A GLOBAL PERSPECTIVE IN BIOENERGY

JOSÉ ROBERTO MOREIRA

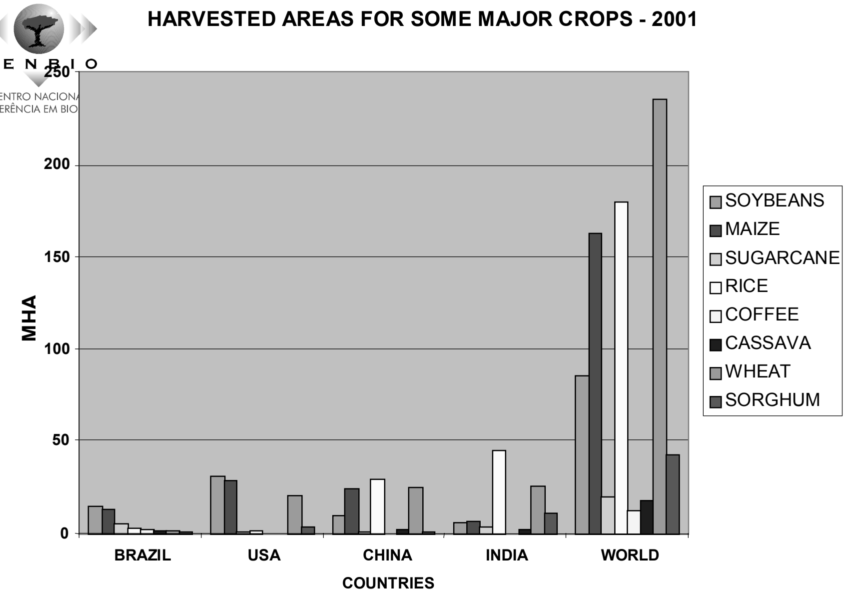
CENBIO – Brazilian Reference Center on Biomass

INTERNATIONAL WORKSHOP
"BIOENERGY FOR SUSTAINABLE RURAL DEVELOPMENT- LAMNET WORKSHOP"

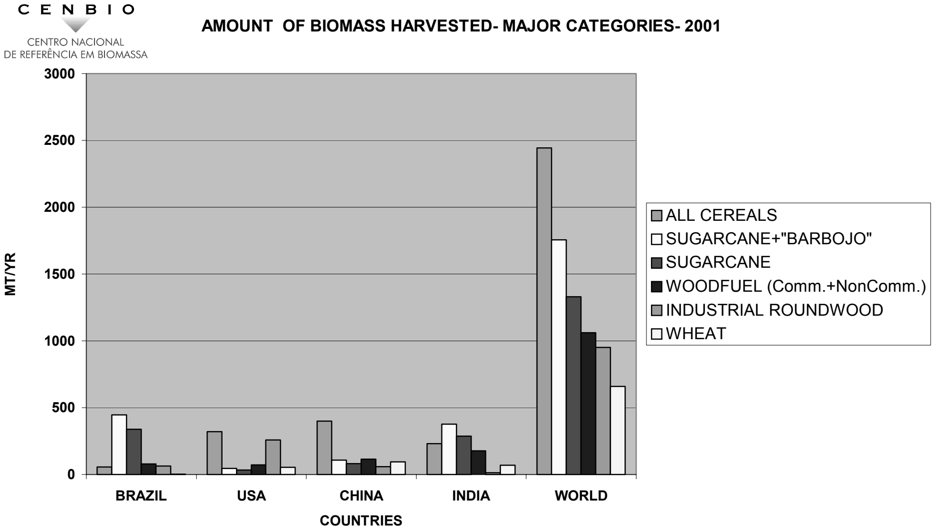
Vina del Mar, Chile

8-10 November 2004

	Gross potential arable land (rainfed cultivation) (1,000 ha)	Protected Land		Settlement (% of total area)	Net potential arable land (rainfed cultivation) (1,000 ha)	Actual arable land (1994) (1,000 ha)	% of potential arable land (rainfed cultivation) actually in use (1994)	Equivalent potential arable land (1,000ha)
		% of total area	% of potential arable					
Sub-Saharan Africa	1,119,492	8.6	4.3	1.9	1,050,083	157,608	15	752,344
North Africa and Near East	50,017	8.1	4.0	6.4	44,815	71,580	160	29,009
North Asia, East of Urals	286,800	3.0	1.5	(2.3)	275,802	175,540	64	226,774
Asia and the Pacific	812,561	9.4	4.7	3.9	742,672	477,706	64	561,890
South and Central America	1,046,071	10.6	5.3	1.2	979,946	143,352	15	743,243
North America	463,966	9.9	4.9	(2.1)	431,465	233,276	54	345,169
Europe	363,120	10.1	5.0	(5.8)	323,803	204,322	63	286,887
World	4,144,017	8.9	4.4	2.8	3,818,809	1,463,384	38	2,945,316

