WORKSHOP ON SUSTAINABLE BIOMASS PRODUCTION FOR THE WORLD MARKET

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Biodiesel in Brazil

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Evolution of biodiesel in Brazil

1920 : First initiatives for vegetable oil use in motors, with limited results

1970-1980: Trying to replicate ethanol program Brazilian Government put forward Pro-óleo and OVEG programs, without results

2002: Science and Technology Ministry launches the PROBIODIESEL Network, to promote research and development in this field

Evolution of biodiesel in Brazil

2002-2004: ANP (Regulatory Agency for Fuels) sets the Brazilian Biodiesel specification

2004: The Brazilian Government issues a National Biodiesel Program (Law 11.097/2005), introducing:

- ✓ ***B2 use is allowed from 2006***
- ✓ ***mandatory B2 adoption from 2008***
- ✓ ***progressive biodiesel increment reaching B5 in 2013***
- ✓ ***fiscal support for small farmers, Northeast region and castor and palm producers***

The feedstock issue

Many alternatives:

Plant	Oil product	Oil content (%)	Harvest duration (months)	Oil production (t/ha)
Oil palm (*Elaeis guineensis N.*)	nut	26	12	3,0-6,0
Babassu (*Attalea speciosa M.*)	nut	66	12	0,4-0,8
Sunflower (*Helianthus annus)*	seed	38-48	3	0,5-1,5
Rapeseed (*Brassica campestris*)	seed	40-48	3	0,5-0,9
Castor plant (*Ricinus communis*)	seed	43-45	3	0,5-1,0
Peanut (*Arachis hipogaea*)	seed	40-50	3	0,6-0,8
Soybean (*Glycine max*)	seed	17	3	0,2-0,6

The importance of productivity, energy balance, oil quality and byproducts utilization

The feedstock issue

Potential of tropical palms:

Oil Palm (*Elaeis guineensis*)

Licuri (*Syagrus coronata*)

Fat acids in vegetable oils

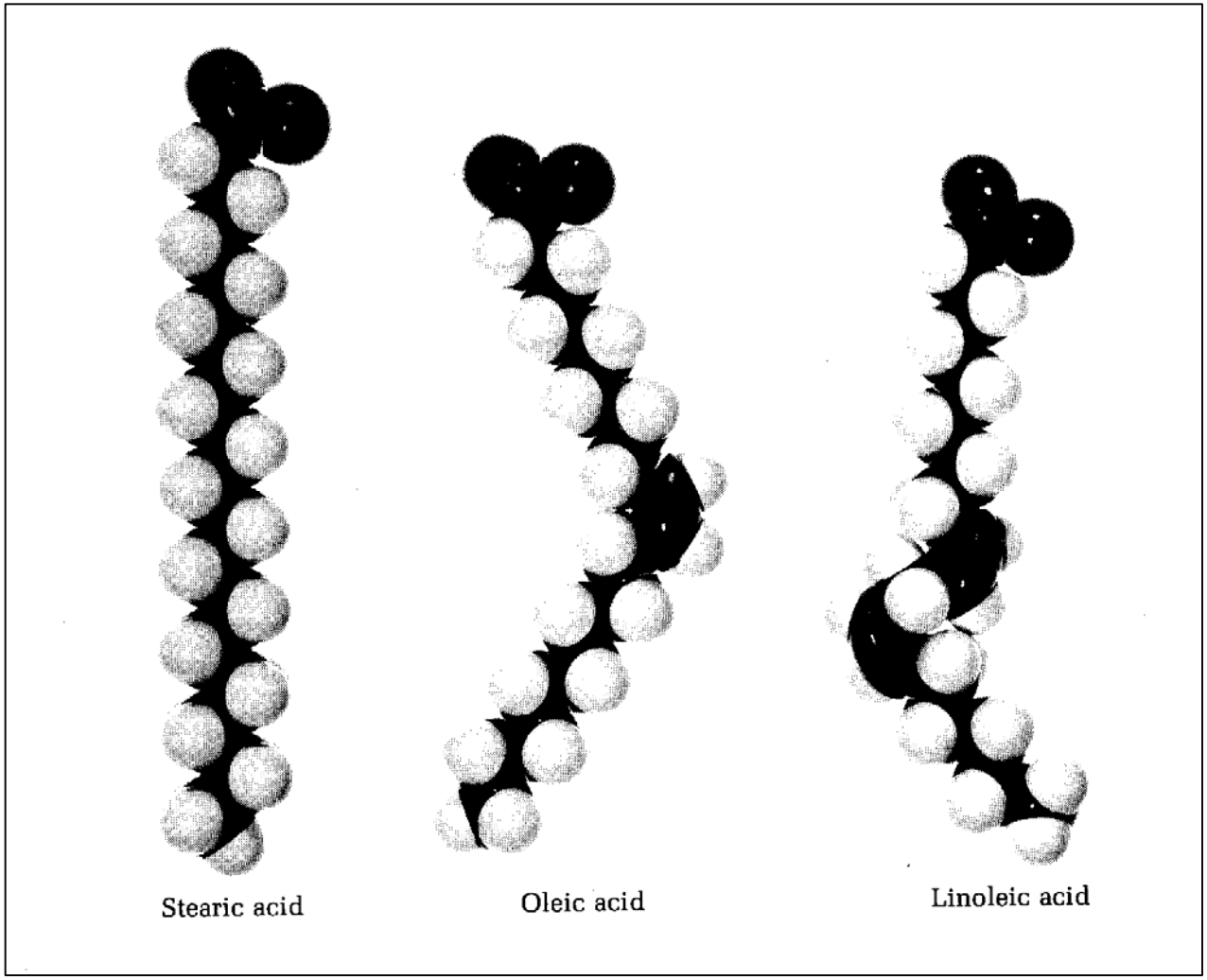
Approximate Chain Length Distributions
of Regularly Used Fats and Oils

