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BRAZIL--HOW TO HARNESS THE BIOMASS GIANT

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ABSTRACT

Brazil is currently facing up to the challenge of sustaining the pace of its industrial development on basis of the natural solar energy fixation potential of its territory. The dimensions of this challenge can best be described by considering that (a) the monetary value of energy from dry biomass (in form of pulpwood) is one-tenth that of electricity, and one-eighth that of gasoline; (b) the growth potential of trees is among the highest in the world, and the productivity of eucalyptus species averages around 500 cu. ft./acre, and has been reported to reach peaks of more than 100 t/ha annually; (c) wood consumption may amount to only a few hundredths of the sustained reproductive yield; and (d) Brazil has the potential of fixing as much solar energy in the form of biomass on 1% of its territory, an area with a 100-mile radius, as Iran produces annually in the form of oil. The commercial exploitation of this immense reproductive biomass power is limited to a large extent by the absence of modern integrated technologies on biomass basis. Several Brazilian viewpoints of this situation are discussed.

Ladies and Gentlemen:

In the following paper on "Brazil--How to Harness the Biomass Giant," I will attempt to provide you with an impression of the renewable resource situation in Brazil. The paper will address this topic in four main sections; these are (1) a description and definition of what we mean by "biomass giant"; (2) a description of Brazil's current situation in regard to energy and its industrial development as far as it pertains to biomass utilization; (3) a report on how Brazil views its economic future in light of its natural and particularly renewable resources; and (4) some ideas as to how this country can and needs to assist Brazil in its effort to harness the biomass giant.

I. "Biomass Giant" Description

Slide 1. A fact not well recognized in the United States is that Brazil has a territory almost as large as that of the continental United States. In fact, if one would disregard Alaska, Brazil would exceed the size of the United States. In terms of total forest area, Brazil is indeed somewhat larger than the United States.

Slide 2. The figures on this slide give a comparison between the United States and Brazil in terms of biomass potential. They are somewhat daring on my part, as it is almost impossible to find good and reliable figures on the productivity of the Amazon forest. However, rough estimates, supported by several literature sources, suggest that Brazil currently holds about 20% of the world's standing forest resources, and that the average tree growth in a eucalyptus plantation in the south of Brazil exceeds the average forest productivity in the United States by about ten times. Figures on plantation productivity again vary considerably, and 400 cu. ft./acre seems to be a regional average that can easily be sustained. Other sources are quoting

biomass productivity figures as high as 100 to 250 t/ha per year; but these figures must be less representative and should be taken with great skepticism. Considering the enormous forest reserves and growth potentials, roundwood removals appear minimal indeed. They seem to amount only to approximately 3% as compared to the 75% in the United States.

Slide 3. The principal reason why the giant forest reserves are utilized only to such a small extent is explained with the concentration of more than 75% of all forests in the Amazon region. Inaccessibility and species wealth seem to be the Amazon forest's primary handicap to a more complete utilization. Only slightly more than 10% of the forest area is concentrated in the south and southeast where Brazil's population and industries are located. This area also holds most of the man-made, plantation forests, which presently amount to approximately five million acres. These are the forests that are well managed, well utilized, and show a high productivity.

Slide 4. Of the roughly three billion cu. ft. of wood that are annually utilized in Brazil, only about 10% are converted into pulp and paper. The rest goes into charcoal, firewood, and solid wood products. These figures seem to support again an impression of inefficient renewable resource utilization, for which forest distribution, transportation difficulties, and outdated technologies are to be held responsible.