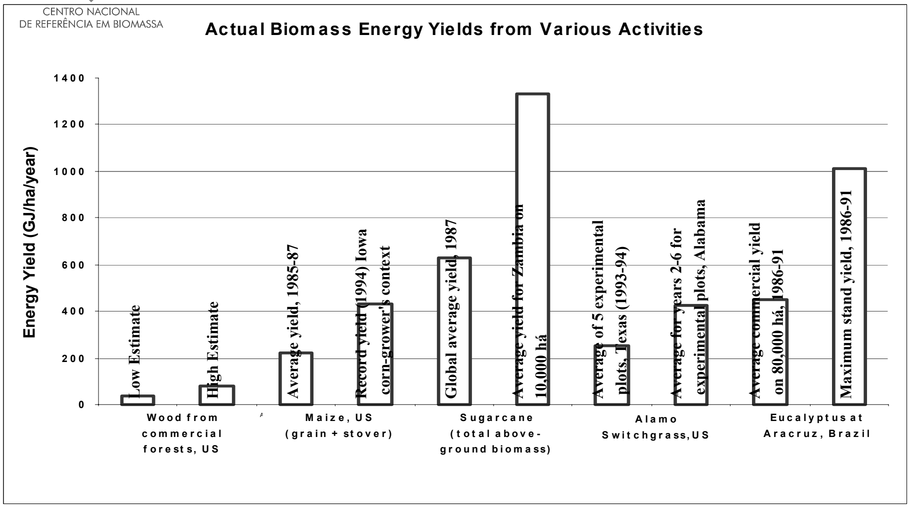


Author with data from FAO, 2002



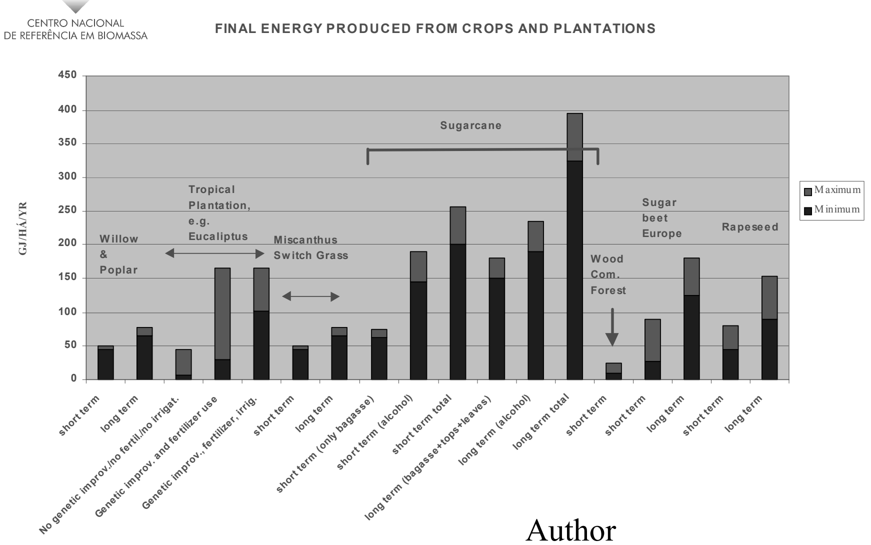
Author with data from FAO, 2002

CENBIO
CENTRO NACIONAL
DE REFERÊNCIA EM BIOMASSA



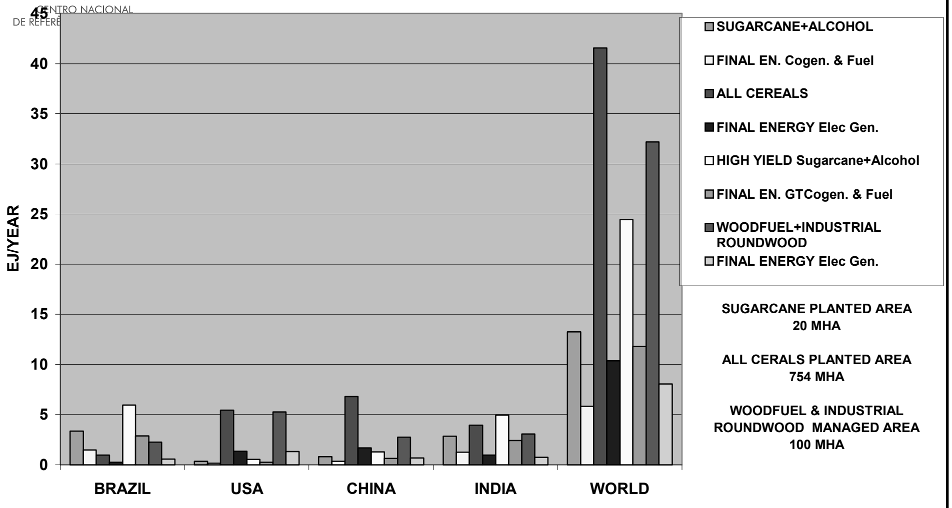
IPCC SAR, 1996

CENBIO
CENTRO NACIONAL
DE REFERÊNCIA EM BIOMASSA



Author

ENERGY CONTEND IN SOME BIOMASS RESIDUES - WORLD 2002



Author with data from FAO, 2002

SOURCE [a]	TYPES OF RESIDUES[b]	BIOMASS RESIDUE POTENTIALLY AVAILABLE (EJ/yr) YEAR			
		1990	2020-2030	2050	2100
1	FR, CR, AR		31		
2[c]	FR, CR, AR, MSW		30	38	46
3	FR, MSW		90		
4					272
5	FR, CR, AR, MSW			217 – 245	
6		88			
7[c]	FC, CR, AR, MSW		62	78	
8	FR, CR, AR		87		
A1[d]	Energy crops			660	1118
A2[d]	Energy crops			310	396
B1[d]	Energy crops			449	703
B2[d]	Energy crops			324	485

[b] FR = forest residues, CR = crop residues, AR = animal residues, MSW = municipal solid waste