		Coconut	Palm Kernal	Soybean	Canola	Tallow	Palm	Yellow Grease	Choice White
Caproic	C6								
Caprylic	C8	7	3						
Capric	C10	6	3						
Lauric	C12	47	47	1				1	
Myristic	C14	19	16	1		3		2	2
Pentadecanoic	C15					1	1	1	
Palmitic	C16	10	9	10	5	24	45	22	24
Palmitoleic	C16:11				0	4		3	3
Margaric	C17					2		2	0
Stearic	C18	3	2	4	2	20	4	15	12
Oleic	C18:1	6	17	22	60	43	40	46	44
Linoleic	C18:2	2	3	54	21	4	10	10	11
Linolenic	C18:3			8	9	1	0	1	3
Arachidic	C20				1				
Eicosenic	C20:1	0		0	2				

Various Sources

Source: Weber, J.A., 2002

Different C-18 fat acids



Source: Weber, J.A., 2002

Conversion paths: methyl or ethyl esters?

The large availability of ethanol in Brazil has stimulated the search of ethyl alcohol routes for biodiesel production, displacing methanol.

So far, in spite of the efforts done, such alternative remains in development and all current biodiesel production uses methanol.

The basic problems to solve are related to glycerin separation, catalyzer selection and energy balance.

Specification of Brazilian biodiesel

The Brazilian biodiesel specification (ANP Order 42/2004) is closer to the European and American ones (DIN 51606 and ASTM D 6751-02).

There is no restriction for ethyl or methyl esters and basically all fat feedstock are permitted.

Allowance is done for biodiesel viscosity and some other parameters, but the biodiesel blend properties should be similar of regular diesel.

Improvements in biodiesel quality measuring are required, mainly for cetane number and stability evaluation

Specification of Brazilian biodiesel

ANP Order 42/2004, biodiesel parameters (partial)

CARACTERÍSTICAS	UNIDADES	LIMITES	MÉTODOS		
			ABNT NBR	ASTM D	EN/ISO
Destilação 90% volume recuperado, máx.	°C	360,0	-	1160	-
Resíduo de carbono, máx.	% massa	0,10	- -	4530 189	EN ISO 10370 -
Índice de acidez, máx.	mg KOH/g	0,80	14448	664	BS EN 14104
Glicerina livre, máx.	%massa	0,02	- -	6584 -	BS EN 14105 BS EN 14106
Glicerina total, máx.	%massa	0,38	-	6584	BS EN 14105
Metanol ou Etanol, máx.	% massa	0,5	-	-	BS EN 14110
Índice de iodo, máx.	% massa	Anotar	-	-	BS EN 14111
Monoglicerídeos, máx.	% massa	Anotar	-	6584	BS EN 14105
Diglicerídeos, máx.	% massa	Anotar	-	6584	BS EN 14105
Triglicerídeos, máx.	% massa	Anotar	-	6584	BS EN 14105
Sódio + Potássio, máx.	mg/kg	Anotar	- -	- -	BS EN 14108 BS EN 14109
Fósforo, máx.	mg/kg	Anotar	-	4951	BS EN 14107
Estabilidade à oxidação a 110°C, mín.	h	6	-	-	BS EN 14112

