months, it is harvested in 4 to 5 months manually or mechanized, with no need of special machines and can be processed between the harvest seasons of sugar cane, creating a potential extra production of about 90 million liters of ethanol per year.

The production and logistics systems for sweet potato are simple, with low implementation costs; therefore, this production practice could be a viable alternative for family farming to be included in the production of biofuels in different parts of the country.

The Northeast region is currently the area with the highest rate of development in the country. The State of Pernambuco stands out for producing sugar cane, cassava and fresh fruits like banana, grape, coconut, guava and mango. Moreover, it is notorious for the diversity of its raw materials and strategic innovation for regional bioenergy.

One workshop presenter called attention to the production, although not yet on commercial-scale, of biofuels from microalgae. The advantage of microalgae technology is that it does not depend on the supply of crop based raw materials, or costly access to arable land intended for human consumption. The main costs are in labor, and constructing the tanks to serve as bioreactors, fertilizers (urea) and salt (for water salinization of bioreactors). For a hectare of algae production are needed 5000 tons of CO₂, which give rise to 2500 tonnes of seaweed, and half of it is oil. The project described in the workshop is expected to produce approximately 1.67 million liters per hectare / year of algal oils or up to 2.2 million liters of bioethanol per hectare year.

Several palm species were presented as promising such as Macaúba, Licuri, Catolé and Babaçu. All have potential to produce over 5,000 kg per hectare of oil, and the varieties are suitable for conversion to kerosene because of the percentages and characteristics of fatty lauric acids. Many palm species have a very high oil content, and since they are perennial they do not need to be replanted for many years.

Interesting to note is that while some of these palms are already generally grown in all of the Northeast, such as Licuri, others are more specialized (Babaçu only in Maranhão), and Catolé and Macaúba (only thrive in some parts of the Northeast).

Processing would require special attention to the issue of oil extraction, especially with Babaçu, since cracking the coconut is traditionally done manually by women, thus creating many jobs. But it's not clear whether this will remain an economical method of processing, while some local communities still depend on this employment.

It was stressed that the more viable crops in the Northeast would be those that are not irrigated, such as cotton and castor seed. Castor oil has the advantage of possibility to be produced in combination with other food crops (such as maize, for example). Other feedstocks that could be considered include jatropha. Pinhão manso (*Jatropha curcas*), which has a high oil content, has not been domesticated in the Northeast region yet, and current results demonstrate that further research is needed. So far, the shrubs lose their leaves during the dry season and do not produce oil in quantity, so there are challenges to make it a viable crop in the Northeast.

The oiticica (*Licania rigida*) is endemic to the Caatinga and to the transition zone between the semi-arid of Northeast and the Amazon region. It was presented as an alternative crop because its production is already domesticated and it can also be used to recover river bank areas, thus protecting water resources.

The advantage of oiticica are: environmental (protects rivers in the semiarid region); social (generates income in seed collection), and economic (allows money to circulate in the poorest regions).

A few decades ago, thousands of families depended on the harvest of this fruit to overcome the drought, and this can be repeated if there is encouragement from the authorities. It is a native tree and well adapted to the region, not requiring great care in planting and cultivation. The harvested fruit was exported, for the manufacturing of paints and other industries. Today, there is a market for this raw material, mainly outside the country and possible for biofuels production.

According to the participants, they foresee a transition in the production scenario for sugar cane in the Northeast. Currently sugar cane harvesting is done manually, however due to the overall economic improvement of the country it is becoming increasingly difficult to maintain a workforce for manual production. In addition, the hilly landscape makes mechanization very challenging. This could open an opportunity to invest in other crops in the future, thus enabling the production of biofuels in the Northeast based on oil seeds, such as palm and jatropha.

South: The southern region of Brazil is nationally recognized for its advanced level of social organization, strong governments and highly efficient production capacity. Admittedly a region of great opportunity, a few factors make this a promising region for sustainable investments, such as the quality of infrastructure, development of policies and programs of technological innovation.

