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University of Brasília

Laboratory of Energy and Environment

On the Characterization of Data Quality of the 1st Brazilian GHG Inventory

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International Workshop on LCI-Quality 2003

Karlsruhe, 20-21 October 2003

Objectives

- **To assess Brazilian 1st Inventory of Anthropogenic Greenhouse Gases (GHG) emissions, focusing on:**
  - **Data availability within Brazilian data bases;**
  - **Results: direct / indirect measurements, mathematical treatments;**
  - **Data quality, regarding their technological, temporal and geographical scales.**

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Brazilian Regional Characteristics

- **5th largest country in the world, 8,500,000 km², 26 states and one Federal District (Brasília, the capital).**
- **5 geographical regions:**
  - **North: % area, 4.9% population, % GNP;**
  - **Northeast: % area, 29.3% population , % GNP;**
  - **Center West: % area, 6.3% population , % GNP;**
  - **Southeast: % area, 43.5% population , % GNP;**
  - **South: % area, 16% population , % GNP.**
- **regional diversities + increasing social, cultural and economic contrasts.**
- **very complex and dynamic economy: a large agricultural producer, producer of pig iron and steel, cement, aluminum, chemical and biochemical products, petrochemical feedstock and petroleum.**

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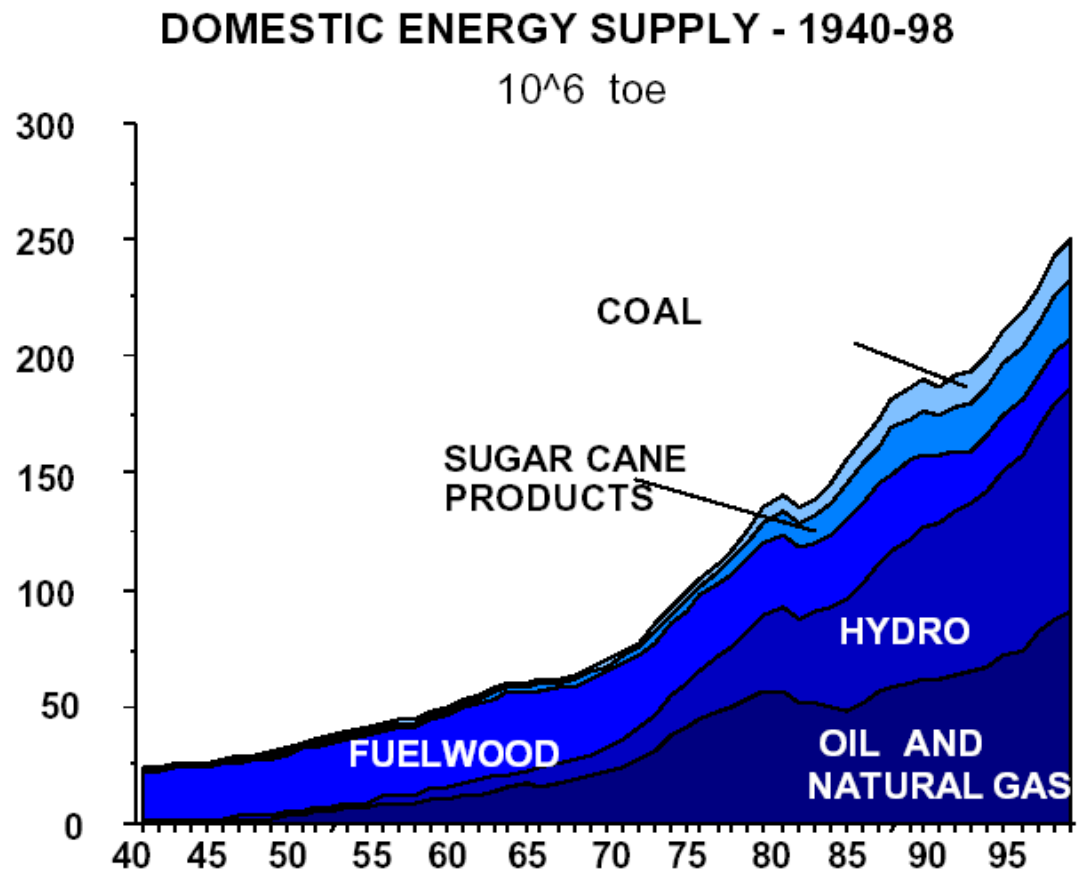
Brazilian Energy Systems



