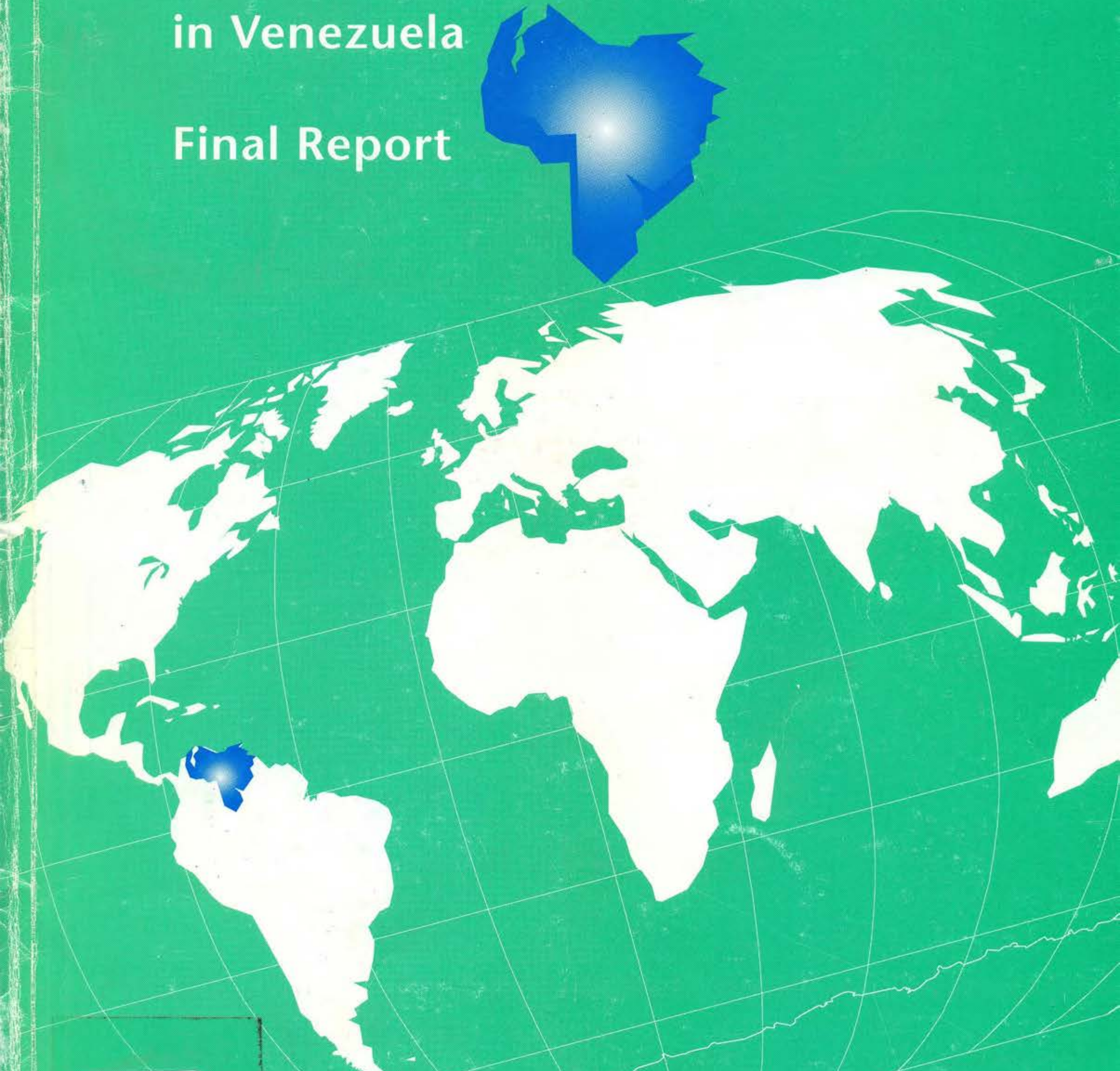
Country Case Study on Sources and Sinks of Greenhouse Gases in Venezuela

Final Report



Global Environment Facility

UNEP

PREFACE

In accordance with Article 4 of the United Nations Framework Convention on Climate Change (UNFCCC), all Parties are required to develop, periodically update, publish and make available to the Conference of the Parties, national inventories of anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled by the Montreal Protocol using comparable methodologies to be agreed upon by the Conference of the Parties.

A methodology for conducting such inventories was developed by the OECD Environment Directorate, the International Energy Agency (IEA), and the IPCC Working Group I Technical Support Unit and was proposed as the standard methodology as required under the Convention.

In order to test and further refine the method, the UNEP Atmosphere Unit, working in collaboration with the UNEP Global Environment Facility (GEF), implemented a series of nine complementary national studies using these "IPCC Guidelines for National Greenhouse Gas Inventories".

This report is one of the nine technical reports resulting from this effort. Based partly on this study and on a series of regional workshops sponsored by UNEP under the GEF funded programme and with the assistance of experts from a number of countries, an improved version of the IPCC Guidelines was prepared and approved at the Tenth Plenary Session of the IPCC in Nairobi (November 1994).

The First Conference of the Parties to the UNFCCC (Berlin, April 1995) also adopted the IPCC methodology as the recommended standard to be employed by all Parties in making their inventories in accordance with Article 4.

It is hoped that this report will assist other country study teams in the development and updating of future inventories of greenhouse gases.

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PRELIMINARY NATIONAL GREENHOUSE GAS INVENTORY:VENEZUELA

PROJECT GF/4102-92-40

Government of Venezuela
United Nations Environment Programme (UNEP)
Global Environment Facility (GEF)
US Country Study Program (USCSP)

ACKNOWLEDGMENTS

The Venezuelan Country Study to Address Climate Change would like to thank the Environmental Affairs Department of Petróleos de Venezuela, S.A. (PDVSA), who coordinated the active participation of the oil industry, and also to the Exploration & Production and Manufacture Coordination. These coordinations, together with PDVSA's affiliates oil companies, LAGOVEN, MARAVEN and CORPOVEN, as well as the Research and Development affiliate, INTEVEP, contributed with important inputs to data collection in the estimation of emissions from the oil industry.

We would also like to thank the contribution of the Venezuelan Scientific Research Institute (IVIC), through the Atmospheric Chemistry Laboratory, in the non-energy sector emission estimates.

Finally, we appreciate the support and constant contribution from the differents Directorates of the Ministries of Environment and Renewable Natural Resources and Energy and Mines.

MINISTRY OF ENVIRONMENT AND RENEWABLE NATURAL RESOURCES
MINISTRY OF ENERGY AND MINES

UNEP

UNITED NATIONS ENVIRONMENT PROGRAMME
GLOBAL ENVIRONMENT FACILITY

U.S. COUNTRY STUDIES PROGRAM

PRELIMINA GREENHOUSE GAS I NEZUELA

UNEP PROJET GF / 4102-92-40

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PRELIMINARY NATIONAL GREENHOUSE GAS INVENTORY : VENEZUELA

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FOREWORD

This document presents the results of the UNEP Project GF/4102-92-40 "Country Case Study on Sources and Sinks of Greenhouse Gases in Venezuela", initiated in November, 1993. The project is jointly coordinated by the Ministry of Environment and Renewable Natural Resources, through the General Directorate of International Relations, and the Ministry of Energy and Mines, through the General Directorate of Energy. The project constitutes one of the areas to be developed within the initiative to define a national strategy on climate change. A first step in the context of this initiative was the formulation of a national project entitled "Venezuelan Case Study to Address Climate Change", which is being implemented in three different, but interrelated, modules: Module I, on inventory of sources and sinks of greenhouse gases; Module II, on mitigation strategies; and Module III, on adaptation strategies to sea level rise and forestry.

The UNEP Project represents a major achievement in the development of Module I, which will continue through a process of data validation and formulation of specific in-depth studies, in order to improve the greenhouse gas emission inventory. A final document will be produced by the end of 1995.

All the financial and technical resources required for the development of the national study were provided by the Global Environment Facility (GEF), through the United Nations Environment Programme (UNEP); the U.S. Government, through the U.S. Country Study Program (USCSP); and the Government of Venezuela.

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EXECUTIVE SUMMARY

This document presents the results of the UNEP Project GF/4102-92-40 "Country Case Study on Sources and Sinks of Greenhouse Gases in Venezuela", which has been developed within the framework of the National Study to Address Climate Change. The study was initiated in October 1993, with the financial and technical assistance of the Government of United States, through the U.S. Country Study Program (USCSP), and the Glogal Environment Facility (GEF), through the United Nations Environment Programme (UNEP).

The objective of the project is to perform a national inventory of anthropogenic emissions by sources and removals by sinks of all greenhouse gases, in accordance with the United Nations Framework Convention on Climate Change and the IPCC/OECD methodology for national greenhouse gas inventories. The international standards set for the inventory process, based on a common methodology, seek to ensure that all mechanisms and approaches adopted by the countries to evaluate their greenhouse gas emissions are consistent and transparent and that their results can be compared on a systematic manner.

This national inventory represents a valuable tool to predict future greenhouse gas emissions under various economic development scenarios and to identify and rank the best mitigation strategies that the country could implement to reduce its emission levels. However, the inventory is still considered preliminary since it can be validated and updated as better data become available and new guidance on the methodology approach is provided by the IPCC.

The estimation of emissions from all sources was based on the methodology provided by the IPCC Draft Guidelines for National Greenhouse Gas Inventories (IPCC/OECD, 1994). Most emission factors and some default values provided by the methodology for specific source categories were used in the inventory as local data were not always available. In many cases, the required data were specifically generated for the inventory through literature search, site visits, or interviews with experts. In a few cases, specific studies were performed in order to produce or validate some of the data.

The results of the inventory are also presented in accordance with the IPCC guidelines, following the reporting instruction tables. Besides the analysis and estimates of 1990 greenhouse gas emissions and sinks, the document provides a global picture of the main anthropogenic activities responsible for these emissions in the country and a description of particular situations that could introduce additional elements in the inventory process. It also provides specific discussions on methodologies, data used, and information sources for each category.

The gases included in this inventory are carbon dioxide, methane, nitrous oxide, nitrogen oxides, carbon monoxide, and nonmethane volatile organic compounds. Chlorofluorocar bons are excluded as they are controlled by the Montreal Protocol. Table S-1 provides a summary of greenhouse gas emissions by source category. The energy sector is the most important anthropogenic source in the country. Emissions come mainly from the use of energy as fuel, land use change, and from fugitive emissions generated by oil and gas production.

TABLE S- 1
VENEZUELAN GREENHOUSE GAS EMISSIONS. 1990

SOURCES	EMISSIONS (Gg)					
	CO2	CH4	N2O	NOX	CO	NMVOCs
NATIONAL EMISSIONS	**190618**	**3178**	**4.60**	**400**	**4285**	**250**
ENERGY SECTOR	**107289**	**1838**	**0.64**	**339**	**1878**	**250**
COMBUSTION (*)	105931	12	0.64	339	1878	250
STATIONARY SOURCES	-	2	0.22	143	49	-
MOBILE SOURCES	-	10	0.42	197	1830	250
FUGITIVES	1358	1826	-	-	-	-
OIL & NATURAL GAS	1358	1823	-	-	-	-
COAL MINING	-	04-3	-	-	-	-
INDUSTRIAL PROCESSES	**2867**	-	-	-	-	-
AGRICULTURE	-	**961**	**2.88**	**22**	**1027**	-
DOMESTIC ANIMALS		853	-	-	-	-
RICE CULTIVATION		67	-	-	-	-
SAVANNA BURNING		31	0.39	14	821	-
AGRICULTURAL WASTE BURNING		10	0.23	8	206	-
AGRICULTURAL SOILS		-	2.26	-	-	-
LAND USE CHANGE & FORESTRY	**80462**	**158**	**1.08**	**39**	**1380**	-
FOREST CLEARING	84790	158	1.08	39	1360	-
MANAGED FOREST	(5530)	-	-	-	-	
GRANLAND CONVERTION	1202					
WASTE	-	**221**	-	-	-	-

(*) Estimate based on Top - Down methodology.
NOTE : Totals may not add due to rounding.

TABLE S - 2
CUMULATIVE CLIMATE EFFECT OF GREENHOUSE GAS EMISSIONS. 1990

GASES	EMISSIONS (Gg) FULL MOLECULAR WEIGHT	GWP (1) 100 year Horizon	RELATIVE CONTRIBUTION (%)
CARBON DIOXIDE (CO2)	190618	1	70.6
COMBUSTION (*)	105931		39.2
FUGITIVES	1358		0.5
INDUSTRIAL PROCESSES	2867		1.1
LAND USE CHANGE & FORESTRY	80462		29.8
METHANE (CH4)	3178	24.5	28.8
COMBUSTION	12		0.1
FUGITIVES	1826		16.6
AGRICULTURE	961		8.7
LAND USE CHANGE & FORESTRY	158		1.4
WASTE	221		2.0
NITROUS OXIDE (N2O)	4.60	320	0.5
COMBUSTION	0.64		0.1
AGRICULTURE	2.88		0.3
LAND USE CHANGE & FORESTRY	1.08		0.1
TOTAL			100

(1) Direct and inderect effects - IPCC, 1994, Table 5.
(*) Estimate based on Top - Down methodology
NOTE : Totals may not add due to rounding.

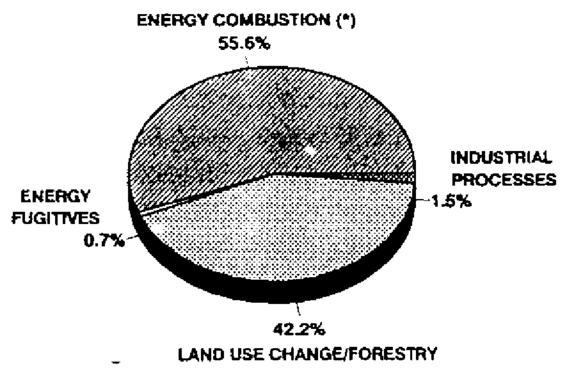
Table S-2 presents a summary of the emissions by source and gas in full molecular weight and the relative contribution of each gas to total radiative forcing based on the Global Warming Potential concept. Carbon dioxide is the most important gas, whose emissions are originated primarily from fuel combustion and forest clearing. Methane has also an important contribution and it originates primarily from oil and gas production and agricultural activities.

The following sections summarize the emission estimates and present a brief discussion on the relative importance of each source category within the national inventory of greenhouse gas emissions.

CARBON DIOXIDE

Carbon dioxide contributes to nearly one third of the natural greenhouse effect. A continuous increase of its concentration in the atmosphere, produced by anthropogenic activities, has been observed from the begining of the industrial period, at a global level. Since then, the concentration of carbon dioxide has increased by more than 25%, mainly due to the use of fossil fuels. Venezuela generated 190,618 Gg of carbon dioxide in 1990. The main sources are energy-combustion and land use change (Figure S-1).

FIGURE S - 1
CO2 NATIONAL EMISSIONS
(190618 Gg)



(*) Estimates based on Top-Down methodology

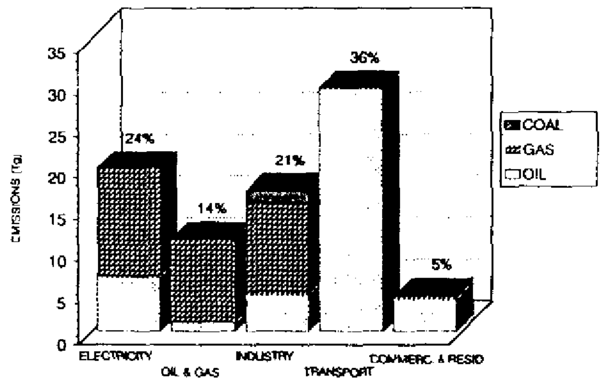
Energy Sector

The use of fossil fuels constitutes the main anthropogenic source of greenhouse gases. Within this, carbon dioxide is the most important contributor; emissions of this gas occur during the combustion process, when the carbon contained in the fuel is combined with oxygen. The quantity of carbon in fossil fuels varies significantly by fuel type. Coal contains the greatest amount of carbon per unit of energy, while crude oil and natural gas contain 25% and 50% less than coal, respectively.

In Venezuela, the energy sector emitted 107,289 Gg of carbon dioxide in 1990, which represented 56% of CO2 national emissions. Energy combustion generated 105,931 Gg, 98.7% of the energy sector while gas flaring in the oil and gas systems produced the remainder 1,358 Gg,1.3% of the sector. Total CO2 emissions were estimated in accordance with the Top-Down method.

Carbon dioxide emissions from combustion are mainly caused by the use of oil and natural gas. The former generated 53,313 Gg while emissions from natural gas were estimated to be 50,742 Gg, which represented 50% and 48% of these emissions, respectively. Coal accounted only for 2% since coal consumption in the country is very low. Based on a sectorial analysis, as shown in Figure S-2, emissions are mainly generated by the transport sector (36%) and the operations of the energy industry (38%) (Figure S-2).

FIGURE S-2
CO2 EMISSIONS FROM ENERGY COMBUSTION
BY SECTOR AND ENERGY SOURCES



(*) Estimates based on Bottom-Up methodology

Estimates of Sectorial CO2 emissions were based on the Bottom-Up method. It is important to note that total figures obtained from both methodologies show some differences.

Stationary Sources

In 1990, stationary sources emitted 51,560 Gg of carbon dioxide, mainly from the use of oil (31%) and natural gas (67%). The greatest amount of emissions within the stationary sources corresponds to the energy industry, which generated 30,516 Gg. The emission sources in this industry are related primarily to electricity generation (19,519 Gg) and oil and gas production (10,997 Gg).

The second largest source is the manufacture industry, which generated 16,775 Gg of CO2. Most of these emissions comes from the energy used for steam generation (41%) and direct heat (44%). The industrial categories that produce the greatest quantities of emissions are: basic metallic; food, beverages and tobacco; chemicals and non-metallic mineral industries, which all together contributed with 86% of the emissions from the manufacture sector.

The residential sector generated 3,678 Gg of CO2 while the commercial and service sectors emitted 572 Gg. Based on the types of fuel used in these sectors, petroleum is the main emitter, followed by natural gas.

Mobile Sources

The 1990 emissions of carbon dioxide from mobile sources were estimated to be 29,205 Gg; gasoline vehicles are the most important emitter, with 21,164 Gg. Emissions from national transportation are primarily generated by road transportation (94%). Private vehicles is the most important source within this sector, with 10,593 Gg of carbon dioxide, representing 39%, followed by the emissions from heavy duty trucks, with 27%. Emissions from public transportation are the least significant, as they only contributed with 14%.

Industrial Processes

Carbon dioxide emissions are also produced as by-product of different industrial processes. These emissions are not a result of energy consumed during the process but are directly generated by the process itself. Chemical transformation of raw materials from one state to another usually emits greenhouse gases, being carbon dioxide the most important of these gases.

The cement industry is an important CO2 emitter. This greenhouse gas is generated during the production of clinker, an intermediate product from which finished portland and masony cement are made. The 1990 estimates of carbon dioxide emissions from cement industry in Venezuela were 2,867 Gg.

Land Use Change and Forest Management

Human activities that alter the biosphere for food, fuel and fiber production have been increasingly contributing to the concentration of greenhouse gases in the atmosphere. Carbon dioxide is considered to be the most important gas associated with land use changes. Three categories are included in the national inventory: forest clearing, forest management, and conversion of grasslands to cultivated lands. Land use-change is largely responsible for greenhouse gas emissions in Venezuela. The forest convertion process that the country has witnessed during the last decades has increased significantly as land pressure to establish different economic activities has determined the fate of large forest areas. Furthemore, land clearing for agricultural use is the most important activity leading the process of land use change.

Forest Clearing

The forest area of the country is roughly 58 million hectares, which represents more than 60 % of the national territory. About 70 % of the forest land is found in the south of the country, where the Venezuelan Amazonian Basin is located.

The annual rate of forest clearing in Venezuela has not been consistently docummented. The country was divided into three main geographical regions, according to specific sources of information on forest clearing rates: Northwest, northeast, and South, in order to derive an average deforestation rate. The analysis estimated an average cleared area of approximately 517.000 hectares per year (excluding the southern region). This value was used to provide an aproximation of greenhouse gas emissions in the country due to forest clearing until a more detailed study on deforestation rates at a national level is performed. An initiative is already being coordinated to achieve this goal in the near future.

The amount of carbon dioxide emitted by forest clearing has been estimated to be 84,790 Gg in 1990, which represents about 44% of national CO2 emissions. Being one of the most important sources of carbon dioxide and other gases as well as one of the most complex areas, a number of issues will still need to be refined in order to improve the estimates and update the inventory.

Managed Forests

Carbon dioxide uptake from managed forests has been estimated to be 5,530 Gg in 1990, which represents an offset of about 6 and 3% of CO2 emissions from forest clearing and all sources respectively. Although its importance as a carbon dioxide sink may not seem relevant within the national greenhouse gas emission context, the potential contribution of forest management to offseting CO2 emissions is quite large. The total forest area managed by commercial forest product industries during the 1970-90 period has reached 215,000 hectares. On the other hand, forest plantations have reached, for the same period, about 430.000 hectares. More than 90 % of the area corresponds to commercial plantations while the rest has been established for protection purposes.

Conversion of Grasslands to Agricultural Lands

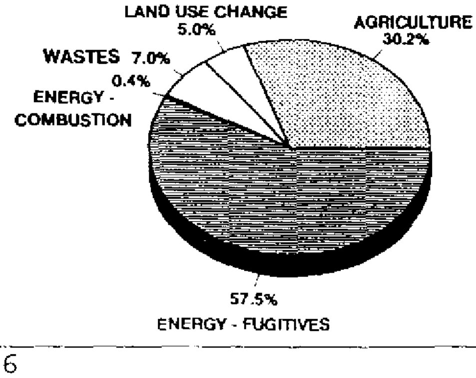
Conversion of grasslands to cultivated lands is not a significant source of carbon dioxide in the country, as agricultural activities have been rather marginal within the national economic development context. Most of the agricultural activities in these areas are related to extensive cattle raising, which does not involve land tilling. However, some important crops have been established on open savannas, especially during the 1984-1989 period, when government subsidies resulted in a substantial increase of agricultural production. Based on local data for soil carbon content, the estimated net converted area, and a rate of soil loss carbon of 2% per year, emissions were calculated to be 1202 Gg of carbon dioxide. As the data used are not very reliable, the resuit obtained is highly uncertain and should be viewed as a general approximation of the magnitude of emissions from this source.

METHANE

Methane is the second most important gas responsible for global warming, accounting for about 15% of the "radiative forcing" added to the atmosphere in the 1980's at a global level. Its concentration have more than doubled in the past 300 years and continue to increase by about 1% per year. Although global methane emissions are much smaller than global CO2 emissions, its overall contribution to global warming is large since it is 24.5 times more effective at trapping heat in the atmosphere over 100-year time horizon when direct and indirect effects are accounted for.

Methane emissions in Venezuela were estimated to be 3,178 Gg for 1990, maily generated by fugitive emissions from the oil and natural gas industry and emissions from agricultural activities (Figure S-3).

FIGURE S - 3
METHANE EMISSIONS, 1990
(3178 Gg)



Energy Sector

The energy sector emitted 1,838 Gg of methane in 1990, which represented 58% of national methane emissions. Fugitive emissions are the most important source of this gas with 99.3% while fuel combustion only generated 0.7%.

Oil and gas systems are the main methane emitters, especially during production activities, which generated around 83% of the total fugitive emissions. Emissions corresponding to processing, transportation and distribution of natural gas represented 17%. The contribution of coal mining is very small, due to the low level of production of this fuel in the country.

The use of fossil fuel in transportation is the most important source of emissions of the other non-CO2 gases originated by combustion, mainly those generated by incomplete combustion, such as methane. The mobile sector is the second largest emitter of methane with 9.8 Gg, representing 81% of combustion emissions; gasoline vehicles produced the biggest amounts, especially private vehicles which generated 4.9 Gg.

Agriculture

Methane is the most important greenhouse gas produced by the agricultural sector and is responsible for the emission of 961 Gg, which represents 30% of national methane emissions. Management of domestic livestock and animal manure contributes 90% of the methane emissions from agricultural activities. Rice cultivation and savanna burning are a less important source of methane, releasing 7% and 3% of the emissions from agricultural activities, respectively. Field burning of agricultural residues are a negligible source of methane and other greenhouse gases as this practice is not common in the country.

Enteric Fermentation

Emissions from enteric fermentation in domestic animals are estimated to be 826 Gg of methane, which represents about 26% of national methane emissions and 86% of methane emissions from agricultural activites. The more detailed approach of the IPCC methodology, refered to as Tier 2, was applied in order to derive methane emissions from cattle. Dairy and beef cattle are the major contributors, accounting for 97% of total emissions from enteric fermentation. Methane emissions from other domestic animals include buffalo, sheep, horses, swine, goats, mules and asses. The approach used to calculate the emissions from this non-cattle source was based on the Tier 1 method, and consequently, a less detailed analysis was performed. Methane emissions from these animals have been calculated to be 23.2 Gg, about 3% of methane emissions from enteric fermentation in all domestic animals.

Manure Management

Methane emissions from animal manure are estimated to be 26.7 Gg, which represents only 3% of the total amount generated by domestic livestock and less than 1% of national methane emissions. Manure in the country is usually not treated or stored in anaerobic environments. Thus, almost all livestock manure is managed as solid on pastures and ranges. Of the different animal categories included in this estimate, cattle and swine manure are the most significant emitters, accounting for approximately 55% and 34% of total methane emissions from animal manure, respectively.

Rice Production

Rice fields generate about 67 Gg of methane per year and represent 2% of national methane emissions. Rice is one of the country's major crops and most of its production is concentrated in two regions with similar climate patterns and cultivation practice. Rice fields are commonly irrigated or rainfed. The floodwater depth is usually less than one meter , which is a basic condition to generate methane through the anaerobic decomposition of organic matter in the fields. Although some variations were found in the number of days flooded per year, this period has an average of nearly 90 days, corresponding to a continuously flooded regime. Rice is not cultivated under intermittently flooded or dry regime in the country.

Savanna Burning

More than one fourth of the country (approximately 22 million hectares) is covered by savannas, found in most geographical regions, but mainly in the Llanos of the central part of the country. Extensive cattle raising have been traditionally established on savanna areas, which involves burning during the dry season, as a common agricultural practice to eliminate weeds and pests and encourage growth of new grass. This periodical burning of a great portion of savanna areas releases important non-CO2 trace gases. Carbon dioxide, which is also emitted in large quantities, is not taken into acccount in the greenhouse gas inventory for this sector because it is reabsorbed by the vegetation regrowth between the burning cycles. Methane emissions from this source were estimated to be 31 Gg, which represents only 1% of methane national emissions.

The proportion of the savanna areas burned in Venezuela is highly uncertain as there are not reliable national statistics that compile, on a regular basis, the frequency and extent of savanna burning. Consequently, a satellite imagery study (Landsat TM, 1:250.000 scale) was performed on about half of the savanna area of the country in order to determine this figure. An extrapolation of the study's results indicates that approximately 3.1 million hectares of savanna are annually burned, which represents 13% of the country's savanna area. These results are very controversial as the proportion of savanna burned appears to be very low, especially when compared to the regional default data provided by the IPCC methodology. Based on this source, savannas are burned worldwide every one to four years on average (IPCC/OECD, 1994).

Burning of Agricultural Residues in the Fields

The contribution of this source to greenhouse gas emissions in the country is rather negligible as only 10 Gg of methane were generated by agricultural waste burning. Most of the agricultural residues are not burned since they are commonly used to feed cattle and other animals or plowed back into the field during land tilling. The only two crops whose residues are indeed burned for different reasons are sugar cane and cotton. Sugar cane fields are traditionaly burned before the harvest for both practical and safety reasons while cotton residues are burned for sanitary reasons in order to eliminate any posible pest or weed that may affect the health and yield of the following crop.

Landfills

Landfills do not constitute a significant source of methane in the country since a great fraction of solid wastes is still disposed off in open dumping. Sanitary landfilling generates 221 Gg of methane, which represents about 7% of national emissions. Twenty landfills were identified, with a wide size range. The smallest of these receives an average of less than 3,000 tones of solid wastes per year while more than 1 million tones per year are placed in the biggest landfill. The latter alone, which serves the capital's metropolitan area, accounts for more than 40% of the total landfilled waste in the country.

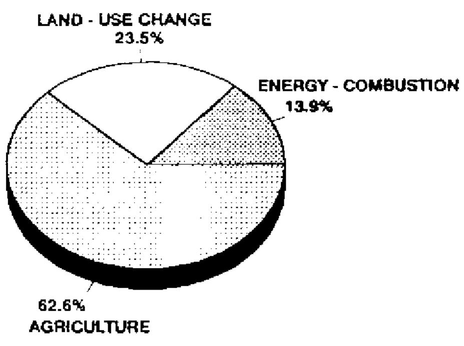
Other Sources

Other activities that generate methane in the country are related to land use change and wastewater management. Biomass burning that occurs in conjunction with forest clearing has been included in the national inventory. Emissions from this practice were estimated to be 158 Gg, which represents nearly 5% of national methane emissions. This estimate will be updated once the deforestation rate data is validated. Wastewater treatment is a negligible emitter of greenhouse gases as only 0.2 Gg of methane were generated by this source.

NITROUS OXIDE

Nitrous oxide is another important infrared absorbing trace gas that contributes to the greenhouse effect. According to the World Meteorological Organization (WMO) its current atmospheric concentration is about 8% greater than during the pre-industrial era. Nitrous oxide is approximately 320 times more powerful than CO2 at trapping heat in the atmosphere over a 100-year time horizon. The current rate of accumulation of N2O in the atmosphere is about 0.2% to 0.3% per year.

FIGURE S - 4
NITROUS OXIDE EMISSIONS. 1990
(4.60 Gg)



Although the estimates are relatively uncertain, nitrous oxide emissions in Venezuela were calculated to be 4.60 Gg for 1990. The most important contributor is the agricultural sector, especially the use of fertilizer (agricultural soil management). Nitrous oxide is also produced directly from biomass burning in the non energy sector and combustion of fossil fuels (Figure S-4). Nevertheless, the mechanisms that cause its formation from these sources are not well understood. N2O production is highly temperature-dependent.

Energy Sector

The Venezuelan energy sector is the least important contributor to nitrous oxide emissions with 0.64 Gg, representing 15% of the national emissions in 1990. Within this sector, 66% comes from mobile sources, especially road vehicles (93%); the highest proportion corresponds to heavy-duty trucks. Contrary to the industrialized countries estimates, where fuel consumption, mainly from aged 3-way catalytic converters, is an important emitter, in Venezuela this source is the least relevant since the vehicle fleet has not yet incorporated catalytic converter control.

Stationary sources emitted 0.23 Gg of nitrous oxides, 36% of the combustion emissions, where 43% comes from energy and transformation industries, 35% from manufacture industry and 22% from residential and commercial sectors.

Agricultural Soil Management

In 1990, nitrous oxide emission from the use of chemical fertilizers were estimated to be 2.26 Gg. This is the main source of nitrous oxide in Venezuela, and represents almost half of total N2O emissions in the country and 78% of the agricultural sector's emissions. Organic fertilizers are not included in this estimate due to the lack of the required data. Although crop residues and animal manure are used in certain agricultural fields, this type of fertilizer does not usually enter the commercial market, and consequently, no reliable source of information is available to estimate the total amount of organic fertilizer and the equivalent nitrogen content.

Other Sources

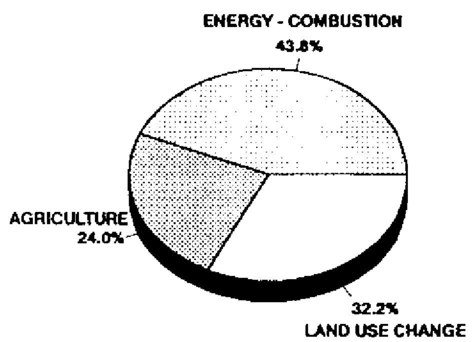
Other sources of nitrous oxides in the country are related to biomass burning as a result of land use change and agricultural practices. Both forest burning that occurs in conjunction with land clearing and savanna burning account for 1.47 Gg of nitrous oxide, which represents about 32% of national N2O emissions. Agricultural waste burning contributes with only 5% of these emissions.

CARBON MONOXIDE AND NON-METHANE VOLATILE ORGANIC COMPOUNDS

Carbon monoxide and non-methane volatile organic compounds (NMVOCs) are unburnt gaseous fuels that are emitted in small quantities due to incomplete combustion. They contribute to the formation of urban smog and hence they have been the target of emission control policies in some countries. The impact of these gases on global climate is indirect. The most important of these effects is their role as precursors of tropospheric ozone. In this role, they contribute to ozone formation and alter the atmospheric lifetimes of other greenhouse gases. However, many uncertainties are associated with quantifying the indirect effects.

Carbon monoxide emissions in Venezuela were estimated to be 4,285 Gg for 1990. As shown in Figure S-5, agriculture activites and land use change contribute with 56% while energy combustion representes 44% of national emissions. All non-methane volatile organic compounds is emitted by the transport sector, which generated 250 Gg in 1990.

FIGURE S - 5
CARBON MONOXIDE EMISSIONS. 1990
(4285 Gg)



Energy Sector

In energy combustion, emissions of these gases are directly influenced by ussage patterns, technology type and size, vintage, maintenance and operation of the technology and usage patterns. Emissions can vary by several orders of magnitude for facilities that are improperly maintained and poorly operated such as the case of many older units. Carbon monoxide emissions from the Venezuelan energy sector were basically generated by the transport sector, which produced 97%; the remainder 3% corresponded to stationary sources, especially from the manufacture industry. It is important to mention that almost all emissions of carbon monoxide (94%) and NMVOCs (94%) are generated by gasoline vehicles.

The need to manage a wide range of variables and the numerous conditions that could affect the yield of each mobile sources category, especially those related to road transport, make very difficult any attempt to generalize the emission characteristics in this area. A similar situation is observed for stationary sources since the emission factors provided by the IPCC methodology are not sufficiently disaggregated. Some adjustments were made in order to perform the emission estimates.

Savanna Burning

Savanna burning represents an important source of carbon monoxide in the country. This agricultural practice generates 821 Gg or 19% of national carbon monoxide emissions. However, since the proportion of savanna burned calculated for the country is believed to be underestimated, the emissions from this source could increase significantly, once more reliable data is incorported in the national inventory. If the default value of 50% burned on average per year is used to perform the estimate, as provided by the IPCC methodology for the Latin American region, carbon monoxide emissions from this source would be four times higher than the result obtained in this preliminary inventory. This issue will need further discussions in order to provide a more reliable estimate of from savanna burning.

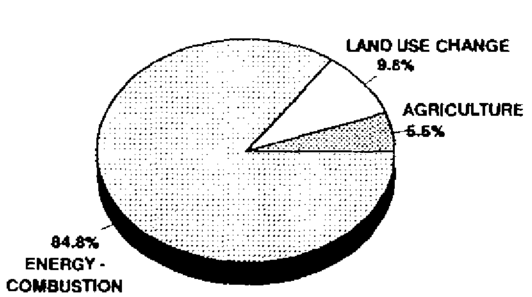
Land Use Change

Forest burning that occurs in conjunction with land clearing is responsible for more than a third of the national carbon monoxide emissions, as 1380 Gg of the gas were emitted from this source in 1990. Contrary to savanna burning, emissions from this source may be overestimated as a result of the rather high value obtained for deforestation rate in the country. Although the average cleared area used for the inventory still does not cover the entire country, discussions with several experts have pointed out the fact that some methodological limitation of the deforestation rate study may be responsible for inconsistencies in the results. An initiative is already underway to clarify this issue in the near future.

NITROGEN OXIDES

Nitrogen oxides have been the target of enviromental policies for their role in forming ozone, as well as for their direct acidification effects. They are also produced by incomplete combustion. In Venezuela, NOx emissions for 1990 were estimated to be 400 Gg, generated mainly by fossil fuel combustion, with 85% of national emissions of this gas . The remainder 14% corresponded to biomass burning in the non energy sector (Figure S-6).

FIGURE S - 6
NITROGEN OXIDES EMISSIONS. 1990
(400 Gg)



Energy Sector

Similarly to carbon monoxide and NMVOCs, nitrogen oxides is a technology-dependent gas. Its emissions depend in part on the nitrogen contained in the fuel. Electricity generation and industrial fuel combustion activities also provide combustion conditions conducive to NOx formation. Excess air and high temperatures contributes to high NOx emissions. It is also produced from incomplete combustion.

As mentioned above, the most important NOx source is the combustion of fossil fuels, with 143 Gg from stationary sources and 197 Gg from mobiles. Electricity generation contributed with 48% of the emissions from the stationaries. In mobile sources, 92% was produced by road transportation.

Other Sources

As in the case of nitrous oxide, biomass burning associated to land use change and agricultural practices constitute other sources of nitrogen oxides emissions. Forest burning that occurs in conjunction with land clearing, savanna burning and agricultural waste burning emited 61 Gg of nitrogen oxides, which represents about 15% of national emissions of this gas.

UNCERTAINTIES

This preliminary national inventory provides a comprehensive picture of Venezuelan greenhouse gas emissions and constitutes a powerful tool to evaluate and plan the best mitigation strategies that the country could develop to reduce and control its emission levels. Nevertheless, some weaknesses and limitations still represent an important problem to be addressed in order to improve the reliability of the information used as well as the methodologies applied in some cases.

Most source categories are likely to present qualitative and quantitative limitations reflected in the calculation of greenhouse gas emissions. However, the uncertainties associated with the emission estimates were not quantified due to the limited available information and the difficulty on identifying the level of reliability for most of the data used in the inventory. Besides limitations associated with the methodology, the poor quality of some of the data is probably highly responsible for the uncertainties of the results. Special efforts should be made in the near future to solve this crucial issue and produce more accurate national estimates.

In the case of the energy sector, in-depth studies have already been initiated for the main carbon dioxide emission sources, with the objective of validating the data and generating more appropiate emission factors. Similarly, as land use change respresents a significant source of carbon dioxide, an effort to determine more reliable data on deforestation rates is being coordinated by the Ministry of Environment and Renewable Natural Resources. Methane emission estimates could also be improved through the implementation of specific projects to generate additional and more reliable data-for the oil and gas industry -the main source of methane. A project will be formulated shortly to address this issue in conjunction with the Venezuelan oil industry.

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I. INTRODUCTION

Overview

The greenhouse effect is a natural phenomenon produced when the solar energy reradiated by the earth is trapped by atmospheric gases. The radiatevely-active gases that absorb some of this energy in the atmosphere are called greenhouse gases. These are mainly water vapor, carbon dioxide, methane, nitrous oxides, and ozone. Clorofluorocarbons and some photochemical gases, such as carbon monoxide, nitrogen oxides, and non-methane volatile organic compounds contribute also to the greenhouse effect. As a result, the earth stays warmer than it would otherwise be without the presence of the greenhouse gases.

Atmospheric concentrations of these gases have been increasing as a result of a wide range of human activities and have been especially noticeable after the 1950's. This increase is believed to alter the redistribution of energy in the atmosphere and, consequently, affect climate by altering some related natural phenomenon, such as increment of mean global temperature, changes in frequency and distribution of precipitation, circulation and weather patterns, and hydrological cycle, among others.

Not all atmospheric gases have the same contribution to the greenhouse effect. Direct and indirect effects have been reported in order to make a distinction between a greenhouse gas itself and a gas that produces or can influence a greenhouse gas in the atmosphere. For this reason, an index has been developed to compare the effects of these gases on the same basis. This is called Global Warming Potential (GWP), and it measures the ratio of both direct and indirect radiative forcing from one unit of a greenhouse gas to one unit of carbon dioxide, over a given period of time (carbon dioxide is used as the reference gas). The periods that have been commonly used are 20 or a 100 years. For example, for 100 year period, a Global Warming Potential of 24.5 has been used for methane to measure direct and indirect effects. On the other hand, a GWP of 320 has been recommended for nitrous oxides, to account for the direct effects (IPCC/OECD,1992).

The possibility of a global climate change, as a result of anthropogenic emissions of greenhouse gases, has become a major concern within the international scientific community in the last few years. This concern was the basis for the creation of the Intergovernmental Panel on Climate change(IPCC) and for the process of international negotiations that led to the approval of the United Nations Framework Convention on Climate Change. The convention was signed by 155 countries at the 1992 Earth Summit, held in Rio de Janeiro, Brazil.

The objective of the Convention on Climate Change is to "achieve stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system". This level should be achieved "within a time frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner".

The Government of Venezuela signed the United Nations Framework Convention on Climate Change (UNFCCC) in June 1992, which was ratified by the National Congress in December 1994. As the Convention requires all parties to develop and publish national inventories of anthropogenic greenhouse gas emissions as well as national plans to reduce or control emissions, the Ministry of Environment and Renewable Natural Resources and the Ministry of Energy and Mines formulated the "Country Study to Address Climate Change". The study was initiated in October 1993, with the financial and technical assistance of the Government of United States, through the U.S. Country Study Program (USCSP), and the Global Environment Facility (GEF), through the United Nations Environmental Programme (UNEP).

Background Information

Venezuela is located in the northern part of South America, between 60 and 75 degrees Longitude West, 2 and 13 degrees Latitude North. It has a total land area of 916,445 km2 and is divided into 22 States and 1 Federal District. The population of the country is approximately 20 million inhabitants.

The country is characterized by three distinctive geographic regions: the Andes Mountains on the West, the Interior Plains (lowlands) on the Center, South-West and East, and the Lofty Plateau on the South. It has about 3,000 Km. of coastline, apart from insular territories and the Delta zone of the Orinoco river, with important coastal marine ecosystems, canals for navigation, recreational beaches, 52 urban centers with approximately 4,2 million inhabitants as well as fishery and industrial activities.

The capital, Caracas, is located in the central northern coastal region. This region pioneered the sprout of the industries during the 1950's as a consequence of the incentives given during those years to industrial development; therefore, most of the population and major industrial areas are located in this zone and in the basin of Lake Maracaibo (western area). The north western and north eastern regions concentrate the biggest hydrocarbon production. The oil industry represents the main source of revenues of the country. In the southern region the most important heavy industries (aluminum and steel) and the hydroelectric developments are located. Agriculture and animal husbandry is found mainly in the Llanos (eastern, central and western lowlands) and forestry in the south eastern and Guayana regions.

Although Venezuela has a relatively extensive territory and a moderate population, the concentration of populated areas and industrial activity on the central-northern coastline generates environmental problems of different nature, including air and water pollution as well as an excess of solid waste production.

In spite of the relative high deforestation rate, the country still preserves a considerable area of natural forests that act as reservoirs and sinks for the greenhouse gases: 58% of its territory is occupied by several types of forest, including a high percentage of humid tropical forest.

All these and other relevant natural and socio-economic characteristics of the country as well as the main environmental issues associated to the establishment and development of economic activities were taken into consideration in the formulation of the Country Study to Address Climate Change. This process helped to ensure that most important areas would be covered by all components of the study.

Venezuelan Case Study to Address Climate Change

A team of experts from several Venezuelan ministries and institutions are in charge of conducting this study, with the following objectives:

(i) Develop a national inventory of anthropogenic emissions by sources and removals by sinks of all greenhouse gases in accordance with the IPCC/OECD guidelines.

(ii) Predict future greenhouse gas emissions under various economic development scenarios.

(iii) Identify, analyze, and rank abatement strategies through the formulation of a national plan to mitigate greenhouse gas emissions in the country and enhance reservoirs and sinks.

(iv) Assess the potential impacts generated by sea level rise on Margarita Island and Venezuelan coastal zones and outline the possible adaptation responses.

(v) Assess the potential impacts on Venezuelan Forests due to climate change.

The study was subdivided in three different but interrelated modules:

Module I: Inventories of sources and sinks of greenhouse gas emissions

A. Energy, cement and industry
B. Agriculture, forest, land use and wastes

Module II: Mitigation (Abatement) strategies

Module III: Adaptation strategies to sea level rise and forestry.

Each Module has its own tasks and budget, under a global coordination and management by the Ministry of Environment and Renewable Natural Resources.

A study of this kind is very important for a developing country like Venezuela, whose National Plans include programs of industrial development, increase in public services and expansion of petroleum industry activities, all of which will likely increase greenhouse gas emissions, unless programs of conservation, efficient use of energy and gas control are implemented simultaneously. These development plans have also affected forest areas extensively as the establishment of a wide range of economic activities have been traditionally linked to land clearing. On the other hand, the National Government has formulated land use plans for all coastal states, at regional, sub-regional and local levels and the strategies to implement these plans. However, natural and human induced risks have to be taken into account while developing and implementing these plans. Sea level rise is one of those risks that need to be addressed in detail.

This study involves a large number of Venezuelan energy and environmental offices in a first-of-its-kind analysis, and allows local experts to gain extensive experience and training to perform similar analysis in the future and assess, with greater expertise, different climate change issues in the country.

The final project reports are intended to be released as official documents of the Government of Venezuela as a first step to implementing the guidelines set forth in the United Nations Framework Convention on Climate Change.

Venezuelan Greenhouse Gas Inventory

This document presents the results of the UNEP Project GF/4102-92-40 "Country Case Study on Sources and Sinks of Greenhouse Gases in Venezuela", which corresponds to Module I of the National Study to Address Climate Change.

Besides the analysis and estimates of 1990 greenhouse gas emissions and sinks for the country, the document provides a global picture of the main anthropogenic activities responsible for these emissions as well as a description of particular situations that could introduce additional elements in the inventory process. The gases included in this inventory are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), nitrogen oxides (NO_x), carbon monoxide (CO), and non-methane volatile organic compounds (NMVOCs). Chlorofluorocarbons are excluded as they are controlled by the Montreal Protocol.

The methodology used is based on the IPCC Draft Guidelines for National Greenhouse Gas Inventories (IPCC/OECD, 1994), which seek to ensure consistency and transparency of emission inventories developed by countries as well as to make possible comparison among nations. The analysis and results are also presented in accordance with these guidelines, following the reporting instruction tables.

Table I-1 provides a summary of greenhouse emissions by source category while Table I-2 presents a more detailed level of the emissions by gas and source in full molecular weight as well as the relative contribution of each gas to total radiative forcing based on the Global Warming Potential concept.

The document also provides specific discussions on methodologies, data used, and information sources for each category. The assumptions made to perform some of the estimates are described in the related section while all the detailed estimates are included throughout the document, in the chapter describing each category, along with summary tables.

The inventory is presented in different sections, according to the main source categories identified by the IPCC Draft Guidelines for National Greenhouse Gas Inventories. The first

TABLE I - 1
VENEZUELAN GREENHOUSE GAS EMISSIONS. 1990

SOURCES	EMISSIONS (Gg)					
	CO2	CH4	N2O	NOX	CO	NMVOCs
NATIONAL EMISSIONS	**190618**	**3178**	**4.60**	**400**	**4285**	**260**
ENERGY SECTOR	**107289**	**1838**	**0.64**	**339**	**1878**	**260**
COMBUSTION (*)	105931	12	0.64	339	1878	250
STATIONARY SOURCES	-	2	0.22	143	49	-
MOBILE SOURCES	-	10	0.42	197	1830	250
FUGITIVES	1358	1826	-	-	-	-
OIL & NATURAL GAS	1358	1823	-	-	-	-
COAL MINING	-	04.3	-	-	-	-
INDUSTRIAL PROCESSES	**2867**	-	-	-	-	-
AGRICULTURE	-	**961**	**2.88**	**22**	**1027**	-
DOMESTIC ANIMALS		853	-	-	-	-
RICE CULTIVATION		67	-	-	-	-
SAVANNA BURNING		31	0.39	14	821	-
AGRICULTURAL WASTE BURNING		10	0.23	8	206	-
AGRICULTURAL SOILS		-	2.26	-	-	-
LAND USE CHANGE & FORESTRY	**80462**	**158**	**1.08**	**39**	**1380**	-
FOREST CLEARING	84790	158	1.08	39	1380	-
MANAGED FOREST	(5530)	-	-	-	-	
GRANLAND CONVERTION	1202					
WASTE	-	221	-	-	-	-

(*) Estimate based on Top - Down methodology.
NOTE : Totals may not add due to rounding.

