



## PART II

---

# NEEDS AND TECHNOLOGICAL CAPABILITIES

## 8 CURRENT SCIENTIFIC AND TECHNOLOGICAL CAPABILITIES

---

Augusto Barbosa Cortez [et al.]. "Current scientific and technological capabilities", p.127-130. In: Luís Augusto Barbosa Cortez (Editor). **Roadmap for sustainable aviation biofuels for Brazil — A Flightpath to Aviation Biofuels in Brazil**, São Paulo: Editora Edgard Blücher, 2014.  
<http://dx.doi.org/10.5151/BlucherOA-Roadmap-008>

## 8 CURRENT SCIENTIFIC AND TECHNOLOGICAL CAPABILITIES

---

### 8.1 Feedstock

The success of Brazilian agriculture is not just a matter of land availability and good climatic conditions. Brazil has a tradition in public agriculture research and education centers that have paved the way to its success. In the past 50 years the Brazilian government, both at federal and state levels created new research institutions and promoted R&D in an expanding university system. At the same time, the dynamism and opportunities of Brazilian agriculture have attracted private companies and cooperatives to develop technology in agriculture related fields.

Many public institutions have R&D activities in multiple areas. This is the case of Embrapa, the Federal agriculture research institution with 48 research units throughout Brazil. Embrapa has research centers dedicated to crops or themes directly related with bioenergy: Agroenergy Center, Soybean Center, Forest Research Center, Cassava Center.

APTA – The São Paulo State Agency of Technology of the Agrobusiness has a model similar to that of Embrapa, but in a smaller scale and at the state level. Some of its institutes such as the Agronomic Institute of Campinas (IAC), Biological Institute (IB) and Animal Science Institute (IZ) do research in topics of bioenergy. IAC Sugarcane Center has a sugarcane breeding program since 1933. Other states have also similar institutions such as IAPAR, Goiás Rural Agency, EPAMIG, Empaer MT, among others.

Currently there are 80 graduate programs offering M.Sc. and or Ph.D. level degrees in areas of agricultural sciences with some research activity. Of those, many have a long standing tradition in agricultural research such as ESALQ-USP, CENA, UNESP, UNICAMP, USFCAR, IAC (in the state of São Paulo), UFLA, UFV and UFU (Minas Gerais), UFRGS, UFSM, UFPE (Rio Grande do Sul), UFPR, UEL (Paraná), UFRRJ (Rio de Janeiro), UFSC and UDESC (Santa Catarina), UFRPE (Pernambuco), UFBA, UFRB (Bahia) and several other new graduate programs.

Several institutions develop sugarcane varieties in Brazil, which make possible the availability of a large number of varieties, adapted to the different regions and soil types. Among the public institutions are IAC, already mentioned, and RIDESA (Interuniversity Network of Sugarcane Plant breeding Program) which is the present leader of varieties in Brazil and started to breed sugarcane in 1972. Embrapa is a newcomer in the field but has good infrastructure to progress rapidly. CTC (Sugarcane Technology Center) is the oldest of the private institutions, funded by the sugarcane business sector, which started its program in 1968. Several international companies started to develop sugarcane varieties in Brazil: Monsanto (Canavialis), Syngenta and BASF.

Soybean varieties were initially developed by public institutions such as IAC, Embrapa, IAPAR, EMGOPA, EPAMIG and some university departments, but, more recently there are more than ten soybean seed companies, many of them international, which are competing in the market, bringing new technologies and expertise: Pioneer, Monsanto, Nidera, Syngenta,

and many Brazilian private companies such as Coodetec, TMG, Brasmax, Adriana, Agroeste and others.

Seeds for biofuel crops are being tested in Brazil by international companies such as SGB (Seeds Genomics Biofuels) from San Diego, USA, which develops jatropha hybrids, and the Camelina Company (Spain, USA) which is adapting camelina varieties to Brazilian conditions.

Public institutions such as Embrapa, IAPAR and IAC have breeding programs for hundreds of plant species, including grasses for pasture; some of the private companies also develop hybrids and varieties for other crops, but usually those of higher market value such as maize, soybean, cotton, sunflower, etc.

Plant breeding was pointed out as key for improving biofuel crops, decreasing feedstock prices, and solving specific problems of crops in the short and long term. It is clear that Brazil has a very good R&D infrastructure for developing or adapting new varieties and hybrids for biofuel crops.

Other R&D topics are also important for jet biofuel. The main institutions working on the subject in Brazil are listed in **Table 26**.