The state of Paraná has a variety of local raw materials (feedstocks), with high oil content and which do not compete with food, which could be used for biofuel production. Among them is notable the production of nabo forrageiro, crambe, tungue, cártamo, macaúba and Pinhão Mando (*Jatropha curcas*), which all are studied at the Agronomic Institute of Paraná – IAPAR. Oils derived from such plants have also been studied by the Institute of Technology of Paraná – Tecpar, aimed at producing biofuels.

One of the great opportunities offered by the state is expertise in forest plantations, with now more than 1 million hectares planted, which could be the basis for the production of biofuels for aviation.

Brazil as a whole has knowledge and technology in forestry, especially eucalyptus, planted commercially for 50 years, and now has more than 5 million ha (an increase of 330,000 ha/year). There is a wide availability of land for expansion of the planted area, without competing with agriculture and without promoting deforestation. The knowledge and domain of eucalyptus forestry in the region, with a yield of 40 m³/ha/year, presents a great opportunity for the use of forest residues to produce biofuels. In addition, forest planting can be used as a cost effective alternative in recovering degraded areas. It is estimated that there are between 50 and 80 million hectares of areas in the country with some degree of degradation, which could benefit from forest planting.

Conclusions: Several agricultural and forest residues could be used in the production of biofuels, including aviation, but one of the main barriers is the need to create effective legislation to regularize the sector.

The main focus should be given to medium sized producers in the near future, since they have more chances to produce at the scale needed for aviation biofuels. Family farming is a good alternative for regional development, but it needs more incentives and it might take a while to scale up to serve this new demand.

It is very important to highlight the agronomic and technological “knowhow” for new and current feedstocks production at the regional level in Brazil. There are several state agronomic institutes such as IPA and IAPAR, local Embrapas, and entities such as CETENE, FAMATO, TECPAR, etc that are working on developing the technology and the knowledge transfer to producers in order to increase the production.

The main challenges presented in these workshops that relate to feedstocks are: i. very few of the regional crops could be produced in large scale in the near future, so further development is needed to scale up production; ii. there is a lack or inefficiency of technical assistance to small and medium producers; iii. in some parts of the country there is a difficulty of harvesting (perhaps developing mini-harvesters would be helpful to support the mechanization of the harvest in areas, especially in the Northeast); iv. there is a need to extend agronomic studies to the new availability of regional raw materials; v. there is need for better education in the form of rural outreach and better access to financing resources; vi. it is important to strengthen cooperatives and other producer associations; vii. there is a need for land use optimization (“vertical” growth productivity); viii. also a necessity to explore further the potential of family farming in the production of biofuels, (more receptivity by the agencies and the fuel buyers); and xi. the meetings emphasized the need to decrease the competition for land between food production and bioenergy.

The main opportunities presented were: i. that there is a potential to increase production of both energy and protein using the same plant, with systems integration (agriculture and

livestock) and improvement in the rotation process (e.g. combining soybeans, corn and sweet potatoes); ii. it is important to promote local production to achieve regional development; iii. the search for new raw materials and the research on genetic improvement can lead to lower risks on availability of feedstocks; iv. the creation of a national program for improvement of rural extension can improve the knowledge transfer to producers and increase chances of an integrated production systems; v. Brazil already has a domain expertise in forestry crops and there is a research interest in new sources of raw materials for the production of bioenergy (eg. microalgae and forest residues), which can be better used and supported.

Table 1 Basic Indicators feedstocks presented at the regional outreaches.