TABLE I - 2
CUMULATIVE CLIMATE EFFECT OF GREENHOUSE GAS EMISSIONS. 1990

GASES	EMISSIONS (Gg) FULL MOLECULAR WEIGHT	GWP (1) 100 year Horizon	RELATIVE CONTRIBUTION (%)
CARBON DIOXIDE (CO2)	**190618**	1	**70.6**
COMBUSTION (*)	105931		39.2
FUGITIVES	1358		0.5
INDUSTRIAL PROCESSES	2867		1.1
LAND USE CHANGE & FORESTRY	80462		29.8
METHANE (CH4)	**3178**	24.6	**28.8**
COMBUSTION	12		0.1
FUGITIVES	1826		16.6
AGRICULTURE	961		8.7
LAND USE CHANGE & FORESTRY	158		1.4
WASTE	221		2.0
NITROUS OXIDE (N2O)	**4.60**	320	**0.5**
COMBUSTION	0.64		0.1
AGRICULTURE	2.88		0.3
LAND USE CHANGE & FORESTRY	1.08		0.1
TOTAL			100

(1) Direct and inderect effects - IPCC, 1994, Table 5.
(*) Estimate based on Top - Down methodology
NOTE : Totals may not add due to rounding.

one corresponds to emissions from the energy sector, subdivided in emissions from combustion, which provides an analysis of carbon dioxide and other gases separately, and from fugitive emissions, which includes oil and gas industry and coal mining.

The second section covers emissions from agriculture and includes domestic animals and manure management, rice cultivation, savanna burning, agricultural residue burning, and agricultural soil management (fertilizer use).

The third section deals with emissions from land-use change and forestry. This provides emission estimates from land clearing, carbon fluxes from forestry management, and carbon dioxide emissions from conversion of grasslands to cultivated lands.

The last section covers emissions from wastes, subdivided in landfills and wastewater treatment.

A section on industrial processes was not included in this report as only emissions from cement production were evaluated. However, the related emissions are accounted for in the national inventory. On the other hand, emissions from solvent use were not considered since not all the required data were available.

An information system (INVENE) was developed to manage and process all the information related to greenhouse gas emission inventories in order to ensure a practical and reliable process of data and calculation updating. Annex 1 presents a general description of the system and all inventory results tables. The first section (MENU A3) contains the tables in accordance with Reporting Instructions, IPCC/OECD, 1994, vol.1.

It is necessary to make emphasis on the fact that this document provides a **preliminary** national greenhouse gas emission inventory for 1990. Although fairly reliable, the inventory can be validated and updated as new data are identified or additional information is provided by local studies and on-going researches. The preliminary character of the inventory should be kept in mind not to justify errors or possible inconsistencies in the emission estimates from any source, but rather to stress out the fact that the emission inventory is based on a dynamic process, which intents to continuously improve the estimates as better data become available and as new guidance on the methodology approach is provided by the IPCC. In any case, this inventory represents a significant step in providing a comprehensive picture of the country's greenhouse gas emissions, despite its weaknesses and limitations, and constitutes a powerful tool to evaluate and plan the best mitigation strategies that the country could implement to reduce its emissions levels.

The overview INVENE/TABLE 7-A in Annex 1 summarize the assesment of completness and quality of major source/sink inventory estimates. It gives a brief overview of the categories taken into account in the emissions inventory, as well as the level of documentation and dissaggregation of the categories.

Unfortunately, the uncertainties associated with the emissions estimates were not quantified due to the limited available information and the difficulty on identifying the level of the reliability for most of the data used in the inventory. Besides limitations associated with the methodology, the poor quality in some of the data is likely responsible for the uncertainties of the results. A special effort will need to be made in the near future to solve this crucial issue and estimate emissions with greater levels of consistency and precision.

In the case of the energy sector, in-depth studies have been already initiated for the main carbon dioxide emission sources, namely electricity generation, manufacture industry, and transport, with the objective of improving the inventory and identifying the areas where more effort should be put on in the implementation of mitigation actions. Similarly, as land use-change represents a significant source of carbon dioxide emissions, an initiative is already underway to generate better data on deforestation rates that will result in a more reliable emission inventory.

Methane emissions estimates could also be improved if more accurate data is generated, especially on fugitive emissiions at the oil and gas industry. A project will be formulated shortly to address this issue in conjunction with the Venezuelan oil industry. Another area that would require a more detailed analysis relates to savanna burning, as the basic data needed to perform greenhouse emission estimates could be greatly improved.
All these iniciatives, developed within the framework of the Country Study to Address Climate Change, would contribute to both perform a more reliable greenhouse gas emission inventory and outline the national strategies to reduce or mitigate greenhouse gas emissions in the country.

II.ENERGY SECTOR

The energy sector is the most important source of greenhouse gases at a global level. Emissions of these gases are mainly generated by the use of energy as fuel and by fugitive emissions from oil, gas and coal production.

In Venezuela, the energy sector's activities generate most of the GHG emissions. In 1990, the energy sector emitted 107,289 Gg of carbon dioxide and 1,838 Gg of methane, which represented 56% and 58% of the national emissions of these gases, respectively. The contribution of this sector to the total emissions of other GHG gases is also very important: Carbon monoxide, 46%; nitrous oxide, 15%; nitrogen oxides, 94%; and NMVOCs, 100%. Table II-1 shows the emission estimates of the different GHG in the energy sector; it can be noted that combustion is the main emission source of all gases except for methane, which is primarily originated by fugitive emissions from the petroleum and natural gas production systems.

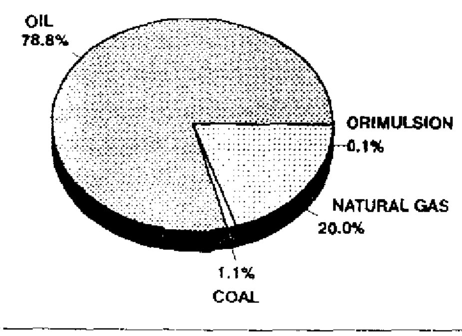
TABLE II - 1
EMISSIONS FROM ENERGY SECTOR

SOURCES	EMISSIONS (Gg)					
	CO2	CH4	N2O	NOX	CO	NMVOCs
NATIONAL EMISSIONS	190618	3178	4.60	400	4285	250
EMISSIONS ENERGY SECTOR	107289	1838	0.64	339	1878	250
COMBUSTION	(*)105931	12	0.64	339	1878	250
STATIONARY	-	2	0.22	143	49	-
MOBILE SOURCES	-	10	0.42	197	1830	250
FUGITIVE EMISSIONS	1358	-	-	-	-	-
OIL AND NATURAL GAS SYSTEM	1358	1823	-	-	-	-
COAL MINING	-	0.4 - 3	-	-	-	-

(*) Estimate based on Top - Down methodology
NOTE : Totals may not add due to rounding

The production of primary energy in Venezuela in 1990, was 6,828 Petajoules (Pj); 92.7% of this production corresponded to fossil fuel, mainly oil (78.8%) followed by natural gas (20%), as shown in Figure II-1.

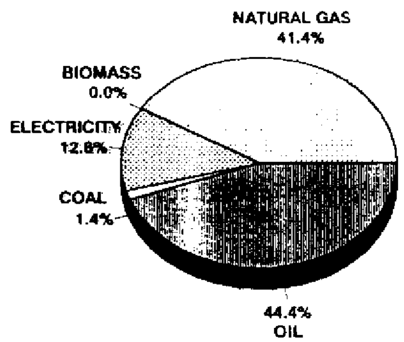
FIGURE II-1
FOSSIL FUEL PRODUCTION
(6329 PJ)



Almost 57% of oil production was exported while the rest was processed in national refineries, which produced 2,269 Pj of oil products; of this total, 62.8% was also exported. Internal consumption of these products was nearly 700 Pj; 12.7% of this amount was used for electricity generation while the rest was distributed among different consumption sectors, mainly the transportation sector.

The net production of natural gas was 1,264 Pj, which was basically used to obtain 938 Pj of dry gas and 173 Pj of liquid hydrocarbons; the rest of the production, approximately 12%, was released into the atmosphere during petroleum production operations. Dry gas was used to generate electricity (24%) and to cover national consumption demand, especially from the manufacture industry and the energy sector itself.

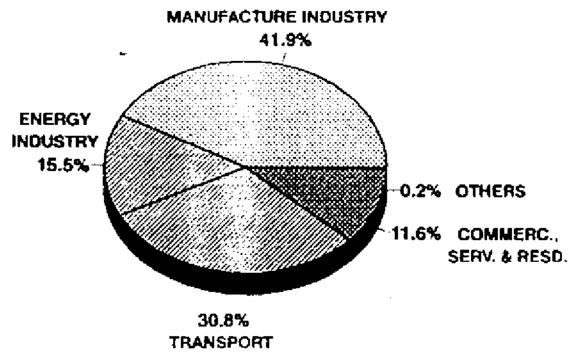
FIGURE II-2
FINAL ENERGY CONSUMPTION BY FUEL.
(1365 PJ)



Coal production in Venezuela is irrelevant, despite the fact that it has increased considerably since 1988. In 1990, coal production reached 67 Pj, which was mainly exported (83.8%). Internal consumption was limited to some uses in the manufacture industry, mainly the basic metallic industries.

Venezuela has 18 GW of power generation capacity, 58% corresponds to hydroelectrical plants. In 1990, 59.3 TWh of electricity was produced, 22.3 TWh of this came from thermoelectrical plants, that required 319 Pj of fossil fuel.

FIGURE II-3
FINAL ENERGY CONSUMPTION BY SECTOR
(1365 PJ)



In 1990, final energy consumption, including the consumption of the energy sector itself, was 1365 Pj, distributed by type of energy and sectors as shown on Figures II-2 and II-3.

Annex 1 presents all inventory tables of INVENE system which contain data, detailed calculations and emission results. Energy sector information is contained in MENU A1. INVENE/TABLES D1-1, D1-2 show summary of energy results by Top-Down methodology and INVENE TABLES C3-1, C3-2 those related to Bottom-Up approach.

II.1 EMISSIONS FROM COMBUSTION

The use of fossil fuels constitutes the main anthropogenic source of greenhouse gases. Within this, carbon dioxide is the most important contributor; emissions of this gas occurs during the combustion process, when the carbon contained in the fuel is combined with oxygen.

Because combustion is not always complete, a small quantity of this carbon is emitted as carbon monoxide, methane, and some heavier volatile hydrocarbons. These gases are then oxidized to carbon dioxide in the atmosphere in a period of time than can range from a few days to ten years.

Additionally, the oxidation of the nitrogen contained in fuels produces the formation of nitrous oxide and nitrogen oxides; emissions of the latter are closely linked to the air-fuel relation, combustion temperatures, and equipment control mechanisms. The formation of nitrous oxides is not yet well understood.

The level of reliability associated to the emission estimates varies between carbon dioxide and the rest of the gases. The former can be calculated with greater precision as the emission factors only depend on the carbon content of the fuel, the amount of fuel used and the oxidized fraction. Coal contains the greatest quantity of carbon, while crude oil and natural gas contain 25% and 50% less than coal, respectively.

Carbon dioxide emission estimates from combustion were based on the two methodologies proposed by IPCC: Top-Down and Bottom-Up (IPCC/OECD, 1994, vol.3). Top-down approach is based on apparent consumption of the different types of primary fuels, and is used to generate total CO2 emissions from combustion. The Bottom-Up method, allows the estimation of emissions by sectors, based on final fuel consumption data. Theoretically, the application of these two alternative methods should make no difference in a country's total CO2 emission estimate, since the amount of fuel consumed, and hence the amount of carbon oxidized, should be the same in both approaches.

However, it is important to note that the venezuelan inventory shows a 20% difference between CO2 emission results obtained by both methodologies, originated by the fact that apparent consumption for Top-Down,is 25% higher than the corresponding figure for the Bottom-Up (Table II-2).

This situation is basically explained by two factors: on one hand, apparent consumption is calculated based on the primary energy production which, in the national energy balance, includes losses and statistical adjustments (Table II-3). These items are not considered in the Bottom-Up since, as it was above mentioned, this method is based on final fuel consumption of the different economic sectors. On the other hand, the use of different data sources for feedstocks and electricity autogeneration, may also contribute to increase the difference between consumption data used by both methods.

TABLE II - 2
ENERGY SECTOR - CO2 EMISSIONS
COMPARISON " TOP - DOWN " - "BOTTOM - UP "

ACTIVITY	"TOP - DOWN" (1)	BOTTOM - UP " (2)	DIFFERENCE TD VS BU (%)
FUEL CONSUMPTION (Tj)	1779461	1342239	24.6
CO2 EMISSIONS (Gg)	105931	84453	20.3

NOTE : Totals may not equal sum of components due to independent rounding.

TABLE II - 3
NATIONAL ENERGY BALANCE
LOSSES AND ADJUSTMENTS

ACTIVITY	(Tj)
LOSSES	178593
* CRUDE OIL TRANSP. & DISTRIB.	7214
* REFINING	150524
* MARACAIBO CITY'S NETWORK	20855
STATISTICS ADJUSTMENTS	282466

The venezuelan energy balance is being studied in depth, in order to determine where consumption or losses exactly occur and the implications on CO2 emissions. Annex 2 presents a detailed explanation and analysis of Top-Down and Bottom-Up methodologies.

For this report, total CO2 emissions from the energy sector mentioned up to this point, are refered to the results obtained by Top-Down (Tables S-1, S-2, I-1, I-2 and II-1). In next sections the total combustion figures are related to the sum of CO2 sectorial emissions based on Bottom-Up. Each Figure and Table has the explanation notes.

The emission estimates of the non-CO2 trace gases are less reliable since they are originated by incomplete combustion. Related emission factors depend on the type of fuel, the technology used, the size and age of the equipment, the operation temperature, the combustion efficiency, the emission control technology, as well as the maintenance and operating conditions.

TABLE II - 4
ENERGY SECTOR - COMBUSTION SUMMARY

SOURCES	EMISSIONS (Gg)					
	CO2	CH4	N2O	NOX	CO	NMVOCs
FUEL COMBUSTION	84453	12.02	0.642	339.3	1878.6	250
MOBILES	29164	9.79	0.415	196.6	1830.0	250
TRANSPORT	29164	9.79	0.415	196.6	1830.0	250
STATIONARIES	51560	2.23	0.226	142.7	48.6	NA
ENERGY & TRANSF.INDUSTRIES	30516	1.65	0.101	83.1	10.9	N.A
MANUFACTURE INDUSTRY	16775	0.44	0.077	56.1	27.9	N.A
COMMERCIAL & SERVICES	572	0.01	0.037	0.5	0.1	N.A
RESIDENTIAL	3678	0.13	0.011	2.9	9.0	N.A
OTHERS	19	0.01	0.000	0.1	0.7	N.A
CARBON NON-SEQ IN NON-ENERGY PRODUCTS (*)	3729	-	-	-	-	-

(*) Fraction oxidized from non - energy products (lubricants, fertilizer, etc). More details provided in Annex 2.

NOTE:

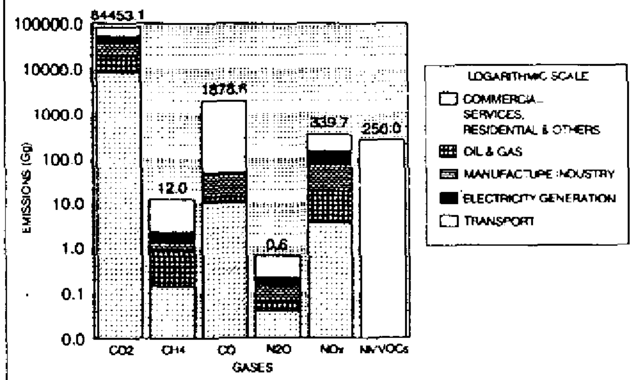
(1) It is important to clarify that these CO2 emissions are different from those in Table II-1. The differences are due to the estimation methodologies, sectorial CO2 emissions of this Table were estimated using BOTTOM - UP; while for total CO2 emissions in Table II-1 TOP - DOWN was used. More detail is explained in Annex 2

(2) Totals may not add due to rounding

In 1990, Venezuela consumed 1,508 Pj of fossil fuel; 793 Pj corresponded to gas consumption and 696 Pj to crude oil and oil products. The related emissions, originated by combustion, are shown on Table II-4, and have been classified, according to their origin, in stationaries and mobiles. Stationary sources include all industrial activities and the residential, commercial, service and other sectors, while mobile sources refer to transportation activities.

A more detailed analysis is made below for each specific area, in two separated sections for CO2 and other gases. Figure II-4 shows each gas emissions by source; a logarithmic scale was used due to the existance of considerable differences among the emission figures of the different gases. CO2 contributes with the largest proportion of all emissions.

FIGURE II-4
EMISSIONS FROM ENERGY COMBUSTION BY SECTOR

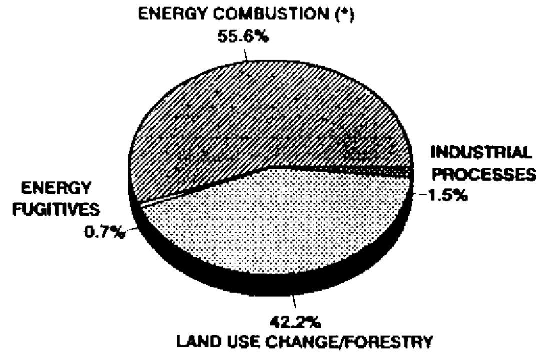


(*) Estimates based on Bottom-Up methodology

II.1.1 CARBON DIOXIDE EMISSIONS

Carbon dioxide contributes to nearly one third of the natural greenhouse effect. A continuous increase of its concentration in the atmosphere, produced by antropoghenic activities, has been observed from the beginning of the industrial period, at a global level. Since then, concentrations of carbon dioxide have increased by more than 25%, mainly due to the use of fossil fuel.

FIGURE II-5
CO2 NATIONAL EMISSIONS
(190618 Gg)



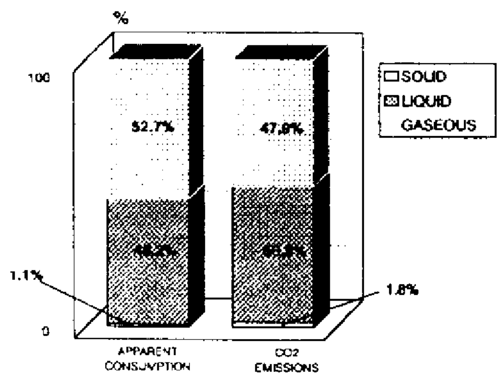
(*) Estimates based on Top-Down methodology

Venezuela generated 190,618 Gg of carbon dioxide in 1990 . The most important source was energy combustion, which contributed with 105,931 Gg, or 56% of the total CO2 emissions (Figure II-5). The amount mentioned above correspond to estimates obtained from the application of the Top-Down Method.

The emission factors for the different fuels used are those recommended by the IPCC (IPCC/OECD 1994, vol. 2). The differences between these and the national factors (INTEVEP,1994) are negligible, except for natural gas, due to variations found on its composition.

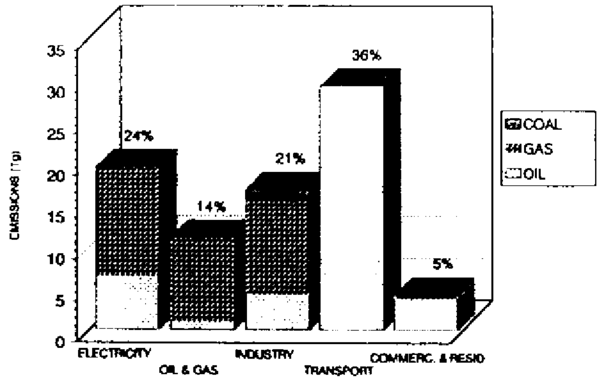
Regarding the degree of oxidation, it is necessary to note that not all carbon is oxidized to CO2 when a fuel is burned, due to inefficiencies of the process. Consequently, some carbon is not affected by burning or remain as ashes. In accordance to IPCC recommendations, the following non-oxidized fractions were used: 2% for solid fuels, 1% for liquid fuels, and 0.5% for gases. Additionally, it is important to mention that not all the fuels provided to industrial processes are burned. In some industries, such as petrochemical and others, they are used as feedstocks to produce different goods.

FIGURE II-6
CO2 EMISSIONS FROM COMBUSTION
TOP-DOWN METHODOLOGY



In some of these cases, such as fertilizers, lubricants, and detergents, the carbon contained in the fuels is rapidly oxidized, when exposed to the air. In other cases, on the contrary, the carbon is sequestered by the product for hundreds of years, such as plastics, rubber, formaldehyde, and asphalt. The CO2 emission values initially obtained must be adjusted for the amount of sequestered carbon.

FIGURE II-7
CO2 EMISSIONS FROM ENERGY COMBUSTION
BY SECTOR AND ENERGY SOURCES



(*) Estimates based on Bottom-Up methodology

Carbon dioxide emissions produced by the energy sector are mainly caused by the use of oil and natural gas , according to Top-Down method. The former generated 53,313 Gg in 1990 while emissions from natural gas were estimated to be 50,742 Gg, which represented 50% and 48%, respectively (Figure II-6). Emissions from coal represented only 2%, as coal consumption in the country is very low. Figure II-6 also shows an opposite relation in the composition of apparent consumption between both sources, oil 46% and natural gas 53%, due to the differences in carbon content in the fuels.

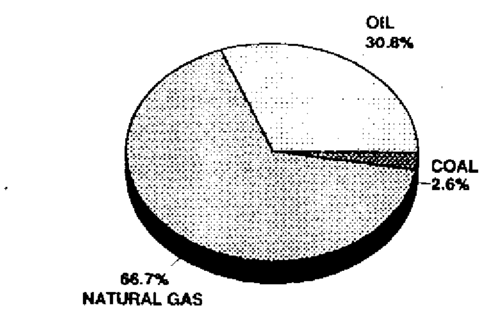
The emission estimates of carbon dioxide by sectors were based on the Bottom-Up methodology. As shown in Figure II-7, the larger amount of the emissions comes from the transportation sector (36%) and energy industry (38%): 24% from electricity generation and 14% from oil and gas industry. Unlike the other gases, the emissions of carbon dioxide are distributed more evenly among the different origin sources, as can be observed in Figure II-4.

All of the emissions generated by transportation are due to the use of oil products while in both the energy sector itself and the manufacture industry, the emissions are mainly related to the use of gas, with 75% and 63% , respectively.

Stationary Sources

In 1990, stationary sources emitted 51,560 Gg of carbon dioxide, mainly from the natural gas (67%) and oil (31%) (Figure II-8).

FIGURE II-8
CO2 EMISSIONS FROM STATIONARY SOURCES
BY FUEL
(51560 Gg)

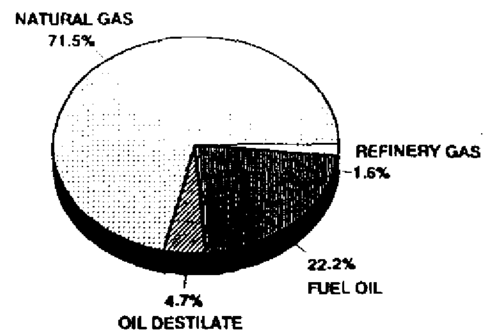


(*) Estimates based on Bottom-Up methodology

The energy consumption data, disaggregated by activity, were obtained from the following sources: the National Energy Balance (MEM 1990), the Energy Survey of the Manufacture Industry (OCEI/MEM, 1990), PDVSA and the electrical industry.

The largest amount of emissions within the stationary sources corresponds to the energy industry, which generated 30,516 Gg in 1990. The sources of emissions in this industry are basically related to power generation (19,519 Gg) and oil and gas production (10997 Gg).

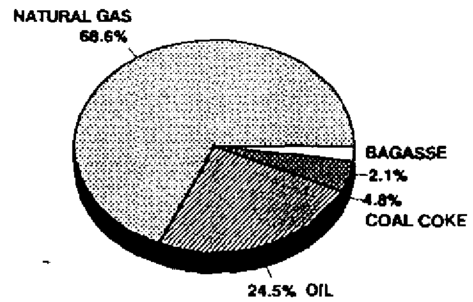
FIGURE II-9
ELECTRICITY GENERATION FUEL CONSUMPTION
(319 Pj)



(*) Estimates based on Bottom-Up methodology

Electricity plants consumed 319 Pj of fuel , distributed as shown in Figure II-9. In the case of the oil and gas industry, 192 Pj of fuel were used, mainly natural gas (92%). As a result, most of the emissions from these industries come from natural gas and distillates, although in the case of electrical plants, 22% corresponds to fuel oil.

FIGURE II-10
MANUFACTURE INDUSTRY FUEL CONSUMPTION
(290 PJ)



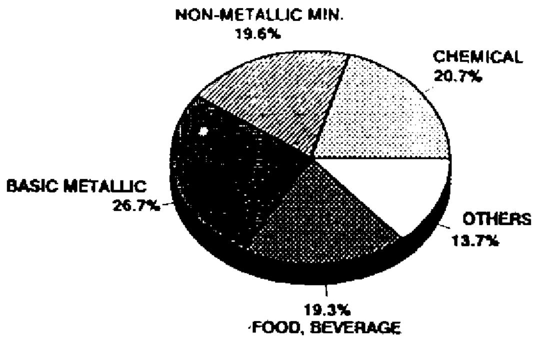
The second most important source is the manufacture industry, which generates 16,775 Gg of carbon dioxide; similarly to the energy industry, most of the emissions come from the use of natural gas (66%) and oil products (25%). The emission estimate is based on the amount of fuel, 290 Pj, burned by the manufacture industry in 1990. Figure II-10 shows the distribution of fuels by type. Fuel used for transportation (11 Pj) was not included for emissions estimate in this sector but within the mobile sources.

This industry also consumes an important amount of fuels (180 Pj) that is used as feedstocks in the production processes (150 Pj) and non energy uses (30 Pj); most part of the carbon contained is not released, such as in combustion, but remains sequestered in the products. In this case, the non-sequestered amount was estimated, in order to make the necessary adjustments in the results of the Top-Down method. This result is not included in the total emissions from stationary sources, as it is not considered by the IPCC methodology.

The emission estimates for the industrial sector were made for categories of two digits in accordance to the International Standard Industrial Classification of All Economic Activities (ISIC). Additionally, each category was considered separately for the following energy uses: steam generation, direct heat and other uses.

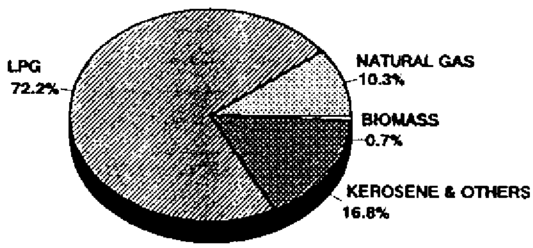
The industrial categories that produce the largest quantities of emissions are basic metallic (ISIC 37), food processing, beverages and tobacco (31), chemicals (35), and non-metallic mineral industries (36), which all together generate 87% of the emissions from the manufacture sector (Figure II-11). Most emissions from the use of energy comes from steam generation (41%) and direct heat (44%), the rest corresponds to engines, refrigeration, and others.

FIGURE II-11
CO2 EMISSIONS FROM MANUFACTURE INDUSTRY.
(16775 Gg)



The residential sector generated 3,678 Gg of carbon dioxide while the commercial and service sectors emitted 572 Gg. Petroleum is the main emitter, followed by natural gas. In 1990, these sectors consumed 68 Pj and, as can be seen in Figure II-12, the most commonly used fuels are natural gas and LPG, which are most frequently used for cooking. Kerosene, mainly used in rural areas, has also a relatively important participation (17%).

FIGURE II-12
COMMERCIAL / SERVICES & RESIDENTIAL SECTORS
FUEL CONSUMPTION
(68 PJ)



The energy data were based on the 1990 National Energy Balance, but some estimates on the consumption of natural gas and LPG had to be done, as the Balance does not discriminate them by sectors. It was asumed that 70% of the domestic natural gas and 90% of LPG are used by the residential sector and the rest by the commercial and service sectors. Figure II-7 (page 14) presents the emission estimates for these sectors by type of fuel. MENU D2 (Annex1) contains all data, calculations and emission results of stationary sources.

Mobile Sources

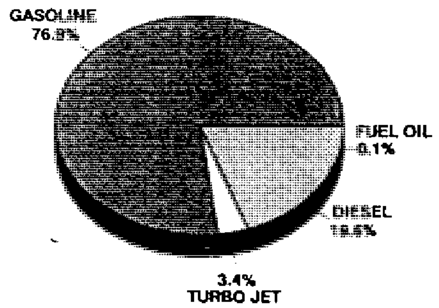
Carbon dioxide emissions from mobile sources were estimated to be 29,164 Gg (Table II-5). According to the IPCC methodology (IPCC/OECD, 1994, vol. 3) CO_2 emissions from bunkers (3,793 Gg) should not be taken into account in the fuel origin country, hence the mobile sources estimates consider only national emissions. Gasoline is the most important emitter, with 21,760 Gg (77%), as shown in Figure II-13.

TABLE II - 5
CO2 EMISSIONS FROM MOBILE SOURCES

SOURCES	CO2 (Gg)
TOTAL TRANSPORTATION	29164
NATIONAL	29164
AIR TRANSPORTATION	1025
ROAD VEHICLES	27306
RAILWAYS	5
NAVIGATION	26
INDUSTRIAL USES	802
INTERNATIONAL (BUNKERS)	3793

NOTE : Totals may not equal sum of components due to independent rounding.

FIGURE II-13
CO2 EMISSIONS FROM MOBILE SOURCES BY FUEL
(29164 Gg)

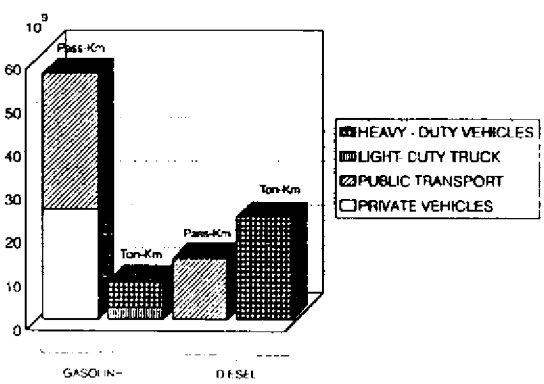


(*) Estimates based on Bottom-Up methodology

The 1990 data used to estimate emissions from road transport were taken from MEM-RISO,1993. These data show some deficiencies due to the limited available information, as the country lacks reliable and updated national automotive fleet statistics. The emission calculation was based on a total of 2.3 millions units; this figure and the fleet characteristics were estimated with difficulty. The calculations were based on assumptions and estimates of: number of vehicles by type, fuel consumption, Km-lt specifications, average milage, passengers-Km, and freight-Km. The primary sources are: MEM, 1990; PULIDO,1992 and INTEVEP, 1994.

Figures II-14 contains demand estimates of passenger transportation(PASS-KM) and freight (TN-KM), by type of vehicle and fuel used. Figure II-15 shows fuel consumption estimates for road transportation (392.9 Pj) by type of vehicle, where private vehicles consumed the largest amount of fuel (39%). It is important to note that the results obtained for public transport consumptions seem to be low,

FIGURE II-14
TRANSPORT DEMAND BY VEHICLE TYPE



considering that big cities have high densities of vehicules and low fuel use efficiency, mainly due to the fleet age, poor maintenance, and high traffic volume. The reliability of emission estimates depends on the quality of this information.

Emissions from national transportation are mostly generated by road transportation, 27,306 Gg (96%), whose disaggregation by type of fuel and vehicle is shown in Figure II-16. The emissions originated by private vehicles are the most important within this sector, with 10,593 Gg of carbon dioxide in 1990, which represented 39% of the total road transport emissions, followed by heavy duty trucks, with 27%. Emissions from public transportation are the least significant, as only contributed with 14.4%, 3,932 Gg; this amount also seems to be low when considering the primary data problems mentioned above. MENU D3 (Annex1) contains all data, calculations and emission results of mobile sources.

FIGURE II-15
FUEL CONSUMPTION BY VEHICLE TYPE

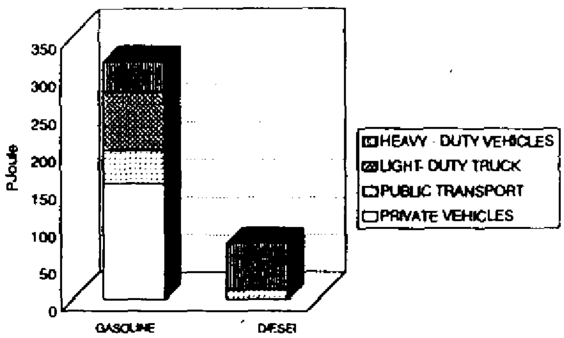
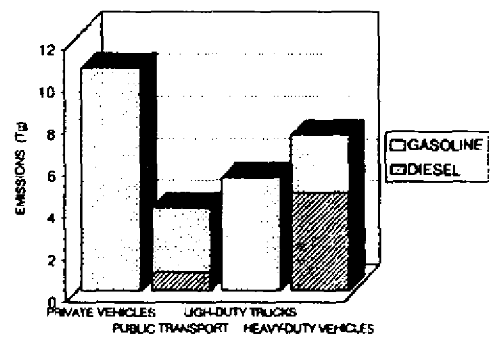


FIGURE II-16
CO2 EMISSIONS FROM ROAD TRANSPORTATION

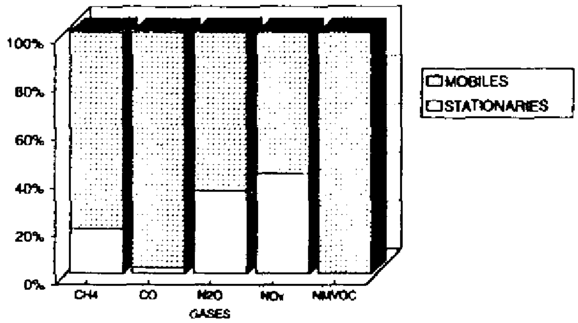


(*) Estimates based on Bottom-Up methodology

II.1.2 EMISSIONS OF OTHER GASES

The other greenhouse gases generated by energy consumption are methane, nitrous oxide, and the photochemical gases from incomplete combustion, such as nitrogen oxides, carbon monoxide and NMVOC.

FIGURE II-17
OTHER GASES EMISSIONS FROM COMBUSTION



Emissions of these gases vary according to the type of activity where the combustion occurs, and basically depend on the type of fuel, technology, size and age of the equipment, pollution control, maintenance, and operating conditions.

Emissions of these greenhouse gases are calculated separately for stationary sources and mobile sources. Figure II-17 shows that the latter are responsible for most of the emissions.

Stationary Sources

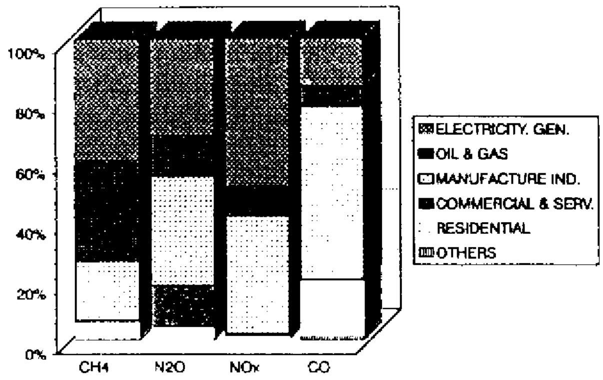
TABLE II - 6
OTHER GASES EMISSIONS FROM STATIONARY SOURCES

SOURCES	EMISSIONS (Gg)			
	CH4	N2O	NOX	CO
NATIONAL EMISSIONS	3178.00	4.60	400.00	4285.00
COMBUSTION	12.02	0.64	339.24	1878.48
STATIONARY SOURCES EMISSIONS	2.23	0.23	142.33	48.6
ENERGY & TRANSFORMATION INDUSTRIES	1.65	0.10	83.14	10.9
ELECTRICITY GENERATION	0.91	0.07	68.87	7.67
OIL AND GAS	0.74	0.03	14.28	3.23
MANUFACTURE INDUSTRY	0.44	0.08	56.10	27.87
FOOD, BEVERAGE AND TOBACCO	0.09	0.02	5.69	10.69
CHEMICAL AND COAL	0.12	0.01	4.10	0.93
NON - METALLIC MINERALS	0.06	0.02	42.49	3.98
BASIC METALLIC	0.10	0.03	1.45	10.32
OTHERS	0.00	0.01	2.37	1.95
COMMERCIAL & SERVICES	0.01	0.04	0.46	0.11
RESIDENTIAL	0.13	0.01	2.53	9.00
OTHERS	0.01	0.00	0.10	0.72

NOTE : Totals may not add due to rounding.

Table II-6 presents the emission estimates from stationary combustion for the different gases by source while their distribution in percentage can be seen in Figure II-18. In general, the main source of emission is the energy industry (electricity generation and petroleum and gas industry) followed by the manufacture industry.

FIGURE II-18
OTHER GASES EMISSIONS FROM STATIONARY SOURCES



Stationary combustion is an important source of nitrogen oxides; in 1990, emissions from this source represented 36% of the national emissions of nitrogen oxides. However, the contribution of this source to the rest of the gases in not significant.

Electricity Generation

Electricity generation is the most important source of emissions within the stationary combustion activities as it represents 41% of methane, 50% of nitrous oxide, 48% of nitrogen oxides, and 16% of carbon monoxide of the gases generated by the stationary sources.

TABLE II - 7
EMISSIONS FROM ELECTRY GENERATION

SOURCES	FUEL CONSUMPTION (PJ)	EMISSIONS (Gg)			
		CH4	N2O	NOx	CO
TOTAL ELECTRICITY GENERATION	**319**	**0.91**	**0.07**	**68.87**	**7.68**
BY PLANTS					
STEAM PLANTS	174	0.06	0.05	41.65	3.04
GAS PLANTS	145	0.85	0.02	27.22	4.64
BY FUELS					
NATURAL GAS	228	0.72	0.02	51.35	5.94
OIL	86	0.15	0.05	16.57	1.60
REFINERY GAS	5	0.03	0.00	0.95	0.16

NOTE : Totals may not add due to rounding.

As mentioned above, electricity geneneration plants used 319 Pj of fossil fuel; 77% was used in public plants while the rest in autogeneration by the petroleum sector and the manufacture industry. Public electricity generation was mainly performed in steam plants, and, in smaller proportion, in gas turbines simple cycle.

The emission estimates from electricity generation by type of plant and fuel used are presented in Table II-7. Steam plants generate most of the emissions of nitrogen oxides (61%) and nitrous oxide (71%) while gas plants have a greater contribution to methane

(93%) and carbon monoxide (60%) emissions. Regarding distribution by fuel type, natural gas contributes with most of the emissions of all gases, except for nitrous oxide, whose emissions are mainly generated by oil products (71%).

The data used for the emission estimates are based on the information provided by MEM, 1990 regarding electrical plants, which was disaggregated by type of plant according to the information obtained from OPSIS, 1994. The data on electricity autogeneration were adjusted with the information used by MEM-RISO, 1993. Due to the lack of all necessary information on the characteristics of autogeneration plants, it was assumed that gas turbines are used, although it is known that the manufacture industry also utilizes steam plants. The emission factors used are provided by Table 1-7 of the IPCC/OECD, 1994, Vol 3.

Petroleum and Gas

The petroleum and gas industry used 192 Pj of fuel in 1990, mainly natural gas (92%). For this sector disaggregated information on fuel uses is not available, estimations were made based on general emission factors provided by Table 1-17 and 1-18 of the IPCC/OECD, 1994, Vol 3.

Information on the areas of operation and refineries are being collected in order to obtain a more reliable estimate of the emissions from this source.

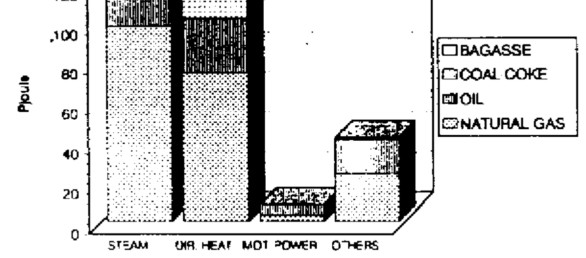
Manufacture Industry

The manufacture industry is the main source of carbon monoxide (74%) and the second most important source of emissions of the other gases originated by stationary combustion (Figure II-18).

As mentioned earlier, the manufacture industry consumed 290 Pj as fuel in 1990; Figures II-19 and II-20 present its distribution by fuel type, industry category, and energy uses. The industries with the highest fuel consumption are basic metallic, chemical, non-metallic mineral, and food, beverage, and tobacco industries.

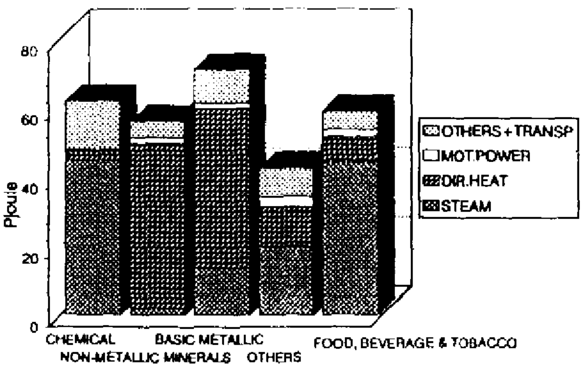
Fuel consumed by the manufacture industry is mainly dedicated to steam generation and direct heat, other uses include engines, refrigeration, air conditioning, and transport. More than 70% of steam generation is found in the food, beverage and tobacco industry and the chemical industry, while the use

FIGURE II-19
MANUFACTURE INDUSTRY FUEL CONSUMPTION BY FUELS AND USES



of direct heat is concentrated in the basic metallic and non-metallic mineral industries.

FIGURE II-20
MANUFACTURE INDUSTRY FUEL CONSUMPTION
BY USES AND BRANCH



The information sources for energy consumption were the same as the ones used for CO2 emission estimates. It is important to notice that the emission factors provided by IPCC/OECD, 1994, Vol 3 in Tables 1-8 and 1-9, are not sufficiently disaggregated to perform emission estimates with the same levels of details (industry categories and energy use) available for CO2 calculations; and consequently, it was necessary to make some adjustments, not all adequate. Other sources of information will need to be identified in order to develop some national factors, especially for those industries that generate important amounts of emissions.

Emission estimates from the manufacture industry. are presented in Table II-8, the

TABLE II - 8
EMISSIONS FROM MANUFACTURE INDUSTRY

SOURCES	FUEL CONSUMPTION (PJ)	EMISSIONS (Gg)			
		CH4	N2O	NOX	CO
TOTAL MANUFACTURE INDUSTRY	**278**	**0.44**	**0.08**	**56.10**	**27.87**
BY BRANCH					
(31) FOOD, BEVERAGE AND TOBACCO	57	0.09	0.02	5.69	0.69
(32) TEXTILE, CLOTHING AND LEATHER	10	0.02	0.00	0.79	0.15
(33) WOOD INDUSTRIES	1	0.00	0.00	0.09	0.01
(34) PULP AND PAPER	14	0.02	0.00	0.93	0.21
(35) CHEMICAL AND COAL	61	0.12	0.01	4.1	0.93
(36) NON-METALLIC MINERAL	52	0.06	0.02	42.49	3.98
(37) BASIC METALLIC	70	0.10	0.03	1.45	10.32
(38) MACHENERY, EQUIPMENTS & METALLIC	13	0.02	0.00	0.53	1.57
(39) OTHER INDUSTRIES	0	0.00	0.00	0.03	0.00
BY FUELS					
NATURAL GAS	199	0.32	0.02	40.44	12.1
OIL	60	0.10	0.04	14.93	2.92
COAL COKE	14	0.02	0.02	0.21	2.91
BAGASSE	6	0.00	0.00	0.51	9.94
BY USES					
STEAM	124	0.20	0.02	10.52	10.46
DIREC HEAT	116	0.12	0.04	43.62	15.37
OTHER USES	39	0.12	0.01	1.97	2.05

NOTE : Totals may not add due to rounding.

industrial categories with the highest emissions are also those with the highest energy consumption, mentioned earlier. These categories all together emit more than 80% of the total emissions of each gas (Figure II-21).

Figure II-22 shows the distribution of emissions by fuel. Natural gas emits most of the methane and nitrogen oxides while oil products, coal, and coke are responsible for most nitrous oxide emissions. Natural gas and bagasse are the main contributors to carbon monoxide emissions.

Emissions by energy uses can be seen in Figure II-23. Direct heat is the most important source of nitrogen oxides, nitrous oxides, and carbon monoxide, while steam generation is largely responsible for methane emissions.

Commercial and Services, Residential, and Others.

The contribution of commercial and services, residential and other sectors to GHG emissions from stationary sources is very limited, except for nitrous oxide as 17% of this gas is generated by these sectors (Figure II-18). Their influence is rather indirect since they have high electricity consumption and, as mentioned earlier, electricity generation is the most important source of emissions from stationary combustion. Fuels that are mostly used in these sectors are LPG and natural gas, followed by kerosene, other

FIGURE II-21
EMISSIONS FROM MANUFACTURE INDUSTRY BY BRANCHS

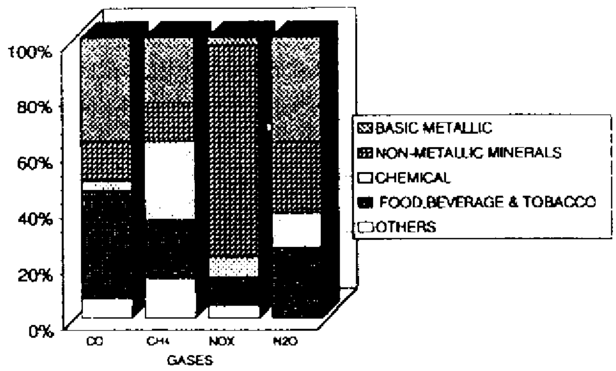


FIGURE II-22
EMISSIONS FROM MANUFACTURE INDUSTRY BY FUELS

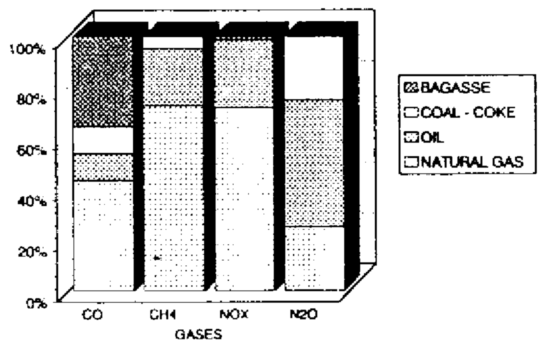
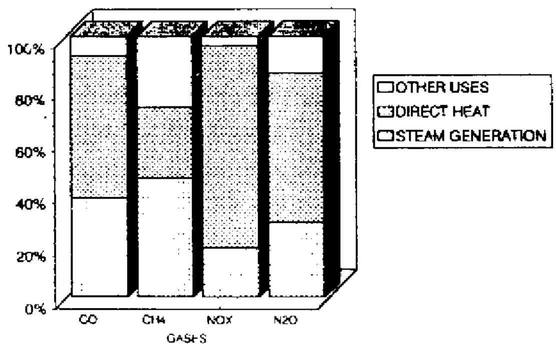


FIGURE II-23
EMISSIONS FROM MANUFACTURE INDUSTRY BY ENERGY USES



distillates, and biomass.