Table 26 Public and private organizations involved in R&D for biofuel feedstocks in Brazil.	
FEEDSTOCK	ORGANIZATIONS
<i>Sugarcane</i>	IAC
	CTC
	RIDESA
	Embrapa
	Universities in general
	CTBE – Brazilian Bioethanol Science and Technology Laboratory
<i>Sorghum</i>	CERES
	Embrapa
	IAC
	IAPAR
<i>Cassava</i>	IAC
	Embrapa
	IAPAR
	EPAGRI
	Consolidated breeding programs (IAC, EMBRAPA, IAPAR)
<i>Soybean</i>	Embrapa
	IAC
	Universities (ESALQ, Federal University of Viçosa, Federal University of Rio Grande do Sul)

Table 26 Public and private organizations involved in R&D for biofuel feedstocks in Brazil (continued).	
FEEDSTOCK	ORGANIZATIONS
<i>Palm and Jatropha</i>	SGB
	Embrapa Agroenergy
	IAC
	IAPAR
<i>Camelina</i>	Camelina Company (Brazil, Spain, USA)
<i>Eucalyptus</i>	Universities (ESALQ, UNESP, Federal University of Viçosa, Federal University of Parana, Federal University of Lavras, Federal University of Santa Maria, among others)
	SIF – Society of Forest Investigation
	FUPEF – Forest Research Foundation of Parana
	Embrapa – Forest Center
	Rede de Pesquisas em Florestas Energéticas no Plano Nacional de Agroenergia
<i>Grasses</i>	Embrapa
	IZ
<i>Municipal Solid Waste</i>	Brazil: CENBIO - Brazilian Reference Center on Biomass

## 8.2 Refining Technologies

There is less technological capability on refining technology in Brazil than on feedstocks and agriculture. The best potential capability for jet biofuel in Brazil is related to large scale fermentation of sugarcane to bioethanol and hydrocracking of vegetable oils (HBio/Petrobras). However, in other countries, the technological capabilities are more advanced, as shown by the different presenters in the workshops. Branches of international companies such as Amyris, Solazyme, Novozymes and others, are working with Brazilian private companies to develop or adapt feedstock processing technologies.

Embrapa (Brazilian Agriculture Research Corporation) is one of the most important research institutions on agribusiness, including many specialized branches for different products/technologies and regions. In addition, there are other relevant research centers and groups, such as universities and public and private organizations with tradition in agriculture research and related technologies.

Sugarcane and Sorghum refining technology is developed mostly at CTBE Laboratório Nacional de Ciência e Tecnologia do Bioetanol, CTC Centro Tecnologia Canavieira. The State and Federal Universities (UNICAMP, USP, UNESP, UFSCAR, UFV, UFRJ and others) also are very important actors on the generation and advances on refining technologies, where the advances are mostly done at the Food Engineering, Chemical Engineering, Agriculture Engineering, Mechanical Engineering schools and at Institutes of Biology and Chemistry).

Technology for eucalyptus is also investigated in universities (ESALQ, UNESP, UFV, UFPR, UFL), and research centers such as Fundação de Pesquisas Florestais do Paraná (FUPEF), EMBRAPA – Centro de Florestas, Rede de Pesquisas em Florestas Energeticas no Plano Nacional de Agroenergia, and Instituto de Pesquisas Tecnológicas de São Paulo (IPT).

The current implementation of commercial plants to produce cellulosic biofuels is not fully implemented worldwide, including in Brazil. However, several second and third generation technologies for biofuel production seem to start to go into commercial scale, although many previously announced such initiatives failed to materialize (THE ECONOMIST, 2013).

Solazyme has recently announced two plants to produce oils from sugar, through algae fermentation, one in the USA and one in Brazil. In the USA, Solazyme intends to produce 20,000 t/yr of oil from dextrose in a joint project with Archer-Daniels-Midland (ADM), primarily for the industry and food markets (SOLAZYME, 2013).

In Brazil, at Usina Moema, in São Paulo State, Solazyme launched a project for 100,000 t/yr production of oils from sugarcane for the Brazilian industry and fuel market, starting in late 2013, in a joint venture with Bunge Limited (SOLAZYME, 2013).

GranBio, a Brazilian company, has started building a second generation ethanol plant in Alagoas, in the Northeastern sugarcane region, with a nominal capacity of 82 ML of ethanol from sugarcane bagasse and trash. Steam explosion technology of the Italian company Chemtex, enzymes from Novozymes and yeast from ADM will be used there. The plant is expected to start operating in 2013 (GRAALBIO, 2012).

Amyris has launched a plant to produce farnasene at Usina Paraíso, Brotas – SP with six reactors with 200,000 liters capacity each.

These Brazilian initiatives are supported by funds from BNDES, the Brazilian National Development Bank. If successful, the outcomes of such biofuel businesses may represent a new stimulus to an industry plagued with projects postponed or canceled, and have a positive effect on sustainable jet fuel research, development and deployment.