CENBIO
CENTRO NACIONAL
DE REFERÊNCIA EM BIOMASSA

ENERGY CROP SELECTED IN THIS STUDY

SUGARCANE

Amount of energy produced from sugar/alcohol mills distributed over world agricultural land area at a density of 1 every 6,200km² – BIG, Combined Cycle, and 40% more yield – Total number of renewable energy producing units is 4,000

FINAL ENERGY CATEGORY	PRIMARY ENERGY (EJ/yr)	FINAL ENERGY (EJ/yr)	TOTAL LAND AREA USED FOR CROPS
ELECTRICITY	94.1	37.9	
LIQUID FUEL	69.9	51.5	
TOTAL	163.9	89.5	1.43 X 10^6 km² (143 MHA)

Source: Author

TECHNICAL ASPECTS (1)

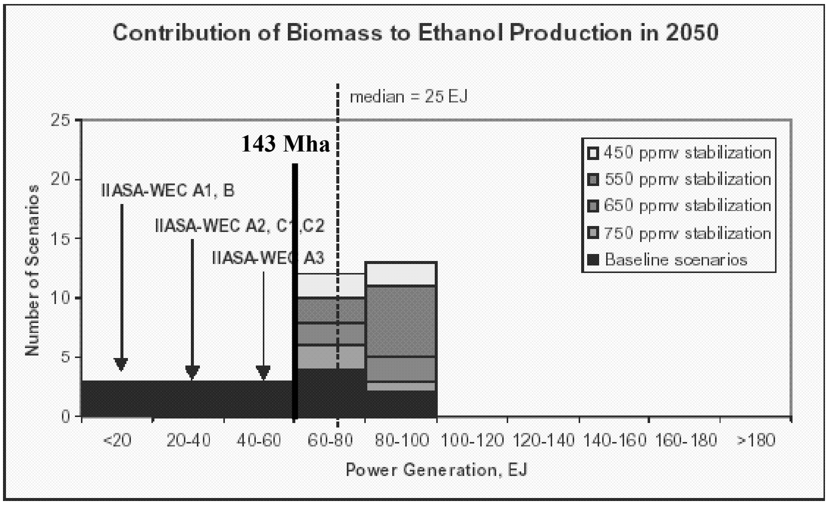


Figure B. Histogram of ethanol production from biomass across scenarios in 2050.

Nakicenovic&Riahi, 2002; Author

TECHNICAL ASPECTS (2)

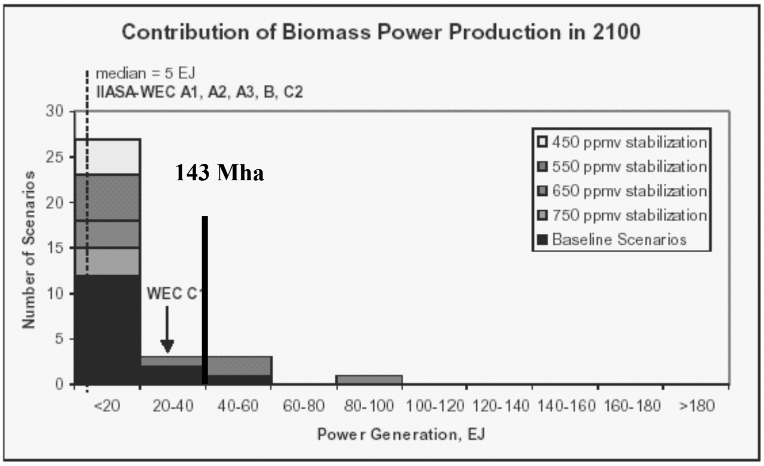
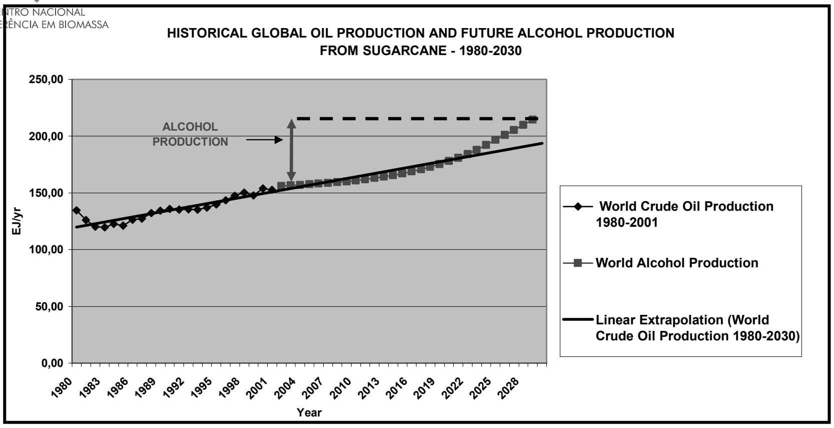