III. Brazil's Energy and Industrial Development Situation

Slide 5. The impact of spiraling energy costs felt throughout the world is grossly aggravated in developing countries. These are countries that very often are establishing industries based on fossil fuel-powered technologies without having fossil resources themselves. At the same time, these countries seem to have perpetual difficulties with balancing their foreign

trades. These nations are now faced with the alternative of either sharply reducing energy consumption, thus slowing or even terminating an industrial development just started, or encouraging energy consumption and industrial development, and thereby fueling inflation through ever-increasing foreign debts. The figures on this slide give a good illustration of the dependence of the Brazilian economy on imports of foreign fossil resources. Almost half of Brazil's energy comes from liquid fuels, which is somewhat more than world average. Brazil uses very little coal and natural gas; but Brazil seems to be blessed with a wealth of hydroelectric power. Energy from biomass makes up roughly 27% of the entire energy need. Although the Brazilian government has unsuccessfully attempted to reduce gasoline consumption in Brazil, mostly by adjusting the price to $1.50 per gallon, it must be emphasized that the government is clearly devoted to further industrial development rather than reduction of energy consumption. As a consequence, the Brazilian government has explored several new and unconventional alternatives for energy generation since 1974. Among them are new explorations into oil and gas reserves; new hydroelectric power projects; a large scale nuclear power program revolving around the purchase of nine nuclear-power generating units, and enrichment know-how from West Germany; and a program focusing on the photosynthetic, solar energy-fixing potential of its territory. In the following I will discuss how the Brazilian government anticipates harnessing this photosynthetic potential of its country.

Slide 6. Biomass utilization in the form of charcoal already amounts to a sizable portion of the entire Brazilian energy consumption. Of the 60% energy that is generated nationally, about half comes from biomass in the form of charcoal.

Slide 7. The future role of biomass for the Brazilian economy is illustrated in this slide. Brazil holds roughly two-thirds of the proven reserves of this planet's iron ore. This ore, which is accessible to surface mining and can be recovered in high concentration, offers the great potential of generating foreign currencies. Thus, the manufacture of steel is very high on the national priority list for industrial development. And charcoal is an excellent raw material for the energy needed in steel refining. Another industry of high priority to the Brazilian government is the pulp and paper industry. The potential generation of energy and chemicals from biomass can be accomplished, and is being accomplished in Brazil now, in the form of firewood, charcoal, and ethanol. Brazil has become very aware of the enormous renewable resource potential of its country, and it is trying to employ this potential as much as possible for its future economic and industrial development. As a country with a particular imbalance between fossil and renewable resources, Brazil will need to employ technologies that are based on renewable resources to a much greater degree than do other countries. And Brazil is now beginning to develop or adapt such technologies to its unique raw material situation. Areas of particular concern are charcoal for the steel industry, pulpwood for the pulp and paper industry, and ethanol for carburation fuels. In the following I will present some highlights in each of these three areas.

IV. Brazil's Plan to "Harness the Giant"

Slide 8. When compared to its forest reserves and tree growth potential, Brazil has indeed been a pulp and paper "dwarf" among the nations. With 20% of the world's forest reserves, its pulp and paper production amounts to only one or two percent of the world market; and Brazil continues to remain a net importer of paper.

Slide 9. However, in recognition of its great biomass potential, Brazil is expected to move soon into the upper ranks among the pulp and paper producing countries. It is expected to triple its production by 1980 and increase twentyfold its current production by the year 2000. At this time its industrial capacity for chemical wood pulp will amount to 10% of the world market.

Slide 10. The United Nations' Food and Agriculture Organization seems to agree with these projections. Its statistics predict that world capacities for chemical wood pulp will increase by 17 million metric tons between 1975 and 1980, and that North America will contribute five million metric tons where Brazil will add three to this. This development is expected to create about 200,000 new jobs in Brazil, 50,000 of which would be in industry and 150,000 in forestry.

Slide 11. The national plan for the development of the pulp and paper industry calls for the establishment of 30 forest districts with each 350,000 acres. This size was selected for the purpose of supplying two 1,000 ton per day pulp mills with raw material. The total area needed for these 30 forest districts will exceed 10 million acres, an area covering half a percent of Brazil's territory. The species planted on this area are eucalyptus and pine. Two-thirds of the forest districts will be located in central Brazil, in the states of Minas Gerais, Goias, Espirito Santos, and southern Bahia; and one-third of all districts will be located in the north and northeastern parts of the country.