The emission estimates were based on MEM, 1990 and the emission factors provided by the IPCC/OECD,1990, Vol 3, in Tables 1-10, 1-11, and 1-18. The emission factors were selected considering the use of gas heaters, propane/butane furnaces, and distillate oil furnaces for the residential sector, while gas boilers, distillate boilers, and propane/butane furnaces were considered for the commercial and service sector. However, the emission factors used do not adjust well to the use of energy in Venezuela, and consequently, it will be necessary to research on more appropriate factors or develop national values.

Tables II-9 and II-10 show the emissions estimates for these sectors by type of fuel.

TABLA II - 9
EMISSIONS FROM RESIDENTIAL SECTOR

FUELS	FUEL CONSUMPTION (TJ)	EMISSIONS (Gg)			
		CH4	N2O	NOX	CO
TOTAL RESIDENTIAL	**58.63**	**0.13**	**0.01**	**2.86**	**9.00**
NATURAL GAS	5.12	0.01	0	0.24	0.05
OIL	53.06	0.90	0.01	2.53	0.56
BIOMASS	0.45	0.03	0	0.09	8.40

NOTE : Totals may not add due to rounding.

TABLE II - 10
EMISSIONS FROM COMMERCIAL / SERVICES SECTOR

FUELS	FUEL CONSUMPTION (PJ)	EMISSIONS (Gg)			
		CH4	N2O	NOX	CO
TOTAL COMERCIAL/ SERVICES	**9.07**	**0.01**	**0.04**	**0.46**	**0.10**
NATURAL GAS	2.19	0.01	0.01	0.33	0.02
OIL	6.88	0.00	0.03	0.13	0.08

NOTE : Totals may not add due to rounding.

Biomass burned for energy

The data available on biomass burned for energy show a very low consumption of this fuel in the country; MEM,1990 reports 0.453 Pj consummed in residential sector as wood and charcoal. Additionaly, the sugar industry burned 5.8 Pj of bagasse for energy. Validation in this area will be necessary in order to ensure the reliability of the data.

Other gases emissions from biomass were estimated for residential and industrial sectors, using the emissions factors in Tables 1-8 and 1-10 of the IPCC/OECD,1994. Results are included in Tables II-8 and II-9.

Mobile Sources

The use of fossil fuel in transportation is the most important source of emissions of the other gases originated by combustion, mainly those generated by incomplete combustion, such as carbon monoxide, methane and NMVOC. All emissions of NMVOC were produced by transportation, wich generated 250 Gg in 1990.

Mobile sources emitted 1,830 Gg of carbon monoxide and 9.8 Gg of methane, which represented 97% and 81% of these gases total emissions generated by combustion (Table II-11). The contribution of transport to nitrous oxide emissions was comparatively less important, with 66% of the national emission of this gas, only 0.4 Gg of nitrogen oxides were produced by this source.

TABLE II - 11
OTHER GASES EMISSIONS FROM MOBILE SOURCES

SOURCES	EMISSIONS (Gg)				
	CH4	CO	N2O	NOX	NMVOCs
NATIONAL TOTAL EMISSIONS	3178	4285	4.60	400	250.13
COMBUSTION	12.03	1864.90	0.64	325	250.13
MOBILES	**9.79**	**1830.24**	**0.42**	**199.34**	**250.13**
NATIONAL	**9.79**	**1830.24**	**0.42**	**199.34**	**250.13**
AIR TRANSPORTATION	0.08	21.38	0.00	5.29	2.91
ROAD VEHICLES	9.41	1802.17	0.39	180.11	245.39
RAILWAYS	0.00	0.04	0.00	0.06	0.01
NAVIGATION	0.00	0.03	0.00	2.09	0.00
INDUSTRIAL USES	0.30	6.62	0.02	11.79	1.82
INTERNATIONAL (BUNKERS)	**N.A.**	**4.92**	**0.07**	**75.38**	**3.48**

NOTE : Totals may not add due to rounding.

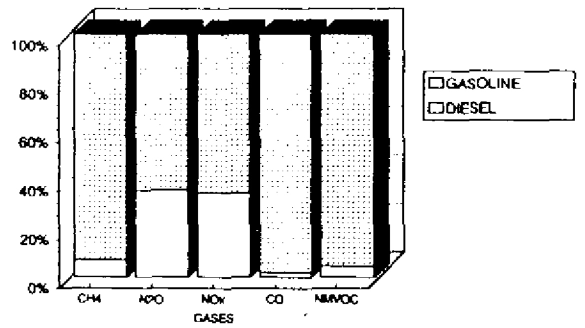
As mentioned earlier, the emission estimates of the non-CO2 gases have a high degree of uncertainty as, on one hand, the emission factors depend on a set of variables, usually with no available information, and highly sensitive to variations of any of these variables. On the other hand, due to deficiencies of the automotive fleet data, mentioned in the CO2 chapter.

Some of the variables that affect the emission factors are: type of fuel, mode of transportation and type of vehicle, characteristics of "operation" (driving cycle), emission controls, age of the fleet, maintenance, travel distances, yield per liter, road conditions, average speed, etc.

The need to manage a wide range of variables and the numerous conditions that could affect the yield of each mobile source category, especially those related to road transport, make very difficult any attempt to generalize the emission characteristics in this area. This is even a very complex problem for countries with much experience in developing national emission inventories and recognized discipline of data gathering and statistics.

As developing national emission factors for the emission inventory of NOx, CO, CH4, and NMVOC was not possible, the calculation was based on some of the factors published in Tables I-21 to I-26 of IPCC/OECD,1994. Vol.3 and information provided by MOBILE4 Model of U.S. EPA. The emission factors taken into consideration corresponded to non-catalytic emission control technology while for diesel heavy duty trucks, it was assumed that the available models do not incorporate any kind of control. Some inconsistencies were observed in the factors provided by IPCC/OECD, 1994. Vol 3 for all diesel vehicles when compared with those of gasoline.

FIGURE II-24
OTHER GASES EMISSIONS FROM ROAD TRANSPORTATION



The emissions of the photochemical gases: CO, CH4, and NMVOC, as in the case of CO2, are mainly generated by gasoline vehicles with a contribution, in all cases, of more than 90%. In the nitrous oxides and nitrogen oxides emissions, as can be seen in Figure II-24, the contribution of gasoline and diesel to both gases emissions are similar.

Table II-12 shows the distribution of the emissions generated by the different types of vehicles for each gas. For NOx and N2O, the highest proportion corresponds to heavy-duty trucks. For the rest of the gases, private vehicles and light-duty trucks account for most of the emissions. Public transport, in all cases, has the lowest contribution to the emissions.

TABLE II - 12
OTHER GASES EMISSIONS FROM ROAD TRANSPORTATION

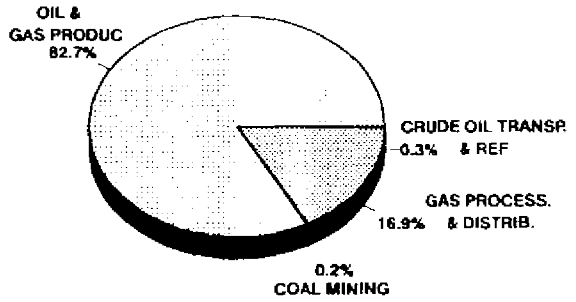
ACTIVITIES	EMISSIONS (Gg)				
	CH4	CO	N2O	NOx	NMVOC*
TOTAL ROAD EMISSIONS	**9.41**	**1802.21**	**0.39**	**180.17**	**245.40**
RAILROAD	0.00	0.04	0.00	0.06	0.01
ROAD VEHICLES	9.41	1802.17	0.39	180.11	245.39
PRIVATE VEHICLES	4.85	663.90	0.14	55.68	88.01
PUBLIC TRANSPORT	1.32	206.86	0.05	19.15	29.50
< 12 Seats	0.86	117.48	0.02	9.84	15.57
< 32 Seats	0.37	60.52	0.02	6.91	9.70
> 32 Seats	0.09	28.86	0.01	2.40	4.23
LIGHT-DUTY TRUCKS	1.81	538.22	0.05	30.54	72.83
HEAVY- DUTY VEHICLES	1.44	393.19	0.14	74.86	55.05
Two axle	0.81	295.07	0.05	26.49	38.57
Three axle	0.44	87.37	0.05	30.00	13.46
Four axle	0.19	10.75	0.04	18.37	3.02

NOTE : Totals may not add due to rounding.

II.2 FUGITIVE EMISSIONS

Fugitive emissions originate from production, transportation, storage and energy distribution, especially from the oil and gas systems and coal mines. The emissions are basically methane, although small quantities of NMVOC and CO2 are also produced. Methane is the most important component of natural gas and consequently, any loss or emission during operation of any of the systems mentioned above will directly emit methane to the atmosphere.

FIGURE II - 25
ENERGY SECTOR CH4 FUGITIVE EMISSIONS
(1826 Gg)



Fugitive emissions from the energy sector are the most important source of methane in the country; 1,826 Gg were emitted in 1990, which represented 60% of the national emissions of this gas. Figure II-25 shows the distribution of methane from fugitive emissions by area, where oil and gas systems are the main emitter, especially during production activities. The contribution of coal mining is very small, due to the low level of production of this fuel in the country.

The emission estimates were based on the average emission factors provided in Table 1-47 of IPCC/OECD, 1990 Vol. 3, for member countries of the Organization of Petroleum Exporting Countries (OPEC), and on national data, when sufficient information was available.

II.2.1 OIL AND GAS SYSTEMS

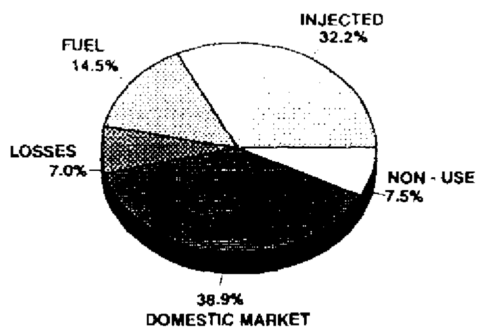
Production

Around 83% of fugitive methane emissions is generated by oil and gas production operations. Venezuela produced 3,738 millions of cubic feet per day of natural gas in 1990, almost all associated to crude oil production. Of the gas production, 32% was re-injected to the oil fields, 7% corresponded to liquid removed in compressor stations, 8% to non-utilized gas, which was vented or flared and the rest (net production), was sold in the national market or used as fuel by the oil industry itself (Figure II-26).

Few data are available on methane emissions generated by loss during normal operations and routine maintenance of the oil and gas production systems; and consequently, the emission estimates were based on the information available on the volume of gas thrown into the atmosphere as venting and flaring, reported in the gas balances of production areas. It was assumed that this volume of gas trhown is equivalent to all losses, from the system. Thus methane emissions are a function of venting gas and CO_2 emissions of flaring gas.

These estimates were based on the information provided by the oil companies and the Ministry of Energy and Mines, disaggregated by production areas, taking into consideration the composition and characteristics of the gas produced in these areas.

FIGURE II - 26
USES OF NATURAL GAS PRODUCTION
(3922 MMSCFD)



The results obtained are summarized in Table II-13 and the detailed calculations are shown in Annex 1 INVENE/TABLE D4-2. As can be seen, 1,511 Gg of methane were emitted by oil and gas production operations in 1990; 94% of this was generated in the production areas located in the western part of the country, since the characteristics of the oil fields and the operation conditions do not facilitate collecting and gas utilization.

TABLE II - 13
CH4 EMISSIONS FROM OIL & GAS PRODUCCION

AREAS	NATURAL GAS (MMSCFD)		EMISSIONS (Gg)	
	VENTING	FLARING	CH4	CO2
TOTAL	281	56	1511	1358
WESTERN	262	-	1416	-
EASTERN	19	56	95	1358

NOTE : Totals may not equal sum of components due to independent rounding.

This emission estimate value is higher than the one obtained through the use of the average emission factors presented by the IPCC methodology, which resulted in a range between 1,018 Gg and 1,468 Gg. More research is needed since the information used shows some inconsistency, especially in relation to the volumes of vented and flared gas.

All CO_2 emissions, 1358 Gg, are generated by the eastern production areas, where most of the non-utilized gas is flared.

Refining, Transportation, and Storage

Emission from these activities are presented in Table II-14. As can be seen, these are negligible as they represent only 0.3% of total methane fugitive emissions. The estimates were based on the emission factors provided by the IPCC methodology for oil producing countries.

Processing, Transportation, and Distribution of Gas

Methane fugitive emissions from the gas distribution systems were estimated to be 308 Gg, which represented 17% of total methane emissions from the energy sector, in 1990. These emissions are very high due to losses from the gas distribution system of the city of Maracaibo, which reached 46 million cubic feet daily or the equivalent to 84% of the managed gas. The system was originally installed in 1937 and lately expanded several times. A project aimed at reducing gas losses is being developed by PDVSA, MARAVEN, MEM, FIME, and GEF.

TABLE II - 14
EMISSIONS FROM CRUDE OIL TRANSPORTATION AND REFINING

SOURCES	ENERGY (PJ)	CH4 (Gg)
TOTAL EMISSIONS		4.88
TRANSPORTATION	3887	2.90
REFINING	2241	1.67
STORAGE TANKS	2241	0.31

NOTE : Totals may not equal sum of components due to independent rounding.

The estimates for the rest of the systems were based on the information provided by CORPOVEN, which indicates that losses from the distribution systems are 0.74% of the managed gas. The calculation considered the composition and characteristics of the gas distributed by the different companies. The estimation detail is shown in Annex 1 INVENE/TABLE D4-4.

When the emissions from the Maracaibo network (259 Gg) is taken out, the distribution systems would only emit 49 Gg of methane, which would represent 2.6% of the total generated by the energy sector.

Emission estimates from processing and transportation were not performed as the required information was not available.

II.2.2 COAL MINING

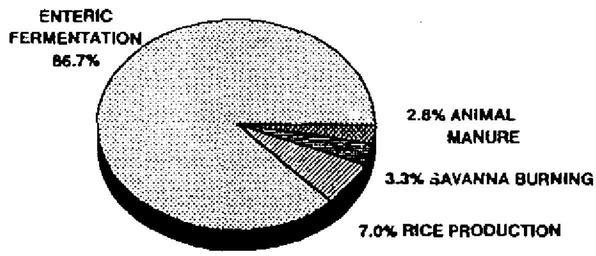
Methane emissions generated by coal production are only 0.16% of total emissions from the energy sector. The estimates were based on coal production data provided by the Ministry of Energy and Mines and the IPCC's emission factors.

III. AGRICULTURE

Greenhouse gas emissions from agricultural activities are related to different sources, which are largely responsible for national methane and nitrous oxide emissions. Some of the agricultural practices are also important sources of carbon monoxide and nitrogen oxides. The sectors that are analyzed in this section include: Domestic livestock and animal manure, rice cultivation, savanna burning, agricultural soil management, and field burning of agricultural residues. In some cases, the information used to calculate the related emissions was obtained from national statistics while in others the required data were basically collected from specific studies/research and interviews with experts in the fields. Some site visits were also required to validate the information or collect the data at various research institutes and universities.

Methane is the most important greenhouse gas generated by agricultural activities. In Venezuela this sector is responsible for 961 Gg of methane, which represents 30% of the 1990 national emissions of this gas. Domestic livestock (enteric fermentation and animal manure) contributes with 90% of methane emissions from this sector and 27% of national methane emissions. Rice cultivation and savanna burning are less important sources of methane, releasing 7% and 3% of the emissions from the agricultural sector, respectively. Field burning of agricultural residues are a minor source of methane and other greenhouse gases as this practice is not common in the country.

FIGURE III-1
METHANE EMISSIONS FROM AGRICULTURE BY SOURCE
(961 Gg)



* Agricultural Residue Burning: 1%

Agricultural soil management (fertilizer use) is the largest emitter of nitrous oxide of all anthropogenic source, accounting for almost 50% of national emissions. While savanna burning is not a significant source of nitrous oxide or nitrogen oxides, it is an important contributor to carbon monoxide emissions, with approximately 20% of national emissions.

III.1 DOMESTIC LIVESTOCK

This section provides an estimation of methane emissions from enteric fermentation (methane produced during the normal digestive process of animals) and manure management of domestic livestock. Emissions from enteric fermentation in Venezuela are estimated to be 826 Gg of methane, which represents about 26% of national methane emissions and 86% of methane emissions from agricultural activities. This includes the main domestic animal categories considered by the methodology: cattle, buffalo, goats, sheep, horses, mules, asses, and swine. Dairy and beef cattle are the major contributors, accounting for about 97% of total emissions from enteric fermentation. Although wild animals also generate methane through a similar process, they are not considered in this estimate since only anthropogenic sources are included in the IPCC methodology.

Emissions from animal manure depend basically on the way these wastes are handled and represent a minor source of methane in the country since only a small portion of the manure is managed under anaerobic conditions. In addition to the previous animals categories, poultry is included in this emission estimate. Methane emissions from animal manure has been estimated to be 26.8 Gg, accounting for less than 1% of national methane emissions and no more than 3% of the methane emitted by the agricultural sector.

III.1.1 ENTERIC FERMENTATION IN CATTLE

Considering the importance of the cattle population in the country, Tier 2 method (IPCC/OECD, 1994) was applied to perform the emission estimates and validate the applicability of default values provided for the Latin American region. Cattle population is subdivided in the same categories given for the region in order to derive the appropriate emission rates. Based on the methodology, these factors were then multiplied by the applicable animal population in each category to generate national methane emissions from this source.

The data on the number of cattle and were obtained from statistics provided by the Ministry of Agriculture and Animal Husbandry, which were validated through the review of other data sources from the National Institute for Agricultural Research. Animals characteristics required to estimate methane emissions, based on Tier 2, were obtained from various interviews to experts in this area at different universities and the main related research institute since most of these data are not consistently documented. This information includes: population structure (validated with national statistics), weight, rate of weight gain, portion of cows giving birth each year, milk production per cow and feed digestibility.

Although different types of cattle, based mainly on sizes, feeding situations, and management practices, could be found for several regions in the country, it is not possible to define these regional differences as national statistics do not provide the necessary details. Furthermore, all the collected data are intended to provide the best possible representative average values in order to calculate methane emissions from this source at a national level.

The national emission factors obtained for dairy and non dairy cattle, 69 kg/yr and 59 kg/yr respectively (see Table III-1), were higher than the corresponding regional values, 57 kg/yr and 49 kg/yr, and were rather similar to the data provided for developed countries. In the case of dairy cows, animal size and milk production data were higher than the average values provided by the methodology for the Latin American region.

Given that these variable have a very important influence on the emission rates, the estimated emission factor of 69 kg/head/year, based on the local data, was obviously also higher than the region's corresponding default values of 57 kg/head/year (a difference greater than 20%). Other factor that may contribute to this difference has to do with the rather low feed digestibility (56% instead of the 60% given by the methodology as default data for Latin America). The value for Venezuela, however, will need to be revised in the future as it was based on the information obtained from conversations with some professors at the Agronomy Department, who recommended additional research to validate these data.

TABLE III - 1
METHANE EMISSIONS FROM CATTLE BY ANIMAL TYPE. 1990

ANIMAL TYPE	POPULATION (heads)	EMISSIONS FACTORS (kg / h/year)	EMISSIONS (Gg)
DAIRY CATTLE			
SUB - TOTAL	**1,204,992**	**69.00**	**83**
NON DAIRY CATTLE			
MATURE FEMALES	4,850,459	74.00	359
MATURE MALES	606,308	68.00	41
YOUNG	6,669,382	48.00	320
SUB - TOTAL	**12,126,149**	**59.40**	**720**
TOTAL CATTLE	13,331,141	-	803

Non-dairy emission factors were also higher than the region's values, primarily as a result of higher average weights of mature female and male categories and lower values of feed digestibility. Additionally, average milk production was almost twice of the region's default number, which contributed to produce the greatest difference in the methane emission factors observed for any cattle category. Young cattle showed the smallest difference regarding this factor. Population structure and feeding situation for all cattle categories are very similar to default data provided for the region.

Non-dairy cattle accounts for about 90% of methane emissions from enteric fermentation in cattle while the remainder 10% results from diary cattle.

III.1.2 ENTERIC FERMENTATION IN OTHER DOMESTIC ANIMALS

Methane emissions from other domestic animals include buffalo, sheep, horses, swine, goats, mules and asses. The approach used to calculate the emissions was based on Tier 1 method, which provides default emission factors for each animal category in developed and developing countries. These figures were used since no local data were available to estimate local emission factors, and consequently, a less detailed analysis was performed.

The number of animals per category was obtained from the Ministry of Agriculture and Animal Husbandry's Statistics and the FAO Production Yearbook. The population data were not validated since no other reliable source of information was available. This fact, in conjunction with the lack of local emission rates, contributes to the uncertainty in the emission estimates from enteric fermentation in domestic animals. However, due to the rather negligible overall contribution of this source to methane emissions, the estimate is considered satisfactory.

TABLE No. III - 2
METHANE EMISSIONS FROM OTHER ANIMALS. 1990

ANIMAL	POPULATION (heads)	EMISSIONS FACTORS (kg / h/year)	EMISSIONS (Gg)
GOATS	710,493	5.00	3.55
SHEEPS	144,690	5.00	0.72
PIGS	2,961,118	1.00	2.96
HORSES	495,000	18.00	8.91
MULES/ASSES	512,000	10.00	5.12
BUFFALOS	35,786	55.00	1.97
TOTAL	-	-	**23.23**

Emissions from these domestic animals have been calculated to be 23.2 Gg of methane (see Table III-2), less than 1% of the national methane emission and 2.7% of the total from enteric fermentation. Despite the fact that buffalos have the highest emission factor, their contribution within these group of domestic animal is one of the lowest, since they are also lower in number. On the contrary, due to their large population, the contribution of swine fall behind that of horses in spite of having the lowest enteric fermentation emission factors of all domestic animals.

III.1.3 MANURE MANAGEMENT

Methane emissions from animal manure are estimated to be 26.77 Gg, which represents only 3% of the total amount generated by domestic livestock and less than 1% of national methane emissions. Methane production from this source depends basically on the way animal waste is handled and the amount of manure produced.

Specific data on manure management practices are not available in the country. However, some research through interviews to experts and literature search were performed at various universities, research institutes and producers´associations in order to determine, in general, the most common management practices. Most experts agreed that manure is usually not treated or stored in anaerobic environments. Consequently, similar conditions and practices presented by the IPCC methodology for the Latin American Region are applicable to Venezuela, specifically in the case of cattle. Thus almost all livestock manure is managed as solid on pastures and ranges.

Although large numbers of swine and poultry are managed in confined areas, a small portion of manure is handled in systems that promote an oxygen-free environment, such as liquid in lagoons. Most of the poultry's wastes are either used as fertilizer in the agricultural lands located near the poultry farms or incorporated into animal diets with some previous treatment.

The methodology used to estimate methane emissions from animal manure is based on Tier 1 method of the IPCC guidelines, which provides default emission factors by animal type in developed and developing countries. Factors are also provided for 3 different climates. This simple method was used for cattle and swine since some of the data needed to apply the Tier 2 method was not available in the country. Also, when considering that most manure management practices do not favor anaerobic conditions, as described above, the Tier 1 method provides an appropriate level of details to perform the country's emission estimate from this source.

The data on animal populations used to calculate methane emissions were obtained from the Ministry of Agriculture and Animal Husbandry's statistics and the FAO Yearbook Production. The default emission factors for all types of animals used in the analysis corresponded to a warm climate region (average temperature greater than 25°C), even though some regions of the country may fall within the category of temperate climate. This simple assumption was made based on two different factors: first, the statistics do not reflect climate variation on the animal population data; and secondly, most of the regions have an average temperature close or greater than 25°C. However, the emission factor for cold climate was used to calculate emissions from sheeps since these domestic animals are only raised in The Andes region, in areas with low average temperatures.

TABLE No. III - 3
METHANE EMISSIONS FROM MANURE MANAGEMENT BY ANIMAL TYPE. 1990

ANIMAL	POPULATION (heads)	EMISSIONS FACTORS (kg / h/year)	EMISSIONS (Gg)
BEEF CATTLE	12,126,149	1.00	12.12
DAIRY CATTLE	1,204,992	2.00	2.41
GOATS	710,493	0.22	0.16
SHEEPS	144,690	0.16	0.02
PIGS	2,961,118	3.00	8.88
HORSES	495,000	2.20	1.09
MULES/ASSES	512,000	1.20	0.61
BUFFALOS	35,786	2.00	0.07
POULTRY	56,500,000	0.023	1.30
TOTAL	-	-	26.66

Of the different animal categories included in this estimate, cattle and swine manure are the most significant emitters (see Table III-3), accounting for 55 % and 34 % of total methane emissions from animal manure, respectively. However, there is substantial uncertainty in the estimates of domestic livestock manure due to knowledge gaps on the way animal wastes are specifically managed in the country and the fact that Methane Conversion Factors provided by the methodology for the different animal categories have not been validated through field measurements.

III.2 RICE PRODUCTION

Rice fields generate about 67 Gg of methane per year and represent 2% of the national methane emissions. Emissions from this source are likely to remain at the same levels over the next few years mainly because the cultivated areas are not expected to expand significantly.

Rice is one of the country's major crops and most of its production is concentrated in two regions with similar climate patterns and cultivation practice. Both regions were visited as well as one of the biggest rice companies in order to validate the data and learn in situ about the typical management practices.

The IPCC methodology was used to estimate methane emissions from rice cultivation, which is basically based on the harvested flooded area and a daily emission factor. Information on annual average harvested area was obtained from the Ministry of Agriculture and Animal Husbandry. According to this source, 119,980 hectares of rice per year were harvested in the period 1989-91. This three year period (centered on 1990) was used with the objective of avoiding any major data difference as a result of particular economic situations or climatic conditions. This figure, however, has not shown any significant fluctuation during the last decade and is considered to be fairly reliable since the site visits made to the rice growing regions helped verify the accuracy of these data as well as the information on management practices.

The average harvested area includes two crops per year, classified as winter and summer harvests (corresponding to the rainy and dry seasons respectively). Most of the rice in the country is produced in the rainy season. Although some differences between these two crop seasons may be found (e.g. season length and water management) the data are not reported in such a way to perform any separate emission estimates.

Rice fields are commonly irrigated or rainfed, with less than one meter of floodwater depth, which is a basic conditions to generate methane through the anaerobic decomposition of organic matter in the fields. Although some variations were found, rice fields are continuously flooded for 90 days on average. Rice is not cultivated under intermittently flooded or dry regime in the country.

The average season length is about 120 days. However, as rice fields are commonly drained one month before the harvest, the 90 day flooded period was used to perform the emission estimate. In a very small proportion, water is never drained and this implies that both land tilling and harvesting occur under flooded conditions. The growing season average temperature for the rice regions is 28 °C. No significant regional variations in temperature or cultivation practices were found.

Local estimates, based on laboratory research, field experiments or theoretical calculations, have not been conducted in the country to determine the appropriate methane emission factors. The default values corrected for average temperature given by the IPCC Methodology were then used to estimate methane emissions from this source. According to this, the emission factors for an average temperature of 28°C and flooded regime is 6.25 kg/ha/day. However, this value is considered to be overestimated for the country due to some local management practices that could reduce methane emissions. First, it was found that a continuing freshwater input to the flooded rice fields is commonly done as it is believed it benefits the plant's growth. No scientific basis or specific study was found to support this argument, but the continuous input of oxygenated water could reduce the anaerobic conditions and, furthermore, inhibit the methane production capacity of the flooded fields.

Another factor that could also contribute to an overestimation of the emissions is based on the fact that chemical fertilization is more commonly used in Venezuelan rice fields while it is known that Asian countries'practices, where the methane emission factors are derived from, rely more on organic fertilizer. According to different studies, some types of nitrogen fertilizer may suppress methane production as opposed to organic fertilizers which increase methane generation. It has been reported, for example, that methane emission rates were 1.5 and 3 times larger than chemical fertilization when compost and rice straw were applied to rice paddies, respectively. However, due to the complex interrelations of the variables that affect methane production under different growing conditions and management practices, it is not possible to generalize the influence of these factors or incorporate these local results to national emission estimates.

Furthermore, any effort to improve the country's estimate should be based on a detailed study of management practices and research in different sites in order to take emission measures directly in the fields. This type of research could also help validate the default emission factors given by the methodology. Being aware of the substantial differences found in rice producing countries, local values that could be obtained from well designed research projects would introduce new knowledge on this area for the Latin American region.

III.3 SAVANNA BURNING

Different types of savanna formations constitute a very important ecosystem in Venezuela from both ecological and socio-economic perspectives. More than one fourth of the country (approximately 22 million hectares) is covered by savannas, found in most geographical regions, but mainly in the Llanos of the central part of the country. The vegetation formations which define these savannas can vary substantially: From the open savannas, with a continuous grass cover, occasionally interrupted by trees and shrubs and no more than 4 gramineous species to the woody savannas, characterized by the presence of trees and shrubs that can cover up to 15% of the area.

Agricultural activities have been traditionally established on a great extension of the savanna area, through a very high dynamic process of land use change, which fluctuates according to the country's economic situation and specific agricultural policies. Some of the most important crops are grown on savannas such as corn, rice and sorghum, among others, while extensive and intensive cattle raising represents the most significant economic activity of these areas.

Savanna burning during the dry season is a common agricultural practice in the country, mainly to eliminate weeds and pests and encourage growth of new grass for animal grazing through the promotion of nutrient cycling. This periodical burning of a great portion of the savanna areas releases important non-CO2 trace gases: methane, carbon monoxide, nitrous oxide, and nitrogen oxides. Carbon dioxide, which is also emitted in large quantities, is not included in the greenhouse gas inventory because, as knowledged by the IPCC methodology, it is reabsorbed by the vegetation regrowth between the burning cycles. Consequently, in an annual basis, net carbon dioxide emissions from savanna burning is considered to be zero.

Emissions of these gases haven been calculated in accordance with the IPCC methodology, which is based on estimates of the annual instantaneous gross release of carbon from savanna burning and ratios of other trace gases released from burning to total carbon released by burning. The basic data required to calculate net greenhouse gas emissions are: the savanna area burned annually, the aboveground biomass density, the fraction of the biomass which actually burns, and the fractions which oxides.

The proportion of the savanna areas burned in Venezuela is highly uncertain as there are not reliable national statistics that compile, on a regular basis, the frequency and extent of savanna burning. Consequently, a satellite imagery study (Landsat TM, 1:250.000 scale) was performed on about half of the savanna area of the country in order to determine this fraction and provide a more reliable knowledge of this process.

The dates of the selected satellite images were made to coincide with a time period towards the end of the dry season (March and April), under the assumption that such a time framework would ensure the inclusion of most of the burning which could have occurred within the covered area. In order to choose representative years around 1990, in terms of climatic conditions, the average monthly precipitation of the study area for a ten year series was carefully analyzed so that the dates of the selected images would not coincide with any particularly dry or wet year that could bias the study's results.

A total of five satellite images at 1:250.000 scale were chosen, covering about 25% of the national territory and close to 50% of the savanna area. The interpretation was done visually while the area calculation of the different vegetation units and burned portions was performed through the implementation of a Geographical Information System. The results from the study show that approximately 13% of the savanna area was burned on average. However, the fractions burned by region vary widely: from less than 1% in the Nor-oriente Region to almost 50% in the Centro-occidente Region (see Table III-4). The corresponding burned fractions, obtained from the study, were extrapolated to the entire savanna area in each region in order to estimate the average burned area in the country. Based on this extrapolation, an average of 3.1 million hectares of savannas are annually burned in the country.

Aboveground biomass density data were gathered from different local studies, ranging from 3.3 to 6.1 t dm/ha, and have also been assigned to specific regions, based on their proximity and general ecological characteristics. Similar approach was used to extrapolate the values provided by the same studies on dead and live biomass fractions. These local data were used to determine the amount of carbon released by the burnings.

TABLE No. III - 4
SAVANNA BURNING:
BASIC DATA FOR EMISSION ESTIMATES

REGION	SAVANNA AREA (km2)	AVERAGE BURNED AREA (%)	ABOVEGROUND BIOMASS (t dm / ha)	BURNED AREA (km2)	TOTAL BIOMASS BURNED (tones)
ANDES	21,430	11.2	5.08	2,400	1,036,320
ZULIA	4,128	11.2	5.34	462	209,703
CENTRO - OCCIDENTE	11,940	49.8	4.30	5,946	2,173,263
LLANOS	90,390	17.1	6.07	15,457	7,975,039
NOR - ORIENTE	46,845	0.6	3.31	281	79,059
GUAYANA	60,887	11.2	6.02	6,820	3,489,794
TOTAL	**235,620**	**13.3**	**5.02**	**31,366**	**14,963,178**

SOURCES : Savanna area data by region were obtained from 1980 Venezuelan Vegetation map (MARNR, 1982). Average Area Burned data were derived from the Savanna Study conducted for this Inventory. The Andes, Zulia, and Guayana regions were not included in this study; the corresponding percentage burned (11.2 %) is an estimate average from the other regions. Aboveground biomass data were derived from different local studies and extrapolated to the entire regions.

Thus annual average greenhouse gas emissions from savanna burning in Venezuela have been estimated to be as follow: 31 Gg of methane (1% of national CH_4 emissions), 0.4 Gg of nitrous oxide (9% of national N_2O emissions), 14 Gg of nitrogen oxides (4% of national NO_x emissions), and 821 Gg of carbon monoxide (19% of national CO emissions). These results are presented, by region, in Table III-5. In general, except for carbon monoxide, savanna burning seems not to be an important source of greenhouse gas emissions.

The results are very controversial as the proportion savanna burned annually in the country (13%) obtained from the study, appears to be very low, especially when compared to the regional data provided by the IPCC methodology. According to different local studies, conducted mainly in Africa and some parts of tropical America, it has been determined that savannas are burned worldwide every one to four years on average (IPCC/OECD, 1994). Discussions with various Venezuelan scientists have also confirmed that savannas are very likely burned in the country in a much higher, but still undetermined, proportion than the fraction reported by the study.

TABLE No. III - 5
SAVANNA BURNING
TRACE GAS EMISSIONS

REGION	TOTAL CARBON RELEASE (tones)	TOTAL NITROGEN RELEASE (tones)	EMISSIONS ESTIMATES (Gg)			
			CH4	N2O	NOX	CO
ANDES	405,460	2,433	2.16	0.03	0.96	56.76
ZULIA	81,780	491	0.44	0.01	0.19	11.45
CENTRO - OCCIDENTE	856,750	5,141	4.57	0.05	2.04	119.95
LLANOS	3,125,820	18,755	16.67	0.21	7.39	437.61
NOR - ORIENTE	31,180	187	0.17	(*) 0.00	0.07	4.37
GUAYANA	1,365,380	8,191	7.28	0.09	3.23	191.15
TOTAL	5,866,370	35,198	31.29	0.39	13.88	821.29

(*) LESS THAN 0.01 Gg

One of the main reasons that have been identified to explain this difference is based on the effectiveness of the methodology employed to determine the burned fraction. As mentioned above, various satellite images of different savanna regions were included in the study, but without any multitemporal analysis that would have required a series of images for the same sites within the dry season, in order to account for all the burning throughout the year. Contrary to the initial assumption, the study's results might then just be showing how much has been burned in an undefined period of time within the entire dry (burning) season, despite the fact that the dates of the selected images (March and April) are considered to be representative of the months with the highest fire frequency in the country.

Furthermore, taking into account that most savanna areas can be covered with grass again within a few weeks after the burning occurs, it is very likely that the study is not able to determine all burned area prior to the date of the image was taken, neither can it say anything about how much may be burned afterwards. However, it is important to recall the wide differences found for the burned fractions when the satellite images are analyzed individually. These factors ranged from as low as 1% to the highest value of almost 50%.

Since no more reliable information is available, the burned fraction of 13% has been used to estimate national greenhouse gas emissions from savanna burning. However, aware of the limitation of the study to provide fairly representative data on average burned area, the 50% per year provided by the IPCC methodology as a default value for Tropical America, could be also used to determine the possible upper limit of greenhouse gas emissions from this source in the country. Emissions will then be almost 5 times higher than the previously reported results. This issue will need further discussions in order to provide a more reliable estimates of greenhouse gas emissions from savanna burning. If the default data is found to be applicable for Venezuela, this source would become an important contributor to the national emissions of greenhouse gases. On the contrary, if the satellite imagery study is determined to be representative of savanna burning practices in Venezuela, this result may introduce new information on the extent of this process in some regions of the tropics.

III.4 BURNING OF AGRICULTURAL RESIDUES IN THE FIELDS

The contribution of this source to greenhouse gas emissions in the country is rather negligible. Although many of the crops whose residues are believed to be burned in most developing countries, namely maize, rice, shorgum, bean, soya, sugar cane and peanut, are grown in Venezuela, most of the agricultural residues are not burned. They are commonly used to feed cattle and other animals or plowed back into the soil during land tilling. This conclusion was drawn from interviews with experts at different universities and research institutes as well as from some literature search. It was also confirmed that the two main crops whose residues are indeed burned for different reasons are sugar cane and cotton.

Non-CO2 trace gas emissions from crop waste burning (methane, carbon monoxide, nitrous oxide, and nitrogen oxides) are included in this estimate. As proposed by the IPCC methodology, carbon dioxide is excluded since it is assumed that the carbon released to the atmosphere is reabsorbed during the next growing season. The methodology is based on total carbon released and the application of emission ratios of CH4 and CO to carbon released, and N2O and NOx to nitrogen released from biomass fires. The essential requested data relates to the amount of crops whose residues are commonly burned. Table III-6 summarizes the basic data needed to perform the emission estimates. Sugar cane fields are traditionally burned before the harvest for both practical and safety reasons. By eliminating weeds and most of the sugar cane leaves,

TABLE No. III - 6
AGRICULTURAL RESIDUE BURNING:
BASIC DATA FOR EMISSION ESTIMATES

CROP	PRODUCTION (tones)	RES. / CROP (*) RATIO	FRACTION BURNED	DRY (*) MATTER (%)	FRACTION (*) CARBON	NITROGEN - CARBON RATIO
SUGAR CANE	6,900,000	0.2	1.0	50	0.4092	0.014
COTTON	85,200	50.0	1.0	88	0.3600	0.014

(*) DATA WERE TAKEN FROM TANZANIA'S PRELIMINARY GHG INVENTORY (1994)

the harvesting activities are performed more effectively while at the same time fires help get rid of snakes that are commonly found in these fields. It should be noted that although the biomass burned here may not strictly fall within this category, it has been considered that the methodology applied for this area can be appropriately used to estimate the emissions generated from this practice.

The biomass burned in the fields basically relates to the sugar cane leaves, and consequently the residue/crop ratio tends to be rather low. On the other hand, the residues produced by the sugar cane sugar industry (bagasse) are either used by the pulp mill industry for paper production or as a biomass fuel at sugar processing plants, in which case it is included as a greenhouse gas source in the energy sector.

The average yearly production (1989-1991) of sugar cane is about 6,900,000 metric tones and it represents one of the most important crops of the country. Although the burning practice of the sugar cane fields is not a major contributor to GHG emissions, it represents a significant source of air pollution during the harvesting season, especially in those towns located nearby.

Cotton residues are also burned but mainly for sanitary reasons in order to eliminate any pest or weed that may affect the health and yield of the following crop. To a lower extent, it is done to prepare the fields for the next cropping season. Cotton seeds are partly used to feed livestock. Although its average annual production (1989-1991) is only 85,200 metric tones, the contribution of cotton residue burning to greenhouse gas emissions is much higher than emissions from sugar cane residue burning.

Annual crop production statistics for cotton and sugar cane were obtained from the Ministry of Agriculture and Animal Husbandry. An average of a three year period was also used to avoid any significant distortion of the data on harvested area. Although no information on the fraction burned in the fields was documented, it was assumed, given the purpose and burning practices, that all residues produced in the fields by both crops are actually burned. This assumption was validated through different interviews with experts in the fields.

The rest of the required information, residue/crop ratio, dry matter content, carbon content, and nitrogen content, is not available in the country neither is provided by the IPCC methodology (no default values were included for these crops). Furthermore, the data generated by Tanzania's preliminary greenhouse gas inventory was used for our own estimate, despite the geographical and management practice differences that may characterize both countries. The contribution of this source to total emissions of non-CO2 trace gases has been estimated as follow: 9.79 Gr of methane (0.8% of national CH4 emissions), 0.23 Gg of nitrous oxides (5% of national N2O emissions), 8.11 Gg of nitrogen oxides (2% of national NOx emissions), and 206 Gg of carbon monoxide (5% of national CO emissions). Table III-7 shows the results by type of crop.

Based on this information, greenhouse gas emissions from agricultural residue burning can be considered negligible when compared to the national emission levels from all other sources. The lack of local data makes the emission estimates highly uncertain. However, considering the minor contribution of this source, an improvement of the calculation. for example by obtaining more reliable information in the future, will not result on any noticeable changes of the country's global emission picture.

TABLE No. III - 7
AGRICULTURAL RESIDUE BURNING:
TRACE GAS EMISSIONS

CROP	BIOMASSA BURNING (t dm)	CARBON RELEASE (t)	NITROGEN RELEASE (t)	EMISSIONS ESTIMATES (Gg)			
				CH4	N2O	NOX	CO
SUGAR CANE	621.000	254.110	3.558	1.69	0.04	1.40	35.52
COTTON	3.374.000	1.215.000	17.000	8.10	0.19	6.70	170.10
TOTAL	3,995,000	1,469,110	20,558	9.79	0.23	8.11	205.62

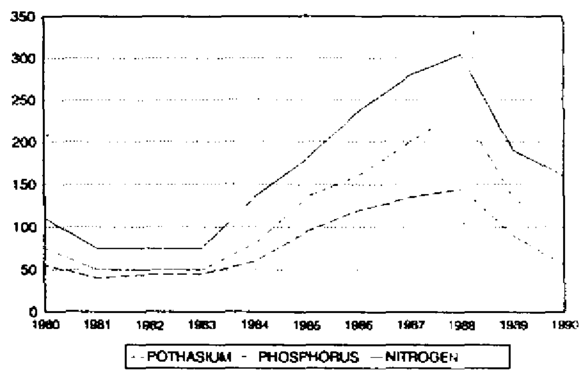
III.5 AGRICULTURAL SOIL MANAGEMENT

Fertilizer use in the country has been declining at a very fast rate since 1988, when most governmental subsides on fertilizer consumption were eliminated by the middle of 1989. Thus from 1.5 MMT of chemical fertilizers in 1988, the highest value ever reached, consumption levels dropped by half in 1990, when the national statistics showed that only 0.8 MMT were consumed. This fact has obviously had a strong influence in the level of emissions of nitrous oxide associated to agricultural soil practices in the country.

In 1990, nitrous oxide emission from this source were estimated to be 2.26 Gg. This is the main source of nitrous oxide in Venezuela,as it contributes with almost half of national N2O emissions and 78% of the agricultural sector's emissions.

Emissions of nitrous oxide from fertilizer use were based on the simplified IPCC methodology, which assumes that 1% of the nitrogen applied as fertilizer is released into the atmosphere. Although the validity of this suggestion can be argued, the limitation of the knowledge and the little new information on nitrous oxide emissions from agricultural soils, as reported by the methodology, make this approach a viable alternative to provide an estimate of the emissions from this source.

FIGURE III-2
FERTILIZER CONSUMPTION BY TYPE OF NUTRIENTS
1980 - 1990



SOURCE: PALMAVEN

The information on fertilizer use was obtained from the statistics of the national institute in charge of fertilizer distribution until 1990 (PALMAVEN). The centralization of all the commercial aspects (fertilizer import and distribution) by this institute ensures the reliability of the data provided on fertilizer consumption. According to this source, about 800,000 MT of synthetic fertilizer were consumed in the country in 1990. This figure includes multi-nutrient and nitrogen fertilizers with a total nitrogen content of about 144,000 metric tones. Figure III-2 shows the amount of fertilizer consumed by type of nutrient from 1980 to 1990. As can be seen, the level of consumption dropped significantly after 1988.

Organic fertilizers (animal manure and plant residues) are not included in this estimate due to the lack of the required data. Although crop residues and animal manure are used in some agricultural areas (this was mentioned in the related sections), this type of fertilizer do not usually enter the commercial market, and consequently, no reliable source of information is available to estimate the total amount of organic fertilizer and the equivalent nitrogen content. Emissions due to nitrogen-fixing crops are not included either due to the difficulty in estimating the amount of nitrogen fixed by the crop.

The IPCC's recommended average of three years of fertilizer consumption (centered in 1990) was not used as no information for 1991was not available in the country. Since the level of consumption is clearly decreasing, as described above, an attempt to produce an average number that would include any year before 1990 would have introduced a significant bias, given the fast declining rate of fertilizer consumption in the country. Furthermore, the 1990 data was used to derive nitrous oxide emissions from this source.

As acknowledged by the methodology, nitrous oxide emissions from fertilizer use are not very reliable due to uncertainty related to the emission factor, associated with a number of individual factors that are controllers of nitrification and denitrification. Within the national context, nitrous oxide emissions may be underestimated considering that organic fertilizers have not been included in this estimate. Although national consumption of different kinds of organic fertilizers is likely to be much lower than chemical fertilizer, its contribution in the near future might become more important due to the increasing prices of the latter. Some research on this area is needed to generate new and additional information and to derive more reliable estimates.

IV. LAND-USE CHANGE AND FOREST MANAGEMENT

Human activities that alter the biosphere for food, fuel and fiber production have been increasingly contributing to the concentration of greenhouse gases in the atmosphere. Carbon dioxide is considered to be the most important gas associated to land use changes. Other important gases generated when biomass burning is involved are methane, nitrous oxide, carbon monoxide, and nitrogen oxides. Three categories of land use change are considered in this inventory: forest clearing, forest management, and conversion of grasslands to cultivated lands.

Land-use change is largely responsible for greenhouse gas emissions in Venezuela, especially carbon dioxide. The forest conversion process that the country has witnessed during the last decades has increased significantly as land pressure to establish different economic activities has determined the fate of large forest areas. Land clearing for agricultural use is the most important activity leading the process of land use change.

Land-use change accounts for about 42% of carbon dioxide national emissions, mainly associated to an average of 517,000 hectares of forest clearing per year during the last decade. Biomass burning that occurs in conjunction with land use change is also an important contributor to trace gas emissions. In relation to national emissions of non CO_2 gases, this source contributes with approximately 5% of methane, 23% of nitrous oxide, 10% of nitrogen oxides, and 32% of carbon monoxide.

On the other hand, forest management, which includes logging for forest products and establishment of forest plantation, can potentially produce significant carbon fluxes and does not necessarily result in a net flux to the atmosphere. Forest management represents an offset of only 7% of the carbon dioxide national emissions from deforestation, despite the fact that large areas of industrial plantations have been established in the last twenty years and that managed natural forests, under sustainable management plans, have also increased significantly during this period.

Conversion of natural grasslands to cultivated or pasture land has also been considered a source of carbon dioxide when this process involves land tilling, which causes soil disturbance and, consequently, oxidation of soil carbon. However, this type of land use change is a minor greenhouse gas contributor in the country as it accounts for less than 1 % of total carbon dioxide emissions.

Abandonment of managed lands, which can re-accumulate carbon on the vegetation and in the soil, is not included in the national greenhouse gas inventory due to the lack of the required information to perform the basic calculations and the difficulty of generating any reliable data.

IV.1 FOREST CLEARING

According to the 1980 Venezuelan Vegetation Map, the forest area of the country is roughly 58 million hectares, which represents more than 60% of the national territory. About 70% of the forest land is located south to the Orinoco river, where also the Venezuelan Amazonian Basin is located. The amount of forest land in this region has not changed significantly when compared to the North of the country, where most of the population is concentrated. The high population density in this part of the country has led the land use change process in which large forest areas are mainly cleared for agricultural use.