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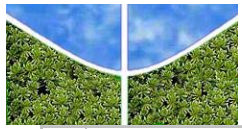
Reports on Brazilian Anthropogenic GHG

- **14 reports prepared by Brazilian Minister of Science and Technology, under Brazilian IPCC commitment**
- **13 studies on anthropogenic sources of GHG:**
  - **Carbon dioxide and methane emissions from Brazilian hydroelectric reservoirs**
  - **Emissions and removals of carbon dioxide by soils from land use change and liming**
  - **Carbon dioxide emissions and removals from changes in the stocks of planted forests**
  - **Emissions of greenhouse gases from burning of agricultural residues**
  - **Methane emissions from livestock**
  - **Methane emissions from rice cultivation**
  - **Nitrous oxide (N_2O) emissions from agricultural soils**
  - **Greenhouse gas emissions from fuel combustion: bottom-up approach**
  - **Carbon dioxide emissions from fuel burning: top-down approach**
  - **Fugitive emissions from coal mining and handling**
  - **Greenhouse gas emissions from movable sources in the energy sector**
  - **Greenhouse gas emissions from industrial processes and use of solvents**
  - **Methane emissions from waste treatment and disposal**
- **A fourteenth report on nonanthropogenic GHG emissions from biomass burning in Cerrado using orbital data**
- **Methodology suggested by the IPCC , OECD and IEA**

	Source / Sink	Data Availability
1	**Soils from land use change and liming**	Statistical data from the **Agricultural census** for 1970, 1975, 1980, 1985 and 1995-1996; from map of Brazilian soils and map of vegetation; and data on agricultural lime sales.
2	**Changes in the stocks of planted forests**	Obtained from two major **Brazilian agencies in the forest sector**, the National Pulp and Paper Manufacturers Association - ANFPC, and the Brazilian Association of Renewable Forests – ABRACAVE.
3	**Rice cultivation**	Data obtained with **research institutes and specialists** in rice cultivation.
4	**Burning of agricultural residues**	Data obtained with **research institutes and specialists** in sugar cane and cotton growing.
5	**Agricultural soils**	Data about agricultural and animal production from **IBGE (Brazilian Institute for Geography and Statistics) official statistics**.
6	**Biomass burning in Cerrado**	**Statistical orbital sampling strategy** for estimating the area burnt in the non-anthropogenic cerrado, according to area and degree of human intervention.
7	**Livestock**	**Official data** for livestock from IBGE.
8	**Hydroelectric reservoirs**	There were **no reports of *in loco* scientific studies**. Total emissions of GHG, through a program of systematic sampling. Emissions in the Miranda, Barra Bonita, Segredo, Três Marias, Xingó, Samuel and Tucuruí reservoirs were assessed by **sampling, with extrapolation of results to the complete reservoir**.
9	**Fuel combustion and burning**	**Analysis based on Brazilian energy matrix**, namely renewable energy sources such as firewood, water energy, charcoal, and sugar cane bagasse and alcohol.
10	**Coal mining and handling**	**Industrial data** for two types of coal: steam coal used industrially in the generation of steam and energy, and coking coal, used in the steel industry.
11	**Movable sources in the energy sector**	Light and heavy vehicles data was supplied by several **Governmental and research institutions**, aircraft fuel information provided by **Brazil's Civil Aviation Institute** (IAC).
12	**Industrial processes and use of solvents**	Cement, lime and barilla-related emissions were estimated based on **data provided by the respective industrial association**.
13	**Waste treatment and disposal**	Sanitation data from the **National Survey on Basic Sanitation**.