The impression that is evolving now is one of Brazil as an "embryonal" or "dormant biomass giant," in spite of the fact that it already possesses 20% of all forest reserves. Government and industry seem to agree in their expectations that the future economic development of the country will depend

largely on the harvesting of the forest growth potential of subtropical regions of Brazil. The future is identified with highly productive monoculture forests in the south and south central regions of Brazil. There, forests covering only 3% of Brazil's territory would be sufficient to supply the entire world with chemical pulp. And only 2% or less of the entire Brazilian territory would be enough to fix as much solar energy photosynthetically as is consumed by the entire country.

In spite of the industry's heavy emphasis on man-made plantations in the Brazilian south and central regions, Amazonia is not altogether forgotten. In contrast to the many small private businesses operating in the Amazon region, one gigantic U.S.-financed enterprise has been started in recent years which is worth mentioning in this context.

Slide 12. A wealthy American by the name Daniel Ludwig, the owner of a gigantic shipping enterprise, among others, purchased approximately 12 years ago from a group of Brazilian landowners an area along the Amazon river equal in size to about one-third of the state of Israel. On this ranch he has since started activities in cattle and rice farming, kaolin mining, reforestation with Gmelina arborea and Pinus carybea species, and he is proceeding with the establishment of a 750 tons per day chemical pulp mill. This pulp mill is presently being built in Japan, and it will be towed on barges across the Pacific and installed in a tributary of the Jari River. Current investments are reported to total approximately $100 to $150 million, and this amount will double or triple by the time the ranch is in full operation. Following a brief description of these efforts in Time magazine, notes to the editor on the subject were published under the title "Mad King Ludwig." As a Bavarian, I might point out that no matter how mad King Ludwig may have been,

he is certainly one of the very few Bavarian kings who is still being remembered many generations hence for his lasting creations. I, for one, am convinced that Mr. Ludwig is providing with this very commendable effort an enormous service to the entire developing world. It takes an effort like this to demonstrate whether this planet's population will ever be able to depend on useful contributions from its tropical regions or not. And no governmental or multi-national bureaucracy will ever be able to undertake this venture, no matter how big the investment.

Slides 13, 14. Pine trees; eucalyptus forest.

Slide 15. This slide illustrates a more conventional investment in the pulp and paper future of Brazil. It is a typical 750 tons per day chemical pulp mill located in the state of Minas Gerais, in the central region of Brazil. It will produce fully bleached eucalyptus kraft pulp for the world market. It is the first mill of a billion dollar joint Brazilian-Japanese venture into reforestation and pulp mills.

Slide 16. Its location is in the heart of the iron ore mining country. The information on these two new pulp and paper installations in Brazil reinforces the impression of Brazil as a potential biomass giant, but not necessarily an existing one. Both mills, whether they are in the tropics or the subtropics, are based on monoculture plantation forests rather than existing biomass. In the following I shall highlight the implications that the Brazilian steel and ethanol programs have on the photosynthesis power of the country.

Slide 17. Like pulp and paper production, steel production is also expected to quadruple within the next ten years. The current production of ten million metric tons per year uses mostly mineral coal-derived coke as energy

source. Only about 30% of all steel is presently manufactured with charcoal as the energy source. Raising the production to 40 million tons by 1985 will cause a decline of charcoal's contribution to the energy source for steel manufacturing to less than 20%, if reforestation efforts are not greatly increased. This figure is based on the assumption that all wood harvested from eucalyptus forests of the state of Minas Gerais will be used for charcoal generation; and it ignores the fact that pulp mills will compete for the raw material in the same region. An ambitious reforestation plan of an additional 3.25 million acres by 1985 is setting the stage for Scenario B. The 30% contribution of charcoal to the energy needed for steel manufacture could be maintained only if Brazil decided to reforest an additional 400,000 acres per year for eight years in order to supply the charcoal needed by one single steel mill.

Slide 18. The figures on this slide express steel production in terms of energy needs either in the form of mineral coal and coke, or in the form of charcoal from eucalyptus forests. The manufacture of one ton of steel requires the sustained wood production from roughly two-thirds acre of eucalyptus forest. Thus, total replacement of all energy needs by charcoal would require an area of roughly 30 million acres, which is more than six times as much as is presently available in all of Brazil. Therefore, one can expect that competition for raw material will be harsh, particularly in the region where steel mills are concentrated.