The annual rate of forest clearing in Venezuela has not been consistently documented. Although national statistics report annual data on legal clearcutting for most regions, remote areas are usually not included. Additionally, an unknown, yet relevant, amount of illegal clearcutting is believed to contribute significantly to the depletion of forest lands, as occurs in most tropical countries. Consequently, different sources of information were used to determine the average area cleared annually, which is needed to calculate the related emissions of greenhouse gases.

The country was divided into three main geographical regions, according to specific sources of information on forest clearing rates: Northwest, northeast, and South. A deforestation study was available for the northwest region (Catalán, 1993), based on a multitemporal analysis of satellite images between 1973 and 1988. According to this study, the region's annual cleared area, for the mentioned period, was estimated to be approximately 300,000 hectares, which constitutes a deforestation rate of 3% per year.

Forest clearing data for the northeast region were obtained from the same study performed to derive the annual average area of savanna burning, which was based on satellite images dated around year 1990. The forest land area determined by this study was compared to the information provided by the 1980 Venezuelan Vegetation Map, through the implementation of a geographical information system. The deforestation rate derived from this multitemporal analysis was nearly 4% per year, which was extrapolated to the region's 1980 forest area. However, it is very likely that this deforestation rate of 4% overestimates the total cleared area in the region since it was derived from the analysis of forest areas located in savannas with high land use pressure. Additionally, only a small portion (less than 20%) of the region's forests was, in fact, covered by the satellite images included in this study. Furthermore, these data will need to be validated in the near future, through the implementation of a specific study to determine a more reliable deforestation rate for the entire region.

An underway project on the Panamazonian Area, coordinated by the Ministry of Environment and Renewable Natural Resources, will provide the deforestation rate data for the southern region. The project has been partly completed and will be included in the national estimate of cleared lands once it is finished. No attempt was made to extrapolate any average deforestation rate in the northern part of the country to these forest areas, given the great differences found in the process of land use change between the northern and southern regions. For example, the deforestation rate for one of the states (Amazonas state) south to the Orinoco river has been estimated to be nearly 0.03% per year, which in turn is far from providing a representative number for the entire region.

The analysis and processing of all this information have resulted in a average cleared area of approximately 517.000 hectares per year (see Table IV-1), excluding the southern region. This value was used to provide an approximation of greenhouse emissions in the country due to forest clearing until the Panamazonian study for the southern region is completed. It is believed that the inclusion of this region might increase the country's annual deforestation rate by 5% to 10% and, consequently, the emissions in the same proportion. The estimated average cleared area represents a declining rate of less than 1% per year of the country's forest lands, during the last decade.

The IPCC methodology was used to derive the greenhouse gas emissions, which is based on the amount of carbon emitted by burning aboveground biomass (immediate emissions, occurring in the year of clearing) and carbon released by decay of aboveground biomass (delayed emissions, occurring over a ten year period). Carbon released from soil is not included in this estimate due to the uncertainty associated to this source and the lack of reliable data. Calculation of non-CO2 trace gases is based on the same method used for biomass burning.

One of the most important data needed for the calculations relates to aboveground biomass densities of the forests affected by clearing. As these data are not available in the country, biomass density values were indirectly obtained from two main sources of information. First, the 1980 Venezuelan Vegetation Map, which subdivides the country's forest area on the basis of height and density characteristics. This information was used to subdivide the annual cleared lands proportionally to the area covered by the different forest types identified by the Map.

TABLE No. IV - 1
ANNUAL AVERAGE OF CLEARED AREA BY FOREST TYPE
(1980 - 90 PERIOD)

FOREST TYPE		10 YEAR AVERAGE AREA CLEARED (ha)	ABOVEGROUND BIOMASS (t dm / ha)	BIOMASS AFTER CONVERSION (tdm / ha)	LOSS OF BIOMASS (t dm)
CLOSED FORESTS	I	21,720	400	10	8,470,800
	II	17,060	240	10	3,924,800
	III	237,340	140	10	30,855,200
OPEN FORESTS		240,970	55	10	10,843,650
TOTAL		517,090	-		54,094,450

Forest types correspond to an aggregate of the categories defined by the 1980 Venezuelan Vegetation Map, based on height and density of the forest.

Secondly, a national forest inventory (Veillon, 1977), which provides information on commercial biomass, in cubic meters of roundwood, for different types of forests in a wide range of locations in the country. Various expansion factors were applied to these values (Brown, L, et.al., 1989) to account for the non-commercial biomass and were then converted into mass of dry matter. The two studies were linked in order to derive the most appropriate biomass density values for the relevant types of forests affected by clearing. Thus four categories of aboveground biomass density were identified, ranging from 55 to 400 t dm/ha.

Table IV-II summarizes the emission estimates by type of forest. The amount of carbon dioxide emitted by forest clearing has been estimated to be 84,790 Gg in 1990, which represents about 44% of carbon dioxide national emissions. The estimation of the other greenhouse gases are: methane, 158 Gg; nitrous oxide, 1.1 Gg; nitrogen oxides, 39 Gg; and carbon monoxide, 1380 Gg. Of the non-CO2 trace gases, this source contributes more significantly to national emissions of nitrous oxide (23%) and carbon monoxide (32%).

As the country seems to have a rather high deforestation rate, any effort aimed at improving some of the basic data as well as obtaining a better knowledge on the land use change process, may considerable improve the greenhouse gas emission estimates from this source. For example, the methodology assumes that 50% of the cleared forests are burned in the first year with the remaining 50% left to decay over a 10 year period, but no research has been done in the country to verify the validity of this assumption.

On the other hand, a portion of the cleared biomass is commonly removed for different purposes such as fuel and some forest products. However, the amount and fate of the removed biomass is also unknown. Additionally, the annual deforestation rate derived for this inventory is 3 to 4 times higher than the average reported by the national statistics on legal clearcuting. Although discussed with official from the Ministry of Environment and Renewable Natural Resources, no reasonable answers have been found to explain this great difference. It is been argued that extrapolating a deforestation rate of 4%, obtained from very specific areas, to the entire nor-eastern region of the country could have introduced a significant source of error, likely resulting on an overestimation of the annual average of land clearing.

TABLE No. IV - 2
FOREST CLEANING
GREENHOUSE GAS EMISSION ESTIMATES. 1990

FOREST TYPE		TOTAL CARBON RELEASE (Gg)	TOTAL NITROGEN RELEASE (Gg)	EMISSIONS ESTIMATES (Gg)				
				CO2	CH4	N2O	NOX	CO
CLOSED FORESTS	I	3,621	15	13,278	25	0.2	5.9	216
	II	1,678	7	6,151	11	0.1	2.9	100
	III	13,191	56	48,364	90	0.6	22.2	787
OPEN FORESTS		4,635	20	16,997	32	0.2	7.9	277
TOTAL		23,125	98	84,790	158	1.1	38.9	1,380

Forest types correspond to an aggregate of the categories defined by the 1980 Venezuelan Vegetation Map, based on height and density of the forest.

These are some of the main factors that can significantly contribute to the uncertainty of the greenhouse gas emission estimates associated with forest clearing. Being one of the most important source of carbon dioxide and other gases as well as one of the most complex areas, a number of issues will need to be refined in the future to improve the estimates and update the inventory.

IV.2 MANAGED FORESTS

The category Managed Forests used in this section includes two main activities of land use practices: management of commercial forests and establishment and management of commercial plantations and other afforestation/reforestation programs. Fuelwood gathering and village/farm trees are not considered here as these are not important for biomass accounting in the country.

Carbon dioxide uptake from these activities has been estimated to be 5,530 Gg in 1990, which represents an offset of about 6 and 3 % of carbon dioxide emissions from forest clearing and all sources respectively. Although its importance as a carbon dioxide sink may not seem relevant within the national greenhouse gas emission context, the potential contribution of forest management to offsetting CO2 emissions is quite large.

The estimation is based on the IPCC methodology, which calculates the net uptake of CO2 based on the annual increase of biomass in plantations and managed commercial forests and the amount of wood harvested for different purposes. As proposed by the methodology, it has been assumed that all carbon removed in wood and other biomass from forests is oxidized in the year of removal, despite the fact that most wood harvested is used for long-term products. Estimates of average annual accumulation of dry matter as biomass per hectare for forests naturally regrowing have been based on a local study performed on a managed area (Plonczak, 1993). This study reports an average annual growth of 3.8 m3/ha/year which is equivalent to 3.3 t dm/ha. This value is less than half of the default value provided by the IPCC methodology for closed forests in Tropical America and will need to be revised, as this figure represents a significant source of uncertainty in the estimates of CO2 uptake by managed forests.

According to statistics of the Venezuelan Forest Service, the total forest area managed by commercial forest product industries during the 1970-90 period had reached 215,460 hectares. More than half of these areas was incorporated to commercial production during the last 10 years. Forest harvesting has been traditionally selective as a few number of species are considered to have a high demand within the national market.

Forest plantations within the 1970-90 period have reached, according to the same statistics, about 430.000 hectares, of which more than 95% are commercial plantations. The rest has been established for protection purposes. Pinus caribaea is the dominant specie, mainly concentrated in the north eastern region of the country, and was initially planted for pulp and paper production. The objectives of the plantations have been redefined in the last few years, and now include lumber and other uses.

The planted area has not been commercially harvested in any relevant proportion yet, and consequently, no carbon emission are estimated from management of commercial plantations. Only carbon uptake is included here, as a result of biomass growth. The average annual accumulation of dry matter of biomass for the plantation has been estimated to be 6.4 t/ha, which is significantly lower than the default value of 10 t/ha provided by the IPCC methodology for Pinus caribaea. The local data was derived from measurements performed by the national company in charge of this plantation, which reports and average growth rate of 8 m3/ha/year.

As most of the data used for both managed forest and commercial plantation areas are fairly reliable, the most important issue that remain to be refined relates to annual biomass increments as management practices as well as ecological characteristics can significantly influence the growth rates of natural forests and plantations.

IV.3 CONVERSION OF GRASSLANDS TO CULTIVATED LANDS

Conversion of grasslands to cultivated lands is not a significant source of carbon dioxide in the country, as agricultural activities have been rather marginal within the national economic development context, especially after the oil industry became basically the only source of revenues. Furthermore, the savanna (grassland) areas of the country have traditionally been considered marginal to agricultural development, in both cultivated pastures and crops (Silva and Moreno, 1993). However, some important crops have been established on open savannas, which means that a conversion process has taken place, to certain extent. The colonization of these areas became more important during the 1984-1989 period, when government subsidies resulted in an important extension of the agricultural frontier.

The calculation of carbon flux from this land use change requires a twenty-five year time horizon, in which the total area of grasslands converted to cultivated lands must be estimated. This information is not available in the country, and consequently two different approaches were used to derive these data. First, an analysis of a 25 year period statistics of the most important crops that are partly established in savanna areas. The crops included in this analysis are maize, sorghum, rice, sesame, peanut, and cotton. Cultivated pasture was not considered as no information was available. The series evolution shows an irregular pattern of growth and declining of the cultivated area for all these crops, likely following the country's economy fluctuations. A very rough estimate of the net converted area within this period was around 520.000 hectares.

The second approach was based on the same satellite image study performed for savanna burning, which was used, in this case, to determine the amount of new cultivated areas within the boundaries of the savanna region. As much of the conversion process occurred within the period used for the multitemporal analysis (1979-1989), it was considered that this study would provide a very rough average of the net savanna area converted to cultivated lands, which could then be compared with the result obtained from the previous approach. About 820.000 hectares of converted savannas were estimated from this satellite image study.

Average soil carbon content for a typical savanna was also determined. This was indirectly calculated by an established relationship between organic material and organic carbon (approximately 2 to 1). Many research studies performed on different types of savannas in the country have measured soil organic material content, which have been averaged for the purpose of this estimate and then multiplied by the average soil density, in order to determine the content of soil carbon. The result obtained of nearly 20 tC/ha is much lower than the 60 tC/ha given by the IPCC methodology as default value for tropical areas.

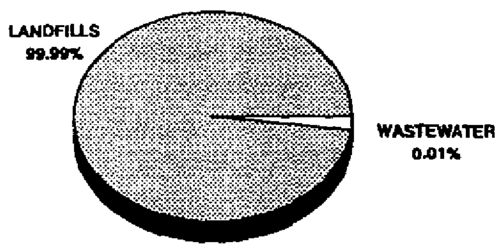
The annual rate of soil carbon loss of 2 % reported by the methodology for temperate areas was used to determine carbon dioxide emissions from grassland conversion. Based on the highest value of net converted area and the local data on soil carbon content, emissions were estimated to be 1202 Gg of carbon dioxide. However, as all the data used may be easily questionable, the result obtained is highly uncertain and should be viewed as a general approximation of the emissions magnitude from this source.

V. WASTE

Methane is the most important gas generated by the disposal and treatment of municipal and industrial wastes. Two sources can produce significant quantities of methane through the anaerobic systems employed to manage the biodegradable wastes resulting from human activities: landfills and wastewater treatment.

Of these two sources, landfills are basically the only methane source from waste management in Venezuela as anaerobic treatment of municipal and industrial wastewater is not a common practice in the country. Landfilling of solid wastes has been increasing in the last few years and, as a result, the contribution of this source to methane emissions is likely to increase in the future. In 1990, methane emissions accounted for around 7% of total Venezuelan methane emissions.

FIGURE V-1
METHANE EMISSIONS FROM WASTE BY SOURCE
(221 Gg)



Open dumping, which is the most common waste management practice in the country, can also result in methane production. However, due to the uncertainty associated with the suggested approach for estimating emissions from this source (IPCC/OECD, 1994), methane from open dumping is not included in this national inventory.

V.1 LANDFILLS

Landfills do not constitute a significant source of methane in the country since a great fraction of solid wastes is still disposed off in open dumping. Sanitary landfilling generates 221 Gg of methane, which represents basically all the methane emitted by waste disposal and treatment.

Most landfills in the country were identified as well as the average daily amount of waste placed in these sites. This information was used to determine the total amount of waste landfilled per year and, although fairly reliable, should be considered an approximation since the data was based on the average amount of waste collected in the urban areas that practice sanitary landfilling and not on the actual amount of wastes received by these landfills.

Twenty landfills were identified, with a wide size range. The smallest of these receives an average of less than 3,000 tones of solid wastes per year while more than 1 million tones per year are placed in the biggest landfill (see Table V-1). The latter alone, which serves the capital's metropolitan area, accounts for more than 40% of the total landfilled waste in the country.

TABLE No. V - 1
NUMBER OF LANDFILLS AND AMOUNT OF WASTE

SIZE OF LANDFILLS (tones waste / year)	NUMBER OF LANDFILLS	TOTAL WASTE (tonnes / year)	CONTRIBUTION TO TOTAL LANDFILLED WASTE (%)
> 1 MILLION	1	1,277,500	43
0.5 - 1 MILLION	-	-	-
100,000 - 500,000	4	1,071,600	36
10,000 - 100,000	9	566,540	19
< 10,000	6	32,810	1
TOTAL	20	2,948,500	100

The size variations as well as other landfill designs and physical differences may have an important influence on the rates of methane emissions. However, the complex interrelations among these variables and the lack of information, make practically impossible to account for their effects in the emission estimates.

The methodology used to calculate methane emissions from landfills is based on the simple IPCC approach, which basically consists on the amount of waste landfilled; the fraction of degradable organic carbon and the amount which actually degrades; and the fraction of methane in landfill gas.

The total amount of waste landfilled in the country was obtained from different sources: site visits to some of the main landfills, interview with the manager of the biggest waste collecting company, and specific related studies/statistics analysis. With all the collected information, there was no need to indirectly estimate this value through the urban population and the default values provided by the IPCC methodology regarding average waste generation rate and fraction landfilled. This research also helped to determine that waste generation rates for Venezuelan urban areas range from 0.7 to 1.2 kg/cap/day (almost double of the default value for developing countries) and that the fraction landfilled is about 50% (significantly lower than the default value of 80% given for developing countries).

In general, landfills in the country do not have adequate provisions for the safe control and the management practices are rather poor in terms of the appropriate use of intermediate daily covers. These factors would likely influence methane production from the landfills by not providing, on a regular basis, the necessary anaerobic conditions.

Additionally, scavenging activities (inmediatelly after the waste is placed on the sites) and burning are common practices in some landfills, which may also affect the quantity of degradable organic matter. When all these practices are taken into consideration, methane emission from landfills in the country could be overestimated. However, since quantifying the effects of all these elements in the gas production potential will require a detailed set of research and site measurements, it has been assumed, for practical reasons, that all landfills have adequate management practices.

Another element that was not taken into account in this estimate, and which may also affect the amount of methane reported, is the flaring technique commonly included in the design of landfills in the country. Nevertheless, considering the poor management practices and the difficulty of estimating the extent of flaring with accuracy, the amount of flared methane has been assumed to be negligible.

V.2 WASTEWATER

Wastewater treatment plants are a negligible source of methane in the country. Methane emissions from municipal wastewater have been calculated to be between 0.2 and 0.6 Gg, which accounts for less than 0.01% of national methane emissions. Two different approaches were used to calculate emissions from municipal wastewater: one based on BOD content and the other on volatile solid content.

The first one is based on the IPCC method, which is to estimate the amount of organic material in wastewater, indicated by the Biochemical Oxygen Demand (BOD), multiplied by the fraction of water treated anaerobically and the methane emissions factor.

The number of anaerobic treatment plants as well as the total volume of treated wastewater were determined, based on the information provided by the national headquarter of the Water Management Company. Fourteen anaerobic treatment plants were identified in the country, which are managed by regional companies, recently decentralized. The wastewater volume treated by these plant represents only 1% of the total wastewater generated by the country. This proportion is far away from the 10 % given by the IPCC methodology as a default value for the fraction treated anaerobically in developing countries. Most of the wastewater in Venezuela (both municipal and industrial) is still directly discharged to rivers, lakes, and oceans without any kind of treatment; or, in some cases, is aerobically treated.

With an urban population of about 18.6 million people, the fraction of wastewater treated anaerobically, the recommended methane emission factor , and the BOD default value (validated with local data), methane emissions from municipal wastewater were estimated to be 0.6 Gg.

The second method is based on the quantity of volatile solid content of untreated wastewater (VSC) and methane production, both measured at a local experimental wastewater treatment plant. As the former, it relies on the urban population to estimate the total amount of wastewater generated by the country and also on the fraction treated anaerobically. The VSC method is based on the following data and equation:

$$\left[\frac{gr\ CH4}{year}\right]=\left[\frac{Urban}{Population}\right]\left[\frac{l.\ wastewater}{cap/day}\right]\left[\frac{365\ days}{year}\right]\left[\frac{Kg\ VS}{l.wastewater}\right]\left[\frac{gr\ CH4}{Kg\ VS}\right]\left[\frac{Anaerobic}{Fraction}\right]$$

The application of this method resulted in 0.2 Gg of methane per year, significantly lower than the value (0.6 Gg) obtained through the use of the BOD approach. However, it is believed that the approach based on VSC is more applicable for Venezuela, as the BOD based method assumes both the treatment quality of the wastewater is homogenous and the activated sludge yield is about the same in the country while the calculation of the former is based on direct measurements of gas production in a local anaerobic wastewater treatment plant for a representative initial water quality. The result obtained from this method is then used to provide an estimate of methane emissions generated by anaerobic treatment plants in the country.

In order to evaluate methane emissions from industrial wastewater treatment plants, a short survey of a randomly selected number of the key industry groups in the country (those with high BOD content) was performed. The objective of the survey was to identify the extent in the use of anaerobic treatment plants by the industrial sector and collect some of the basic data needed for the emission estimates. Some experts in this field were also interviewed to roughly determine the technologies most commonly used in the country to treat industrial wastewater. Based on this preliminary research, only 3 or 4 big industries have anaerobic plants (two of them with provisions for gas recovery), which do not generate any relevant volume of wastewater. Consequently, methane emissions from industrial wastewater are not provided.

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ANNEX 1

ANNEX 1

INFORMATION SYSTEM OF GREENHOUSE GAS EMISSIONS INVENTORY (INVENE)

An information system was developed to manage and process all the information related to greenhouse gas emission inventories in order to ensure a reliable process of data and calculation updating. The Information System of Greenhouse Gas Emissions Inventory (INVENE) was developed in Excel, version 4.0, using MACROS. The system has a friendly interface, based on selection botones of WINDOWS type.

The system integrates different interrelated data and calculation tables, which allows for updating and data management, calculation updating, screen consultations, and report printing. INVENE includes the national emission inventory tables as required by the Greenhouse Gas Inventory Reporting Instructions (IPCC/OECD, 1994, vol. 1). The flow chart and tables of the system are shown below.

ENERGY (MENU A1)

The area ENERGY (MENU A1) has six disaggregation levels to access the information for each emission source included in the energy sector inventory. The first level (MENU B1) subdivides the area in two emission sources: combustion (MENU C1) and fugitive emissions (MENU C2); it also includes a section (MENU C3) to access emission information of the entire energy sector through two consolidated reports by activity (Table C3-1) and a short summary (Table C3-2).

MENU C1, which corresponds to emissions from combustion, considers the two source categories: stationaries (MENU D2) and mobiles (MENU D3) as well as a detailed calculation of CO2 emission based on the Top-down methodology (MENU D1), adjustments for CO2 emission estimate differences resulting from the application of the Top-down and Bottom-up methodologies (Table C1-2), and a summary of emissions from combustion (Table C1-3).

CO2 emission estimates based on the Top-down methodology (MENU D1) include two tables, sequestered carbon (Table D1-1) and CO2 emissions (Table D1-2), which contain all the information and calculation used. These tables correspond to Worksheet 1-1 of the Greenhouse Gas Inventory Workbook (IPCC/OECD, 1994, vol.2, pags 1-25 and 1-31).

The stationary and mobile sources Menus include the data and calculations used for emission estimates of all gases, including CO_2 emissions based on the Bottom-up methodology.

Stationary sources (MENU D2) is subdivided in several emission sectors and includes a summary of emissions from stationary sources. Tables for each sector provide information on energy consumption data, selected emission factors, and emission estimates. Each sector has a different dissagregation level. Thus the commercial & service and residential sectors are not disaggregated; all these sectors information is presented in Tables D2-3 and D2-4, respectively. Energy industry is disaggregated (MENU E1) in electricity generation (Table E1-1) and oil and gas industry (Table E1-2). Lastly, manufacture industry (MENU E2) is disaggregated by category at two digits of ISIC; in this case, the energy consumption data (Tables G1-1to G1-6) (MENU G1) and the emission estimate tables (Table G2-1 to G2-9) for each industry category (MENU G2)are presented separaely. MENU E2 also includes summaries of manufacture industry emissions by category, energy use, and fuel (Tables F2-1, F2-2, and F2-3).

Mobile sources (MENU D3) are subdivided, according to transportation modes, in road transportation and other modes, and includes international transportation (Table D3-1), separately. A summary of mobile sources emissions (Table D3-4) is also included. Road transportation (MENU E3) is disaggregated according to fuel type: gasoline (Table F3-1) and diesel (Table F3-2); a summary is also presented (Table E3-2).

NON-ENERGY

All the tables of the area NON-ENERGY (MENU A2) correspond to the worksheets as presented in the Greenhouse Gas Inventory Workbook, and follow the same categories: Agriculture, Land Use Change and Forestry, and Waste. MENU B5 includes all the sources corresponding to Agriculture; MENU B6, all Land Use Change and Forestry Sources; except for Abandonment of Managed Lands; and MENU B7, those corresponding to Waste, except for Industrial Wastewater.

CONSOLIDATED (MENU A3)

This section includes Minimum Data Tables for the emission source categories considered in this national inventory, and Summary and Short Summary Reports for National Greenhouse Inventory, as required by IPCC in the Greenhouse Gas Inventory Reporting Instructions (IPCC/OECD, 1994, vol. 1).

All the tables mentioned are available on request.

ESQUEMA DE FLUJO DEL SISTEMA

MENU PRINCIPAL
(MAIN MENU)

- ENERGIA E INDUSTRIA
  - MENU A1
    - SECTOR ENERGETICO (VER @1, Pag P2)
    - PROCESOS INDUSTRIALES
    - SOLVENTES
    - CONSOLIDADO
    - RETORNAR
- NO-ENERGETICOS (Ver @2, Pag P4)
  - MENU A2
    - AGRICULTURA
    - USO DE LA TIERRA Y BOSQUES
    - DESECHOS
    - CONSOLIDADO
    - RETORNAR
- CONSOLIDADO
  - MENU A3
    - DATOS MINIMOS (1-6) (Ver @3, Pag P5)
    - RESUMEN (6A)
    - RESUMEN ABREVIADO (6B)
    - TABLA GENERAL (7A)
    - RETORNAR
- ACTUALIZAR BASE DE DATOS
- SALIR

esquem.prs

ESQUEMA DE FLUJO DEL SISTEMA

(@1) SECTOR ENERGETICO

MENU B1

- **COMBUSTION**
- **FUGITIVAS**
- **CONSOLIDADO**
- **RETORNAR**

MENU C1 (COMBUSTION)

- CO2 TOP-DOWN
- FUENTES ESTACIONARIAS
- FUENTES MOVILES
- BIOMASA
- AJUSTES C1-2
- RESUMEN C1-3
- RETORNAR

MENU D1 (CO2 TOP-DOWN)

- CARBONO SECUESTRADO (D1-1)
- EMISIONES DE CO2 (D1-2)
- RETORNAR

MENU D2 (FUENTES ESTACIONARIAS)

- INDUSTRIA ENERGETICA
- INDUSTRIA MANUFACTURERA (VER @4, PAG P3)
- COMERCIO Y SERVICIOS (D2-3)
- RESIDENCIAL (D2-4)
- OTROS (D2-5)
- RESUMEN (D2-6)
- RETORNAR

MENU E1 (INDUSTRIA ENERGETICA)

- GENERACION ELECTRICA (E1-1)
- PETROLEO Y GAS (E1-2)

MENU D3 (FUENTES MOVILES)

- TRANSPORTE TERRESTRE
- BUNKERS (D3-1)
- OTROS (D3-3)
- RESUMEN (D3-4)
- RETORNAR

MENU E3 (TRANSPORTE TERRESTRE)

- DESAGREGADO
- RESUMEN (E3-2)
- RETORNAR

MENU F3 (DESAGREGADO)

- GASOLINA(F3-1)
- DIESEL (F3-2)

MENU C2 (FUGITIVAS)

- SISTEMA PETROLEO/GAS
- CARBON (C2-2)
- RESUMEN (C2-3)
- RETORNAR

MENU D4 (SISTEMA PETROLEO/GAS)

- TIER 1 : -
  - APROX. METODOLOGICA
- TIER 2 :
  - PRODUCCION PETROLEO/GAS (D4-2)
  - TRANSP. REFINACION CRUDO (D4-3)
  - PROCESAM./DISTRIBUCION GAS (D4-4)
  - RETORNAR

MENU C3 (CONSOLIDADO)

- POR ACTIVIDADES (C3-1)
- POR ACTIVIDADES Y COMBUSTIBLE (C3-2)

ESQUEMA DE FLUJO DEL SISTEMA

@4 INDUSTRIA MANUFACTURERA

MENU E2

POR RAMA

RESUMEN

RETORNAR

MENU F1

DATOS CONSUMO
DE ENERGIA

EMISIONES

MENU G1

USO/COMBUSTIBLE1 (G1-1)
USO/RAMA (G1-2)
RAMA/COMBUSTIBLE (G1-3)
GEN.VAPOR (G1-4)
CALOR DIRECTO (G1-5)
OTROS USOS (G1-6)

MENU G2

31 (G2-1)
32 (G2-2)
33 (G2-3)
34 (G2-4)
35 (G2-5)
36 (G2-6)
37 (G2-7)
38 (G2-8)
39 (G2-9)

MENU F2

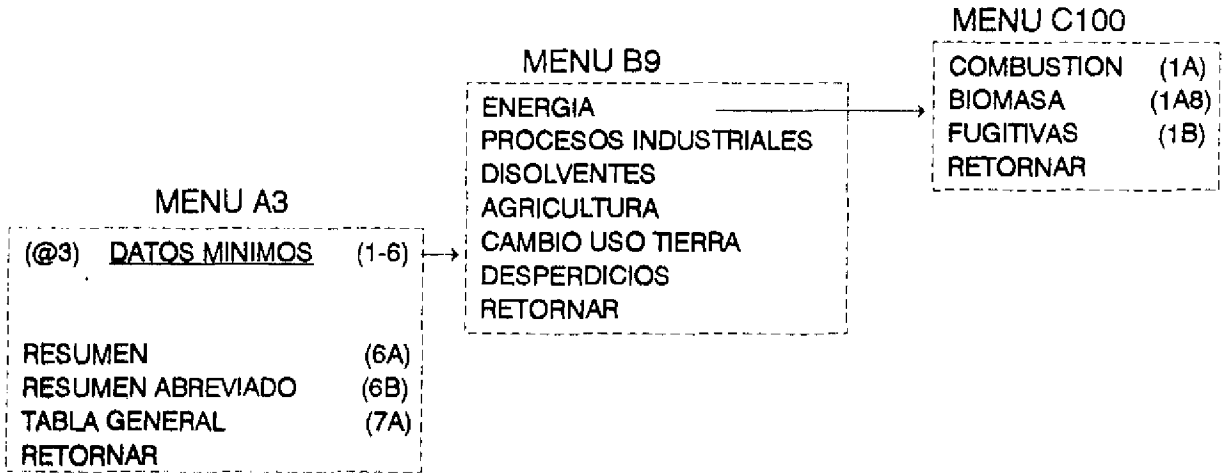
RAMA Y USOS (F2-1)
RAMA Y COMBUSTIBLE (F2-2)
POR RAMA (F2-3)

ESQUEMA DE FLUJO DEL SISTEMA

NO-ENERGETICOS (@2)

MENUA2
- AGRICULTURA
  - MENUB5
    - ANIMALES DOMESTICOS B5-1
    - CULTIVOS DE ARROZ B5-2
    - QUEMA DE SABANAS
      - MENUC7
        - PAG 1 C7-1
        - PAG 2 C7-2
        - PAG 3 C7-3
    - DESECHOS AGRICOLAS
      - MENUC8
        - PAG 1 C8-1
        - PAG 2 C8-2
        - PAG 3 C8-3
    - FERTILIZANTES B5-5
- USO DE LA TIERRA Y BOSQUES
  - MENUB6
    - PLANTACIONES Y MANEJO FORESTAL
      - MENUC9
        - PAG 1 C9-1
        - PAG 2 C9-2
        - PAG 3 C9-3
    - CONVERSION DE PASTOS Y BOSQUES
      - MENUC10
        - PAG 1 C10-1
        - PAG 2 C10-2
        - PAG 3 C10-3
        - PAG 4 C10-4
        - PAG 5 C10-5
        - PAG 6 C10-6
    - QUEMA DE BOSQUES B6-3
- DESECHOS
  - MENUB7
    - RELLENOS SANITARIOS B7-1
    - AGUAS RESIDUALES B7-2
- CONSOLIDADO

ESQUEMA DE FLUJO DEL SISTEMA



TABLES FROM IPCC REPORTING INSTRUCTIONS

INVENE/TABLE 1A

PRELIMINARY ESTIMATION OF GHG EMISSIONS
BOTTOM - UP METHODOLOGY

MINIMUM DATA TABLES I ENERGY
(IA) Energy Fuel Combustion Activities (Part I)

COUNTRY : VENEZUELA

YEAR : 1990

SOURCE AND SINK CATEGORIES	ACTIVITY DATA	EMISSIONS ESTIMATES						AGGREGATE EMISSION FACTORS					
Sector Specific Data (units)	A Apparent Consumption (PJ)	B (Gg of full mass of pollutant)						C (Kg (pollutant)/Gj) C=B/A					
		CO2 (*)	CH4	N2O	NOx	CO	NMVOC	CO2	CH4	N2O	NOx	CO	NMVOC
I A Fuel Combustion Activities (**)	1278	84453	12.02	0.64	339.24	1878.48	250.04	66.1	0.0094	0.0005	0.2656	1.4703	0.1957
Oil	641	45025	10.18	0.55	233.49	1835.98	250.04	70.2	0.0159	0.0009	0.3642	2.8635	0.3900
Gas	616	34382	1.79	0.07	104.94	21.26		55.8	0.0029	0.0001	0.1704	0.0345	
Coal	14	1316	0.02	0.02	0.21	2.91		92.7	0.0011	0.0015	0.0149	0.2050	
Biomass	6	688	0.03	0.00	0.60	18.33		109.6	0.0053	0.0001	0.0961	2.9203	
Other (specify) (***)	0	3729	0.00	0.00	0.00	0.00		#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	
I A 1 Energy and Transformation Activities	511	30516	1.65	0.10	83.14	10.90		59.8	0.0032	0.0002	0.1628	0.0214	
Oil	101	7629	0.18	0.06	19.00	1.83		75.8	0.0018	0.0006	0.1888	0.0181	
Gas	410	22887	1.46	0.04	64.15	9.08		55.8	0.0036	0.0001	0.1564	0.0221	
Coal													
Biomass													
Other (specify)													
I A 2 Industry (ISIC)	279	16774	0.44	0.08	56.10	27.87		60.2	0.0016	0.0003	0.2014	0.1000	
Oil	60	4372	0.10	0.04	14.93	2.92		72.9	0.0017	0.0006	0.2490	0.0487	
Gas	199	11087	0.32	0.02	40.44	12.10		55.8	0.0016	0.0001	0.2036	0.0609	
Coal	14	1316	0.02	0.02	0.21	2.91		92.7	0.0011	0.0015	0.0149	0.2050	
Biomass	6	639	0.00	0.00	0.51	9.94		109.7	0.0000	0.0000	0.0880	1.7059	
Other (specify)													
I A 3 Transport	420	29164	9.79	0.42	196.58	1829.88	250.04	69.4	0.0233	0.0010	0.4676	4.3528	0.5948
Oil	420	29164	9.79	0.42	196.58	1829.88	250.04	69.4	0.0233	0.0010	0.4676	4.3528	0.5948
Gas													
Coal													
Biomass													
Other (specify)													

(*) CO2 EMISSIONS FROM BIOMASS ARE NOT INCLUDED IN THE TOTAL, THIS IS ONLY FOR INFORMATION PURPOSES.
(**) ESTIMATE BASED ON BOTTOM-UP METHODOLOGY.
(***) INCLUDES CO2 EMISSIONS FROM CARBON NON-SEQUESTERED IN FRACTION OXIDIZED FROM NON-ENERGY USES OF THE FUELS (e.g. FERTILIZER) . DETAILS IS PROVIDED IN ANNEX 2.
NOTE : Totals may not equal sum of components due to independent rounding.

INVENE/TABLE 1A

PRELIMINARY ESTIMATION OF GHG EMISSIONS
BOTTOM - UP METHODOLOGY

(IA)Energy Fuel Combustion Activities (Part II)

COUNTRY : VENEZUELA

YEAR : 1990

SOURCE AND SINK CATEGORIES	ACTIVITY DATA	EMISSIONS ESTIMATES						AGGREGATE EMISSION FACTORS					
	A	B						C					
Sector Specific Data (units)	Apparent Consumption (PJ)	(Gg of full mass of pollutant)						(Kg (pollutant)/GJ) C=B/A					
		CO_2 (*)	CH_4	N_2O	NO_x	CO	NMVOC	CO_2	CH_4	N_2O	NO_x	CO	NMVOC
I A 4 Commercial / Institutional	9	572	0.01	0.04	0.46	0.10		63.1	0.0010	0.0041	0.0510	0.0112	
Oil	7	450	0.01	0.03	0.36	0.08		65.4	0.0010	0.0046	0.0519	0.0117	
Gas	2	123	0.00	0.01	0.11	0.02		55.8	0.0012	0.0024	0.0480	0.0096	
Coal													
Biomass													
Other (specify)													
I A 5 Residential	59	3678	0.13263	0.01101	2.86172	9.00432		62.7	0.0023	0.0002	0.0488	0.1536	
Oil	53	3392	0.09	0.01	2.53	0.56		63.9	0.0018	0.0002	0.0477	0.0106	
Gas	5	286	0.01	0.00	0.24	0.05		55.8	0.0010	0.0001	0.0470	0.0100	
Coal													
Biomass	0.453	49	0.03	0.00	0.09	8.40		108.2	0.0740	0.0014	0.2000	18.5330	
Other (specify)													
I A 6 Agriculture / Forestry and Others	0.270	19	0.01	0.00	0.10	0.72		69.9	0.0209	0.0008	0.3632	2.6531	
Oil	0.270	19	0.01	0.00	0.10	0.72		69.9	0.0209	0.0008	0.3632	2.6531	
Gas													
Coal													
Biomass													
Other (specify)													

(*) CO2 EMISSIONS FROM BIOMASS ARE NOT INCLUDED IN THE TOTAL, THIS IS ONLY FOR INFORMATION PURPOSES. ESTIMATE BASED ON BOTTOM-UP METHODOLOGY.

NOTE : TOTALS MAY NOT EQUAL SUM OF COMPONENTS DUE TO INDEPENDENT ROUNDING.

INVENE/TABLE 1A8

PRELIMINARY ESTIMATION OF GHG EMISSIONS

I A 8 Traditional Biomass Burned for Energy

COUNTRY : VENEZUELA

YEAR : 1990

Sector Specific Data	ACTIVITY DATA A Apparent Consumption (1) (Pj)	EMISSIONS ESTIMATES (Gg)					AGGREGATE EMISSION FACTORS (Kg (pollutant) / Gg) C=B/A				
		CH4	N2O	NOx	CO	NMVOC	CH4	N2O	NOx	CO	NMVOC
	0.463	0.03	0.00	0.80	18.33		0.0740	0.0014	1.3313	40.4650	
Fuelwood	0.286	0.02	0.00	0.06	5.30		0.0740	0.0014	0.2000	18.5330	
Charcoal Production	0.167	0.01	0.00	0.03	3.10		0.0740	0.0014	0.2000	18.5330	
Charcoal Consumption											
Dung											
Agriculture residues											
Bagasse	0	0.00	0.00	0.51	9.94		#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	
Other (specify)											

(1) Apparent consumption in Kt dm is not available.

INVENE/TABLE 1B1 Y 1B2 PRELIMINARY ESTIMATION OF GHG EMISSIONS

I B I Fugitive Fuel Emissions (Oil and Gas)

COUNTRY : VENEZUELA

YEAR : 1990

SOURCE AND SINK CATEGORIES	ACTIVITY DATA	EMISSIONS ESTIMATES		AGGREGATE EMISSION FACTORS	
	Fuel Quantity (PJ)	CH_4 (Gg)	CO_2 (Gg)	CH_4 (Kg / Gg)	CO_2 (Kg / Gg)
I B I a Crude Oil (Total)		4.88			
i Production					
ii Transported	3886.85	2.90		0.0007	
iii Refined	2240.84	1.98		0.0009	
I B I b Natural Gas (Total)		307.58	0.00		
i Production					
ii Processing, Transp.& distrib.	972.44	307.58		0.3163	
I B I c Oil / Gass Joint (1)	1263.86	1610.78	1358.49	1.1954	1.0749

(1) Fuel quantity is net production of natural gas which is associated to oil production.

I B 2 Fugitive Fuel Emissions (Coal Mining)

COUNTRY : VENEZUELA

YEAR : 1990

SOURCE AND SINK CATEGORIES	ACTIVITY DATA	EMISSIONS ESTIMATES			AGGREGATE EMISSIONS FACTORS	
Coal Mining	Production (mt)	Total CH_4 (Gg CH_4)	Production (Gg CH_4)	Post Processing (Gg CH_4)	Production (Kg CH_4 / t)	Post Processing (Kg CH_4 / t)
I B 2 a Surface	2.243	0.45-3.0			1.3375	
b Underground						

PRELIMINARY ESTIMATION OF GHG EMISSIONS

MINIMUN DATA TABLES 4 AGRICULTURE

4 A & B ENTERIC FERMENTATION & ANIMAL WASTES

COUNTRY : VENEZUELA | YEAR : 1990

Source And Sink Categories	Activity Data	Emission Estimates		Aggregate Emission Factor	
	A	B		C	
Sector Specific Data (units)	Number of Animals	Enteric Fermentation	Animal Wastes	Enteric Fermentation	Animal Wastes
	(1000)	(Gg CH4)		(Kg CH4 per animal)	
4 AGRICULTURE					
A & B Enteric Fermentation & Wastes					
1 Cattle					
1.1 Beef	12126.149	720.29	12.12	59.00	1.00
1.2 Dairy	1204.992	83.14	2.41	69.10	2.00
2 Goats	710.493	3.55	0.16	5.00	0.22
3 Sheep	144.690	0.72	0.02	5.00	0.16
4 Pigs	2961.118	2.96	8.88	1.00	3.00
5 Horses/ Mules/Asses	1007.000	14.03	1.70	13.93	1.20
6 Buffalo	35.786	1.97	0.07	55.00	2.00
7 Camels And Llamas	-	-	-	-	-
8 Poultry	56500.000	-	1.30	-	1.30

PRELIMINARY ESTIMATION OF GHG EMISSIONS

4 C RICE CULTIVATION

COUNTRY : VENEZUELA | YEAR : 1990

Source And Sink Categories	Activity Data		Emission Estimates	Aggregate Emissions Factor
	A	B	C	D
Sector Specific Data (units)	Area cultivated in hectares (Mha)	Hectare-Days of Cultivation (Mha-days)	Emissions of CH4 (Gg CH4)	CH4/N2o Average Emission Factor (Kg CH4 per ha-day)
				D = C/B
C Rice Cultivation				
1 Flooded	0.12	90	67.49	0.75
2 Intermittent				
3 Dry Regime				

PRELIMINARY ESTIMATION OF GHG EMISSIONS

4 D AGRICULTURAL SOILS

COUNTRY : VENEZUELA

YEAR : 1990

Source And Sink Categories	Activity Data		Emission Estimates	Aggregate Emissions Factor (a)	
	A	B	C	D	E
Sector Specific Data	Amount of nitrogen applied in fertilizer and manure (tN)	Area Cultivated (ha)	(Gg N2O)	Nitrogen oxide released per tonne N applied (ton N2O/tonn)	Amount of biological fixation of nitrogen (t N)
				D = C/A	
List by type of crop					
	144000	(*)	2.3	0.016	-

(*) The area cultivated was not calculated since the emission estimate was bared on the amount of nitrogen applied.

PRELIMINARY ESTIMATION OF GHG EMISSIONS

4 E AGRICULTURAL WASTE BURNING

COUNTRY : VENEZUELA

YEAR : 1990

Source Categories	Activity Data		Emissions Estimate				Aggregate Emissions Factors			
Sector Specific Data (units)	A Annual Burning of Crop Residues (kt dm)	B Carbon Fraction (t / t dm)	C Full Mass of Pollutant (Gg)				D Pollutant per tonne of dry matter (Kg / t dm)			
							D = C / A * 1000			
			CH4	N2O	NOx	CO	CH4	N2O	NOx	CO
E Agricultural Waste Burning										
a..... List crop type here										
Sugar Cane	621.0	0.4092	1.69	0.04	1.40	35.52	2.72	0.06	2.25	57.20
Cotton	33.7	0.36	8.1	0.19	6.70	170.00	240.36	5.64	198.81	5044.51

PRELIMINARY ESTIMATION OF GHG EMISSIONS

4 F SAVANNA BURNING

COUNTRY . VENEZUELA

YEAR : 1990

Activity Data			Emissions Estimates				Aggregate Emission Factors			
A	B	C	D Full Mass of Pollutant (Gg)				E = (D/B) * 1000 Pollutant per tonne of dry matter (kg / t dm)			
Area of Svanna burned K ha / year	Biomass Burned kt dm	Carbon Fraction	N_2O	NO_x	CO	CH_4	N_2O	NO_x	CO	CH_4
3136.6	14963.17	0.45 / 0.40	0.39	13.88	821.29	31.29	0.03	0.93	54.89	2.09

PRELIMINARY ESTIMATION OF GHG EMISSIONS

MINIMUM DATA TABLES 5 LAND USE CHANGE AND FORESTRY

5 A 1 FOREST CLEARING : CO2 RELEASE FROM BURNING ABOVEGROUND BIOMASS

COUNTRY VENEZUELA

YEAR : 1990

Source And Sink Categories				Activity Data			Emission Estimates	Aggregate Emissions Factor
				A Area Cleared (k ha)	B Total Biomass Change (kt dm)	C Quantity of Biomass Burned (on and off-site) (kt dm)	D Quantity of CO2 Released (Gg CO2)	E (Mg CO2 / kt dm Burned)
								E = D/C
Tropical	Closed Forests	Broadleaf	Category I	21.72	8470.80	4235.40	6289.57	1.49
			Category II	17.06	3923.80	1961.90	2913.42	1.48
			Category III	237.34	30854.20	15427.10	22909.24	1.48
	Open forests			240.97	10843.65	5421.83	8051.42	1.49

I - BOSQUE ALTO - DENSO
II - BOSQUE ALTO - MEDIO
III - BOSQUE MEDIO - DENSO, MEDIO - MEDIO
IV - BOSQUE BAJO - DENSO, BAJO - MEDIO, RALO

PRELIMINARY ESTIMATION OF GHG EMISSIONS

5 A 2 ON - SITE BURNING OF CLEARED FORESTS

COUNTRY : VENEZUELA

YEAR : 199X

Source And Sink Categories	Activity Data		Emissions Estimates				Aggregate Emission Ratios			
	A Carbon Release Gg	B Nitrogen Release Gg	C Emissions Estimates Gg				D Aggregate Emissions Ratios			
							D = C / A		D = C / B	
			CH4	CO	N2O	NOx	CH4	CO	N2O	NOx
On- Site Burning of Cleared Forests	9858.35	98.58	157.73	1380.17	1.08	38.87	0.0159996	0.140	0.011	0.394

PRELIMINARY ESTIMATION OF GHG EMISSIONS

5 A 3 FOREST CLEARING : CO_2 RELEASE FROM DECAY OF ABOVEGROUND BIOMASS

COUNTRY : VENEZUELA

YEAR : 1990

Source And Sink Categories				Activity Data			Emission Estimates	Aggregate Emissions Factor
				A 10 - Year Average Area Cleared (k ha)	B 10 - Year Average Actual Loss of Biomass (kt dm)	C Average Quanty of Biomass to Decay (kt dm)	D CO_2 Emissions (Gg CO_2)	E Emissions Factor Mg CO_2 / kt dm Burned
								E = D/C
Tropical	Closed Forests	Broadleaf	Category I	21.72	8470.80	4235.4	6988.41	1.65
			Category II	17.06	3923.80	1961.90	3237.14	1.65
			Category III	237.34	30854.20	15427.10	25454.72	1.65
	Open Forests			240.97	10843.65	5421.83	8946.02	1.65

I - BOSQUE ALTO - DENSO

II - BOSQUE ALTO - MEDIO

III - BOSQUE MEDIO - DENSO, MEDIO - MEDIO

IV - BOSQUE BAJO - DENSO, BAJO - MEDIO, RALO

PRELIMINARY ESTIMATION OF GHG EMISSIONS

5 A 5 TOTAL CO2 EMISSIONS FROM FOREST CLEARING

COUNTRY : VENEZUELA — YEAR : 1990

CATEGORY	EMISSIONS (Gg)
CO2 from Burning of Cleared Biomass	40163.65
CO2 from Decay of Cleared Biomass	44626.29
CO2 from Soil Carbon Release	-
TOTAL	84789.94

5 C 1 ABANDONMENT OF MANAGED LANDS

(ANNUAL REMOVALS FROM LANDS ABANDONED OVER THE PREVIOUS 20 YEARS)

COUNTRY : VENEZUELA

YEAR : 1990

Source Sink Categories				Activity Data			Removal Estimates			Aggregate Removal Estimates	
				A Total Area Abandoned (Previous 20 Years) (k ha)	B Aboveground Biomass in Mature Systems (t dm / ha)	C Soil Carbon In Mature Systems (t C / ha)	D Aboveground Biomass (Gg C)	E Soils (Gg C)	F Total	G Carbon Removal In Aboveground Biomass (Mg / ha)	H Carbon Removal In Soils (Mg / ha)
									F = D + E	G = D / A	H = E / A
Tropical Forests	Closed Forests	Broadleaf	Undisturbed								
			Logged								
		Conifers	Undisturbed								
			Logged								
			Unproductive								
			Sub Total								
	Open Forests		Productive								
			Unproductive								
			Sub-total								

5 C 3 ABANDONMENT OF MANAGED LANDS - TOTAL CO_2 REMOVALS

COUNTRY : VENEZUELA

YEAR : 1990

SINK CATEGORY	A Carbon Removals (Gg C)	B CO_2 Removals (Gg CO_2)
		B = Ax (44/12)
Lands Abandoned Over the Previous 20 Years		
Lands Abandoned More Than 20 Years Previously		
Total		

PRELIMINARY ESTIMATION OF GHG EMISSIONS

5 D 1 MANAGED FORESTS: ANNUAL GROWTH INCREMENT

COUNTRY : VENEZUELA

YEAR : 1990

Source And Sink Categories			Activity Data	Emission Estimates	Aggregate Emissions Factor
Forest Tipe			A Area of managed Forest (k ha)	B Carbon Removal (Gg C)	C Carbon Removal Factor (Mg C)
					C = B/A
Tropical	Plantations (specify type)	Eucalyptus spp	8.29	54.09	6.52
		Tectona grandis	3.25	11.70	3.60
		Pinus caribaea	416.27	1198.86	2.88
		Mixed Fast - Growing Hardwords	2.19	12.32	5.63
	Logged	Closed Broadleaf	214.56	322.48	1.50
		Closed Coniferous			
		Open			
	Other				
			Number of Trees 1000	Carbon Removal (Gg C)	Carbon Removal Factor (Mg C)
					C = B/A
Forest Plantations			-	-	-
Village & Farm Trees			-	-	-

PRELIMINARY ESTIMATION OF GHG EMISSIONS

5 D 2 MANAGED FORESTS : HARVEST

COUNTRY : VENEZUELA YEAR : 1990

Source And Sink Categories	Activity Data	Emission Estimates	Aggregate Emissions Factors
	A	B	C
	Amount of Biomass Harvested (kt dm)	Carbon Emission/Removal (Gg- C)	Carbon Emission Factors (Mg - C/ t dm)
			C = B/A
Commercial Timber	202.77	91.25	0.45
Fuelwood	-	-	-
Other (specify)	-	-	-

PRELIMINARY ESTIMATION OF GHG EMISSIONS

5 D 3 MANAGED FORESTS : NET EMISSIONS/REMOVALS (SUMMARY)

COUNTRY : VENEZUELA YEAR : 1990

Category	Emissions / Removals
	CO_2 (Gg)
Total Growth Increment	5864.65
Total Harvest	334.57
NET EMISSIONS (+) OR REMOVALS (-)	5530.08

PRELIMINARY ESTIMATION OF GHG EMISSIONS

MINIMUM DATA TABLES 6 WASTE

6 A WASTE : LANDFILLS

COUNTRY : VENEZUELA

YEAR : 1990

Source And Sink Categories	Activity Data		Emissions Estimates	Aggregate Emissions Factor (s)	
	A	B	C	D	E
Waste Type	Total MSW (kg per year)	MSW Landfilled (kg) / year	CH 4 Emissions (Kg) / year	Emission Factor (kg CH4/kg MSW Lanfiled)	Qty of CH4 recovered (kg CH4)
				D = C/B	
A Landfills	5.94E+09	2.95E+09	2.21E+08	0.075	0

PRELIMINARY ESTIMATION OF GHG EMISSIONS

6 B WASTE : SEWAGE TREATMENT

COUNTRY : VENEZUELA | YEAR : 1990

Source And Sink Categories		Activity Data		Emissions Estimates	Aggregate Emissions Factors	
Waste Type		A Quantity BOD in Wastewater (kg) / añO	B Quantity of BOD anarobically digested (kg CH4) / año	C CH4 Emissions (kg) / año	D Emissions Factor (kg CH4 / kg BOD)	E Qty of CH4 recovered (kg CH4)
					D = C / B	
B Wastewater	Municipal	2.64E+08	2.60E+06	5.80E+05	0.22	O
	Industrial	NE	NE	NE	NE	NE
C Other						

(*) Estimation based on the IPPC methodology (BOD content)
Estimation based on volatile solid content is not reported in this table.