Figure C. Histogram of biomass contribution to electricity generation across scenarios in 2100. Biomass contribution is an aggregate of two technologies, Bio STC and Bio GTC (see Box 1).

Nakicenovic&Riahi, 2002; AutHor

CENBIO
CENTRO NACIONAL
DE REFERÊNCIA EM BIOMASSA

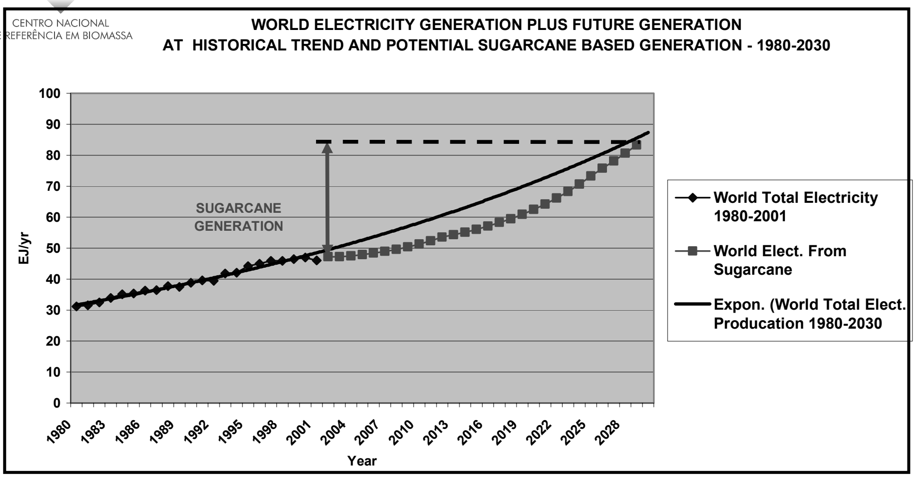
TECHNICAL ASPECTS (3)



Author

CENBIO
CENTRO NACIONAL
DE REFERÊNCIA EM BIOMASSA

TECHNICAL ASPECTS (4)

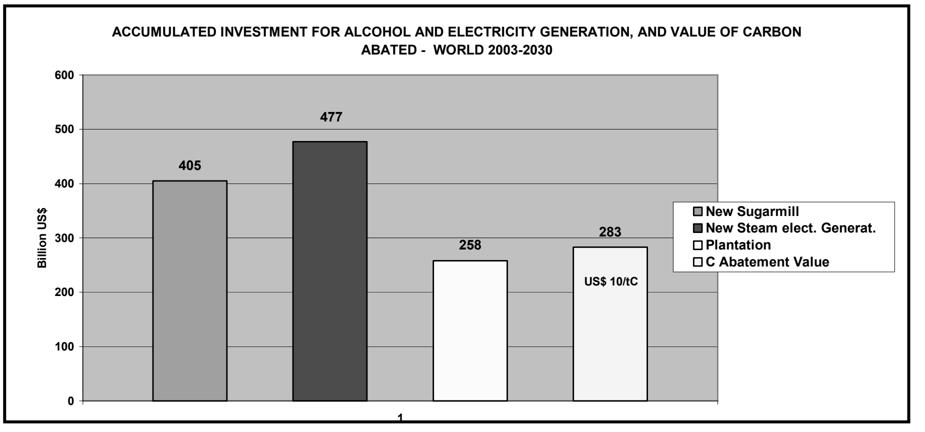


Author

CENBIO

CENTRO NACIONAL DE REFERÊNCIA EM BIOMASSA

ECONOMIC ASPECTS (1)



Author

ECONOMIC ASPECTS (2)