FEEDSTOCKS	TIME FOR PRODUCTION	PRODUCTIVITY	BIOFUEL PRODUCED	OIL CONTENT %	VOLUME	PRODUCTION COST (US\$/HA)
Sweet potato ⁽¹⁾ <i>Ipomoea batatas</i>	4-5 months	65 tons/ha	Ethanol	NA	10.500	800
Oiticica ⁽²⁾ <i>Licania rigida</i>	NA	75 kg/seeds/tree	Oil	60 to 63%	2,850 l/ha ⁽⁵⁾	NA
Macaúba ⁽³⁾ <i>Acrocomia intumescens</i>	4 - 5 years	30 tons/ha (seeds)	Oil	54%	5 tons/ha	NA
Pinhão Manso ⁽³⁾ <i>Jatropha curcas</i>	1 year	500 to 1,200 kg/ha (seeds)	Oil	23 to 34 %	1,890 l/ha ⁽⁵⁾	NA
Licuri ⁽³⁾ <i>Syagrus coronata</i>	6 years	2,000 to 4,000 kg/ha (seeds)	Oil	67%	NA	NA
Catolé ⁽³⁾ <i>Syagrus cearensis</i>	5 years	2,000 to 4,000 kg/ha (seeds)	Oil	67%	NA	NA
Castorbean ⁽⁴⁾ <i>Ricinus communis</i>	NA	680 kg/ha	Oil	45 to 55 %	380 kg/ha	NA
Sunflower ⁽⁴⁾ <i>Helianthus annuus</i>	NA	1,425 kg/ha	Oil	45 to 55 %	713 kg/ha	NA
Dendê ⁽⁴⁾ <i>Elaeis guineensis</i>	NA	25,000 kg/ha	Oil	20 to 22%	6,000 kg/ha	NA
Cotton ⁽⁴⁾ <i>Gossypium hirsutum</i>	NA	1,950 kg/ha	Oil	11 to 17%	215 kg/ha	NA
Nabo forrageiro ⁽⁵⁾ <i>Raphanus sativus</i>	NA	1,000 kg/ha (seeds)	Oil	32 to 42%	NA	NA
Canola ⁽⁵⁾ <i>Brassica napus</i>	NA	2,200 kg/ha (seeds)	Oil	40 to 48%	1,190 kg/ha	NA
Crambe ⁽⁵⁾ <i>Hochst abyssinica</i>	NA	1,200 kg/ha (seeds)	Oil	26 to 36%	360 kg/ha	NA
Tungue ⁽⁵⁾ <i>Aleurites fordii</i>	NA	2,000 kg/ha (seeds)	Oil	30 to 35%	650 kg/ha	NA

Table 1 Basic Indicators feedstocks presented at the regional outreaches (continued).

FEEDSTOCKS	TIME FOR PRODUCTION	PRODUCTIVITY	BIOFUEL PRODUCED	OIL CONTENT %	VOLUME	PRODUCTION COST (US\$/HA)
Cártamo ⁽⁵⁾ <i>Carthamus tinctorius</i>	NA	1,500 kg/ha (seeds)	Oil	40%	525 kg/ha	NA
Eucalyptus ⁽⁶⁾ <i>Eucalyptus spp.</i>	NA	40 m ³ /ha	NA	NA	NA	NA

Sources:

(1) – Presentation Aldo Biodiesel – RO Cuiabá

(2) – Presentation Dr. Júlio Zoe Brito (IPA) – RO Recife

(3) – Presentation James Melo (CETENE) – RO Recife

(4) – Presentation Ivan de Oliveira (IPA) – RO Recife

(5) – Presentation Matheus Azevedo (IAPAR) – RO Curitiba

(6) – Presentation Paulo Eduardo Telles (Embrapa Florestas) – RO Curitiba

NA – Not Available

2. Refining technologies

The refining technologies discussed during the outreach sessions were basically those that have been produced inside the universities and research centers.

The main processes can be summarized in this image presented by Dr. Bill Costa, from Center of Renewable Energy (Tecpar) in Paraná.