INVENE/TABLE 6A

PRELIMINARY ESTIMATION OF GHG EMISSIONS
SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES
BOTTOM - UP METHODOLOGY

COUNTRY : VENEZUELA

YEAR : 1990

SUMMARY REPORT FOR NATIONAL GAS INVENTORIES
(Gg)

Greenhause Gas Source and Sink Categories	CO2 (*)	CH4	N2O	NOx	CO	NMVOC
Total (Net) National Emissions	169140	3178.05	4.60	400.35	4285.16	250
1 All Energy (Fuel Combustion + Fugitive)	86811	1838.26	0.64	339.24	1878.48	250
A Fuel Combustion (**)	84453	12.02	0.64	339.24	1878.48	250.04
Energy & Transformation Industries	30516	1.66	0.10	83.14	10.90	
Industry (ISIC)	16774	0.44	0.08	56.59	17.93	
Transport	29164	9.79	0.42	196.58	1829.88	250.04
Comercial / Institutional	572	0.01	0.04	0.46	0.10	
Residential	3678	0.10	0.01	2.77	0.61	
Agriculture/Forestry & others	19	0.01	0.00	0.10	0.72	
Biomass Burned for Energy (*)	888	0.03	0.00	0.60	18.33	
Carbon non - seq in non-energy products (***)	3729					
B Fugitive Fuel Emission	1358	1826.24				
Oil and Natural Gas Systems	1358	1823.24				
Coald Mining		0.45-3.0				
2 Industrial Processes	2867					
A Iron and Steel						
B Non-Ferrous Metals						
C Inorganic Chemicals						
D Organic Chemicals						
E Non-Metalic Mineral products	2867					
F Other						
3 Solvent Use						
A Paint Application						
B Degreasing and Dry Cleaning						
C Chemical Products Manufacture / Processing						
D Other						
4 Agriculture		960.79	2.88	22.11	1026.68	
A Enteric Fermentation		826.00				
B Animal Wastes		27.00				
C Rice Cultivation		67.00				
D Agricultural Soils			2.26			
E Agricultural Waste Burning		9.79	0.23	8.11	205.68	
F Savannah Burning		31.00	0.39	14.00	821.00	
5 Land Use Change & Forestry	80462	168.00	1.08	39.00	1380.00	
A Forest Clearing & On-Site Burning of Cleared	84790	168.00	1.08	39.00	1380.00	
B Grassland Conversion	1202					
C Abandoment of Managed Lands						
D Managed Forests	(5530)					
6 Waste		221.00				
A Landfills		221.00				
B Wastewater		0.20				
C Other						

(*) CO2 EMISSIONS FROM BIOMASS ARE NOT INCLUDED IN THE TOTAL, THIS IS ONLY FOR INFORMATION PURPOSES.
(**) ESTIMATE BASED ON BOTTOM-UP METHODOLOGY.
(***) FRACTION OXIDIZED FROM NON-ENERGY PRODUCTS (e.g. FERTILIZER). MORE DETAILS PROVIDED IN ANNEX 2.
NOTE : TOTALS MAY NOT EQUAL SUM OF COMPONENTS DUE TO INDEPENDENT ROUNDING.

05/6/95

INVENE/TABLE 6B

PRELIMINARY ESTIMATION OF GHG EMISSIONS

SHORT SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES

BOTTOM - UP METHODOLOGY

COUNTRY : VENEZUELA

YEAR : 1990

SHORT SUMMARY REPORT FOR NATIONAL GAS INVENTORIES
(Gg)

Greenhause Gas Source and Sink Categories	CO2 (*)	CH4	N2O	NOx	CO	NMVOC
Total (Net) National Emissions	169140	3178.05	4.72	400.35	4285.16	250
1 All Energy (Fuel Combustion + Fugitive) (**)	85811	1838.26	0.64	339.24	1878.48	250
A Fuel Combustion	84453	12.02	0.64	339.24	1878.48	250
B Fugitive Fuel Emission	1358	1826.24				
2 Industrial Processes	2867					
3 Solvent Use						
4 Agriculture		960.79	2.88	22.11	1026.68	
A Enteric Fermentation		826.00				
B Animal Wastes		27.00				
C Rice Cultivation		67.00				
D Agricultural Soils			2.26			
E Agricultural Waste Burning		9.79	0.23	8.11	205.68	
F Savannah Burning		31.00	0.39	14.00	821.00	
5 Land Use Change & Forestry	80462	158.00	1.20	39.00	1380.00	
6 Waste		221.00				

(*) CO2 EMISSIONS FROM BIOMASS ARE NOT INCLUDED IN THE TOTAL, THIS IS ONLY FOR INFORMATION PURPOSES.
(**) ESTIMATE BASED ON BOTTOM-UP METHODOLOGY. INCLUDES CO2 EMISSIONS FROM CARBON NON-SEQUESTERED IN NON-ENERGY USES OF THE FUELS (e.g. FERTILIZER). DETAILS PROVIDED IN ANNEX 2
NOTE : TOTALS MAY NOT EQUAL SUM OF COMPONENTS DUE TO INDEPENDENT ROUNDING.

05/6/95

TABLE 7A OVERVIEW TABLE FOR NATIONAL GREENHOUSE GAS INVENTORIES

OVERVIEW TABLE

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO2		CH4		N2O		NOx		CO		NMVOC		Documentation	Disaggregation	Footnotes
	Estimate	Quality	Estimate	Quality	Estimate	Quality	Estimate	Quality	Estimate	Quality	Estimate	Quality			
Total National Emission and Sink	ALL	M	ALL	M	ALL	M	ALL	M	ALL	M	ALL	M	H	2	
1 All Energy (Fuel Combustion + Fugitive)	ALL	M	ALL	L	ALL	M	ALL	M	ALL	L	ALL	L	H	2-3	
A Fuel Combustion	ALL	M	ALL	M	ALL	M	ALL	M	ALL	L	ALL	L	H	2-3	(1)
B Fugitive Fuel Emission	PART	L	ALL	L									M		
2 Industrial Processes	ALL	M	NA		NA		NA		NA		NA		L	1	(2)
3 Solvent and Other Product Use	NE														
4 Agriculture	NA		ALL	M	PART	M/L	ALL	M	ALL	M	NA		H	2	
A Enteric Fermentation	NA		ALL	M	NA		NA		NA		NA		H	2	
B Animal Wastes	NA		ALL	M	NA		NA		NA		NA		H	2	
C Rice Cultivation	NA		ALL	M	NA		NA		NA		NA		H	1	
D Agricultural Soils	NA		NA		PART	L	NA		NA		NA		H	1	
E Agricultural Waste Burning	NA		ALL	M	ALL	M	ALL	M	ALL	M	NA		H	2	
F Savannah Burning	NA		ALL	L	ALL	L	ALL	L	ALL	L	NA		H	2	
5 Land Use Change & Forestry	PART	M	ALL	M	ALL	M	ALL	M	ALL	M	NA		H	2	(3)
6 Waste	NA		ALL	M	NA		NA		NA		NA		H	2	

KEY

Estimates code	meaning	Quality code	meaning	Documentation code	meaning	Disaggregation * code	meaning
PART	Partial Estimate	H	High Confidence in Estimation	H	High (all background information included)	1	Total emissions estimated
ALL	Full Estimate of all possible sources	M	Medium Confidence in Estimation	M	Medium (some background information included)	2	Sectoral split
NE	Not estimated	L	Low Confidence in Estimation	L	Low (only emission estimates included)	3	Sub- sectoral split
IE	Estimated but included elsewhere						
NO	Not Occurring						
NA	Not Applicable						

* See following table for a complete explanation of each code

(1) CO2 Emission estimates from combustion reported here are refered to Top - Down methodology. Regarding CO2 emissions estimate by Bottoom - Up method : Full estimated of all possible sources (All) ; low confidence in estimation (L).

(2) Includes only cement industry

(3) Abandonment of managed lands is not calculated due to lack of data.

ENERGY SECTOR

CO2 TOP - DOWN

INVENE/TABLE D1-1

PRELIMINARY ESTIMATION OF GHG EMISSIONS
ESTIMATION OF CARBON SEQUESTERED IN PRODUCTS

COUNTRY : VENEZUELA

YEAR : 1990

FUEL	1 Estimated Fuel Quantity (Gj)	2 Emission Coeff. (Kg/Gj)	3 Potential Carbon Seq'd (Gg)	4 Act. % Carbon Seq'd (%)	5 Carbon Seq'd (Gg C)	6 Carbon Non - Seq. (Gg C)
1) Naphtas	0	0	0	0	0	0
2) Lubricants	9740000	20	195	50	97	97
3) Bitumen	24040000	22	529	100	529	0
4) Ligth Oil/Tar	652100	25.8	16.8	75	12.6	4
5) Gas as Feedstock	89230000	15.3	1365	33	451	915
6) LPG as Feedstock	430000	17.2	7	80	6	1

(*) In Venezuela the naphta is not used as feedstock in Petrochemical Industry.

NOTE : Totals may not equal sum of components due to independent rounding.

05/6/95

EMI002-1.XLS

INVENE/TABLE D1-2

PRELIMINARY ESTIMATION OF GHG EMISSIONS
CO2 EMISSIONS FROM THE ENERGY SYSTEM

COUNTRY: VENEZUELA

YEAR: 1990

FUELS		A Production (TJ)	B Importation (TJ)	C Exportation (TJ)	D Stock Change (TJ)	E Apparent Consumption (TJ)	F Conversion Factor	G Apparent Consumption (TJ)	H Carbon Emissions Coefficient (Kg C/GJ)	J Potential Emissions (Gg C)	K Carbon Sequestered (Gg C)	L Net Carbon Emissions (Gg C)	M (%)	N Adjusted carbon Emissions (Gg C)	O CO2 Emissions (Gg CO2)
						E=(A + B - C - D)		G = (E * F)		J=(G * H) * 10^-3		L = (J - K)		N = (L * M)/100	O=(N * (44 / 12))
Liquid Fossil															
Primary Fuels	Crude Oil	4990040		2835357	89104	2065579	1	2065579	20.0	41312		41312	99	40898	149961
	Orimulsion	8246		5566	2689	0	1	0	20.0	0		0	99	0	0
	Natural Gas Liquid	172538		0	0	172538	1	172538	15.2	2623		2623	99	2596	9520
Second Fuels	Gasoline			279896	1125	-281021	1	-281021	18.9	-5311		-5311	99	-5258	-19280
	Kerosene				408	-408	1	-408	19.6	-8		-8	99	-8	-29
	Jet Fuel			163607	386	-163993	1	-163993	19.5	-3198		-3198	99	-3166	-11608
	Gas/Diesel Oil			343506	3413	-346919	1	-346919	20.2	-7008		-7008	99	-6938	-25438
	Residual Oil			517343	-6443	-510900	1	-510900	21.1	-10780		-10780	99	-10672	-39131
	LPG			31146	-160	-30986	1	-30986	17.2	-533	5.9	-539	99	-533	-1956
	Naphta				5330	-5330	1	-5330	20.0	-107	0.0	-107	99	-106	-387
	Bitumen			53598	-239	-53359	1	-53359	22.0	-1174	528.8	-1703	99	-1686	-6181
	Lubricants			6356	100	-6455	1	-6455	20.0	-129	97.4	-227	99	-224	-822
	Petroleo Coque			0	3249	-3249	1	-3249	27.5	-89		-89	99	-88	-324
	Ref. Feedstocks			0	0	0	1	0	20.0	0		0	99	0	0
	Others Oil			13921	0	-13921	1	-13921	20.0	-278		-276	99	-276	-1011
Total Liquid Fossil		5170823	0	4250286	98962	821577		821577		16319	632	14687		14540	53313
Solid Fossil															
Primary Fuels	Coking Coal	66931		56061		10869	1	10869	25.8	280	12.6	267.8	98	262	962.4
	Steam Coal					0	1	0	25.8	0		0	98	0	0
	Lignite					0	1	0	27.6	0		0	98	0	0
	Subbit. Carbon					0	1	0	26.1	0		0	98	0	0
	Peat					0	1	0	28.9	0		0	98	0	0
Second Fuels	BKB & Pat Fuel					0	1	0	25.8	0		0	98	0	0
	Coke		8533			8533	1	8533	29.5	252		252	98	249	914
Total Solid Fossil		66931	8533	56061	0	19403		19403		532	0.1	520		512	1876
Gaseous Fossil															
	Natural Gas (Dry)	938482	0	0	0	938482	1	938482	15.3	14369	460.5	13908	99.5	13839	50742
Total Gaseous Fossil		938482	0	0	0	938482		938482		14369		13908	99.5	13839	50742
TOTAL		6176236	8533	4306346	98962	1779461		1779461		30210		29115		28890	105931
Bunkers	Jet Fuel Bunkers					16175	1	16175	19.6	316		315	99	312	1146
	Gas / D.O. Bunkers					5090	1	5090	20.2	103		103	99	102	373
	Fuel Oil Bunkers					29742	1	29742	21.1	628		628	99	621	2278
	Other Oil Bunkers						1	0	20.0	0		0	99	0	0
	Total bunkers					51006		51006		1046		1046		1035	3796
Biomass	Solid Biomass	1397	0	0	0	1397	1	1397	29.9	42		42		41	152
	Liquid Biomass	0	0	0	0	0	1	0	20.0	0		0		0	0
	Total Biomass	1397	0	0	0	1397		1397		42		42		41	152

NOTE : Totals may not equal sum components due to independent rounding.

05/8/95

STATIONARY SOURCES

MENU E1

INVENE/TABLE E1-1

PRELIMINARY ESTIMATION OF GHG EMISSIONS

STATIONARY SOURCES. UTILITIES

COUNTRY : VENEZUELA

YEAR : 1990.

UTILITIES FUEL CONSUMPTION (Tj)

	NAT. GAS	RESIDUAL	DISTILLATE	REF. GAS.	TOTAL
PUBLIC (*)					
STEAM PLANTS	107053	64055	2850		173958
GAS	59911	1	10276		70188
TOTAL	166964	64056	13126		244146
AUTOGENERATION (**)					
INDUSTRY	16742	351	1530		18623
OIL & GAS	44475	6434		5035	55944
TOTAL	61217	6785	1530	5035	74567
TOTAL FUEL CONSUMPTION	228181	70841	14656	5035	318713

(*) NATIONAL ENERGY BALANCE 1990.
(**) GREENHOUSE GAS ABATEMENT COSTING STUDIES. PHASE II: APPENDIXES. RISO - MEM.

EMISSIONS FACTORS (g / Gj)

	CO (1)	CH4 (1)	NOx (1)	N2O (2)	CO2 (3)
NATURAL GAS BOILERS	19	0.1	267	0.1	56100
RESIDUAL OIL BOILERS	15	0.7	201	0.6	77367
DISTILLATE OIL BOILERS	15	0.03	68	0.6	74067
GAS TURBINE SIMPLE CYCLE	32	5.9	188		

EMISSIONS (Gg)

PUBLIC	FUELS CONSUM. (Tj)	CO (1)	CH4 (1)	NOx (1)	N2O (2)	CO2 (3)
STEAM PLANTS						
NATURAL GAS	107053	2.03	0.01	28.58	0.01	5976
RESIDUAL OIL	64055	0.96	0.04	12.88	0.04	4906
DISTILLATE OIL	2850	0.04	0.00	0.19	0.00	209
TOTAL	173958	3.04	0.06	41.65	0.05	11091
GAS PLANTS						
NATURAL GAS	59911	1.92	0.35	11.26	0.006	3344
RESIDUAL OIL	1	0.00	0.00	0.00	0.000	0
DISTILLATE OIL	10276	0.33	0.06	1.93	0.006	753
TOTAL	70188	2.25	0.41	13.20	0.012	4098
TOTAL PUBLIC	244146	5.28	0.47	54.85	0.06	15189
AUTOGENERATION (*)						
NATURAL GAS	61217	1.96	0.36	11.51	0.006	3417
RESIDUAL OIL	6785	0.22	0.04	1.28	0.004	520
DISTILLATE OIL	1530	0.05	0.01	0.29	0.001	112
REFINERY GAS	5035	0.16	0.03	0.95	0.001	281
TOTAL AUTOGENERATION	74567	2.39	0.44	14.02	0.012	4330
TOTAL UTILITIES EMISSIONS	318713	7.67	0.91	68.87	0.07	19519

(*) AUTOGENERATION IS WITH GAS PLANTS

SOURCE:
(1) TABLE 1-7 PAG 1-44 GREENHOUSE GAS INVENTORY. FIRST DRAFT. VOL 3
(2) TABLE 1-18 PAG 1-56 GREENHOUSE GAS INVENTORY. FIRST DRAFT. VOL 3
(3) TABLE 1-3 PAG 1-8 GREENHOUSE GAS INVENTORY. FIRST DRAFT. VOL 2

NOTE : Totals may not equal sum of components due to independent rounding.

05/6/95

INVENE/TABLE E1-2

PRELIMINARY ESTIMATION OF GHG EMISSIONS
STATIONARY SOURCES. OIL & GAS INDUSTRY

COUNTRY : VENEZUELA

YEAR : 1990.

FUELS CONSUMPTION (Tj) (*)

	NATURAL GAS	LPG	FUEL OIL	REF. GAS	GASOLINE	KEROSENE	DIESEL	TOTAL
TRANSFORMATION	58445	78	1996	45				60564
OTHER OPERATION	118316		5329		518	23	7162	131348
TOTAL	176761	78	7326	45	518	23	7162	191912

(*) NATIONAL ENERGY BALANCE 1990

SOURCE	FUEL CONSUMPTION (TJ)	EMISSIONS FACTORS (g/GJ)				
		CO (1)	CH4 (2)	NOx (1)	N2O (3)	CO2 (4)
NATURAL GAS	176761	17	4.0	67	0.1	56100
LPG	78	15	4.0	161	0.6	63067
GASOLINE	518	15	1.0	161	0.6	69300
KEROSENE	23	15	1.0	161	0.6	71867
DIESEL	7162	15	1.0	161	0.6	74067
FUEL OIL	7325	15	3.0	161	0.6	77367
REFINERY GAS	45	17	4.0	67	0.1	56100
TOTAL	191912					
		EMISSIONS (Gg)				
NATURAL GAS		3.00	0.707	11.84	0.018	9867
LPG		0.00	0.000	0.01	0.000	5
GASOLINE		0.01	0.001	0.08	0.000	36
KEROSENE		0.00	0.000	0.00	0.000	2
DIESEL		0.11	0.007	1.15	0.004	526
FUEL OIL		0.11	0.022	1.18	0.004	561
REFINERY GAS		0.00	0.000	0.00	0.000	3
TOTAL		3.23	0.737	14.28	0.027	10997

SOURCE:

(1) TABLE 1-8 , PAG. 1-39. GREENHOUSE GAS INVENTORY , VOL.3 - DEFAULT VALUES WERE USED DUE TO ANOTHER SPECIFIC VALUES ARE NOT AVAILABLE

(2) TABLE 1-17 , PAG. 1-53. GREENHOUSE INVENTORY - FIRST DRAFT. VOL 3

(3) TABLE 1-18 , PAG. 1-56. GREENHOUSE INVENTORY - FIRST DRAFT. VOL 3

(4) TABLE 1-3 , Pag. 1-8. GREENHOUSE INVENTORY - FIRST DRAFT. VOL 2

NOTE : Totals may not equal sum of components due to indepent rounding.

05/6/95

INVENE/TABLE G1-1 PRELIMINARY ESTIMATION OF GHG EMISSIONS

ENERGY DATA. MANUFACTURE INDUSTRY

FUEL CONSUMPTION BY USES AND FUEL

COUNTRY : VENEZUELA YEAR : 1990

(TJOULE)							
FUEL	STEAM	DIR.HEAT	MOT.POW	TRANSP	OTHERS (1)	FEEDST.	TOTAL
NAT. GAS	97900	74205	2746	328	23764	144085	343028
LPG	673	3048	996	1911	1437	402	8467
FUEL OIL	5666	9884	297	170	105	143	16265
GASOIL	13624	12609	4157	8462	3134	166	42152
GASOLINE	0	0	115	508	102	38	763
COAL	534	9368	0	0	50	201	10153
COKE	70	4179	0	0	1	4660	8910
KEROSENE	686	2501	56	15	868	416	4542
BAGASSO(2)	4940	0	0	0	884	0	5824
OTHERS	0	0	0	0	30490	0	30490
TOTAL	**124093**	**115794**	**8367**	**11394**	**60835**	**150111**	**470594**
(% BY USES)							
NAT.GAS	28.5	21.6	0.8	0.1	6.9	42.0	100
LPG	7.9	36.0	11.8	22.6	17.0	4.7	100
FUEL OIL	34.8	60.8	1.8	1.0	0.6	0.9	100
GASOIL	32.3	29.9	9.9	20.1	7.4	0.4	100
GASOLINE	0.0	0.0	15.1	66.6	13.4	5.0	100
COAL	5.3	92.3	0.0	0.0	0.5	2.0	100
COKE	0.8	46.9	0.0	0.0	0.0	52.3	100
KEROSENE	15.1	55.1	1.2	0.3	19.1	9.2	100
BAGAZO	84.8	0.0	0.0	0.0	15.2	0.0	100
OTHERS	0.0	0.0	0.0	0.0	100.0	0.0	100
TOTAL	**26.4**	**24.6**	**1.8**	**2.4**	**12.9**	**31.9**	**100**
(% BY FUEL)							
NAT.GAS	78.9	64.1	32.8	2.9	39.1	96.0	72.9
LPG	0.5	2.6	11.9	16.8	2.4	0.3	1.8
FUEL OIL	4.6	8.5	3.5	1.5	0.2	0.1	3.5
GASOIL	11.0	10.9	49.7	74.3	5.2	0.1	9.0
GASOLINE	0.0	0.0	1.4	4.5	0.2	0.0	0.2
COAL	0.4	8.1	0.0	0.0	0.1	0.1	2.2
COKE	0.1	3.6	0.0	0.0	0.0	3.1	1.9
KEROSENE	0.6	2.2	0.7	0.1	1.4	0.3	1.0
BAGAZO	4.0	0.0	0.0	0.0	1.5	0.0	1.2
OTHERS	0.0	0.0	0.0	0.0	50.1	0.0	6.5
TOTAL	**100**	**100**	**100**	**100**	**100**	**100**	**100**

(1) NON ENERGY USES

INVENE/TABLE G1-2

PRELIMINARY ESTIMATION OF GHG EMISSIONS

ENERGY DATA. MANUFACTURE INDUSTRY

FUEL CONSUMPTION BY USES AND BRANCH

COUNTRY : VENEZUELA

YEAR : 1990

(TJOULE)							
BRANCH	STEAM	DIR.HEAT	MOT.POW	TRANSP	OTHERS(2)	FEEDST.	TOTAL
31	44058	7514	1965	1871	3472	92	58972
32	7663	957	39	158	1286	30	10133
33	445	115	141	372	254	0	1327
34	9482	3113	580	665	1124	61	15025
35	44805	2720	324	912	38542	50430	137733
36	1891	47818	1616	3624	2864	256	58069
37	13429	46288	1525	640	9024	98705	169611
38	2191	7203	2136	3127	4139	478	19274
39	129	66	41	25	129	59	449
TOTAL	124093	115794	8367	11394	60834	150111	470593
(% BY USES)							
31	74.7	12.7	3.3	3.2	5.9	0.2	100
32	75.6	9.4	0.4	1.6	12.7	0.3	100
33	33.5	8.7	10.6	28.0	19.1	0.0	100
34	63.1	20.7	3.9	4.4	7.5	0.4	100
35	32.5	2.0	0.2	0.7	28.0	36.6	100
36	3.3	82.3	2.8	6.2	4.9	0.4	100
37	7.9	27.3	0.9	0.4	5.3	58.2	100
38	11.4	37.4	11.1	16.2	21.5	2.5	100
39	28.7	14.7	9.1	5.6	28.7	13.1	100
TOTAL	26.4	24.6	1.8	2.4	12.9	31.9	100
(% BY BRANCH)							
31	35.5	6.5	23.5	16.4	5.7	0.1	18.4
32	6.2	0.8	0.5	1.4	2.1	0.0	3.2
33	0.4	0.1	1.7	3.3	0.4	0.0	0.4
34	7.6	2.7	6.9	5.8	1.8	0.0	4.7
35	36.1	2.3	3.9	8.0	63.4	33.6	27.2
36	1.5	41.3	19.3	31.8	4.7	0.2	18.0
37	10.8	40.0	18.2	5.6	14.8	65.8	22.1
38	1.8	6.2	25.5	27.4	6.8	0.3	5.9
39	0.1	0.1	0.5	0.2	0.2	0.0	0.1
TOTAL	100	100	100	100	100	100	100

SOURCE:
NATIONAL ENERGY BALANCE 1990

BRANCH
31 FOOD, BEVERAGE AND TOBACCO
32 TEXTILE, CLOTHING AND LEATHER
33 WOOD INDUSTRIES
34 PULP AND PAPER INDUSTRIES
35 CHEMICAL AND COAL PRODUCTS MANUFACTURE
36 NON-METALLIC MINERAL PRODUCTS MANUFACTURE
37 BASIC METALLIC INDUSTRIES
38 MACHINERY, EQUIPMENTS AND METALLIC MANUFACTURE
39 OTHER INDUSTRIES

05/6/95

INVENE/TABLE G1-3

PRELIMINARY ESTIMATION OF GHG EMISSIONS

ENERGY DATA. MANUFACTURE INDUSTRY

FUEL CONSUMPTION BY BRANCH AND FUEL (1)

(TERAJOULES)

COUNTRY : VENEZUELA

YEAR : 1990

INDUSTRIAL BRANCH	NAT. GAS	LPG	FUEL-OIL	GASOIL	GASOLINE	COAL	COKE	KEROSENE	BAGASSE	OTHERS	TOTAL
31	29210.36	3087.19	5769.54	11920.22	143.11	0.13		2960.88	5823.68	78.04	58972
32	8055.05	71.26	42.11	1778.28	20.91			138.81		25.01	10133
33	254.34	11.85	13.04	849.70	69.65	6.12		48.35		73.98	1327
34	13339.22	730.67	22.88	459.22	26.38			232.07		218.24	15025
35	106342.46	819.25	209.60	4267.78	97.73	16.82	0.11	529.03		25442.61	137733
36	31187.90	2484.57	9682.17	12406.32	68.18	303.73	32.04	128.96		1794.09	58068
37	147569.25	259.07	276.05	2639.52	83.23	9715.60	8800.13	115.90		113.37	169611
38	6896.40	1017.88	250.12	7650.42	232.90	110.35	76.73	385.63		2654.09	19274
39	117.11	26.88	0.00	190.48	21.38			1.57		92.19	449
TOTAL	342972.09	8468.22	16265.49	42161.93	782.45	10152.85	8909.00	4541.21	5823.68	30489.63	470593
(% BY BRANCH)											
31	49.53	5.20	9.78	20.21	0.24	0.00		5.02	9.88	0.13	100.00
32	79.49	0.70	0.42	17.55	0.21			1.37		0.25	100.00
33	19.17	0.89	0.98	64.03	5.25	0.46		3.64		5.57	100.00
34	88.78	4.86	0.15	3.06	0.17			1.54		1.44	100.00
35	77.21	0.59	0.15	3.09	0.07	0.01	0.00	0.38		18.47	100.00
36	53.71	4.24	16.67	21.37	0.12	0.52	0.06	0.22		3.09	100.00
37	87.00	0.15	0.16	1.56	0.05	5.73	5.19	0.07		0.07	100.00
38	35.78	5.28	1.30	39.69	1.21	0.57	0.40	2.00		13.77	100.00
39	26.08	5.94	0.00	42.42	4.76			0.35		20.53	100.00
(% BY FUEL)											
31	8.52	36.22	35.47	28.28	18.77	0.00		65.20	100.00	0.26	
32	2.35	0.84	0.26	4.22	2.74			3.06		0.08	
33	0.07	0.14	0.08	2.02	9.13	0.06		1.06		0.24	
34	3.89	8.63	0.14	1.09	3.33			5.11		0.71	
35	31.01	9.67	1.29	10.10	12.82	0.17	0.00	11.65		83.45	
36	9.09	29.10	59.53	29.43	8.94	2.99	0.36	2.84		5.88	
37	43.03	3.06	1.70	6.26	10.92	95.69	98.78	2.55		0.37	
38	2.01	12.02	1.54	18.15	30.56	1.09	0.86	8.49		8.70	
39	0.03	0.32	0.00	0.45	2.80			0.03		0.30	
TOTAL	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	

(1) FUEL CONSUMPTION INCLUDES FEED STOCKS AND NON-ENERGY USES

BRANCH

31. FOOD, BEVERAGE AND TOBACCO
32. TEXTILE, CLOTHING AND LEATHER
33. WOOD INDUSTRIES
34. PULP AND PAPER INDUSTRIES
35. CHEMICAL AND COAL PRODUCTS MANUFACTURE
36. NON-METALLIC MINERAL PRODUCTS MANUFACTURE
37. BASIC METALLIC INDUSTRIES
38. MACHINERY, EQUIPMENTS AND METALLIC MANUFACTURE
39. OTHER INDUSTRIES

INVENE/TABLE G1-3

PRELIMINARY ESTIMATION OF GHG EMISSIONS
ENERGY DATA. MANUFACTURE INDUSTRY
FUEL CONSUMPTION BY BRANCH AND FUEL (1)
(B.E.P.)

COUNTRY : VENEZUELA

YEAR : 1990

INDUSTRIAL BRANCH	NAT. GAS	LPG	FUEL-OIL	GASOIL	GASOLINE	COAL	COKE	KEROSENE	BAGASSE	OTHERS	TOTAL
31	4884676	612908	964808	1993348	23931	22		495130	973860	13060	9861731
32	1348999	11916	7041	297372	3497			23213		4183	1694221
33	42531	1981	2180	142090	11647	1023		8085		12371	221908
34	2230639	122186	3822	76792	4244			38807		36181	2512650
35	17783020	136999	35051	712004	16342	2829	18	88487		4254617	23029347
36	5216368	412136	1619092	2074836	11398	50791	5358	21568		300015	9710359
37	24677132	43323	46183	441392	13918	1624682	1471693	19382		18959	28356544
38	1153244	170180	41826	1279336	38847	18464	12831	84487		443828	3223132
39	19583	4482		31850	3576			283		15417	75151
TOTAL	57353192	1416090	2719981	7048818	127600	1697801	1489800	769400	973860	5098601	78885043
(% BY BRANCH)											
31	49.53	6.20	9.78	20.21	0.24	0.00		5.02	9.88	0.13	100.00
32	79.61	0.70	0.42	17.56	0.21			1.37		0.26	100.00
33	19.17	0.89	0.98	64.03	5.26	0.46		3.64		5.57	100.00
34	88.78	4.86	0.15	3.06	0.17			1.54		1.44	100.00
35	77.22	0.59	0.15	3.09	0.07	0.01	0.00	0.38		18.47	100.00
36	53.71	4.24	16.67	21.37	0.12	0.52	0.06	0.22		3.09	100.00
37	87.02	0.15	0.16	1.56	0.05	5.73	5.19	0.07		0.07	100.00
38	35.78	5.28	1.30	39.69	1.21	0.57	0.40	2.00		13.77	100.00
39	26.06	5.94	0.00	42.38	4.76			0.35		20.51	100.00
(% BY FUEL)											
31	8.52	38.22	35.47	28.28	18.77	0.00		65.20	100.00	0.26	
32	2.35	0.84	0.26	4.22	2.74			3.06		0.08	
33	0.07	0.14	0.08	2.02	9.13	0.06		1.06		0.24	
34	3.89	8.63	0.14	1.09	3.33			5.11		0.71	
35	31.01	9.67	1.29	10.10	12.82	0.17	0.00	11.65		83.45	
36	9.09	29.10	59.53	29.43	8.94	2.99	0.36	2.84		5.88	
37	43.03	3.06	1.70	6.26	10.92	95.69	98.78	2.56		0.37	
38	2.01	12.02	1.54	18.16	30.56	1.09	0.86	8.49		8.70	
39	0.03	0.32	0.00	0.45	2.80			0.03		0.30	
TOTAL	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	

(1) FUEL CONSUMPTION INCLUDES FEED STOCKS AND NON-ENERGY USES

BRANCH

31. FOOD, BEVERAGE AND TOBACCO
32. TEXTILE, CLOTHING AND LEATHER
33. WOOD INDUSTRIES
34. PULP AND PAPER INDUSTRIES
35. CHEMICAL AND COAL PRODUCTS MANUFACTURE
36. NON-METALLIC MINERAL PRODUCTS MANUFACTURE
37. BASIC METALLIC INDUSTRIES
38. MACHINERY, EQUIPMENTS AND METALLIC MANUFACTURE
39. OTHER INDUSTRIES

INVENE/TABLE G1-4

PRELIMINARY ESTIMATION OF GHG EMISSIONS

ENERGY DATA. MANUFACTURE INDUSTRY

FUEL CONSUMPTION FOR STEAM

COUNTRY ; VENEZUELA **YEAR : 1990**

(TJOULE)									
BRANCH	**NAT. GAS**	**LPG**	**FUEL OIL**	**GASOIL**	**KEROSENE**	**COAL**	**COKE**	**BAG.**	**TOTAL**
31	25098	361	5527	7591.	542	0	0	4940	44058
32	6463	11	40	1069	80	0	0	0	7663
33	103	1	0	341	0	0	0	0	445
34	9264	0	0	219	0	0	0	0	9482
35	42059	267	63	2382	35	0	0	0	44805
36	1226	0	0	361	0	304	0	0	1891
37	13139	0	3	54	2	230	0	0	13429
38	542	34	34	1484	27	0	70	0	2191
39	6	0	0	123	0	0	0	0	129
TOTAL	**97900**	**673**	**5666**	**13624**	**686**	**534**	**70**	**4940**	**124093**
(% BY FUEL)									
31	57.0	0.8	12.5	17.2	1.2	0.0	0.0	11.2	100
32	84.3	0.1	0.5	14.0	1.0	0.0	0.0	0.0	100
33	23.1	0.2	0.0	76.7	0.0	0.0	0.0	0.0	100
34	97.7	0.0	0.0	2.3	0.0	0.0	0.0	0.0	100
35	93.9	0.6	0.1	5.3	0.1	0.0	0.0	0.0	100
36	64.9	0.0	0.0	19.1	0.0	16.1	0.0	0.0	100
37	97.8	0.0	0.0	0.4	0.0	1.7	0.0	0.0	100
38	24.7	1.6	1.6	67.7	1.2	0.0	3.2	0.0	100
39	4.5	0.0	0.0	95.5	0.0	0.0	0.0	0.0	100
TOTAL	78.9	0.5	4.6	11.0	0.6	0.4	0.1	4.0	100
(% BY BRANCH)									
31	25.6	53.5	97.5	55.7	78.9	0.0	0.0	100.0	35.5
32	6.6	1.6	0.7	7.8	11.6	0.0	0.0	0.0	6.2
33	0.1	0.1	0.0	2.5	0.0	0.0	0.0	0.0	0.4
34	9.5	0.0	0.0	1.6	0.0	0.0	0.0	0.0	7.6
35	43.0	39.6	1.1	17.5	5.1	0.0	0.0	0.0	36.1
36	1.3	0.0	0.0	2.6	0.0	56.9	0.0	0.0	1.5
37	13.4	0.0	0.1	0.4	0.3	43.1	0.0	0.0	10.8
38	0.6	5.1	0.6	10.9	4.0	0.0	100.0	0.0	1.8
39	0.0	0.0	0.0	0.9	0.0	0.0	0.0	0.0	0.1
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

SOURCE:

NATIONAL ENERGY BALANCE 1990

BRANCH

31 FOOD, BEVERAGE AND TOBACCO

32 TEXTILE, CLOTHING AND LEATHER

33 WOOD INDUSTRIES

34 PULP AND PAPER INDUSTRIES

35 CHEMICAL AND COAL PRODUCTS MANUFACTURE

36 NON-METALLIC MINERAL PRODUCTS MANUFACTURE

37 BASIC METALLIC INDUSTRIES

38 MACHINERY, EQUIPMENTS AND METALLIC MANUFACTURE

39 OTHER INDUSTRIES

05/6/95

INVENE/TABLE G1-4

PRELIMINARY ESTIMATION OF GHG EMISSIONS

ENERGY DATA. MANUFACTURE INDUSTRY

ENERGY CONSUMPTION FOR STEAM

COUNTRY ; VENEZUELA

YEAR : 1990

(BOE)

BRANCH	NAT. GAS	LPG	FUEL OIL	GASOIL	KEROSENE	COAL	COKE	BAG	TOTAL
31	4197054	60288	924184	1269459	90560	22	0	826044	7367611
32	1080774	1823	6613	178809	13347	0	0	0	1281366
33	17184	117	0	57034	0	0	0	0	74335
34	1549081	0	0	36554	0	0	0	0	1585635
35	7033248	44616	10507	398308	5877	0	0	0	7492556
36	205044	0	46	60292	0	50791	0	0	316173
37	2197202	41	491	9055	378	38452	0	0	2245619
38	90642	5713	5704	248105	4558	44	11702	0	366468
39	983	0	0	20635	0	0	0	0	21618
TOTAL	16371212	112598	947545	2278251	114720	89309	11702	826044	20751381
(% BY FUEL)									
31	57.0	0.8	12.5	17.2	1.2	0.0	0.0	11.2	100
32	84.3	0.1	0.5	14.0	1.0	0.0	0.0	0.0	100
33	23.1	0.2	0.0	76.7	0.0	0.0	0.0	0.0	100
34	97.7	0.0	0.0	2.3	0.0	0.0	0.0	0.0	100
35	93.9	0.6	0.1	5.3	0.1	0.0	0.0	0.0	100
36	64.9	0.0	0.0	19.1	0.0	16.1	0.0	0.0	100
37	97.8	0.0	0.0	0.4	0.0	1.7	0.0	0.0	100
38	24.7	1.6	1.6	67.7	1.2	0.0	3.2	0.0	100
39	4.5	0.0	0.0	95.5	0.0	0.0	0.0	0.0	100
TOTAL	78.9	0.5	4.6	11.0	0.6	0.4	0.1	4.0	100
(% BY BRANCH)									
31	25.6	53.5	97.5	55.7	78.9	0.0	0.0	100.0	35.5
32	6.6	1.6	0.7	7.8	11.6	0.0	0.0	0.0	6.2
33	0.1	0.1	0.0	2.5	0.0	0.0	0.0	0.0	0.4
34	9.5	0.0	0.0	1.6	0.0	0.0	0.0	0.0	7.6
35	43.0	39.6	1.1	17.5	5.1	0.0	0.0	0.0	36.1
36	1.3	0.0	0.0	2.6	0.0	56.9	0.0	0.0	1.5
37	13.4	0.0	0.1	0.4	0.3	43.1	0.0	0.0	10.8
38	0.6	5.1	0.6	10.9	4.0	0.0	100.0	0.0	1.8
39	0.0	0.0	0.0	0.9	0.0	0.0	0.0	0.0	0.1
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

SOURCE:

NATIONAL ENERGY BALANCE 1990

BRANCH

31 FOOD, BEVERAGE AND TOBACCO
32 TEXTILE, CLOTHING AND LEATHER
33 WOOD INDUSTRIES
34 PULP AND PAPER INDUSTRIES
35 CHEMICAL AND COAL PRODUCTS MANUFACTURE
36 NON-METALLIC MINERAL PRODUCTS MANUFACTURE
37 BASIC METALLIC INDUSTRIES
38 MACHINERY, EQUIPMENTS AND METALLIC MANUFACTURE
39 OTHER INDUSTRIES

05/6/95

INVENE/TABLE G1-5 **PRELIMINARY ESTIMATION OF GHG EMISSIONS**

ENERGY DATA. MANUFACTURE INDUSTRY

INDUSTRIAL FUEL COMSUPTION FOR DIRECT HEAT

COUNTRY : VENEZUELA **YEAR : 1990**

(TJOULE)								
BRANCH	**NAT. GAS**	**LPG**	**FUEL OIL**	**GASOIL**	**KEROSENE**	**COAL**	**COKE**	**TOTAL**
31	2785	320	217	2018	2174	0	0	7514
32	599	31	0	319	8	0	0	957
33	44	7	0	61	3	0	0	115
34	3104	5	0	4	0	0	0	3113
35	2280	25	0	297	118	0	0	2720
36	28941	2068	9560	7125	99	0	26	47818
37	31177	105	107	1383	0	9367	4148	46288
38	5251	462	0	1385	99	1	5	7203
39	23	25	0	18	0	0	0	66
TOTAL	**74205**	**3048**	**9884**	**12609**	**2501**	**9368**	**4179**	**115794**
(% BY FUEL)								
31	37.1	4.3	2.9	26.9	28.9	0.0	0.0	100
32	62.6	3.2	0.0	33.3	0.9	0.0	0.0	100
33	38.0	6.2	0.0	53.5	2.3	0.0	0.0	100
34	99.7	0.2	0.0	0.1	0.0	0.0	0.0	100
35	83.8	0.9	0.0	10.9	4.3	0.0	0.0	100
36	60.5	4.3	20.0	14.9	0.2	0.0	0.1	100
37	67.4	0.2	0.2	3.0	0.0	20.2	9.0	100
38	72.9	6.4	0.0	19.2	1.4	0.0	0.1	100
39	34.7	38.3	0.0	27.0	0.0	0.0	0.0	100
TOTAL	64.1	2.6	8.5	10.9	2.2	8.1	3.6	**100**
(% BY BRANCH)								
31	3.8	10.5	2.2	16.0	86.9	0.0	0.0	6.5
32	0.8	1.0	0.0	2.5	0.3	0.0	0.0	0.8
33	0.1	0.2	0.0	0.5	0.1	0.0	0.0	0.1
34	4.2	0.2	0.0	0.0	0.0	0.0	0.0	2.7
35	3.1	0.8	0.0	2.4	4.7	0.0	0.0	2.3
36	39.0	67.8	96.7	56.5	3.9	0.0	0.6	41.3
37	42.0	3.4	1.1	11.0	0.0	100.0	99.3	40.0
38	7.1	15.1	0.0	11.0	4.0	0.0	0.1	6.2
39	0.0	0.8	0.0	0.1	0.0	0.0	0.0	0.1
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

SOURCE:
NATIONAL ENERGY BALANCE 1990

BRANCH

31 FOOD, BEVERAGE AND TOBACCO
32 TEXTILE, CLOTHING AND LEATHER
33 WOOD INDUSTRIES
34 PULP AND PAPER INDUSTRIES
35 CHEMICAL AND COAL PRODUCTS MANUFACTURE
36 NON-METALLIC MINERAL PRODUCTS MANUFACTURE
37 BASIC METALLIC INDUSTRIES
38 MACHINERY, EQUIPMENTS AND METALLIC MANUFACTURE
39 OTHER INDUSTRIES

INVENE/TABLE G1-5 **PRELIMINARY ESTIMATION OF GHG EMISSIONS**

ENERGY DATA. MANUFACTURE INDUSTRY

INDUSTRIAL FUEL COMSUPTION FOR DIRECT HEAT

COUNTRY : VENEZUELA **YEAR : 1990**

(BOE)