Present and forecast biodiesel production

Currently there are some plants starting to produce biodiesel, eg. AGROPALMA

Source: Agropalma, 2005

Present and forecast biodiesel production

Pilot plants have been implemented, generally associated to rural cooperatives.





The main problems to overcome in these small plants are related to agriculture productivity, transesterification unit (design/operation), product logistic and biodiesel quality evaluation.

Source: Jörgdieter Anhalt, 2004

Present biodiesel production

Registered Biodiesel Plants (November 2005)

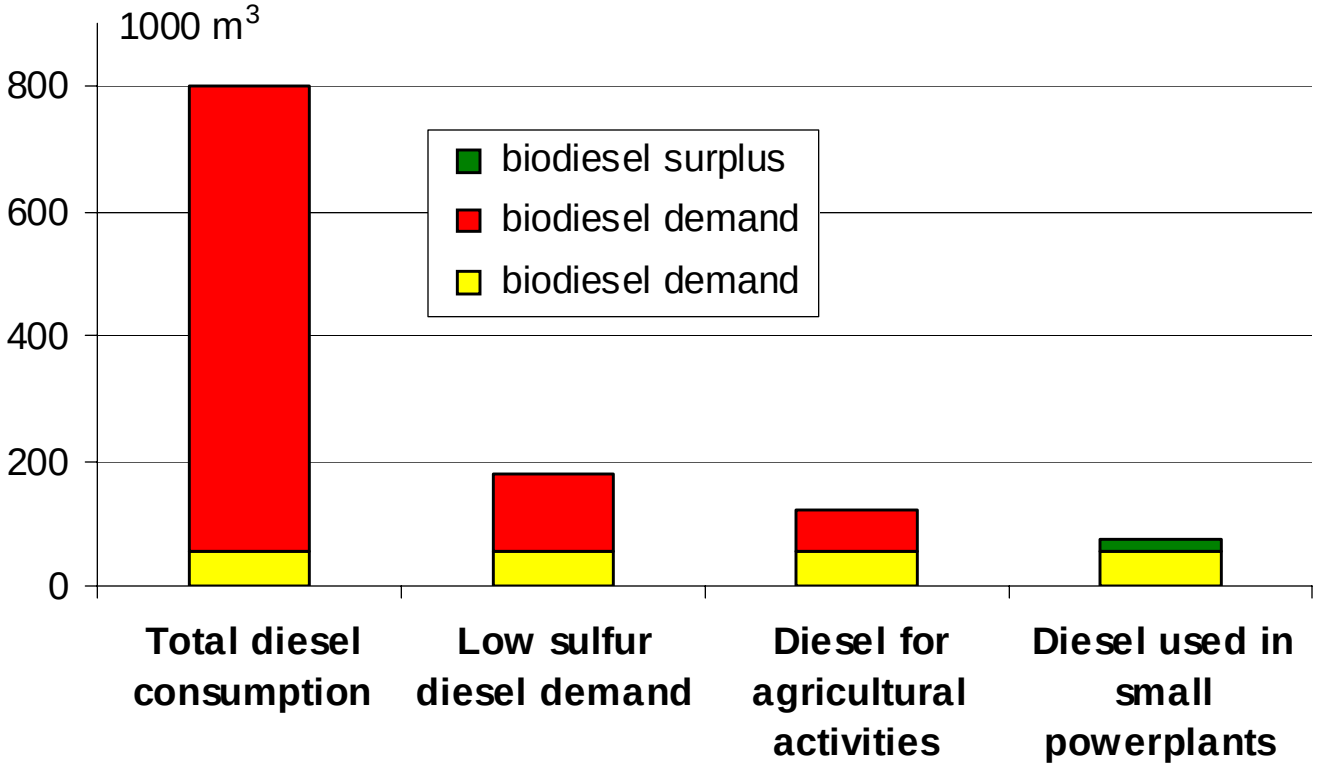
Producer	Site	Estimated Annual Output (1000 t)	Main Feedstock
Soyminas	Cássia/MG	12,0	sunflower and soybean oil
Agropalma	Bélem/PA	8,1	palm oil
Brasil Biodiesel	Teresina/PI	0,6	castor oil
Biolix	Rolândia/PR	9,0	soybean
Brasil Biodiesel	Floriano/PI	27,0	castor oil
NUTEC	Fortaleza/CE	0,7	castor oil
Total		57,4	