Slide 19. The ethanol program of the Brazilian government has recently received much publicity, mostly because it is a unique attempt at finding a solution to the energy problem. This program is based on the one side on the fact that Brazil is a major sugar producer, and ethanol is a byproduct of

sugar refining, and on the other side on the fact that ethanol is an effective carburation fuel, which gallon for gallon delivers as much power as fossil fuel-derived gasoline. Furthermore, ethanol has the advantage of being practically pollution-free, a benefit particularly welcome in the overcrowded and polluted Brazilian population centers. Mixtures of 80% gasoline and 20% ethanol can be used without difficulty in regular automobile engines which will run clean enough to meet even California's stringent pollution standards. With these facts in mind, Brazil has embarked into a fuels-from-biomass venture of gigantic proportions. The plan calls for the manufacture of approximately 4.5 million cubic meters of ethanol by the year 1980, which will amount to an eightfold increase over present production. Wood has so far not found consideration as a potential raw material for ethanol generation. By contrast, Brazil envisions establishing sugarcane plantations on 2.3 million acres of its territory. Sugarcane's drawbacks of seasonal availability can be overcome by using manioc, a potato-like vegetable root, which contains 20 to 25% starch. Where sugarcane does not require a sophisticated hydrolysis technology prior to fermentation, manioc does. Although the Brazilian government has financed successful pilot operations, manioc has so far not become the favorite raw material of alcohol distillers. The reason for this seems to rest with the fact that manioc stills cannot be operated energy-independently as sugar mills can. Sugar mills count on the large supply of bagasse to cover their operational energy needs. Until now, the government has received a total of 102 applications for financing of stills on sugarcane basis, and only two applications for manioc-based distilleries.

The financing of the ethanol program seems to be assured through a government-administered fund which is perpetually replenished from the sale of ethanol

for gasoline at $1.50 per gallon, whereas distilleries can manufacture ethanol at a healthy profit for $1 per gallon. The ethanol will be acquired wholesale by the sole government-owned and operated gasoline distributor in Brazil, Petrobras, which will funnel the profit into the ethanol fund.

One of the beneficial side effects of this fuel from biomass scheme is that one expects that this program will lead to the creation of between 250,000 and one million new jobs in Brazil. Furthermore, these jobs will be located in the economically deprived rural areas of Brazil where unemployment is particularly high.

Slide 20. I am summarizing the highlights of Brazil's expectations in terms of economic advantages possible from a more efficient harnessing of the country's photosynthetic potential. Brazil expects to reforest within the next five years 1.5 million acres annually in order to meet its charcoal for steel, wood for pulp and paper, and lumber needs. Steel and pulp will thereby require about 40% each of all biomass from reforestations. In addition to biomass from forests, Brazil expects to plant 3/4 million acres per year with sugarcane for conversion into ethanol.

We are now perceiving an embryonal biomass giant that is extending its solar energy fixation devices, and/getting ready to base its industrial development on the photosynthetic solar energy fixation power of its fertile territory.

Everybody recognizes that this is an ambitious undertaking; the question is whether it is at all possible. Experts seem to think that it is indeed possible and point to the fact that Brazil has grown within the short period of eight years into the world's number one soybean growing country. Today Brazil has 15 million acres under soybeans, and an additional 100 million acres of unused fertile arable land. By this we do not wish to leave you with the

impression that the task is easy. However, the real difficulties are not expected to result from the energy fixation capacity, the planting and harvesting of biomass, but rather from such factors as reliance on and understanding of research; absence of lines of communication between research centers, universities, and the government; and the lack of self-confidence in its own, national Brazilian technology.

V. The Role of the Outside World

It must be pointed out that Brazil is not entirely on its own in its attempt to utilize its tremendous biomass generation potential. Many North American, European, and Japanese companies are involved and provide assistance in this field. However, these are private enterprises which are establishing manufacturing facilities based on known and proven technology often only poorly adapted to the conditions of the Brazilian environment. And what is needed more than this is concentrated international help in the development of an integrated biomass-based technology, which could be readily transplanted into other developing tropical countries. The application of political pressures aimed at abandoning plans for the establishment of nuclear power plants for the reason of nonproliferation of nuclear technology is unreasonable where there are no real, existing alternatives to nuclear technology. It seems politically wiser to offer scientific and technological assistance aimed at creating such alternatives, such as for the development of a biomass-based technology; a technology of which this country has a great deal of knowledge, and is in the process of further refining. Such help could well be coordinated by such agencies as ERDA or NSF.