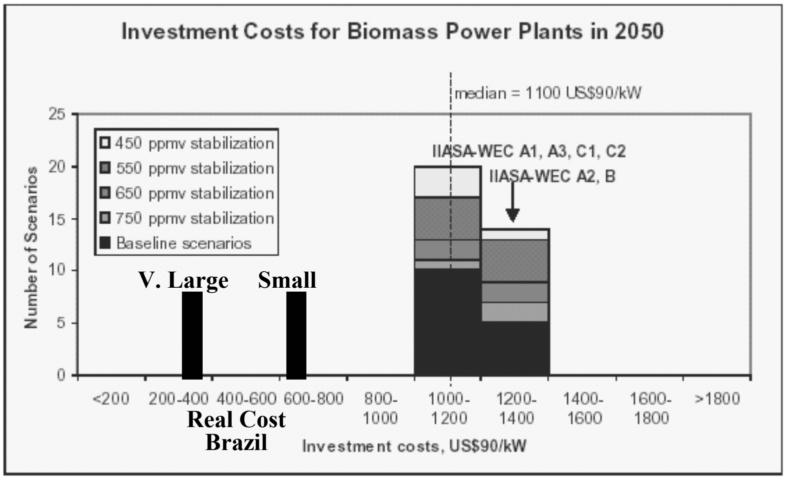


Figure B. Histogram of investment costs for biomass power plants across scenarios in 2050. Average costs for two biomass technologies, Bio STC and Bio GTC technologies (see Box 1).

Nakicenovic&Riahi, 2002; Author

ECONOMIC ASPECTS (3)

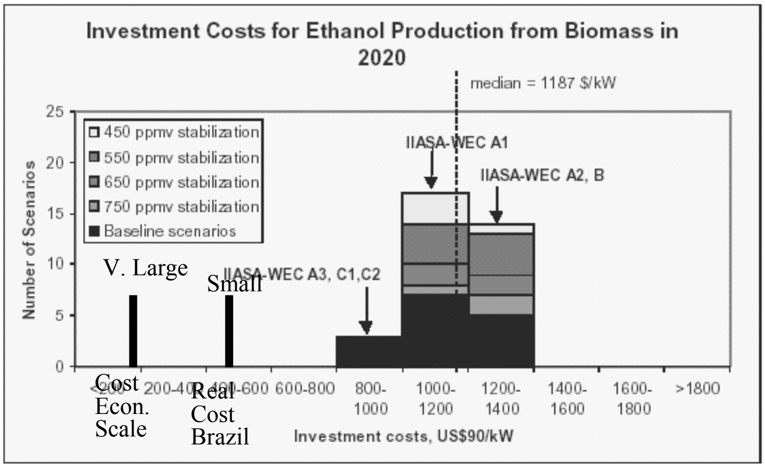


Figure A. Histogram of investment costs for ethanol production from biomass across scenarios in 2020.

Nakicenovic&Riahi, 2002; Author

CENBIO
CENTRO NACIONAL DE REFERÊNCIA EM BIOMASSA

FOREST PLANTATION SELECTED IN THIS STUDY

SCENARIO FROM IPCC SAR CHAPTER 24

Region/Country	Land Available (Mha)	MAI (m^3/ha/yr)	Rotation Length (yr)	Planting Rate (Mha/yr)
High Latitudes				
Canada	28.3	2.5 – 8.0	60	1.14
Nordic	0.35	5	60	0.014
FSU	66.5	3	80	1.66
Mid-Latitudes				
USA	21.0	6 – 15	15 – 40	0.70
Europe	7.74	6 – 10	20 – 60	0.31
China	62.5	2.3	80	2.5
Asia	12.5	12	40	0.50
South Africa	1.9	16	30	0.075
South America	4.6	15	25	0.18
Australia	4.3	6 – 23	30	0.123
New Zealand	5.0	25	25	0.1
Low Latitudes				
Tr. America	40.8	8 – 25	20	0.74
Tr. Africa	31.6	8 – 16	30	0.58
Tr. Asia	57.7	8 – 16	20	1.05

TECHNICAL ASPECTS (1)

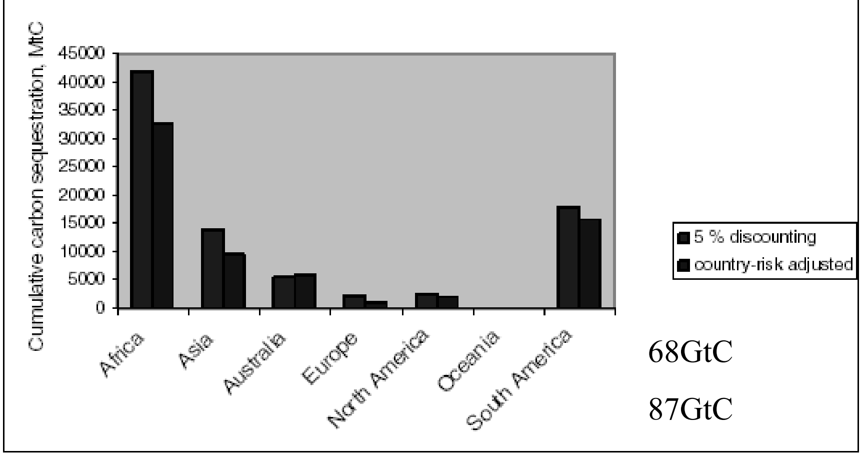


Figure 4: Comparison of carbon supply per continent for a 20-year period and a carbon price of $100/tC.