Source: ANP, 2005

In a recent bidding process promoted by the Brazilian Government and involving only biodiesel producers with "social tag", 70.000 m³ of biodiesel were sold (average price 0,82 US$/liter), to be produced in 2006.

Present biodiesel production

Biodiesel demand and supply (B2, 2006)



The present availability of biodiesel is very limited compared with required fuel, even considering more restrict markets.

Biodiesel in Brazil, Horta Nogueira, 2005

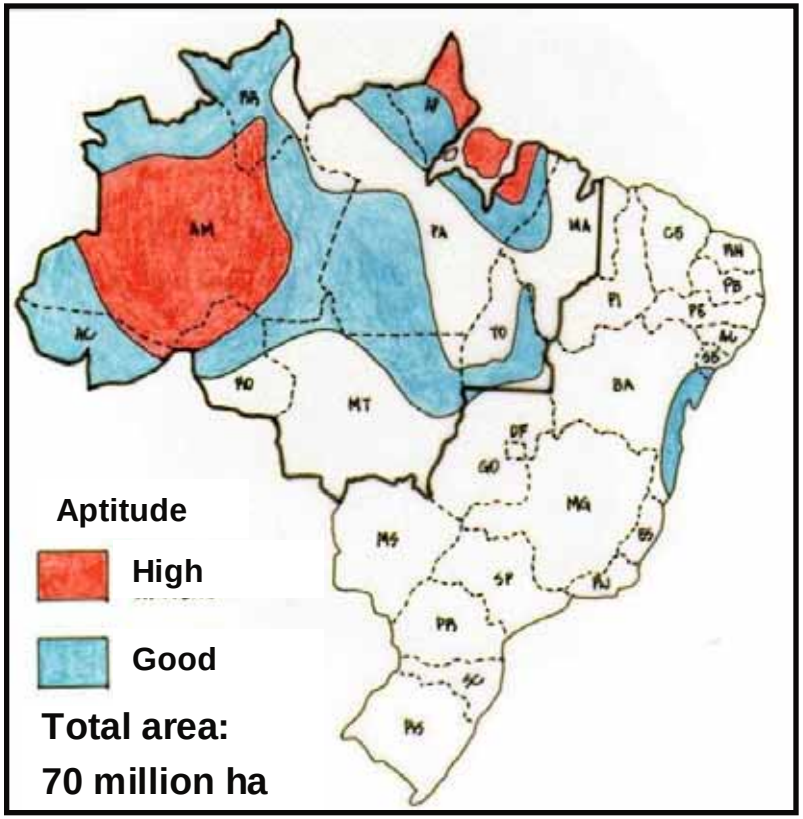
Potential biodiesel production

Basically three species have been largely considered to produce biodiesel in Brazil, however it seems that differences in costs and productivity will play a essential role, defining oil palm as one of the best options.

Feedstock	Biodiesel productivity liter/ha	Required area for B5 million ha	Area for B5 / Area for ethanol (2005)
Soybean oil	600	3,33	67 %
Castor oil	1.000	2,00	40 %
Palm oil	5.000	0,40	8 %

Potential biodiesel production

Considering just 10% of oil palm suitable areas in Northern Brazil, it could be produced more than 52 million m³ of biodiesel, about the current Brazilian diesel demand.



