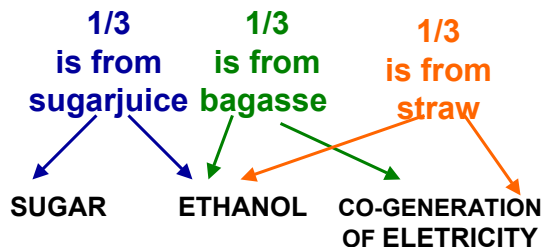


SUGARCANE AS A PERFECT BIOMASS FOR ENERGY PRODUCTION

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SUGARCANE IS PURE ENERGY



BRAZILIAN'S SUGARCANE ENERGETIC VALUE: FOR 1 TON

PRODUCTION	ENERGY EQUIV. (MCAL) ⁽²⁾	TOE
75 l (ethanol) ⁽¹⁾	500	0,046
280 kg of bagasse (50% humidity)	630	0,058
280 kg of straw (50% humidity)	630	0,060
TOTAL	1.760	0,162

(1) Better results: 85/90 l

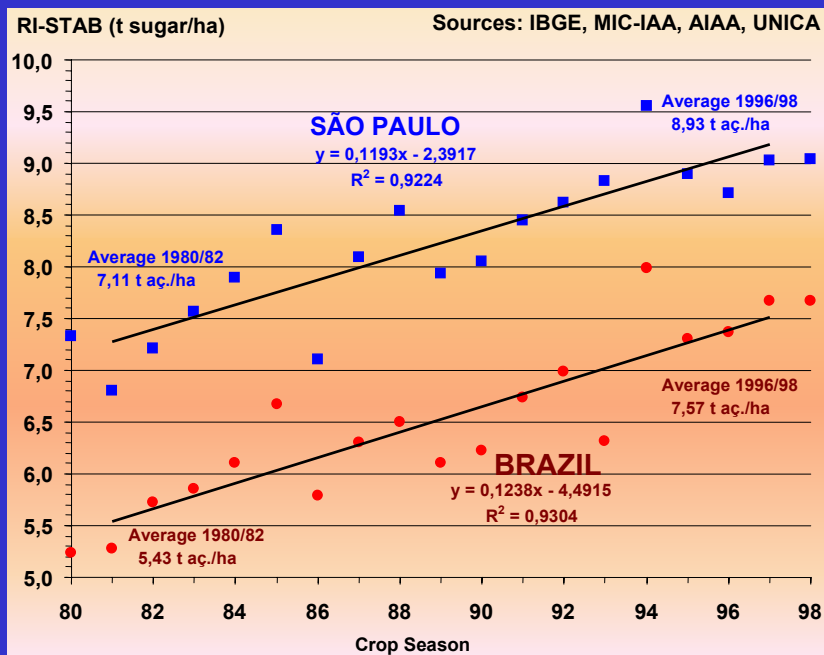
2) Superior calorific power

Source: CTC/Copersucar, May 2002

Results:

- a) 1 ton of cane is equivalent to 1 barrel of oil
- b) 1 ha of cane (85 ton) is equivalent to 60 barrels of oil (net result)
- c) 5 mm ha represents 300.000.000 barrels of oil or 820.000 b/day (the actual oil consumption in Brasil is 1,5 mm b/day)

AGRI-INDUSTRIAL PRODUCTIVITY (sugar / ha)



SUGARCANE AGRIBUSINESS POSSIBILITIES: LOWER PRODUCTION COSTS

- **NEXT FIVE YEARS:** technology implementation (could reduce 20% the average production costs)

- **“CO-PRODUCTS”:** energy; ethanol from bagasse; use of trash for energy purposes; other possibilities (biodegradable plastic, etc)

- **Medium Long Term Perspectives of Biotechnology**
 - DHR
 - Fermentation Process
 - Others

Source: Carvalho, LCC



Alcohol & Sugar

Next Future Evolution

➤ With the DHR – Dedini’s Rapid Hydrolysis (Alcohol from Bagasse) and the utilization of Tops, Leaves and Straws, the productivity will increase and the cost will decrease (Alcohol competitiveness with gasoline from U\$D 18 per barrel of oil). They are conducting it in an association with the CTC-COPERSUCAR.