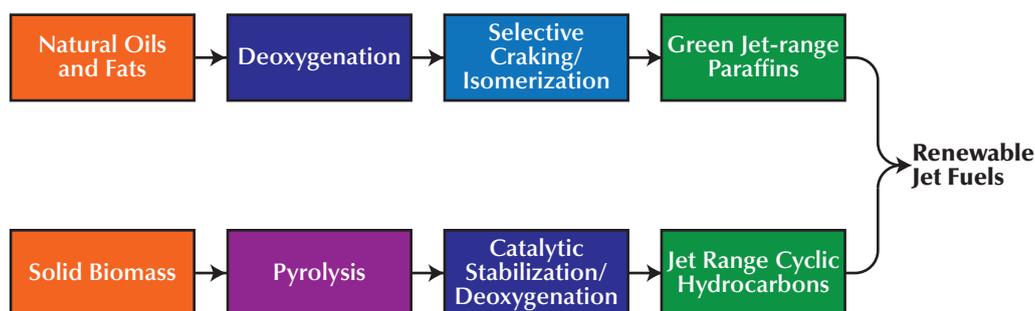


Figure 2 Refining technologies for aviation biofuels.

The main challenges for the regional development of new technology routes addressed by the participants were the lack of cooperation between researchers and industry for research and development of new technologies; the lack of investments for research; difficulty in purchasing equipment for the universities (due to laws and regulations); the need to reduce or mitigate the high cost of innovation projects on a pilot scale and the difficulty of dialogue and high degree of bureaucracy that impedes partnerships between government, industry and research centers.

Other challenges noted were related to the logistics issues, the difficulty of using genetically modified organisms, and the high cost of “scale up” for installations of medium and high complexity such as photobioreactors, in the case of microalgae.

The main opportunities presented were the interest of regional technological centers and universities in technological innovation, and to improve the dialogue with the industry, and the possibilities of new national and foreigner investments in Brazil to supply these new markets.

A bio-kerosene technology was presented by Adilson Liebsch, from Amyris. They have developed a process to make bio-kerosene by converting sugars into hydrocarbons using yeasts. The sugar is derived from sugar cane, although they state any sugar can be used. This aviation biofuel is expected to be approved by ASTM in 2014. In 2012, Amyris fuel was used in a 50% mixture with traditional jet fuel in an experimental flight of an Embraer Azul Airlines jet during Rio +20. The forecast is for this fuel to be available for commercial use at the World Cup in 2014 in Brazil. According to a study by Icone, Amyris biofuel reduces emissions up to 82% of greenhouse gases compared to fossil fuel.

3. Sustainability

Whether biofuels, and in particular bio-based jet fuels for aviation, can be produced sustainably on a large scale raises important questions, which will affect the long-term prospects for both the aviation and biofuels industries. This subject was addressed in each of the outreach sessions.

As originally formulated at the UN Conference on Environment and Development (the Rio Earth Summit in 1992), the concept of “sustainable development” includes three aspects: social, environmental and economic. It calls for “meeting the needs of the present without compromising the ability of future generations to meet their own needs.” All three aspects are important to both the aviation and biofuels industries.

Economic: From the point of view of economics, a major challenge is how to promote the right incentive policies over time, at regional and national levels, to eventually make the production viable. This requires the right investments, tied to adequate “extension services” (meaning knowledge transfer), and improvement of the capacity of regional research centers to provide information about the best practices of production.

A specific challenge for economic sustainability is that new raw materials (such as jatropha, castor, canola, etc.) are not covered by traditional value chain (it is necessary to understand any business as a supply chain and not just a product). Also, the country produces 59% less biodiesel than it could, which hinders (economic) sustainability. Furthermore there is much uncertainty in planning for production, because it is difficult to forecast the national or external demand for products; as one of the pillars of sustainability, it is necessary to invest in technological innovation and diversification of agricultural raw materials for biofuel production in the country, but outside of traditional crops there is little incentive for this.

Both the biofuels and aviation industries have goals to grow over time, and need public support for that development (in terms of permits for new runways and routes for aviation, and various forms of financial incentives for biofuels). Therefore it makes business sense to avoid controversies, such as conflicts over land, water or labor conditions, food prices and deforestation. In addition, the biofuels industry needs to demonstrate long-term financial viability in a world that may be dominated by climate change and its effects on agriculture.