Pablo Benítez Ian McCallum Michael Obersteiner and Yoshiki Yamagata, May 2004

TECHNICAL ASPECTS (2)

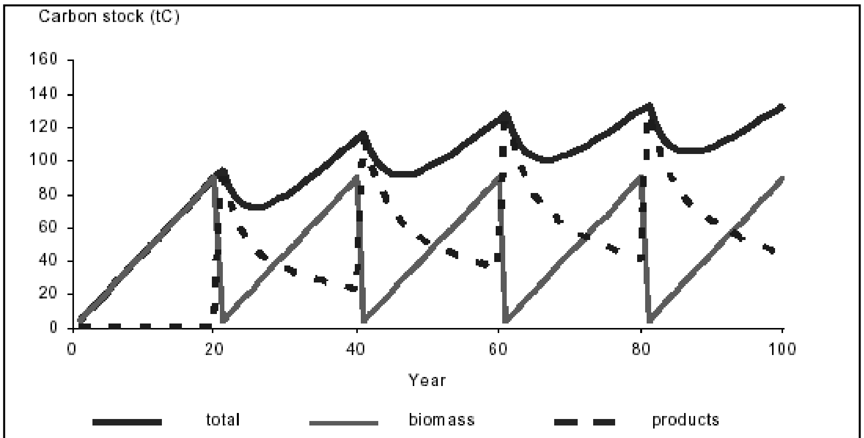
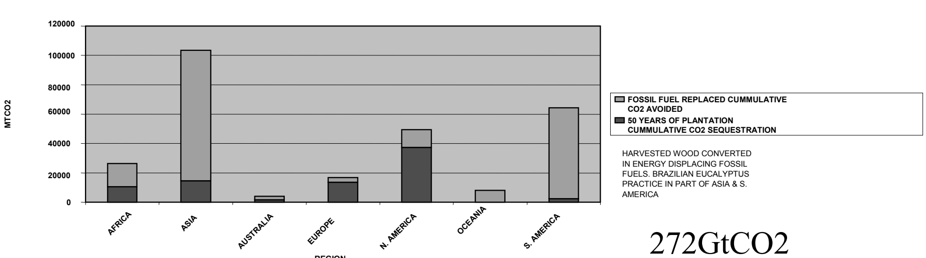


Figure 5: Time profile of carbon sequestration in a forest stand; example of a 20 year rotation.

Pablo C. Benítez Michael Obersteiner May 2003

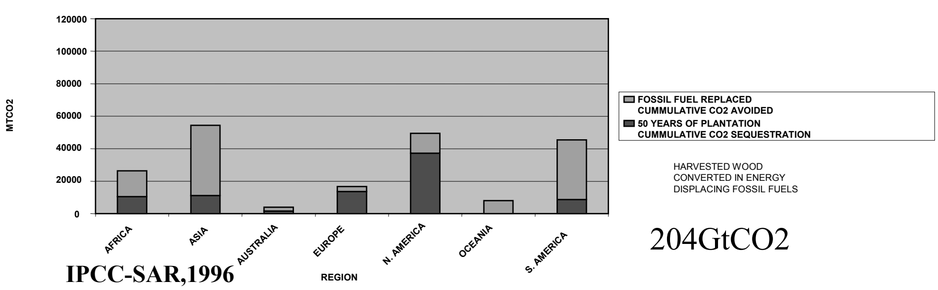
CUMMMULATIVE CO2 SEQUESTRATION AND ABATEMENT FROM PLANTED FOREST IN IN 50 YEARS PERIOD