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Results

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	Source / Sink	Related to (1994)	CO2-Eq	CO2	CH4	N2O	NOx	CO	NMVOC
1	Soils from land use change and liming	emissions from changes in carbon stocks in mineral soils and from liming;	64800	64800					
2	Changes in the stocks of planted forests	6.9 million hectares, with 93% of the total area planted with Eucalyptus and 7% with Pinus;	-11000	-11000					
3	Rice cultivation	approximately 1,468 thousand hectares of flooded rice fields in Brazil, accounting for 33% of all rice growing area in the country (4,452 thousand hectares);	5943		283				
4	Burning of agricultural residues	from burning of sugar cane and cotton, produced by 262,674,150 tonnes of sugar cane on a harvested area of 4,287,630 ha, as well as 1,783,175 tonnes of cotton on a harvested area of 1,391,880 ha;	90832	2790	130	7	260		
5	Agricultural soils	manure from grazing animals (56%), crop residues (34%) and biological nitrogen fixation (21%);	152320			476			
6	Biomass burning in Cerrado	Brazilian Cerrado area of 2,0 x 10^6 km2, TM-Landsat scenes from the June/July period;	52938		306	8	137	8	
7	Livestock	224 million heads: 67% of cattle, 15% of swine, 9% of sheep and 5% of goats;	205800		9800				
8	Hydroelectric reservoirs	Seven lakes: Miranda-50.6km^2, 3Marias-1040km^2, Barra Bonita-312km^2, Segredo-82km^2, Xingu-60km^2, Samuel-559km^2, Tucuruí-2430km^2;	5920	2785	149				
9	Fuel combustion and burning	total end use energy consumption of 190,858,000 Toe;	780704	231408	293	9	1601	12266	1169
10	Coal mining and handling	total production of run-of-mine coal of 9.7 million tons, 59% from underground mines and 41% from open pit mines;	1113		53				
11	Movable sources in the energy sector	11.745 million of light vehicles, 35% fueled by ethyl alcohol; 1.497 million heavy vehicles, 60% trucks, 28% light vehicles and 13% buses; 1.443 million m^3 of aviation kerosene in domestic routes, 43% in 547,000 operations of landing and takeoff;	703850	83710	10	2	1888	5898	1180
12	Industrial processes and use of solvents	cement, lime and barilla production;	13676	13676					
13	Waste treatment and disposal	municipal solid waste of 54 thousand metric tons per day, namely 0.4 to 0.7 kg/inhab.day.	14217		677				
	Total	----------	2081113	Gg					

Data Quality

	Source / Sink	Data Quality
1	**Soils from land use change and liming**	• Estimates are still scarce. • In the absence of specific data, factors used were suggested by IPCC.
2	**Changes in stocks of planted forests**	• Accuracy is hard to quantify, because of the variance in figures. • Estimating methods are well developed, accuracy of 85%.
3	**Rice cultivation**	• Size of the country and its different ecosystems and climatic conditions should influence the estimates.
5	**Agricultural soils**	• Data required by IPCC is not available in Brazil, some factors used obtained in other countries.
6	**Biomass burning in Cerrado**	• There are not, for each orbit/point, complete sets of images to cover the entire burning season.
7	**Livestock**	• Lack of data for characterizing cattle populations, food supply season and climatic fluctuations. • Animal wastes information obtained in consultation with specialists.
8	**Hydroelectric reservoirs**	• Intensity of emissions dependent on measurement site, time of flooding, temperature, depth, wind, sunlight, water physical-chemistry, biosphere composition and reservoir operational regime.
9	**Fuel combustion and burning**	• Validation relied on the values recommended by the IPCC do not accurately reflect the conditions of production and use of energy in Brazil.
13	**Waste treatment and disposal**	• National-related literature should be used.

Data Quality

- Scarcity of data.
- Completeness of data.
- Complexity of conditions: size of the country, ecosystems and climatic conditions diversity.
- Inaccuracy of validation relied on foreign values.
- Information obtained with specialists.
- Inexistence of regular basis inventory statistics.

Further Topics

- Brazilian 1st Inventory of GHG is a valuable collection of information, although less detailed than LCI.
- Data describes aggregated mass flux crossing Brazilian economy.
- National statistics available do not always allow an adequate evaluation of emissions. In many cases, indicators were estimated.
- Part of the analysis relied on values recommended by the IPCC.
- These questions emphasize the importance of region-specific conditions in environmental evaluation.
- LCA force tasks must take into account regional specificity, namely social, economic, geographical, technological and industrial characteristics.
- It should be recognized that the development of a national life cycle inventory is a resource-intensive undertaking. Priorities should be established for carrying out research and studies of impacts for social and economic sectors.