Social: The main social challenge is to provide more and better employment, without causing major disruptions to rural communities and cultures. Several speakers mentioned the

potentially beneficial prospects for regional development when feedstocks and processing facilities can grow at an appropriate scale and pace for local conditions. Agricultural policy should include consideration of community and cultural cohesion as well as enhancements of crop yields.

Environmental: Today, scientists have demonstrated that one of the major threats to environmental security in Brazil, as well as many other countries, stem from agricultural expansion. This has caused deforestation, loss of biodiversity and GHG emissions; risks to water resources from inefficient use of fertilizers and irrigation (increasing both scarcity and contamination); soil erosion, loss of ecosystem services, and other impacts. Since current biofuels production has up till now depended on agriculture, the industry would benefit from being able to demonstrate the ability to expand production while avoiding these consequences.

Also, the production of biofuels may cause additional GHG emissions and water use during processing and refining.

There are many ways to circumvent these potential problems by using best practices in production and processing.

A significant challenge for environmental sustainability in Brazil is the relationship between crop agriculture, forest management and the livestock industry. There currently are 205 million cattle in Brazil, and deforestation is often driven for producing cattle pasture – someone said “Sustainability is the cow” (meaning there is an urgent need to integrate livestock and agricultural crops, and also to avoid deforestation). This integration could lead to a sustainable biofuels industry, because food, feed and fuel could be maximized on the same land.

Opportunities: Presentations were made during the outreach meetings about the potential of global systems of sustainability standards and voluntary certification (using environmental and social criteria), such as the Roundtable on Sustainable Biofuels. This system of certification allows producers to demonstrate to their whole supply chain that they are using good practices. This gives producers an advantage in the market for biofuels, especially aviation fuels, where the buyers are interested in proving the sustainability of their fuel supplies.

Other main opportunities presented were to expand on existing investments in integrated production systems which include livestock and crops, along with soil protection; it would be useful to encourage and disseminate knowledge about these and other best production practices. These would be likely to achieve sustainable certification.

Other opportunities were mentioned, such as to incentivize greater efficiency in production processes (Brazil takes only 35% of potential use of planted forests, for example). And to decrease the historical environmental liabilities, such as avoiding the competition for land between food production and bioenergy, and reducing the use of agrochemicals.

4. Policies and incentives and R&D Gaps

There are an impressive number of laws and regulations related to biofuels production in Brazil and some regional governmental programs are been developed to take their share on this new demand.

At a national level, the actions of the Ministry of Science and Technology promote the production of biofuels and renewable energy, with a focus on biodiesel program and the production of ethanol. For biodiesel, the highlight is the creation of the Brazilian Biodiesel Technology Network (RBTB). In ethanol, the creation of the Center for Science and Technology of Bioethanol (CTBE) and the Network of RD & I for agribusiness development and genetic improvement of sugarcane varieties (RIDESA) have been essential for development. There are many publications made by the Management Centre for Strategic Studies (CGEE) about aviation biofuels, which focus on the progress and technological and economic challenges to the use of this alternative fuel in Brazil and abroad.

President Dilma Rousseff announced recently that will re-create a new national company devote to agricultural extension (EMBRATER), similar to the one which existed in Brazil until the early 90s. This initiative is critical to coordinate national actions of state entities extension. According to the participants, the rural development agents (extension agents) are “the transmission belt of knowledge for farmers,” and they are also fundamental to the inclusion of family agriculture. Half of these farmers do not have access to technology, credit and knowledge. Finally, it was emphasized that there is the need to generate income for the producer to stay on the land and also to achieve environmental sustainability.

In Pernambuco, the state government created the program “Todos por Pernambuco” (“All for Pernambuco”) with the goal to identify the needs of society and outline a strategy for action.