In the Past	Today	DHR
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4.620	7.740	12.740 (50% straw)
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In november/02 it will begin a 5.000 l/day project in Dedini’s mill.

2. Energy in cane and ethanol production (MJ/t cane)*

	Averages (MJ/t cane)		Best Values (MJ/t cane)	
Sugar Cane Production (total)	189,87		175,53	
- Agricultural Operations	30,10		30,10	
- Cane Transportation	34,92		31,87	
- Fertilizers	66,96		56,09	
- Lime, herbicides, etc	19,06		19,06	
- Seeds	5,76		5,34	
- Equipment	33,07		33,07	
Ethanol Production (total)**	46,08		36,39	
- Electricity (bought)	0,00		0,00	
- Chemicals and Lubricants	7,34		7,34	
- Buildings	10,78		8,07	
- Equipment	27,96		20,98	
External Energy Flows (agriculture + industry)***				
	Input	Output	Input	Output
Agriculture	189,87		175,53	
Industry	46,08		36,39	
Ethanol produced		1.996,37		2.045,27
Bagasse surplus		175,14		328,54
Total (external flows)	235,95	2.171,51	211,92	2.373,81
Output/Input	9,2		11,2	
<p>(*) Three levels of "energy utilization" are considered: direct fuel and (external) electricity utilization; energy used for production of chemicals, lubricants, lime, etc.; energy for production and maintenance of equipment and buildings.</p> <p>(**) Only "external energy: not including energy from bagasse utilized at the sugar mill, as steam or electricity.</p> <p>(***) External energy inputs are mainly from fossil fuels (fuel oil, diesel); although in Brazil most of the electric power input is renewable (hydro-electric) it is considered here as component of buildings, equipment, chemicals, etc.</p>				

Source: Macedo, Isaias de Carvalho, Greenhouse Gas Emissions and Bio-Ethanol Production / Utilization in Brazil, Jan/97, CTC - Copersucar

BRAZIL'S: SUGARCANE AGRIBUSINESS – THE CHANGE

3. SUGARCANE AS A SYSTEM, UPTAKING CO₂ FROM ATMOSPHERE

10⁶ t C (equiv.)/year

Fossil fuel utilization in the agro-industry (inputs)	+ 1.28
Methane emissions (sugar cane burning)	+ 0.06
N ₂ O emissions	+ 0.24
Ethanol substitution for gasoline	- 9.13
Bagasse substitution for fuel oil (food and chemical industry; includes sugar)	- 5.20
Net contribution (Carbon uptake)	- 12.74

Source: Macedo, I.C. – CTC/Copersucar

ETHANOL COMPETITIVENESS IN C/S - BRAZIL (NO TAX)

ANHYDROUS SELL'S PRICE - US\$ / B	SCEN 1 25,00⁽¹⁾	SCEN 2 40,00⁽²⁾
INTERNATIONAL GASOLINE IN BRAZIL (CIF)	35,00⁽³⁾	61,00⁽⁴⁾

(1) PRODUCTION COST (AVERAGE) - C/S REGION

(2) ACTUAL MARKET PRICE PLUS CIDE

(3) GASOLINE PRICE AT REFINARY

(4) GASOLINE PRICE AT REFINARY PLUS CIDE

NOTES: - 1 US\$ = 3 R\$

- ETHANOL REDUCES THE GASOLINE PRICE

Souce: Carvalho, LCC



EXAMPLE

**CONSUMPTION INCREASE OF AROUND 500 MILLION LITERS OF
ETHANOL PER YEAR**

- **100,000 new ethanol cars (CDM project Brazil - Germany)**

or

- **Substitution of the use of MTBE**

2 million cars in USA (10% ethanol)

4 million cars in EU (5% ethanol)