BRANCH	NAT. GAS	LPG	FUEL OIL	GASOIL	KEROSENE	COAL	COKE	TOTAL
31	465755	53581	36255	337421	363534	0	0	1256546
32	100141	5125	0	53278	1413	0	0	159957
33	7312	1190	0	10277	445	0	0	19224
34	519089	818	0	733	0	0	0	520640
35	381336	4185	49	49655	19680	0	0	454905
36	4839661	345857	1598638	1191393	16488	0	4286	7996323
37	5213609	17544	17909	231296	0	1566383	693661	7740402
38	878028	77221	0	231553	16630	174	884	1204490
39	3857	4260	0	3002	0	0	0	11119
TOTAL	**12408788**	**509781**	**1652851**	**2108608**	**418190**	**1566557**	**698831**	**19363606**
(% BY BRANCH)								
31	37.1	4.3	2.9	26.9	28.9	0.0	0.0	100
32	62.6	3.2	0.0	33.3	0.9	0.0	0.0	100
33	38.0	6.2	0.0	53.5	2.3	0.0	0.0	100
34	99.7	0.2	0.0	0.1	0.0	0.0	0.0	100
35	83.8	0.9	0.0	10.9	4.3	0.0	0.0	100
36	60.5	4.3	20.0	14.9	0.2	0.0	0.1	100
37	67.4	0.2	0.2	3.0	0.0	20.2	9.0	100
38	72.9	6.4	0.0	19.2	1.4	0.0	0.1	100
39	34.7	38.3	0.0	27.0	0.0	0.0	0.0	100
TOTAL	64.1	2.6	8.5	10.9	2.2	8.1	3.6	**100**
(% BY USES)								
31	3.8	10.5	2.2	16.0	86.9	0.0	0.0	6.5
32	0.8	1.0	0.0	2.5	0.3	0.0	0.0	0.8
33	0.1	0.2	0.0	0.5	0.1	0.0	0.0	0.1
34	4.2	0.2	0.0	0.0	0.0	0.0	0.0	2.7
35	3.1	0.8	0.0	2.4	4.7	0.0	0.0	2.3
36	39.0	67.8	96.7	56.5	3.9	0.0	0.6	41.3
37	42.0	3.4	1.1	11.0	0.0	100.0	99.3	40.0
38	7.1	15.1	0.0	11.0	4.0	0.0	0.1	6.2
39	0.0	0.8	0.0	0.1	0.0	0.0	0.0	0.1
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

SOURCE:
NATIONAL ENERGY BALANCE 1990

BRANCH

31 FOOD, BEVERAGE AND TOBACCO
32 TEXTILE, CLOTHING AND LEATHER
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36 NON-METALLIC MINERAL PRODUCTS MANUFACTURE
37 BASIC METALLIC INDUSTRIES
38 MACHINERY, EQUIPMENTS AND METALLIC MANUFACTURE
39 OTHER INDUSTRIES

INVENE/TABLE G1-6

PRELIMINARY ESTIMATION OF GHG EMISSIONS
ENERGY DATA. MANUFACTURE INDUSTRY

INDUSTRIAL FUEL CONSUMPTION FOR OTHER USES (1)

COUNTRY : VENEZUELA — YEAR : 1990

(TJOULE)

BRANCH	NAT. GAS	LPG	FUEL OIL	GASOIL	GASOL.	KEROSENE	COAL	COKE	BAG.	OTHERS (2)	TOTAL
31	1203	1707	7	1264	52	243	0	0	884	78	5437
32	961	24	3	274	7	31	0	0	0	25	1325
33	108	4	10	138	10	46	6	0	0	74	396
34	919	156	23	181	9	200	0	0	0	216	1705
35	12161	97	56	1011	22	76	0	0	0	25443	38866
36	972	68	74	1520	21	30	0	0	0	1794	4480
37	9325	129	94	716	30	113	25	1	0	113	10548
38	830	248	136	2140	64	184	19	0	0	2654	6275
39	30	0	0	45	1	1	0	0	0	92	170
TOTAL	26510	2433	402	7291	217	924	50	1	884	30490	69202
(% BY FUEL)											
31	22.1	31.4	0.1	23.3	0.9	4.5	0.0	0.0	16.3	1.4	100
32	72.6	1.8	0.2	20.7	0.5	2.3	0.0	0.0	0.0	1.9	100
33	27.2	1.0	2.6	35.0	2.4	11.5	1.5	0.0	0.0	18.7	100
34	53.9	9.2	1.3	10.6	0.5	11.7	0.0	0.0	0.0	12.7	100
35	31.3	0.2	0.1	2.6	0.1	0.2	0.0	0.0	0.0	65.5	100
36	21.7	1.5	1.7	33.9	0.5	0.7	0.0	0.0	0.0	40.0	100
37	88.4	1.2	0.9	6.8	0.3	1.1	0.2	0.0	0.0	1.1	100
38	13.2	3.9	2.2	34.1	1.0	2.9	0.3	0.0	0.0	42.3	100
39	17.9	0.1	0.0	26.5	0.8	0.5	0.0	0.0	0.0	54.3	100
TOTAL	38.3	3.5	0.6	10.5	0.3	1.3	0.1	0.0	1.3	44.1	100
(% BY BRANCH)											
31	4.5	70.2	1.7	17.3	23.8	26.3	0.0	0.0	100.0	0.3	7.9
32	3.6	1.0	0.6	3.8	3.1	3.3	0.0	0.0	0.0	0.1	1.9
33	0.4	0.2	2.6	1.9	4.4	4.9	12.2	0.0	0.0	0.2	0.6
34	3.5	6.4	5.7	2.5	4.2	21.7	0.0	0.0	0.0	0.7	2.5
35	45.9	4.0	14.0	13.9	10.2	8.3	0.0	0.0	0.0	83.4	56.2
36	3.7	2.8	18.4	20.8	9.8	3.3	0.0	0.0	0.0	5.9	6.5
37	35.2	5.3	23.3	9.8	14.0	12.2	50.4	100.0	0.0	0.4	15.2
38	3.1	10.2	33.7	29.4	29.7	19.9	37.4	0.0	0.0	8.7	9.1
39	0.1	0.0	0.0	0.6	0.7	0.1	0.0	0.0	0.0	0.3	0.2
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

(1) INCLUDE: (Mot. Pow + Refrig. + Air Cond. + Lighting + others), TRANSPORT AND FEEDSTOCKS USES ARE NOT INCLUDED

(2) NON-ENERGY USES

BRANCH

31 FOOD, BEVERAGE AND TOBACCO
32 TEXTILE, CLOTHING AND LEATHER
33 WOOD INDUSTRIES
34 PULP AND PAPER INDUSTRIES
35 CHEMICAL AND COAL PRODUCTS MANUFACTURE
36 NON-METALLIC MINERAL PRODUCTS MANUFACTURE
37 BASIC METALLIC INDUSTRIES
38 MACHINERY, EQUIPMENTS AND METALLIC MANUFACTURE
39 OTHER INDUSTRIES

INVENE/TABLE G1-6

PRELIMINARY ESTIMATION OF GHG EMISSIONS

ENERGY DATA. MANUFACTURE INDUSTRY

INDUSTRIAL FUEL CONSUMPTION FOR OTHER USES

COUNTRY : VENEZUELA | YEAR : 1990

(BOE)

BRANCH	NAT. GAS	LPG	FUEL OIL	GASOIL	GASOL.	KEROSENE	COAL	COKE	OTHERS	BAG	TOTAL
31	201105	285464	1148	211422	8629	40629	0	0	13050	147816	909263
32	160693	4052	425	45847	1140	5152	0	0	4183	0	221524
33	18036	674	1717	23141	1597	7640	1023	0	12371	0	66232
34	153665	26144	3801	30271	1536	33477	0	0	36161	0	285089
35	2033596	16220	9396	169122	3694	12758	0	0	4254617	0	6499438
36	162571	11327	12381	254163	3571	5078	0	0	300015	0	749142
37	1559437	21634	15697	119786	5081	18908	4222	228	18959	0	1763952
38	138853	41390	22668	357942	10774	30710	3134	0	443828	0	1049299
39	5086	20	0	7527	236	128	0	0	15417	0	28414
TOTAL	4433042	406925	87233	1219221	36258	154480	8379	228	5098601	147816	11572193
(% BY BRANCH)											
31	22.1	31.4	0.1	23.3	0.9	4.5	0.0	0.0	1.4	16.3	100
32	72.5	1.8	0.2	20.7	0.5	2.3	0.0	0.0	1.9	0.0	100
33	27.2	1.0	2.6	34.9	2.4	11.5	1.5	0.0	18.7	0.0	100
34	53.9	9.2	1.3	10.6	0.5	11.7	0.0	0.0	12.7	0.0	100
35	31.3	0.2	0.1	2.6	0.1	0.2	0.0	0.0	65.5	0.0	100
36	21.7	1.5	1.7	33.9	0.5	0.7	0.0	0.0	40.0	0.0	100
37	88.4	1.2	0.9	6.8	0.3	1.1	0.2	0.0	1.1	0.0	100
38	13.2	3.9	2.2	34.1	1.0	2.9	0.3	0.0	42.3	0.0	100
39	17.9	0.1	0.0	26.5	0.8	0.5	0.0	0.0	54.3	0.0	100
TOTAL	38.3	3.5	0.6	10.5	0.3	1.3	0.1	0.0	44.1	1.3	100
(% BY USES)											
31	4.5	70.2	1.7	17.3	23.8	26.3	0.0	0.0	0.3	100.0	7.9
32	3.6	1.0	0.6	3.8	3.1	3.3	0.0	0.0	0.1	0.0	1.9
33	0.4	0.2	2.6	1.9	4.4	4.9	12.2	0.0	0.2	0.0	0.6
34	3.5	6.4	5.7	2.5	4.2	21.7	0.0	0.0	0.7	0.0	2.5
35	45.9	4.0	14.0	13.9	10.2	8.3	0.0	0.0	83.4	0.0	56.2
36	3.7	2.8	18.4	20.8	9.8	3.3	0.0	0.0	5.9	0.0	6.5
37	35.2	5.3	23.3	9.8	14.0	12.2	50.4	100.0	0.4	0.0	15.2
38	3.1	10.2	33.7	29.4	29.7	19.9	37.4	0.0	8.7	0.0	9.1
39	0.1	0.0	0.0	0.6	0.7	0.1	0.0	0.0	0.3	0.0	0.2
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

BRANCH

31 FOOD, BEVERAGE AND TOBACCO
32 TEXTILE, CLOTHING AND LEATHER
33 WOOD INDUSTRIES
34 PULP AND PAPER INDUSTRIES
35 CHEMICAL AND COAL PRODUCTS MANUFACTURE
36 NON-METALLIC MINERAL PRODUCTS MANUFACTURE
37 BASIC METALLIC INDUSTRIES
38 MACHINERY, EQUIPMENTS AND METALLIC MANUFACTURE
39 OTHER INDUSTRIES

MENU G2

INVENE/TABLE G2-1

PRELIMINARY ESTIMATION OF GHG EMISSIONS
STATIONARY SOURCES.MANUFACTURE INDUSTRY
CALCULATION FOR BRANCH 31: FOOD, BEVERAGE AND TOBACCO

COUNTRY ; VENEZUELA — YEAR ; 1990

ENERGY CONSUMPTION FOR BRANCH 31 (Tj) / **TOTAL GHG EMISSIONS**

FUELS	STEAM	DIR. HEAT	OTHER (9)	TOTAL	CO	CH4	NOx	N20	CO2
NAT. GAS	25098	2785	1203	29086	0.47	0.04	1.91	0.00	1624
OIL	14020	4729	3273	22022	0.29	0.05	3.26	0.01	1606
COAL-COKE	0	0	0	0	0.00	0.00	0.00	0.00	0
BAGASSE	4940	0	884	5824	9.94	0.00	0.61	0.00	638
OTHER (7)	0	0	78	78	0.00	0.00	0.00	0.00	0
TOTAL	44058	7514	5437	57010	10.69	0.09	5.69	0.02	3869

GHG EMISSIONS- STEAM

SOURCE	ENERGY CONSUMP	CO (2)	CH4 (2)	NOx (2)	N20 (3)	CO2 (4)	
		EMISSIONS FACTORS (g/Gj)					
NAT. GAS-FIRED	25098	17	1.4	67	0.1	56100	
RES. OIL-FIRED (1)	14020	15	2.9	161	0.6	73848	(8)
COAL-FIRED	0	93	2.4	329	1.4	94600	
BAGASSE	4940	1706		88		109633	
		EMISSIONS (Gg)					
NATURAL GAS		0.43	0.04	1.68	0.003	1401	
OIL		0.21	0.04	2.26	0.008	1022	
COAL		0.00	0.00	0.00	0.000	0	
BAGASSE		8.43	0.00	0.43	0.00	542	
TOTAL		9.06	0.08	4.37	0.011	2965	

GHG EMISSIONS-DIRECT HEAT

SOURCE	ENERGY CONSUMP	CO (5)	CH4 (5)	NOx (5)	N20 (3)	CO2 (4)	
		EMISSIONS FACTORS (g/Gj)					
DRYER-NATURAL GAS	2785	11	1.1	64	0.1	56100	
DRYER-OIL	4729	16	1.0	168	0.6	73848	(8)
DRYER-COAL	0	179	1.0	226	1.4	94600	
		EMISSIONS (Gg)					
NATURAL GAS		0.03	0.00	0.18	0.000	156	
OIL		0.08	0.00	0.79	0.003	345	
COAL		0.00	0.00	0.00	0.000	0	
TOTAL		0.11	0.01	0.97	0.003	500	

GHG EMISSIONS-OTHER USES (9)

SOURCE	ENERGY CONSUMP	CO (10)	CH4 (6)	NOx (10)	N20 (3)	CO2 (4)	
		EMISSIONS FACTORS (g/Gj)					
NATURAL GAS	1203	9.6	4.0	44	0.1	56100	
OIL	3273	16	1.0	64	0.6	73648	(8)
COAL	0		10.0		1.4	94600	
BAGASSE	884	1706		88		109633	
OTHER (7)	78						
		EMISSIONS (Gg)					
NATURAL GAS		0.01	0.005	0.05	0.000	67	
OIL		0.00	0.003	0.21	0.002	239	
COAL		0.00	0.000	0.00	0.000	0	
BAGASSE		1.61	0.000	0.08	0.000	97	
OTHER		0.00	0.000	0.00	0.000	0	
TOTAL		1.62	0.01	0.34	0.00	403	

(1) RES OIL FIRED EMISSIONS FACTORS WERE USED, SINCE NO MORE DATA WERE AVAILABLE
(2) TABLE 1-8 Pag. 1.44 GREENHOUSE GAS INVENTORY. FIRST DRAFT, VOL. 3
(3) TABLE 1-18 Pag. 1.55 GREENHOUSE GAS INVENTORY. FIRST DRAFT, VOL. 3
(4) TABLE 1-3 Pag. 1-8 GREENHOUSE GAS INVENTORY, FINAL DRAFT. VOL.2 (CORRIGENDA)
(5) TABLE 1-9 Pag. 1.45 GREENHOSE GAS INVENTORY, FIRST DRAFT, VOL. 3
(6) TABLE 1-17 Pag. 1.53 GREENHOSE GAS INVENTORY, FIRST DRAFT, VOL. 3
(7) NON-ENERGY USES
(8) CO2 average Emission factor several types of oil products consumed
(9) INCLUDE (Mot. Pow + Refrig. + Air Cond. + lighting + others) transport and feedstoks uses are not included
(10) Table 1.11 pag 1.46 GREENHOUSE GAS INVENTORY, FINAL DRAFT, VOL 3

NOTE : Totals may not equal sum of components due to independent rounding.

05/6/95

INVEN/TABLE G2-2

PRELIMINARY ESTIMATION OF GHG EMISSIONS
STATIONARY SOURCES. MANUFACTURE INDUSTRY
CALCULATION FOR BRANCH 32: TEXTILE, CLOTHING AND LEATHER

COUNTRY : VENEZUELA — YEAR : 1990

ENERGY CONSUMPTION FOR BRANCH 32 (TJ) — **TOTAL GHG EMISSIONS**

FUELS	STEAM	DIR. HEAT	OTHER (2)	TOTAL	CO	CH4	NOx	N2O	CO2
NAT.GAS	6463	599	961	8023	0.13	0.01	0.61	0.00	448
OIL	1200	358	339	1896	0.03	0.00	0.27	0.00	138
COAL-COKE	0	0	0	0	0.00	0.00	0.00	0.00	0
OTHEF. (7)	0	0	26	26	0.000	0.000	0.000	0.000	0
TOTAL	**7663**	**957**	**1326**	**9944**	**0.16**	**0.02**	**0.79**	**0.00**	**596**

GHG EMISSIONS- STEAM

SOURCE	ENERGY CONSUMP	CO (2)	CH4 (2)	NOx (2)	N2O (3)	CO2 (4)	
		EMISSIONS FACTORS (g/GJ)					
NAT. GAS-FIRED	6463	17	1.4	67	0.1	56100	
RES. OIL-FIRED (1)	1200	15	2.9	161	0.6	73648	(8)
COAL-FIRED	0	93	2.4	329	1.4	94600	
		EMISSIONS (Gg)					
NATURAL GAS		0.110	0.009	0.43	0.00	361	
OIL		0.018	0.003	0.19	0.00	87	
COAL		0.000	0.000	0.00	0.00	0	
TOTAL		**0.129**	**0.013**	**0.63**	**0.00**	**448**	

GHG EMISSIONS-DIRECT HEAT

SOURCE	ENERGY CONSUMP	CO (5)	CH4 (5)	NOx (5)	N2O (3)	CO2 (4)	
		EMISSIONS FACTORS (g/GJ)					
DRYER-NATURAL GAS	599	11	1.1	64	0.1	56100	
DRYER-OIL	358	16	1.0	168	0.6	73648	(8)
DRYER-COAL	0	179	1.0	226	1.4	94600	
		EMISSIONS (Gg)					
NATURAL GAS		0.01	0.001	0.04	0.000	33	
OIL		0.01	0.000	0.06	0.000	26	
COAL		0.00	0.000	0.00	0.000	0	
TOTAL		**0.01**	**0.001**	**0.10**	**0.000**	**60**	

GHG EMISSIONS-OTHER USES (9)

SOURCE	ENERGY CONSUMP	CO (10)	CH4 (6)	NOx (10)	N2O (3)	CO2 (4)	
		EMISSIONS FACTORS (g/GJ)					
NATURAL GAS	961	9.6	4.0	44	0.1	56100	
OIL	339	16	1.0	64	0.6	73648	(8)
COAL	0		10.0		1.4	94600	
OTHER (7)	26						
		EMISSIONS (Gg)					
NATURAL GAS		0.009	0.0038	0.04	0.000	54	
OIL		0.006	0.0003	0.02	0.00020	25	
COAL		0.000	0.0000	0.00	0.00	0	
OTHER		0.000	0.0000	0.00	0.00	0	
TOTAL		0.016	0.0042	0.06	0.000	78	

(1) RES OIL FIRED EMISSIONS FACTORS WERE USED, SINCE NO MORE DATA WERE AVAILABLE
(2) TABLE 1-8 Pag. 1.44 GREENHOUSE GAS INVENTORY. FIRST DRAFT, VOL. 3
(3) TABLE 1-18 Pag. 1.55 GREENHOUSE GAS INVENTORY. FIRST DRAFT, VOL. 3
(4) TABLE 1-3 Pag. 1-8 GREENHOUSE GAS INVENTORY, FINAL DRAFT, VOL.2 (CORRIGENDA)
(5) TABLE 1-9 Pag. 1.45 GREENHOSE GAS INVENTORY, FIRST DRAFT, VOL. 3
(6) TABLE 1-17 Pag. 1.53 GREENHOSE GAS INVENTORY, FIRST DRAFT, VOL. 3
(7) NON-ENERGY USES
(8) CO2 average Emission factor several types of oil products consumed
(9) INCLUDE (Mot. Pow + Refrig. + Air Cond. + lighting + others) transport and feedstoks uses are not included
(10) Table 1.11 pag 1.46 GREENHOUSE GAS INVENTORY. FINAL DRAFT, VOL 3

NOTE : Totals may not equal sum of components due to independent rounding.

BRAN33.XLS

INVENE/TABLE G2-3

PRELIMINARY ESTIMATION OF GHG EMISSIONS
STATIONARY SOURCES. MANUFACTURE INDUSTRY
CALCULATION FOR BRANCH 33: WOOD INDUSTRIES

COUNTRY : VENEZUELA — YEAR : 1990

ENERGY CONSUMPTION FOR BRANCH 33 (Tj) — TOTAL GHG EMISSIONS

FUELS	STEAM	DIR. HEAT	OTHER (9)	TOTAL	CO	CH4	NOx	N20	CO2
NAT.GAS	103	44	108	254	0.00	0.00	0.01	0.00	14
OIL	342	71	208	621	0.01	0.00	0.08	0.00	46
COAL-COKE	0	0	6	6	0.00	0.00	0.00	0.00	1
OTHER (7)	0	0	74	74	0.000	0.0000	0.000	0.000	0
TOTAL	445	115	396	955	0.01	0.00	0.09	0.00	60

GHG EMISSIONS- STEAM

EMISSIONS FACTORS (g/Gj)

SOURCE	ENERGY CONSUMP	CO (2)	CH4 (2)	NOx (2)	N20 (3)	CO2 (4)	
NAT. GAS-FIRED	103	17	1.4	67	0.1	56100	
RES. OIL-FIRED (1)	342	15	2.9	161	0.6	73648	(8)
COAL-FIRED	0	93	2.4	329	1.4	94600	

EMISSIONS (Gg)

	CO	CH4	NOx	N20	CO2
NATURAL GAS	0.00	0.0001	0.01	0.00001	6
OIL	0.01	0.0010	0.06	0.00021	25
COAL	0.00	0.0000	0.00	0.00000	0
TOTAL	0.01	0.0011	0.08	0.00022	31

GHG EMISSIONS-DIRECT HEAT

EMISSIONS FACTORS (g/Gj)

SOURCE	ENERGY CONSUMP	CO (5)	CH4 (5)	NOx (5)	N20 (3)	CO2 (4)	
DRYER-NATURAL GAS	44	11	1.1	64	0.1	56100	
DRYER-OIL	71	16	1.0	168	0.6	73648	(8)
DRYER-COAL	0	179	1.0	226	1.4	94600	

EMISSIONS (Gg)

	CO	CH4	NOx	N20	CO2
NATURAL GAS	0.00048	0.00005	0.00	0.00000	2
OIL	0.00114	0.00007	0.01	0.00004	5
COAL	0.00000	0.00000	0.00	0.00000	0
TOTAL	0.00162	0.00012	0.01	0.00005	8

GHG EMISSIONS-OTHER USES (9)

EMISSIONS FACTORS (g/Gj)

SOURCE	ENERGY CONSUMP	CO (10)	CH4 (6)	NOx (10)	N20 (3)	CO2 (4)	
NATURAL GAS	108	9.6	4.0	44	0.1	56100	
OIL	208	16	1.0	64	0.6	73648	(8)
COAL	6		10.0		1.4	94600	
OTHER (7)	74						

EMISSIONS (Gg)

	CO	CH4	NOx	N20	CO2
NATURAL GAS	0.001	0.0004	0.00	0.00001	6
OIL	0.003	0.0002	0.01	0.00012	15
COAL	0.000	0.0001	0.00	0.00001	1
OTHER	0.000	0.000	0.000	0.000	0
TOTAL	0.004	0.0007	0.02	0.00014	22

(1) RES OIL FIRED EMISSIONS FACTORS WERE USED, SINCE NO MORE DATA WERE AVAILABLE
(2) TABLE 1-8 Pag. 1.44 GREENHOUSE GAS INVENTORY. FIRST DRAFT, VOL. 3
(3) TABLE 1-18 Pag. 1.55 GREENHOUSE GAS INVENTORY. FIRST DRAFT, VOL. 3
(4) TABLE 1-3 Pag. 1-8 GREENHOUSE GAS INVENTORY, FINAL DRAFT, VOL.2 (CORRIGENDA)
(5) TABLE 1-9 Pag. 1.45 GREENHOSE GAS INVENTORY, FIRST DRAFT, VOL. 3
(6) TABLE 1-17 Pag. 1.53 GREENHOSE GAS INVENTORY, FIRST DRAFT, VOL. 3
(7) NON-ENERGY USES
(8) CO2 average Emission factor several types of oil products consumed
(9) INCLUDE (Mot. Pow + Refrig. + Air Cond. + lighting + others) transport and feedstoks uses are not included
(10) Table 1.11 pag 1.46 GREENHOUSE GAS INVENTORY, FINAL DRAFT, VOL 3

NOTE : Totals may not equal sum of components due to independent rounding.

05/6/95

BRAN34.XLS

INVENE/TABLE G2-4

PRELIMINARY ESTIMATION OF GHG EMISSIONS
STATIONARY SOURCES. MANUFACTURE INDUSTRY
CALCULATION FOR BRANCH 34: PULP AND PAPER INDUSTRIES

COUNTRY : VENEZUELA — YEAR : 1990

ENERGY CONSUMPTION FOR BRANCH 34 (TJ) — **TOTAL GHG EMISSIONS**

FUELS	STEAM	DIR. HEAT	OTHER (9)	TOTAL	CO	CH4	NOx	N20	CO2
NAT.GAS	9264	3104	919	13287	0.20	0.02	0.86	0.00	742
OIL	219	9	569	797	0.01	0.00	0.07	0.00	58
COAL-COKE	0	0	0	0	0.00	0.00	0.00	0.00	0
OTHER (7)	0	0	216	216	0.000	0.000	0.000	0.000	0
TOTAL	9482	3113	1706	14300	0.21	0.02	0.93	0.00	800

GHG EMISSIONS- STEAM

EMISSIONS FACTORS (g/Gj)

SOURCE	ENERGY CONSUMP	CO (2)	CH4 (2)	NOx (2)	N20 (3)	CO2 (4)	
NAT. GAS-FIRED	9264	17	1.4	67	0.1	56100	
RES. OIL-FIRED (1)	219	15	2.9	161	0.6	73648	(8)
COAL-FIRED	0	93	2.4	329	1.4	94600	

EMISSIONS (Gg)

	CO	CH4	NOx	N20	CO2
NATURAL GAS	0.157	0.013	0.62	0.00	517
OIL	0.003	0.001	0.04	0.00	16
COAL	0.000	0.000	0.00	0.00	0
TOTAL	0.161	0.014	0.66	0.00	533

GHG EMISSIONS-DIRECT HEAT

EMISSIONS FACTORS (g/Gj)

SOURCE	ENERGY CONSUMP	CO (5)	CH4 (5)	NOx (6)	N20 (3)	CO2 (4)	
DRYER-NATURAL GAS	3104	11	1.1	64	0.1	56100	
DRYER-OIL	9	16	1.0	168	0.6	73648	(8)
DRYER-COAL	0	179	1.0	226	1.4	94600	

EMISSIONS (Gg)

	CO	CH4	NOx	N20	CO2
NATURAL GAS	0.034	0.003	0.199	0.000	173
OIL	0.000	0.000	0.002	0.000	1
COAL	0.000	0.000	0.000	0.000	0
TOTAL	0.034	0.003	0.200	0.000	174

GHG EMISSIONS-OTHER USES (9)

EMISSIONS FACTORS (g/Gj)

SOURCE	ENERGY CONSUMP	CO (10)	CH4 (6)	NOx (10)	N20 (3)	CO2 (4)	
NATURAL GAS	919	9.6	4.0	44	0.1	56100	
OIL	569	16	1.0	64	0.6	73648	(8)
COAL	0		10.0		1.4	94600	
OTHER (7)	216						

EMISSIONS (Gg)

	CO	CH4	NOx	N20	CO2
NATURAL GAS	0.009	0.0037	0.04	0.000	61
OIL	0.009	0.0006	0.04	0.000	42
COAL	0.000	0.0000	0.00	0.000	0
OTHER	0.000	0.000	0.000	0.000	0
TOTAL	0.018	0.0042	0.08	0.000	93

(1) RES OIL FIRED EMISSIONS FACTORS WERE USED, SINCE NO MORE DATA WERE AVAILABLE
(2) TABLE 1-8 Pag. 1.44 GREENHOUSE GAS INVENTORY. FIRST DRAFT, VOL. 3
(3) TABLE 1-18 Pag. 1.55 GREENHOUSE GAS INVENTORY. FIRST DRAFT, VOL. 3
(4) TABLE 1-3 Pag. 1-8 GREENHOUSE GAS INVENTORY, FINAL DRAFT, VOL.2 (CORRIGENDA)
(5) TABLE 1-9 Pag. 1.45 GREENHOSE GAS INVENTORY, FIRST DRAFT, VOL. 3
(6) TABLE 1-17 Pag. 1.53 GREENHOSE GAS INVENTORY, FIRST DRAFT, VOL. 3
(7) NON-ENERGY USES
(8) CO2 average Emission factor several types of oil products consumed
(9) INCLUDE (Mot. Pow + Refrig. + Air Cond. + lighting + others) transport and feedstoks uses are not included
(10) Table 1.11 pag 1.46 GREENHOUSE GAS INVENTORY, FINAL DRAFT, VOL 3

NOTE : Totals may not equal sum of components due to independent rounding.

05/6/96

BRAN35.XLS

INVENE/TABLE G2-5

PRELIMINARY ESTIMATION OF GHG EMISSIONS
STATIONARY SOURCES. MANUFACTURE INDUSTRY
CALCULATION FOR BRANCH 35: CHEMICAL AND COAL PRODUCTS MANUFACTURE

COUNTRY : VENEZUELA

YEAR : 1990

ENERGY CONSUMPTION FOR BRANCH 35 (TJ) — **TOTAL GHG EMISSIONS**

FUELS	STEAM	DIR. HEAT	OTHER (9)	TOTAL	CO	CH4	NOx	N2O	CO2
NAT.GAS	42059	2280	12181	56500	0.86	0.11	3.50	0.01	3164
OIL	2747	440	1263	4450	0.07	0.01	0.60	0.00	324
COAL-COKE	0	0	0	0	0.00	0.00	0.00	0.00	0
OTHER (7)	0	0	25443	25443	0.000	0.000	0.000	0.000	0
TOTAL	44806	2720	38866	86392	0.93	0.12	4.10	0.01	3478

GHG EMISSIONS- STEAM

SOURCE	ENERGY CONSUMP	CO (2)	CH4 (2)	NOx (2)	N2O (3)	CO2 (4)	
		EMISSIONS FACTORS (g/GJ)					
NAT. GAS-FIRED	42059	17	1.4	67	0.1	56100	
RES. OIL-FIRED (1)	2747	15	2.9	161	0.6	73648	(8)
COAL-FIRED	0	93	2.4	329	1.4	94600	
		EMISSIONS (Gg)					
NATURAL GAS		0.71	0.06	2.82	0.00	2348	
OIL		0.04	0.01	0.44	0.00	200	
COAL		0.00	0.00	0.00	0.00	0	
TOTAL		0.76	0.07	3.26	0.01	2548	

GHG EMISSIONS-DIRECT HEAT

SOURCE	ENERGY CONSUMP	CO (5)	CH4 (5)	NOx (5)	N2O (3)	CO2 (4)	
		EMISSIONS FACTORS (g/GJ)					
DRYER-NATURAL GAS	2280	11	1.1	64	0.1	56100	
DRYER-OIL	440	16	1.0	168	0.6	73648	(8)
DRYER-COAL	0	179	1.0	226	1.4	94600	
		EMISSIONS (Gg)					
NATURAL GAS		0.025	0.003	0.15	0.000	127	
OIL		0.007	0.000	0.07	0.000	32	
COAL		0.000	0.000	0.00	0.000	0	
TOTAL		0.032	0.003	0.22	0.000	159	

GHG EMISSIONS-OTHERS USES (9)

SOURCE	ENERGY CONSUMP	CO (10)	CH4 (6)	NOx (10)	N2O (3)	CO2 (4)	
		EMISSIONS FACTORS (g/GJ)					
NATURAL GAS	12181	9.6	4.0	44	0.1	56100	
OIL	1263	16	1.0	64	0.6	73648	(8)
COAL	0		10.0		1.4	94600	
OTHER (7)	25443						
		EMISSIONS (Gg)					
NATURAL GAS		0.117	0.0486	0.54	0.00	679	
OIL		0.020	0.0013	0.08	0.00	92	
COAL		0.000	0.0000	0.00	0.00	0	
OTHER		0.000	0.000	0.000	0.000	0	
TOTAL		0.137	0.0499	0.62	0.00	771	

(1) RES OIL FIRED EMISSIONS FACTORS WERE USED, SINCE NO MORE DATA WERE AVAILABLE
(2) TABLE 1-8 Pag. 1.44 GREENHOUSE GAS INVENTORY. FIRST DRAFT. VOL. 3
(3) TABLE 1-18 Pag. 1.55 GREENHOUSE GAS INVENTORY. FIRST DRAFT. VOL. 3
(4) TABLE 1-3 Pag. 1-8 GREENHOUSE GAS INVENTORY, FINAL DRAFT. VOL.2 (CORRIGENDA)
(5) TABLE 1-9 Pag. 1.45 GREENHOSE GAS INVENTORY, FIRST DRAFT, VOL. 3
(6) TABLE 1-17 Pag. 1.53 GREENHOSE GAS INVENTORY, FIRST DRAFT, VOL. 3
(7) NON-ENERGY USES
(8) CO2 average Emission factor several types of oil products consumed
(9) INCLUDE (Mot. Pow + Refrig. + Air Cond. + lighting + others) transport and feedstoks uses are not included
(10) Table 1.11 pag 1.46 GREENHOUSE GAS INVENTORY. FINAL DRAFT, VOL 3

NOTE : Totals may not equal sum of components due to independent rounding.

05 6 95

BRAN36.XLS

INVENE/TABLE G2-6

PRELIMINARY ESTIMATION OF GHG EMISSIONS
STATIONARY SOURCES. MANUFACTURE INDUSTRY
CALCULATION FOR BRANCH 36: NON--METALLIC MINERAL PRODUCTS MANUFACTURE

COUNTRY : VENEZUELA — YEAR : 1990

ENERGY CONSUMPTION FOR BRANCH 36 (TJ) / TOTAL GHG EMISSIONS

FUELS	STEAM	DIR. HEAT	OTHER (9)	TOTAL	CO	CH4	NOx	N20	CO2
NAT.GAS	1226	28941	972	31140	2.43	0.04	32.28	0.00	1738
OIL	361	18851	1713	20925	1.52	0.02	10.10	0.01	1526
COAL-COKE	304	26	0	329	0.03	0.00	0.11	0.00	31
OTHER (7)	0	0	1794	1794	0.000	0.000	0.000	0.000	0
TOTAL	1891	47818	4480	54188	3.98	0.06	42.49	0.02	3294

GHG EMISSIONS- STEAM

SOURCE	ENERGY CONSUMP	CO (2)	CH4 (2)	NOx (2)	N20 (3)	CO2 (4)	
		EMISSIONS FACTORS (g/GJ)					
NAT. GAS-FIRED	1226	17	1.4	67	0.1	56100	
RES. OIL-FIRED (1)	361	15	2.9	161	0.6	73648	(8)
COAL-FIRED	304	93	2.4	329	1.4	94600	
		EMISSIONS (Gg)					
NATURAL GAS		0.021	0.002	0.08	0.000	69	
OIL		0.005	0.001	0.06	0.000	26	
COAL		0.028	0.001	0.10	0.000	28	
TOTAL		0.055	0.00	0.24	0.001	123	

GHG EMISSIONS-DIRECT HEAT

SOURCE	ENERGY CONSUMP	CO (5)	CH4 (5)	NOx (5)	N20 (3)	CO2 (4)	
		EMISSIONS FACTORS (g/GJ)					
KILNS-NATURAL GAS	28941	83	1.1	1111	0.1	56100	
KILNS-OIL	18851	79	1.0	527	0.6	73648	(8)
KILNS-COAL	26	79	1.0	527	1.4	94600	
		EMISSIONS (Gg)					
NATURAL GAS		2.402	0.032	32.15	0.003	1616	
OIL		1.489	0.019	9.93	0.011	1374	
COAL		0.002	0.000	0.01	0.000	2	
TOTAL		3.893	0.051	42.10	0.014	2992	

GHG EMISSIONS-OTHER USES (9)

SOURCE	ENERGY CONSUMP	CO (10)	CH4 (6)	NOx (10)	N20 (3)	CO2 (4)	
		EMISSIONS FACTORS (g/GJ)					
NATURAL GAS	972	9.6	4.0	44	0.1	56100	
OIL	1713	16	1.0	64	0.6	73648	(8)
COAL	0		10.0		1.4	94600	
OTHER (7)	1794						
		EMISSIONS (Gg)					
NATURAL GAS		0.009	0.0039	0.04	0.000	54	
OIL		0.027	0.0017	0.11	0.001	125	
COAL		0.000	0.0000	0.00	0.000	0	
OTHER		0.000	0.0000	0.00	0.000	0	
TOTAL		0.037	0.0056	0.15	0.001	179	

(1) RES OIL FIRED EMISSIONS FACTORS WERE USED, SINCE NO MORE DATA WERE AVAILABLE
(2) TABLE 1-8 Pag. 1.44 GREENHOUSE GAS INVENTORY. FIRST DRAFT, VOL. 3
(3) TABLE 1-18 Pag. 1.55 GREENHOUSE GAS INVENTORY. FIRST DRAFT, VOL. 3
(4) TABLE 1-3 Pag. 1-8 GREENHOUSE GAS INVENTORY, FINAL DRAFT, VOL.2 (CORRIGENDA)
(5) TABLE 1-9 Pag. 1.45 GREENHOSE GAS INVENTORY, FIRST DRAFT, VOL. 3
(6) TABLE 1-17 Pag. 1.53 GREENHOSE GAS INVENTORY, FIRST DRAFT, VOL. 3
(7) NON-ENERGY USES
(8) CO2 average Emission factor several types of oil products consumed
(9) INCLUDE (Mot. Pow + Refrig. + Air Cond. + lighting + others) transport and feedstoks uses are not included
(10) Table 1.11 pag 1.46 GREENHOUSE GAS INVENTORY, FINAL DRAFT, VOL 3

NOTE : Totals may not equal sum of components due to independent rounding.

05/6/96

INVENE/TABLE G2-7

PRELIMINARY ESTIMATION OF GHG EMISSIONS
STATIONARY SOURCES. MANUFACTURE INDUSTRY
CALCULATION FOR BRANCH 37: BASIC METALLIC INDUSTRIES

COUNTRY : VENEZUELA — YEAR : 1990

ENERGY CONSUMPTION FOR BRANCH 37 (Tj) — **TOTAL GHG EMISSIONS**

FUELS	STEAM	DIR. HEAT	OTHER (9)	TOTAL	CO	CH4	NOx	N20	CO2
NAT. GAS	13139	31177	9326	53642	6.89	0.09	1.29	0.01	2994
OIL	60	1595	1083	2738	0.55	0.00	0.08	0.00	200
COAL-COKE	230	13515	27	13772	2.87	0.01	0.08	0.02	1277
OTHER (7)	0	0	113	113	0.000	0.000	0.000	0.000	0
TOTAL	13429	46288	10548	70265	10.32	0.10	1.45	0.03	4471

GHG EMISSIONS- STEAM

EMISSIONS FACTORS (g/Gj)

SOURCE	ENERGY CONSUMP	CO (2)	CH4 (2)	NOx (2)	N20 (3)	CO2 (4)	
NAT. GAS-FIRED	13139	17	1.4	67	0.1	56100	
RES. OIL-FIRED (1)	60	15	2.9	161	0.6	73648	(8)
COAL-FIRED	230	93	2.4	329	1.4	94600	

EMISSIONS (Gg)

	CO	CH4	NOx	N20	CO2
NATURAL GAS	0.22	0.02	0.88	0.00	733
OIL	0.00	0.00	0.01	0.00	4
COAL	0.021	0.00055	0.08	0.00	21
TOTAL	0.25	0.02	0.97	0.00	759

GHG EMISSIONS-DIRECT HEAT

EMISSIONS FACTORS (g/Gj)

SOURCE	ENERGY CONSUMP	CO (5)	CH4 (6)	NOx (5)	N20 (3)	CO2 (4)	
NATURAL GAS	31177	211	1	0	0.1	56100	
OIL	1595	211	1	0	0.6	73648	(8)
COAL	13515	211	1	0	1.4	94600	

EMISSIONS (Gg)

	CO	CH4	NOx	N20	CO2
NATURAL GAS	6.58	0.03	0.00	0.00	1740
OIL	0.34	0.00	0.00	0.00	116
COAL	2.852	0.01352	0.00	0.02	1253
TOTAL	9.77	0.05	0.00	0.02	3110

GHG EMISSIONS-OTHER USES (9)

EMISSIONS FACTORS (g/Gj)

SOURCE	ENERGY CONSUMP	CO (10)	CH4	NOx (10)	N20 (3)	CO2 (4)	
NATURAL GAS	9326	9.6	4.0	44	0.1	56100	
OIL	1083	16	1.0	64	0.6	73648	(8)
COAL	27		10.0		1.4	94600	
OTHER (7)	113						

EMISSIONS (Gg)

	CO	CH4	NOx	N20	CO2
NATURAL GAS	0.090	0.0373	0.41	0.00093	521
OIL	0.216	0.0011	0.07	0.00065	79
COAL	0.000	0.0003	0.00	0.00004	2
OTHER	0.000	0.0000	0.00	0.00000	0
TOTAL	0.306	0.0387	0.48	0.00162	602

(1) RES OIL FIRED EMISSIONS FACTORS WERE USED, SINCE NO MORE DATA WERE AVAILABLE
(2) TABLE 1-8 Pag. 1.44 GREENHOUSE GAS INVENTORY, FIRST DRAFT, VOL. 3
(3) TABLE 1-18 Pag. 1.56 GREENHOUSE GAS INVENTORY, FIRST DRAFT, VOL. 3
(4) TABLE 1-3 Pag. 1-8 GREENHOUSE GAS INVENTORY, FINAL DRAFT, VOL.2 (CORRIGENDA)
(5) TABLE 1-9 Pag. 1.45 GREENHOSE GAS INVENTORY, FIRST DRAFT, VOL. 3
(6) TABLE 1-17 Pag. 1.53 GREENHOSE GAS INVENTORY, FIRST DRAFT, VOL. 3
(7) NON-ENERGY USES
(8) CO2 average Emission factor several types of oil products consumed
(9) INCLUDE (Mot. Pow + Refrig. + Air Cond. + lighting + others) transport and feedstoks uses are not included
(10) Table 1.11 pag 1.46 GREENHOUSE GAS INVENTORY, FINAL DRAFT, VOL 3

NOTE : Totals may not equal sum of components due to independent rounding.

05/6/95

INVENE/TABLE G2-8

PRELIMINARY ESTIMATION OF GHG EMISSIONS
STATIONARY SOURCES. MANUFACTURE INDUSTRY
CALCULATION FOR BRANCH 38: MACHINERY, EQUIPMENTS AND METALLIC MANUFACTURE

COUNTRY : VENEZUELA — YEAR : 1990

ENERGY CONSUMPTION FOR BRANCH 38 (Tj) — **TOTAL GHG EMISSIONS**

FUELS	STEAM	DIR. HEAT	OTHER (9)	TOTAL	CO	CH4	NOx	N20	CO2
NAT. GAS	642	5251	830	6623	1.13	0.01	0.07	0.00	370
OIL	1579	1946	2772	6297	0.43	0.01	0.43	0.00	459
COAL-COKE	70	6	19	95	0.01	0.00	0.02	0.00	9
OTHER (7)	0	0	2664	2664	0.000	0.000	0.000	0.000	0
TOTAL	2191	7203	6275	15669	1.57	0.02	0.53	0.00	838

GHG EMISSIONS- STEAM

EMISSIONS FACTORS (g/Gj)

SOURCE	ENERGY CONSUMP	CO (2)	CH4 (2)	NOx (2)	N20 (3)	CO2 (4)	
NAT. GAS-FIRED	642	17	1.4	67	0.1	56100	
RES. OIL-FIRED (1)	1579	15	2.9	161	0.6	73648	(8)
COAL-FIRED	70	93	2.4	329	1.4	94600	

EMISSIONS (Gg)

	CO	CH4	NOx	N20	CO2
NATURAL GAS	0.01	0.00	0.04	0.00	30
OIL	0.02	0.00	0.25	0.00	116
COAL	0.007	0.00017	0.02	0.00	7
TOTAL	0.04	0.01	0.31	0.00	152

GHG EMISSIONS-DIRECT HEAT

EMISSIONS FACTORS (g/Gj)

SOURCE	ENERGY CONSUMP	CO (5)	CH4 (5)	NOx (5)	N20 (3)	CO2 (4)	
NATURAL GAS	5251	211	1	0	0.1	56100	
OIL	1946	211	1	0	0.6	73648	(8)
COAL	6	211	1	0	1.4	94600	

EMISSIONS (Gg)

	CO	CH4	NOx	N20	CO2
NATURAL GAS	1.11	0.01	0.00	0.00	293
OIL	0.41	0.00	0.00	0.00	142
COAL	0.00	0.00	0.00	0.00	1
TOTAL	1.52	0.01	0.00	0.00	436

GHG EMISSIONS-OTHER USES (9)

EMISSIONS FACTORS (g/Gj)

SOURCE	ENERGY CONSUMP	CO (10)	CH4 (6)	NOx (10)	N20 (3)	CO2 (4)	
NATURAL GAS	830	9.6	4.0	44	0.1	56100	
OIL	2772	16	1.0	64	0.6	73648	(8)
COAL	19		10.0		1.4	94600	
OTHER (7)	2664						

EMISSIONS (Gg)

	CO	CH4	NOx	N20	CO2
NATURAL GAS	0.008	0.0033	0.04	0.00008	46
OIL	0.000	0.0028	0.18	0.00166	202
COAL	0.000	0.0002	0.00	0.00003	2
OTHER	0.000	0.0000	0.00	0.00000	0
TOTAL	0.008	0.0063	0.21	0.00177	250

(1) RES OIL FIRED EMISSIONS FACTORS WERE USED, SINCE NO MORE DATA WERE AVAILABLE
(2) TABLE 1-8 Pag. 1.44 GREENHOUSE GAS INVENTORY, FIRST DRAFT, VOL. 3
(3) TABLE 1-18 Pag. 1.55 GREENHOUSE GAS INVENTORY, FIRST DRAFT, VOL. 3
(4) TABLE 1-3 Pag. 1-8 GREENHOUSE GAS INVENTORY, FINAL DRAFT, VOL.2 (CORRIGENDA)
(5) TABLE 1-9 Pag. 1.45 GREENHOSE GAS INVENTORY, FIRST DRAFT, VOL. 3
(6) TABLE 1-17 Pag. 1.53 GREENHOSE GAS INVENTORY, FIRST DRAFT, VOL. 3
(7) NON-ENERGY USES
(8) CO2 average Emission factor several types of oil products consumed
(9) INCLUDE (Mot. Pow + Refrig. + Air Cond. + lighting + others) transport and feedstcks uses are not included
(10) Table 1.11 pag 1.46 GREENHOUSE GAS INVENTORY, FINAL DRAFT, VOL 3

NOTE : Totals may not equal sum of components due to independent rounding.