Through partnerships between government, academia and industries, a vision was developed for the state energy policy until 2014: “Being a state with a technological and industrial base, able to develop, produce and use in excellence solutions to promote clean energy and efficient and responsible use of energy and natural resources”. The government did work to identify opportunities in renewable energy: bioenergy, solar energy, SHP (small hydro) and wind power.

In the South, the Paraná State government has adopted a strategic plan for investment opportunities in Paraná, including in the area of technology and innovation.

The plan called “Paraná Competitivo” (“Competitive Paraná”) was created in early 2011 to reenter the state into the agenda of national and international investors. The program includes a series of measures, such as the extension of deadlines for payment of taxes (ICMS), and state investments to improve infrastructure, trade, bureaucracy and job training, to make the state attractive to new productive enterprises that generate employment, income, wealth and sustainable development throughout the state.

The benefits are defined for specific outcomes, and take into account criteria such as the type of investment, job creation, economic and environment impacts, and degree of innovation. The more poor and needy is the region, the greater are the incentives granted by the State Government.

Until September 2012, the plan has attracted investments of 20 billion dollars and generated 114,000 jobs. In the area of bioenergy, investments were made for the installation and expansion of biodiesel plants.

In September of 2012, a new law of technological innovation was created, to bring feasibility to the development of new technologies and employment generation in the state. The goals to be achieved by this law are expanding the dialogue between business and academia, increase the accountability and respect for contracts.

The challenges for implementing this law are the lack of specific investments and the difficulty of financing projects.

Some of the challenges reported were the difficulty of dialogue and bureaucracy for partnerships between government, industry and research centers, the lack of skilled labor, the difficulty of articulation between the productive sectors and modernization of public administration to reduce public spending and taxes.

The solutions suggested would be more investment in agricultural research and technology on new materials, the design of better links for cooperation between research institutes, universities and funding, as well as the involvement of industries for technology development and support feasible regional feedstocks.

The strategic actions to overcome the challenges presented include integrated local solutions (potential for regional economic development) and government policies outlining an agriculture-oriented energy, with incentives to produce local raw materials on a large scale. Other key improvements would be to make greater use of the training centers, and increase the knowledge transfer and cooperation among the research centers in the country. The main centers that took part on the regional outreaches were:

INSTITUTION/ REGION	RESEARCH AREAS	WEBSITE
Embrapa Agroenergia/ Northeast	biodiesel; biogas; ethanol; energy forests	www.cnpae.embrapa.br
Embrapa Algodão/ Northeast	cultivars; production systems; biological control; biotechnology; agricultural mechanization; quality of the fibers and cotton; food technology; production of biodiesel from castor	www.cnpa.embrapa.br
IPA – Agricultural Research Center of Pernambuco/ Northeast	biotechnology; natural resources; agroenergy and industrial; crops; horticulture and floriculture; animal production; fruit production; grains, beans, roots and tubers; biocontrol of pests	www.ipa.br
Embrapa Florestas/South	genetic resources and cultivar development; promotion and control of biological agents; ecology of forest plantations; forest management; agroforestry; ecology of natural systems; forest economy; legislation and adding value to wood	www.cnpf.embrapa.br
IAPAR – Agronomic Institute of Paraná/South	chemical waste; bacteriology and virology; plant biotechnology; entomology; plant physiology and biotechnology; herbology; ecological pest management; mycology; animal microbiology; nematology; animal parasitology; duck logy seed; soil and plant tissue; animal nutrition; phytopathology; animal reproduction	www.iapar.br
TECPAR – Technology Institute of Paraná/South	analysis and testing technology; biofuels; certification; technological education; extension technology; inspection; artificial intelligence; metrology; immunobiological production; social technologies	www.tecpar.br

Brazil needs a Medium and Long-Term Common Strategic Vision for 2020 – 2050, taking advantage of our potential production chain. It is necessary to create public policies with vision for the future and prospects of investment returns over the long term, to support the expansion of the production of biodiesel with expansion of regional development, social and environmental, allowing the industry to develop projects with goal of achieving greater competitiveness, enhance crop diversification and increase demand.