EMISSIONS REDUCTION

(MTBE - USA/EU) of around **1.000.000 ton/year CO₂**

(Brazil - CDM project) of around * **700.000 ton/year CO₂**

* 25% of ethanol in the brazilian gasoline



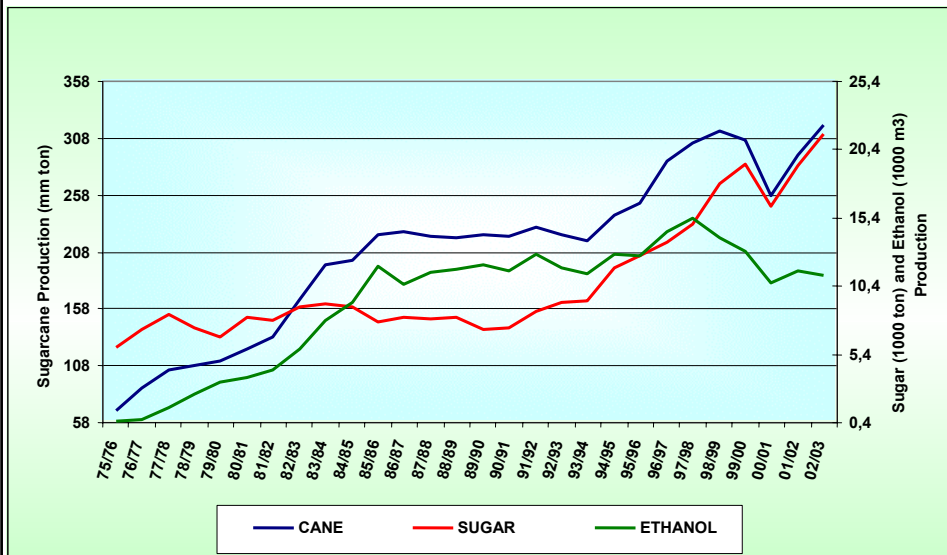
EMISSION REDUCTION (Equivalent tons of CO₂ and CERs).

10 years – proposed deadline for the project – the total of reduced carbon in the project 100.000 new fleet alcohol fueled cars is of about

7.100.000 ton/ CO₂ (seven million and a hundred thousand tons of CO₂).

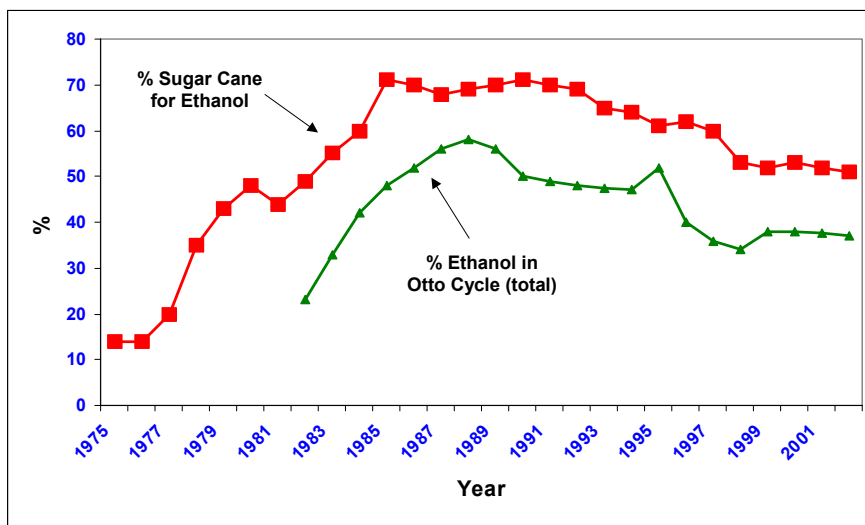
The unity average value of CO₂ ton = U\$ 5.90

BRAZILIAN SUGARCANE AGRIBUSINESS SUGARCANE, SUGAR AND ETHANOL PRODUCTION



Source: UNICA

Ethanol and Gasoline Utilization



Source: Macedo, Isaias de C.