BRAN39.XLS

INVEN/TABLE G2-9

PRELIMINARY ESTIMATION OF GHG EMISSIONS
STATIONARY SOURCES. MANUFACTURE INDUSTRY
CALCULATION FOR BRANCH 39: OTHER INDUSTRIES

COUNTRY : VENEZUELA — YEAR : 1990

ENERGY CONSUMPTION FOR BRANCH 39 (Tj) — TOTAL GHG EMISSIONS

FUELS	STEAM	DIR. HEAT	OTHER (9)	TOTAL	CO	CH4	NOx	N20	CO2
NAT. GAS	6	23	30	59	0.00	0.00	0.00	0.00	3
OIL	123	43	47	214	0.00	0.00	0.03	0.00	16
COAL-COKE	0	0	0	0	0.00	0.00	0.00	0.00	0
OTHER (7)	0	0	92	92	0.000	0.0000	0.000	0.000	0
TOTAL	129	66	170	366	0.00	0.00	0.03	0.00	19

GHG EMISSIONS- STEAM

SOURCE	ENERGY CONSUMP	CO (2)	CH4 (2)	NOx (2)	N20 (3)	CO2 (4)	
		EMISSIONS FACTORS (g/Gj)					
NAT. GAS-FIRED	6	17	1.4	67	0.1	56100	
RES. OIL-FIRED (1)	123	16	2.9	161	0.6	73648	(8)
COAL-FIRED	0	93	2.4	329	1.4	94600	
		EMISSIONS (Gg)					
NATURAL GAS		0.00	0.0000	0.00	0.00000	0	
OIL		0.00	0.0004	0.02	0.00007	9	
COAL		0.00	0.0000	0.00	0.00000	0	
TOTAL		0.00	0.0004	0.02	0.00007	9	

GHG EMISSIONS-DIRECT HEAT

SOURCE	ENERGY CONSUMP	CO (5)	CH4 (5)	NOx (5)	N20 (3)	CO2 (4)	
		EMISSIONS FACTORS (g/Gj)					
DRYER-NATURAL GAS	23	11	1.1	64	0.1	56100	
DRYER-OIL	43	16	1.0	168	0.6	73648	(8)
DRYER-COAL	0	179	1.0	228	1.4	94600	
		EMISSIONS (Gg)					
NATURAL GAS		0.00026	0.00003	0.00	0.00000	1	
OIL		0.00069	0.00004	0.01	0.00003	3	
COAL		0.00000	0.00000	0.00	0.00000	0	
TOTAL		0.00095	0.00007	0.01	0.00003	4	

GHG EMISSIONS-OTHER USES (9)

SOURCE	ENERGY CONSUMP	CO (10)	CH4 (6)	NOx (10)	N20 (3)	CO2 (4)	
		EMISSIONS FACTORS (g/Gj)					
NATURAL GAS	30	9.6	4.0	44	0.1	56100	
OIL	47	16	1.0	64	0.6	73648	(8)
COAL	0		10.0		1.4	94600	
OTHER (7)	92						
		EMISSIONS (Gg)					
NATURAL GAS		0.000	0.0001	0.00	0.00000	2	
OIL		0.001	0.0000	0.00	0.00003	3	
COAL		0.000	0.0000	0.00	0.00000	0	
OTHER		0.000	0.000	0.000	0.000	0	
TOTAL		0.001	0.0002	0.00	0.00003	5	

(1) RES OIL FIRED EMISSIONS FACTORS WERE USED, SINCE NO MORE DATA WERE AVAILABLE
(2) TABLE 1-8 Pag. 1.44 GREENHOUSE GAS INVENTORY. FIRST DRAFT. VOL. 3
(3) TABLE 1-18 Pag. 1.55 GREENHOUSE GAS INVENTORY. FIRST DRAFT. VOL. 3
(4) TABLE 1-3 Pag. 1-8 GREENHOUSE GAS INVENTORY, FINAL DRAFT, VOL.2 (CORRIGENDA)
(5) TABLE 1-9 Pag. 1.45 GREENHOSE GAS INVENTORY, FIRST DRAFT, VOL. 3
(6) TABLE 1-17 Pag. 1.53 GREENHOSE GAS INVENTORY, FIRST DRAFT, VOL. 3
(7) NON-ENERGY USES
(8) CO2 average Emission factor several types of oil products consumed
(9) INCLUDE (Mot. Pow + Refrig. + Air Cond. + lighting + others) transport and feedstoks uses are not included
(10) Table 1.11 pag 1.46 GREENHOUSE GAS INVENTORY, FINAL DRAFT, VOL 3

NOTE : Totals may not equal sum of components due to independent rounding.

05/6/96

MENU F2

INVENE/TABLE F2-1

PRELIMINARY ESTIMATION OF GHG EMISSIONS
STATIONARY SOURCES. MANUFACTURE INDUSTRY
SUMMARY BY BRANCH AND USES

COUNTRY : VENEZUELA

YEAR : 1990

USES FOR BRANCH	TOTAL EMISSIONS BY USES (Gg)					% BY USES				
	CO	CH4	NOx	N2O	CO2	CO	CH4	NOx	N2O	CO2
TOTAL	27.87	0.44	56.10	0.08	17413	100	100	100	100	100
STEAM	10.46	0.20	10.52	0.02	7668	38	46	19	32	43
DIRECT HEAT	15.37	0.12	43.62	0.04	7443	56	27	78	56	43
OTHER USES (1)	2.06	0.12	1.87	0.01	2403	7	27	4	12	14
	EMISSIONS BY BRANCH (Gg)									
BRANCH 31	10.69	0.09	5.69	0.02	3868	100	100	100	100	100
STEAM	9.06	0.08	4.37	0.01	2965	85	83	77	68	77
DIRECT HEAT	0.11	0.01	0.97	0.00	500	1	9	17	19	13
OTHER USES	1.52	0.01	0.34	0.00	403	14	9	6	13	10
BRANCH 32	0.16	0.02	0.79	0.00	586	100	100	100	100	100
STEAM	0.13	0.01	0.63	0.00	448	83	71	79	84	76
DIRECT HEAT	0.01	0.00	0.10	0.00	60	8	6	12	8	10
OTHER USES	0.01	0.00	0.06	0.00	78	9	24	8	8	13
BRANCH 33	0.01	0.00	0.09	0.00	60	100	100	100	100	100
STEAM	0.01	0.00	0.06	0.00	31	53	58	65	53	51
DIRECT HEAT	0.00	0.00	0.01	0.00	8	13	6	16	12	13
OTHER USES	0.00	0.00	0.02	0.00	22	34	36	19	35	36
BRANCH 34	0.21	0.02	0.93	0.00	800	100	100	100	100	100
STEAM	0.16	0.01	0.66	0.00	533	76	64	70	59	67
DIRECT HEAT	0.03	0.00	0.20	0.00	174	16	16	21	17	22
OTHER USES	0.02	0.00	0.08	0.00	93	8	20	8	24	12
BRANCH 35	0.93	0.12	4.10	0.01	3478	100	100	100	100	100
STEAM	0.76	0.07	3.26	0.01	2548	82	56	80	70	73
DIRECT HEAT	0.03	0.00	0.22	0.00	159	3	2	5	6	5
OTHER USES	0.14	0.05	0.62	0.00	771	15	42	15	24	22
BRANCH 36	3.98	0.06	42.49 *	0.02	3294	100	100	100	100	100
STEAM	0.05	0.00	0.24	0.00	123	1	6	1	5	4
DIRECT HEAT	3.89	0.05	42.10	0.01	2992	98	85	99	88	91
OTHER USES	0.04	0.01	0.15	0.00	179	1	9	0	7	5
BRANCH 37	10.32	0.10	1.45	0.03	4471	100	100	100	100	100
STEAM	0.25	0.02	0.97	0.00	759	2	18	67	6	17
DIRECT HEAT	9.77	0.05	0.00	0.02	3110	95	44	0	87	70
OTHERS USES	0.31	0.04	0.48	0.00	602	3	37	33	6	13
BRANCH 38	1.57	0.02	0.53	0.00	838	100	100	100	100	100
STEAM	0.04	0.01	0.31	0.00	152	3	29	59	24	18
DIRECT HEAT	1.52	0.01	0.00	0.00	436	97	38	0	37	52
OTHER USES	0.01	0.01	0.21	0.00	250	1	33	41	39	30
BRANCH 39	0.00	0.00	0.03	0.00	18	100	100	100	100	100
STEAM	0.00	0.00	0.02	0.00	9	49	61	61	56	49
DIRECT HEAT	0.00	0.00	0.01	0.00	4	24	11	26	21	24
OTHER USES	0.00	0.00	0.00	0.00	5	27	28	13	23	27

(1) INCLUDE: (Mot. Pow + Refrig. + Air Cond. + Lighting + others). TRANSPORT AND FEEDSTOCKS USES ARE NOT INCLUDED

BRANCH
31 FOOD, BEVERAGE AND TABACCO
32 TEXTILE, CLOTHING AND LEATHER
33 WOOD INDUSTRIES
34 PULP AND PAPER INDUSTRIES
35 CHEMICAL AND COAL PRODUCTS MANUFACTURE
36 NON-METALLIC MINERAL PRODUCTS MANUFACTURE
37 BASIC METALLIC INDUSTRIES
38 MACHINERY, EQUIPMENTS AND METALLIC MANUFACTURE
39 OTHER INDUSTRIES

* THIS VALUE SEEMS TO BE TOO HIGH DUE TO THE EMISSION FACTOR USED (TABLE 1-17 PAGE 1-53 VOLUME 3 IPCC DRAFT GUIDELINES FOR NATIONAL GHG INVENTORIES)

NOTE : Totals may not equal sum of components due to independent rounding.

05/6/95

INVENE/TABLE F2-2

PRELIMINARY ESTIMATION OF GHG EMISSIONS
STATIONARY SOURCES. MANUFACTURE INDUSTRY
SUMMARY BY BRANCH AND FUELS

COUNTRY : VENEZUELA

YEAR : 1990

FUELS	TOTAL EMISSIONS BY FUEL (Gg) CO	CH4	NOx	N2O	CO2	% BY FUEL CO	CH4	NOx	N2O	CO2
TOTAL	27.87	0.44	56.10	0.08	17413	100	100	100	100	100
NAT. GAS	12.10	0.32	40.44	0.02	11087	43	74	72	26	64
OIL	2.92	0.10	14.93	0.04	4372	10	23	27	46	25
COAL-COKE	2.91	0.02	0.21	0.02	1316	10	4	0	28	8
BAGASSE	9.94	0.00	0.51	0.00	638	36	0	1	0	4
OTHERS (1)	0.00	0.00	0.00	0.00	0	0	0	0	0	0
EMISSIONS BY BRANCH (Gg)										
BRANCH 31	10.69	0.09	5.69	0.02	3868	100	100	100	100	100
NAT. GAS	0.47	0.04	1.91	0.00	1624	4	47	34	18	42
OIL	0.29	0.05	3.26	0.01	1606	3	53	57	82	42
COAL-COKE	0.00	0.00	0.00	0.00	0	0	0	0	0	0
BAGASSE	9.94	0.00	0.51	0.00	638	93	0	9	0	17
OTHER	0.00	0.00	0.00	0.00	0	0	0	0	0	0
BRANCH 32	0.15	0.02	0.79	0.00	586	100	100	100	100	100
NAT.GAS	0.13	0.01	0.51	0.00	446	81	76	65	22	76
OIL	0.03	0.00	0.27	0.00	138	19	24	35	31	24
COAL-COKE	0.00	0.00	0.00	0.00	0	0	0	0	46	0
OTHER	0.00	0.00	0.00	0.00	0	0	0	0	0	0
BRANCH 33	0.01	0.00	0.09	0.00	60	100	100	100	100	100
NAT.GAS	0.00	0.00	0.01	0.00	14	25	32	16	6	24
OIL	0.01	0.00	0.08	0.00	45	75	65	86	92	75
COAL-COKE	0.00	0.00	0.00	0.00	1	0	3	0	2	1
OTHER	0.00	0.00	0.00	0.00	0	0	0	0	0	0
BRANCH 34	0.21	0.02	0.93	0.00	800	100	100	100	100	100
NAT.GAS	0.20	0.02	0.86	0.00	742	94	94	92	74	93
OIL	0.01	0.00	0.07	0.00	58	6	6	8	26	7
COAL-COKE	0.00	0.00	0.00	0.00	0	0	0	0	0	0
OTHER	0.00	0.00	0.00	0.00	0	0	0	0	0	0
BRANCH 35	0.93	0.12	4.10	0.01	3478	100	100	100	100	100
NAT.GAS	0.86	0.11	3.50	0.01	3154	93	92	85	68	91
OIL	0.07	0.01	0.60	0.00	324	7	8	15	32	9
COAL-COKE	0.00	0.00	0.00	0.00	0	0	0	0	0	0
OTHER	0.00	0.00	0.00	0.00	0	0	0	0	0	0
BRANCH 36	3.98	0.06	42.49 *	0.02	3294	100	100	100	100	100
NAT.GAS	2.43	0.04	32.28	0.00	1738	61	63	76	19	53
OIL	1.52	0.02	10.10	0.01	1526	38	36	24	78	46
COAL-COKE	0.03	0.00	0.11	0.00	31	1	1	0	3	1
OTHER	0.00	0.00	0.00	0.00	0	0	0	0	0	0
BRANCH 37	10.32	0.10	1.46	0.03	4471	100	100	100	100	100
NAT.GAS	6.89	0.09	1.29	0.01	2994	67	83	89	20	67
OIL	0.56	0.00	0.08	0.00	200	5	3	5	6	4
COAL-COKE	2.87	0.01	0.08	0.02	1277	28	14	5	73	29
OTHER	0.00	0.00	0.00	0.00	0	0	0	0	0	0
BRANCH 38	1.57	0.02	0.53	0.00	838	100	100	100	100	100
NAT.GAS	1.13	0.01	0.07	0.00	370	72	49	14	14	44
OIL	0.43	0.01	0.43	0.00	459	28	49	82	83	55
COAL-COKE	0.01	0.00	0.02	0.00	9	1	2	4	3	1
OTHER	0.00	0.00	0.00	0.00	0	0	0	0	0	0
BRANCH 39	0.00	0.00	0.03	0.00	19	100	100	100	100	100
NAT.GAS	0.00	0.00	0.00	0.00	3	16	26	10	4	18
OIL	0.00	0.00	0.03	0.00	16	84	74	90	96	82
COAL-COKE	0.00	0.00	0.00	0.00	0	0	0	0	0	0
OTHER	0.00	0.00	0.00	0.00	0	0	0	0	0	0

(1) NON ENERGY USES

BRANCH

31 FOOD, BEVERAGE AND TOBACCO
32 TEXTILE, CLOTHING AND LEATHER
33 WOOD INDUSTRIES
34 PULP AND PAPER INDUSTRIES
35 CHEMICAL AND COAL PRODUCTS MANUFACTURE
36 NON-METALLIC MINERAL PRODUCTS MANUFACTURE
37 BASIC METALLIC INDUSTRIES
38 MACHINERY, EQUIPMENTS AND METALLIC MANUFACTURE
39 OTHER INDUSTRIES

* THIS VALUE SEEMS TO BE TOO HIGH DUE TO THE EMISSION FACTOR USED (TABLE 1-17 PAGE 1-53 VOLUME 3 IPCC DRAFT GUIDELINES FOR NATIONAL GHG INVENTORIES)

NOTE : Totals may not equal sum of components due to independent rounding.

06/6/96

INVENE/TABLE F2-3

PRELIMINARY ESTIMATION OF GHG EMISSIONS
STATIONARY SOURCES. MANUFACTURE INDUSTRY
SUMMARY BY BRANCH

COUNTRY : VENEZUELA

YEAR :1990

BRANCH	EMISSIONS (Gg)					PERCENTAGE (%)				
	CO	CH4	NOx	N20	CO2 (*)	CO	CH4	NOx	N20	CO2
(31) FOOD, BEVERAGE AND TOBACCO	10.69	0.09	5.69	0.02	3229	38	21	10	21	19
(32) TEXTILE CLOTHING AND LEATHER	0.15	0.02	0.79	0.00	586	1	4	1	5	3
(33) WOOD INDUSTRIES	0.01	0.00	0.09	0.00	60	0	0	0	1	0
(34) PULP AND PAPER INDUSTRIES	0.21	0.02	0.93	0.00	800	1	5	2	2	5
(35) CHEMICAL AND COAL PRODUCTS MANUFACTURE	0.93	0.12	4.10	0.01	3478	3	27	7	11	21
(36) NON-METALLIC MINERAL PRODUCTS MANUFACTURE	3.98	0.06	42.49	0.02	3294	14	14	76	21	20
(37) BASIC METALLIC INDUSTRIES	10.32	0.10	1.45	0.03	4471	37	24	3	34	27
(38) MACHINERY. EQUIPMENTS AND METALLIC MANUFACTURE	1.57	0.02	0.53	0.00	838	6	4	1	6	5
(39) OTHER INDUSTRIES	0.00	0.00	0.03	0.00	19	0	0	0	0	0
TOTAL	27.87	0.44	56.10	0.08	16776	100	100	100	100	100

(*) DO NOT INCLUDE BIOMASS.

NOTE : Totals may not equal sum of components due to independent rounding.

05/6/95

MENU D2

INVENE/TABLE D2-3

PRELIMINARY ESTIMATION OF GHG EMISSIONS

ENERGY SECTOR. STATIONARY SOURCES. COMERCIAL AND SERVICES

COUNTRY : VENEZUELA

YEAR : 1990.

FUELS CONSUMPTION (Tj) (1)

FUELS	
NATURAL GAS	2195
LPG	4884
TOTAL	7079
KEROSENE	607
DIESEL	1181
OTHER DISTILLATES	206
TOTAL	1994
WOOD	
CHARCOAL	
TOTAL	

SOURCE	FUELS CONSUMPTION (1) (Tj)	EMISSIONS FACTORS (g/Gj)				
		CO (2)	CH4 (2)	NOx (2)	N2O (2)	CO2 (4)
GAS BOILERS	2195	9.6	1.2	48	2.4	56100
PROPANE/BUTANE FURNACES	4884	10	1.1	47	0.1	63067
DISTILLATE OIL BOILERS						
kEROSENE	607	16	0.6	64	15.7	71867
DIESEL	1181	16	0.6	64	15.7	74067
OTHERS	206	16	0.6	64	15.7	74067
		EMISSIONS (Gg)				
NATURAL GAS		0.02	0.00	0.11	0.01	123
LPG		0.05	0.01	0.23	0.00	305
kEROSENE		0.01	0.00	0.04	0.01	43
DIESEL		0.02	0.00	0.08	0.02	87
OTROS		0.00	0.00	0.01	0.00	15
TOTAL		0.10	0.01	0.46	0.04	572

SOURCE:

(1) NATIONAL ENERGY BALANCE

(2) TABLE 1-11, PAG. 1.46. GREENHOUSE INVENTORY. REFERENCE MANUAL. VOL. 3

(3) TABLE 1-18, PAG. 1.55. GREENHOUSE INVENTORY. REFERENCE MANUAL. VOL. 3

(4) TABLE 1-3, PAG. 1.6. GREENHOUSE INVENTORY. REFERENCE MANUAL. VOL. 2

NOTE : Totals may not equal sum of components due to rounding.

05/6/95

INVENE/TABLE D2-4

PRELIMINARY ESTIMATION OF GHG EMISSIONS

ENERGY SECTOR. STATIONARY SOURCES. RESIDENTIAL

COUNTRY : VENEZUELA

YEAR : 1990.

FUELS CONSUMPTION (Tj) (1)

FUELS	
NATURAL GAS	5122
LPG	43957
TOTAL	49079
KEROSENE	9106
DIESEL	
OTHER DISTILLATES	
TOTAL DISTILLATES	9106
WOOD	286
CHARCOAL	167
TOTAL BIOMASS	453
TOTAL CONSUMPTION	58638

SOURCE	FUELS CONSUMPTION (1) (Tj)	EMISSIONS FACTORS (g/Gj) CO (2)	CH4 (2)	NOx (2)	N2O (3)	CO2 (4)
GAS HEATERS	5122	10	1	47	0.1	56100
PROPANE/BUTANE FURNACES	43957	10	1.1	47	0.1	63067
DISTILLATE OIL FURNACES	9106	13	5.0	51	0.6	71867
WOOD STOVES	453	18533	74	200	1.4	108533
		EMISSIONS (Gg)				
NATURAL GAS	5122	0.05	0.01	0.24	0.00	286
LPG	43957	0.44	0.05	2.07	0.00	2744
KEROSENE	9106	0.12	0.05	0.46	0.01	648
TOTAL FUELS	58185	0.61	0.10	2.77	0.01	3678
WOOD	286	5.30	0.02	0.06	0.00	31
CHARCOAL	167	3.10	0.01	0.03	0.00	18
TOTAL BIOMASS	453	8.40	0.03	0.09	0.00	49
TOTAL		9.00	0.13	2.86	0.01	3727

SOURCE:
(1) NATIONAL ENERGY BALANCE
(2) TABLE 1-10, PAG. 1.45. GREENHOUSE GAS INVENTORY. REFERENCE MANUAL. VOL. 3
(3) TABLE 1-18, PAG. 1.55. GREENHOUSE GAS INVENTORY. REFERENCE MANUAL. VOL. 3
(4) TABLE 1-3, PAG. 1.3. GREENHOUSE GAS INVENTORY. REFERENCE MANUAL. VOL. 2
NOTE : Totals may not equal sum of components due to independent rounding.

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INVENE/TABLE D2-5

PRELIMINARY ESTIMATION OF GHG EMISSIONS

ENERGY SECTOR. STATIONARY SOURCES
AGRICULTURE AND OTHERS

COUNTRY : VENEZUELA

YEAR : 1990.

FUELS CONSUMPTION (Tj) (3)

GASOLINES	205.1
TURBO KEROSENE	2.2
DIESEL	43.8
FUEL OIL	18.4
TOTAL	269.5

SOURCE	FUELS CONSUMPTION (3) (Tj)	CO	CH4	NOx	N2O	CO2 (3)
		EMISSIONS FACTORS (g/Gj)				
GASOLINES (1)	205.1	3440	26.9	440	0.9	69300
TURBO kEROSENE (2)	2.2	120	2.0	290		71500
DIESEL	43.8	210	2.4	160	0.9	74u67
FUEL OIL	18.4					77367
		EMISSIONS (Gg)				
GASOLINES		0.71	0.01	0.09	0.00	14.07
TURBO KEROSENE		0.00	0.00	0.00	0.00	0.16
DIESEL		0.01	0.00	0.01	0.00	3.21
FUEL OIL		0.00	0.00	0.00	0.00	1.41
TOTAL		0.72	0.01	0.10	0.00	18.85

SOURCE:
(1) LIGHT - DUTY TRUCKS
(2) TABLE 1-31, PAG. 1.82. GREENHOUSE INVENTORY. REFERENCE MANUAL. VOL. 3
(3) NATIONAL ENERGY BALANCE
NOTE : Totals may not equal sum components due to independent rounding.

05/6/95

INVENE/TABLE D2-6

PRELIMINARY ESTIMATION OF GHG EMISSIONS

ENERGY SECTOR. COMBUSTION. STATIONARY SOURCES

(Gigagramos)

COUNTRY : VENEZUELA

YEAR : 1990

SOURCES		CO_2 (*)	CH_4	N_2O	NO_x	CO
STATIONARY SOURCES EMISSIONS	TOTAL	51561	2.23	0.23	142.67	48.59
ENERGY AND TRANSFORMATION INDUSTRI	TOTAL	30516	1.65	0.10	83.14	10.90
ELECTRICITY GENERATION		19519	0.91	0.07	68.87	7.67
OIL AND GAS		10997	0.74	0.03	14.28	3.23
MANUFACTURE INDUSTRY	TOTAL	16775	0.44	0.08	56.10	27.87
FOOD, BEVERAGE AND TOBACCO		3229	0.09	0.02	5.69	10.69
CHEMICAL AND COAL		3478	0.12	0.01	4.10	0.93
NON-METALLIC MINERALS		3294	0.06	0.02	42.49	3.98
BASIC METALLIC		4471	0.10	0.03	1.45	10.32
OTHERS		2302	0.06	0.01	2.38	1.95
COMERCIAL AND SERVICES	TOTAL	572	0.01	0.04	0.46	0.10
RESIDENTIAL	TOTAL	3678	0.13	0.01	2.86	9.00
OTHERS	TOTAL	19	0.01	0.00	0.10	0.72

(*) EMISSIONS FROM BIOMASS ARE NOT INCLUDED IN THE TOTAL, THIS IS ONLY FOR INFORMATION PURPOSES.

NOTE : Totals may not equal of components due to independent rounding.

05/6/95

MOBILE SOURCES

INVENE/TABLE F3-1

MENU F3

PRELIMINARY ESTIMATION OF GHG EMISSIONS

ENERGY SECTOR- MOBILE SOURCES
ROAD TRANSPORT: GASOLINE

COUNTRY: VENEZUELA — YEAR: 199

AGE (years)	PASS-KM Millions	PASS-KM %	ENERGY CONSUMPTION MBOE	ENERGY CONSUMPTION %	ENERGY CONSUMPTION (TJ) / TJoules	EMISSIONS (Giga grs.) NOx	CH4	NMVOC	CO	N2O	CO2
1.- TOTAL GASOLINE VEHICLES					317173.22	117.28	8.76	234.51	1763.81	0.26	21760.3
PRIVATES VEHICLES											
0 5	6104.8	24.36	5145.3	19.93	30768.894						
6 10	7923.1	31.62	7624.1	29.53	45592.118						
11 15	7380.1	29.45	8193.6	31.74	48997.728						
>15	3651.9	14.57	4855.7	18.81	29037.086						
TOTAL	25059.9	100.00	25818.7	100.00	154395.826	55.58	4.85	88.01	663.90	0.14	10692.6
PUBLIC TRANSPORT (< 12 seats)											
0 5	3668.7	30.63	1243.8	27.22	7437.924						
6 10	6254.8	52.22	2425	53.08	14501.5						
11 15	2043.7	17.06	894.3	19.57	5347.914						
>15	11.3	0.09	5.7	0.12	34.086						
TOTAL	11978.5	100.00	4568.8	100.00	27321.424	9.84	0.86	15.57	117.48	0.02	1874.44
SMALL BUSES (< 32 seats)											
0 5	2676.4	20.84	388.6	17.45	2323.828						
6 10	5504.1	42.86	927.4	41.64	5545.852						
11 15	3927.8	30.58	747.9	33.58	4472.442						
>15	734.1	5.72	163.2	7.33	975.936						
TOTAL	12842.4	100.00	2227.10	100.00	13318.058	5.86	0.36	9.32	59.40	0.01	913.71
BUSES (> 32 seats)											
0 5	983	15.02	68.1	11.26	407.238						
6 10	1234.8	18.87	100.3	16.58	599.794						
11 15	2446	37.37	231	38.18	1381.38						
>15	1881.1	28.74	205.6	33.98	1229.488						
TOTAL	6544.9	100.00	605.00	100.00	3617.9	1.36	0.08	3.63	27.62	0.00	248.21
LIGHT TWO AXLE TRUCKS (1)											
0 5	524.2	20.66	2163.2	16.54	12935.936						
6 10	773.9	30.50	3716.7	28.41	22219.866						
11 15	900.5	35.49	4956.5	37.90	29639.87						
>15	338.7	13.35	2242.6	17.15	13410.748						
TOTAL	2537.3	100.00	13078	100.00	78206.44	30.54	1.81	72.83	538.22	0.06	5365.51
HEAVY TWO AXLE TRUCKS (1)											
0 5	583.9	19.90	851.2	15.78	5090.176						
6 10	916	31.22	1552.3	28.77	9282.754						
11 15	917.8	31.29	1759.5	32.61	10521.81						
>15	515.9	17.59	1232	22.84	7367.36						
TOTAL	2933.6	100.00	5395	100.00	32262.1	11.29	0.65	36.13	285.84	0.02	2213.41
HEAVY THREE AXLE TRUCKS (1)											
0 5	382.5	12.32	125.3	9.31	749.294						
6 10	844.7	27.20	324.6	24.11	1941.108						
11 15	1224.6	39.43	539.3	40.05	3225.014						
>15	653.9	21.05	357.2	26.53	2136.056						
TOTAL	3105.7	100.00	1346.4	100.00	8051.472	2.82	0.16	9.02	71.34	0.00	552.39

(1) TON-KM ARE USED INSTEAD OF PASS-KM

EMISSIONS FACTORS (grs/MJ)

Alt. (*)		VEHICLE TYPE	NOx	CH4	NMVOC	CO	N2O	CO2
4	1972	PRIVATE GASOLINE VEHICLES	0.36	0.0314	0.57	4.3	0.0009	69.3
4	1972	LIGHT-DUTY GASOLINE TRUCKS	0.44	0.0269	0.7	4.46	0.0009	69.3
2	1983	HEAVY-DUTY GASOLINE TRUCKS	0.35	0.02	1.12	8.86	0.0006	69.3

(*) IT REFERS TO THE ALTERNATIVE SELECTED FROM THE TABLES PUBLISHED IN THE IPCC METHODOLOGY AS TI IS DEFINED BY THE U.S. EPA.

NOTE : Totals may not equal sum of components due to independent rounding.

INVENE/TABLE F3-2

Page 1

PRELIMINARY ESTIMATION OF GHG EMISSIONS.

ENERGY SECTOR - MOBILE SOURCES

ROAD TRANSPORT: DIESEL

COUNTRY: VENEZUELA **YEAR: 1990**

					ENERGY CONSUMPTION (TJ)	EMISSIONS (Giga grs.)					
						NOx	CH4	NMVOC	CO	N2O	CO2
1.- TOTAL DIESEL VEHICLES					76727.73	62.77	0.66	10.90	38.06	0.14	5550.84
AGE (years)	PASS-KM		ENERGY CONSUMPTION								
	Millions	%	MBOE	%	TJoules						
SMALL BUSES (< 32 seats)											
0 5	1442	27.29	232.7	23.39	1391.546						
6 10	2358	44.62	441.6	44.38	2640.768						
11 15	1309.7	24.78	277	27.84	1658.46						
>15	175	3.31	43.6	4.38	260.728						
TOTAL	5284.7	100.00	994.90	100.00	5949.502	0.95	0.01	0.36	0.93	0.01	436.10
BUSES (> 32 seats)											
0 5	229.6	2.71	176.8	16.88	1057.264						
6 10	2293.2	27.02	207	19.76	1237.86						
11 15	3670.5	43.25	385.3	36.78	2304.094						
>15	2293.1	27.02	278.5	26.58	1665.43						
TOTAL	8486.4	100.00	1047.6	100.00	6264.648	1.02	0.01	0.53	1.09	0.01	459.20
HEAVY TWO AXLE TRUCKS (1)											
0 5	367	26.11	576	21.52	3444.48						
6 10	493.2	35.08	902.3	33.70	5395.754						
11 15	393.4	27.98	814.2	30.41	4868.916						
>15	152.2	10.83	384.6	14.37	2299.908						
TOTAL	1405.8	100.00	2677.1	100.00	16009.058	15.20	0.16	2.44	9.23	0.03	1173.46
HEAVY THREE AXLE TRUCKS (1)											
0 5	2165.6	20.53	775.7	16.37	4638.686						
6 10	3379.3	32.04	1419.4	29.95	8488.012						
11 15	3673.2	34.83	1769.4	37.32	10576.032						
>15	1328	12.59	775.1	16.36	4635.098						
TOTAL	10546.1	100.00	4738.6	100.00	28336.828	27.18	0.28	4.44	16.03	0.05	2077.09
FOUR AXLE TRUCKS (1)											
0 5	2254.3	19.90	506.3	15.85	3027.674						
6 10	3448.1	30.43	898.4	28.13	5372.432						
11 15	4018.4	35.47	1200.1	37.58	7176.598						
>15	1608.6	14.20	589	18.44	3522.22						
TOTAL	11329.4	100.00	3193.8	100.00	19098.924	18.37	0.19	3.02	10.75	0.04	1399.85
RAILROAD TRAIN											
	PASS-KM		ENERGY CONSUMPTION								
PASSENG.	Millions		MBOE		TJoules						
	64.1		3.9		23.322	0.02	0.00	0.00	0.01	0.00	1.71
	TON-KM		ENERGY CONSUMPTION								
FREIGHT	Millions		MBOE		TJoules						
	35.4		7.6		45.448	0.04	0.00	0.01	0.03	0.00	3.33
	TOTAL RAILROAD		11.5		68.77	0.06	0.00	0.01	0.04	0.00	5.04

(1) TON-KM ARE USED INSTEAD OF PASS-KM

EMISSIONS FACTORS (grs/MJ)

Alt. (*)	VEHICLE TYPE	NOx	CH4	NMVOC	CO	N2O	CO2
2 1983	DIESEL PASSENGER CARS (mod)	0.17	0.002	0.054	0.16	0.0019	73.3
3 1978	DIESEL PASSENGER CARS (unc.)	0.14	0.001	0.073	0.15	0.0019	73.3
2 1983	LIGHT-DUTY DIESEL TRUCKS (mod)	0.15	0.0014	0.06	0.14	0.0009	73.3
3 1978	LIGHT-DUTY DIESEL TRUCKS (unc)	0.17	0.001	0.1	0.19	0.0019	73.3
2 1983	HEAVY-DUTY DIESEL TRUCKS	0.9	0.01	0.13	0.63	0.0019	73.3
3 1988	HEAVY-DUTY DIESEL TRUCKS	1.01	0.01	0.18	0.51	0.0019	73.3

(*) IT REFERS TO THE ALTERNATIVE SELECTED FROM THE TABLES PUBLISHED IN THE IPCC METHODOLOGY AS TI IS DEFINED BY THE U.S. EPA

NOTE : Totals may not equal of components due to independent rounding.

05/6/95

INVENE/TABLE E3-2

PRELIMINARY ESTIMATION OF GHG EMISSIONS

ENERGY SECTOR, COMBUSTION, MOBILE SOURCES
ROAD TRANSPORTATION
(Gigagrams)

COUNTRY: VENEZUELA

YEAR: 1990

ACTIVITIES		CO2	CH4	CO	N2O	NOx	NMVOCs
ROAD TRANSPORTATION EMISSIONS	TOTAL	**27311.15**	**9.41**	**1801.86**	**0.39**	**180.05**	**245.31**
	Gasoline	21760.30	8.76	1763.81	0.25	117.28	234.51
	Diesel	5550.84	0.65	38.05	0.14	62.77	10.80
RAILROAD TRAIN	TOTAL	**5.04**	**0.00**	**0.04**	**0.00**	**0.06**	**0.01**
	Diesel	5.04	0.00	0.04	0.00	0.06	0.01
ROAD VEHICLES	TOTAL	**27306.10**	**9.41**	**1801.82**	**0.39**	**179.99**	**245.30**
	Gasoline	21760.30	8.76	1763.81	0.25	117.28	234.51
	Diesel	5545.80	0.65	38.01	0.14	62.71	10.79
PRIVATE VEHICLES	TOTAL	**10592.63**	**4.85**	**663.90**	**0.14**	**55.58**	**88.01**
	Gasoline	10592.63	4.85	663.90	0.14	55.58	88.01
PUBLIC TRANSPORT	TOTAL	**3931.66**	**1.31**	**206.51**	**0.06**	**19.03**	**29.42**
< 12 Seats	Gasoline	1874.44	0.86	117.48	0.02	9.84	15.57
< 32 Seats	Gasoline	913.71	0.36	59.40	0.01	5.86	9.32
	Diesel	436.10	0.01	0.93	0.01	0.95	0.36
> 32 Seats	Gasoline	248.21	0.08	27.62	0.00	1.38	3.63
	Diesel	459.20	0.01	1.08	0.01	1.02	0.53
LIGHT-DUTY TRUCKS	TOTAL	**5365.51**	**1.81**	**538.22**	**0.05**	**30.54**	72.83
	Gasoline	5365.51	1.81	538.22	0.05	30.54	72.83
HEAVY- DUTY VEHICLES	TOTAL	**7416.30**	**1.44**	**393.18**	**0.14**	**74.85**	**55.05**
Two axle	Gasoline	2213.41	0.65	285.84	0.02	11.29	36.13
	Diesel	1173.46	0.16	9.23	0.03	15.20	2.44
Three axle	Gasoline	552.39	0.16	71.34	0.00	2.82	9.02
	Diesel	2077.09	0.28	16.03	0.05	27.18	4.44
Four axle	Diesel	1399.95	0.19	10.75	0.04	18.37	3.02

NOTE : Totals may not equal sum of components due to independent rounding.

05/6/95

MENU E3

INVENE/TABLE D3-1

PRELIMINARY ESTIMATION OF GHG EMISSIONS
ENERGY SECTOR - COMBUSTION. MOBILE SOURCES
BUNKERS EMISSIONS

COUNTRY: VENEZUELA

YEAR: 1990

SOURCE	ENERGY CONSUMPTION		EMISSIONS (Gg)					
	MBOE	Tj	CO2	CH4	CO	N2O	NOx	NMVOCs
TOTAL BUNKERS	8537.4	51053.65	3792.67	0.06	4.92	0.07	75.26	3.48
INTERNATIONAL AVIATION	2709.5	16202.81	1145.36	0.03	2.24	0.00	4.69	2.92
Aviation Gasoline	2.1	12.56	0.86	0.00	0.30	0.00	0.00	0.01
Turbo Jet	2703.8	16168.72	1144.50	0.03	1.94	N.A	4.69	2.91
Other Oil Products (Non - Energi)	3.6	21.53	0.00	0.00	0.00	0.00	0.00	0.00
INTERNATIONAL MARINE	5827.9	34850.84	2647.31	0.03	2.68	0.07	70.57	0.56
Diesel Oil	850.8	5087.78	369.21	0.03	2.54	0.01	8.14	0.56
Fuel Oil	4971.6	29730.17	2278.10	N.A	0.14	0.06	62.43	N.A
Other Oil Products (Non - Energi)	5.5	32.89	0.00	0.00	0.00	0.00	0.00	0.00

EMISSIONS FACTORS	CO2	CH4	CO	N2O	NOx	NMVOCs
Aviation Gasoline	69.3	0.06	24	0.0009	0.08	0.54
Turbo Jet	71.5	0.002	0.12	N.A.	0.29	0.18
Other Oil Products	77.4	N.A.	0.0046	0.002	2.1	N.A
Diesel Oil	73.3	0.005	0.5	0.002	1.6	0.11
Fuel Oil	77.4	N.A.	0.0046	0.002	2.1	N.A
Other Oil Products	77.4	N.A.	0.0046	0.002	2.1	N.A

NOTE : Totals may not equal sum of components due to independent rounding.

05/6/9

MENU D3

INVENE/TABLE D3-3

PRELIMINARY ESTIMATION OF GHG EMISSIONS

ENERGY SECTOR - COMBUSTION. MOBILE SOURCES

OTHER TRANSPORTATION MODES

COUNTRY: VENEZUELA

YEAR: 1990

SOURCE	ENERGY CONSUMPTION		EMISSIONS (Gg)					
	MBOE	TJ	CO2	CH4	CO	N2O	NOx	NMVOCs
TOTAL OTHER TRANSPORTATION SOURCE	2692	16098.78	1050.54	0.08	21.40	0.00	4.73	2.91
NATIONAL AVIATION	2524	15093.52	1024.87	0.08	21.38	0.00	4.05	2.91
Aviation Gasoline	137.5	822.25	56.41	0.05	19.73	0.00	0.07	0.44
Turbo Jet	2286.4	13672.67	967.82	0.03	1.64	N.A	3.97	2.46
Kerosene	1.4	8.37	0.64	N.A.	0.00	N.A	0.02	N.A.
Other Oil Products (Non-Energ.)	98.7	590.23	0.00	0.00	0.00	0.00	0.00	0.00
NATIONAL NAVIGATION	168.1	1005.27	25.66	0.00	0.03	0.00	0.69	0.00
Diesel Oil	7.4	44.25	3.21	0.00	0.02	0.00	0.07	0.00
Fuel Oil	47.4	283.45	21.72	N.A	0.00	0.00	0.60	N.A
Kerosene	1.6	9.57	0.73	N.A	0.00	0.00	0.02	N.A
Other Oil Products (Non-Energ.)	111.7	668.00	0.00	0.00	0.00	0.00	0.00	0.00

EMISSIONS FACTORS	CO2	CH4	CO	N2O	NOx	NMVOCs
Aviation Gasoline	69.3	0.06	24	0.0009	0.08	0.54
Turbo Jet	71.5	0.002	0.12	N.A.	0.29	0.18
Other Oil Products	77.4	N.A	0.0046	0.002	2.1	N.A.
Diesel Oil	73.3	0.005	0.5	0.002	1.6	0.11
Fuel Oil	77.4	N.A.	0.0046	0.002	2.1	N.A.
Other Oil Products	77.4	N.A.	0.0046	0.002	2.1	N.A.

NOTE : Totals may not equal sum of components due to independent rounding.

05/6/95

INVENE/TABLE D3-4

PRELIMINARY ESTIMATION OF GHG EMISSIONS

ENERGY SECTOR - COMBUSTION: MOBILE SOURCES SUMMARY

(Gigagrams)

COUNTRY : VENEZUELA

YEAR : 1990

ACTIVITY	CO2	CH4	CO	N2O	NOx	NMVOCs
TOTAL TRANSPORTATION	29164	9.79	1829.88	0.42	196.58	250.04
NATIONAL	29164	9.79	1829.88	0.42	196.58	250.04
Air Transportation	1025	0.08	21.38	0.00	4.05	2.91
Road Vehicles	27306	9.41	1801.82	0.39	179.99	245.30
Railways	5	0.00	0.04	0.00	0.06	0.01
Navigation	26	0.00	0.03	0.00	0.69	0.00
Industrial Uses	802	0.30	6.62	0.02	11.79	1.82

NOTE : Totals may not equal sum of components due to independent rounding.

05/6/95

INVENE/ TABLE C1 - 2

PRELIMINARY ESTIMATION OF GHG EMISSIONS
ENERGY SECTOR - CO2 EMISSIONS
COMPARISON " TOP - DOWN " - "BOTTOM - UP "

ACTIVITY	"TOP - DOWN" (1)	BOTTOM - UP " (2)	DIFFERENCE TD VS BU (%)
FUEL CONSUMPTION (Tj)	1779461	1342239	24.6
CO2 EMISSIONS (Gg)	105931	84453	20.3

NOTE : Totals may not equal sum of components due to independent rounding.

PRELIMINARY ESTIMATION OF GHG EMISIONS
NATIONAL ENERGY BALANCE
LOSSES AND ADJUSTMENTS

ACTIVITY	(Tj)
LOSSES	178593
* CRUDE OIL TRANSP. & DISTRIB.	7214
* REFINING	150524
* MARACAIBO CITY'S NETWORK	20855
STATISTICS ADJUSTMENTS	282466

INVENE/TABLE C1-3

PRELIMINARY ESTIMATION OF GHG EMISSIONS
ENERGY SECTOR - COMBUSTION SUMMARY
BOTTOM - UP METHODOLOGY
(Gigagrams)

COUNTRY: VENEZUELA

YEAR: 1990

SOURCE	CO2	CH4	CO	N2O	NOx	NMVOCs
FUEL COMBUSTION TOTAL	**80724**	**12.02**	**1878.48**	**0.64**	**339.24**	**250.04**
Energy & Transf. Industries	30516	1.65	10.90	0.10	83.14	N.A.
Manufacture Industry	16775	0.44	27.87	0.08	56.10	N.A.
Transport	29164	9.79	1829.88	0.42	196.58	250.04
Commercial and Services	572	0.01	0.10	0.04	0.46	N.A.
Residential	3678	0.13	9.00	0.01	2.86	N.A.
Others	19	0.01	0.72	0.00	0.10	N.A.
Carbon non - seq in non - energy Prod.	(*) 3729	-	-	-	-	-

(*)INCLUDES CO2 EMISSIONS FROM CARBON NON - SEQUESTERED IN FRACTION OXIDIZED FROM NON - ENERGY USES OF THE FUELS. DETAILS ARE PROVIDED IN ANNEX 2.

NOTE : Totals may not equal sum of components due to independent rounding.

05/6/95

FUGITIVE EMISSIONS

INVENE/TABLE D4-2

PRELIMINARY INVENTORY OF GHG EMISSIONS
NATURAL GAS PRODUCTION
(MSCFD)

COUNTRY: VENEZUELA

YEAR : 1990.

AREAS	GAS PRODUCTION	DISPOSAL		VENTING		FLARING	
		VOLUME	% FROM PRODUCCION	VOLUME	% FROM DISPOSAL	VOLUME	% FROM DISPOSAL
LAGOVEN							
WESTERN	1265	166.7	13.2	166.7	100.0	0.0	0.0
EASTERN	178	4.6	2.6	0.0	0.0	4.5	98.3
MARAVEN							
LAKE	527	42.7	8.1	42.7	100.0	0.0	0.0
EARTH	136	52.2	38.4	52.2	100.0	0.0	0.0
CORPOVEN							
ANACO	1632	46.5	2.8	2.3	4.9	44.2	95.1
SAN TOME		9.0		6.5	72.2	2.5	27.8
NORTH MONAGAS		14.5		10.1	69.7	4.4	30.3
TOTAL	3738	336.2	8.99	280.5	83.43	55.60	16.54

NOTE : Totals may not equal sum of components due to independent rounding.

26/05/95

MENU D4

INVENE/TABLE D4-2

PRELIMINARY INVENTORY OF GHG EMISSIONS
FUGITIVE EMISSIONS. OIL & GAS PRODUCTION

COUNTRY: VENEZUELA

YEAR : 1990.

AREAS	DISPOSAL GAS (MSCFD)			GAS PROPERTIES				EMISSIONS (Ggr)	
	VENTING	FLARING		% MOLAR CH4	Molecular Weight gr / gr. mol	ESPECIFIC GRAVITY	HEAT VALUE	CH4	CO2
	A	B		C	D	E	F	G	H
							(GJ / MSPCD)		
LAGOVEN									
WESTERN	166.7		(1)	83.3	19.60	0.6767	1023	920	0
EASTERN	0	4.5	(2)	83.3	19.60	0.6767	1023	0	94
MARAVEN									
LAKE	42.7	0	(3)	74.1	22.05	0.761	1304	209	0
EARTH	52.2	0	(4)	83	19.00	0.656		287	0
CORPOVEN									
ANACO	2.3	44.2	(5)	76.4	22.04	0.761	1222	12	1106
SAN TOME	6.5	2.5	(6)	80	21.61	0.747	1120	34	57
NORTH MONAGAS	10.1	4.4	(7)	81.2	23.60	0.73	1120	49	101
TOTAL	280.5	55.6						1511	1358

G = [A (MSCFD) * 0.028(M3/SCF) * 366(DAY/YEAR) * C(gr MOL CH4/gr MOL GAS) * 16.043(gr CH4/gr MOL CH4) * E * 1.17 * 10E3(grGAS/M3GAS)] /D * (gr GAS/gr MOL GAS)

H = B (MSCFD) * F (Gjoule / MSPCD) * 365 * 56100 * 10E-9 * Ggr/Gjoule

(1), (2) TIPICAL LAGOVEN'S GAS PRODUCTION

(3) EL TABLAZO INPUT GAS

(4) TIA JUANA FLOW STATION'S

(5) SAN JOAQUIN INPUT GAS

(6) FIELO ISLA'S GAS PRODUCTION

(7) PANTIN INPUT GAS

NOTE : Totals may not equal sum of components due to independent rounding.

INVENE/TABLE D4-3

PRELIMINARY ESTIMATION OF GHG EMISSIONS

ENERGY SECTOR. FUGITIVE EMISSIONS

CRUDE OIL TRANSPORTATION AND REFINING

COUNTRY : VENEZUELA

YEAR : 1990.

SOURCES	CH_4
TRANSPORTATION	2.90
REFINING	1.67
STORAGE TANKS	0.31
TOTAL	4.88

NOTE : Totals may not equal sum of components due to independent rounding.

30/03/95

INVENE/TABLE D4-4

PRELIMINARY ESTIMATION DE GHG EMISSIONS

ENERGY SECTOR. FUGITIVE EMISSIONS

NATURAL GAS PROCESSING, TRANSPORTATION AND DISTRIBUTION

COUNTRY : VENEZUELA

YEAR : 1990.