Slide 21. This is one example of how Brazil is currently attempting to improve its technological capabilities; this is an artist's conception of the

now completed Brazilian Pulp and Paper Research Center in Sao Paulo, Brazil. This center, for which the planning work was done by Professor Rytti of Helsinki on contract by Jaakko-Poyri several years ago, is part of the Technological Research Institute in Sao Paulo, a conglomerate of research institutes employing 1600 people and conducting research and providing technical assistance in all areas of raw material and/technological needs in Brazil. The technical staff of this pulp and paper research center is presently involved in a large-scale training program in the United States. This program is sponsored by US-AID and is coordinated by VPI & SU in Virginia. We believe that this is a good start of the type of technical assistance in biomass technology that Brazil needs, and which this country is in a good position to provide. We are hopeful that such cooperative programs will increase in number and intensify in order to make a significant contribution towards the harnessing of the Biomass Giant.

Thank you, ladies and gentlemen, for your attention.

LITERATURE SOURCES

1. _____; _____. 1976. Problemas e Perspectivas do Abastecimento de Carvao Vegetal a Siderurgia. Tendo em Vista o seu Crescimento Esperado na Decada de 70. Instituto Brasileiro de Siderurgia, 31.5. 1976, pp. 133-144.

2. Paulo Azevedo Berutti. 1975. Aspectos do Reflorestamento no Brasil. Brasil Florestal 6(21), 3-7 (1975).

3. _____/_____. 1976. Distritos Florestais Silvicultura, Maio/ Junho, 18-32 (1976).

4. Paulo Azevedo Berutti. 1976. Contribuicao Energetica das Florestas Brasileiras. Silvicultura, Julho/Agosto, 20-24 (1976).

5. Jose Israel Vargas e Juarez Tavora Veado. 1976. A Energia Fotossiutetica. Ciencia e Cultura 28(9), 1058-1064 (1976).

6. Carlos Dias Brosch. 1976. O Carvao Brasileiro. Ciencia e Cultura 28(9), 1037-1044 (1976).

7. Lauro de Moraes Faria. 1976. Necessidade de Siderurgia a Carvao Vegetal. XXXI Congresso Anual da ABM, Belo Horizonte, Julho 1976, pp. 1-25.

8. _____/_____. Consequencias e Riscos na Reducao dos Incentivos Fiscais, para o Campo Florestal. Instituto Brasileiro de Desenvolvimento Florestal. pp. 1-27.

9. Jose Goldemberg. 1976. Necessidades Energeticas Brasileiras Seminario Alternativas de Desenvolvimento: Energia Solar; Secretaria da Cultura, Ciencia e Tecnologia, pp. 47-55.

   Jean Pheline. 1976. Pesquisas em Energia Solar e Outras Fontes--Alternativas de Energia na Franca. Ibid., pp. 79-82.

   Lamartine Navarro Junior. 1976. O Sol e a Politica do Alcool. Ibid., pp. 95-100.

10. Alberto F. Lima e Wolfgang G. Glasser. 1976. Potencial Energetico Brasileiro Atraves da Fixacao de Energia Solar. _____/_____. pp. 1-14. (2 versions)

11. Alberto F. Lima. 1977. Viabilidade do Aproveitamento do Bagaco de Cana na producao de Alcool Etilico. Position paper.

12. _____/_____. 1976. Propostas para montagem de Destilenias de Alcool ja Euquadradas no programa Nacional do Alcool. List.