Employments

Employments in the production of the vehicle and of fuel
men-year per thousand vehicles

MEN YEAR GENERATED	ALCOHOL VEHICLES	"C" GASOLINE VEHICLES	"A" GASOLINE VEHICLES
Vehicle Production	51,3	51,3	51,3
Fuel Production In 15 years of average life	1.482,0	369,9	18,8
Total Employments	1.533,36	421,2	70,1
Ratio of employments per type of vehicle	21,87 ⁽¹⁾	6,01	1 ⁽²⁾

(1) Considering that an alcohol driven vehicle consumes, on average, 2.600 liters of hydrated alcohol per year, during average work life of 15 years, and that the production of one million liters of alcohol per year, generates 38 direct employments on average in Brazil.

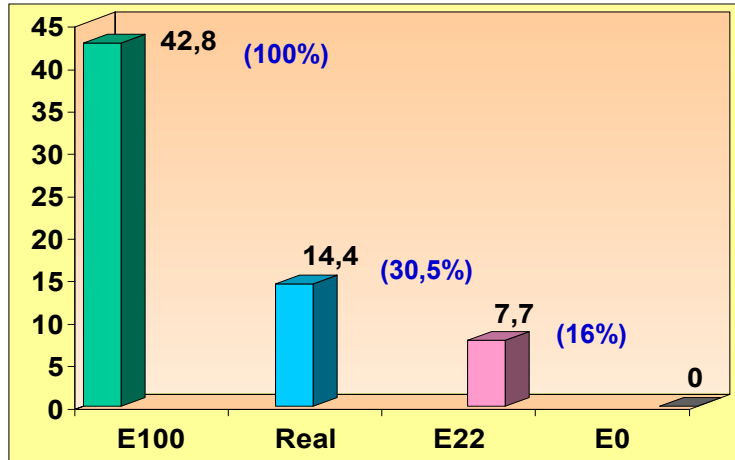
(2) Considering that a gasoline driven vehicle spends 20% less fuel than a similar alcohol vehicle, and that the production of one million liters of gasoline per year generates 0.6 direct employments in the country. (Petrobrás had 41,173 employees in 1997, extracting 1 million barrels/day of petroleum and refining 1.45 million).

Source: UNICA / ANFAVEA / Matriz Energética / Petrobrás, 2001

ENVIRONMENTAL RESULTS

AVOIDED CO₂ EMISSION SCENARIOS IN BRAZIL – 2000 (million metric tons of CO₂)

Spark Ignition Vehicle Fleet = 17,8 million (18,9% Etoh/81,1% Gasohol)