Suitable areas for oil palm cultivation

(MCT, 2003)

Perspectives for exporting

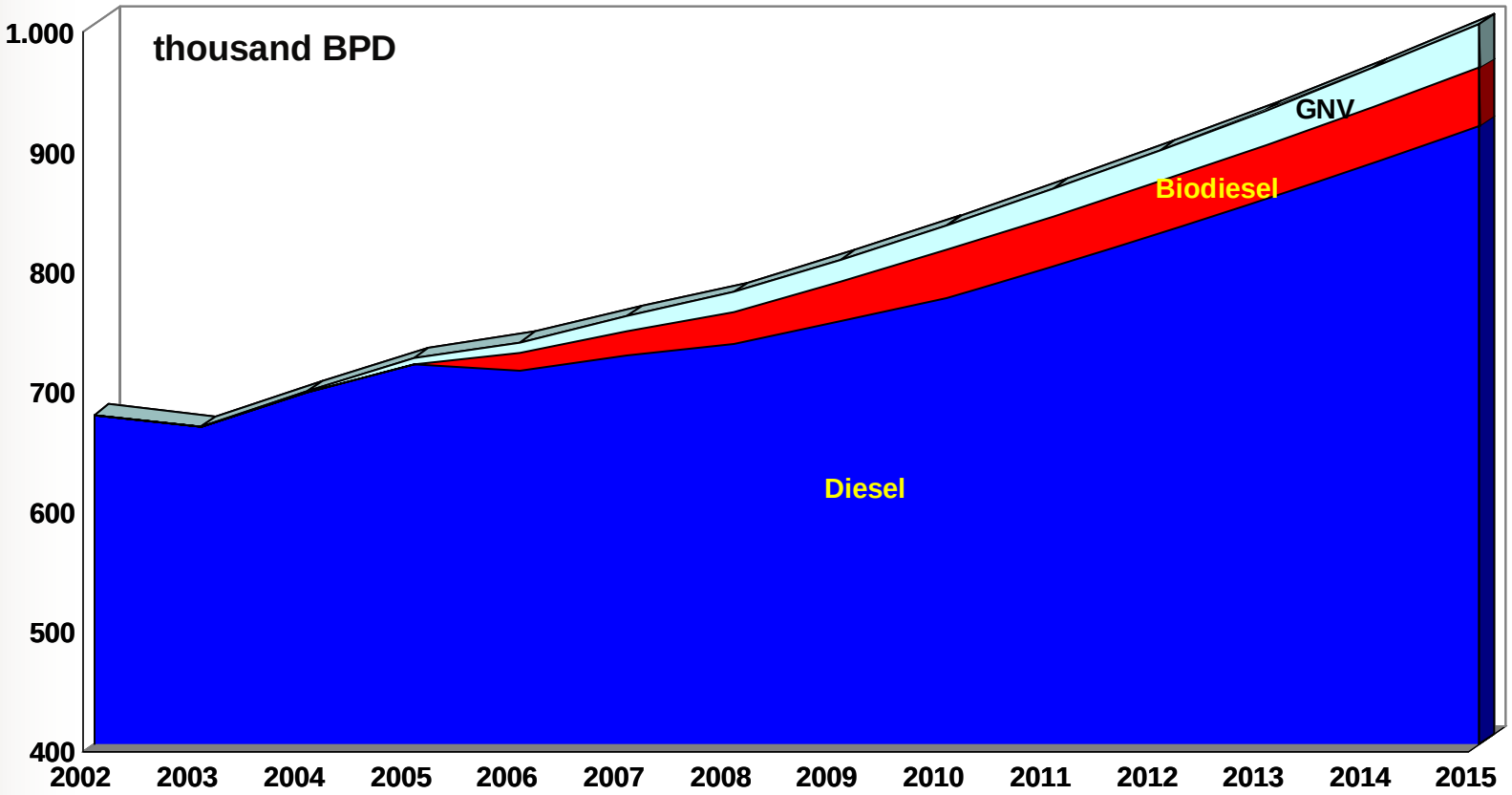
The clear potential for biodiesel production in Brazil is not necessarily related to exporting. Many relevant issues should be taken into account in order to convert such apparent availability in effective biofuel trade.

One basic aspect is the national demand. Brazil is a huge diesel consumer, importing about 10% of domestic diesel demand. So, the Brazilian biodiesel must be used primarily in the internal market.

Perspectives for exporting

B5 in whole diesel means about 2,5 million m³ biodiesel demand.