	A	B	C = A*B	D	E	F	G
				GAS PROPERTIES			
	NATURAL GAS (MMPCD)	% LEAKS	LEAKS (MMPCD)	% MOLAR CH4	P.M	ESPECIFIC GRAVETY	CH4 EMISSIONS Ggr
PROCESSING	-	-	-	-	-	-	-
TRANSPORTATION AND DISTRIBUTION							
LAGOVEN	195.0	0.74	1.44	83.3	19.603	0.6767	7.96
MARAVEN							
FIME	54.6	84.2	45.97	85.1	18.98	0.655	259.00
OTHERS	79.3	0.74	0.59	85.1	18.98	0.655	3.31
CORPOVEN	918.2	0.74	6.79	82.9	19.46	0.672	37.31
TOTAL							307.58

NOTE : Totals may not equal sum of components due to independent rounding.

30/03/95

INVENE/TABLE C2-2

PRELIMINARY ESTIMATION OF GHG EMISSIONS

ENERGY SECTOR. FUGITIVE EMISSIONS
METHANE EMISSIONS FROM COAL PRODUCTION

COUNTRY : VENEZUELA

YEAR : 1990

Mining Activity		A Amount of Coal Produced (millions t)	B Average Emissions Factor (m3 CH4 / t)	C Methane Emissions (millions m3) C=(A*B)	D Conversion Factors (Default 0,67 Gg / CH4 10^6m3)	E Methane Emissions (Gg CH4) E=(C*D)
Surface Mines	Mining	2.243	0.3-2.0	0.67-4.49	0.67	0.45-3.0
	Post-Mining					
					Total	0.45-3.0

NOTE : totals may not equal sum of components due to independent rounding.

30/03/95

MENU C2

INVENE/TABLE C2-3

PRELIMINARY ESTIMATION OF GHG EMISSIONS

ENERGY SECTOR - FUGITIVE EMISSIONS SUMMARY

COUNRY : VENEZUELA

YEAR : 1990.

SOURCES	CO2	CH4
FUGITIVE EMISSIONS(1)	**1358**	**1826**
OIL AND GAS SYSTEMS	**1358**	**1823**
OIL AND GAS PRODUCTION	1358	1511
CRUDE OIL TRANSPORTATION AND REFINING		4.88
NATURAL GAS PROCESSING, TRANSPORTATION AND DISTRIBUTION		307.58
COAL PRODUCTION		0.45-3.0

(1) Upper limit of emissions from carbon production was used

NOTE : totals may not equal sum of components due to independent rounding.

30/03/95

ENERGY SECTOR SUMMARY

INVENE/TABLE C3-1

PRELIMINARY ESTIMATION OF GREENHOUSE GAS EMISSIONS AND SINKS
SUMMARY. ENERGY SECTOR

COUNTRY : VENEZUELA

YEAR : 1990.

SOURCE		CO2	CH4	N2O	NOx	CO	NMVOCs
B. FUGITIVES FUEL EMISSIONS	**TOTAL**	**1358**	**1826.24**				
OIL AND NATURAL GAS PRODUCTION	TOTAL	1358	1510.78				
CRUDE OIL TRANSPORTATION AND REFINING	TOTAL		4.88				
GAS PROCESSING AND DISTRIBUTION	TOTAL		307.58				
COAL MINING	TOTAL		3.00				

NOTE : Totals may not equal sum of components due to independent rounding.

28/05/96

INVENE/TABLE C3-1

PRELIMINARY ESTIMATION OF GREENHOUSE GAS EMISSIONS AND SINKS
SUMMARY. ENERGY SECTOR - BOTTOM - UP METHODOLOGY
(Gigagramos)

COUNTRY : VENEZUELA — YEAR : 1990.

SOURCE AND SINK CATEGORIES (Activity)		CO2 (*)	CH4	N2O	NOx	CO	NMVOCs
ENERGY ACTIVITIES	TOTAL	85812	1838.26	0.64	339.24	1878.48	250.04
A. FUEL COMBUSTION (BOTTOM-UP METHODOLOGY) (**)		84453	12.02	0.64	339.24	1878.48	250.04
STATIONARY SOURCES	TOTAL	51561	2.23	0.23	142.67	48.59	
ENERGY AND TRANSFORMATION INDUSTRIES	TOTAL	30516	1.65	0.10	83.14	10.90	
Electricity Generation	TOTAL	19519	0.91	0.07	68.87	7.67	
Public		15189	0.47	0.06	54.86	5.28	
Autogeneration		4330	0.44	0.01	14.02	2.39	
Oil & Gas Industries	TOTAL	10997	0.74	0.03	14.28	3.23	
INDUSTRY	TOTAL	16775	0.44	0.08	56.10	27.87	
(31) Food, Beverage and Tobacco		3229	0.09	0.02	5.69	10.69	
(32) Textile, Clothing and Leather		586	0.02	0.00	0.79	0.15	
(33) Wood Industries		60	0.00	0.00	0.09	0.01	
(34) Pulp and Paper Industries		800	0.02	0.00	0.93	0.21	
(35) Chemical and Coal Products Manufacture		3478	0.12	0.01	4.10	0.93	
(36) Non-Metallic Mineral Products Manufacture		3294	0.06	0.02	42.49	3.98	
(37) Basic Metallic Industries		4471	0.10	0.03	1.46	10.32	
(38) Machinery, Equipments and Metallic Manufacture		838	0.02	0.00	0.53	1.57	
(39) Other Industries		19	0.00	0.00	0.03	0.00	
COMMERCIAL	TOTAL	572	0.01	0.04	0.46	0.10	
RESIDENTIAL	TOTAL	3678	0.13	0.01	2.86	9.00	
AGRICULTURE AND OTHERS	TOTAL	19	0.01	0.00	0.10	0.72	
MOBILE SOURCES	TOTAL	29164	9.79	0.42	196.58	1829.88	250.04
NATIONAL	TOTAL	29164	9.79	0.42	196.58	1829.88	250.04
Road Vehicles		27306	9.41	0.39	179.99	1801.82	245.30
Railways		5	0.00	0.00	0.06	0.04	0.01
Air Transportation		1025	0.08	0.00	4.05	21.38	2.91
Navigation		26	0.00	0.00	0.69	0.03	0.00
Industrial uses	TOTAL	802	0.30	0.02	11.79	6.62	1.82

(*) CO2 EMISSIONS FROM BIOMASS ARE NOT INCLUDED IN THE TOTAL. THIS IS ONLY FOR INFORMATION PURPOSES.
(**) INCLUDES CO2 EMISSIONS FROM CARBON NON-SEQUESTERED IN NON-ENERGY USES OF THE FUELS (e.g. FERTILIZER). DETAILS PROVIDED IN ANNEX 2.
NOTE : Totals may not equal sum of components due to independent rounding.

INVENE/TABLE C3-2

PRELIMINARY ESTIMATION OF GREENHOUSE GAS EMISSIONS AND SINKS
SUMMARY. ENERGY SECTOR - BOTTOM - UP METHODOLOGY
(Gigagramos)

COUNTRY : VENEZUELA — YEAR : 1990.

SOURCE AND SINK CATEGORIES (Activity)		CO2 (*)	CH4	N2O	NOx	CO	NMVOCs
ENERGY ACTIVITIES	TOTAL	85812	1838.26	0.64	339.24	1878.48	260.04
A. FUEL COMBUSTION (BOTTOM-UP METHODOLOGY)(**)		84453	12.02	0.64	339.24	1878.48	260.04
STATIONARY SOURCES	TOTAL	51561	2.23	0.23	142.67	48.59	
ENERGY AND TRANSFORMATION INDUSTRIES	TOTAL	30516	1.65	0.10	83.14	10.90	
INDUSTRY	TOTAL	16775	0.44	0.08	56.10	27.87	
COMMERCIAL	TOTAL	572	0.01	0.04	0.46	0.10	
RESIDENTIAL	TOTAL	3678	0.13	0.01	2.86	9.00	
AGRICULTURA AND OTHERS	TOTAL	19	0.01	0.00	0.10	0.72	.
MOBILE SOURCES		29164	9.79	0.42	196.58	1829.88	260.04
NATIONAL	TOTAL	29164	9.79	0.42	196.58	1829.88	260.04
INTERNATIONAL (BUNKERS)	TOTAL	802	0.30	0.02	11.79	6.62	1.82
B. FUGITIVES FUEL EMISSIONS	TOTAL	1358	1826.24				
OIL AND NATURAL GAS PRODUCTION	TOTAL	1358	1510.78				
CRUDE OIL TRANSPORTATION AND REFINING	TOTAL		4.88				
GAS PROCESSING AND DISTRIBUTION	TOTAL		307.58				
COAL MINING	TOTAL		3.00				

(*) CO2 EMISSIONS FROM BIOMASS ARE NOT INCLUDED IN THE TOTAL. THIS IS ONLY FOR INFORMATION PURPOSES.

(**) INCLUDES CO2 EMISSIONS FROM CARBON NON-SECUESTERED IN NON-ENERGY USES OF THE FUELDS (e.g. FERTILIZER). DETAILS PROVIDED IN ANNEX 2.

NOTE : totals may not equal sum of components due to independent rounding.

28/06/95

INDUSTRIAL PROCESSES

INVENE/TABLE A1.2

PRELIMINARY ESTIMATION OF GHG EMISSIONS
INDUSTRIAL PROCESSES EMISSIONS

COUNTRY: VENEZUELA

YEAR: 1990

SOURCE AND SINK CATEGORIES	ACTIVITY DATA	Emission Estimates						Aggregate Emission Factors					
	A Production Quantity	B Full Mass of Pollutant (Gg)						C Tonne of pollutant per tonne of Product (t/t)					
	(kt)	CO_2	CO	CH_4	N_2O	NO_x	NMVOC	CO_2	CO	CH_4	N_2O	NO_x	NMVOC
A Iron and Steel													
B Non-Ferrous Metals													
Aluminium Production													
Other													
C Inorganic Chemicals (excepting solvent use)													
Nitric Acid													
Fertilizer Production													
Other													
D Organic Chemicals													
Adipic Acid													
Other													
E Non-Metallic Mineral Products	5654	2867						0.507					
a. Cement	5654	2867						0.507					
b. Lime													
c. Other													
F Other (ISIC)													

MENU A2

NON-ENERGY SECTOR

PRELIMINARY ESTIMATION OF GHG EMISSIONS

INVENE/TABLE B5-1

	MODULE	AGRICULTURE				
	SUBMODULE	METHANE EMISSIONS FROM DOMESTIC LIVESTOCK ENTERIC FERMENTATION AND MANURE MANAGEMENT				
	WORKSHEET	4 -1				
	SHEET	1 OF 1				
Livestock Type	A Number of Animals (1000s)	B Emissions Factor for Enteric Fermentation (Kg / head / year)	C Emissions from Enteric Fermentation (t / year)	D Emissions Factor for Manure Management (Kg / head / year)	E Emissions from Manure Mangement (t / year)	F Total Annual Emissions from Domestic Livestock (Gg)
			C = (A x B)		E = (A x D)	F = (C + E) / 1000
Dairy Cattle	1204.992	69.00	83,144	2.00	2410	85.55
Non - Dairy Cattle	12126.149	59.40	720293	1.00	12126	732.42
Buffalo	35.786	55.00	1968	2.00	72	2.04
Sheep	144.690	5.00	723	0.16	23	0.75
Goats	710.493	5.00	3552	0.22	156	3.71
Horses	495.000	18.00	8910	2.20	1089	10.00
Mules & Asses	512.000	10.00	5120	1.20	614	5.73
Swine	2961.118	1.00	2961	3.00	8883	11.84
Poultry	56500.000	N.A	N.A	0.023	1300	1.30
		Totals	**826,673**		**26673**	**853.35**

PRELIMINARY ESTIMATION OF GHG EMISSIONS

INVENE/TABLE B5-2

	MODULE	AGRICULTURE			
	SUBMODULE	METHANE EMISSIONS FROM FLOODED RICE FIELDS			
	WORKSHEET	4 -2			
	SHEET	1 OF 1			
	STEP 1			STEP 2	
Water Management Regime	A Harvest Area (Mha)	B Season Length (days)	C Megahectare-Days (Mha - days)	D Emissions Factor (Kg / ha - day)	E CH4 Emissions by Water Mangement (Gg)
			C = (A x B)		E = (C x D)
Continuously Flooded	0.119980	90	10.7982	6.25	67.49
Intermittently Flooded	-	-	-	-	-
Totals	0.119980				67.49

PRELIMINARY ESTIMATION OF GHG EMISSIONS

INVENE/TABLE C7-1

MODULE	AGRICULTURE
SUBMODULE	PRESCRIBED BURNING OF SAVANNAS
WORKSHEET	4 -3
SHEET	1 OF 3

STEP 1					STEP 2		
A Area Burned by Category (specify) (K ha)	B Biomass Density of Savanna (t dm / ha)	C Total Biomass Exposed to Burning (Gg dm)	D Fraction Actually Burned	E Quantity Actually Burned (Gg dm)	F Fraction of Living Biomass Burned	G Quantity of Living Biomass Burned (Gg dm)	H Quantity of Dead Biomass Burned
		C = (A x B)		E = (C x D)		G = (E - F)	H = (E - G)
240.00	5.08	1219.20	0.85	1036.32	0.50	518.16	
							518.16
46.20	5.34	246.71	0.85	209.70	0.50	104.85	
							104.85
594.60	4.30	2556.78	0.85	2173.26	0.33	717.18	
							1456.09
1545.70	6.07	9382.40	0.85	7975.04	0.46	3668.52	
							4306.52
28.10	3.31	93.01	0.85	79.06	0.47	37.16	
							41.90
682.00	6.02	4105.64	0.85	3489.79	0.5	1744.90	
							1744.90

PRELIMINARY ESTIMATION OF GHG EMISSIONS

INVENE/TABLE C7-2

MODULE	AGRICULTURE		
SUBMODULE	PRESCRIBED BURNING OF SAVANNAS		
WORKSHEET	4 -3		
SHEET	2 OF 3		
	STEP 3		
I Fraction Oxidised of living and dead Biomass (Gg dm)	J Total Biomass Oxidised (Gg dm) Living : J = (G x I)	K Carbon Fraction of Living & Dead Biomass	L Total Carbon Released (Gg C)
	Dead : J = (H x I)		L = (J x K)
Living 0.85	440.44	0.45	198.20
Dead 1.00	518.16	0.40	207.26
Living 0.85	89.12	0.45	40.11
Dead 1.00	104.85	0.40	41.94
Living 0.85	609.60	0.45	274.32
Dead 1.00	1456.09	0.40	582.43
Living 0.85	3118.24	0.45	1403.21
Dead 1.00	4306.52	0.40	1722.61
Living 0.85	31.58	0.45	14.21
Dead 1.00	41.90	0.40	16.76
Living 0.85	1483.16	0.45	667.42
Dead 1.00	1744.90	0.40	697.96
Living 0.85			
Dead 1.00			
		Total	**5866.43**

PRELIMINARY ESTIMATION OF GHG EMISSIONS

INVENE/TABLE C7-3

		MODULE	AGRICULTURE				
		SUBMODULE	PRESCRIBED BURNING OF SAVANNAS				
		WORKSHEET	4 -3				
		SHEET	3 OF 3				
		STEP 4			STEP 5		
L Total Carbon Released (Gg C)	M Nitrogen - Carbon Ratio	N Total Nitrogen Content (Gg N)	O Emissions Ratio	P Emissions (Gg C or Gg N)	Q Conversion Ratio	R Emissions from Savanna Burning (Gg)	
		N = (L x M)		P = (L x O)		R = (P x Q)	
			0.004	23.466	16 / 12	31.29	CH4
			0.06	351.986	28 / 12	821.30	CO
5866.43	0.006	35.199		P = (N x O)		R = (P x Q)	
			0.007	0.246	44 / 28	0.39	N2O
			0.12	4.224	46 / 14	13.88	NOx

PRELIMINARY ESTIMATION OF GHG EMISSIONS

INVENE/TABLE C8-2

	MODULE	**AGRICULTURE**		
	SUBMODULE	**FIELD BURNING OF AGRICULTURAL RESIDUES**		
	WORKSHEET	**4 -4**		
	SHEET	**2 OF 3**		
	STEP 4		**STEP 5**	
	I Carbon Fraction of Residue	J Total Carbon Released (Gg C)	K Nitrogen- Carbon Ratio	L Total Nitrogen Released (Gg N)
		J = (H x I)		L = (J x K)
	0.4092	254.11	0.014	3.56
	0.36	1214.61	0.014	17.00
Total		**1468.72**		**20.56**

PRELIMINARY ESTIMATION OF GHG EMISSIONS

INVENE/TABLE C8-1

MODULE	AGRICULTURE
SUBMODULE	FIELD BURNING OF AGRICULTURAL RESIDUES
WORKSHEET	4-4
SHEET	1 OF 3

	STEP 1			STEP 2		STEP 3		
Crops (specify locally important crops)	A Annual Production (Gg crop)	B Residue to Crop Ratio	C Quantity of Residue (Gg biomass) C = (A x B)	D Dry Matter Fraction	E Quantity of Dry Residue (Gg dm) E = (C x D)	F Fraction Burned in Fields	G Fraction Oxidised	H Total Biomass Burned (Gg dm) H = (ExFxG)
Sugar Cane	6900.0	0.2	1380.0	0.5	690.0	1.0	0.9	621.0
Cotton	85.2	50.0	4260.0	0.9	3748.8	1.0	0.9	3373.9
							Total	3994.9

26/05/95

PRELIMINARY ESTIMATION OF GHG EMISSIONS

INVENE/TABLE C8-3

	MODULE	AGRICULTURE		
	SUBMODULE	FIELD BURNING OF AGRICULTURAL RESIDUES		
	WORKSHEET	4 -4		
	SHEET	3 OF 3		
		STEP 6		
	M Emissions Ratio	N Emissions (Gg C or Gg N)	O Conversion Ratio	P Emissions from Field Burning of Agricultural Residues
				(Gg)
		N = (J x M)		P = (N x O)
CH4	0.005	7.344	16 / 12	9.79
CO	0.06	88.123	28 / 12	205.62
		N = (L x M)		P = (N x O)
N2O	0.007	0.1439	44 /28	0.23
NOx	0.12	2.4675	46 / 14	8.11

PRELIMINARY ESTIMATION OF GHG EMISSIONS

INVENE/TABLE B5-5

	MODULE	AGRICULTURE		
	SUBMODULE	AGRICULTURAL SOILS		
	WORKSHEET	4 -5		
	SHEET	1 OF 1		
STEP 1			**STEP 2**	
A Amount of Nitrogen Applied in Fertiliser (GgN)	**B** Fraction N Released	**C** Total Nitrogen Released (Gg N) C = (A x B)	**D** Conversion Ratio	**E** N2O Emissions from Fertiliser use (Gg) E = (C x D)
144	0.01	1.44	44/28	2.26

PRELIMINARY ESTIMATION OF GHG EMISSIONS

INVENE/TABLE C9-1

			MODULE	LAND USE CHANGE AND FORESTRY			
			SUBMODULE	CHANGES IN FOREST AND OTHER WOODY BIOMASS STOCKS			
			WORKSHEET	5 - 1			
			SHEET	1 OF 3			
			STEP 1				
			A Area of Forest / Biomass Stocks (kha)	B Annual Growth Rate (t dm / ha)	C Annual Biomass Increment (kt dm)	D Carbon Fraction of Dry Matter	E Total Carbon Uptake Increment (kt C)
					C = (A x B)		E = (C x D)
Tropical	Plantations	Eucalyptus spp.	8.29	14.5	120.21	0.45	54.09
		Tectona grandis	3.25	8.0	26.00	0.45	11.70
		Pinus caribaea	416.27	6.4	2664.13	0.45	1198.86
		Mixed Fast-Growing Hardwoods	2.19	12.5	27.38	0.45	12.32
	Other Forests	Managed	214.56	3.34	716.63	0.45	322.48
						Total	1599.45

PRELIMINARY ESTIMATION OF GHG EMISSIONS

INVENE/TABLE C9-2

	MODULE	LAND USE CHANGE AND FORESTRY
	SUBMODULE	CHANGES IN FOREST AND OTHER WOODY BIOMASS STOCKS
	WORKSHEET	5 - 1
	SHEET	2 OF 3

STEP 2

Harvest Categories (specify)	F Commercial Harvest (if applicable) (1000 m3 roundwood)	G Biomass Conversion / Expansion Ratio (if applicable) (t dm/m3)	H Total Biomass Removed in Commercial Harvest (Kt dm)	I Total Traditional Fuelwood Consumed (Kt dm)	J Total Other Wood Use (Kt dm)	K Total Biomass Consumption (Kt dm)	L Wood Removed From Forest Clearing	M Total Biomass Consumption From Stocks (Kt dm)
			H = (F x G)	(From colum H, Worksheet 1 - 2)		k = (H + I + J)	(From colum H, Worksheet 5 - 2, sheet 3)	M = K - L
Other Forest	230.42	0.88	202.77	-	-	202.77		
Totals							-	202.77

PRELIMINARY ESTIMATION OF GHG EMISSIONS

INVENE/TABLE C9-3

MODULE	LAND USE AND FORESTRY		
SUBMODULE	CHANGES IN FOREST AND OTHER WOODY BIOMASS STOCKS		
WORKSHEET	5 - 1		
SHEET	3 OF 3		
STEP 3			
N Carbon Fraction	O Annual Carbon Release (Kt C)	P Net Annual Carbon Uptake (+) or Release (-) (Kt C)	Q Convert to CO2 Annual Emission (-) or removal (+) (Gg CO2)
	O = (M x N)	P = (E - O)	Q = (P x [44/12])
0.45	91.25	1508.21	5530.09

PRELIMINARY ESTIMATION OF GHG EMISSIONS

INVENE/TABLE C10-1

		MODULE	LAND USE CHANGE AND FORESTRY				
		SUBMODULE	FOREST AND GRASSLAND CONVERSION				
		WORKSHEET	5 - 2				
		SHEET	1 OF 6				
Land Types			STEP 1				
			A Area Converted Annually (Kha)	B Biomass Before Conversion (t dm/ha)	C Biomass After Conversion (t dm/ha)	D Net Change in Biomass Density (t dm/ha)	E Annual Loss of Biomass (kt dm)
						D = (B - C)	E = (A x D)
Tropical	Closed Forest	Category I	21.72	400	10	390	8470.80
		Category II	17.06	240	10	230	3923.80
		Category III	237.34	140	10	130	30854.20
	Open	Forests	240.97	55	10	45	10843.65
Grassland							
Other							

PRELIMINARY ESTIMATION OF GHG EMISSIONS

INVENE/TABLE C10-2

		MODULE	LAND USE CHANGE AND FORESTRY					
		SUBMODULE	FOREST AND GRASSLAND CONVERSION					
		WORKSHEET	5 - 2					
		SHEET	2 OF 6					
Land Types			STEP 2					
			F Fraction of Biomass Burned On Site	G Quantity of Biomass Burned On Site (Kt dm)	H Fraction of Biomass Oxidised On Site	I Quantity of Biomass Oxidised On Site (Kt dm)	J Carbon Fraction of Above - ground Biomass (burned on site)	K Quantity of Carbon Released (from Biomass burned) (Kt C)
				G = (E x F)		J = (G x H)		K = (I x J)
Tropical	Closed Forests	Category I	0.45	3811.86	0.9	3430.67	0.45	1543.80
		Category II	0.45	1765.71	0.9	1589.14	0.45	715.11
		Category III	0.45	13884.39	0.9	12495.95	0.45	5623.18
	Open	Forests	0.45	4879.64	0.9	4391.68	0.45	1976.26
Grassland								
Other								
							Sub - Total	9858.35

PRELIMINARY ESTIMATION OF GHG EMISSIONS

INVENE/TABLE C10-3

		MODULE	LAND USE CHANGE AND FORESTRY							
		SUBMODULE	FOREST AND GRASSLAND CONVERSION							
		WORKSHEET	5 - 2							
		SHEET	3 OF 6							
Land Types			STEP 3				STEP 4			
			L Fraction of Biomass Burned Off Site	M Quantity of Biomass Burned Off Site (Kt dm)	N Fraction of Biomass Oxidised Off Site	O Quantity of Biomass Oxidised Off Site (Kt dm)	P Carbon Fraction of Above-ground Biomass (burned off site)	Q Quantity of Carbon Released (from Biomass burned off site) (Kt C)	R Total Carbon Released (from on & off site burning) (Kt C)	S Total CO2 released (from on & off site burning) (Kt CO2)
				M = (E x L)		O = (M x N)		Q = (O x P)	R = (K + Q)	S = R x [44/12]
Tropical	Closed Forests	Category I	0.05	423.54	0.9	381.19	0.45	171.53		
		Category II	0.05	196.19	0.9	176.57	0.45	79.46		
		Category III	0.05	1542.71	0.9	1388.44	0.45	624.80		
	Open	Forest	0.05	542.18	0.9	487.96	0.45	219.58		
Grassland										
Other										
			Sub - Total	2704.62			Sub - Total	1095.37	10953.72	40163.64

PRELIMINARY ESTIMATION OF GHG EMISSIONS

INVENE/TABLE C10-4

		MODULE	LAND USE CHANGE AND FORESTRY								
		SUBMODULE	FOREST AND GRASSLAND CONVERSION								
		WORKSHEET	5 - 2								
		SHEET	4 OF 6								
Land ypes			STEP 5								
			A Average Area Converted (10 year Average) (Kha)	B Biomass Before Conversion (t dm/ha)	C Biomass After Conversion (t dm/ha)	D Net Change in Biomass Density (t dm/ha)	E Average Annual Loss of Biomass (Kt dm)	F Fraction Left to Decay	G Quantity of Biomass Left to Decay (Kt dm)	H Carbon Fraction in Above - ground Biomass	I C Released from Decay of Above - ground Biomass (Kt C)
						D = (B - C)	E = (A x D)		G = (E X F)		I = (G x H)
Tropical	Closed Forests	Category I	21.72	400	10	390	8470.80	0.5	4235.40	0.45	1905.93
		Category II	17.06	240	10	230	3923.80	0.5	1961.90	0.45	882.86
		Category III	237.34	140	10	130	30854.20	0.5	15427.10	0.45	6942.20
	Open	Forests	240.97	55	10	45	10843.65	0.5	5421.83	0.45	2439.82
Grassland											
Other											
										Sub - Total	12170.80

PRELIMINARY ESTIMATION OF GHG EMISSIONS

INVENE/TABLE C10-5

		MODULE	LAND USE CHANGE AND FORESTRY				
		SUBMODULE	FOREST AND GRASSLAND CONVERSION				
		WORKSHEET	5 - 2				
		SHEET	5 OF 6				
Land Types			STEP 6				
			A Average Annual Forest/ (*) Grassland Converted (25 year average) (Kha)	B Carbon Content of Soil Before Conversion (t/ha)	C Total Annual Potential Soil Carbon Losses (Kt C)	D Fraction of Carbon Released over 25 year	E Carbon Release from Soil (Kt C)
					C = A x B		E = (C x D)
Tropical	Closed Forests	Category I					
		Category II					
		Category III					
	Open	Forests					
Grassland			32.8	20	656	0.5	328
Other							
						Sub - Total	328

(*) Data on Average Annual forest converted (25 year average) are not available in the country. Consequently, carbon released from forest soil is not calculated.

PRELIMINARY ESTIMATION OF GHG EMISSIONS

INVENE/TABLE C10-6

MODULE	LAND USE CHANGE AND FORESTRY			
SUBMODULE	FOREST AND GRASSLAND CONVERSION			
WORKSHEET	5 - 2			
SHEET	6 OF 6			
STEP 7				
A Inmediate Release From Burning (Kt C)	B Delayed Emissions From Decay (Kt C) (10- year average)	C Long Term Emissions From Soil (Kt C) (25 - year average)	D Total annual Carbon Release (Kt C)	E Total Annual CO2 Release (Gg CO2) (Kt C)
			D = (A + B + C)	E = (D x [44/12])
10953.72	12170.80	328.00	23452.52	85992.58

PRELIMINARY ESTIMATION OF GHG EMISSIONS

INVENE/TABLE B6-3

		MODULE	LAND USE CHANGE AND FORESTRY				
		SUBMODULE	ON - SITE BURNING OF FOREST				
		WORKSHEET	5- 3				
		SHEET	1 OF 1				
STEP 1			STEP 2				
A Quantity of Carbon Released (Kt C)	B Nitrogen - Carbon Ratio	C Total Nitrogen Released (Kt N)		D Trace Gas Emissions Ratios	E Trace Gas Emissions (Kt C)	F Conversion Ratio	G Trace Gas Emissions from Burning of Cleared Forest (Gg CH4 CO)
(From column K, sheet 2, of Worksheet 5 - 2)		C = (A x B)			E = (A x D)		G = (E x F)
			CH4	0.012	118.30	16/12	157.73
			CO	0.06	591.50	28/12	1380.17
					Kt N		Gg N2O, NOx
9858.35	0.01	98.58			E = (C x D)		G = (E x F)
			N2O	0.007	0.69	44/28	1.08
			NOx	0.12	11.83	46/14	38.87

PRELIMINARY ESTIMATION OF GHG EMISSIONS
BOD BASED METHOD

INVENE/TABLE B7-2

MODULE	WASTE							
SUBMODULE	METHANE EMISSIONS DOMESTIC AND COMMERCIAL WASTEWATER TREATMENT							
WORKSHEET	6A - 2							
SHEET	1 OF 1							
STEP 1			STEP 2				STEP 3	
A Population (Specify sub - categories if any) (1.000 persons)	B Wastewater BOD Value (Gg BOD5 / 1.000 persons / year)	C Annual BOD (Gg BOD5)	D Fration Wastewater Anaerobic - ally Treated	E Quantity of BOD from Anaerobic - ally Treated Wastewater (Gg BOD5)	F Methane Emissions Factor (Gg CH4 / Gg BOD5)	G Total CH4 released (Gg CH4)	H Methane Recovered (Gg CH4)	I Net CH4 Emissions (Gg CH4)
		C = (A x B)		E = (C x D)		G = (E x F)		I = (G x H)
18090	0.0146	264.1	0.01	2.641	0.22	0.581	0	0.581

Industrial waste water does not constitute a source of methane in the country.

PRELIMINARY ESTIMATION OF GHG EMISSIONS

INVENE/TABLE B7-1

MODULE	WASTE									
SUBMODULE	METHANE EMISSIONS FROM LANDFILLS									
WORKSHEET	6 - 1									
SHEET	1 OF 1									
STEP 1	STEP 2				STEP 3					
A Annual MSW Landfilled (Specify sub categories if any) (Gg)	B Fraction DOC	C Annual DOC Landfilled (Gg)	D Fraction Which Actually Degrades	E Annual Carbon Released as Biogas (Gg)	F Fraction C - CH4 to C - Biogas	G Annual carbon Released as CH4 (Gg C)	H Conversion Ratio (16/12)	I CH4 Released (Gg CH4)	J CH4 recovered (Gg CH4)	K Net CH4 Emissions (Gg CH4)
		C = (A x B)		E = (C x D)		G = (E x F)		I = (G x H)		K = (I - J)
2948.5	0.15	442.3	0.75	331.7	0.50	165.9	16/12	221.1	0	221.1

PRELIMINARY ESTIMATION OF GHG EMISSIONS VS BASED METHOD

INVENE/TABLE B7-3

MODULE	WASTE
SUBMODULE	METHANE EMISSIONS DOMESTIC WASTEWATER TREATMENT
WORKSHEET	6B - 2
SHEET	1 OF 1

STEP 1			STEP 2				
A Population (1000 persons)	B Wastewater Generation (l/1000 persons/year)	C Annual Wastewater (liters wastewater) C = (A x B)	D Volatile Solid Content (Gg VS/ liter wastewater)	E Fraction wastewater Anaerobically Treated	F Quantity of VS In Anaerobically Treated Wastewater (Gg VS) F = (C x D x E)	G Methane Emissions Factor (Gg CH4/Gg VS)	H Total CH4 released (Gg CH4) H = (F x G)
18090	6.20E+07	1.12E+12	3.16E-10	0.01	3.54	0.058	0.21

PRELIMINARY ESTIMATION OF GREENHOUSE GAS EMISSIONS AND SINKS
SUMMARY. NO-ENERGY SECTOR
(Gigagramos)

INVENE/TABLE A4-1

COUNTRY : VENEZUELA

YEAR : 1990.

SOURCE AND SINK CATEGORIES (Activity)		CO2	CH4	N2O	NOx	CO	NMVOCs
NON-ENERGY ACTIVITIES	TOTAL	80482	1332.97	3.78	54.22	2238.75	
AGRICULTURE	TOTAL		953.90	2.69	15.35	858.58	
Domestic Livestock			853.35				
Rice Fields			67.49				
Savanna Burning			31.29	0.39	13.88	821.30	
Crop Residue Burning			1.78	0.04	1.47	37.28	
Agricultural Soils				2.26			
LAND USE CHANGE & FOREST	TOTAL	80482	157.73	1.08	38.87	1380.17	
Forest Management		(5530)	157.73	1.08	38.87	1380.17	
Forest Clearing		84790					
Grassland Conversion		1203					
WASTE	TOTAL		221.34				
Landfills			221.14				
Wastewater			0.21				

INVENE/TABLE D1-2

PRELIMINARY ESTIMATION OF GHG EMISSIONS
CO2 EMISSIONS FROM THE ENERGY SYSTEM

COUNTRY: VENEZUELA

YEAR: 1990

FUELS		A Production (TJ)	B Importation (TJ)	C Exportation (TJ)	D Stock Change (TJ)	E Apparent Consumption (TJ) E = (A + B - C - D)	F Conversion Factor	G Apparent Consumption (TJ) G = (E * F)	H Carbon Emissions Coefficient (Kg C/GJ)	J Potential Emissions (Gg C) J = (G * H) * 10^-3	K Carbon Sequestered (Gg C)	L Net Carbon Emissions (Gg C) L = (J - K)	M (%)	N Adjusted Carbon Emissions (Gg C) N = (L * M)/100	O CO2 Emissions (Gg CO2) O = (N * (44 / 12))
Liquid Fossil															
Primary Fuels	Crude Oil	4990040		2836357	89104	2066579	1	2066579	20.0	41312		41312	99	40898	149961
	Orimulsion	8245		5556	2689	0	1	0	20.0	0		0	99	0	0
	Natural Gas Liquid	172638		0	0	172638	1	172638	15.2	2623		2623	99	2596	9520
Second Fuels	Gasoline			279896	1126	-281021	1	-281021	18.9	-5311		-5311	99	-5258	-19280
	Kerosene				408	-408	1	-408	19.6	-8		-8	99	-8	-29
	Jet Fuel			163607	386	-163993	1	-163993	19.5	-3198		-3198	99	-3166	-11608
	Gas/Diesel Oil			343506	3413	-346919	1	-346919	20.2	-7008		-7008	99	-6938	-25438
	Residual Oil			517343	-6443	-510900	1	-510900	21.1	-10780		-10780	99	-10672	-39131
	LPG			31146	-160	-30986	1	-30986	17.2	-533	5.9	-539	99	-533	-1956
	Naphta				5330	-5330	1	-5330	20.0	-107	0.0	-107	99	-106	-387
	Bitumen			53598	-239	-53359	1	-53359	22.0	-1174	528.8	-1703	99	-1686	-6181
	Lubricants			8356	100	-8456	1	-8456	20.0	-129	97.4	-227	99	-224	-822
	Petroleo Coque			0	3249	-3249	1	-3249	27.5	-89		-89	99	-88	-324
	Ref. Feedstocks			0	0	0	1	0	20.0	0		0	99	0	0
	Others Oil			13921	0	-13921	1	-13921	20.0	-278		-278	99	-276	-1011
Total Liquid Fossil		5170823	0	4250285	98962	821577		821577		15319	632	14687		14540	53313
Solid Fossil															
Primary Fuels	Coking Coal	66931		56061		10869	1	10869	25.8	280	12.6	267.8	98	262	962.4
	Steam Coal					0	1	0	25.8	0		0	98	0	0
	Lignite					0	1	0	27.6	0		0	98	0	0
	Subbit. Carbon					0	1	0	26.1	0		0	98	0	0
	Peat					0	1	0	28.9	0		0	98	0	0
Second Fuels	BKB & Pat Fuel					0	1	0	25.8	0		0	98	0	0
	Coke		8533			8533	1	8533	29.5	252		252	98	249	914
Total Solid Fossil		66931	8533	56061	0	19403		19403		532	0.1	520		512	1876
Gaseous Fossil															
	Natural Gas (Dry)	938482	0	0	0	938482	1	938482	15.3	14359	450.5	13908	99.5	13839	50742
Total Gaseous Fossil		938482	0	0	0	938482		938482		14359		13908	99.5	13839	50742
TOTAL		6176236	8533	4306346	98962	1779461		1779461		30210		29116		28890	105931
Bunkers	Jet Fuel Bunkers					18175	1	18176	19.5	316		316	99	312	1146
	Gas / D.O. Bunkers					5090	1	5090	20.2	103		103	99	102	373
	Fuel Oil Bunkers					29742	1	29742	21.1	628		628	99	621	2278
	Other Oil Bunkers						1	0	20.0	0		0	99	0	0
	Total bunkers					51006		51006		1046		1046		1036	3796
Biomass	Solid Biomass	1397	0	0	0	1397	1	1397	29.9	42		42		41	152
	Liquid Biomass	0	0	0	0	0	1	0	20.0	0		0		0	0
	Total biomass	1397	0	0	0	1397		1397		42		42		41	152

NOTE : Totals may not equal sum components due to independent rounding.

INVENE/TABLE D1-1

PRELIMINARY ESTIMATION OF GHG EMISSIONS

ESTIMATION OF CARBON SEQUESTERED IN PRODUCTS

COUNTRY : VENEZUELA

YEAR : 1990

FUEL	1 Estimated Fuel Quantity (Gj)	2 Emission Coeff. (Kg/Gj)	3 Potential Carbon Seq'd (Gg)	4 Act. % Carbon Seq'd (%)	5 Carbon Seq'd (Gg C)	6 Carbon Non - Seq. (Gg C)
1) Naphtas	0	0	0	0	0	0
2) Lubricants	9740000	20	195	50	97	97
3) Bitumen	24040000	22	529	100	529	0
4) Ligth Oil/Tar	652100	25.8	16.8	75	12.6	4
5) Gas as Feedstock	89230000	15.3	1365	33	451	915
6) LPG as Feedstock	430000	17.2	7	80	6	1

(*) In Venezuela the naphta is not used as feedstock in Petrochemical Industry.

NOTE : Totals may not equal sum of components due to independent rounding.

26/05/95

MENU C1

INVENE/ TABLE C1 - 2

PRELIMINARY ESTIMATION OF GHG EMISSIONS
ENERGY SECTOR - CO2 EMISSIONS
COMPARISON " TOP - DOWN " - "BOTTOM - UP "

ACTIVITY	"TOP - DOWN" (1)	BOTTOM - UP " (2)	DIFFERENCE TD VS BU (%)
FUEL CONSUMPTION (Tj)	1779461	1342239	24.6
CO2 EMISSIONS (Gg)	105931	84453	20.3

NOTE : Totals may not equal sum of components due to independent rounding.

PRELIMINARY ESTIMATION OF GHG EMISIONS
NATIONAL ENERGY BALANCE
LOSSES AND ADJUSTMENTS

ACTIVITY	(Tj)
LOSSES	178593
* CRUDE OIL TRANSP. & DISTRIB.	7214
* REFINING	150524
* MARACAIBO CITY'S NETWORK	20855
STATISTICS ADJUSTMENTS	282466

ANNEX 2

ANNEX 2

CO2 EMISSION ESTIMATES METHODOLOGIES

The purpose of this annex is to describe the two different methods provided by IPCC emission inventory guidelines (IPCC/OECD, 1994, Vol.3) for CO_2 emission estimates from the use of fossil fuels and to make a comparison analysis of the results obtained for Venezuelan emission estimates for 1990. These two approaches are refered as "Top-Down" and "Bottom-Up" methodologies.

Top-Down

This methodology is based on an accounting of the carbon in fuels supplied to the economy. It mal es use of a simple assumption: once carbon is brought into a national economy in fuel, it is either saved in some way (increases in fuel stock, stored in products, left unoxidized in ash) or it must be released to the atmosphere. It is not necessary to know exactly how the fuel was used or what intermediate transformations it underwent in order to calculate the carbon released.

Carbon accounting is based mainly on the total supply of primary fuels and the net quantities of secondary fuels brought into the country. The basic calculations can be characterized as six fundamental steps; the detailed calculations for Venezuelan inventory is shown on table INVENE/TABLE1, which is the recommended by the IPCC guidelines (IPCC/OECD 1994, Vol 2, Worksheet 1-1). The steps are summarized as follow:

1.- Estimating consumption of fuels by fuel product type.

2.- Converting fuel data to energy units. It must be done before carbon emissions can be calculated since the carbon content of fuel varies with the fuel's heat content.

3.- Selecting carbon emission factors for each fuel product type and estimating total carbon potentially released from the use of fuels, multiplying fuel consumption by emission factors for each fuel product type and then summed across all fuel types.

4.- Estimating the amount of carbon stored in products for long periods of time.

5.- Accounting for carbon not oxidized during combustion.

6.- Converting emissions as carbon to full molecular weight of CO_2.

To calculate the supply of fuels to the country, the following data are required for each fuel:

* The amounts of primary fuels produced (production of secondary fuels and fuel products is excluded).

* The amounts of primary and secondary fuels and fuel products imported.

* The amounts of primary and secondary fuels and fuel products exported.

* The net increases or decreases in stocks of fuels. An increase in stocks is a positive stock change, this results in a decrease in apparent consumption.

The apparent consumption of primary fuels is, therefore, calculated as:

$$\mathbf{A.C._{PF} = Production + Imports - Exports - Stock\ change} \quad (1)$$

Flows of secondary fuels are calculated as:

$$\mathbf{A.C._{SF} = Imports - Exports - Stock\ Change} \quad (2)$$

This calculation can result in negative numbers for Apparent Consumption. This is a perfectly acceptable result since it indicates a net export or stock increase in the country when domestic production is not considered.

To determine the total Apparent Consumption, flows of secondary fuels should be added to apparent consumption of primary fuel.

Once Apparent Consumption has been estimated, the next step consists on selecting the Carbon Emission Factors for the fuels, which are average values based on net calorific value (lower heat value). In the Venezuelan inventory the factors suggested by IPCC Reference Approach were used (IPCC/OECD 1994, Vol.2, Table 1.3). These values are similar to those calculated by the Venezuelan Petroleum Research Institute, INTEVEP.

The third step consists on estimating total carbon content of all fuels used by the economy. The resulting quantities are potential emissions that could be released to the atmosphere if all carbon in the fuels were converted to CO2.

In the next two steps, carbon sequestered in non-fuel uses of fossil fuels and carbon remained unoxidized are estimated and subtracted from the total amount of carbon already calculated.

Some carbon contained in non-energy products is sequestered and a portion of this carbon is expected to oxidize over a long time (> 20 years) period. All of the fossil fuels are used for non-energy purposes to some degree,e.g. natural gas is used for a number of purposes, including production of ammonia and plastics. A wide variety of products are produced from oil refineries, including asphalt, naphtas and lubricants.

Not all non-energy uses of fossil fuels, however, result in the sequestering of carbon, e.g. the carbon from natural gas used in ammonia production is oxidized quickly. In the approach used by Marland and Rotty(IPCC/OECD 1994, Vol.3), they assume that nearly 1/3 of the carbon used for non-energy purposes does not oxidize over long periods of time. All of the carbon in asphalt is assumed to remain unoxidized for long periods.

Okken and Kram (IPCC/OECD 1994, Vol.3) assume that carbon from the following non-energy uses of fossil fuels oxidizes quickly: fertilizer production (ammonia), lubricants, detergents,volatile organic solvents, etc. Carbon from the following non-energy uses remain stored for long periods of time (in some cases, hundreds of years): plastics, rubber, asphalt, bitumen, formaldehyde, etc.

The IPCC suggested approach for estimating carbon stored in products (IPCC/OECD 1994, Vol.3) was used in the Venezuelan inventory.INVENE/TABLE D1-1 illustrates the calculations for 1990. It is described as follows:

* Column 1 Estimated fuel uses.

* " 2 Emission coefficients were taken from INVENE/TABLE D1-2.

* " 3 Maximum amount of carbon that could be potentially sequestered if all the carbon in the fuel were stored in non-fuel products. It results from multiplying (1) by (2).

* " 4 Percentages of carbon that remains sequestered, IPCC default values (IPCC/OECD 1994, Vol.3, Table 1-5) were used.

* " 5 Carbon sequestered in non-energy uses of fossil fuels

* " 6 Carbon fraction from non-energy products oxidized quickly in the atmosphere (3) - (5).

As mentioned earlier, since combustion processes are not a hundred percent efficient, not all carbon is oxidized during the combustion of fossil fuels. The amount of carbon that falls into this category is usually a small fraction of the total carbon; a large portion of this carbon oxidizes in the atmosphere shortly after combustion. Based on the work by Marland and Rotty, 1984, the IPCC has recommended the following default values for the percentage of unoxidized during combustion by fuel:

Liquid Fuels 1%
Solid Fuels 2%
Gaseous Fuels 0,5%

Regarding Bunker Fuels, the IPCC guidelines (IPCC/OECD 1994, Vol.3) do not account for these fuels as part of the energy balance of the country in which they were delivered to ships or aircraft. Thus CO2 emissions from combustion of those fuels would not appear in the country of delivery. However, for informational purposes,these quantities are shown separately in INVENE/TABLED1-2.

Bottom-Up

This methodology is the detailed technology-based approach discussed in the IPCC Emission Inventory Guidelines (IPCC/OECD 1994, Vol.3). This methodology is a detailed, end-use oriented approach in that emissions are estimated by sector of economic activity and/or by type of technology in which the fuel is consumed. The results for a wide range of end-uses and transformations activities must be summed to arrive at total national emissions. Detailed calculations tables in Annex 2.

It may account for actual consumption for specific fuels in various end-use subcategories, further broken down by specific processes and technologies. It is necessary to work backwards to arrive at the total amounts of fuel carbon supplied to an economy. The formula used is:

$$\textbf{POTENTIAL CO2 EMISSIONS} = (\textbf{FCons.* Em.FACTOR})_{sectors/techn} \qquad (3)$$

The detailed technology based calculations should be conceptually the same as those used to estimate emissions other than CO2 from stationary and mobile sources combustion.

Calculations and results regarding the Bottom-Up methodology used by Venezuela for estimating CO2 emissions for 1990, are illustrated in Figures from II-7 to II-18 (Pages 14 to 18) and Tables II-4 (Page 11).

Top-Down /Bottom-Up comparison results

Theoretically, the application of these two alternative methods should make no difference in a country's total CO2 emission estimate, since the amount of fuel consumed, and hence the amount of carbon oxidized, should be the same in both approaches. However, the Venezuelan inventory results are different for both methodologies. INVENE/TABLE C1-2 and II-3, included in this annex shows the comparison of the calculations.

Differences in CO2 emissions may be basically explained by the fact that Top-Down method uses apparent consumption estimates while the Bottom-Up method uses final consumption. These two numbers should be equal, but there always seems to be differences that are often accounted for in the Energy Balance (MEM 1990):

* products mixed to the crude oil: this figure include some feedback streams during refining processing.

* statistical adjustments: are quantities used sometimes in order to conciliate input-output figures.

* losses charged to crude oil transportation & distribution and to refining process. This item has to be analized in detail with some experts of the oil industry, because it is not clear whether they are producing CO2 emissions.

These flows have to be studied in depth in order to determine which of them indeed generate CO2 emissions

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