It is important to seize opportunities, such as the 2014 World Cup and the 2016 Olympics, to promote the country as green fuels leader, and to catalyze policies and processes for the production of sustainable biofuels.

5. Logistics and support

The expansion of investment in infrastructure is a fundamental condition for the acceleration of sustainable development in Brazil. Thus, the country can overcome the bottlenecks in the economy, stimulating increase of productivity and reduction of regional and social inequalities.

The federal government created a program to accelerate the national growth (PAC) through investments in three major points: Logistics Infrastructure, involving the construction and expansion of roads, railways, ports, airports and waterways; Energy Infrastructure, corresponding to the generation and transmission of electricity, production, exploration and transportation of oil, natural gas and renewable fuels, and Social and urban Infrastructure encompassing sanitation, housing, subways, commuter rail, universal Light for All program and water resources. By 2020, the Brazilian transport grid will receive investments of U\$ 54 billion.

In the Center-West region, those predicted investments are not real yet. The conditions of the roads are very precarious, most of them have only two ways and very bad signs. The main bottleneck identified was the small investment on roads and rail systems to transport the production out of the state border. The lack of such investments may cause the increase of prices and loss of competitiveness of products.

In the Northeast, in the State of Pernambuco, the new investments have a focus on the ports of Suape and Recife (sugar terminal) and Petrolina airport, which are the main exit of sugarcane production and fruit produced in the state. Moreover, there are plans of future investments in logistics infrastructure, focusing on the Transnordestina highway and the Sugar Terminal in Suape.

The Port of Suape is one of the most technological in the country. In 2011, it handled 400,000 containers/year and a possible increase to 1,500,000 in 2014. The access channel is of 390 meters width and 16.5 m deep, allowing big commercial boats to enter. The exports in 2011 were of almost U\$ 50 billion. The main export destinations are Russia, Europe, EUA and north of Africa.

The new Transnordestina has a goal of connecting the Port of Pecém (Ceará) to the Port of Suape (Pernambuco), in a total of 1,728 km. It will have the ability to carry around 3 Million/T per year, and has an estimated cost of U\$3 billion. The completion date is 2014.

In the South region, the logistics opportunities highlighted were the advantages of strategic location, close to major consumption centers in Latin America (eg São Paulo, Rio de Janeiro and Buenos Aires); logistics for a wide variety of production, with technologically

advanced ports (port of Paranaguá); expansion of the rail network, connecting the state from west to east and the creation of mechanisms for integration and cooperation.

The Port of Paranaguá handled in 20 million tons of products in the first half of 2012, which was a total of U\$ 8,7 billion. The port has predicted public and private investments of U\$ 490 million in the next 3 years.

The state of Paraná had also invested in the railways that cross the border with other states, to connect production areas, such as the connection between Maracaju (MS) to Cascavel (PR) of 420 km.

Conclusion

It was evident from the workshops that Brazil has a huge potential and variability of raw materials to be explored to produce biofuels.

The main challenges were the lack of investment in research and innovation in local and lesser known crops, the difficulty of dialogue among various sectors of society, the complex bureaucracy for access to state resources, the logistical challenge due to the size of our continental country and the lack of training in sustainable practices of producers.

Opportunities and challenges were highlighted in each workshop and this work seems to have planted the seed for more multi sectoral discussions on the issue of sustainability and the importance of planning in land use for biofuel production, agriculture and others. Also the workshops expanded the knowledge of the public about the importance, challenges and opportunities that a new world demand can bring to all stakeholders.

The contacts made and strengthened during the seminars shows once again that the transfer of information, as well as creating opportunities for discussion, are still the best ways to build a participatory process of change towards sustainability.

And with a bit of political participation and multi sector awareness, much can be done to change the course of production and commercialization of biofuels for aviation in Brazil.