272GtCO2

IPCC-SAR&AUTHOR

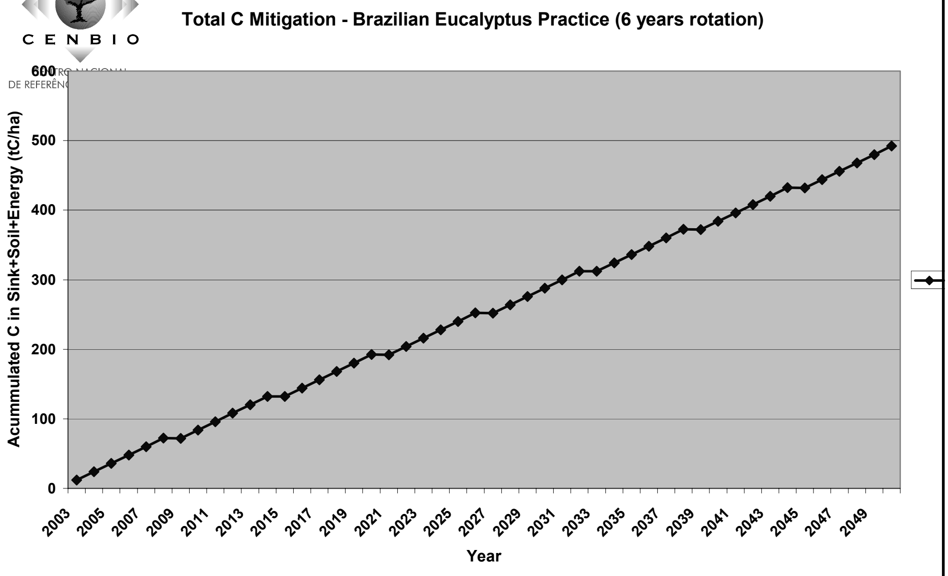
CUMMULATIVE CO2 SEQUESTRATION AND ABATED DUE PLANTED FOREST IN 50 YEARS PERIOD



204GtCO2

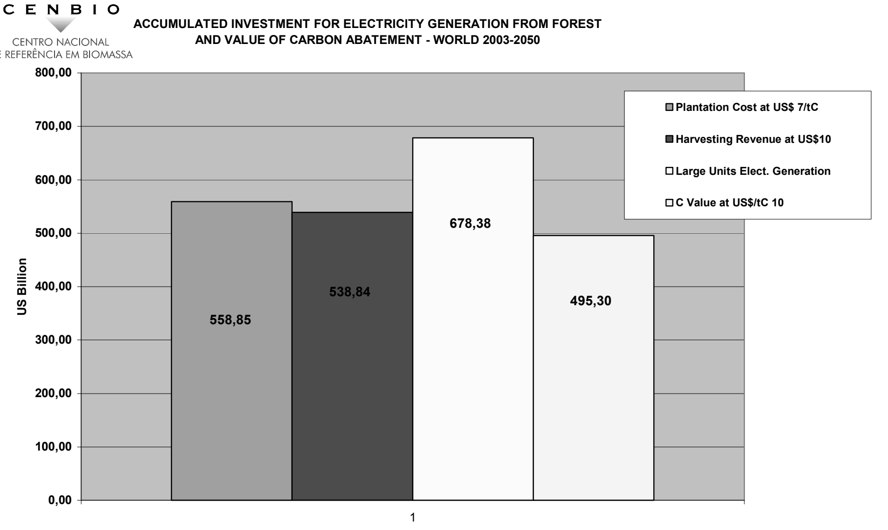
IPCC-SAR,1996

TECHNICAL ASPECTS (4)



Author

ECONOMIC ASPECTS (1)



Author

ECONOMIC ASPECTS (2)

COSTS OF CARBON SEQUESTRATION IN ASIA AND AFRICA			
Country	Practice	Cost (US$ / tC)	Reference
China	Reforestation	10	Winjum et al. (1993)
China	Plantations	0 – 2	Xu (1995)
India	Reforestation	15	Winjum et al. (1993)
India	Plantations	0 – 1.1	Kolshus (2001)
Malaysia	Reforestation	5	Winjum et al. (1993)
Indonesia	Plantations	0 – 1	Sathaye et al. (2001)
Tanzania	Plantations	0 – 3	Sathaye et al. (2001)
South Africa	Reforestation	9	Winjum et al. (1993)
All Countries Plantation		7	This paper
Pablo C. Benitez & M. Obersteiner May 2003; Author			

TECHNICAL ASPECT

CONSIDER CARBON CAPTURE AND STORAGE (CCS) FROM BIOMASS ENERGY PRODUCING PLANTS

•CCS FROM SUGAR TO ETHANOL FERMENTATION

•CCS FROM COMBUSTION OF SUGARCANE BAGASSE AND FIREWOOD

ECONOMIC ASPECT

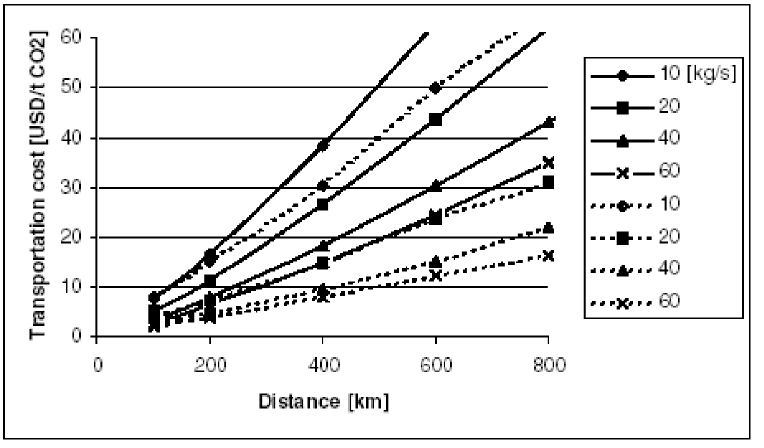


Figure 1: CO_2 transportation cost in varied distances.