13. _____/_____. Programa Nacional do Alcool--Regulamento das Operacoes Industriais. Banco Central do Brasil.

and related publications

14. Conselho de Desenvolvimento Economico-CDE. 1974. Programa Nacional de Papel e Celulose. pp. 3-56.

15. Alberto F. Lima e Wolfgang G. Glasser. 1976. Fixacao da Energia Solar. O Estado de Sao Paulo 21/11/76. Suplemento Cultural, pagina 9, Anol, No. 6 (with translation).

16. _____/_____. 1976. O IPT produz energia da madeira Gazeta Mercantil, Novembro 23, 1976.

17. Allen L. Hammond. 1977. Alcohol: A Brazilian Answer to the Energy Crisis. Energy: Brazil Seeks a Strategy Among Many Options. Science, Vol. 195, 11 February 1977, 564-567.

18. _____/_____. 1976. World's Biggest Ranch. VISAO--Brazil Report 75, 17-18.

19. G. Krogh. 1976. Brazil. Pulp and Paper International, 1976 Review Number, p. 166-167.

20. _____/_____. 1976. Building Blocks of Progress. 1976 Yearbook of American Chamber of Commerce, 88, 17-18.

21. _____/_____. Latin America Cannot Reduce its Energy Consumption Without Curbing Development. ? , p. 4-6.

22. FAO. 1976. Pulp and Paper Capacities--Survey 1975-1980. Food and Agriculture Organization of the United Nations, Rome.

23. Samuel Klabin. 1975. Brazil's New Pulp and Paper Program. American Paper Institute, International Forum, Ponte Vedra Club, Ponte Vedra Beach, Florida, May 28-30, 1975. pp. 53-59.

SLIDE 1

FOREST AREA

	Territory 1000 sq. miles	Forest Area 10^6 acres		Total, in % of Territory
		Total	Commercial[1)]	
USA	3615.1	754	500	32.6
BRAZIL	3286.5	871	?	41.4

[1]Min. of 20 cu.ft./acre annual growth

SLIDE 2

ESTIMATED FOREST PRODUCTIVITY AND USE

	Total Annual Growth[1)] -Estimated-		Roundwood Removals -Estimated-	
	cu.ft./acre	total area 10^9 cu.ft.	10^9 cu.ft.	%
USA	38	18.6	14	75
BRAZIL	400[2)]	80-100[3)]	2-3	3

[1]Average of commercial forests

[2]Eucalyptus forest in Sao Paulo

[3]From Berutti: Amazonas on 50-year rotations alone: 65 x 10^9 cu.ft.

SLIDE 3

BRAZIL'S FOREST DISTRIBUTION

	Forest Area 10^6 acres		In Percent	
	Natural	Man-Made	of Territory	of Total Forests
North	674.8		32.1	77.5
Northeast	32.4		1.5	3.7
Southeast	33.1	4.9	1.6	3.8
South	35.3		1.7	3.8
Central	94.9		4.5	10.9
TOTAL	870.5		41.4	100.0

SLIDE 4

ESTIMATED WOOD UTILIZATION
BY CATEGORIES
1976
(1000 METRIC TONS)

Pulp and Paper	4.000
Charcoal	20.000
Others (lumber, firewood, etc.)	20.000
TOTAL	44.000

(Equivalent to 3 x 10^9 cu.ft.)

SLIDE 5

ENERGY SOURCES - 1973
(in Percent)

	World	USA	Brazil
Solid Fuels (mineral, coal, etc.)	30.0	17.8	3.2
Liquid Fuels	43.7	42.0	48.4
Natural Gas	23.0	34.8	0.3
Hydro and Nuclear	3.4	5.0	20.7
Photosynthetic			27.4

SLIDE 6

BRAZIL'S ENERGY SOURCES BY ORIGIN
(in Percent)

Imported		40
Nationally Generated, total		60
--Fossil Fuels	10	
--Hydroelectric	20	
--Charcoal	30	

SLIDE 7

THE ROLE OF BIOMASS IN THE
NATIONAL ECONOMY

Manufactured Product	Biomass-Derived Raw Material
Steel	Charcoal
Pulp and Paper	Pulpwood
Energy and Chemicals	Charcoal, Firewood, Ethanol