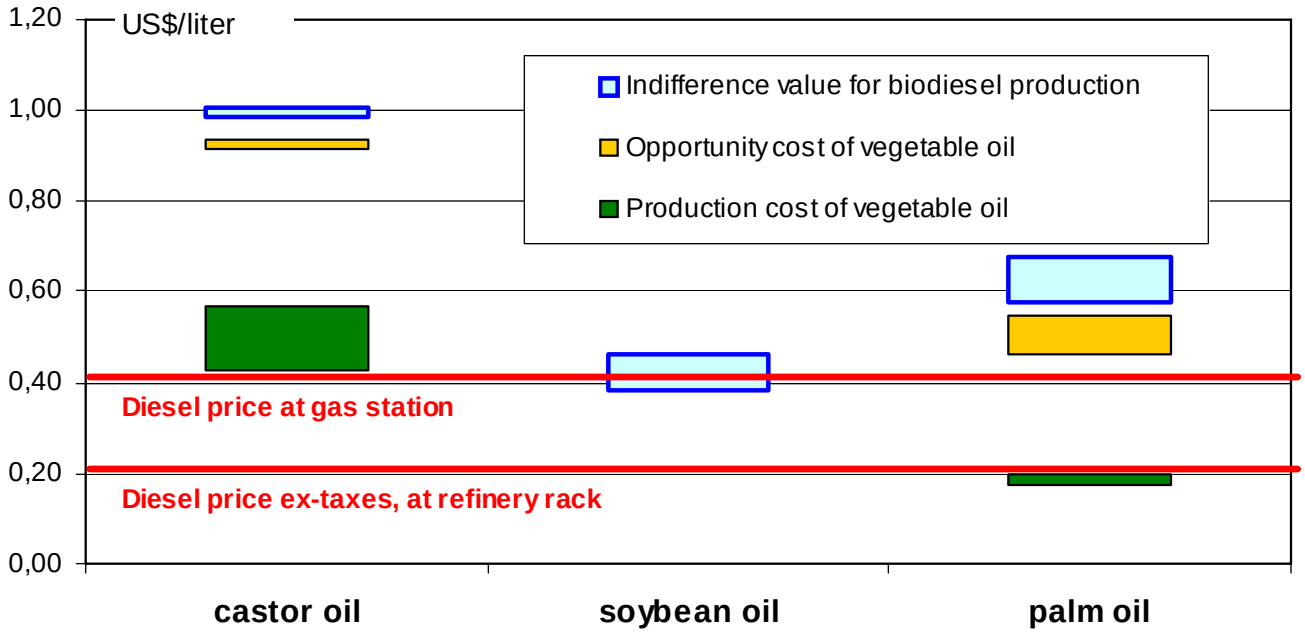
Diesel fuels demand forecast



Source: Petrobras, 2005

Perspectives for exporting

An decisive issue is the economic feasibility of biodiesel production, either in terms of comparative costs facing conventional fuels or opportunity costs for other applications of vegetable oils.



Source: Macedo e Horta Nogueira, 2005

Final comments

To build a sustainable biodiesel program in Brazil is fundamental to set clear and feasible objectives. Nowadays there are at least two conflicting visions about biodiesel,

one concerned with social issues, jobs generation and small farmers assistance

another linked with expansion of agribusiness in energy applications, replicating the ethanol results.

The optimum scale, the appropriated technology and even the sustainability concept are not the same for each case.

Final comments

What production scheme for biodiesel in Brazil?

Soybean harvest in Mato Grosso, 2004

Castor fruits harvest in Piauí, 2005

Final comments

Besides the production contradiction, arises the utilization question:

- ***biodiesel for all applications?***
- ***biodiesel to reduce trucks and buses emissions in cities?***
- ***biodiesel to improve lubricity of low sulfur diesels used in metropolitan areas?***
- ***biodiesel for power generation in isolated villages?***
- ***biodiesel for export?***

For every application a biodiesel specification and an economic context should be considered.

Final comments

Frequently the embryonic Brazilian biodiesel program is compared with the succeed ethanol program, claiming that all problems will be solved along the time, but ethanol and biodiesel are really diverse.

Similarities

renewable fuel, environmentally correct, large manpower demand, good social acceptance

Differences

energy balance, agroindustrial diversification and flexibility, economic feasibility (direct and opportunity costs), production scales, know-how

Final comments

The future dimension of Brazilian biodiesel production will depend basically on the path adopted to solve or to reduce these differences and conflicts.

Maybe is too early to forecast the future biodiesel production in Brazil, conformed by the domestic demand and the amount exported. This share is affected crucially by trade barriers, more than the intrinsic rationality of biofuel production itself.

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Final comments

What the developed countries are looking for when they promote biofuels:

to USE renewable energy or

to PRODUCE renewable energy?