Noim Uddin, July 2004; Author

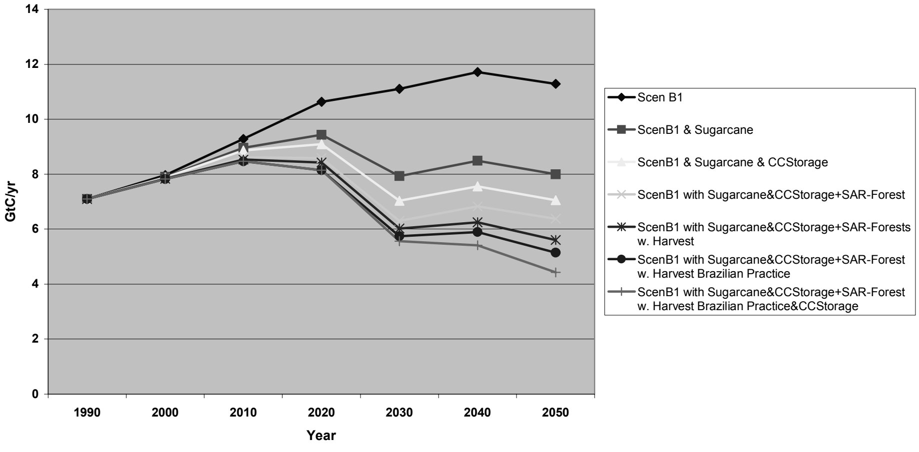
This Paper Cost
US$ 8/tCO2
Size 40kg/s

CENBIO
CENTRO NACIONAL
DE REFERÊNCIA EM BIOMASSA

CONCLUSIONS

CENBIO
CENTRO NACIONAL
DE REFERÊNCIA EM BIOMASSA

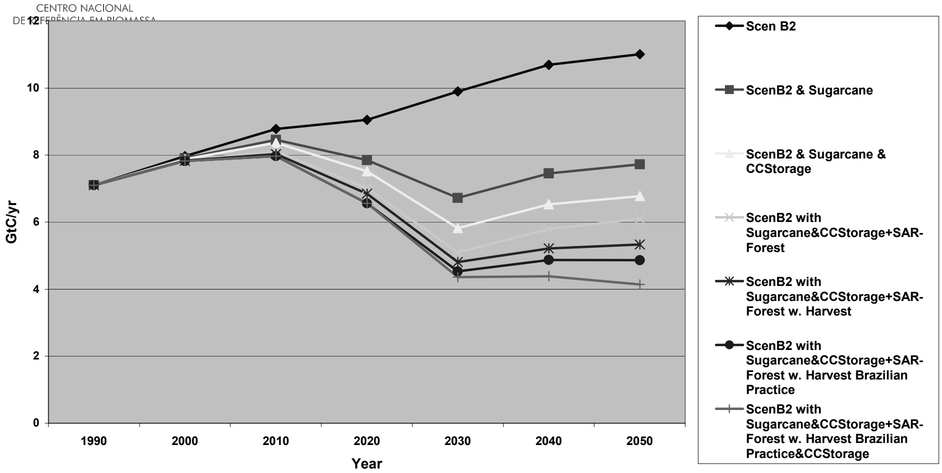
CO2 ENERGY AND LAND USE EMISSIONS IN SCENARIO IPCC B1, WITH SUGARCANE, AND WITH SUGARCANE PLUS SAR-FOREST



Author

CENBIO
CENTRO NACIONAL
DE REFERÊNCIA EM BIOMASSA

CO2 ENERGYAND LAND USE EMISSIONS IN SCENARIO IPCC B2, WITH SUGARCANE, AND WITH SUGARCANE PLUS SAR-FOREST



Author

CENBIO
CENTRO NACIONAL DE REFERÊNCIA EM BIOMASSA

- BIOMASS HAS TECHNICAL AND ECONOMIC POTENTIAL TO PROVIDE ALL NEW INCREMENTAL ELECTRICITY AND OIL DEMAND TILL 2030, AND PROBABLY FOR 2050
- USING ALL MODERN TECHNOLOGIES IT IS POSSIBLE TO REDUCE GLOBAL CO2 EMISSIONS SIGNIFICANTLY
- CONSIDERING REGIONAL ASPECTS, BIOMASS IS NOT THE SILVER BULLET TO SOLVE CLIMATE CHANGE. BUT COMBINED WITH OTHER RENEWABLES CAN SOLVE IT UNDER SOME REASONABLE SCENARIOS
- IN CASE ABRUPT CLIMATE CHANGE BECOME A RISK IN SHORT TIME BIOMASS MAY BE THE ONLY TOOL.

CENBIO
CENTRO NACIONAL DE REFERÊNCIA EM BIOMASSA

THANK YOU!!