SLIDE 8

1975 PULP, PAPER AND PAPERBOARD CAPACITIES
(in 10^6 metric tons)

	World	USA	Brazil
Total Wood Pulp (paper grades)	126.8	42.2	1.66
Other Fiber Pulp	9.3	.64	.19
Dissolving Pulp	6.0	1.62	.14
Total Paper and Paperboard	175.0	57.2	2.46

SLIDE 9

WOOD PULP CAPACITY OUTLOOK
FOR BRAZIL

1975 Wood Pulp Capacities	1,655,000 tons
--in % of world capacities	1.3%
1980 Wood Pulp Capacities	4,941,000 tons
--in % of world capacities	3.3%
2000 Wood Pulp Capacities	32,500,000 tons
--in % of world capacities	10.0%

SLIDE 10

FAO PROJECTION:

WORLD CAPACITY FOR CHEMICAL WOOD PULP WILL INCREASE BY 17 x 10^6 M TONS BETWEEN 1975 and 1980.

NORTH AMERICA WILL CONTRIBUTE 5.1 x 10^6 M TONS, BRAZIL WILL ADD 3.1 x 10^6 M TONS.

THIS WILL CREATE 200,000 NEW JOBS IN BRAZIL; ¼ IN INDUSTRY AND 3/4 IN FORESTRY.

SLIDE 11

THIS PLAN WILL REQUIRE 30 "FOREST DISTRICTS" WITH EACH 350,000 ACRES; EACH SUPPLYING TWO 1000 t/d PULPMILLS WITH RAW MATERIAL.

TOTAL AREA NEEDED:	10.5 x 10^6 ACRES
% OF BRAZIL'S TERRITORY:	0.5
SPECIES REFORESTATION:	EUCALYPTUS AND PINUS

LOCATION: 20 DISTRICTS IN CENTRAL BRAZIL (M.G., GOIAS, E.S., S. BAHIA)
10 DISTRICTS IN NORTH AND NORTH-EASTERN BRAZIL

SLIDE 17

PROJECTED STEEL PRODUCTION
AND ENERGY SOURCES FOR REDUCTION
(in 10^6 metric tons p.a.)

Energy Source	1975		1985			
			Scenario A		Scenario B	
	Production	%	Production	%	Production	%
Coke	5.1	52	24.2	60.5	20	50
Charcoal	2.8	29	7.0	17.5	12	30
Scrap Iron	1.5	15	3.8	9.5	3	7.5
Direct Reduction	0.4	4	5.0	12.5	5	12.5
TOTAL	9.8	100	40.0	100	40.0	100

SLIDE 18

PRODUCTION OF ONE TON OF STEEL REQUIRES 0.6 t COKE, EQUIVALENT TO 0.8 t MINERAL COAL (IMPORTED TO THE EXTENT OF 70%); OR 3.3 m^3 OF CHARCOAL, EQUIVALENT TO THE SUSTAINED YIELD OF 0.65 ACRES OF EUCALYPTUS FOREST.

SLIDE 19

PROJECTED ETHANOL PRODUCTION
("ALCOHOL PROGRAM")

--FROM SUGAR CANE (93%)
--FROM MANIOC (6.2%)

--AS BY-PRODUCT FROM SUGAR OR HONEY PRODUCTION
--AS INDEPENDENT DISTILLERIES

--CURRENT PRODUCTION (m^3): 650×10^3
--PROJECTED PRODUCTION--1980 (m^3): 4600×10^3
(other sources: $3{,}000 \times 10^3 m^3$)
--ACREAGE NEEDED FOR EXPANSION: 2.3 MILLION ACRES OF SUGAR CANE PLANTATIONS

--GOAL: USE OF 20% ETHANOL IN GASOLINE

SLIDE 20

GOALS

TO REFOREST IN NEXT FIVE YEARS
1.5 MILLION ACRES ANNUALLY TO MEET:

--PULPWOOD NEEDS (41%)
--CHARCOAL NEEDS (42%)
(Scenario A)
--LUMBER NEEDS (18%)

AND

TO PLANT SUGAR CANE ON AN ADDITIONAL
2.3 MILLION ACRES, AT UP TO 750,000
ACRES PER YEAR.