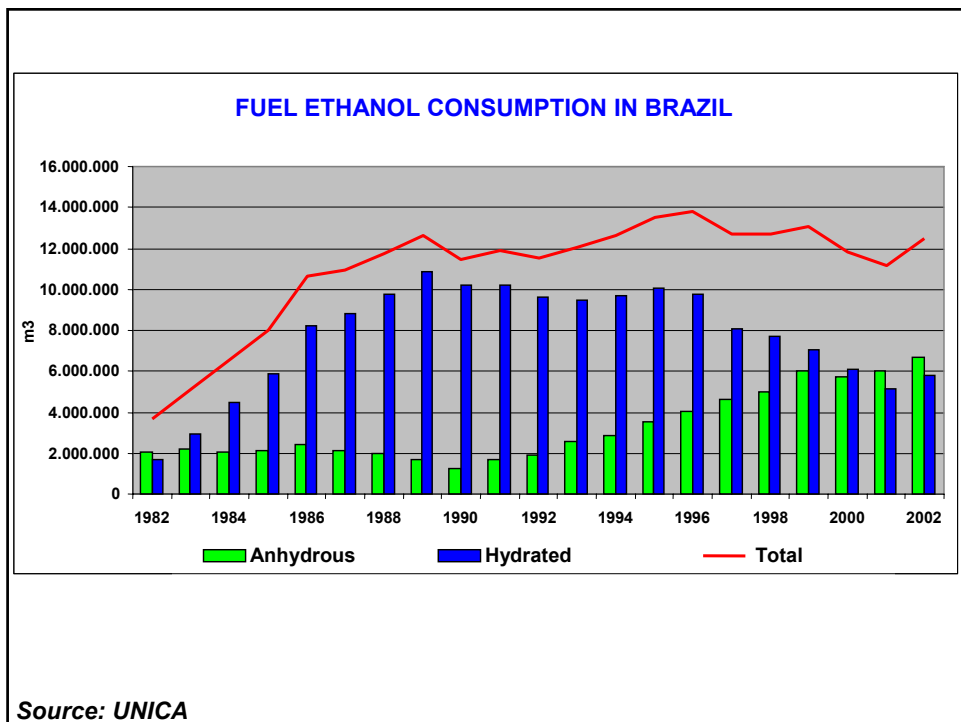


Source: Szwarc,A., 2001

EXCHANGE VALUE SAVED WITH ETHANOL USE IN BRAZIL							THE TRADE BALANCE AND ETHANOL
Year	Ethanol Fuel Consumption (in million liters/ year)			Gasoline Price CIF Brazil US\$/ bb	Ethanol Value Consumed US\$ Million (Jan/ 01)	Considering Interest Tax into the External Debt (PV - Jan/ 01)	
	Anhydrous	Hydrous	Gasoline Equivalent				
1976	172		172	15,60	51,62	267,63	
1977	639		639	15,80	182,36	924,16	
1978	1.504	2	1.506	19,60	495,16	2.178,59	
1979	2.219	16	2.232	42,10	1.415,56	6.686,03	
1980	2.253	429	2.599	44,55	1.537,15	7.029,20	
1981	1.146	1.392	2.269	44,43	1.211,54	5.145,98	
1982	2.021	1.674	3.371	40,83	1.560,35	5.915,04	
1983	2.197	2.950	4.577	35,79	1.798,33	6.131,99	
1984	2.082	4.575	5.773	32,77	1.990,74	6.248,45	
1985	2.121	6.088	7.032	32,51	2.324,10	6.682,69	
1986	2.442	8.397	9.216	21,67	1.993,92	5.254,19	
1987	2.136	8.919	9.331	22,33	2.003,88	4.973,05	
1988	1.966	9.760	9.839	19,83	1.806,00	4.204,02	
1989	1.622	11.068	10.551	27,09	2.522,86	5.493,78	
1990	1.301	10.205	9.533	34,97	2.792,65	5.697,87	
1991	1.647	10.251	9.916	30,35	2.417,17	4.624,50	
1992	1.899	9.631	9.668	27,16	2.048,06	3.689,55	
1993	2.548	9.404	10.135	24,12	1.851,45	3.176,49	
1994	2.850	9.665	10.647	22,10	1.736,43	2.816,96	
1995	3.368	9.722	11.211	23,11	1.861,10	2.821,85	
1996	4.024	9.783	11.916	29,02	2.411,94	3.407,54	
1997	4.765	8.306	11.466	23,70	1.843,12	2.426,09	
1998	5.017	7.717	11.242	18,83	1.412,96	1.711,31	
1999	5.869	7.051	11.557	23,42	1.760,30	1.985,59	
2000	5.706	6.082	10.612	36,91	2.463,60	2.600,08	
Total	63.515	153.086	187.009		43.492,36	102.092,63	

Note:
 1) Real Value (US - CPI)
 2) Two numbers representing the exchange value saved with ethanol use in Brazil; It must be considered the one that includes the interest tax for brazilian external debt

Source: DATAGRO



BRAZIL AND RENEWABLES (SUGARCANE)

- a) **ACTUAL AREA: 5 MILLION HA (1,5%)**
- b) **PRODUCTION (ENERGY EQUIVALENT): 300.000 b/day**
- c) **POTENTIAL AREA (10% OF THE TOTAL AGRICULTURAL BRAZILIAN AREA (TODAY IS 10% OF THE BRAZILIAN CULTIVATED AREA)): 33 MILLION HA (10%)**
- d) **POTENTIAL PRODUCTION: 2.000.000 b/day**
 - in a competitive way
 - without improvements
 - a lot of by-products
 - sustainable developments

“Brazil is a country with a real possibility of self sufficiency in energy only thinking in renewables”

Prof. Rogerio Cerqueira Leite, 2002